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THE FIRST RECORD OF THE EULOPHID GENUS *AZOTUS* FROM INDIA (CHALCIDOIDEA: HYMENOPTERA).

By K. B. LAL, M.Sc. (Ald.), Ph.D. (Edin.), F.R.E.S., Second Assistant Entomologist, Imperial Agricultural Research Institute, New Delhi.

(Contribution from the Laboratory of the Imperial Entomologist.)

INTRODUCTION.

The genus *Azotus* was created by Howard (1898), who described the type-species, *A. marchali*, from two specimens, one reared by Prof. P. Marchal of Paris from *Diaspis ostreaeformis* on pear and another from *Aspidiotus nerii* on *Baloghia lucida* in Sydney, N. S. W. Since then a dozen more species have been known from China, Africa, Southern Europe, Australia, North America, Java and Japan. So far no species has been recorded from India.

The species of *Azotus* are pre-eminently parasites of scale insects, and there is no record of their having been bred from a host other than the Coccidæ. The present example, which is specifically new, is, therefore, interesting also from the fact that it provides the first record of a species of *Azotus* reared from an Aleurodid host. The females of Coccidae, which are the forms usually met with, are often not very different in appearance and habits from the full grown nymphs of Aleurodidae and, as such, an insect that is used to parasitising the former should not have much difficulty in attacking the latter, provided other circumstances are favourable.

The whitefly, *Aleurolobus barodensis*, the parasite of which is described hereafter, is distributed all over India and has been reported to do serious damage to sugarcane in the Central Provinces, Bihar, Orissa, Bengal and the United Provinces, being specially destructive to ratoon crop. The nymphs, which are responsible for most of the damage, fix themselves to the undersurface of the leaves and injure the plant by desapping. As they grow they become covered with a white waxy meal which helps to protect them from the action of insecticides. Spraying, under the best of circumstances, is not very satisfactory against a sugarcane pest and, therefore, the discovery of an efficient parasite of the whitefly of sugarcane is a distinct need. So far, two more species of Eulophidae are known to parasitise this insect; these are still unidentified. According to Karam Singh (1931) puparia and nymphs of whitefly are also liable to be attacked by a fungus, and it seems that two species of fungi are involved: 1. *Pythium* sp., which kills the insect, and 2. *Cladosporium* sp., which secondarily grows on it after death.

SYSTEMATIC DESCRIPTION.

Two descriptions of the genus are available. The original one by Howard (*op. cit.* p. 138) is of the male and in this the antennae are said to be 8-jointed with a 2-jointed club. In the other description, by Schmiedeknecht (1909), the antennae are described as 7-jointed

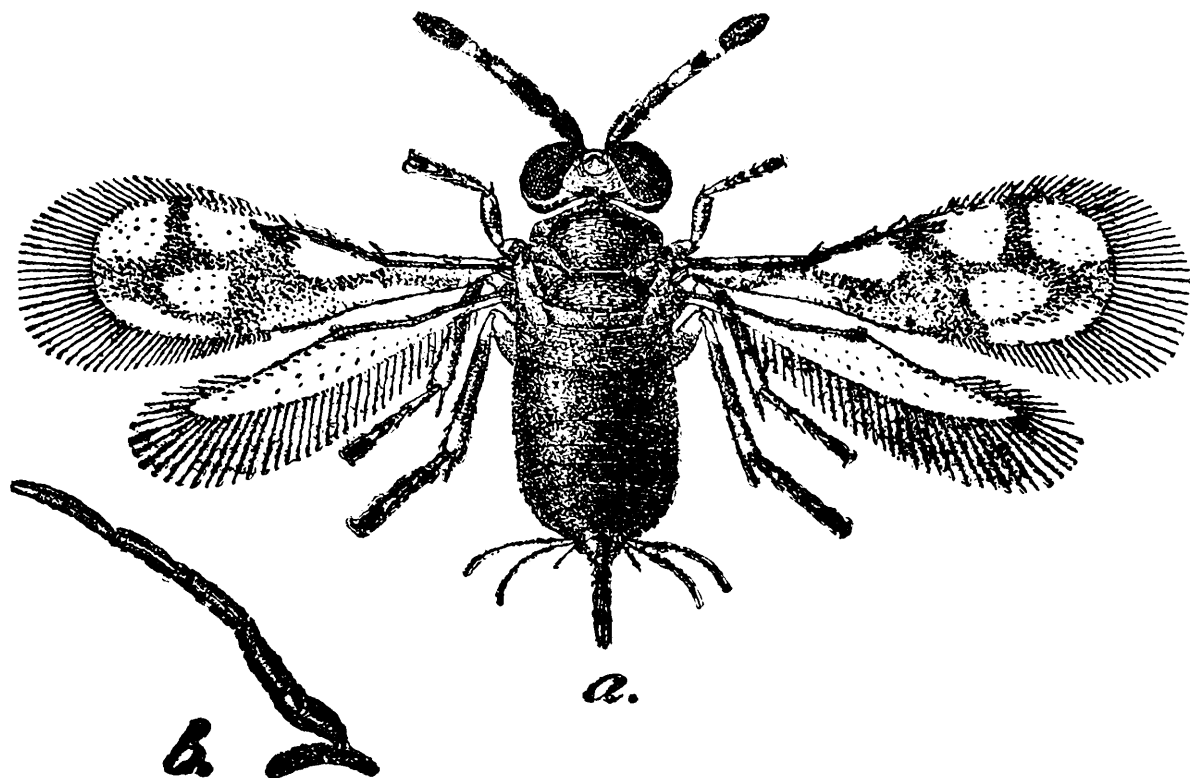
with the club 1-jointed. This discrepancy in an important diagnostic character results from the fact that in some species (or possibly specimens only) the suture between the two joints of the club is obscure (as in the new species to be described below) or even absent (as in *A. silvestrii* Compere). Schmiedeknecht also mentions the 'Endsporn der Mittelschienen halb so lang als der Metatarsus; der Metatarsus nicht viel kurzer als die folgenden Glieder zusammen' This, judging by the specimens in front of me, does not seem to be correct. There is also a slight discrepancy about the knob of the stigmal vein. Howard describes it 'not large' and Schmiedeknecht 'grossem runden knopf' The following description of the genus is based on the descriptions given by Howard (*loc. cit.*) and by Schmiedeknecht (*op. cit.*):—

Genus *Azotus* Howard.

Antennae 7-8 jointed, club 1-2 jointed, pedicel smaller than first funicle joint, third funicle joint much shorter than other funicle joints. Wings without oblique hairless line, marginal vein a trifle shorter than sub-marginal, stigmal vein well marked, with a fairly large knob, descending at an angle of about 30° into disc of wing, post-marginal vein absent, forewings with long marginal cilia regularly increasing in length from point just beyond stigmal vein to anal angle. Middle and hind tibiae each with a rather long apical spur, that on middle tibiae longer, tarsi 5-jointed.

Azotus delhiensis, sp. nov.

Female.—Length without ovipositor 0.76 mm.; exerted ovipositor 0.14 mm.; width across mesothorax 0.26 mm. *Body* dark brown;



Azotus delhiensis, sp. nov. $\times 60$.
a. Adult female; b. Antenna of male.

eyes deep salmon-red, dorsum of thorax sub-opaque, second and fourth funicle joints of antennae, tegulae, parts of femora and tibiae and first four tarsal joints whitish to pale yellowish, ovipositor yellow, ovipositor sheath brown.

Head transverse, slightly narrower than thorax, eyes completely encircling head and converging at vertex; antennae 8-jointed, scape at least twice as long as broad at apex, broadening evenly but markedly from base to apex, pedicel not much longer than wide, third funicle joint about one third the length of fourth, club 2-jointed, suture between two joints not distinct, each joint longer than fourth funicle joint. *Forewings* about three times as long as broad, submarginal vein slightly longer than marginal, with a solitary bristle near its junction with latter, stigmal vein making an angle of about 25° with wing margin and with a prominent knob, marginal cilia longest near anal angle, forewing traversed by narrow infuscated bands running lengthwise and transversely; infuscated area beset with strong black bristles, a number of similar bristles converging towards knob of stigmal vein. Middle tibial spur almost equal to first tarsal joint, which is much shorter than the last four tarsal joints taken together. *Abdomen* broader than thorax, boat-shaped behind, ovipositor exerted at least half the length of abdomen.

Male.—Length 0.62 mm.; width across mesothorax 0.24 mm. Antennae uniformly light brown. Smaller than female. Eyes not encircling head, antennae 8-jointed, scape thrice the length of pedicel, first and second funicle joints slightly longer than scape, third funicle joint very small, about one sixth the length of fourth, club 2-jointed. Infuscated bands on forewings faint, knob of stigmal vein not very prominent. Other characters as in female.

Described from three female and two male specimens reared from nymphs of *Aleurolobus barodensis* Mask., infesting sugarcane at Buldi-Karnal, Delhi.

Types deposited in the Pusa Collection in the laboratory of the Imperial Entomologist, New Delhi.

ECONOMIC STATUS.

The economic status of the species of *Azotus* is not quite settled. Although they are known to parasitise scale insects, there are two cases in which it was doubted if they did not develop at the expense of other primary parasites also present with them and thus deserve the status of a secondary parasite. Compere (1926) in describing a new species, *A. silvestrii* reared from the Florida Red Scale, *Chrysomphalus aonidum* Linn., at Shanghai, remarks that the specimens appeared in a cage in which *Aphelinus diaspidis* How., was also present. He thinks it possible, therefore, that *A. silvestrii* reproduced in this cage at the expense of the primary parasites. The second case is of *A. americanus*, a new species from Delaware, described by Dozier (1928), who reports that his specimens were reared from branches of *Sorbaria stellipila* heavily infested with the San Jose Scale, *Aspidiotus perniciosus* Comst., which produced numbers of its primary parasite, *Prospaltella perniciosi* Tower. He,

therefore, suggests the possibility that the *Azotus* may have been the secondary parasite upon the beneficial *P. perniciosi*.

If these suspicions prove well founded, at least some members of the genus *Azotus* will have to rank as injurious insects, parasitising beneficial primary parasites of pests, instead of their being themselves primary parasites, and thus useful. Further elucidation of this point, specially from regions where *Azotus* spp. occur and are likely to be of some value in controlling pests, will be awaited with interest.

ACKNOWLEDGMENT.

I wish to acknowledge my indebtedness to Dr. Hem Singh Pruthi, Imperial Entomologist, for encouraging me to work on Parasitic Hymenoptera and kindly going through the manuscript of this paper.

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CHANGES IN THE INTERNAL STRUCTURE OF THE AIR-BLADDER OF *SILONIA SILONDIA* (HAM.) DURING GROWTH.

By K. KRISHNAN NAIR, B.A., *Officiating Gallery Assistant, Zoological Survey of India, Calcutta.*

The earlier accounts of the structure of the air-bladder of *Silonia silondia* (Ham.) by Taylor¹, Day² and Bridge and Haddon³ differ greatly from one another, and as in the case of *Pangasius pangasius* (Ham.)⁴, Dr. S. L. Hora⁵ was of the opinion that the differences were due to the relative sizes of the specimens examined by the respective workers. He accordingly suggested to me to make a detailed study of the air-bladder of *S. silondia* for elucidating the changes in its structure during growth. In order to enable me to carry out the proposed investigation, Dr. Hora very kindly placed the valuable material in the Indian Museum at my disposal and helped me in procuring further specimens. Thus it has been possible to dissect specimens ranging from 45 mm. to 1,250 mm. in total length.

I take this opportunity to record my grateful thanks to Dr. Bains Prashad, Director, Zoological Survey of India for affording me the necessary facilities for work. The work has been carried out under the supervision and guidance of Dr. S. L. Hora to whom I am greatly indebted for the material, valuable suggestions and constant encouragement.

DESCRIPTION OF THE MATERIAL.

1. *Size of the specimen* : 45 mm. in total length (text-fig. 1, a. & b).

The air-bladder of a specimen 45 mm. in total length is somewhat reniform, with its anterior wall concave and its posterior wall slightly convex. The bladder is broader towards the posterior end and its long axis is disposed transversely. The inside cavity is divided into a short but somewhat broad anterior chamber (*ac.*), and two lateral chambers (*lc.*) by the primary transverse (*ts.*) and longitudinal (*ls.*) septa. The transverse septum is very thick and short; dorsally it is closely applied to the ventral and lateral surfaces of the bony elements of the vertebral column. The longitudinal septum is continuous in the ventral half (text-fig. 1, b.) of the bladder, but in the dorsal half it does not quite reach the posterior wall. There is, however, an outgrowth from the posterior wall of the bladder towards this incomplete longitudinal septum. A small space in between the posterior wall and the incomplete longitudinal septum is thickened by root-like fibrous growths (*rf.*) from the wall of the bladder. A pneumatic duct⁶ connecting the air-bladder

¹ Taylor, *Edinburgh Journ. Science*, (N. S.), V, p. 33, (1831).

² Day, *Proc. Zool. Soc. London*, p. 703, (1871).

³ Bridge and Haddon, *Trans. Roy. Soc. London* (B) CLXXXIV, pp. 221-223, (1894).

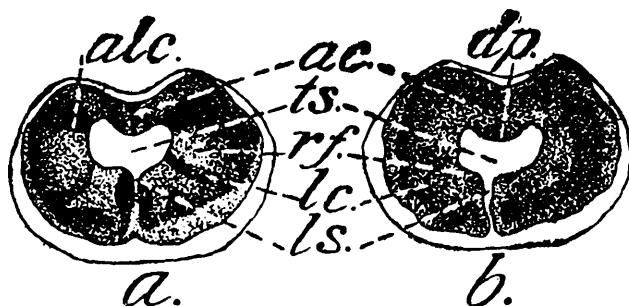
⁴ Nair K. K., *Rec. Ind. Mus.*, XXXIX, pp. 117-124, (1937).

⁵ Dr. Hora very kindly allowed me to consult his manuscript on the revision of the Schilbeidae which is to be published in the *Records of Indian Museum*.

⁶ Though Bridge and Haddon could detect no trace of a pneumatic duct, Dr. Hora had already observed one in the course of his taxonomic studies referred to above.

with the oesophagus is present ; it opens into the bladder on its ventral wall (*dp.*) in the middle and just in front of the transverse septum.

In the dorsal half (text-fig. 1, *a.*) of the bladder there are two deep cavities (*alc.*) at the sides of the antero-lateral portions of the transverse septum. These cavities inwardly correspond with the two bulging pockets on the dorsal surface of the air-bladder which approximate



TEXT-FIG. 1. Air-bladder of a specimen of *Silonia silondia* (Ham.) 45 mm. in total length. $\times 6$.

- a.* Dorsal half. *b.* Ventral half. *ac.* anterior chamber ; *alc.* the deep cavities at the sides of the antero-lateral portions of the transverse septum ; *dp.* opening of the pneumatic duct into the bladder ; *lc.* lateral chambers ; *ls.* longitudinal septum ; *rf.* root-like fibrous growths ; *ts.* transverse septum.

upwards, but there is no connection between the two. The antero-lateral portions of the bladder are well protected by the deflected anterior divisions of the modified transverse processes, and the wall in this region is very thin, while that of the remaining parts of the bladder is very thick. The cavities of the lateral chambers are broken up by the root-like fibrous thickening which arise from the septa and the walls of the bladder.

The bladder is relatively very small and its walls do not come in contact with those of the body cavity. The cavity of the bladder is filled with some sort of loose tissue. It may here be noted that the condition of some of the internal structures may sometimes be found, similar to that described above even in larger specimens (*vide* text-fig. 3).

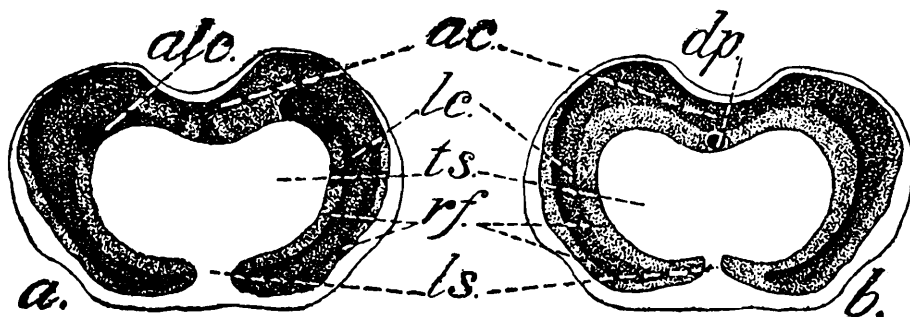
2. *Size of specimen : 127 mm. in total length.*

The air-bladder of a specimen 127 mm. in total length is similar in shape to the one described above. Internally, the transverse septum is better developed and the longitudinal septum meets both the dorsal and the ventral walls. The number of the root-like fibrous structures is considerably greater.

3. *Size of specimen : 153 mm. in total length* (text-fig. 2, *a.* & *b.*).

The transverse septum (*ts.*) of the air-bladder of a specimen 153 mm. in total length is very thick and broad, and in consequence, the longitudinal septum (*ls.*) is considerably shortened : it is equally well developed. The transverse septum is so voluminous that it forms a broad central pillar. The comparatively much narrower longitudinal septum connects the pillar with the posterior wall of the bladder and thus divides an otherwise circular cavity of the bladder into two lateral portions. The anterior chamber (*ac.*) is less deep along the median line than at the sides, where the cavities, especially in the dorsal half, are very deep (text-fig. 2, *a.*). The lateral chambers (*lc.*) are considerably filled up by the fibrous thickenings (*rf.*) which arise from the septa

and the postero-lateral walls. There is a pneumatic duct (*dp.*) connecting the air-bladder with the oesophagus, though it ends blindly into



TEXT-FIG. 2. Air-bladder of a specimen of *Silonia silondia* (Ham.) 153 mm. in total length. $\times 4\frac{1}{2}$.

a. Dorsal half. *b.* Ventral half. *ac.* anterior chamber; *alc.* the deep cavities at the sides of the antero-lateral portions of the transverse septum; *dp.* opening of the pneumatic duct into the bladder; *lc.* lateral chambers; *ls.* longitudinal septum; *rf.* root-like fibrous growths; *ts.* transverse septum.

the oesophagus. The walls of the antero-lateral portions are thin while those of the other parts are thick. The posterior edge of the bladder is almost straight and not convex as in the earlier stages.

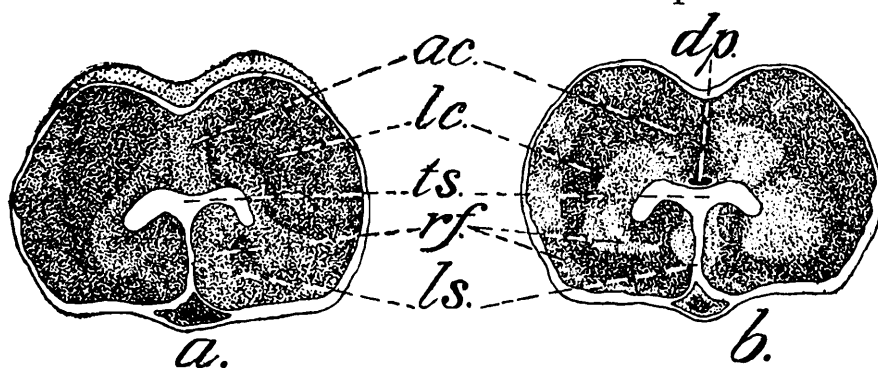
Bridge and Haddon¹ described the air-bladder of a specimen of about seven inches long which is a size intermediate between the one described above and the next one. My observations of the internal structure of the air-bladder of a specimen of about the same size do not agree with those of Bridge and Haddon. They state that the actual cavity of the bladder is reduced to the condition of a comparatively narrow circular canal surrounding the central pillar which extends vertically between the dorsal and ventral walls, while in my dissections the longitudinal septum was found to divide the cavity into two lateral portions.

4. *Size of specimen : 274 mm. in total length.*

The shape of the air-bladder of a specimen 274 mm. in total length is almost the same as the one described above. Here the transverse and longitudinal septa are very thin as shown in the next stage (text-fig. 3). The cavity of the bladder is spacious and the walls are rather thin.

5. *Size of specimen : 336 mm. in total length (text-fig. 3, *a.* & *b.*)*

The internal structure of the air-bladder of a specimen 336 mm. in



TEXT-FIG. 3. Air-bladder of a specimen of *Silonia silondia* (Ham.) 336 mm. in total length. $\times 1\frac{1}{2}$.

a. Dorsal half. *b.* Ventral half. *ac.* anterior chamber; *dp.* opening of the pneumatic duct into the bladder; *lc.* lateral chambers; *ls.* longitudinal septum; *rf.* root-like fibrous growths; *ts.* transverse septum.

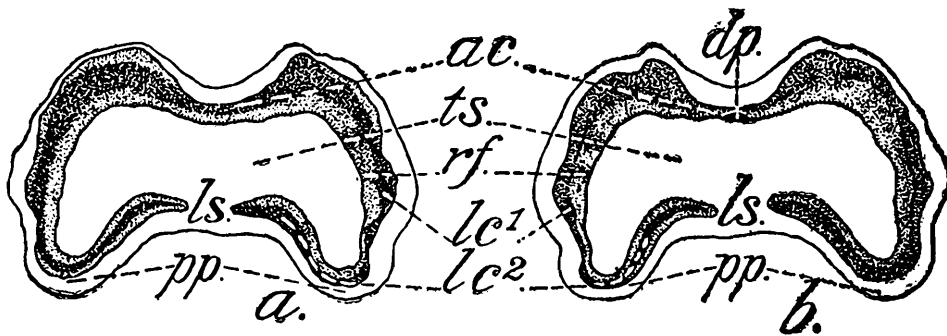
¹ Bridge and Haddon, *Trans. Roy. Soc. London (B)* CLXXXIV, pp. 221-223, (1894).

total length is rather different from those described above. There are the primary transverse (*ts.*) and longitudinal (*ls.*) septa which are not very thick. These septa divide the cavity into one big anterior chamber (*ac.*) and two lateral chambers (*lc.*) one on either side of the longitudinal septum. The extremities of the transverse septum are deflected backwards into the lateral chambers. The longitudinal septum forks at its posterior end and these branches join the posterior wall of the bladder, thus subtending a small cavity roughly in the shape of a triangle in between them. There is a pneumatic duct with a definite opening (*dp.*) into the bladder. The anterior chamber is spacious, especially in the dorsal half (text-fig. 3, *a.*). No separate cavities, as found in the previous bladders in the anterior chamber of the dorsal half could be seen here. The root-like fibres (*rf.*) of the transverse septum encroach upon the cavity of the anterior chamber. The cavities of the lateral chambers are also invaded by fibrous growths from the transverse and longitudinal septa.

The bladder is comparatively more hollow, and the walls more thin. The ventral surface of the bladder was covered by a thick layer of fat and was not in contact with the walls of the body cavity. The relatively simple condition of the bladder in the above specimen may be due to a retardation of the normal process of growth.

6. *Size of specimen* : 527 mm. in total length (text-fig. 4, *a.* and *b.*).

The air-bladder of a specimen 527 mm. in total length is different in shape from those described above. The posterior contour of the bladder



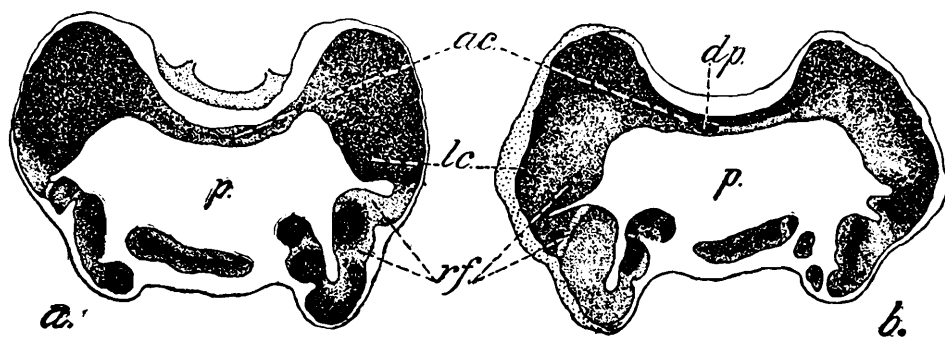
TEXT-FIG. 4. Air-bladder of a specimen of *Silonia silondia* (Ham.) 527 mm. in total length. $\times 1\frac{3}{4}$.

a. Dorsal half. *b.* Ventral half. *ac.* anterior chamber; *dp.* opening of the pneumatic duct into the bladder; *lc*¹. first part of the original lateral chamber; *lc*². second part of the original lateral chamber; *ls.* longitudinal septum; *pp.* postero-lateral pouches; *rf.* root-like fibrous growths; *ts.* transverse septum.

is concave and constricted in the median portion so that there are two postero-lateral pouches (*pp.*) pointing backwards. The transverse septum (*ts.*) has extended much and its deflected lateral extremities grow into the postero-lateral pouches, thus dividing the lateral chambers into two portions (*lc*¹ and *lc*²). The two posterior divisions (*lc*²) of the lateral chambers are not continuous since there is the stout longitudinal septum (*ls.*) extending between them. The anterior chamber (*ac.*) of the bladder is very narrow in the median portion, though it is slightly dilated towards the sides. The whole cavity of the bladder is filled by the transverse septum and the fibrous growths (*rf.*) which arise from all parts of the walls. There is still a pneumatic duct (*dp.*) opening into the anterior chamber. The walls of the bladder are thickened and very tough.

7. *Size of specimen*: 851 mm. in total length (text-fig. 5, a. and b).

The antero-lateral portions of the air-bladder of a specimen 851 mm. in total length bulge upwards and are accommodated in the bony recesses



TEXT-FIG. 5. Air-bladder of a specimen of *Silonia silondia* (Ham.) 851 mm. in total length. $\times 1\frac{1}{2}$.

a. Dorsal half. b. Ventral half. ac. anterior chamber; dp. opening of the pneumatic duct into the bladder; lc. lateral chambers; p. the thick pillar formed by the growth of the transverse and longitudinal septa into each other; rf. root-like fibrous growths.

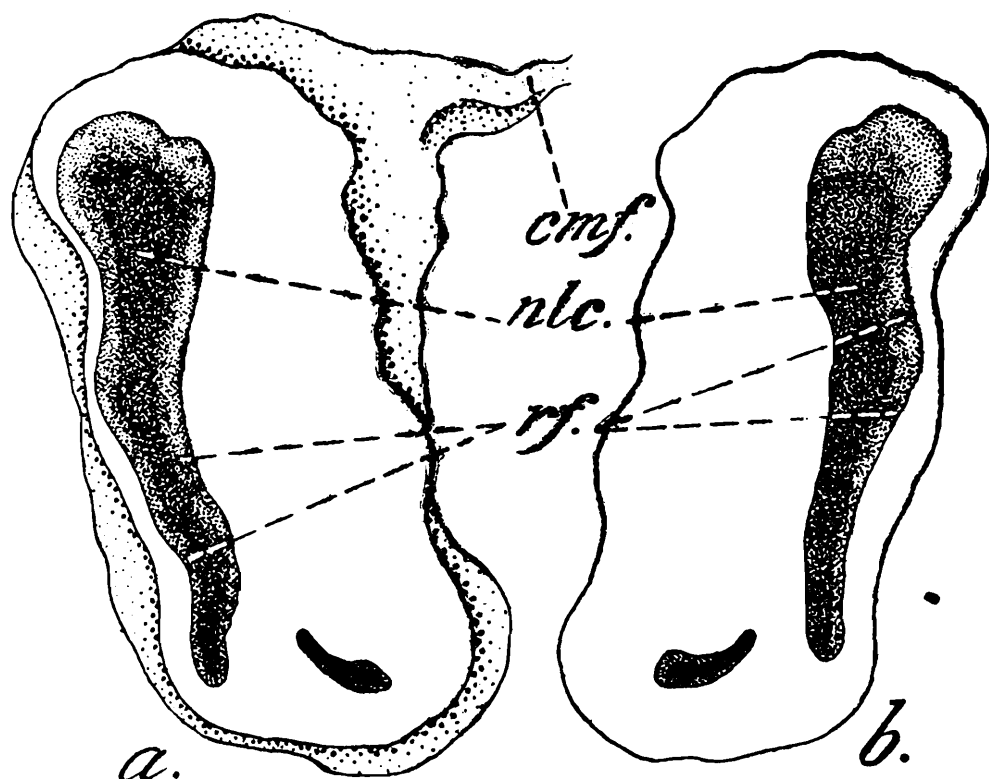
of the modified transverse processes. The whole dorsal surface is closely applied to the ventral and lateral surfaces of the bony elements immediately above. Internally, there is no differentiation of a longitudinal septum from a transverse septum. They have grown into each other and have formed a thick pillar (*p.*). The lateral deflected extremities of this pillar, which were found to be entire in an earlier stage of the bladder described above (*vide p. 8*), are divided into numerous branches which grow away from it to terminate laterally before reaching the outer walls of the bladder. They break up the cavities of the lateral chambers and subtend small spaces between them. The whole of the cavity of the bladder becomes very shallow on account of the growth of root-like fibrous tissues (*rf.*) from the walls of the bladder as well as from the pillar-like structure. In the dorsal half of the bladder (text-fig. 5, a.) the antero-lateral pockets are deep, but in the ventral half all the portions are invaded by the thick root-like fibres of the pillar. The growth of the fibrous tissues is greater in the ventral half (text-fig. 5, b.) than in the dorsal one. There is still a pneumatic duct (*dp.*) which opens into the bladder.

8. *Size of specimen*: 1,250 mm. in total length (text-fig. 6, a. and b).

The shape of the air-bladder of a specimen 1,250 mm. in total length is different from those described above. It consists of two oblong portions placed laterally, one on each side of the anterior portion of the vertebral column. These two portions are connected together anteriorly by a cylindrical, transverse mass of some tough fibrous tissue (*cmf.*).

In the oblong portion (text-fig. 6.) there is a narrow longitudinal cavity (*nlc.*) Internally it does not communicate with the corresponding one on the other side, since the only connection between the two portions is a solid cylindrical mass of fibres noted above. There is another very small cavity towards the posterior end. The narrow longitudinal cavity with root-like fibrous growths (*rf.*) represents the lateral chamber which, in the earlier stages was noticed being filled in by the growth of the transverse septum and its branches. The small cavity seems to have originated from one of the many small spaces subtended by the branched lateral

extremities of the pillar described above (text-fig. 5). The transverse fibrous connection between the two parts of the bladder was probably formed by the obliteration of the original anterior chamber.



TEXT-FIG. 6. Air-bladder of a specimen of *Silonia silondia* (Ham.) 1,250 mm. in total length. $\times 3\frac{1}{2}$.

a. Dorsal half. *b.* Ventral half. *cmf.* the cylindrical mass of tough fibre which connects the two oblong portions of the air-bladder which are placed laterally on either side of the vertebral column; *nlc.* the narrow longitudinal cavity of the air-bladder; *rf.* root-like fibrous growths.

Day's¹ description of the air-bladder appears to correspond to a great extent with the above description. Taylor² might have had a specimen intermediate in size between the last two stages described above.

CONCLUSION.

Taking all the growth stages described above into consideration it seems probable that the air-bladder of *Silonia silondia* (Ham.), even at a very early stage of its growth is a considerably modified structure. Its small size and laterally oval form show a considerable deviation from the normal siluroid type of air-bladder. During growth the central part of the bladder, normally occupied by a thin transverse septum and a thin longitudinal septum, assumes a solid appearance through the hypertrophy of the fibrous tissue of the septa. This central mass restricts the cavity of the bladder to the sides and in consequence becomes surrounded by a narrow and almost circular canal. With growth this canal becomes sub-divided towards the posterior end. In the largest specimen examined, about 50 inches in total length, the bladder is divided into two, tough-walled, lateral portions which are connected entirely by fibrous tissue.

¹ Day, *Proc. Zool. Soc. London*, p. 703, (1871).

² Taylor, *Edinburgh Journ. Science* (N. S.) V, p. 33, (1831).

In his article on the "Correlation Between the Disposition of the Liver and Kidney and the Form of the Air-bladder in Certain Siluroid Fishes of India", Hora¹ has already explained the probable reasons for the reduction of the bladder in Schilbeid fishes, and they appear to me substantially correct. There can hardly be any doubt that in these fishes the bladder is being sacrificed to provide enough space for the liver and the kidney in the considerably reduced body cavity.

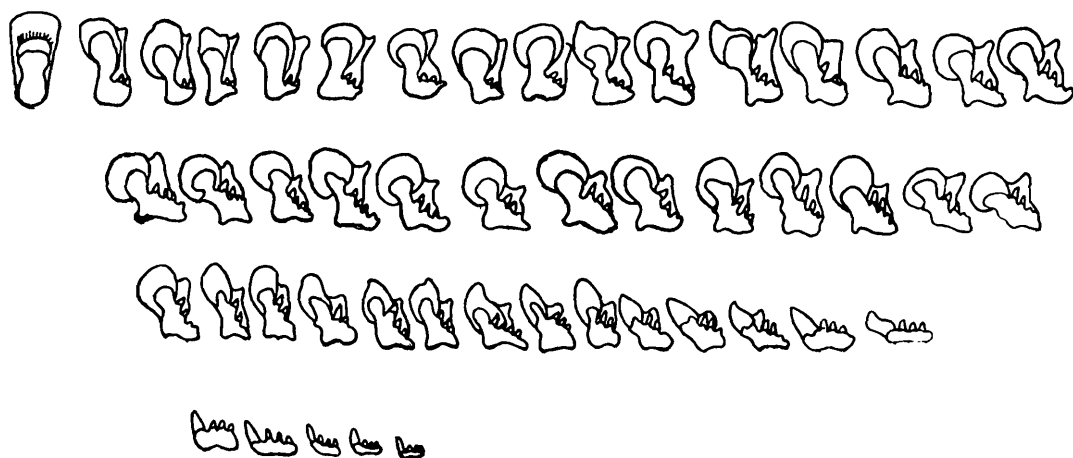
¹ Hora, *Proc. Nat. Inst. Sci. India*, III, pp. 31-43, (1937).

A NOTE ON *EORRHACHIS TRUTTA* (BLANFORD).

By R. V. SESHAIYA, Annamalainagar.

Sometime ago a few specimens of what at first sight appeared to be *Rachisellus praetermissus*, Blanford were obtained from Sudikonda, Godavary District, Madras Presidency, through the courtesy of Mr. T. K. Gopalachari, M.A., of the P. R. College, Cocanada. I had the shells compared with those in the Indian Museum, Calcutta, and in the British Museum, through the kindness of Dr. Baini Prashad and Mr. Winckworth. A comparison with the specimens in the British Museum led to the identification of my shells as those of *Rachisellus trutta* (Blanford). But an examination of the soft parts showed that the animal is not a *Rachisellus* but an *Eorrhachis*. I give below a short description of the soft parts, particularly with reference to the radula and the reproductive system which differ markedly from those of *Rachisellus*.

The radula is about 4 mm. long and more or less of the same width throughout. About 110 transverse rows were counted in one specimen. The radula formula is 46 to 48—1—46 to 48. The transition from the laterals to the marginals is so gradual that it is not possible to define their regions. Text-fig. 1 shows the entire series on one side. The rows



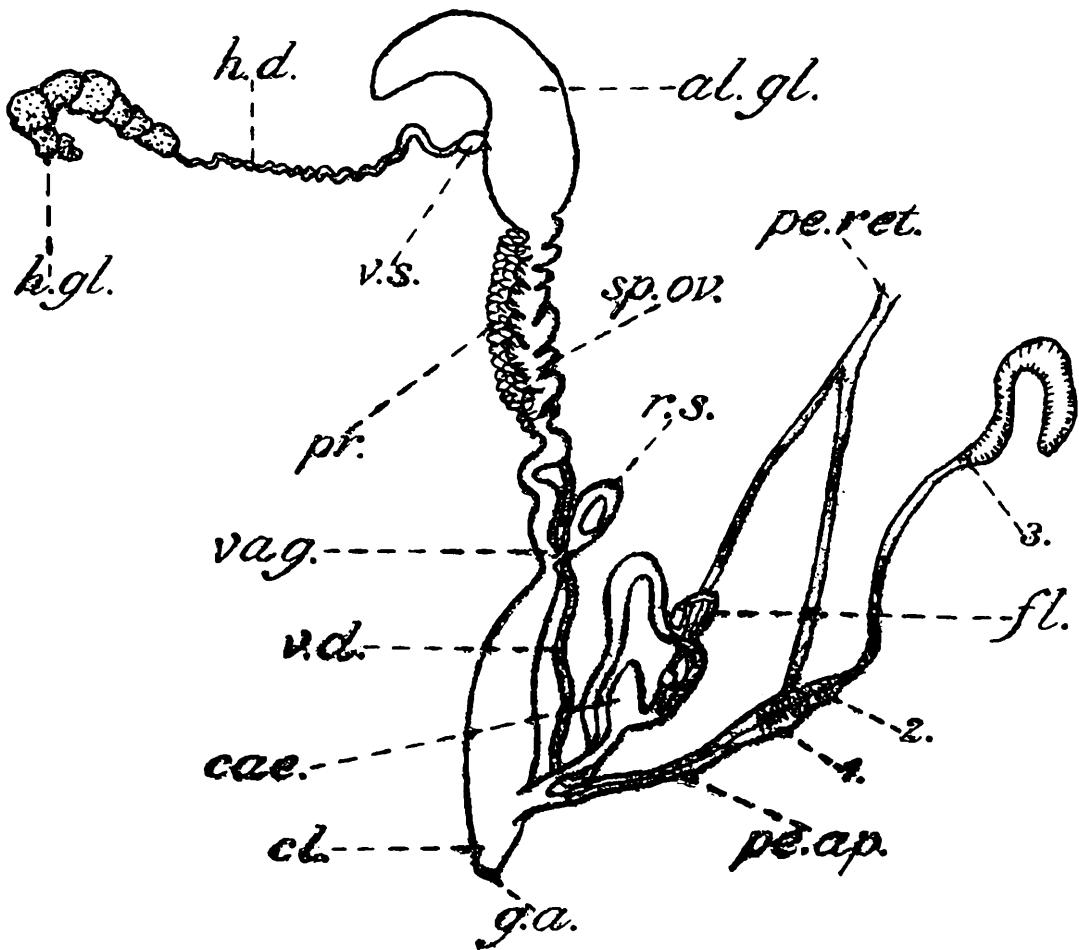
TEXT-FIG. 1.—The teeth of the radula of *Eorrhachis trutta* showing the central, and laterals and marginals of one side of a row.

are obliquely arranged at an inclination of about 30° to the horizontal line, unlike those of *Rachisellus* which are horizontal. The central is large, symmetrical and of nearly the same height as the others. It is rounded in front and has a large basal plate. The next one, that is, the first lateral is assymetrical but is rounded in front like the central; the basal plate is seen displaced towards one side. Four parts can be made out in the lateral teeth, (1) a basal transverse part bearing laterally two cusps; (2) a median portion arising from the former and rounded in front; (3) extending beyond this is the third portion, which is also rounded in front, and (4) the basal plate extending on the outerside. The teeth become gradually modified as they pass to the outer margin

of the radula. The chief modifications that may be noticed are (1) the number of cusps shows a tendency to increase until in the marginal region four to five cusps are noticed, (2) the cusps become obliquely arranged, (3) the second portion of the tooth becomes narrower and finally becomes very much aborted, (4) the third part becomes more rounded and in the marginal region appears as a larger cusps, and (5) the basal plate becomes displaced laterally to the outside, and in the marginal region becomes insignificant.

It will be seen from this account that there is absolutely no point of resemblance between the radulae of *Rachisellus trutta* and *Rachisellus punctatus*.

The examination of the reproductive system also has shown striking differences. The cloaca is much longer and wider, measuring in a medium



TEXT-FIG. 2.—The genitalia of *Eorrhachis trutta*. *al. gl.* albumen gland; *cae.* caecum; *cl.* cloaca; *fl.* flagellum; *h. d.* hermaphrodite duct; *h. gl.* hermaphrodite gland; *g. a.* genital atrium; *pe. ap.* penial appendage; 1. 2. 3. its parts; *pe. ret.* penial retractor; *pr.* prostate; *r. s.* receptaculum seminis; *sp. ov.* spermoviduct; *vag.* vagina; *v. d.* vas deferens; *v. s.* vesicula seminalis.

sized individual about 8 mm. in length, while that of *Rachisellus punctatus* measures about 4 mm. The vagina also is longer measuring about 6 mm. and is slightly convoluted. The spermatheca, which in *Rachisellus* has a long peduncle, is very nearly sessile in *Rachisellus trutta*, the peduncle being very short. It is ovoid in outline measuring about 2 mm. long and 1.3 mm. across. The vas deferens is about 11 mm. in length and separates out from the spermoviduct higher up than in *Rachisellus punctatus*.

The cloaca receives the penial organ about a distance of 3 mm. from its external opening. The structure of this organ also is different from that of *Rachisellus punctatus*. It is short, being about 1.5 mm. in length and divides distally into branches. The outer penial appendage, as in *Rachisellus punctatus*, is divisible into three portions, which, however, present quite a different appearance. The lower portion measures about 6 mm. in length, is narrow in the middle and thicker towards either end. It is greyish in colour. Just below the termination of this part, the penial retractor arises. The second portion of the appendage, which is conical in shape and creamy white in colour, is situated in continuation of the first portion. The third or distal portion of the appendage consists of a lower tubular part prolonged distally into a club-shaped structure usually bent on itself.

The inner part of the penis consists of the epiphallus, flagellum, and caecum. The epiphallus is long, usually somewhat looped on itself, and is about 9 mm. in length. After receiving the vas deferens, it passes below the lower part of the penis, and proceeding up, takes a bend and turns down once again. A caecum is not represented in *Rachisellus punctatus*.

The hermaphrodite gland is about 4 mm. long, and consists of about eight lobes or acini, which are smaller than in *Rachisellus punctatus*. The vesicula seminalis is simply an ovoid swelling of the lower part of the hermaphrodite duct. The albumen gland has the same structure as in *Rachisellus punctatus*. In a full grown specimen it is about 10 mm. in length. The spermoviduct has a coiled appearance. The prostate has a ribbon-like appearance, being composed of transverse bands, but the arrangement is not so regular as in *Rachisellus punctatus*. It overlies the spermoviduct.

The nervous system resembles much that of *Rachisellus punctatus*, the only differences being the greater approximation of the cerebral ganglia, and the greater thickness of the posterior pedal nerves.

It will be seen from this account that the differences between what has been termed *Rachisellus trutta* and *Rachisellus punctatus* are greater than what may be expected between species. Thiele (4) in defining the characters of the family Enidae, states that among the members of the family, *Rachistia* (*Eorrhachis*) alone has large rounded central tooth and that the lateral teeth are arranged in oblique series. *Rachisellus trutta* shows these characteristics, and it is, therefore, certain that what has been known as *Rachisellus trutta* does not belong to the genus *Rachisellus*, but is really an *Eorrhachis*.

Tomlin and Peile (6) in erecting the genus *Eorrhachis* rightly remarked, 'It is probable that all Eastern species with similar form of shell hitherto placed in *Rachis* including certain Indian forms such as *bengalensis*, Lam., and *mavortius*, Rve., will be found to belong to the genus *Eorrhachis* which we now erect.' The segregation of several of the species hitherto attributed to *Rachis* or *Rachisellus* as suggested by Connolly, and Tomlin and Peile on the evidence of radulae and shells, appears justified by the structure of the reproductive system also.

My best thanks are due to Dr. Baini Prashad and Mr. R. Winckworth for comparing my specimens with those in the Indian Museum

and British Museum respectively, and to Dr. H. S. Rao for kindly sending me an extract from Thiele's book.

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A NEW SPECIES OF *BHOORIA* DISTANT (JASSIDAE-RHYNCHOTA).

By S. RIBEIRO, *Entomological Assistant, Zoological Survey of India, Calcutta.*

Dr. Hem Singh Pruthi, Imperial Entomologist, Imperial Agricultural Research Institute, New Delhi, while he was in charge of the Insect Section in the Zoological Survey of India, suggested to me a study of the Subfamily Tettigoniellinae of the Jassidae (Rhynchota). Among the material studied I have come across a unique form which does not agree with any of the published descriptions. The late Dr. G. Horvath of the National Museum of Hungary at Budapest, to whom the specimen was sent for comparison with the material described by the late Dr. Melichar and deposited in the Budapest Museum, was of the opinion that it constituted a new genus of the subfamily Proconiinae. Subsequently the insect was sent to Mr. W. E. China at the British Museum (Natural History) in London for comparison with the type of *Bhooria modulata* which according to Distant¹ "has considerable affinity with the Tettigoniellinae, but the structure of the face, according to my view, locates it in the Gyponinae." I also requested Mr. W. E. China kindly to see whether the anterior tibiae are furrowed in *B. modulata* as on this character in addition to others the late Dr. Melichar² established his Section Proconiaria of the Cicadellidae. In reply Mr. China wrote as follows:—

"The specimen sent is specifically distinct from *Bhooria modulata*, although for the present it can be referred to the same genus. It differs from *B. modulata* in the shape of the head and in the colour pattern of head, pronotum and tegmina. Your species runs down to the genus *Conogonia* Bredd. in Melichar's Monograph of the Cicadellidae. This genus is based on a genotype from New Guinea. It is not represented in the British Museum, and for the present it is preferable to refer your species to *Bhooria* Dist. *B. klossi* Dist. from Dutch New Guinea is not congeneric with *B. modulata*. The anterior tibiae in *B. modulata* are not furrowed, but they are distinctly flattened along the upper side. In spite of this the genus goes into the Cicadellinae and not the Proconiinae. Distant placed it in the Gyponidae but the lateral sutures of face are continued on to dorsal side of head so that it is a Cicadellid."

As unfortunately there is a single specimen available in the collection before me I follow Mr. China's suggestion and describe it here as a new species of *Bhooria* Dist., in spite of the fact that the anterior tibiae are furrowed.

I have to express my gratitude to Dr. Bains Prashad, Director, Zoological Survey of India, for his kindness in revising my manuscript, and to Dr. Hem Singh Pruthi for his valuable help and suggestions.

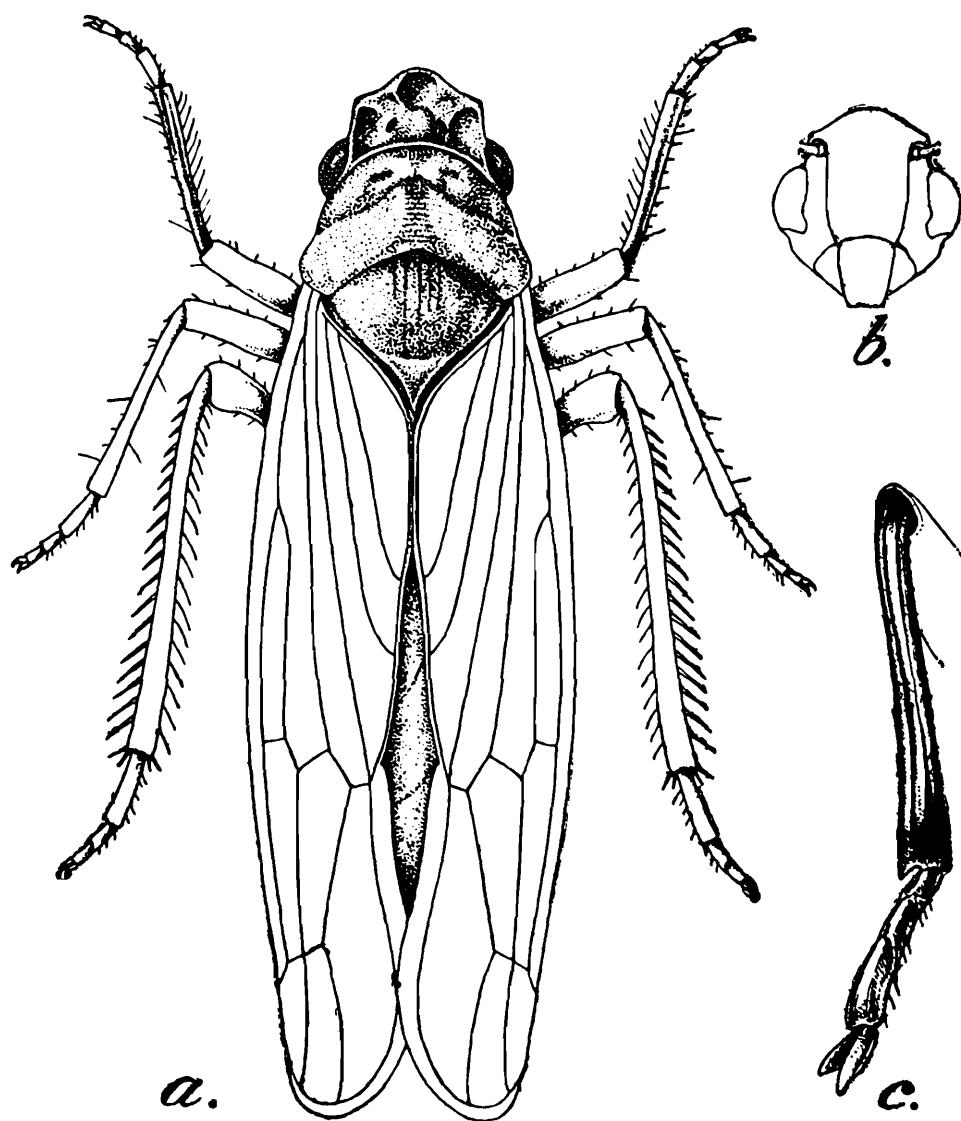
¹ *Faun. Brit. Ind., Rhynchota-Homoptera*, IV, p. 256 (1908).

² *Ann. Mus. Nat. Hungarici*, XXI, p. 197 (1924). It may be brought to notice here that Mr. China has published in *Ann. Mag. Nat. Hist.*, (9) XX, pp. 281-283 (1927) a list of the preoccupied names, etc., of some of the genera dealt with by Melichar in his "Monographie der Cicadellinen".

My thanks are also due to Mr. W. E. China and the late Dr. G. Horvath for their kindness in comparing the new form. The illustrations accompanying this paper have been executed by Babu B. N. Bagchi.

Bhooria subrotundata, sp. nov.

The vertex is produced anteriorly into a short, broadly rounded process. It is ochraceous in colour, nearly twice as broad as long and has the margins somewhat thickened. The lateral margins are concave and somewhat sinuate; they are of a black colour, the black being more extensively diffused on either side of the apical extremity. The vertex is swollen from the middle of the posterior margin to a point three-eighths from the apex of the anterior margin and from this point the tumescence obliquely diverges and meets the anterior margin. The foveate apical and



Bhooria subrotundata, sp. nov. ♂

a. Dorsal view, $\times 12$; b. Face, $\times 12$; c. Anterior tibia, $\times 28$.

the lateral areas of the vertex are sanguineous in colour; the former is small and rounded and the latter are large and ovate. The ocelli are distinct and the inter-ocellar distance is equal to the distance between each eye and ocellus. The pitch-black face is slightly convex; the frons is much longer than broad and furnished with thick, widely

separated transverse striae in the lateral areas ; its upper region is broadly rounded but it is posteriorly moderately narrowed to the clypeus. The clypeus is pitch-black, depressed at the sides and strongly protuberant. The pronotum is ochraceous, broader than long, much longer than the vertex and declivous anteriorly but somewhat depressed a little beyond the middle. The anterior area is marked with darker wavy ochraceous streaks and has two shallow impressions. The anterior margin is black and strongly rounded. The concave posterior margin is brownish-black in colour ; the dark marking is triangularly produced in the middle for about two-thirds the length of the pronotum and there are two elongate sanguineous spots one on either side of the central dark marking situated in the posterior area of the pronotum. The lateral margins are oblique and sinuate and have the posterior angles rounded. The disc is finely wrinkled transversely. The scutellum is triangular, depressed, densely but finely punctured and medially furnished with a series of four longitudinal shallow impressions that extend from the anterior margin to about the basal two-thirds and meeting the deep transverse impression. It is ochraceous in colour with traces of sanguineous markings in the centre at the anterior area. The abdomen is long and slender and the lateral margins project over the edge of the abdomen beneath. The dorsal surface of the abdomen including the anal segment is shining black in colour. The tegmina are long and narrow, brownish-yellow in colour with a central longitudinal brownish streak which terminates before the apical area. The claval area is slightly broader than the apical area. The apical area is narrowly rounded and subhyaline with the inner margins brownish. The veins are thick and prominent except at the claval area where they are thin but distinct, and there are four apical cells, the lowermost longest and broadest [terminology *vide* Distant]¹. The wings are somewhat shorter than the tegmina and are distinctly broadened posteriorly at the anal area. They are fuliginous with the veins much darker. The legs are long and slender and the posterior tibiae are thickly and finely spinulose. The anterior tibiae are sulcate. The anterior coxae are black and the intermediate and the posterior femora are black except at the extremities.

Remarks.—This species differs from *Bhooria modulata* Dist. in having distinctly furrowed anterior tibiae, in the shape and structure of the head, in the venation of the tegmina and in the colour pattern of the head, pronotum, abdomen and tegmina.

Length.—♂ 8.8 mm.

Holotype No. 5327/H7 in the collection of the Zoological Survey of India, Indian Museum, Calcutta.

Locality.—Gangtok, 6,000 feet, Sikkim, Eastern Himalayas (*Col. F. M. Bailey*, May, 1928).

1. *Faun. Brit. Ind., Rhyncho-Homoptera*, IV, p. 256 (1908).

STUDIES ON INDIAN TRYPETIDAE (DIPTERA).

By H. K. MUNRO, *B.Sc., F.R.E.S.*,

Entomologist, Division of Plant Industry, Department of Agriculture, Union of South Africa.

Through the kindness of Dr. H. S. Pruthi, the Imperial Entomologist of India, New Delhi, and of Mr. J. C. M. Gardner, Systematic Entomologist, Forest Research Institute, Dehra Dun, I have been able to examine a number of specimens of Trypetidae from India. I am also indebted to Dr. B. Prashad, Director, Zoological Survey of India, for assistance of the staff of the Indian Museum, Calcutta, in the examination of types and for the loan of specimens.

A study of the insect fauna of India is of great interest both on account of its geographical position and of the variations in climate. As far as the Trypetidae are concerned, the connections with the palaearctic and with the oriental representatives are very evident, and of not less interest, the relationships with species and genera found in Africa. Conversely, it may be said that the African Trypetidae, or at least certain groups, cannot be fully understood without a study of the Indian forms. It is hoped that the notes and observations in the following pages will be of use in furthering the study and interpretation of the relationships of the faunas of the two areas.

Types of new species described are being returned to the Imperial Entomologist.

Callistomyia pavonina Bez.

1913. *Callistomyia pavonina*, Bezzi, *Mem. Ind. Mus.*, III, p. 125, pl. ix, fig. 36.

Two males from Mr. Gardner (Dehra Dun, December 1922, Golataffer : Students' coll.) agree closely with Bezzi's description. The frons is a little less than one-third the width of the head, and has a little brown pubescence ; the lunule is semicircular and yellow ; on the dorsum of the thorax the pubescence is black on the black stripes, as it is also on the black bands and the anterior third of the fifth segment on the male abdomen. The disc of the scutellum is quite flat and has some yellow pubescence.

Gastrozona montana Bez.

1913. *Gastrozona montana*, Bezzi, *Mem. Ind. Mus.*, III, p. 106, pl. viii, fig. 17.

A rather rubbed female (Shillong, 5,000 ft., 22nd May 1928, Fletcher coll. from the Imperial Entomologist) agrees with Bezzi's description. A few points may be noted. The bristles are mostly broken off, but there appear to be two superior and four inferior orbitals, the ocellars short and fine, and a little pale pubescence on the frons. The dorsum of the thorax is light ferruginous, yellowish above the wings. On the

abdomen the pubescence is black on the black bands. The base of the ovipositor ferruginous, black at the tip and with black pubescence; it is about as long as segments three to six together.

Chelyophora ceratitina (Bez.).

1913. *Stictaspis ceratitina*, Bezzi, *Mem. Ind. Mus.*, III, p. 103, pl. viii, fig. 13.

Two males and three females, Dehra Dun, 11th December 1927, C. C. Ollenbach, from bamboo shoot (received from Mr. Gardner).

The species was described from a female. The male is similar and the following notes may be added. The specimens agree with Bezzi's description quite well although they are rather teneral. In the female the third segment of the abdomen is light brown, the fourth and the anterior half of the fifth rather lighter. The base of the ovipositor is as long as the last three segments of the pre-abdomen. In the male the second segment is large, covering about two-fifths of the pre-abdomen, and is yellow with pale pubescence; the third and the front edges of the fourth and fifth are brown, but the whitish bands on the second, fourth and fifth, mentioned by Bezzi, are not particularly evident in these specimens. The genitalia are small and inconspicuous.

Chelyophora gladiella, sp. nov.

A species of which the scutellum has the black divided by yellow lines into a large and a pair of smaller lateral areas, and the marginal band on the wing united to the basal. It is very like *C. ceratitina* (Bez.), but differs in the more extensive black markings on the dorsum of the thorax, there being a median stripe, and the post-scutellum entirely black.

Type male, Pusa, Bihar, 27th April 1913, F. M. H., paratype male, Karallabag, Allahabad, 29th March 1913, F. M. H., type female, Pusa, Bihar, 10th September 1913, F. M. H., paratype female, Pusa, Bihar, 6th April 1929, Fletcher coll., and Calcutta, 1st June 1909, C. V. D.

Length, male, 5.0 mm., female, 6.7 mm., wing-length, male, 5.0 mm., female, 5.5 mm. *Head*, yellowish, normal, short, length half width and two-thirds height; *frons* reddish with black pubescence, two superior and three inferior orbitals, ocellars and genal strong, all bristles black, except an odd yellow bristle on back portion of lower occiput, where hairs are also yellow. Antennae with apical point, arista plumose. *Face* yellowish. *Thorax*: bristles normal, black except yellow cervicals; two mesopleurals. Dorsum (text-fig. 1) pubescence yellow. Post-scutellum shining black, the lower portion with slight dust on the sides. Pleura and sterna yellowish with pale pubescence. *Legs* normal. *Wing* as in *ceratitina*, the marginal united to basal, the cubital to marginal, but the medial only faintly. *Abdomen*, male, second segment very large, nearly half abdomen, yellow with pale pubescence except some black along hind margin, the short third segment is brown with black pubescence, fourth yellow but brown along front edge and pale pubescence, fifth chestnut with pale pubescence, bristles on hind edges of third, fourth and fifth segments. Genitalia inconspicuous. Female,

chestnut, the second, fourth and fifth segments with their hind halves paler and barely silvery-dusted ; pubescence black from hind edge of



TEXT-FIG. 1.—*Chelyophora gladiella*, sp. nov. Dorsum of thorax. The dotted areas are yellow; the cross-ruling shows the whitish dust on the chestnut areas.

second segment, pale before this. Base of ovipositor chestnut, blackish at apex, pubescence black ; about as long as last three segments of pre-abdomen.

***Ceratitis capitata* Wied.**

Although Wiedemann's type of this species is recorded as having come from the "East", the locality has been doubted as the species has not subsequently been found in the oriental region proper. An authentic record that it occurs in India is therefore of interest.

Among the specimens sent to me by the Imperial Entomologist are three females, labelled "Pusa, Bihar, 20.8.07—bred from peach", and a male and a broken specimen "Pusa, Bihar, 23.9.08." It may be noted that these specimens were collected before the appearance of Bezzi's monograph on the Indian Trypetidae in 1913. They are all in rather poor condition, but there is no doubt, especially on account of the spatulate bristles of the male, that they are the Mediterranean fruit-fly.

***Phagocarpus immsi* Bez.**

1913. *Phagocarpus immsi*, Bezzi, *Mem. Ind. Mus.*, III, p. 131, pl. x, fig. 72.

A female, Simla, June 1909, F. M. H. (from the Imperial Entomologist) undoubtedly belongs here. Bezzi refers to the species as "dark yellow", but it is perhaps better described as reddish or chestnut. On the frons there is some rather sparse, fine, black pubescence ; the lunule is short ; the antennae about three-fourths the length of the face, and the arista microscopically pubescent. On the dorsum of the thorax is black, strongly shining pubescence and slight dust, the latter leaving a median and a pair of dorso-central, narrow, shining stripes ; the dorso-central bristles are nearer the prescutellars than to the anterior supra-alars, there are two mesopleurals. The scutellum is rather more convex

above than flat and has four bristles. The abdomen has a more blackish tinge, but the greyish borders to the segments are not apparent in this specimen. The base of the ovipositor is short and broad and about as long as the fifth and sixth segments together, the sixth being very short; it is shining black, but somewhat reddish in the middle, the pubescence black.

Vidalia Rob.-Desv.

1830. *Vidalia*, Robineau-Desvoidy, *Essai sur les Myodaires*, p. 719.
 1870. *Stemonocera*, Rondani, *Prodr.*, VII, *Ortalid.* p. 30.
 1913. *Vidalia*, Bezzi, *Mem. Ind. Mus.*, III, p. 135.
 1915. *Vidalia*, Hendel, *Ann. Mus. Nat. Hung.*, XIII, p. 443.
 1920. *Straussia*, Enderlein, (*nec.* Rob.-Desv.), in Brohmer, *Fauna. v. Deutschland*, p. 302.
 1923. *Hoplاندromyia*, Bezzi, *Ann. Mus. Nat. Paris*, XXIX, p. 577.
 1924. *Hoplاندromyia*, Bezzi, *Bull. Ent. Res.*, XV, p. 111.
 1927. *Vidalia*, Bezzi, in Lindner, *Fl. Pal. Reg.*, XLIX, Tryp., p. 71.
 1933. *Vidalia*, Shiraki, *Tryp. Jap. Empire*, p. 240.

In considering the genus *Vidalia*, it may be noted that the genotype, *V impressifrons*, does not appear to have been recorded again since it was first described. There is also no further information on the type by later authors. Whether the type is still extant may be queried; Hendel, 1915, refers to "der unbekannte Typus", but this may only mean that it was not known to him personally, but then he would probably have said so definitely. When, however, he says "und eine 'chète plumosule' hat", he is incorrect, but seems to have changed his opinion later in 1927. In any case, although Robineau-Desvoidy's description of *Vedalia* is very brief, it is in a way definite. He says "Caractères des Strauzies : chète plumosule. À l'exception du chète, ce genre réunit tous les caractères des Strauzies." One point at least is thus definite, that since the arista is plumose in *Straussia*, it cannot be more than pubescent in *Vidalia*. Thus, even if the type of *impressifrons* is lost, the genus may be regarded as sufficiently recognisable. Finally, if the name *impressifrons* cannot be retained owing to the lack of the type and to the insufficiency of the description, then *V ceratophora* Bez. is proposed as what may be termed a "neogenotype" Hendel's diagnosis (1927) may be accepted although it is very probably not based on the genotype.

Allied to *Vidalia* is *Aischrocrania* Hendel (1927). The genotype is *A. aldrichi* Hend. of which only the male type is known. The characters used to distinguish it are largely those of the male, and the correct relationships of the genus may be better understood when the female has been discovered. The female head may be quite normal, or it may show some modification, particularly of the antennae as is the case in *Ceriocera*. Hendel records scattered, microscopic hairs on the eyes, but these are also present in species of *Vidalia*.

Straussia Rob. Desv. is also similar. It has, however, a peculiarly shaped head, the frons projecting strongly before the small eyes as in *Platyparea*. The ocellar bristles seem stronger in both sexes, and the wing is narrow and pointed outwardly, but the cross-veins are not as strongly approximated as would seem to be indicated by Hendel. Like *Vidalia* it is also distinguished by the curious ornamentation of the head

of the male, and the thickened orbital bristles. Hendel states that the superior orbital bristle is also thickened in *Straussia*, but an examination of specimens of *S. longipennis* it was found that the four bristles on the carina are all the inferior orbitals, and that the superior orbital, in the male, has disappeared.

The species of *Vidalia* may be divided into three groups according to the ornamentation of the male head, and, more or less parallel with these, four groups of wing-pattern may be recognised; these will be explained first.

Two are mentioned by Hendel and include those species having a reduced pattern like that of either (a) *Trypeta artemisiae*, or (b) *Trypeta zoë*. In the other two groups are species with a more heavily-marked pattern as found in (c) species of *Euleia* (*Myiolia*, auct.) and (d) species of *Pseudospheniscus*. Species are fairly readily placed in one or other of these groups, and they are perhaps of more use in separating females. When, however, the species are arranged in accordance with the three types of ornamentation of the male head, there is some over-lapping.

The latter three groups are :—

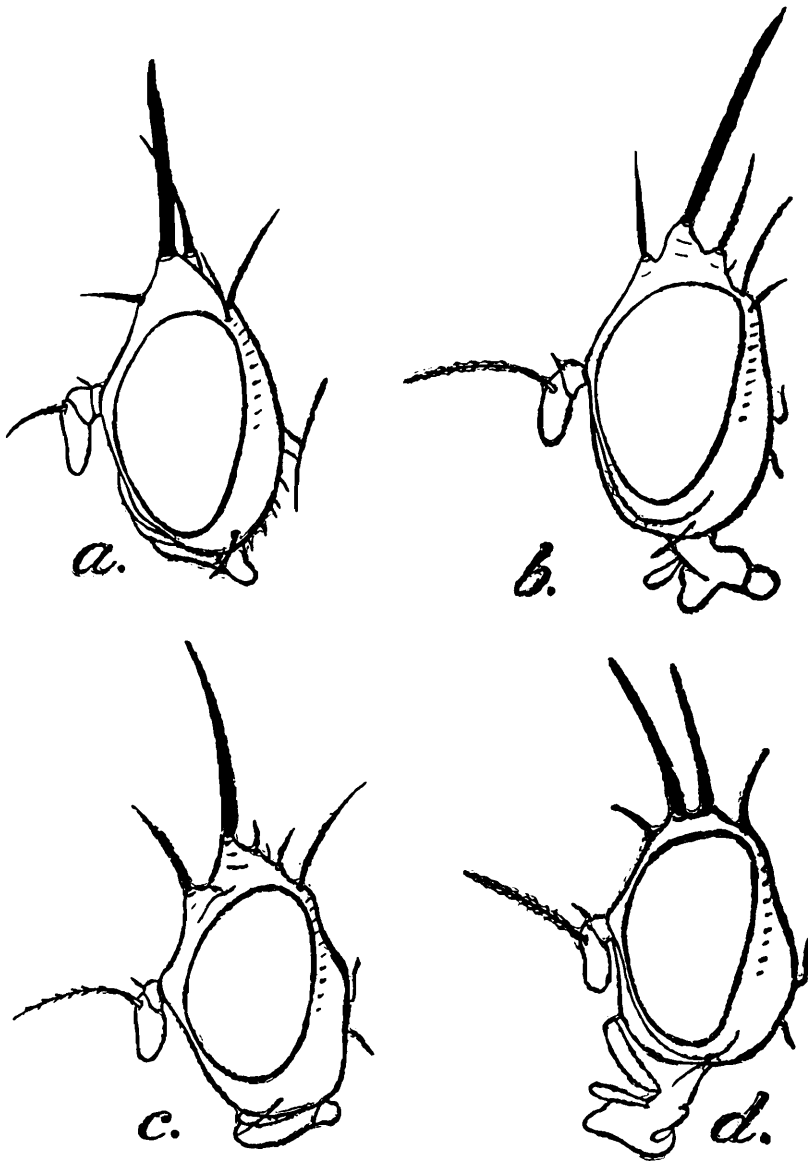
1. Species in which the sides of the anterior portion of the orbits on the frons are produced forward as tubular horns of moderate to considerable length; all, or most, of the inferior orbital bristles occur on the horns, and are black and ribbon-like. In this group are *cervicornis* Brun., *cornuta* Scop., and *appendiculata* Hend., which have an *artemisiae* wing-pattern, and *hendeli* Mro., that of *zoë*.

In regard to these species, two points may be noted. In *appendiculata* the sides of the frons appear, from Hendel's figure, to be merely broadly produced and not distinctly tubular, the species in this particular thus being intermediate between this group and the next. Then, the appearance of the wing-pattern cannot be quite satisfactorily established in the absence of specimens or of figures of the wing, especially in the case of *hendeli*.

2. Species in which the anterior sides of the frons are raised into moderately broad, irregular carinae, more prominent in front. All or most of the inferior orbital bristles are found on top of the ridge, and usually two are ribbon-like. In this group is *armifrons* Portschi, which appears to have an *artemisiae* pattern. Further, there are *spinifrons* Schroed., *triceratops* Bez., and *melanonotum* Brun. with a *zoë* pattern.

3. Here the position is curious and interesting (text-fig. 2, a-d). The carinae are on the hind portion of the sides of the frons. At first sight they would seem to be largely due to the enlargement of the vertical plates, with one, two or three points, three bristles being present. As interpreted by Bezzi, these three bristles might be regarded as two superior and one inferior orbital. It must be noted that Bezzi had no females of the three species he described. It was thus with much interest that I found two pairs of the South African *junodi* Bez. in some material received from the British Museum. A comparison of the heads of the sexes, since the head in the female is quite normal, with one superior and three inferior orbitals, soon convinced me that the three bristles on the carina in this species are all inferior orbitals. Thus in the development of the carinae, the anterior sides of the frons have retreated,

and the fore-most inferior orbital is at about the middle of the frons. The vertical plates are inconspicuous on the inner, lower, hind margins



TEXT-FIG. 2.—Heads of the males of species of *Vidalia* in which the carinae bearing the inferior orbital bristles have retreated backwards. *a. ceratophora* Bez., *b. fletcheri*, sp. nov., *c. bidens* Hend., *d. junodi* (Bez.), (fig. *a.* is redrawn from a sketch of the type kindly made in the Indian Museum).

of the carinae, where the single, small superior orbital is seen. In the description of *junodi* Bezzi says "all 'intorno della prima or. si nota una piccola setola ricurva all' indietro", but he did not realise what it is. In the case of *Vidalia bidens*, of which he had both sexes, Hendel recognised what the bristles are on the carinae. In this the vertical plates and the single superior orbital are on the top of the hind edges of the carinae. Usually two of the inferior orbitals are enlarged and ensiform.

The last two types of wing-pattern are found here. Those with the *Euleia* pattern are *ceratophora* Bez., *bidens* Hend., *fletcheri* sp. nov., and as far as may be judged, the genotype, *impressifrons* Rob.-Desv.; these are all oriental species. The two African species, *tetracera* Bez. and *junodi* (Bez.) (described under *Hoplandromyia*) have a *Pseudo-spheniscus* wing-pattern.

From a consideration of the known species, there seems to be some, although slight, correlation between the two series, as, for instance, no species with tubular horns has a heavily marked wing-pattern. At the same time, since other species may be discovered, it is premature to attempt any division of the genus *Vidalia* at present.

Of *Hoplandromyia*, Bezzi states that it "differs generically from the oriental forms ascribed to the genus *Vidalia*," but he does not say in what way. Probably he had in mind the wing-pattern, but this does not appear to have the importance in generic distinctions given to it by him. I have only seen specimens of the South African *junodi*. This is certainly congeneric with the species of group 3 (male head) known to me, and as there is little doubt that *impressifrons* should be placed there as well, *Hoplandromyia* must be regarded as a synonym of *Vidalia*. Thus is another link between African and Indian Trypetidae established.

***Vidalia cervicornis* Brun.**

1917. *Vidalia cervicornis*, Brunetti, *Rec. Ind. Mus.*, XIII, p. 95, figs. 2, 3.

A male, Pusa, Bihar, 23rd January 1912, M. M. B., and three females, Mashobra, 7,500 ft., 7th June 1921, Fletcher coll. (from the Imperial Entomologist of India); three males and two females, Kanasar, 6,750 ft., Chakrata, U. P., 19th May 1934, J. C. M. Gardner. On leaves of *Juglans regia*, (from Mr. Gardner).

This species is somewhat like *V. cornuta* Scop., but differs in the wing-pattern and in having black, not yellow, pubescence on the dorsum of thorax and abdomen. Also the horns are about twice the head-length, in *cornuta* less, at times only half. In *cervicornis* the bristles are more outwardly directed, two at the tip and four irregularly along the stem; in *cornuta*, besides the apical two, there are two on the stem, the inner shorter. In both species the inferior orbitals are flat and black.

The male has very slight black pubescence on the frons, stronger and longer in the female; in *cornuta* slight and yellow. The ocellars are minute in the female, and seem to be quite absent in the male; there is one superior orbital, four or five inferiors in the female.

On the dorsum of the thorax in the male is a pair of rather wide, sub-median, white-pollinose stripes, widening a little to the dorso-central bristles; in the female the whole of the middle third of the dorsum appears to be slightly white-pollinose. What Brunetti refers to as "two, thin, darker, well-separated, median lines" may be a pair of brownish stripes on the dorso-central lines, and which are more apparent in the female.

The position of the upper cross-vein is a little variable; in the male it is somewhat beyond the middle of the discal cell, in the female practically at the middle. The third vein may have one to five setulae between the knot and the upper cross-vein. The band at the apex of the wing is somewhat wider than in Brunetti's figure, and while in the females it may be well-connected to that over the lower cross-vein, in the male it tends to be disconnected.

Vidalia, sp., *prox.* **V. cornuta** Scop.

A female, Mashobra, 7,500 ft., in jungle, 7th June 1921, Fletcher coll. is very like a male I have of *V. cornuta*, so much so that in the absence of specimens of the other sex in each case, it seems best to leave the species of this female undetermined for the present.

The head is normal, one superior and four inferior orbital bristles, the ocellars minute, and some pale pubescence on the frons; the arista is pubescent. Thorax almost entirely chestnut, with a rather indistinct notopleural stripe; very slight dust and pale pubescence on the dorsum; chaetotaxy complete, two mesopleurals, pteropleural and sternopleural, four scutellars. The postscutellum is coloured like the rest of the thorax, not black as in *cornuta*. Legs normal. Wing practically as in *cornuta*; the band over the upper cross-vein begins at the stigma, and passes more or less faintly to the middle of the third posterior cell, that over the lower cross-vein starts at the third vein, and widens over the cross-vein; that at the middle of the outer part of the marginal cell reaches the third vein; the outer ends of the marginal, submarginal and the upper outer corner of the first posterior cells are infuscated. The abdomen is reddish chestnut, with black pubescence, which, however, is strongly pale-shining obliquely. The base of the ovipositor is chestnut and just a little longer than the fifth segment.

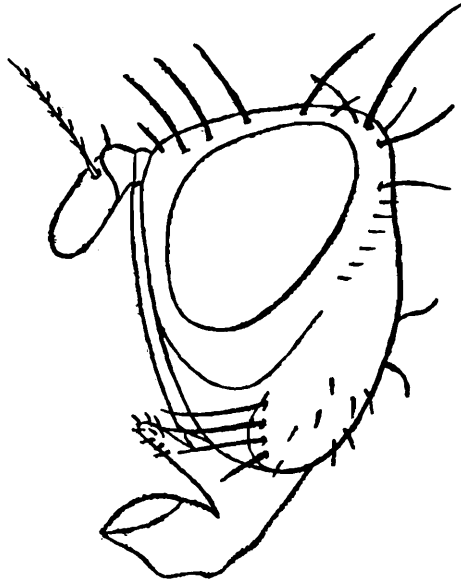
Vidalia trigenata, sp. nov.

A female, Naini Tal, 14th—20th July 1933, P. V. Isaac, is somewhat difficult to locate generically in the absence of the male. Referring to what has already been said about *Aischrocrania*, this specimen runs fairly well to this genus in Hendel's tables. This, however, is mainly on account of the stronger ocellar bristles, as, apart from these, it runs to *Vidalia*. But the ocellars in *Vidalia* are variable and may be absent in the male, moderate in the female, that is, about half the distance from the nearest eye-margin in length; in this specimen they are about as long as this distance. In any case, the female of *Aischrocrania* is still unknown, and it may show some modification corresponding to what is found on the male head. This female is thus perhaps best placed in *Vidalia* as the frons is normal, but it may be noted that the first antennal joint is rather longer than usual. It may be distinguished by the three or four strong genal bristles.

A yellowish species. *Head* (text-fig. 3) width one-fifth greater than height; the lower occiput is greatly swollen and the eyes small. *Frons* flat, five-twelfths width of head and not quite one-fourth longer than wide; with slight black pubescence; bristles black, two superior and four inferior orbitals, ocellars moderate, the dot black. *Lunule* short. *Antennae* about half length of face, first joint longer than usual, arista pubescent. *Face* long and straight, cheeks half width of third antennal joint, genae wide, with a row of three strong bristles and a shorter one and some setulae below. *Eyes* with scattered, microscopic hairs.

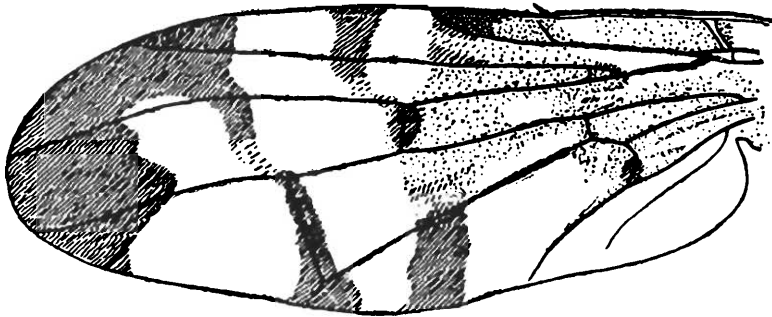
Thorax light chestnut; dorsum blackish, with a pair of rather indistinct, wide, brownish-yellow stripes to dorso-central bristles, and a pair

above wing-base; pubescence black. Chaetotaxy complete, one mesopleural, the dorso-centrals a little behind line of anterior supra-



TEXT-FIG. 3.—*Vidalia trigenata*, sp. nov. Head of female.

alars. *Scutellum* convex above, with four bristles of equal length. Legs normal. Wing (text-fig. 4) pattern of the *Trypeta artemisiae* type, but



TEXT-FIG. 4.—*Vidalia trigenata*, sp. nov. Wing.

with more complete, although irregular, bands (brown) and rather extensive yellow areas (dotted); third vein with some scattered setulae to upper cross-vein. *Abdomen* shining chestnut with black pubescence; base black with reddish apex; about as long as fifth segment.

***Vidalia hendeli*, nom. nov.**

1927. *Vidalia cervicornis*, Hend. (nec. Brun.) in Lindner, *Fl. Pal. Reg.* XLIX, *Tryp.*, p. 73.

As Hendel overlooked the use of the name *cervicornis* by Brunetti (*l. c.*), the above name is proposed for his species, the type of which is in the United States National Museum.

***Vidalia triceratops* Bez.**

1913. *Vidalia triceratops*, Bezzi, *Mem. Ind. Mus.*, III, p. 137, pl. ix, fig. 43.

I have not seen specimens of this species. Some comparisons are given under the following species,

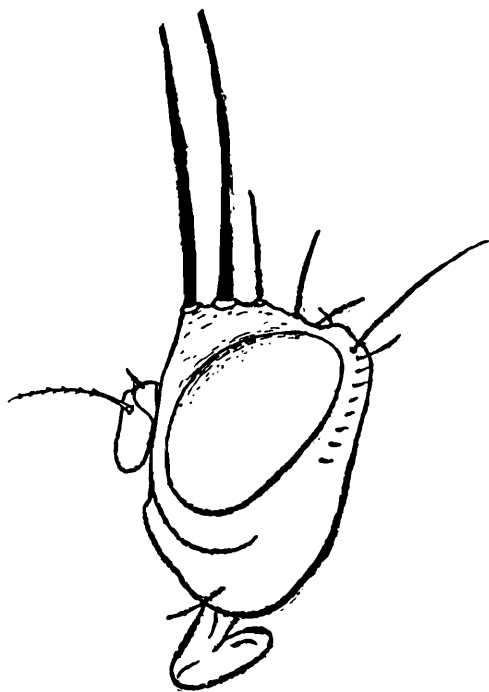
Vidalia melanonotum Brun.

1917. *Vidalia melanonotum*, Brunetti, *Rec. Ind. Mus.*, XIII, p. 96.

Two males and three females received from Mr. Gardner belong to this species, the labels read "Kanasar, 6750, Chakrata, U. P., 19th May 1934, J. C. M. Gardner."

Brunetti described the female. The head and bristles are normal, 4 or 5 inferior orbitals and 2 superior, the ocellars are about half the length of the inferior orbitals. In one female one superior and two of the inferior orbitals are bifid. On the frons is some black pubescence. The thoracic and abdominal pubescence is also black. There are two mesopleural bristles, and a sternopleural and a pteropleural are present; the dorso-centrals a little behind the anterior supra-alars. Brunetti refers to "last segment (of abdomen) shining black"—this is the base of the ovipositor and is quite flattened as so often happens in dry specimens; it is as long as the fifth segment.

In the male head (text-fig. 5) the sides of the frons are raised into



TEXT-FIG. 5.—*Vidalia melanonotum* Brun. Head of male.

broad carinae, lower behind; on these are the four inferior orbital bristles, the anterior two thickened and long (about as long as height of head), the hind two half this length and of normal shape. There is only a single superior orbital, and the ocellars weaker than in the female. Further, the frons seems to be quite bare. The sides of the fourth and fifth segments of the abdomen are more or less black. Otherwise the male is like the female.

This species and *V. triceratops* Bez. seem to be very much alike. In *melanonotum* the two anterior inferior orbitals are long and thickened, while in the other the anterior three are (Bezzi refers to them as the "last three i. or."); further two superior orbitals are recorded for the type, a male. There are also slight differences in the wing-pattern: in *triceratops* the large apical spot is placed obliquely, and there is in

the base of the wing a bar from the inner end of the stigma over the anal cross-veins, the latter absent in *melanonotum*.

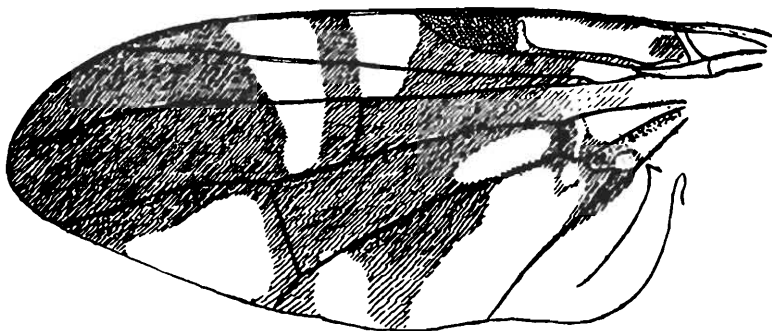
***Vidalia fletcheri*, sp. nov.**

This species is very like *V. ceratophora* Bez., but differs in the ornamentation of the head in the male, and in details of wing-pattern.

Type, a male, Sikkim, 5,000 ft., Kurseong, 7th to 20th June 1922, Fletcher coll. (from Imperial Entomologist).

Length 6 mm., of wing, 6 mm. *Head* (text-fig. 2, b) yellowish brown, length 1.0 mm., width, 1.8 mm., height to top of eye, 1.3 mm., to top of carina, 1.7 mm. *Occiput* flat, not very prominent below. *Frons* with carinae on sides of hind half bearing three inferior orbital bristles, the single superior orbital is a short, thin bristle on lower, hind slope, somewhat on inner side; some integumentary spots on outer side of carinae; ocellars very minute, slight pale pubescence. *Lunule* inconspicuous. *Antennae* normal, coloured as head, about three-fifths length of face; arista pubescent. *Face* flat with shallow grooves; cheeks narrow, appearing linear in profile, about quarter, genae about half width of third antennal joint. *Eyes* rather large. Palpi parallel-sided, bristly outwardly; proboscis short. Bristles black, anterior two inferior orbitals ensiform, the first 0.5 mm., the second, 1.3 mm. in length, the hindmost of normal shape, rather thin.

Thorax: yellowish-brown, with slight integumentary spotting; on dorsum slight silvery dust, but no indication of stripes, pubescence pale; pleura and sterna more yellowish with an indistinctly yellow notopleural stripe. *Scutellum* and post-scutellum like dorsum, apex of former yellower with much integumentary spotting on rather flat disc. Bristles normal, black; cervicals small, two mesopleurals, a sternopleural and pteropleural; dorso-centrals midway between anterior and the inner posterior supra-alars; four scutellars of about equal length. *Legs* yellow, anterior femora with usual row of long bristles below, middle tibiae with strong, black, apical spur, hind tibiae with strong row of short bristles. *Wing* (text-fig. 6) with black pattern very like that of



TEXT-FIG. 6.—*Vidalia fletcheri*, sp. nov. Wing.

V. ceratophora, only second basal and anal cells, and oval area in base of discal hyaline; third vein setulose to upper cross-vein.

Abdomen slightly more reddish brown than thorax, and largely black mottled; pubescence black and strong bristles on sides of last three segments. *Genitalia* blackish, with rather long "forceps" and rather prominent, black, anal region.

Vidalia junodi (Bez.).

1926. *Hoplandromyia junodi*, Bezzi, *Boll. Lab. Zool. Portici*, XVIII, p. 286, fig. I, F.

Among some African Trypetid material of the British Museum collections kindly sent to me by Dr. John Smart are two pairs of this interesting species: two males, Mossel Bay, Cape Province, South Africa, July 1930, and August 1932, and a female, May 1930, as well as another female from the Katberg, Cape Province, September 1933, all collected by R. E. Turner. The type, a male, was taken at Elim, near Louis Trichardt, in the northern Transvaal. It seems opportune to include a record of these specimens here.

This is a striking species, with the head, thorax and legs reddish, the abdomen shining black and with a *Pseudospheniscus*-like wing-pattern. In the male, the carinae are on the hind part of the frons, and bear the inferior orbital bristles (text fig. 2, *d*); the female head is normal, the uppermost of the three inferior orbitals is close to and slightly before the single superior orbital; ocellars absent; there is slight, black pubescence anteriorly. Bezzi refers to differences in the wing-pattern between this and *tetracera* Bez. (the genotype), but after reading his description, it seems that the wing-pattern in the two species must be very much alike, hence that of *tetracera* also *Pseudospheniscus*-like. The post-scutellum (mesophragma of Bezzi) is reddish in *junodi*, black in *tetracera*.

Rhacochlaena Loew and **Staurella** Bezzi.

1913. *Staurella*, Bez., *Mem. Ind. Mus.*, III, p. 121.

1927. *Rhacochlaena*, Lw. see Hendel in Lindner, *Fl. Pal. Reg.*, XLIX, *Tryp.*, p. 69.

These two genera are closely allied, more so, perhaps, to each other than either is to *Euphranta* Lw. They agree in general appearance and in most characters, especially the peculiarly dusted and pseudo-punctate appearance of the dorsum of the thorax, dust being absent in *Euphranta*. In both, too, the single superior orbital bristle and the upper of the inferior orbitals are in close proximity. It may be said that *Staurella* differs from *Rhacochlaena* in having two, and not three, inferior orbitals. On the wing the whitish spot at the tip, absent in *Euphranta*, is characteristic in both; in *Staurella* the upper cross-vein is rather before the middle of the discal cell, while the wing-pattern is banded, strongly so in the genotype, *S. crux* Fabr. and in *S. dissoluta* Bez., but more broken in *S. nigripeda* Bez. (In the absence of specimens it is difficult to determine the position of *Staurella zeylanica* S. W. which has a wing-pattern different from any of those noted). Species of *Rhacochlaena* have a characteristically reduced pattern, and it may be noted that, with regard to *S. nigripeda*, the wing-pattern, added to the fact that it has three inferior orbitals (as stated by Bezzi) seems to suggest that it might be better placed in *Rhacochlaena*.

As far as African species of *Rhacochlaena* are concerned, it may be noted that the eye is larger and the cheeks and genae correspondingly narrower, almost linear, than in the genotype, *R. toxoneura* Lw., of which

I have been able to examine a pair kindly sent to me on loan by Dr. M. Hering of Berlin-Dahlem.

The following new species is of interest as it appears to be the first from India definitely located in *Rhacochlaena*

***Rhacochlaena cassiae*, sp. nov.**

As far as may be judged, the nearest ally of this species is the South African *Rhacochlaena major* Bez¹, with which it agrees in general appearance, in wing-pattern, and in having a more plumose arista. There are only two inferior orbital bristles, as in *Staurella*, but it may be noted that although Bezzi states the type of *major* has three inferior orbital bristles, I have a large series of specimens most of which have only two, some three or a weak third. Thus *cassiae* and *major* seem to occupy a more or less intermediate position between *Staurella* and *Rhacochlaena*, but are perhaps best placed in the latter genus. The chief difference between *cassiae* and *major* is that in the former the head is distinctly—about one-eighth—wider than, and in the latter, as wide as the thorax at the notopleural bristles. In *cassiae* the dorsum of the thorax and of the abdomen is fairly uniformly blackish, while in *major* there is a pair of wide, brownish-black stripes, and the middle third of the abdomen yellow, the sides black. Also in *cassiae* there is a much wider and stronger, yellow notopleural stripe from and including the humerus.

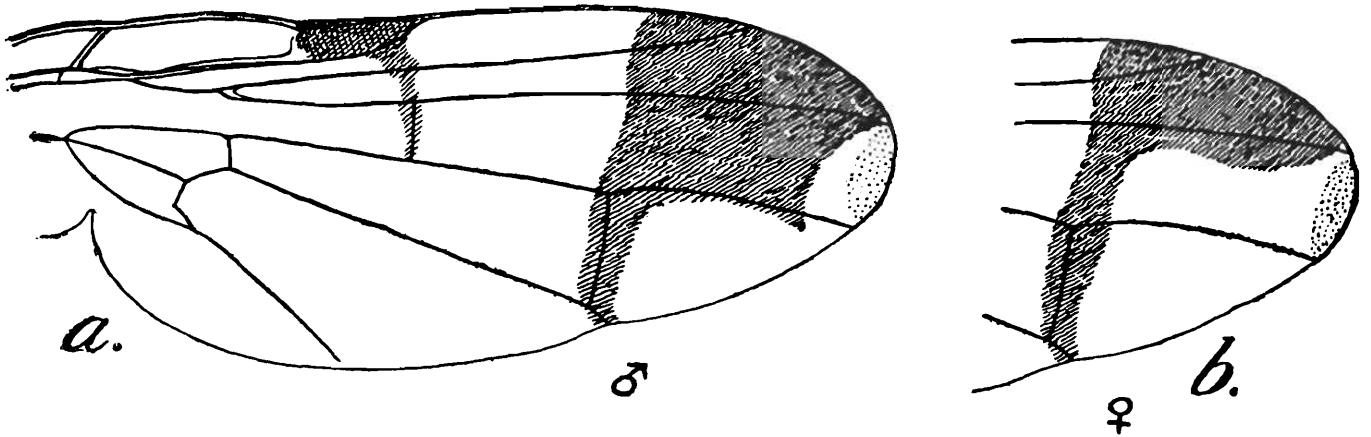
Holotype male, allotype female, two male and six female paratypes, Pusa, 2nd January 1934, Rangi coll. (received from the Imperial Entomologist of India); four male and four female paratypes, Dehra Dun, U. P., 12th December 1932, J. C. M. Gardner (received from Mr. Gardner).

Length, male, 6.5 mm., female, 7.0 mm., of wing in both 6.0 mm. *Head* about one-eighth wider than thorax at notopleural bristles, proportions of length, height and width, 4, 5 and 7, perhaps a fraction shorter in female than in male; *occiput* flat, not prominent below, the bristles fine and black, *frons* moderately prominent before eyes, rather hollowed, parallel-sided, about two-fifths longer than wide, and as wide as an eye, yellow, broadly shining brown centrally, the brown including the ocellar dot, the upper inferior orbital, the superior orbital and barely touching lunule; rather sparse black pubescence; bristles black, the single superior next to, but slightly behind, the upper of the two inferior orbital bristles, ocellars minute and fine. *Lunule* yellow, short. *Antennae* about as long as face, light brownish, blackish on outer sides, end of third joint moderately acuminate but rounded at end, arista short plumose (or long pubescent). *Face* concave, triangular, being wide across the moderately prominent epistome, yellow, dull brown across lower half; cheeks and genae narrow, yellow, genal bristle strong. *Eyes* rather large, rounded and prominent. Yellow palpi broadened to bristly apex, proboscis short yellow.

Thorax moderately large, but rather narrow—a quarter longer than wide—notum shining blackish in front, dark brownish with white silvery dust centrally, paler laterally, and on hind half a median triangular fascia widened behind to include prescutellar bristles; humeri and upper

¹ Bezzi, *Bull. Ent. Res.*, XV, p. 110 (1924).

half of mesopleura bright yellow, otherwise pleura and rest of thorax dark blackish-brown, except scutellum, yellow, flat on top and more or less triangular. Bristles normal, black, no presuturals, dorso-centrals half-way between anterior supra-alars and pre-scutellars, one mesopleural, pteropleural and sternopleural present. *Halteres* pale yellowish. *Legs* yellow with black clothing, front femora rather thickened. *Wing*



TEXT-FIG. 7.—*Rhacochlaena cassiae*, sp. nov. a. Wing of male b. outer end of wing of female, showing slight difference in pattern; the whitish apical spot is dotted.

(text-fig. 7) with reduced pattern with white apical spot; venation, normal, third vein setulose to upper cross-vein.

Abdomen narrow; shining blackish-brown, yellowish at extreme base, and segments two and three in male, two, three and four (least on four) largely with yellowish tinge centrally the combined first and second tergites are unusually long, but are separated from one another by a transverse ridge; pubescence black, whitish on the yellow parts, hind marginal bristles strong on fifth segment, otherwise weak. Male genitalia with bulbous part black, and a pair of long, yellow processes, there is also a curious, flattened, bristly appendage which is probably the proctodaeum or anus. The base of the ovipositor is flattened and appears as wide as the segment before, it is about as long as segments three, four and five together, brownish like the pre-abdomen, the short pubescence black.

Biology.—According to notes on both lots of specimens they were reared from larvae infesting the pods of *Cassia fistula* (Leguminosae). This is of much interest both because the Leguminosae are a group of plants not usually infested by Trypetidae, and that it seems to be the first record of the rearing of a species of *Rhacochlaena*, and of allied genera.

Staurella crux (Fabr.).

1794. *Musca crux*, Fabricius, *Ent. Syst.*, IV, p. 358, fig. 190.

1805. *Dacus crux*, Fabricius, *Syst. Antl.*, p. 277, fig. 23.

1830. *Trypeta crux*, Wiedemann, *Auss. Zweift. Ins.*, II, p. 488, fig. 19.

1913. *Staurella crux*, Bezzi, *Mem. Ind. Mus.*, III, p. 122, pl. ix, fig. 33.

In the material from the Imperial Entomologist is a female, Pusa, Bihar, 20th March 1913, F. M. H.

The following notes show a few differences from and additions to what Bezzi has recorded: The upper of the two inferior orbital bristles

is near the single superior orbital. The face is short and flat, with the epistome jutting out at an angle. The dorsum of the thorax has a peculiar, punctate appearance with slight whitish dust; the anterior two-thirds is largely brownish with brown pubescence, but on the sides before the suture the pubescence is yellowish, the posterior third is yellow with yellow pubescence. The pubescence on the pleura is brownish. The wing-pattern is like that given in Bezzi's figure, but the band from the stigma over the upper cross-vein reaches the hind margin of the wing; the third vein has a few setulae to the upper cross-vein and one just beyond; the costal bristle is inconspicuous. The abdomen is brown at the base, but most of the second and all the third segment yellow with yellow pubescence; segments four, five and six are brown with brown pubescence, the last the darkest. The base of the ovipositor is dark brown with brown pubescence, and about as long as the last three tergites of the pre-abdomen.

***Staurella dissoluta* Bez.**

1913. *Staurella dissoluta*, Bezzi, *Mem. Ind. Mus.*, III, p. 123, pl. ix, fig. 34.

This species is very like the preceding; there are two females, Dehra Dun, 7th June 1932, P. V. Isaac coll., and another Pusa, Bihar, 27th April 1913, F. M. H., from the Imperial Entomologist. Bezzi's description deals with the wing alone, and, apart from the general resemblance to *S. crux*, the following points may be noted. *Frons*; pubescence black, the vertical plates rather conspicuous and shining translucent in these specimens, the upper of the two inferior orbital bristles not quite as close to the single superior orbital as in *crux*, the ocellars weak. *Antennae* a little longer than the short face, the arista short, plumose, the epistome projecting as in *crux*. *Thorax* discoloured in specimens, but generally as in *crux*, pubescence pale, two mesopleural and four scutellar bristles. *Wing* as in Bezzi's figure, the apex whitish and a few setulae at base of third vein. *Abdomen* black with black pubescence, on second segment a semilenticular area on hind half, and a shallow one on hind edge of third, the pubescence on these areas yellow. Base of ovipositor rather narrow, black with some reddish tinge and black pubescence; as long as last four segments of pre-abdomen.

***Spheniscomyia* Bezzi.**

1913. *Spheniscomyia*, Bezzi, *Mem. Ind. Mus.*, III, p. 146.

1927. *Spheniscomyia*, Hendel, in Linder, *Fl. Pal. Reg.*, XLIX, *Tryp.*, p. 105.

1931. *Spheniscomyia*, Hendel, *Bull. Soc. R. Ent. d'Egypte*, V (n. s.), p. 4.

1933. *Spheniscomyia*, Shiraki, *Mem. Fac. Sci. Agric., Taihoku Univ.*, VIII, p. 353.

It seems that only four species should be included in this genus at present. Various other African species have been included by authors, but these have or should be removed. The four are: (1) *filiola* Lw., the genotype, and *quadrincisa* Wied. (recorded from India by Bezzi, *l. c.*) both of which have three hyaline indentations on the hind margin of the wing. (2) *sexmaculata* Macq. the ethiopian, and *atilia* Walk. the oriental species. These have four indentations on the hind margin

of the wing and the third vein setulae ; they may be distinguished from one another as follows :—

Hind tibiae yellow, dorsum of thorax more strongly yellow-dusted and the first hyaline indentation from base of wing narrower.
atilia Walk.

Hind tibiae black, only yellow distally, dorsum of thorax thinly dusted, showing as a rule three bare stripes, first hyaline indentation broader.
sexmaculata Macq.

***Spheniscomyia atilia* Walk.**

1913. *Spheniscomyia sexmaculata*, Bezzi (nec Macquart), *Mem. Ind. Mus.*, III, p. 148.

Three specimens, New Forest, Dehra Dun, a male, 26th September 1927, R. N. Mathur, a male, 21st November 1928, N. C. Chatterjee, and a female, 27th March 1928, S. D. Bhatt. (from Mr. Gardner).

These are rather small and in poor condition. As they are rubbed, the dorsum of the thorax is not as thickly dusted as in specimens I have seen from Formosa. They agree otherwise with *atilia*, particularly as the hind tibiae are yellow. The first hyaline indentation from the base of the wing is narrower, but not much more so, than the black before it.

S. atilia is probably common in India, and, as is the case of *S. sexmaculata* in South Africa, will be found to breed in the flowers of Labiate plants.

The numerous specimens recorded by Bezzi (*l. c.*) are undoubtedly this species because he states that the hind tibiae are yellow.

***Platensina acrostacta* Wied.**

1824. *Platensina acrostacta*, Wiedemann, *Anal. Ent.*, LIV, p. 119.

1830. *Trypeta acrostacta*, Wiedemann, *Auss. Zweit. Ins.*, II, p. 501, fig. 39.

1842. *Ensina guttata*, Macquart, *Mem. Soc. Lille*, I, p. 387, pl. xxxi, fig. 10.

1913. *Tephrostola acrostacta*, Bezzi, *Mem. Ind. Mus.*, III, p. 153, pl. x, fig. 57.

The group to which this species belongs has been termed the Plateninini and it is dealt with in a paper appearing in Vol. 2, pt. 2 of the Entomology Memoirs (Dept. of Agric., Union of South Africa).

There are from the Imperial Entomologist four males and a female all collected at Pusa, Bihar, 31st May 1906, Y. R. C., 4th March 1912, and 2nd April 1913, C. S. S., 27th October 1913, Md. S., and 19th March 1914, J. L. M.

There is a little, coarse, yellow pubescence on the frons ; on the third vein three or four setulae at the base and a sparse row from upper cross-vein to third quarter of last section of the vein ; on the hind tibiae a row of setae as in *Pliomelaena*, or it may be only weakly developed ; the abdomen quite shining black or more or less extensively reddish ; the base of the ovipositor as long as the third to sixth segments together.

***Pliomelaena zonogastra* (Bez.).**

1913. *Tephritis zonogastra*, Bezzi, *Mem. Ind. Mus.*, III, p. 164, pl. x, fig. 66.

A male, Simla, October 1908, F. M. M. labelled "*Tephritis zonogastra* Bez. det. Brunetti," (from the Imperial Entomologist) and two males, Mussoorie, 23rd June 1927, C. C. Ollenbach (from Mr. Gardner).

An examination of these specimens showed that the species should be placed in the genus *Pliomelaena*, and that it is indeed very similar to certain South African species. These, like the previous one, are also included in the *Platensini*. The two to which *zonogastra* shows most resemblance are *P. rufiventris* Bez., and *P. stevensoni* Mro. (a newly described species) both of which have a more predominantly reddish abdomen, and the hyaline spots on the wing developing an anchor-like pattern. *P. stevensoni* is distinguished by the two pteropleural bristles and the third vein setulose over the discal cell; in the other two there is a single pteropleural as usual, but in *zonogastra* the third vein is practically bare, or with only two or three setulae near the base and the dorso-central bristles just on or barely before the anterior supra-alars, while in *rufiventris* the third vein is setulose to the middle of the first posterior cell and the dorso-centrals close to the suture.

African species infest the flowers of Acanthaceous plants, and it may be expected that the Indian species do as well.

INDIAN EARTHWORMS. III. THE GENUS *EUTYPHOEUS*.

By G. E. GATES, *Judson College, Rangoon.*

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INTRODUCTION.

Eutyphoeus is one of the few definitely Indian¹ genera of earthworms, represented in the Indian portion of its range by a number of species some of which are widely distributed and fairly common. Nevertheless, almost nothing has been known hitherto with regard to several characteristics that are very important taxonomically while species have been erected, suppressed, keyed and identified by reference to genital markings, penial setae and spermathecal diverticula, structures which are "often extraordinarily variable" (Stephenson 1923, p. 428), or to

¹ Limited to India or to India and a contiguous portion of Burma.

characteristics that are of no taxonomic value. As a result of this situation the author, some ten years or so ago, reluctantly abandoned an attempt to identify a fairly large collection of *Eutyphoeus* from the Indian Museum. More recently another lot, collected at Calcutta, was received from the same source. Maung Hla Kyaw, while working in this laboratory, studied the collection and eventually concluded that all of the 177 specimens belonged to one species. A considerable number of these worms could be referred, though with some doubt, to *E. masoni* (Bourne) 1889, but other specimens could be referred equally well to other species recognized by Stephenson in 1923. A few worms belonging to species that were suspected of representation in the Burmese fauna were re-examined several years ago (Gates 1934). At the same time, a casual examination of types of other species in the Indian and Hamburg Museums showed that further study of these worms would enable more accurate characterization of some of the species at least, and the suppression of certain forms as synonyms. In order to be able to identify some new material from the Indian Museum and at the same time to lay a better foundation for a study of the distribution of the Indian and Burmese forms, it was finally decided to postpone other work and attempt a revision of the Indian section of the genus. Accordingly Dr. Prashad was appealed to once again and he generously forwarded all of the Indian Museum material.

Some of the worms previously studied by Stephenson and Michaelsen are now in the British and Hamburg Museums and could not be borrowed so that a really complete account is impossible. While regretting this inability to examine limited portions of older material it is felt that this has not affected significantly the results of the present investigation. All types known to be extant, excepting only that of *E. annandalei*, are in the Indian Museum. Study of other material, with the one exception noted, is of minor importance. In order to make available information hitherto unpublished, a statement as to the material which has not been studied and its present location is included in connection with each species.

Types of five species (*orientalis*, *masoni*, *gammiei*, *incommodus* and *nicholsoni*) probably are no longer in existence, at least they cannot be traced. One of these species, *gammiei*, cannot even now be characterized taxonomically with certainty, and in the absence of types the definition must remain in doubt until the fauna of the type locality is worked out.

Of the 21 Indian species admitted by Stephenson in the "Fauna" only 16 have any claims for recognition. To that number must be added *kempi* (reinstated), *assamensis* Stephenson 1926, *lippus* Gates 1934, and two new species erected on recent material collected for the Indian Museum. Two thirds of these species, including *aborianus**, *annandalei**, *assamensis*, *callosus*, *comillahnus*, *festivus**, *kempi**, *lippus*, *manipurensis* (Burmese specimens doubtful), *nainianus**, *nepalensis*, *pharpingianus**, *scutarius* and *turaensis* are known only from the type localities while *E. gigas* is known only from one Indian locality. Of the species named above 6 are known only from a single specimen each (indicated in the list above by an asterisk). Furthermore several species are represented only by acelitellate, possibly juvenile types in which some of the specific

characteristics are not developed, while the condition of types of other species is such that recognition of taxonomically important structures is impossible. As might be expected in these circumstances, it has been somewhat of a problem to decide whether or not to recognize certain of the species just listed, especially those which cannot be characterized properly. The problem is perhaps more difficult than in certain other genera, because of the intra-specific variation, especially of a type that may be called reversionary, known to occur with regard to very important structures. Although the status of several species such as *aborianus*, *annandalei*, *assamensis*, *callosus*, *pharppingianus* and *turaensis* is dubious and others cannot be characterized properly, each of the doubtful forms can be distinguished, at least for the present, from other species by one or more characteristics that appear to be of specific value. Accordingly all of the 21 species have been recognized in spite of the inability fully to characterize a number.

Only two species are common to both Burma and India, *E. gigas* and *E. manipurensis*, and the Burmese specimens of the latter are different enough to arouse a suspicion that they may have to be separated off as a distinct species. Almost no repetition therefore will be necessary as a result of the separate consideration of the Burmese and Indian species.

The author's thanks are again extended to Dr. B. Prashad for the loan of valuable material from the Indian Museum, as well as for other assistance, and to L. W. Trueblood of this college for assistance in connection with geographical problems.

DISTRIBUTION.

An *Eutyphoeus* area may be marked off roughly by a line drawn on the map from Calcutta through Allahabad, Agra, Delhi, Kapurthala to Rawalpindi (Punjab) and from thence east along the Himalayas into Assam, sloping down in Burma to the Irrawaddy River in the Myitkyina district. At Mandalay the boundary shifts east of the Irrawaddy to the Shan Plateau, reaching up onto the westernmost portion of the plateau in the Toungoo district while in the Tenasserim division it is continued south at least into the Mergui district. The genus has not been found on the Andaman Islands. Within this area there are none of those physical features which are usually thought of as effective barriers to earthworm migration nor is there any discontinuity of distribution, so far as the metandric section of the genus is concerned. (*Typhaeus laevis* Rosa 1891 from Ceylon may be disregarded, it is not a *Eutyphoeus* almost certainly.)

The *Eutyphoeus* area is belt-like, curved around to the south in Burma into a sort of arc, the length of the belt or arc very much greater than the width though the long axis is latitudinal in India and longitudinal in Burma. The shape of this area is so peculiar that the question may well be raised as to how far the boundary outlined above coincides with the limits of distribution of the genus. The northern limit of course is unknown but it is extremely unlikely that this boundary will be pushed much further to the north in the Himalayas in a region from Naini Tal east nearly to 98° longitude. It is of course possible that *Eutyphoeus*

may have been able to penetrate slightly into Tibet along the Brahmaputra valley. In northwestern India further penetration from the Punjab to the north may have been possible along the valleys of the Sutlej, Chenab and Jhelum. Practically nothing is known of the earthworms of Burma above Myitkyina but even here physical barriers effectively bar the way, at least north of the Burmese border. The eastern border is fairly definite as considerable collecting has been done on the Shan Plateau. The southeastern limit in Burma has not been determined definitely but the genus becomes progressively less important passing south in the Tenasserim division and it is fairly obvious that any changes here as well as along the eastern and northern borders will be slight and will not significantly modify the shape of the *Eutyphoeus* area. Between the mouths of the Sittang and the Ganges, the southern border is practically at the seashore. In Peninsular India, earthworms have been collected by the Zoological Survey of India just as carefully as elsewhere, according to Dr. B. Prashad, Director of the Survey. It is unlikely therefore that the southern boundary will be changed drastically by future collecting. To the west *waltoni* has been found at Baroda and Ahmedabad both of which are below the 500 ft. level. In the triangular Baroda-Kapurthala-Gwalior-Baroda area which is on a plateau south of the border delimited above, *Eutyphoeus* is unknown, but possibly because of lack of collections within the area. If the *Eutyphoeus* area is to be extended to include Baroda and Ahmedabad the western boundary remains to be determined though still further west the Thar desert provides a definite barrier. Although there are a number of *Eutyphoeus* records from the Punjab these are wholly of *waltoni* and *incommodus*. The former, even in 1910 was regarded by Michaelsen as "in geringem Masse peregrin" while Stephenson later (1923) considered both to be of no zoogeographical value. For the present at least the Bombay and Punjab distribution appears to be due entirely to the presence of unusually wide spread species which have been able in one way or another to pass beyond the limits of the generic region proper. By elimination of areas in which *incommodus* and *waltoni* are the only *Eutyphoeus* representatives the western boundary can be moved east approximately to the longitude of Dehra Dun. But whatever may be the proper western boundary the shape of region probably will not be greatly changed. To the north and to the south in part and possibly also to the west *Eutyphoeus* is shut in by very definite physiographic or climatic barriers, the Tibetan massif, the sea and the Thar desert. On the east the genus apparently is restricted by the escarpment of the Shan plateau and to the south in Peninsular India by the Deccan plateau but it is unlikely that either of these structures can be regarded in a purely mechanical sense as an effective barrier to a genus that has penetrated 6-15,000 ft. into the Himalayas.

The more primitive holandric species (leaving out of consideration the widely spread *incommodus* and the dubious *annandalei* are known only from a small region in Bengal and Bihar and in a very narrow zone that extends southwards from Loktak in Manipur through the Chin Hills district, Lower Chindwin district, Thayetmyo and Prome districts just into Tharrawaddy district (Pegu Yomas only). From the Arakan Yomas west to Calcutta holandric species appear to be lacking. Of

the holandric species *quadripapillatus* is possibly the most primitive. This species is known only from Calcutta and Saraghat in Bengal and Sirsiah in Bihar. The *quadripapillatus* area accordingly is fairly close to the centre of the *Eutyphoeus* region.

Assuming for the moment that the genus originated at or near the centre of its present region in the *quadripapillatus* area of Bengal and Bihar, why has it been able to penetrate so far to the west in northern India and so far to the south in Burma without at the same time reaching further onto the Shan plateau and onto the Deccan in Peninsular India, in directions where physiographic and climatic barriers are apparently lacking ?

As sufficient time appears to have been available for penetration onto the Deccan plateau in Peninsular India as well as to the east on the Shan plateau of Burma, absence of *Eutyphoeus* in those areas must be the result of operation of factors less obvious than those already mentioned. On the Shan plateau and in the Tenasserim division *Eutyphoeus* presumably has come into competition with *Pheretima*, the young and virile genus which, according to Michaelsen, has crushed out all competitors within its vast domain. Such competition has not been effective however in preventing spread of *Eutyphoeus* into the northern part of the Tenasserim division and the Karen Hills of the Toungoo district where endemics of both *Eutyphoeus* and *Pheretima* are found close together. In Peninsular India, to the south of the *Eutyphoeus* region there is no genus or group of worms that appears to be capable of furnishing the virile type of competition postulated for *Pheretima* nor such as might be afforded by the Lumbricidae in Kashmir and the western Himalayas. If the Baroda-Ahmedabad records represent a discontinuous distribution, possibly the result of accidental transportation, and *Eutyphoeus* is really lacking in Rajputana and the Central India agency as well as other portions of the Deccan plateau the barrier to southern migration in India would appear to be edaphic, for on the Deccan plateau the soil is volcanic and has physical and chemical properties quite different from those of the soil types prevailing throughout the *Eutyphoeus* region.

Seven species, *aborianus*, *assamensis*, *comillahnus*, *gigas*, *kempi*, *quadripapillatus* and *scutarius* are known only from elevations below the 500 ft level. *E. nicholsoni* apparently is also a plains species as it has been found only once at an elevation that may be greater than 500 feet (Saharanpur, 500-1,000 ft.). *E. orientalis* appears to be primarily a plains species, having been found only once above the 500 ft. line and then at Dehra Dun (2,000+).

Nine species are known only from the hills, at elevations from 1,500 to 15,000 ft. *annandalei* (4,500), *callosus* (3,000+), *festivus* (3,000+), *lippus* (4,000-8,000 possibly 15,000), *manipurensis* (1,500), *nainianus* (6,000+), *nepalensis* (6,000+), *pharpingianus* (3,000+), and *turaensis* (3,500+).

E. gammiei has been found both in hills and plains but if all specimens now referred to this species are correctly identified, it appears to be primarily a hill form, found up to elevations of 3,900 feet in Assam, and to 5-7,000 feet in Darjeeling district. The plains records are all, except Comillah, of places near to hills.

E. incommodus is known about equally from plains and hill localities, the highest elevation at Kasauli (3,000+).

E. waltoni likewise is known both from plains and hills : below 500 feet 11 records ; 500-1,000, 4 records ; 1,000-1,500, 2 records ; 1,500-2,000, 1 record ; 2,000+, 1 record.

Of the supposedly primitive holandric species, one appears to be restricted to the plains (*quadripapillatus*), two (*annandalei* and *manipurensis*) to the hills, one (*incommodus*) about equally in both but reaching only to heights of 3,000+ feet.

PHYLOGENETIC RELATIONSHIPS.

If morphological similarity is a valid criterion for determination of oligochaete relationships, then *Eutyphoeus* is much more closely related to *Scolioscolides* than to any other genus now known. Indeed, the two genera are distinguished from each other mainly by a characteristic that has been denied even generic value elsewhere in the Megascolecidae. Yet this same characteristic necessitates retention of the two genera in different subfamilies, *Eutyphoeus* in the Octochaetinae and *Scolioscolides* in the Megascolecinae.

This relationship of *Eutyphoeus* to *Scolioscolides* and certain considerations arising therefrom have been outlined briefly in the preceding article of this series (Indian earthworms, II.) and will not be repeated here. There remains to consider the relationship to *Eudichogaster*.

Eutyphoeus according to Michaelsen (1921, p. 34) and Stephenson (1923, p. 364 and 1930, p. 848) is derived directly from *Eudichogaster*. It might be expected, therefore, that *Eutyphoeus* would be like *Eudichogaster* morphologically, at least to the same extent that it is like the totally unrelated (current classification!) *Scolioscolides*. Such however is not the case and actually *Eutyphoeus* has no greater anatomical resemblance to *Eudichogaster* than it has to *Octochaetoides*, the resemblance small in either case, so far as can be determined from a perusal of the literature.

Eudichogaster, in giving rise to *Eutyphoeus*, has undergone the following changes (Stephenson) : completion of the microscolecin reduction, localization of the calciferous glands in xii, and fusion of the two gizzards.

With regard to the gizzard, no evidence has been advanced to prove that it had a double origin in *Eutyphoeus*, indeed Stephenson on several occasions speaks of the arrangement of the hearts as indicating that the gizzard belongs morphologically to vii. The size of the *Eutyphoeus* gizzard is of no real value in this connection, *Pheretima* also has a large gizzard (with no possibility of double origin) in a coelomic space formed by a disappearance of one or two septa, as may *Octochaetoides*. Nor can a supposed similar fusion of gizzards to produce the genus *Mono-gaster* be regarded as valid evidence in this connection. *Scolioscolides* has a gizzard like that of *Eutyphoeus*, large and in the space formed by the disappearance of 6/7-7/8. *Scolioscolides* must be derived, in accordance with current practice, from *Megascolides*, a genus in which there is only one gizzard. Nor is there any Megascolecine genus with two gizzards from which *Scolioscolides* can be derived. Until evidence can

be found to show that the *Eutyphoeus* gizzard is different from that of *Scolioscolides* there would appear to be more justification for considering one double than the other.

In *Eudichogaster* the gizzards are almost always in v and vi. Fusion of these two gizzards presumably would not take place without a simultaneous or previous disappearance of septum 5/6 which is always present and thickly muscular in *Eutyphoeus* and further would not result in a *Eutyphoeus* condition but one more like that in certain species of *Octochaetoides* (one large gizzard in the space between 4/5 and 7/8 or 8/9). Two species of *Eudichogaster* do have gizzards in vi and vii, fusion of which would be more likely to produce a *Eutyphoeus* condition (one large gizzard in a space between 5/6 and 8/9). But *E. matheranensis* has undergone a partial or complete balantine reduction and has stalked calciferous glands. *E. falcifer*, the other species with gizzards in vi and vii¹ apparently also has stalked calciferous glands—the description is not clear on this point, although the sex organs are acanthodriline.

The calciferous glands of *Eutyphoeus* are longitudinally hemi-ellipsoidal bodies in the wall of the gut with the flattened faces mesially, each gland with numerous vertical partitions, the interlamellar spaces in communication dorsally with the gut lumen. This type of gland has been evolved (Stephenson 1930, p. 104) by fusion of the median margins of a longitudinal series of vertical lamellae on the lateral wall of the gut. Presumably then the stage ancestral to *Eutyphoeus* should be characterized by calciferous glands with well developed vertical ridges or lamellae on the lateral walls of the oesophagus, but with no fusion of the median margins of the lamellae. To derive *Eutyphoeus* from *Eudichogaster*, and in particular from species with gizzards in vi and vii, a stalked appendage from the oesophagus containing a calciferous gland has to be retracted into the gut wall, a development that seems rather unlikely. Further consideration of relationships as indicated by the calciferous glands will profit little as almost nothing is known of the anatomy of *Eudichogaster* glands, the slight amount of information available in systematic descriptions usually consists of only brief references to shape, size or location.

Characteristics of the vascular system have been used only rarely in earthworm systematics which may at least partially be responsible for the paucity of information with regard to the hearts of xiii. Accordingly it is impossible at the present time, to assess the taxonomic value of the presence or absence of hearts of a particular segment in many genera or to determine the phylogenetic importance, if any, of these structures. Even when mention has been made of hearts there is often no further statement to indicate whether such hearts are lateral, intestinal or latero-intestinal, or even non-pulsatile commissural loops connecting supra- and sub-oesophageal vessels. Some indication of the status of our knowledge regarding the last pair of hearts in certain Acanthodrilin and Octochaetin genera is furnished by the following statement:—*Notiodrilus* (the ancestral Acanthodrilin genus from which the Megascolecinae and Octochaetinae are derived): in xii, 4 species; in xiii, 5 species; unknown or not mentioned, 19 species (figures from

¹ *E. pusilus* "probably" has the gizzards in v and vi.

Michaelsen 1900). *Howascolex* (the parent genus of the Octochaetinae) : in xiii, 1 species ; unknown, 2 species (figures from Stephenson 1923). *Ramiella* : in xii, 5 species ; unknown, 1 species. *Eudichogaster* : in xii, 14 species ; unknown, 1 species. *Octochaetoides* : in xii, 4 species ; in xiii, 10 species ; in xii or xiii, 1 species ; unknown, 5 species. *Hoplochaetella* : in xiii, 7 species ; in xii or xiii, 1 species ; in xii, 1 species. *Octochaetus* (New Zealand) : in xiii, 4 species ; in xii, 1 species. *Dinodrillus* (New Zealand) : in xiii, 3 species. *Eutyphoeus* : in xiii without exception, though location of the last pair of hearts is unknown in one species.

If the presence of hearts in xiii is a primitive characteristic, for which there is some evidence as shown above, it scarcely seems likely that these structures, having been lost in some remotely ancestral genus and uniformly lacking in both the supposed parental and grandparental genera (*Eudichogaster* and *Ramiella*), should suddenly reappear with invariable fixity in *Eutyphoeus*. Even if the presence of hearts in xiii is not to be considered as primitive, the constancy of these structures throughout *Eutyphoeus* would tend to show a closer relationship to the supposedly more remote ancestral genera that often do have the hearts than to the immediately ancestral genera which never have them. In any case the invariable presence of hearts in xiii marks off *Eutyphoeus* from all other genera hitherto included in the Octochaetinae.

So far as the male reproductive organs are concerned *Eutyphoeus* can be derived from any other Indian Octochaetin genus as well as from *Eudichogaster*. In the latter genus the male organs are variable. Of the two species with gizzards in vi and vii, only one species has male organs from which the *Eutyphoeus* condition can be derived but this species appears to have calciferous glands constricted off from the gut. Although of no importance in this connection it may be noted that the microcolecin reduction has not been completed, so far as is known in any species, the male and prostatic pores may be approximated but are not actually united.

Nor would near completion of the microcolecin reduction, fusion of gizzards even in vi and vii, and localization of calciferous glands in xii alone result in *Eutyphoeus*, the genus thus derived would lack entirely certain *Eutyphoeus* structures such as the ventral intestinal caeca, supra-intestinal glands, ejaculatory bulbs and hearts of xiii, structures which are entirely unrepresented in *Eudichogaster*.

There are then certain objections which can be advanced against the phyletic derivation of *Eutyphoeus* from *Eudichogaster*. In presenting these objections, the discussion has been limited to *Eudichogaster* species as they exist today, and to those species as they now are known. In view of the total absence of fossils and of embryological evidence, we have no knowledge whatever as to what *Eudichogaster* or any other Megascolecoid genus may have been like in the geological past. Nor is our knowledge of this or many other Megascolecoid genera sufficiently detailed to warrant much in the way of inference.

Returning once more to the *Scolioscolides-Eutyphoeus* relationship. The necessity for the retention of two such remarkably similar genera in distinctly different subfamilies provides a startling addition to the slowly increasing body of evidence which indicates that the ideas

inherent in the current scheme of classification may be erroneous, at least so far as the Megascolecidae are concerned. It is becoming necessary, therefore, to re-examine these ideas and to determine whether or not they are sound.

The fundamental concept on which the current classification proceeds may be expressed as follows, paraphrasing Stephenson (1930, p. 711). Ancestral genera have persisted through geological time unmodified or so little modified, alongside their descendants, that the tree of earthworm evolution is before us in all its stages, as if all of the various stages in the ancestry of the horse were still living today. The evidence offered for this concept is the success which has attended the attempt to arrange modern genera in phyletic series and the finding of intermediate forms between the stages thus serialized.

It should be noted, however, that this supposedly successful seriation in the Megascolecidae has been possible only at the cost of restricting generic concepts by excluding reference to all but a few organs, structures or characteristics, some of which at least (excretory organs and calciferous glands), even now are very imperfectly known.

TAXONOMIC CHARACTERISTICS IN *EUTYPHOEUS*.

Length, diameter and number of segments usually have been mentioned in previous specific descriptions and diagnoses. These characterizations however are of very little if any systematic value. Measurements have been made on specimens preserved by widely variant methods so that the worms may be more or less completely relaxed or strongly contracted, or on specimens that have macerated in crowded museum jars or in other unfavourable conditions.

(For determination of vestibular characteristics, it is desirable that the worms be strongly contracted. As strong contraction can be secured uniformly with much greater ease than uniform relaxation it is recommended that worms be killed in such a way as to secure strong contraction. This can be done satisfactorily merely by dropping live worms into strong methylated spirits, care being taken to change the spirits as the latter becomes diluted. Hardening in 10 per cent. formalin should follow after which specimens may be stored either in alcohol or formalin. Preservation by this method is good enough to allow studies of coelomic parasites such as protozoa and nematodes. Formalin preservation is recommended at least until the specimens have been identified, as this affects the pigment much less than spirit.)

Nevertheless, some indication of size may be useful and accordingly measurements have been included in the diagnoses. The number of segments in earthworm species is indefinite and segment-number characterization can be of taxonomic value only when the limits of intra-specific variation have been determined from fully grown, undamaged, unautotomized worms in each species. Such a determination has yet to be made for even one species of *Eutyphoeus*. All that is known on this point, is the number of segments in one particular individual (occasionally 2 or 3) of a species. Accordingly reference to segment numbers has been omitted from the diagnoses.

Pigmentation.—Burmese species of *Eutyphoeus* are either pigmented or unpigmented, without variation. The colour is always brown, but the pigmentation may be sparse or dense, also apparently without variation intraspecifically. The pigment is not soluble in formalin but is leached out by alcohol. The types of *E. lippus*, having been preserved

in formalin, are known to be unpigmented or practically so. Although there have been references to colouration of other Indian species no importance can be attached to such statements, in view of the fact that specimens were alcoholic. It may be suspected that Indian species when pigmented, are brown, like the Burmese. A similar pigmentation has been observed, in Burmese earthworms, only in one species of *Octochaetoides*. In view of the lack of intra-specific variation it is desirable that reference be made to the pigmentation in specific diagnoses.

The prostomium, as in the genus *Pheretima*, does not appear to be a structure of taxonomic importance.

Secondary annulation apparently also is not of specific importance though present, especially on the posterior preclitellar segments of the larger species, because of uniformity throughout the genus.

Setal formulae are also omitted from the diagnoses for the following reasons: the setal ratios may vary from one region to another along the axis of one individual, from one worm to another on the same segment, and apparently are influenced by changes in method of preservation. As a result of this variation exact formulae (for species) containing statements such as $ab = \frac{1}{2}cd$, etc., are not permissible. Generalized formulae containing statements such as $ab < cd$, etc., are so uniform (when preservation is good and in absence of intraspecific variation) that they serve no useful purpose in specific characterization. In certain Burmese species seta *d* always becomes dorsal on each side of the body towards the posterior end and hence may furnish a characteristic of some taxonomic value.

First dorsal pore.—Determination of the site of the first dorsal pore on a particular individual may be difficult if not impossible without sectioning as a result of contraction or of the presence of markings that are more or less pore-like in appearance but which often and almost certainly do not represent functional pores. Nevertheless the site of this pore may be of some importance and should be noted when possible.

On 16 of 21 Indian species the first dorsal pore is on 11/12, two of the 16 species holandric. The site is unknown in two species (*annandalei*-holandric, and *nainianus*-metandric). The pore is on 10/11 or anteriorly on 3 species of which two are holandric.

On 18 of 24 Burmese species the first dorsal pore is on 11/12 or posteriorly, 2 of the 18 holandric. In one metandric and 1 holandric species the pore is more often on 11/12 than 10/11. On 3 species probably all holandric (one doubtfully proandric) the pore is on 10/11, while on one holandric species the pore is about equally on 10/11 or 11/12.

Thus the first dorsal pore is more likely to be on 10/11 on holandric species. The location on 10/11 might be regarded as more primitive were it not for the fact that one holandric species (*quadripapillatus*) that appears to be primitive, at least so far as the penial setae are concerned, has the pore on 11/12 and that one species (*lippus*) which is metandric may have the first dorsal pore as far forward as 7/8. Location anterior to 10/11 is unknown in holandric species.

The clitellum apparently is always annular (except on one Burmese species and even here nearly so) and always covers segments xiv-xvi at least but in addition may cover portions or all of xiii and xvii, more rarely extending onto xii and xviii or even reaching 18/19. Retention

of setae on clitellar segments has been noted on every Indian species of which clitellate specimens have been studied and in view of this uniformity presumably is a generic characteristic which may eventually require expression in the generic definition. (In contrast note the condition in *Pheretima* in which the setae, in many species at least, are lost at the time of clitellar development.)

Spermathecal apertures are always large and superficial.

Female pores.—In the holandric forms there is a pair of female pores on xiv. In many of the metandric species one pore, always the right, either becomes rudimentary or is lost. The single pore remains asymmetrical, slightly to one side of the midventral line, and never becomes median as in *Pheretima*. Some variation intraspecifically has been noted, in uniporal species, an occasional specimen is provided with a rudimentary or even apparently normal right female pore. Diagnostic characterization with regard to female pores refers to the condition prevailing on the majority of specimens: occasional variant forms, while of interest, are not considered of sufficient importance to warrant mention in diagnoses. Both oviducal funnels, so far as is known, are present but the oviduct of the right funnel has atrophied, as was pointed out by Beddard as long ago as 1901 (p. 198). An interesting parallel is afforded by the persistence in certain species of functionless male funnels in x.

Beddard (1901, p. 198) characterized the single female pore of *nicholsoni* as "very conspicuous". The pore is however always minute as in all other species of the genus, and at times may be definitely identifiable only under the best optical conditions. Often indication as to location of the aperture is provided in the form of a transversely placed, shortly elliptical area of local whitening of the clitellar epidermis.

Male genital terminalia.—Bourne, as long ago as 1889, recognized that in *masoni* (= *orientalis*) the male pores "are on papillae which lie in very deep pits" (p. 113). Beddard however called the apertures of the pit-like invaginations in the body wall male pores (referring to the elongately tubular porophore in *nicholsoni* as the everted end of the spermiducal gland) and in this was followed by Michaelsen and Stephenson. Gates (1925a, p. 60 and 1925b, p. 572) pointed out that the apertures on xvii of two Burmese species are not male pores but paired or unpaired openings into deep invaginations containing tubular bodies from which penial setae project. Stephenson (1914, p. 402) previously had also noted slender tubes in paired, deep invaginations on *E. kempfi* but referred to the openings of the invaginations as male apertures. Bahl (1927) found that similar, slender porophores in *waltoni* transfer spermatozoa directly into the spermathecae of a copulatory partner and accordingly designated the tubes penes. These penes have considerable systematic value as they are not, so far as is known, subject to intraspecific variation. A species always has penes (is penile) or else never has them (is apenile). Furthermore the penes are always of a particular type in each species. The penes may be low and more or less thickly annular as in *orientalis* and *gigas* or longer and slenderly tubular as in *waltoni* and *nicholsoni*. An annular penis may be enlarged and provided with eversible and retractile anterior and posterior lobes, as in *gigas*, while similar lobes never have been noted and apparently are lacking on the penes of other forms, such as *orientalis*. The ventral end

of a penis may be sculptured in various ways which are specifically distinctive; anterior and posterior margins smooth, one margin thickened, one margin bilobed or prolonged into flaps or finger-like processes, etc. In absence of especial mention the ventral margin of the penis is assumed to be smooth.

In well preserved specimens the penes usually offer no difficulty in specific characterization. In softened specimens however an annular penis may be difficult to identify or even totally unrecognizable while an occasional well preserved specimen may show, as a result of some peculiar contraction, an appearance of a tubular penis instead of the usual annular type.

Instead of a penis there may be present in the vicinity of each male pore a pair of tag-like tumescences, as in *manipurensis*. These tumescences may possibly be equivalent to the anterior and posterior portions of a penial annulus. In apenile species the male pores may be located within slight, transversely placed fissures. The anterior and posterior margins of such fissures may become tumescent or protuberant and when so protruded superficially resemble a penis. These protuberances are not, however, considered to be penes.

Male pores in the genus *Eutypheus* are probably always minute. They have been identified definitely but seldom, though the approximate (?) or possible (!) sites have been noted in adult or juvenile specimens. According to Stephenson and Ram (1919, p. 450) the male pore in *waltoni* is distinct from the prostatic pore, "on a papilla which is sunk in a depression of the ventral surface". The papilla referred to is a tubular penis. In the same species, according to Bahl, the male pore (*vide* fig. 4, pl. xxxvii, in Bahl 1927) is on the posterior face of a penis and almost at the ventral end. The prostatic pore is within the penis, the larger aperture at the tip of the penis the opening through which the prostatic secretions and the penial setae pass to the exterior. Accordingly in *waltoni* the microscolecin reduction has not been completed by a fusion of the male and prostatic pores, as has been assumed hitherto for the genus as a whole. In Burmese specimens of the apenile *manipurensis* the male and prostatic pores are also separate as can be determined by dissection. Union of male and prostatic pores in *Eutypheus* is, in fact, unknown and all the evidence available, though slight, tends to show that the lack of union is a generic characteristic.

In addition to being minute the male pores probably always are invaginate or on structures that can be retracted into the parietes, located usually in slight, transversely placed fissures or in deeper invaginations. The fissures have already been referred to above. The deeper invagination is termed a vestibulum. Characteristics of this vestibular invagination are of specific importance and require careful description. Thus a species may have paired vestibula, a condition termed bivestibulate, or a single vestibulum, a condition termed univestibulate. Vestibular invaginations may be capable of partial or complete eversion, specific characterization obviously dependent upon specimens with completely retracted vestibular invaginations. After vestibular eversion; in an individual of a bivestibulate species with annular penes, the latter may not be clearly marked off from the vestibular protuberances. While there may be species that show a transition from a bivestibulate to a

univestibulate condition or *vice versa*, in Burmese forms, after preservation by a standard technique, the condition of the vestibular region has always been found to be uniform. Diagnostic characterization of the vestibular region of *E. gammiei* is still uncertain, partly because of maceration and diversity of preservation, but for the present the species is regarded as univestibulate, the variant conditions, in forms with apparent paired vestibula accordingly considered as due to relaxation of the single vestibulum at the midventral region. Within the vestibula, on the walls or roof, there sometimes are markings which may be characteristic and accordingly should be described. A vestibular invagination may be confined to the parietes or slightly or conspicuously protuberant into the coelomic cavity. In the latter case the roof may be markedly thickened and is then termed a vestibular bulb. In the Indian species, excepting only *gigas*, penes are within definite vestibula. In *gigas* the penes are located on parietal thickenings that can be depressed or folded anteroposteriorly so as to conceal the penes from view or protect them from damage.

Genital markings.—These markings are almost always present and are known to characterize all Indian species but one and even that (*kempi*) has indications of markings. Two or possibly three Burmese species appear to lack the markings. Genital markings are variable as to number and location though perhaps not so remarkably as Stephenson thought, and on a rare specimen may be entirely lacking. Failure to recognize genital markings on certain Indian species or on certain regions has been the result of neglecting to remove the cuticle or of the juvenile condition of the specimens.

Usually there is no variation so far as relation of the markings to the segmental limits is concerned. In a particular species the genital markings are either definitely segmental or intersegmental (*i.e.*, extending across a furrow onto 2 successive segments). Yet in a very few species genital markings that appear to be originally or primarily segmental may displace an intersegmental furrow or have a tendency to push across the neighbouring intersegmental furrow, accurate characterization often difficult as the furrows may not be visible, either because of the development of clitellar glandularity or of poor preservation. Genital markings further can be characterized specifically as paired or unpaired, but again with some variation in one species at least.

Glands of the markings offer characteristics of taxonomic value. In some species the genital markings appear to be areas of epidermal modification only, the epidermis translucent rather than opaque. In other species the body wall is thickened noticeably in the region of the markings. In still other species, whitish tissue, apparently glandular, definitely interrupts the longitudinal musculature and protrudes into the coelomic cavity. More rarely such glandular tissue appears to be enclosed within a capsule.

Septa.—Michaelsen (1900, p. 234) is responsible for a statement that septum 5/6 is absent in *khani* (= *nicholsoni*) which is repeated by Stephenson (1923, p. 447). No notes as to position and number of the pregizzard septa were made during the examination of the Indian Museum specimens. Beddard however recorded the presence of 2 thickened septa in front of the gizzard of *nicholsoni* and these should

be 4/5-5/6. Stephenson (1914, p. 355) also pointed out that the septa in front of the gizzard were 4/5-5/6 as in *waltoni*. Assuming that Beddard and Stephenson are correct with regard to the septa in *nicholsoni*, as is very probable, each species of *Eutyphoeus* is characterized by the presence of 4/5-5/6 and in addition of 8/9-9/10. Furthermore these five septa are almost always muscular to thickly muscular, while 8/9-9/10 are always displaced and closely crowded. Septa 6/7-7/8 are always absent and so this characteristic has been included in the generic definition. Reference to the displacement and close crowding of 8/9-10/11 might equally well be included.

Digestive System.—The gizzard is always massive and requires no comment in specific descriptions as a rule. A curious deformation which may be merely the result of an abnormal contraction has been noted in one Burmese species; the gizzard of *turaensis* with more or less of a similar deformation. Phylogenetically the large gizzard is said to be the result of the fusion of the two gizzards of *Eudichogaster*. This assumption is required by a phylogenetic derivation of *Eutyphoeus* from *Eudichogaster* but no evidence has been advanced to support it.

The first intestinal segment is unknown in *annandalei*, *kempi*, *nainianus* and *nepalensis*. In all other species (excepting the Burmese *E. macer*) the first intestinal segment is known to be in xv. In 384 specimens of 16 Burmese species no variation was found with respect to this characteristic.

The typhlosole.—Very little information with regard to this structure is available in the literature. There is however no record of the absence of a typhlosole in any species of the genus. When observed, it seems to be fairly well developed. The last typhlosolar segment probably is definitely related to the supra-intestinal glands but just what that relationship may be is not clear at present. According to Thapar (1934, p. 279), there is no trace of a typhlosole in the supra-intestinal gland segments, the typhlosole ending presumably in the segment just in front of the first supra-intestinal gland segment. In worms examined by dissection from the ventral side the typhlosole often does appear to end abruptly against the first supra-intestinal gland (also *vide* Gates 1925, p. 573). Bahl (1933, p. 111) however maintains that the typhlosole ends abruptly in the last supra-intestinal gland segment, though his figures rather tend to support Thapar's conclusion. In some of the worms examined after a midventral dissection, the typhlosole certainly does appear to be continued, though less obviously than before, through the gland segments. Regardless of which view is correct (possibly merely a matter of definition) no trace of a typhlosole has been found behind the supra-intestinal glands in any of the specimens just examined. In absence of any evidence to the contrary the supra-intestinal glands are considered to indicate the posterior termination of the typhlosole, or the termination of the typhlosole the position of the supra-intestinal glands, when one of these factors is unknown.

The anterior termination, or possibly more aptly the beginning of the typhlosole is not easy to determine and may also be a question of definition. In this paper the term typhlosole is restricted to the midventral ridge that projects conspicuously with a fairly sharp edge into the intestinal lumen. In front of and continuous with the typhlo-

sole as thus defined there is often a much lower ridge which is further distinguished by its darker colour (due to the presence of blood) and its rounded ventral face, the ridge almost hemicircular in cross section.

When lateral intestinal caeca are present the typhlosole begins in the caecal segment while in the acaecal species it often begins in xxviii.

Lateral intestinal caeca have been overlooked hitherto in certain Indian species but should be noted,—they may furnish an additional means of characterization, at least for some species. With regard to caeca, as with so many other characteristics or structures, certain species are more variable than others, intraspecific variation at present, however, appears to be restricted to the Burmese species.

Unpaired, ventral and median intestinal caeca also have been overlooked hitherto in the Indian species but have been found in each specimen in which they have been sought for, condition permitting recognition. Quite possibly these small structures, like the calciferous and the supra-intestinal glands, are so general as to require inclusion in the generic definition. Only one other genus, *Scolioscolides*, is known to have these ventral caeca.

Calciferous glands of the type described by Stephenson and Prashad apparently are always present in all specimens and all species of the genus, in segment xii, though there is little definite information on record with regard to many species. At least absence of glands, either in individuals or species or variation in number has yet to be recorded. As the glands now appear to be uniform as to structure and number throughout the genus, a brief characterisation has been included in the generic definition.

Supra-intestinal glands.—The peculiar and rather characteristic glands on or within the dorsal wall of the intestine were first noted in the type species by Beddard (1888) who stated that they are located in 5 successive segments in a region rather before the end of the middle third of the body. Fedarb (1898) noted that in her specimen of *orientalis* the glands were in xci-xcv. Later Beddard reported (1901) that the glands are in 5 segments beginning about at lxxxiv in *nicholsoni* while in *incommodus* the glands begin further forward, in lxvii. The segmental location for each of these species is within the limits of variation as shown by the Indian Museum specimens a fact which may be of some importance in view of the absence of types of all of the species just mentioned.

Thapar locates the glands in lxxx-lxxxiv in *waltoni* and in lxxxiii-lxxxvii in *khani* (= *nicholsoni*). Bahl, however, maintains that in *waltoni* the glands are always in five successive segments and that those segments are always lxxix-lxxxiii. Reference to a succeeding page will show that the glands (of *waltoni*) may be in 4, 5, or 6 successive segments and that those segments may be anywhere in the region of lxxviii-lxxxvi. Like other characteristics that are or may be of taxonomic value in this genus, the segmental location of the supra-intestinal glands appears to be subject to much more variation on some species than in others. In 34 specimens of *orientalis* the glands are always within a region composed of 10 segments; in 15 specimens of *waltoni*, in a region of 9 segments; in 28 specimens of *incommodus*, in a region of 13 segments; in 2 specimens of *scutarius*, in a region of 12 segments;

while in 5 specimens (definitely univestibulate) of *gammiei*, the glands are within a region of 17 segments and if 10 other specimens probably or possibly belonging to *gammiei* are included the region must be extended to comprise 37 segments. In these circumstances the segmental location of the glands can be used for taxonomic purposes only with caution and after numbers of individuals have been examined. It is curious however that in *orientalis* and *waltoni*, two species so similar that they have been confused by Michaelsen and Stephenson, the regions are distinct though slightly overlapping and that each of the 49 specimens examined can be referred to one or the other species according to the location of the glands (*waltoni*, first gland in lxxviii-lxxxii; in *orientalis*, first gland in lxxxvi-xci). The gland regions of the Indian species are shown below.

Species.	segments.
<i>E. quadripapillatus</i>	62—68
<i>E. incommodus</i>	63—75
<i>E. turaensis</i>	65—71
<i>E. nainianus</i>	66—69
<i>E. lippus</i>	66—70
<i>E. pharpingianus</i>	68—71
<i>E. manipurensis</i>	73—78
<i>E. nepalensis</i>	77—80
<i>E. waltoni</i>	78—86
<i>E. nicholsoni</i>	82—89
<i>E. comillahnus</i>	85—88
<i>E. orientalis</i>	86—95
<i>E. gigas</i>	88—95
<i>E. festivus</i>	92—95
<i>E. callosus</i>	94—101
<i>E. gammiei</i> (all)	98—134
<i>E. gammiei</i> (def. univest.).	101—119
<i>E. assamensis</i>	103—112
<i>E. kemp</i>	113—118
<i>E. scutarius</i>	126—137

For the sake of convenience in use and proof reading arabic numerals are used instead of roman for the segments.

Vascular system.—The location of the last hearts has been noted by the author in 182 specimens of Indian species and in 597 specimens of Burmese species. In each of 778 worms the last pair of hearts is in xiii. In one worm, one heart of xiii is lacking. Except as just mentioned there is no record of absence of hearts in xiii while presence of hearts in xiii has been noted in all species of *Eutyphoeus* excepting only *nainianus*. In view of this uniformity presence of hearts in xiii appears to be a generic characteristic and as such has been included in the generic definition.

In contrast to the uniformity with regard to the presence of the hearts of xiii there is considerable variation with regard to the more anterior commissural vessels and associated therewith, of the termination anteriorly of the dorsal blood vessel. In the holandric species the dorsal blood vessel is usually continued into the pharyngeal region. In these species there are also present in v and vi possibly also in iv,

paired commissures. Although these commissures have not been traced ventrally to a junction with another longitudinal vessel, they probably do pass to the ventral trunk and hence are the equivalent, within their own segments, of the hearts in segments vii-xiii. These commissural vessels accordingly have been termed hearts even though they may not have the histological structure of the hearts of vii-xiii. Fourteen species (8 Indian) have become metandric without change in the anterior portion of the vascular system. The metandric forms are not therefore "essentially similar" (Stephenson 1923, p. 428), a conclusion that was erroneous because of Michaelsen's failure to record important characteristics of the vascular system. One holandric species (Burmese) has undergone a slight fore-shortening of the dorsal blood vessel which now terminates with or just in front of the hearts of vi or on the posterior face of 5/6. Two metandric species are known in which the dorsal trunk terminates with or just in front of the hearts of vi. A similar condition may characterize *turaensis*. In all other metandric species the dorsal blood vessel terminates with or just in front of the hearts of vii.

Intraspecific variation with regard to the anterior portion of the vascular system is slight yet an occasional specimen of a species with fore-shortened dorsal trunk may have, as a reversion to an ancestral condition, a dorsal blood vessel continued anterior to its usual termination. In such variant specimens one or both hearts of vi may also be present. Possibility of such a variation may have to be taken into consideration in dealing with single specimen species.

Excretory organs.—The nephridia of *Eutyphoeus* have yet to be studied carefully, but are quite obviously, in all species, parietal or integumentary micronephridia. As open (*i.e.*, with septal funnel) exonephric, integumentary micronephridia are unknown, it is possible that the nephridia of *Eutyphoeus* are closed. Quite characteristic is the horseshoe-shaped band of closely compacted nephridial tubules on the parietes of segment iii.

Male reproductive organs.—In *Eutyphoeus* there may be two pairs of testes, male funnels, deferent ducts and seminal vesicles (holandric) or only one pair each of those organs (purely metandric). A large majority of the species (all except 7-9, of which 3 or 4 are Indian) are metandric. The holandric species are regarded as primitive, the metandric condition as derived. The development of metandry appears to have been fairly recent as indicated by the presence of vestigial structures or the persistence of unused organs in the purely metandric forms, and may even be underway at the present time in certain species. In two specimens of the type series of the holandric *E. montanus* the anterior testes and seminal vesicles are lacking. In *E. bullatus*, which appears to be metandric, anterior testes are lacking but male funnels are always present in x. Furthermore, although 15 specimens have no anterior seminal vesicles, in another 13 specimens the anterior seminal vesicles are either well developed (3) or represented by small or quite small rudiments (10). The metandric *E. constrictus* (Burmese) always has male funnels in x but the anterior seminal vesicles are almost always lacking, (a single vesicle found in 69 specimens). In *falcifer* and *peguanus*, anterior seminal vesicles have not been found, but male funnels,

rudimentary or well developed, are usually present in x. *E. pharpingianus* with male funnels in x possibly also shows persistence of anterior male funnels after loss of testes of xi (but *vide* discussion in remarks on this species). A male funnel may occasionally be present in a species in which the funnels of x are usually lacking (1 of 25 specimens of *annulatus*; 1 of 40 specimens of *gigas*; 2 of 86 specimens of *rarus*; all Burmese). Persistent male funnels may or may not be connected with the deferent ducts of the posterior funnels.

Segment xi is always reduced at least by the approximation of septa 10/11 and 11/12 and possibly also by the apposition peripherally and dorsally of these two septa. With continued development segment xi is further reduced to a more definitely annular chamber, to a U-shaped chamber and finally to a suboesophageal testis sac.

Seminal vesicles do not require especial comment except to note that in two Indian species the posterior vesicles may extend unusually far back, a condition that may prove to be characteristic. The posterior portion of the male deferent duct in most species is thickened and provided with a well developed muscular layer to form a bulbus ejaculatorious. The bulbus may be large and definitely coelomic, or covered over on the parietes by connective tissue, while in a few forms it is not so well developed and (or) limited to the parietes. The prostatic duct is rather variable in length intraspecifically and hence of no taxonomic significance. The prostates are always tubular, one pair only.

Penial setae.—In xvii, the ventral setae (*a* and *b*) are not ordinarily of the sigmoid type but are replaced by modified chaetae that are called penial, on an assumption that they are used during copulation (*vide* Stephenson 1930, p. 427). As long ago as 1889, Bourne directed attention in *Eutyphoeus* to a muscular follicle containing several penial setae and noted differences in size between functional and reserve setae but without using those terms. In 1901, in brief characterisations of the seven species then known, Beddard included mention of the ornamentation at the ectal portion of the shaft of the setae. Michaelsen (1909) referred to the reserve setae only in connection with one species (p. 233), in the type of which the fully developed setae were supposed to have been lost during copulation, the remaining setae apparently not fully developed. Stephenson (1914) also noted that there are several setae in a follicle and found three fully formed and three immature per bundle in one species (p. 406), 1 or 2 fully formed and protuberant to the exterior with numerous immature chaetae in another species (p. 408). Gates (1925, p. 62) used the term "reserve" to distinguish the smaller setae of the follicle from the two "mature" shafts. Bahl (1927, p. 487) however claims credit for having first noted that *Eutyphoeus* "possesses an armoury of penial setae to replace those that get broken or lost during copulation, a fact unfortunately missed out by previous observers."

"Functional" penial setae may be formed and protuberant to the exterior in quite young juvenile specimens, long before the worm has reached adult size. Such setae quite probably are lost before they can function in copulation. At least one species has been erected on a juvenile specimen because of a belief that the presence of such functional setae was an evidence of sexual maturity.

All species do not, however, possess an armoury or battery of reserve setae. In Burmese specimens of *manipurensis* only two setae, apparently both functional, have been found in the follicle associated with each prostatic duct. (Bahl maintains that there are two distinct follicles associated with each prostatic duct but fails to indicate whether or not the reserve setae are in one or two groups.) A similar condition characterizes other species among which are included three Burmese and possibly several Indian species.

Although always present in species known to be penisetal, penial setae have not yet been found in all species. Of 24 Burmese species the setae have not been found in one (*quinquepertitus*) and further are unknown from two of the 21 Indian species though present in *nepalensis* which was hitherto thought to be apenisetal. In *nainianus* penial setae should be looked for within the parietes when further material is available. In *quadripapillatus* the condition is not clear. A setal follicle apparently is always present on the median face of the prostatic duct within the parietes but may lack setae or contain only fragments (shafts broken in course of removal of the follicle?). The single complete seta that was found is sigmoid, small, and apparently unornamented. If the presence of unornamented sigmoid setae in a follicle that unusually contains ornamented penial setae is characteristic, the species may be regarded as primitive, at least so far as this condition is concerned.

Penial setae have been said to be "of principal importance in the discrimination of species in this genus" (Stephenson 1914, p. 358 and also *vide* 1923, p. 428) and have been given considerable attention, both by Stephenson and Michaelsen, in specific descriptions and diagnoses as well as in keys or synopses. Interspecific variation in length and diameter apparently have been considered of less importance than ornamentation of the ectal portion and conformation of the extreme tip. It should be noted that this ectal portion and especially the tip, most likely to be useful taxonomically, is also the part of the setae which comes into use outside of the worm and accordingly is the part most likely to be damaged or modified by use. That such is actually the case is shown by the large number of setae with bent, cracked, twisted, swollen or softened tips. These alterations often, at least, cannot be explained as a result of long preservation in gradually weakening spirit since they were noted when the specimens were first examined (type of *orientalis* as well as types of other species) and have also been observed on setae from freshly killed individuals. Nor is it uncommon to find that tips have been broken off and lost from functional setae. Furthermore the ectal portion of the shaft just behind the extreme tip is now known to break apart into fibrils. This fibrillar disintegration has been described in at least three species as an ornamentation of chevron-like ridges. Although there may be an intraspecific variation with regard to shape of tip and ornamentation, there is not a great deal of interspecific variation with regard to those characteristics,—note frequency of spoon-shaped tips, and of ornamentation of circles or rows of fine spines. Certain characteristics other than the chevron-like markings, hitherto regarded as specifically distinctive are now clearly not distinctive or else under considerable suspicion. In these circumstances

it is no longer possible to maintain that the penial setae are even of major taxonomic importance in the genus,—species apparently can be adequately characterized without reference to the setae, if well preserved and clitellate individuals are available for study. If material is not well preserved and clitellate, the setae are not likely to be of much use. I do not deny that the penial setae may be of some taxonomic importance in *Eutyphoeus*, but because of age and preservation of many of the specimens, and of the conditions considered above I have decided to exclude all reference to the penial setae from the specific diagnoses. A brief summary of the information now available with regard to valid penisetal characteristics is subjoined in tabular form.

—	Length in mm.	Diameter in micra.	Tip.	Ornamentation.	Remarks.
<i>aborianus</i>	3.3	32	Spoon-shaped?	Sparse; short transverse rows of fine spines.	Shaft with gentle S-shaped curve.
<i>annandalei</i>	?	20	?	?	all broken.
<i>assamensis</i>	2	40 (m)	Widened to 50 μ . With terminal spine?	Rows of circles of fine spines.	Somewhat sickle shaped.
<i>callosus</i>	2.2.5	38—40	Spoon-shaped?	Rows of fine spines.	Slightly curved ectally.
<i>comillahnus</i>	2	40	Spoon-shaped.	Circles of fine spines.	Slightly curved ectally.
<i>festivus</i>	1.05—1.15	20—25	Spoon-shaped	Circles of fine spines.	
<i>gammiei</i>	4—5	—40	May be spoon-shaped.	Closely crowded, irregular rows of fine spines. May be worn down to irregular ridges; frequently interrupted and wider separated rows may produce a fish-scale appearance.	
<i>gigas</i>	5—8	44—50	With terminal spine that may be bifid.	Closely crowded circles of fine spines.	Slight spiral twist in shaft.
<i>incommodus</i>	1.—1.4	?	Bluntly rounded or with terminal spine?	Sparse; rather widely separated circles of fine spines.	
<i>kempi</i>	2.3—3.9	34	Spoon-shaped?	Transverse rows of fine spines.	Shaft with gentle S-shaped curve.
<i>lippus</i>	?	?	?	?	Present.
<i>manipurensis</i>	1.5	47 (m)	Blunt point.	Fine triangular teeth.	Slightly curved ectally.
<i>nainianus</i>					None?
<i>nepalensis</i>	?	?	?	?	Present.

(m) middle of shaft.

—	Length in mm.	Diameter in micra.	Tip.	Ornamentation.	Remarks.
<i>nicholsoni</i> .	3.6—4.4	20	Bluntly round- ed.	Sparse ?	
<i>orientalis</i>	4—5	32—36(m) 50—60 (b). Thick- ened tip may be 40 μ .	Bluntly round- ed, spear- head shaped point, spoon- shaped; rare- ly thickened.	Dense; closely crowded circles of fine spines.	
<i>pharpingianus</i> .	1.6	26	Blunt point.	Sparse.	Slight bend in ectal portion of shaft.
<i>quadripapilla- tus</i> .	?	?	?	? ?	Lacking? Ordinary sigmoid setae instead of penial setae ?
<i>scutarius</i> .	2	80—95	?	Dense; closely crowded circles of fine spines.	Shaft slightly curved.
<i>turaensis</i> .	1.5	35	Bluntly point- ed? Widened and claw- like ?	Dense; irregularly in- terrupted circles of fine spines.	
<i>waltoni</i> .	4—5	22—30	Spoon-shaped.	Fairly closely crowded circles of fine spines; scarcely recognizable under low power.	Shaft with slight spiral twist.

(b) base of shaft.

(m) middle of shaft.

In describing the ornamentation, circle and row do not have a great deal of significance; circles are often interrupted irregularly, if the interruptions are numerous and the gaps widened, the shortened ridges are termed rows but there are variations up and down the shaft and also from one seta to another.

Spermathecae.—The spermathecal duct is always fairly thick and may be quite stout. It also is always rather short (relative to length in other genera), so much so that it has been overlooked in certain species. Nevertheless in certain forms the duct may be more than 1 mm. in length, even 2 mm. or slightly longer, as for instance in *nicholsoni*, *scutarius* and *waltoni*. In these species the duct is said to be long, but "long" is relative only to the condition in other species of *Eutyphoeus* and not to that of other genera.

The diverticula always open into the ental portion of the spermathecal duct. Only 3 types of arrangement of the seminal chambers have been recognized in the genus: (1) a pair of diverticula, one diverticulum median and the other lateral; (2), a single diverticulum which is always lateral; (3) a series of seminal chambers or diverticula on each side of the duct and opening into the duct by two or more median and two or more lateral apertures. Intraspecific variation is infrequent, rarely a single diverticulum of a pair may fail to develop on an odd spermatheca. A word of caution is necessary however with regard to the diverticula. A pair of diverticula may be directed posteriorly into contact with each other and bound together by connective tissue in such a way that there results an appearance of a single posterior diverticulum or a posterior row of seminal chambers. In such a

spermatheca dissection of the duct often will reveal the two diverticular apertures, one median and one lateral. Similarly dissection of the duct is necessary to determine the number of apertures in the third type. The diverticula vary considerably in size, shape and appearance according to the number, size and arrangement of the individual seminal chambers. As a result of these variations diverticular characteristics, aside from the three types mentioned above, are usually of no taxonomic value. However in *gigas* the diverticulum apparently always has a fairly long stalk while in another species, *comillahnus*, it may be possible to characterize the diverticula as elongately ellipsoidal or sausage-shaped. Without exception throughout the genus, the diverticula pass into the ental portion of the spermathecal duct.

Presence of a spermatozoal iridescence in the seminal chambers of acitellate or partially clitellate specimens may, as in *Pheretima* (Gates and Hla Kyaw 1937), indicate a postsexual clitellar regression rather than copulation prior to clitellar development.

Although spermatozoal iridescence at first or often appears to be restricted to the spermathecal diverticula, spermatophore-like structures may be found in the spermathecal ampullae, the head of the spermatophore (?) resting on the aperture leading from the ampulla into the duct, the tail-like prolongation within the duct lumen. Removal of outer layers from the spermatophore may disclose iridescent material towards the central portion of the head.

SYSTEMATICS.

Genus *Eutyphoeus* Michaelsen.

- 1883. *Typhaeus*, Beddard, *Ann. Mag. Nat. Hist.*, (5), XII, p. 219. (Non *Typhoeus* Leach 1815, Coleoptera. No generic definition. With one species, *T. orientalis*.)
- 1888. *Typhaeus*, Beddard, *Quart. J. Mic. Sci.*, XXIX, p. 117.
- 1889. *Typhaeus*, Vaillant, *Hist. Nat. Annel.*, iii, (1), p. 182.
- 1890. *Typhaeus*, Benham, *Quart. J. Mic. Sci.*, XXXI, p. 222.
- 1895. *Typhaeus*, Beddard, *Monog.*, p. 472.
- 1900. *Eutyphoeus*, Michaelsen, *Tier.*, X, p. 322. (Genotype *T. orientalis* Beddard 1883).
- 1901. *Typhoeus*, Beddard, *Proc. Zool. Soc. London*, 1901, p. 205.
- 1909. *Eutyphoeus*, Michaelsen, *Mem. Ind. Mus.*, I, p. 216.
- 1922. *Eutyphoeus*, Michaelsen, *Mitt. Mus. Hamburg*, XXVIII, p. 37.
- 1923. *Eutyphoeus*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 420.
- 1930. *Eutyphoeus*, Stephenson, *The Oligochaeta*, p. 847.

Genotype.—*Typhaeus orientalis* Beddard 1883.

Diagnosis.—Setae lumbricine. Bithecal, spermathecal pores on 7/8. Male and prostatic pores on xvii. One gizzard in a space formed by disappearance of septa 6/7-7/8. Calciferous glands one pair of longitudinally hemi-ellipsoidal bodies in the lateral wall of the oesophagus in xii, the flat faces mesially; each gland with numerous vertical partitions, the interlamellar spaces communicating dorsally with the gut lumen. Supra-intestinal glands present in a middle region of the body. Last hearts in xiii. Excretory organs (closed exonephric?) micronephridia. Prostates tubular. Spermathecal diverticula open into ental portion of the duct.

Distribution.—India and Burma.

Remarks.—So far as is known, all species of *Eutyphoeus* can further be characterized as follows: clitellum annular (lacking at midventral line, 1 Burmese species), with development of clitellar glandularity intersegmental furrows disappear and dorsal pores are occluded but setae are retained; ventral reproductive apertures, male and female pores minute, spermathecal pores larger but superficial; septa 4/5-5/6 and 8/9-10/11 muscular, usually thickly muscular, 8/9-10/11 displaced and closely crowded; intestine begins in xv; a band of nephridial tubules on the parietes in iii.

Key to Indian species of *Eutyphoeus*.

- | | |
|--|--------------------------|
| 1. <i>a.</i> Holandric | 2. |
| <i>b.</i> Metandric | 5. |
| 2. <i>a.</i> Only one spermathecal diverticulum, on the lateral side | <i>manipurensis.</i> |
| <i>b.</i> More than one spermathecal diverticulum | 3. |
| 3. <i>a.</i> Genital markings 2 pairs on or near to 13/14 and 14/15 | 4. |
| <i>b.</i> Genital markings 3-4 pairs on xiii-xv or xvi | <i>incommodus.</i> |
| 4. <i>a.</i> Spermathecal pores in <i>ab</i> | <i>quadripapillatus.</i> |
| <i>b.</i> Spermathecal pores in <i>bc</i> | <i>annandalei.</i> |
| 5. <i>a.</i> Dorsal blood vessel continued into iii* | 6. |
| <i>b.</i> Dorsal blood vessel terminates posterior to iii | 14. |
| 6. <i>a.</i> Vestibulate | 7. |
| <i>b.</i> Avestibulate | 8. |
| 7. <i>a.</i> A large, unpaired, postclitellar genital marking on 19/20 | <i>festivus.</i> |
| <i>b.</i> Postclitellar genital markings lacking | <i>assamensis.</i> |
| 8. <i>a.</i> Lateral caeca present on the intestine† | 9. |
| <i>b.</i> Lateral intestinal caeca lacking† | 11. |
| 9. <i>a.</i> Spermathecal diverticula paired, median and lateral | <i>lippus.</i> |
| <i>b.</i> More than 2 spermathecal diverticula or seminal chambers not aggregated into diverticula but opening into duct independently | 10. |
| 10. <i>a.</i> Genital markings united midventrally and restricted to the clitellum | <i>nainianus.</i> |
| <i>b.</i> Genital markings not united midventrally and not restricted to the clitellum | <i>nepalensis.</i> |
| 11. <i>a.</i> Genital markings unpaired | 12. |
| <i>b.</i> Genital markings definitely paired | 13. |
| 12. <i>a.</i> Genital marking on 15/16 | <i>scutarius.</i> |
| <i>b.</i> Genital marking on (xii) xiii | <i>comillahnus.</i> |
| 13. <i>a.</i> Genital markings restricted to xvi | <i>assamensis.</i> |
| <i>b.</i> Genital markings not so restricted | <i>pharprisingianus.</i> |
| 14. <i>a.</i> Dorsal blood vessel terminates anterior to gizzard* | <i>turaensis.</i> |
| <i>b.</i> Dorsal blood vessel terminates posterior to gizzard | 15. |
| 15. <i>a.</i> Lateral intestinal caeca present | <i>gigas.</i> |
| <i>b.</i> Lateral intestinal caeca lacking | 16. |
| 16. <i>a.</i> Penes short, annular | 17. |
| <i>b.</i> Penes long | 20. |

**Vide* remarks under *turaensis*.

†*Vide* observation *re* intestinal caeca in remarks under *pharprisingianus*.

- | | |
|--|---------------------|
| 17. a. Univestibulate . . . | <i>gammiei</i> . |
| b. Bivestibulate (or if univestibulate with no genital markings on 13/14, <i>callosus</i> ?) . | 18. |
| 18. a. Genital markings lacking on xv-xvi | 19. |
| b. Genital markings present on xv and usually on xvi also | <i>orientalis</i> . |
| 19. a. Postclitellar genital markings present | <i>callosus</i> . |
| b. Postclitellar genital markings lacking | <i>aborianus</i> . |
| 20. a. Seminal chambers grouped into diverticula, one lateral and one median | <i>waltoni</i> . |
| b. Seminal chambers opening independently into the duct by more than two apertures . | 21. |
| 21. a. Genital markings restricted to the clitellum, spermathecal pores in <i>ab</i> . . . | <i>nicholsoni</i> . |
| b. Genital markings posterior to the clitellum, spermathecal pores in <i>bc</i> | <i>kempi</i> . |

The difficulties encountered in constructing this key will be appreciated on recalling the large proportion of doubtful forms, and the number of species known only from single specimens, a clitellate or juvenile individuals, at the same time bearing in mind the frequency of variation with regard to taxonomically important structures. In order to include in the key, each of the Indian species and thereby make it most useful, it has been necessary to enter one species twice, and other species on certain assumptions that future study may show to be incorrect. At appropriate points asterisks or other marks are employed to direct attention of the user to notes that warn of the difficulties involved at these particular places.

As in the previous paper, negative statements are omitted from the diagnoses, *e.g.*, if a species has no lateral intestinal caeca no mention of these caeca is made, but if nothing is known with regard to these caeca, "Lateral caeca ?" draws attention to this fact. The interrogation marks thus serve to indicate characteristics of systematic importance on which further information is needed.

***Eutyphoeus aborianus* Stephenson.**

1914. *Eutyphoeus aborianus*, Stephenson, *Rec. Ind. Mus.* VIII, p. 406. (Type locality, Kobo, Abor country in the East Himalayas. Type in the Indian Museum.)

1923. *Eutyphoeus aborianus*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 428.

Material examined.—From the Indian Museum: 1 clitellate specimen labelled, "*Eutyphoeus aborianus*, sp. nov. Kobo, Alt. 400 ft. (Abor Expenditure). Dr. S. W. Kemp. ZEV 6068/7".

External characteristics.—The spermathecal pores are transversely slit-like, just lateral to *b*.

The vestibular region is contracted, the vestibular apertures small, the vestibula deep. The penis is a low annulus, perhaps a trifle higher than in *orientalis* but less than $\frac{1}{2}$ mm. high.

The clitellar glandularity is lacking on a sharply demarcated, nearly circular area on the right side, the area slightly nearer to the setae of xiii than xiv, in *ab*. This area may or may not be a genital marking (no glandular material visible internally). The preclitellar markings are indistinctly demarcated, transversely placed areas of greyish translucence, on 9/10; the centres slightly median to *b*.

Internal anatomy.—The dorsal blood vessel probably terminated with the hearts of vii.

The bulbus ejaculatorius is unusually large, about 2 mm. long, with a slit-like lumen.

The spermathecal ampulla is sausage-shaped, anteroposteriorly directed. The duct is about 1 mm. long, fairly thick, with muscular sheen, circular in section; the lumen small, anteriorly placed, crescentic in cross section due to the presence of a high vertical ridge on the posterior wall. The duct is narrowed ectally within the parietes and again entally, the ampulla bound down around the narrowed ental portion. The seminal chambers appear to be grouped into a single posterior diverticulum but probably are separable into two distinct groups, one median and one lateral, each group opening into the duct lumen by a single pore at one side or the other of the vertical ridge. (The lumen of the lateral diverticulum has been traced into the duct lumen through a single pore, but the lumen of the median diverticulum not successfully traced.)

Two penial setae were removed from the right follicle. The tips are softened, bent back onto the shaft and with no trace of a spoon like concavity. The ectal portion of each shaft is ornamented by short, transversely placed rows of fine spines. Just behind the tip the rows are of 2, 3, 4 or 5 spines, the rows widely separated. Passing entally the rows are usually longer, *i.e.*, with more spines though still short and widely separated.

Remarks.—As a result of rupture and evagination of the gut, the position of the supra-intestinal glands could not be determined.

Stephenson noted that the holotype was in rather poor condition as long ago as 1914. Even then the penial setae were probably softened which may account for the longitudinal ridges in the bowl (concavity ?) at the tip (shaft partly disintegrated into fibrous shreds ?).

A dubious species. Stephenson (1923, pp. 427 and 430) discussed the relationships and concluded that it was related to, though distinct from, *gammiei*, but stated that evidence might be forthcoming to necessitate fusion. For the present *aborianus* is distinguished from *gammiei* by the paired vestibula, (absence of clitellar genital markings ?), absence of postclitellar genital markings and by the paired preclitellar genital markings; from *orientalis* by the absence of genital markings on xv and xvi, the absence of postclitellar genital markings and the absence of genital marking glands that protrude into the coelomic cavities; from *callosus* by the more anterior location of the preclitellar genital markings and the absence of postclitellar genital markings.

Diagnosis.—Bivestibulate and penile: vestibula deep, vestibular apertures small, with centres about on *b*; penes annular. Genital markings paired, on 9/10, centres slightly median to *b*. Spermathecal pores just lateral to *b*. Female pore on the left side. First dorsal pore on 11/12 (?). Pigmentation? Length 210 mm. Diameter 6 mm.

Ventral intestinal caeca (?); supra-intestinal glands? Dorsal blood vessel ends with hearts of vii. Metandric; testis sac ventral. Spermathecal diverticula paired (?), median and lateral. Longitudinal musculature uninterrupted above the genital markings.

Distribution.—Known only from the type locality, Kobo, Abor country, Assam.

Eutyphoeus annandalei Michaelsen.

1907. *Eutyphoeus annandalei*, Michaelsen, *Mitt. Mus. Hamburg*, XXIV, p. 174. (Type locality Bhim Tal, Kumaon district, Western Himalayas, United Provinces. Type in the Hamburg Museum.)
 1909. *Eutyphoeus annandalei*, Michaelsen, *Mem. Ind. Mus.* I, pp. 111, 217 and 218.
 1910. *Eutyphoeus annandalei*, Michaelsen, *Abh. Nat. Ver. Hamburg*, XIX, (5), p. 12.
 1923. *Eutyphoeus annandalei*, Stephenson, *Oligochaeta*, in *F. B. I. S. ries*, p. 430.

Material examined.—None.

Not examined.—Holotype, in the Hamburg Museum.

Remarks.—The centres of the male pore markings are said to be on or slightly lateral to *a* (Michaelsen, 1907, p. 174), on or a little lateral to *b* (Michaelsen, 1909, p. 217), on or a little lateral to *a* (1909, p. 218), but the figures (fig. 18, p. 174, 1907 and fig. 24, p. 220, 1909) show the male pore areas as circular with centres about on *a*, the median margins of the markings near the midventral line, the lateral margins median to *b*.

The male pores are said to be "transverse slits on the top of big, transversely oval, nearly circular papillae" (1909, p. 217). Presumably the transverse slits are slight parietal fissures, as for instance in *incommodus*, the true, minute male pores located within these fissures. Possibly the anterior and posterior margins of the fissures are protuberant so that the male porophore or a central portion of it has something of a conical appearance.

Penial setae were said to be present but no information was given except that the tips were lacking and that the thickness is about 20 micra.

Paired spermathecal diverticula are figured but the number of diverticular apertures into the lumen of the duct is unknown. If there are only two apertures, *annandalei* would appear to be close to *quadripapillatus*, if more than two apertures relationship to *incommodus* should be considered.

For the present *annandalei* is distinguished from *quadripapillatus* by the more lateral location of the spermathecal pores and from *incommodus* by the paired spermathecal diverticula.

Diagnosis and tentative recognition of the species is possible only on certain assumptions which may be incorrect; that the species is avestibulate and apenile, that the dorsal blood vessel is continued into iii, and that the spermathecal diverticula are paired.

Diagnosis.—Avestibulate (?) and apenile (?); each male pore within a transversely placed fissure (?) on a shortly elliptical, transversely, placed porophore with centre on or near to *a*. Genital markings paired, on 13/14 and 14/15 (?), in *ab*. Female pores paired (?). Spermathecal pores in lateral portion of *bc*. First dorsal pore (?). Pigmentation (?). Length 65 mm. Diameter 2 mm.

Lateral intestinal caeca (?); ventral caeca (?). Supra-intestinal glands (?). Dorsal blood vessel continued into iii (?), with hearts in v and vi (?). Holandric; testis sac (?). Spermathecal diverticula, paired (?), median and lateral. Genital marking glands (?).

Distribution.—Known only from the type locality, Bhim Tal, Kumaon district (Western Himalayas), United Provinces.

Eutyphoeus assamensis Stephenson.

1926. *Eutyphoeus assamensis*, Stephenson, *Rec. Ind. Mus.* XXVIII, p. 262. (Type locality, Katlicherra, S. Cachar, Assam. Types in the Indian Museum.)

1934. *Eutyphoeus assamensis*, Gates, *Rec. Ind. Mus.*, XXXVI, p. 271. (Re-examination of the types.)

Material examined.—From the Indian Museum : 17 acitellate specimens labelled, "*Eutyphoeus assamensis* Stephenson. Type. Katlicherra, S. Cachar, Assam. Dr. S. L. Hora. W. 1951/1".

External characteristics.—The setae are small, lacking or invisible on some of the anteriormost segments, first visible on iv (3 specimens), v (4), or vi (2), usually lacking in part on iv-vi. On xx and neighbouring segments, $ab < cd < bc < aa$ (8).

The first dorsal pore is on 11/12 (5).

The spermathecal apertures are transversely slit-like, small, the centres on or just lateral to *b*.

Paired female pores are identifiable on 3 specimens.

On each side of xvii, on or just lateral to *b*, two penisetal pits are visible. These pits are usually within a tiny, transversely slit-like fissure. A circular region with the fissure at the centre may be marked off peripherally by a very slight furrow and slightly depressed in a regularly concave fashion. On 3 specimens the fissures are more lateral, slightly median to *c* and there is on each side of xvii a conspicuously protuberant though small, u-shaped ridge, the limbs of the "u" directed mesially, terminating abruptly at line *a* and enclosing the male pore area. A midventral region (*aa*) appears to be very slightly depressed. There is no trace of a penial annulus.

On most of the specimens there is recognizable a pair of small, transversely placed genital markings, each marking postsetal on xvi and in *ab*. On 3 specimens a definitely demarcated whitish rim and a greyish translucent central area is recognizable on each marking. On the 3 specimens with u-shaped ridges the markings are not clear and may possibly be lacking but if present each marking is on the median end of the anterior limb of the u-shaped ridge.

Internal anatomy.—The intestine begins in xv (8). Lateral caeca are lacking (8). The supra-intestinal glands are in ciii-cvii (1), civ-cvii (1), cv-cix (1), cvi-cix (3), cvi-cx (1), cvii-cx (1), cvii-cxi (3), cvii-cxii (1), cviii-cxii (1). In one worm which is 235 mm. long the first supra-intestinal gland is in cviii. This segment is 130 mm. from the anterior end but there are 254 segments.

The dorsal blood vessel is continued anteriorly, at least to 5/6, with hearts in vi (4), to 4/5 with paired commissures in v (5). The last pair of hearts is in xiii (8).

In most of the dissected specimens septum 11/12 appears to be present as a normal septum though its attachment to the parietes laterally and dorsally is not recognizable in the pinned out worms. In 2 specimens, opened with especial care, 11/12 is attached to the posterior face of 10/11 peripherally and close to the parietes. In each of these worms the testicular coagulum extends dorsal to the gut. The testis sac accordingly is of the annular type. The prostatic duct is 10-12 mm. long.

The spermathecal duct is just over 1 mm. long, circular in cross section, with rather thin wall and large lumen, on the posterior

wall of which is a prominent, vertical ridge along which is (usually) a deep vertical groove (6). The diverticula are paired, median and lateral, one diverticular aperture on each side of the vertical ridge within the duct.

Eleven penial setae from one side of a single worm were examined. The tips, with but one exception are bluntly rounded. On the exceptional seta there is a rather bluntly rounded, terminal spine. The shaft may be slightly widened just ental to the extreme tip. The ornamentation is of transverse rows of fine spines, the rows rather short, longer, or united into irregular but apparently complete circles, the condition variable along the shaft of a single seta. Regions with short rows may have something of a fish-scale appearance. The ornamentation is recognizable under low power.

The longitudinal musculature is uninterrupted above the genital markings.

Remarks.—The worms are so large that it might be expected that vestibula and penes would be developed, at least partially, if the species is vestibulate and penile and furthermore that genital markings (aside from those on xvi) would be recognizable if present in this species. There is no spermatozoal iridescence in any of the spermathecal diverticula and the reproductive organs may be juvenile. If the types actually are juvenile the male genital terminalia cannot be characterized until clitellate specimens have been studied.

Worms with penisetal pits just lateral to *b* or just median to *c* may represent different stages in development or may belong to distinctly different species. For the present it is assumed that all of the types are conspecific.

The relationships to be considered are with the metandric species that have a dorsal blood vessel continued into iii. Assuming that genital markings, aside from those on xvi, are definitely lacking, *assamensis* is distinguished as follows: from *lippus*, *nainianus*, and *nepalensis* by the absence of lateral intestinal caeca; from *festivus* by the absence of postclitellar genital markings and by the annular testis sac; from *pharpingianus* by the absence of paired genital markings on xiii-xv, the posterior location of the supra-intestinal glands and the paired spermathecal diverticula; from *scutarius* by the absence of an unpaired genital marking on 15/16 and the anterior location of the supra-intestinal glands. In view of these apparent distinctions the species is recognized in spite of the impossibility of adequate characterization. In order to include *assamensis* in the key it has been necessary to enter the species twice as if both vestibulate and avestibulate but it must be noted that this is necessitated by lack of information with regard to the male genital terminalia. The double entry is not intended to suggest that this species is variable with regard to vestibular characteristics.

Diagnosis.—Avestibulate? (or vestibulate but apenile?). Genital markings paired, postsetal on xvi, in *ab*. Female pores paired. Spermathecal pores on or just lateral to *b*. First dorsal pore on 11/12. Pigmentation? Length 185-245 mm. Diameter 4 mm.

Ventral intestinal caeca in xxxvi-xlvi. Supra-intestinal glands in cviii-cviii: cvii-cxii. Dorsal blood vessel continued into iii with hearts in v and vi. Metandric; testis sac annular and formed by the peripheral

apposition of 10/11 and 11/12 close to the parietes. Spermathecal, diverticula paired, median and lateral. Longitudinal musculature uninterrupted above the genital markings.

Distribution.—Known only from the type locality, Katlicherra, S. Cachar, Assam.

***Eutyphoeus callosus*, sp. nov.**

Material examined.—From the Indian Museum : 3 clitellate or partially clitellate and 2 aclitellate specimens labelled, "Dumpep, Khasi Hills (Assam). Dr. S. L. Hora."

External characteristics.—Length (clitellate specimens), 247-320 mm. Diameter 7-8 mm. No pigmentation visible.

The setae are small and on the anteriormost segments, ii-iv or v, are lacking or invisible. Posterior to the clitellum the setae are more readily recognizable, either larger or more protuberant. On xx, *ab* is slightly less than *cd*, *bc* < *aa*, *dd* equal to or slightly greater than one half the circumference. Posteriorly *ab* and *cd* may be about equal but *bc* remains smaller than *aa* throughout.

The first dorsal pore is on 11/12 (2), 12/13 (1), 17/18 (1).

The clitellum is light reddish, annular, extending from a posterior portion of xiii to 17/18 ; inter-segmental furrows and dorsal pores lacking, setae present.

The spermathecal pores are transversely placed slits, the centres just lateral to *b*.

There is a single female pore on xiv, anterior and median to *a*, on the left side.

On the aclitellate specimen with no genital markings there is on xvii on each side, in the region of *ab*, on the posterior half of the segment, a very shallow transversely placed slit. The margins of the slit are very slightly tumescent. On the roof of the slit there are two tiny pores, presumably peni-setal pits. On the posterior wall of the slit and about in line with *b*, is a minute, transversely placed aperture. On the aclitellate specimen with genital markings the vestibular invaginations are deepened, the vestibular apertures and the lumen (in horizontal section) shortly elliptical. On the roof of each vestibulum and extending to both the median and lateral walls is a rudimentary penis, an annular protuberance. On one side a penial seta projects through the central depression of the penis. The pores noted on the more juvenile worm have not been seen on this specimen. On the partially clitellate and clitellate specimens the vestibular invaginations are deeper, especially laterally but are widely open to the exterior. A small, mid-ventral portion of xvii is very slightly depressed and passing laterally is sloped steeply but not abruptly to the roof of the invagination where the penis is located. The penes appear to be of about the same size as on the aclitellate specimen with genital markings.

The genital markings are paired and intersegmental. The post-clitellar markings are transversely placed, almost rectangular but with bluntly rounded corners, extending mesially nearly to the midventral line and laterally to or nearly to mid *bc*, reaching anteroposteriorly to just behind or just in front of the setae. The markings are level or

slightly concave, with a light, yellowish, translucent appearance, the parietes immediately surrounding each marking very slightly tumescent and protuberant. The cuticle is adherent and cannot be removed, without damage to the epidermis. Rims (opaque) are not recognizable, but, if present, are probably united midventrally. The markings are located as follows: 18/19 (4 specimens), 19/20 (4), 20/21 (1), 20/21 right side and 21/22 left side (1). The preclitellar markings are more nearly circular and do not reach so far mesially towards the midventral line, about in *a* to mid *bc*, and are located as follows: 10/11 (2), 10/11 right side only (1), 11/12 (4), 12/13 (3).

Internal anatomy.—The intestine begins in xv (3). There are no lateral intestinal caeca. Unpaired median caeca are present, in segments xxxvii-xlviii (at least, 1 specimen), xxxvii-lxvi (1). The tiny, circular openings into the caeca are clearly visible on the floor of the gut, but the caeca are not easily found because of the compacted masses of coelomic coagulum. The intestine is strongly sacculated from xv through xxvi. The typhlosole is first recognizable in xxvii (2). The supra-intestinal glands are in xciv-xcviii (2), (small on right side and vestigial on left side of xciv, one specimen), xcvi-ci (clitellate specimen), and xcvi-ci (aclitellate specimen with genital markings).

The dorsal blood vessel terminates anteriorly with the hearts of vii (3). The last pair of hearts is in xiii (3). The hearts of xi are held by connective tissue against the gut.

There is a single, unpaired, suboesophageal testis sac. The seminal vessicles extend from 10/11 to 12/13, pushing 12/13-13/14 back into contact with 14/15. The prostates are in xvii or xviii to xix or xx. The prostatic duct is muscular, thickest in a middle portion and slender both ectally and entally, 28 mm. long. The bulbus ejaculatorius is coelomic, large, thickly and shortly spindle shaped, about $2\frac{1}{2}$ mm. long and 1 mm. thick.

The penial setae are $2-2\frac{1}{2}$ mm. long, 0.038-0.04 mm. thick, an ectal portion slightly curved towards one side. The tips of two setae hollowed out slightly and rather spoon-shaped but not widened. The tips of other setae probably softened, not widened and without any recognizable concavity. An ectal portion of each shaft is ornamented with irregularly interrupted, transverse rows of fine spines. In one follicle there are 6 setae: one functional seta lacks a tip (broken off), the other is slightly swollen just behind the tip, the surface with a bark-like appearance, ornamentation recognizable only behind the swollen region; one reserve seta with swollen and softened tip, others with narrowed tips, none spoon-shaped.

The spermathecal ampulla is distended, sausage-shaped and longitudinally placed. The duct passes into the ventral face of the ampulla near the anterior end. The duct is abruptly narrowed entally into a very short and narrow, neck-like region with a rather thin wall. Ectal to the neck the duct is short and stout, shortly elliptical in cross-section, the long axis longitudinal. The lumen of the duct is E-shaped, in section, the back of the E anteriorly, the three limbs directed posteriorly. The limbs of the E are due to the presence on the posterior wall of the duct of two high, vertical ridges. Laterally and anteriorly there may be several low, vertical ridges. The diverticula are paired (?) and pass

into the lateral and median faces of the duct below the neck portion. Each diverticulum is dorsoventrally flattened, rather ear-shaped, perpendicular to the vertical axis of the duct. The diverticula may be in contact or fused posteriorly but anteriorly are separated by a wide gap. Dissections of the spermathecae were unsatisfactory but there are probably only two diverticular apertures. The longitudinal musculature is uninterrupted above the genital markings.

Remarks.—The most mature worms certainly appear to be bivestibulate, and are well preserved and apparently contracted. Nothing, however, is known of the method of preservation and if the types are not contracted it may be possible that full contraction would then produce a univestibulate condition. If univestibulate, *callosus* is close to *gammiei* with which it may have to be merged, being distinguished at present only by the distinct pairing of the genital markings, absence of genital markings on 13/14 and the shortness of the penial setae. If, as seems to be true, the species is bivestibulate, *callosus* is distinguished from *orientalis* by the absence of genital markings on xv and xvi and from *aborianus* by the presence of postclitellar markings.

Diagnosis.—Vestibulate and penile : bivestibulate (?), penes annular. Genital markings paired and intersegmental, on (10/11), 11/12, 12/13, 18/19, 19/20, (20/21, 21/22) ; postclitellar markings almost rectangular, margins united (?) at the midventral line, preclitellar markings more nearly circular, from *a* to mid *bc*. Female pore on the left side. Spermathecal pores just lateral to *b*. First dorsal pore on 11/12. Pigmentation ? Length 247-320 mm. Diameter 7-8 mm.

Ventral intestinal caeca in xxxvii-xlviii. Supra-intestinal glands in xciv-xcvii : : xcvi-c. Dorsal blood vessel terminates with hearts of vii. Metandric ; testis sac ventral. Spermathecal diverticula paired, median and lateral. Longitudinal musculature uninterrupted above the genital markings.

Distribution.—Known only from type locality, Dumpep, Khasi Hills, Assam.

***Eutyphoeus comillahnus* Michaelsen.**

1907. *Eutyphoeus comillahnus*, Michaelsen, *Mitt. Mus. Hamburg*, XXIV, p. 187. (Type locality Comillah, Chittagong district, Bengal. Types in the Indian and Hamburg Museums).
 1909. *Eutyphoeus comillahnus*, Michaelsen, *Mem. Ind. Mus.* I, pp. 111, 219 and 242.
 1910. *Eutyphoeus comillahnus*, Michaelsen, *Abh. Nat. Ver. Hamburg*, XIX, (5), p. 12.
 1923. *Eutyphoeus comillahnus*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 432.

Material examined.—From the Indian Museum : 2 acitellate, undissected and macerated specimens labelled, "*Eutyphoeus comillahnus* Michlsn. Types. Comillah, E. Bengal. Maj. A. R. S. Anderson, I. M. S., ZEV 2837/7." (In addition to the two specimens described below a larger, acitellate specimen is probably to be referred to *E. scutarius*.)

Not examined.—From the Hamburg Museum : 2 (?) specimens, part of the type series.

External characteristics.—Length, ca. 65 mm. Diameter, 3 mm. (larger specimen).

The setae begin on ii and are readily recognizable. Because of maceration the setal ratios cannot be determined on the anterior post-clitellar segments. When first determinable the ratios are ; $ab < cd < bc < aa$.

The first dorsal pore is on 11/12.

Clitellar glandularity is quite unrecognizable, intersegmental furrows and dorsal pores as well as setae present on the clitellar region.

The spermathecal pores are on or just lateral to *a*.

Two closely paired, penisetal pits are visible in *ab* on each side. Male porophores are no longer recognizable. (According to Michaelsen both male pores are on an unpaired, transversely placed, area). On the Hamburg specimens the male pores are in fissures on small, diagonally placed markings of shortly elliptical outline.

The single genital marking is transversely placed, elliptical in outline, postsetal on xii, reaching laterally on each side to *b*. There are no incisions of the anterior and posterior margins at the midventral line or other evidence to indicate a double origin.

Internal anatomy.—The intestine begins in xv. There are no lateral caeca. The supra-intestinal glands are in lxxxv-lxxxviii.

The dorsal blood vessel is continued at least into v, hearts of v and vi present. The last pair of hearts is in xiii. the hearts of xi are bound down to the gut.

The testis sac is ventral. The prostatic duct is sinuous, about 2 mm. long. The vas deferens is readily recognizable but the bulbous ejaculatorius is small.

The spermathecal duct is short, circular in cross-section, with a rather thick wall. The diverticula are paired, elongately ellipsoidal or sausage-shaped, with no definite stalks though slightly narrowed as they pass into the duct. The diverticula are characterized by a spermatozoal iridescence which probably indicates that the worm is in a post-sexual, acitellate condition.

The longitudinal musculature is uninterrupted and not bulged over the genital markings.

Four penial setae from one side were examined. In a small ectal portion of each shaft there are alternatè dark and light stripes, as in the setae of *E. scutarius*. The tips are simple, bluntly rounded. The shaft of one seta is slightly thickened just behind the tip. Two setae have chevron-like ridges on the shafts ectally and on these setae no ornamentation is visible. On the other two setae the ornamentation consists of rather evenly spaced and fairly regular circles of fine spines.

Remarks.—Each specimen is broken completely across at least once and in addition is ruptured in other places. Because of these breaks the segmental locations of the supra-intestinal glands may not be exact.

Diagnosis.—Avestibulate and apenile : each male pore within a fissure in *ab* and on a diagonally or transversely placed, small porophore of shortly elliptical outline. Genital markings unpaired and postsetal, on xii and xiii, reaching laterally on each side to *b*. Female pores ? Spermathecal pores on or slightly lateral to *a*. First dorsal pore on 11/12. Pigmentation ? Length 65-90 mm. Diameter 3-4 mm.

Ventral intestinal caeca ? Supra-intestinal glands in lxxxv-lxxxviii. Dorsal blood vessel continued into iii (?) with hearts in v and vi.

Metandric ; tests sac ventral. Spermathecal diverticula paired, median and lateral. Longitudinal musculature uninterrupted above the genital markings.

Distribution.—Known only from the type locality, Comillah, Chittagong district, Bengal.

***Eutyphoeus festivus*, sp. nov.**

Material examined.—From the Indian Museum : 1 clitellate specimen labelled, ‘‘Dumpep, Khasi Hills, (Assam). October, 1929 Dr. S. L. Hora.’’

External characteristics.—Length, 146 mm. Diameter, 6 mm. No pigmentation visible.

The setae begin on ii. Setae *a* and *b* are more closely paired throughout than *c* and *d*. On xx, $ab < cd < bc < aa$, *dd* about equal to one half the circumference. Posteriorly *bc* is smaller than *cd* and *aa*.

The first dorsal pore is on 11/12.

The clitellum is light reddish, annular, extending from the setae of xiii to 18/19 ; intersegmental furrows lacking, dorsal pores lacking except on 13/14, setae present.

The spermathecal pores are small, transverse slits, in *ab*.

There is a pair of female pores on xiv, each pore just anterior and median to *a*.

On xvii on each side there is a transversely placed, sharply demarcated, protuberant but flat-surfaced male porophore of shortly elliptical outline, in *ab* but reaching slightly median to *a* and lateral to *b*. On each side of these areas is a small, transversely slit-like aperture, the margin of which is very slightly swollen as a faintly annular lip. The aperture opens into a rather shallow, slit-like invagination. On the roof of the slit two setal pits are recognizable in each of which is barely visible the tip of a penial seta. On the posterior wall of the invagination there is a vertical groove and within this groove a minute pore, possibly the male pore.

The single, large genital marking is on 19/20, extending laterally on each side to *b* and anteroposteriorly to the transverse setal lines of xix and xx, seta *a* included within the margin of the marking on each segment. The lateral ends of the marking are bluntly rounded, the marking protuberant, with a flat surface which is mostly of a greyish translucent appearance. A very narrow, peripheral portion of the marking is whitish, but not otherwise marked off from the translucent central portion.

Internal anatomy.—The intestine begins in xv. There are no lateral intestinal caeca. There are 6 ventral caeca, in xxxviii-xlii (approximately). Some of these are well over 1 mm. in length, digitiform, the posteriormost rudimentary. The typhosole begins in xxv (approximately), decreases gradually in size passing posteriorly, and terminates at the anterior supra-intestinal glands. The latter are in xcii-xcv (approximately). On the roof of the gut, at the mid-dorsal line there is a longitudinal row of 7 fairly large apertures leading into the glands. A smaller greyish spot may mark the site of another aperture.

The dorsal blood vessel is continued anteriorly to the pharyngeal region, not recognizable anterior to 4/5 but with paired hearts

in v, another pair anterior to the gizzard, the usual two pairs behind the gizzard; the last pair in xiii.

There are no testes, or male funnels in x or seminal vesicles in ix. The male funnels are in an unpaired, ventral testis sac but the hearts of xi are bound down to the gut. The seminal vesicles of xii push 12/13 and 13/14 back into contract with 14/15. The prostates are in xvii-xix. The prostatic duct is 4 mm. long, looped in an approximation to regularly zigzag. The vas deferens is clearly visible on the parietes from the testis sac posteriorly in spite of the tissues which cover it in places. The bulbus ejaculatorius is small, covered.

The spermathecal duct is much shorter than the ampulla and rather slender, with fairly thick wall and narrow lumen. There are two diverticula, each rather sausage-shaped and posteriorly directed.

The penial setae are 1.05-1.15 mm. long, and 20-25 micra thick. Some are softened ectally but the tips of three are in perfect condition, hollowed out in a spoon-shaped fashion. The ornamentation is of irregularly interrupted circles of fine spines.

The body wall is thickened over the genital markings but the longitudinal musculature appears to be uninterrupted.

Remarks.—*E. festivus* is distinguished from *assamensis* by the more median location of the spermathecal pores, the unpaired postclitellar genital marking and the ventral testis sac.

Diagnosis.—Avestibulate and apenile, male pores in slight transverse fissures, in *ab*; each fissure at the centre of a transversely placed area of parietal thickening with shortly elliptical outline. One genital marking on 19/20, reaching laterally to *b* and anteroposteriorly to the transverse setal lines of xix and xx. Female pores paired. Spermathecal pores in *ab*. First dorsal pore on 11/12. Pigmentation? Length 146 mm. Diameter 6 mm.

Ventral intestinal caeca in xxxviii-xlii. Supra-intestinal glands in xcii-xcv. Dorsal blood vessel continued into iii with hearts in iv-vi. Metandric; testis sac ventral. Spermathecal diverticula paired, median and lateral. Body wall thickened at the genital marking but longitudinal musculature (apparently) uninterrupted.

Distribution.—Known only from the type locality, Dumpep, Khasi Hills, Assam.

***Eutyphoeus gammiei* (Beddard).**

- 1888. *Typhaeus gammii*, Beddard, *Quart. J. Mic. Sci.* XXIX, p. 111. (Type locality, Darjiling. Type, if extant, in the British Museum).
- 1895. *Typhaeus gammii*, Beddard, *Monog.* p. 473.
- 1900. *Eutyphoeus gammiei*, Michaelsen, *Tier.* X, p. 323.
- 1901. *Typhaeus gammii*, Beddard, *Proc. Zool. Soc. London*, 1901, p. 205.
- 1903. *Eutyphaeus gammiei*, Michaelsen, *Geogr. Verbr.* p. 108.
- 1907. *Eutyphoeus chittagongianus*, Michaelsen, *Mitt. Mus. Hamburg*, XXIV, p. 181. (Type locality, Comillah, Chittagong district, Bengal. Types in the Indian and Hamburg Museums).
- 1909. *Eutyphoeus chittago gianus* + *E. gammiei*, Michaelsen, *Mem. Ind. Mus.* 1, pp. 111, 218, 219 and 231.
- 1910. *Euryphoeus chittagongianus* + *E. gammiei*, Michaelsen, *Abh. Nat. Ver. Hamburg.* XIX, (5), p. 12.
- 1914. *Eutyphoeus [koboensis]* + *E. magnus*, Stephenson, *Rec. Ind. Mus.* VIII, pp. 404 and 408. (Type locality of *koboensis*, Kobo, Abor country, Assam; of *magnus*, Upper Rotung, Assam. Types in the Indian Museum).

1920. *Eutyphoeus chittagongianus* (part only ?), Stephenson, *Mem. Ind. Mus.* VII, p. 241. (Excluding the Sureil and Nam Ting Pokri specimens ?).
 1923. *Eutyphoeus gammiei* (part), Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 434. (Excluding *E. kemp*i and also (?) specimens from Sureil and Nam Ting Pokri).
 1925. *Eutyphoeus gammiei*, Stephenson, *Rec. Ind. Mus.* XXVII, p. 72.
 1926. *Eutyphoeus gammiei*, Stephenson, *Rec. Ind. Mus.* XXVIII, p. 264.

Material examined.—From the Indian Museum : A.—C. 1 clitellate, dissected and macerated specimen labelled, "*Eutyphoeus chittagongianus* Michaelsen. Type. Comillah, E. Bengal. Maj. A. R. S. Anderson, I. M. S., ZEV 2839/7." ; 1 dissected and 2 undissected, clitellate specimens labelled, *Eutyphoeus chittagongianus* Michlsn. On paths after rain. Above Tura, Garo Hills, Assam. 3,900 ft. July-August, 1917. "W 176/1, 170/1, and 167/1." ; 1 clitellate, dissected specimen labelled, "*Eutyphoeus chittagongianus* Michlsn. Siju cave, Garo Hills, Assam. Nov. 1917. R. Friel. W 183/1." ; 1 dissected acitellate specimen labelled, "*Eutyphoeus gammiei* Beddard. In damp earth on an island in the lake. Amingaon. Dr. S. L. Hora. W. 1227/1." ; 1 juvenile, 3 acitellate or partially clitellate and 13 clitellate specimens labelled, "*Eutyphoeus gammiei* Beddard. From a small village near Jaulah lake, Amingaon, 14.3.24. Dr. S. L. Hora, W 1226/1." ; and 3 clitellate anterior fragments labelled, "*Eutyphoeus gammiei* (Bedd.). Katlicherra, S. Cachar, Assam. S. L. Hora. March 1925. W 3203/1."
 D. 1 clitellate, dissected specimen labelled, "*Eutyphoeus magnus* Steph. Upper Rotung, alt. ca. 2,000 ft. (Abor Expdt.), S. W. Kemp. ZEV 5383/7."
 E. 1 clitellate, dissected specimen labelled, "*Eutyphoeus koboensis* Stephenson. Type. Kobo, alt. 400 ft. (Abor expdtn.), Dr. S. W. Kemp. ZEV 5152/7."
 clitellate, dissected specimen labelled, "*Eutyphoeus chittagongianus*. Sureil, 5,000 ft. Darjiling district, E. Himalayas. 11-31.x.17. N. A. and F. G. W308/1."
 G. 1 clitellate (?), dissected specimen labelled, "*Eutyphoeus chittagongianus* Mischlsn. Nam Ting, Darjiling district, St. 8. S. Kemp. vi-vii, 1918. W 307/1."

Not examined.—In the British Museum there is a single specimen of *Eutyphoeus* sp. from Darjiling, in Beddard's collection. This specimen may be the type of *gammiei* as there is no record of Beddard having had specimens of other species of *Eutyphoeus* from Darjiling. In the Hamburg Museum : 1 specimen (type) of *chittagongianus*.

One of the types of *gammiei* was probably sectioned. The original specimens are probably no longer in existence, but if extant may be unrecognizable or useless as types. Determination of specific characteristics accordingly is dependent on a description which contains several errors, that is in part self-contradictory and which failed to describe certain structures of considerable importance. The only information of diagnostic value may be summarized as follows : spermathecal pores in *bc* (in median portion close to *b* ?) ; first dorsal pore on 10/11 (?) ; genital markings unpaired (according to fig. 7 no indication of double origin), inter-segmental, on 19/20 and 20/21 ; spermathecal diverticula paired (presumably median and lateral) ; penial setae (with simple tips ?) ornamented by circles (?) of spines. Beddard distinguished *gammiei* from *orientalis* by the genital markings and penial setae. The penial setae of *gammiei* were not described though a figure was given. The penial setae of *orientalis* were almost certainly abnormal (partially disintegrated) but the genital markings do distinguish the two species.

Beddard did not describe the male pore areas but gave a figure which has been the cause of further confusion (pl. xii, fig. 3). Michaelsen (1900,

p. 323) and others to whom the figure has been shown have interpreted the male pore area as a cushion-like elevation of dumbbell-shaped outline. According to this interpretation *gammiei* is avestibulate. Metandric Indian species of *Eutyphoeus* with anterior shortening of the dorsal blood vessel are all (except *gigas*) vestibulate which may be considered as evidence against this interpretation. (In *gigas* there are paired male porophores.)

Stephenson (1923, pp. 426-7) interpreted the figure of the male pore area as a transversely placed depression. According to this view *gammiei* is univestibulate. So characterized the species can adequately be diagnosed from specimens referred by later authors (Michaelson and Stephenson) to *chittagongianus*, more recently synonymized with *gammiei* by Stephenson (1923, p. 434). Unfortunately no specimens with normally developed, single vestibulum are known from the type locality or its vicinity. It is possible that this failure to recognize an unpaired vestibulum on worms from the type locality or vicinity, as well as from other places, is due to abnormality, immaturity, maceration and relaxation or variation in methods of preservation, or it may be that in *gammiei* the male pore region is variable so that definite characterization of the species as uni- or bivestibulate is not possible. There is, however, no such variation, even when other characteristics are quite variable, in Burmese species of *Eutyphoeus*, after preservation according to a standard method. Accepting Stephenson's interpretation of the male area and assuming that *chittagongianus* has been correctly synonymized with *gammiei*, the latter has been diagnosed as shown below. When univestibulate specimens referable to the species as now defined have been found in the type locality of *gammiei* the species can be regarded as definitely fixed.

A. Definitely univestibulate.

External characteristics.—(Specimens from tubes with the following numbers: W 167/1, 170/1, 176/1, 183/1, 3203/1, and ZEV 2839/7). Setae are lacking or invisible on ii-v (3), or only in part present on v (1). On other segments, in addition to ii-v, setae may be lacking. Thus on one specimen there are only 2 setae on xviii, one on xix, three on xx, four on xxi, etc. On or just behind xx, $ab < cd < bc < aa$ (4).

The first dorsal pore is on 11/12. The clitellum extends from a presetal portion of xiii to 17/18 (1).

The spermathecal pores are transversely slit-like, the centres on or lateral to *b* (8).

The single female pore is on the left side (4).

The vestibulum is deep, with a transversely slit-like aperture, the posterior margin straight, the anterior margin with two small, posteriorly directed lobes, one just lateral to the midventral line on each side (8). On the roof of the vestibulum at the midventral region is a very low, longitudinally placed, rather broad ridge (8). The vestibulum and its aperture is much like that of *E. cochlearis* Gates 1931 and *E. excavatus* Gates 1929 (*vide* Gates 1929, p. 31, fig. 17) from Burma. On the wall of the vestibulum in each antero-lateral corner there is marked off a shortly elliptical, vertically placed area with something of a resemblance to a genital marking though the epidermis of the area does not

appear to be especially modified. The penes are small, of the short, annular type (8). On the posterior wall of one penis but within the penial lumen there is visible a minute pore which may be the male pore.

The genital markings are unpaired and transversely placed, reaching laterally to *a*, *b*, or into *bc*, usually without any incisions of the anterior and posterior margins midventrally or other indication of a double origin. On one specimen there are slight incisions at the midventral line of anterior and posterior margins of markings on 10/11 and 13/14. On one of the Katlicherra specimens there is a pair of markings on 13/14, the greyish translucent, depressed areas separated by a midventral opaque strip. The markings are located as follows: 19/20 and 20/21 (1 specimen); 10/11, 13/14, 19/20-21/22 (2); 13/14, and 19/20 (1); 13/14, 19/20-20/21 (3); 13/14, 19/20-21/22 (1).

Internal anatomy.—The intestine begins in xv (4). There are no lateral intestinal caeca (4). The median caeca are in xxv-xcix (1). The supra-intestinal glands are in ci-cv (1), ciii-cviii (type of *chittagongianus*), cxii-cxvii (1), cxiv-cxviii (1), cxiv-cxix (2).

The dorsal blood vessel ends with the hearts of vii (3). In one specimen the dorsal trunk may have been continued anteriorly to the gizzard and then ventrally as a left heart of vi but anterior to the hearts of vii the vessels are empty and damaged by the dissection, hence the uncertainty. The hearts of xi are bound down to the gut (3). The last pair of hearts is in xiii (3). Each heart of xii and xiii bifurcates dorsally (1), the posterior branch passing to the dorsal blood vessel, the anterior branch passing forward for a short distance on or within the gut wall just lateral to a median line on the dorsal face of the gut. In the anterior portion of xiii the right anterior bifurcation disappears from view but that on the left is continued through 12/13 bifurcating just in front of the septum, one branch passing over onto the right side where it receives the anterior bifurcation of the heart of xii, the other branch passing posteriorly on its own side after having received the anterior bifurcation from the left heart of xii. (Cf. Beddard 1889, bifurcations of the hearts of xii and xiii pass into the dorsal and supra-intestinal trunks.)

The testis sac is unpaired and ventral (3). The prostatic duct is about 30 mm. long (2). The bulbus ejaculatorius is large and coelomic.

Each spermatheca has two diverticula, one median and one lateral. The diverticula are directed posteriorly and may be separated, in contact, or even bound together by connective tissue. In the latter case the spermatheca appears to have but a single diverticulum in the form of a semi-circle of seminal chambers around the posterior half of the spermathecal duct. Within each duct however there are but two diverticular apertures (4 spermathecae), the two apertures separated by a high vertical ridge which bears a deep vertical groove.

Two penial setae, probably fully developed reserve setae, from the remaining follicle of one specimen were examined. The tips are softened, the ornamentation of irregular transverse rows (circles?) of spines, an occasional spine enlarged and with an equilaterally triangular outline. Seven penial setae from one side of another specimen all have softened tips but may (2) have a slight concavity near the tip scarcely deep enough to justify the term spoon-shaped. The ornamentation

is of closely crowded, rather irregular rows (circles ?) of spines, so close as to produce almost a fur-like appearance. The ornamentation on one seta from a third specimen is restricted to a smaller portion of the shaft and is of short, transverse rows of small spines. As on the other setae the tip is softened. Functional setae are 4-5 mm. long.

The longitudinal musculature is uninterrupted dorsal to the genital markings.

Remarks.—The Indian Museum type of *chittagongianus* is macerated, hence the segmental location of the supra-intestinal glands may not be exact. The Hamburg Museum type is also macerated but appears to have a single vestibulum. Penes were not noted.

Other worms previously referred to *gammiei* differ from those just described as noted in the sections below.

B. Not definitely univestibulate.

External characteristics.—(Amingaon specimens.) The first dorsal pore is on 11/12 (4), on 11/12 but with a pore slit-like though apparently non-functional on 10/11 (3+), on 12/13 (1). The clitellum extends from a presetal portion of xiii (4) or a postsetal portion of xiii (6) to 17/18.

The single female pore is on the left side (7).

In each of the mature specimens (the juvenile specimen has no penes or vestibular invaginations) the penes are located in paired, usually rather slit-like depressions of varying depth. The median margin of the depression is at or near to *a*, the lateral margin in mid *bc*, or near to *c*. A median region, roughly corresponding to *aa*, between the two penial depressions may be slightly protuberant, level, slightly depressed or more deeply depressed, though less so than the penial invaginations. On the specimen with the greatest midventral depression it is fairly obvious that a further slight retraction of the midventral region of xvii will produce a characteristic univestibulate condition with a deep vestibulum, the vestibular aperture with a straight posterior margin and a lobed anterior margin. Starting from this specimen it is possible to arrange the worms in a series in which the appearance of segment xvii becomes progressively less characteristic, ending with two or three individuals that certainly appear to be definitely bivestibulate. The preservation of these Amingaon specimens is not as good as that of the Tura-Siju Cave specimens of *chittagongianus*, and so it is possible to regard the Amingaon worms as univestibulate but with the vestibular region relaxed or partially protruded. At least five specimens have areas similar to genital markings vertically placed in the anterolateral corners of the penial depressions. One worm with but slight clitellar glandularity has the penes in very small transversely slit-like depressions. Just anterior to the lateral margin of each depression is clearly marked off a small, circular, slightly protuberant area. With fuller development of the penial invagination this circular area would come to lie vertically on the anterolateral wall of the invagination.

The genital markings are areas of greyish translucence which may be slightly protuberant, level or depressed. The areas may be indistinctly delimited or sharply demarcated, in the latter case a whitish

marginal band is usually more or less clearly marked off. The markings are usually unpaired and with no indications of a possible double origin such as incisions of the anterior and posterior margins at the midventral line. The preclitellar markings are usually paired, the greyish, translucent central portions distinct, the marginal bands united at the midventral line. Markings on the right and left sides are asymmetrically developed (no indication of double origin), with a large portion of each marking to the right or left of the midventral line. Thus a marking on 13/14 extends from *a* on the right side into *bc* on the left side, while a marking on 11/12 extends from *a* on the right side to lateral to *b* on the left side. The markings are located as shown below. Two specimens have markings on 20/21-23/24. At least 2, possibly 4 worms (1 clitellate), lack genital markings.

Furrow.	Side if asymmetrical.	Number of specimens.
9/10	..	1
10/11	..	3
12/13	left	1
13/14	..	7
13/14	left	1
19/20	..	6
19/20	left	1
20/21		9
21/22	..	3
21/22	right	2
22/23	..	2
22/23	right	1
23/24		2

Internal anatomy.—The median caeca are in xxxvii-lxviii (1). The supra-intestinal glands are in xcvi-ciii (1), xcix-ciii (3), c-ciii (1). In one specimen with metameric abnormalities the glands are in xcvi-ciii or lxxxix-xcii, depending on which side the segments are counted.

The testis sac is unpaired and ventral (2).

The prostatic duct is 14-16 mm. long.

There is a single semi-circle of seminal chambers on the posterior face of the spermathecal duct (2 specimens), paired diverticula-median and lateral (2 specimens). There are only 2 diverticular apertures into the duct (5 spermathecae).

Penial setae were examined from several specimens. 1. Six reserve setae from one follicle. Tips all simple. Just behind the tip on 4 setae are chevron-like markings. On two of these setae the markings are visible even under low power. With high power it is obvious that the seta has partially disintegrated into fibres though the margins are still intact. The tip of another seta is lacking, the shaft terminating in a brush-like tuft of short fibres each of which tapers to a point. This tuft might have been regarded as a bunch of terminal spines had not the partial disintegration with intact margins been observed. Ornamentation is recognizable even with low power, rather fish-scale like, of short, closely crowded transverse rows of spines, the length of the rows and the number of teeth in the rows variable. 2. Seven setae from one follicle. One seta has chevron-like markings just behind the tip.

Another has transverse cracks just behind the tip but no fibrillar disintegration. Four have short, fibrillated portions but with intact margins. The other seta terminates in a brush-like tuft of fibres. 3. Six reserve setae. The tips of five setae are simple, bluntly rounded, the extreme tips of two slightly fibrillated, chevron-like markings just behind the tip of one seta. The sixth seta has a spoon-shaped concavity just behind the tip. 4. Three functional setae. The ectal end of one shaft is jagged, the tip having been broken off. On another seta the tip is even more jagged and with a slightly brush-like appearance. The tip of the other seta is bluntly rounded. This last seta is fibrillated near the tip, the margin interrupted, the fibrillations continued across the shaft nearly to the other side the margin of which is smooth and uninterrupted.

Remarks.—If the interpretation suggested above as to the condition of the vestibulum is accepted, the Amingaon worms are distinguished from the worms described on a previous page only by a slightly more anterior location of the supra-intestinal glands and the shortness of the prostatic duct (14-16 mm. instead of 30 mm). A difference in length of the prostatic duct cannot be regarded as a valid criterion for specific distinctness. The position of the supra-intestinal glands in *E. gammiei* is subject to considerable variation (*vide* type of *chittagongianus* and other types and specimens more briefly characterized below). The Amingaon worms are accordingly referred to *E. gammiei*.

C.

External characteristics.—(Another Amingaon specimen.) The penes are located in deep, slit-like depressions, the midventral region between the penial depressions sharply depressed but not as deeply as the slits containing the penes. This worm can quite well be considered unives-tibulate. Vertical areas are not recognizable in the antero-lateral corners of the vestibulum. On 20/21 is a slightly protuberant, transverse area that may possibly be a rudiment of a genital marking but no greyish translucence is recognizable. On segments xi and xii (possibly others; Stephenson, 1925, p. 72) there are small, slightly raised areas of circular to oval outline. It is doubtful if these areas are genital markings as similar areas on Burmese specimens of *Eutyphoeus* and *Pheretima* appear to have a parasitic origin.

Internal anatomy.—The supra-intestinal glands are in cxxix-cxxxiv.

Two penial setae were removed from one bundle. Each seta, near the tip, is characterized by the presence of chevron-like markings which are obvious under the low power. Fibrillar disintegration is equally obvious under the high power.

Remarks.—This worm is distinguished from the other Amingaon specimens (of *gammiei*) only by the posterior location of the supra-intestinal glands. This can scarcely be regarded as evidence for specific distinctness and accordingly the worm has been referred to *gammiei*.

D. Type of *E. magnus*.

External characteristics.—The penes are in paired, deep, transversely slit-like depressions that extend from slightly median to *a* nearly to *c*.

The midventral region between these depressions is slightly depressed and crisscrossed by numerous furrows. In the anterolateral corner of each penial depression is a vertically placed area somewhat like a genital marking.

The genital marking, an area of greyish translucence, is on 19/20, reaching laterally on each side to mid *ab*. The shape at first appears to be rather dumbbell-like, probably as the result of contraction, otherwise there is no indication of a double origin. Failure to remove the cuticle doubtless explains the previous inability to recognize this marking.

Internal anatomy.—The supra-intestinal glands are in cvii-cxi. Each spermatheca has paired diverticula, median and lateral; two diverticular apertures in the duct (1 spermatheca). One penial seta from the remaining follicle was examined but the tip is soft. The ornamentation is faint, sparse, of short, transverse rows of fine spines.

Remarks.—Sparse ornamentation on penial setae of definitely unives-tibulate worms has been noted on a previous page and cannot be considered as evidence for specific distinctness. If the vestibular roof can be considered to have fallen at the midventral region nothing remains to distinguish this worm from *gammiei*.

E. The type of koboensis.

External characteristics.—The first dorsal pore is probably on 11/12 rather than 10/11. The spermathecal pores appear to be in mid *bc* rather than in the median portion of *bc* but the location is difficult to determine because of the partial loss of setae on *v* and succeeding segments.

The penes are located in paired depressions but a midventral region, in *aa*, is slightly depressed and crisscrossed with furrows that mark off numerous small tumescences. Vertical areas are not recognizable at the anterolateral corners of the penial depressions. The penes at first do not appear to be annular but shortly conical, the bases not definitely marked off. If a portion of the vestibular roof bearing just a penial annulus of the *gammiei* type can be sharply protruded ventrally the appearance would probably be much like that of the present worm. (Fig. 225 in Stephenson, 1923, p. 434, is of *koboensis*.)

The genital marking on 20/21 is on the left side and is small and indistinct. There is a single median marking on 21/22 with no incisions of the anterior and posterior margins at the midventral line or other indication of a double origin. The clitellar genital marking, on 13/14, reaching on each side, into *bc*, with the anterior and posterior margins incised at the midventral line, has a transversely slit-like appearance, as a result of contraction. This marking was mistaken for paired female pore areas by Stephenson but there is only a single female pore on the left side.

Internal anatomy.—The supra-intestinal glands are in cxvi-cxx, but with rudimentary glands in cxv.

The seminal chambers are arranged in a semi-circular series on the posterior face of the spermathecal duct but there are only 2 diverticular apertures into the duct, one at each side of the vertical ridge.

The single penial setae that could be found has a simple (?) tip but is softened. The ornamentation is restricted to a short region of the

shaft and is of short, transverse rows of spines, each row with but a few teeth.

Remarks.—The specimen is well preserved and in good condition. Assuming that the vestibular roof has fallen at the midventral region and that the appearance of penes is due to slight protuberance ventrally of small portions of vestibular roof, the specimen is referred to *gammiei*.

F Sureil specimen.

The vestibula are small depressions (much smaller than the penial depressions on the mature but apparently bivestibulate specimens from Amingaon) only slightly larger than the penes, the apertures on or just lateral to *b*. There is no trace of a midventral depression between the vestibular apertures or of vertical, anterolateral areas. In *aa*, on each side but not reaching to the midventral line and just behind the transverse setal line of xvii is a slightly raised, sharply demarcated, transversely placed area of nearly elliptical outline. These areas look somewhat like genital markings but the epidermis thereon is not especially modified. The penes are of the short, annular type. The roof of the vestibular invagination is depressed dorsally and deeply just anterior and just posterior to the penis, the two depressions separated from each other by a thin lamella which passes from the penis to the median and lateral walls of the vestibulum. As a result of the depth of the dorsal depressions and the thinness of the lamella between them the penes at first appear to be longer than in *gammiei*, but only that portion of the penis ventral to the free margin of the lamella is equivalent to the penial annulus of *gammiei*.

The genital markings are on 19/20 and 20/21 and are paired areas of greyish translucence, each with a fairly wide marginal, whitish rim, the rims of a pair united midventrally.

Internal anatomy.—The supra-intestinal glands are in xcix-ciii.

Each spermatheca has two diverticula, each diverticulum with a single opening into the duct. The vertical ridge on the posterior wall of the duct is high, without a vertical groove.

Four penial setae from one bundle were examined. The tips are simple, rather bluntly rounded with no terminal spine or concavity near the tip. The ornamentation is of low, rather rough, transverse ridges, each ridge with an appearance of a row of spines that has been somewhat worn down.

Remarks.—The specimen is in good condition, fully clitellate, the spermathecal ampullae distended and the seminal chambers of the diverticula filled with a whitish material in which no spermatozoal iridescence is recognizable.

If this worm really is to be referred to *gammiei*, as seems necessary at present, the vestibulum is certainly in an undeveloped, almost rudimentary condition.

G. The Nam Ting Pokri specimen.

External characteristics.—Vestibula and penial invaginations are entirely lacking. On xvii on each side there is a tiny, transversely placed area of shortly elliptical outline. The area has a convex surface, is sharply demarcated by a circumferential furrow and probably bears

at its centre a penisetal pit but the surface near the centre has been eroded. No penial setae are visible externally.

The genital markings are scarcely recognizable, on 19/20, 20/21, and 21/22, paired, at least on 20/21-21/22, the margins in contact or almost so at the midventral line.

Internal anatomy.—The supra-intestinal glands are in ciii-cvii (as near as can be determined). The spermathecal diverticula are paired, median and lateral, two diverticular openings into the duct. There is spermatozoal iridescence in the seminal chambers.

Remarks.—The gut had been removed from anterior portion of the body, also the penial setae, in a previous dissection. The body wall just behind the clitellum is wrinkled and softened, hence the doubtful characterization of the genital markings. If this worm is to be referred to *gammiei*, it must be regarded as abnormal, the vestibular invaginations and penes having failed to develop. Aside from these differences with regard to the male genital terminalia there is little to distinguish from *gammiei*. The worm has however been able to function sexually and in view of the importance of the male terminalia for specific determination in *Eutyphoeus* the status of this specimen must be regarded as doubtful.

Diagnosis.—Univestibulate and penile: vestibular aperture transversely placed, with straight posterior margin and lobed anterior margin; penes annular. Genital markings unpaired or if paired or of double origin in contact or united midventrally, on (9/10-12/13), 13/14, 19/20, 20/21, (21/22-23/24). Female pore on the left side. Spermathecal pores on *b* or in the median half of *bc*. First dorsal pore on 11/12. Pigmentation dense? Length—250 mm. Diameter—7 mm.

Ventral intestinal caeca in xxv-xcix. Supra-intestinal glands in xcvi-cxx (cxxx-cxxxiv). Dorsal blood vessel ends with hearts of vii. Metandric; testis sac ventral. Spermathecal diverticula paired, median and lateral. Longitudinal musculature uninterrupted above the genital markings.

Distribution.—Comillah (Chittagong district), Darjiling (?), Sureil (?), Nam Ting Pokri (?) (Darjiling district), Bengal; Tura, Siju Cave, Amingaon, Upper Rotung, Abor, Katlicherra (S. Cachar), Assam.

Notes.—The diagnosis above is based on all the specimens that have been considered. If the diagnosis were based only on the definitely univestibulate specimens two slight changes would be necessary, excluding of course reference to the vestibula.

These changes would be as follows: genital markings on (10/11), 13/14, 19/20, 20/21, (21/22); supra-intestinal glands in ci-cxiv: : cv-cxix.

Location of genital markings of all specimens is shown in tabular form below.

Furrow.	Number of specimens.
9/10	1
10/11	5
12/13	1
13/14	17
19/20	18
20/21	20
21/22	9
22/23	3
23/24	2

Location of the supra-intestinal glands in all specimens is shown in tabular form below.

Segments.	Number of specimens.
98-103	1
99-103	4
100-103	1
101-105	1
103-107	1
103-108	1
107-111	1
112-117	1
114-118	1
114-119	2
115-120	1
129-134	1

For greater convenience the segments have been indicated by Arabic instead of the usual Roman numerals.

Eutyphoeus gigas Stephenson.

1917. *Eutyphoeus gigas*, Stephenson, *Rec. Ind. Mus.* XIII, p. 408. (Type locality, Rangamati, Chittagong Hill Tracts, Bengal. Type in the Indian Museum.)
 1919. *Eutyphoeus gigas*, Stephenson and Prashad, *Trans. R. Soc. Edinburgh* LII, p. 465. (Calciferous glands.)
 1923. *Eutyphoeus gigas*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 436.
 1934. *Eutyphoeus gigas*, Gates, *Rec. Ind. Mus.* XXXVI, p. 272. (Re-examination of the type.)

Material examined.—From the Indian Museum: 1 clitellate dissected specimen labelled, "*Eutyphoeus gigas*, Stephenson. Type. Rangamati, Chittagong Hill Tracts, Bengal. R. Hodgart. W 73/1."

External characteristics.—The setae begin on ii; on xx, $ab < cd < bc < aa$.

The spermathecal pores are in the median portion of bc , the median margin about at b .

The female pore has not been definitely identified though its probable site on the left side is visible.

The penis is annular but large and thick. From the annulus an anterior as well as a posterior flap is protuberant, the posterior flap the longer. On the anterior face of the posterior flap is a minute pore which may possibly be a male pore. (In one Burmese specimen the bulbus ejaculatorius has been traced through the parietes practically to this pore.) The penis is located at the centre of a circular area but as a result of contraction the penes at first appear to be on a lateral portion. The area has a rough appearance due to the presence of numerous small, greyish tumescences and is slightly depressed. Close to the anterior and posterior margins of each area are rather indefinite markings suggestive of the crescentic areas of *E. longiseta* Gates 1930, the posterior crescent probably on the anterior portion of xviii.

The genital markings are paired. The markings on 19/20 are small, indistinctly demarcated, transversely placed areas of greyish translucence, the areas with pointed ends, centres lateral to b , reaching mesially towards or perhaps slightly median to a . The anterior clitellar markings are depressed, in ac , postsetal (?) on xv or possibly on 15/16. The

posterior clitellar markings are small, probably postsetal on xvi, the centres about at *b*, reaching mesially to or nearly to *a*.

Internal anatomy.—The lateral intestinal caeca are about 5 mm. long. The supra-intestinal glands are in lxxxviii-xciii.

The dorsal blood vessel ends anteriorly with the hearts of vii.

The testis sac is unpaired and ventral. The prostatic duct is about 15 mm long, and passes ectally into a raised mass of tissue (parietal thickening) with a longitudinally elliptical outline. The bulbus is small.

Three reserve penial setae were removed from the remaining peni-setal follicle. Each of these setae has at the ectal tip a terminal spine.

The spermathecal duct apparently is not narrowed entally and the opening into the ampulla is large. The duct is stout, not short for *Eutyphoeus*, nearly circular in cross-section, with numerous fine, vertical ridges on the wall. The lumen of the long diverticular stalk is large and also with longitudinally ridged wall. At the ental end of each diverticular stalk is a more or less cauliflower-like mass of seminal chambers, the diverticula median and lateral.

The genital marking glands (?) of xv and xvi interrupt the longitudinal musculature and protrude into the coelomic cavities.

Remarks.—Only one specimen is known from India. A number of Burmese specimens have been examined (*E. longiseta*). The post-clitellar markings of the Burmese specimens have all been unpaired.

Diagnosis.—Avestibulate and penile: penes annular but stout and with one anterior and one posterior retractile flap-like lobe, the male pore (?) on the anterior face of the posterior flap, the penis at the centre of an area of parietal thickening with circular to longitudinally elliptical outline. Genital markings: paired, in *bc* (or *cd*), postsetal on vii-viii, presetal on viii, postsetal on xiv-xvi; unpaired and median, in *aa*, presetal on vii-ix, postsetal on viii-x, postsetal on xiv-xvi, intersegmental on 11/12-12/13, 18/19-21/22. Female pore on the left side. Spermathecal pores in the median half of *bc*. First dorsal pore on 11/12. Pigmentation dense. Length 175-290 mm. Diameter 7-11 mm.

Lateral intestinal caeca in xxviii; ventral caeca in xxxii-xlvii. Supra-intestinal glands in lxxxviii-xc::xciii-xcv. Dorsal blood vessel terminates with the hearts of vii. Metandric; testis sac ventral. Spermathecal diverticula paired, median and lateral. Clitellar genital marking glands interrupting the longitudinal musculature and protuberant into the coelomic cavity.

Distribution.—Rangamati, Chittagong Hill Tracts (Bengal) to Akyab and Sandoway in the Arakan division of Burma.

***Eutyphoeus incommodus* (Beddard).**

1901. *Typhoeus incommodus*, Beddard, *Proc. Zool. Soc. London*, 1901, pp. 200 and 206. (Type locality Calcutta. Types probably no longer in existence.)

1903. *Eutyphaeus incommodus*, Michaelsen, *Geogr. Verbr.* p. 109.

1909. *Eutyphoeus incommodus*, Michaelsen, *Mem. Ind. Mus.* I, pp. 111, 218 and 222.

1910. *Eutyphoeus incommodus*, Michaelsen, *Abh. Nat. Ver. Hamburg*, XIX, (5), pp. 12 and 90.

1914. *Eutyphoeus incommodus* + *E. mohammedi*, Stephenson, *Rec. Ind. Mus.* X, pp. 349 and 350. (Type locality of *mohammedi* Allahabad. Types in the Indian Museum.)
1916. *Eutyphoeus incommodus* + *E. annandalei* var. *fulgidus*, Stephenson, *Rec. Ind. Mus.* XII, p. 342. (Type locality of *fulgidus*, Anwarganj, Cawnpore district. Types in the Indian and British Museums.)
1917. *Eutyphoeus incommodus*, Stephenson, *Rec. Ind. Mus.* XIII, p. 408.
1920. *Eutyphoeus incommodus* + *E. mohammedi*, Stephenson, *Mem. Ind. Mus.* VII, pp. 240 and 241.
1923. *Eutyphoeus incommodus* + *E. mohammedi*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, pp. 438 and 443.
1924. *Eutyphoeus incommodus*, Stephenson, *Rec. Ind. Mus.* XXXVI, p. 348.

Material examined.—From the Indian Museum : 1 clitellate, dissected specimen labelled, "*Eutyphoeus incommodus* (Bedd.). Rajmehal, Bengal. 31. vii. 07. R. H. Hodgart (Mus. Coll.) ZEV 4153/7." 1 dissected and 1 undissected, clitellate specimens labelled, "*Eutyphoeus incommodus* (Bedd.). Pusa. 10. ix. 1912. B. Das. W 19/1." ; 8 juveniles in poor condition labelled, "*Eutyphoeus incommodus* (Bedd.) Basi Muda, Hoshiarpur district. July 1913. Ibrahim. W 413/1." ; 16 specimens in very poor condition of which at least 9 are clitellate, labelled, "*Eutyphoeus incommodus* (Bedd.) Ambala. Aug. 1913. Ibrahim. W 20/1." ; 1 dissected and 5 undissected, a clitellate specimens labelled, "*Eutyphoeus mohammedi* Stephenson. Type. Allahabad, U. P. Lt. Col. J. Stephenson, I.M.S. W 24/1." ; 2 dissected and 2 undissected, clitellate specimens labelled, "*Eutyphoeus incommodus* (Bedd.) R. Pindi. Dec. 1915. Raghunath Sahai. W 51/1." ; 2 dissected and 6 undissected, clitellate specimens labelled, "*Eutyphoeus annandalei* var. *fulgidus*, n. v. Anwarganj, Cawnpore dist. United Provinces. J. W. Caunter. 1—13. x. 11. ZEV 6571/7." ; 1 a clitellate, undissected, macerated specimen labelled, "Prob. *Eutyphoeus incommodus* not quite mature, Rurki. 1916. Ibrahim. W 394/1." ; 1 a clitellate (?), dissected, macerated specimen labelled, "*Eutyphoeus incommodus* (Bedd.). Bharatpur. 15. vii. 17. B. Prashad. W 228/1." ; 1 a clitellate, dissected, broken specimen labelled, "*Eutyphoeus mohammedi* Stphsn. Rawalpindi. June and July 1917. R. Hodgart. W 231/1." ; 1 clitellate, dissected specimen labelled, "*Eutyphoeus incommodus* (Bedd.) Calcutta. Museum Collector. ZEV 2838/7." ; 6 clitellate, undissected specimens labelled, "*Eutyphoeus incommodus* (Bedd.) Allahabad, U. P. F. B. Khan, M. J. Mukerjee. W 413/1." ; and one clitellate specimen lacking the tail and internal organs of the anterior end, from a tube labelled, "*Eutyphoeus masoni* (A. G. Bourne). Ballygunj, Calcutta. R. H. Hodgart. W 3156/1." The Allahabad specimens are unusually large (413/1), 200 × 7 mm, but were obviously killed in a completely relaxed condition.

Not examined.—In the British Museum : 1 specimen of *annandalei* var. *fulgidus* from Anwarganj ; 34 specimens of *incommodus* from India, and 5 specimens from Hoshiarpur district ; 1 specimen of *mohammedi* from Allahabad. Specimens of *fulgidus* and *mohammedi* are types. In the Hamburg Museum : specimens of *incommodus*.

External characteristics.—The setae begin on ii and on this segment are readily visible (20). On xx the setal ratios are usually (18) as follows ; $ab < cd < bc < aa$. On other specimens the ratios between *cd*, *bc* and *aa* may be different, possibly as a result of some unusual contraction.

The first dorsal pore is on 11/12 (11), on 11/12 but with a pore ke though apparently non-functional marking on 10/11 (6).

The clitellum is usually annular but may be rather thin or possibly lacking midventrally (Allahabad specimens, 413/1) and extends from 12/13 to 17/18 (4), from a pre-setal portion of xiii to 17/18 (4), or from

a presetal portion of xiii onto xviii (7), or from 12/13 onto xviii (3). The reddish colouration is usually lacking on a midventral region of xvii.

The spermathecal pores are transversely slit-like, the centres just lateral to *b* or nearer to mid *bc* (25).

There is a pair of female pores (19).

The male porophores are circular to shortly elliptical in outline, in the latter case usually transversely placed, occasionally diagonally placed. The porophores are sharply demarcated, slightly elevated and rather disc-like. The surface may be level, a central portion may be more or less protuberant, or the whole porophore may have a somewhat conical appearance but with a bluntly rounded tip. At the centre of each porophore is a slight, transversely placed fissure. Within the fissure there may be visible one or two penial setae or peni-setal pits, and just lateral to the setae or pits a minute pore, possibly the male pore. The centre of the porophore is on or close to *b*, the median margin at or close to *a*.

The genital markings are always postsetal, small, circular to shortly elliptical (transversely or longitudinally placed). Each marking has a whitish, band-like margin and greyish, translucent central area, the two portions sharply marked off from each other. The markings are always in *ab*, but the centres of the markings occasionally are nearer to line *a* than *b*. The markings are on xiii-xvi (26), xiii-xv and left side of xvi (1), xiii-xv (8), the positions of markings on some of the macerated specimens not recorded.

Internal anatomy.—The intestine begins in xv (7). No lateral intestinal caeca have been found. The median caeca are in xxvii-xxxiv (1). The supra-intestinal glands are located as follows: lxiii-lxvii (1), lxv-lxviii (1), lxvi-lxx (1), lxvi-lxxi (1), lxvii-lxx (1), lxvii-lxxii (1), lxviii-lxxi (3), lxviii-lxxii (4), lxix-lxxii (2), lxix-lxxiii (5), lxx-lxxiv (5), lxxi-lxxv (1), lxxii-lxxv (2). The typhlosole begins gradually in xxv or xxvi (2).

The dorsal blood vessel extends into iii with hearts or heart-like commissures at least in vi and v (13), occasionally heart-like commissures recognizable in iv. The last pair of hearts is in xiii (9).

Segment xi is opened by dissection, septum 11/12 apparently normal though the attachment to the parietes laterally and dorsally is usually not recognizable, perhaps as a result of the condition of the specimens (peripheral apposition of 10/11 and 11/12 ?). The vasa deferentia of a side may not unite until in xvi. There is a fairly large, coelomic bulbus ejaculatorius, covered over by delicate tissue. The prostatic duct is 2-6 mm. long, slender.

The spermathecal duct is short, circular in cross section, lumen transversely slit-like with several vertical ridges. The ampulla is firmly bound down to the entalmost portion of the duct. The diverticula form a circle or frill around the duct. The diverticula may be bound together and to the duct so that only a circle of 12-15 seminal chambers is visible, or shortly stalked diverticula may be protuberant from the duct, each diverticulum with 1-4 seminal chambers. One spermatheca has 2 lateral and 2 median stalked diverticula. The number of openings into the duct appears to be variable, 4 (spermatheca with four

diverticula and another with complete circle of seminal chambers), 5 (2), 6 (2). As a result of the presence within the duct of a very sticky material and the condition of the specimens, determination of the number of openings is difficult and the number obtained from examination of other spermathecae (4-5 openings) may not be exact.

The longitudinal musculature is uninterrupted (7) above the genital markings which are areas of epidermal modification only (1).

The functional penial setae may reach a length of 1.4 mm. The tips are rounded or taper to a blunt point. One seta apparently tapers to a spine-like termination but the extreme tip of the spine is lacking. The ornamentation is sparse, of rather widely separated rows of very short spines. The rows may be short, longer or completely (?) circular, the short and long rows present on a single seta.

Remarks.—Rudiments of genital markings on xiii-xv of the Rurki specimen of *incommodus* are rather indefinite. In this worm the supra-intestinal glands are in lxvi-lxxi. One of the Rawalpindi specimens is abnormal, with the right male porophore on xvi. On xvii, on the right side setae, *a* and *b* are present and in the normal position. On the right side of xvii is a postsetal genital marking. A wedge-shaped half segment is intercalated between xviii and xix on the left side.

It is highly improbable that the Ballygunj specimen (from W 3156/1) after dissection could be mistaken for *masoni*. Presumably the worm got into the *masoni* tube by accident.

On four of the types of *mohammedi* genital markings are present and readily visible after removal of the cuticle, on xiii-xv (2), on xiii-xvi (2). With brilliant illumination the marginal bands and central areas can be recognized easily. The supra-intestinal glands are in lxvi-lxx, lxviii-lxxii, lxix-lxxi (included in the list above). Genital markings have not been found on the Rawalpindi specimen of *mohammedi*.

In the types of *fulgidus* the supra-intestinal glands are in lxviii-lxxi (1), lxix-lxxiii (1), lxx-lxxiv (3), lxxi-lxxv (1), lxxii-lxxv (2). One of the specimens is juvenile, only 30 mm. long, specific characteristics unrecognizable but supra-intestinal glands in lxxii-lxxv.

Diagnosis.—Avestibulate and apenile: male pores within slight, transversely placed fissures, the centres on or close to *b*, each fissure at the centre of a disc-shaped porophore that may be protuberant in a rather conical fashion. Genital markings paired, postsetal, in *ab*, on xiii-xvi. Female pores paired. Spermathecal pores in the median half of *bc*. First dorsal pore on 11/12. Pigmentation dense? Length 75-112 mm. Diameter $4-4\frac{3}{4}$ mm.

Ventral intestinal caeca in xxvii-xxxiv. Supra-intestinal glands in lxiii-lxxii: lxvii-lxxv. Dorsal blood vessel continued into iii, with hearts in v and vi. Holandric; testis sac annular and formed by the peripheral apposition of 10/11 and 11/12 close to the parietes (?). Seminal chambers forming a circle around the spermathecal duct or aggregated into stalked diverticula, 4-6 openings into the duct lumen. Genital marking areas of epidermal modification only.

Distribution.—Rawalpindi, Basi Muda (Hoshiarpur district), Ambala, Kasauli, Punjab; Agra, Allahabad, Anwargunj (Cawnpore district), United Provinces; Bharatpur, E. Rajputana; Pusa, Bihar; Calcutta, Rajmehal, Bengal.

Eutyphoeus kempi Stephenson.

1914. *Eutyphoeus kemp*i, Stephenson, *Rec. Ind. Mus.*, VIII, p. 401. (Type locality, Kobo, Abor country, Assam. Type in the Indian Museum.)
 1920. *Eutyphoeus kemp*i, Stephenson, *Mem. Ind. Mus.*, VII, p. 242.
 1923. *Eutyphoeus gammiei* (part), Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 434. (Excluding all except *E. kemp*i.)

Material examined.—From the Indian Museum; 1 clitellate, dissected specimen labelled, "*Eutyphoeus kemp*i Stephenson. Type. Kobo, alt. 400 ft. (Abor Expedition) Dr. S. W. Kemp. ZEV 5150/7."

External characteristics.—Length, 230 mm. The setae are first visible on v, in part lacking on v-vii; on xxx, $ab < cd < bc < aa$.

Bivestibulate, each vestibulum deep, well-like, circular in horizontal section, the aperture nearly circular and open. There is no trace of a midventral depression between the vestibular apertures which extend from *a* to slightly lateral to *b*.

The penes are of the *waltoni* type, the basal portion of the penis retracted into a depression on the vestibular roof. On segments xviii-xxiv there is a thick, high, longitudinal ridge on each side, in *bc*, with setae *a* and *b* on the median face of each ridge.

Genital markings if present are represented only by indistinct areas of very slight greyish translucence: on 21/22 on the left side, extending from *b* nearly to the midventral line; on 22/23, extending laterally to *b* on each side but with no indication (?) of a double origin midventrally.

Internal anatomy.—The supra-intestinal glands are in cxiii-cxviii (rudimentary in cxiii).

The prostatic duct is 20 mm. long. The bulbus ejaculatorius is fairly large but covered.

The spermathecal duct is rather short, stout, circular in cross section, the lumen eccentric, crescentic in section, anterior, on the posterior wall a high vertical ridge.

There is no vertical groove on the ridge except ventrally just as the duct passes into the parietes. There are five or six diverticular apertures on the wall of the duct on each side of the vertical ridge. The seminal chambers form a ridge extending around the median, posterior and lateral portion of the duct.

The longitudinal musculature is uninterrupted over the regions of the supposed genital markings.

Penial setae apparently all removed in the previous dissection.

Remarks.—This worm is distinguished from *gammiei* by the elongate penes, the number of diverticular apertures into the spermathecal duct, and possibly also by the paired vestibula. The number of diverticular apertures in the spermathecal duct further distinguishes this worm from all metandric species with a fore-shortened dorsal blood vessel.

Diagnosis.—Bivestibulate and penile: penes elongate, each penis within a deep, well-like vestibulum, the lumen circular in section, the aperture circular and in the region of *ab*. Genital markings (?) unpaired and intersegmental, on 21/22-22/23. Female pore on the left side. Spermathecal pores in the median portion of *bc*. First dorsal pore on 11/12. Pigmentation? Length 230 mm. Diameter, 6 mm.

Ventral intestinal caeca? Supra-intestinal glands in cxiii-cxviii. Dorsal blood vessel terminates with the hearts of vii. Metandric;

testis sac ventral. Seminal chambers forming a continuous semicircular ridge around the spermathecal duct posteriorly but opening into the duct through 2 groups of 5-6 apertures. Longitudinal musculature uninterrupted above the genital markings.

Distribution.—Known only from the type locality, Kobo, Abor country, Assam.

Eutyphoeus lippus Gates.

1934. *Eutyphoeus lippus*, Gates, *Rec. Ind. Mus.*, XXXVI, p. 273. (Type locality Ramechap district, East 2, Nepal. Types, in part, in the Indian Museum.)

Material examined.—From author's collection: 1 acitellate, 4 partially clitellate and 1 clitellate specimens from the type series and 8 clitellate specimens labelled, "District, East 2, Nepal, northeast of Katmandu, ca. 45 miles, 4,000-8,000 ft. Sept.-October, 1935. Prof. K. N. Sharma".

External characteristics.—The clitellar colouration, a dark reddish, is present only on one specimen (types) on which the clitellar dorsal pores are partially occluded. On four other specimens the clitellar region has a slightly glandular appearance, colouration no different from that of other segments, functional dorsal pores present on the clitellar region. There is transparent material within the spermathecal apertures similar to that within the spermathecal ducts of the clitellate specimens. These partially clitellate specimens appear to be in a post-sexual stage.

The centres of the spermathecal apertures are about on *b*, but the apertures are relatively very large and may reach to *a* and nearly to *c*.

The male pores (types) are in slight, transversely placed fissures, the latter extending from *a* or slightly median to *a* into *bc*. The margins of the fissures are slightly tumescent. On the anterior wall of each fissure is a transversely placed tumescence which bears the penial setae (the penial setae almost as widely separated as *a* and *b* of other segments). On the roof of the fissures are the male pores, on or close to line *b*. On some specimens there appear to be two pores in each fissure, on others only one and that even more minute than usual can be recognized. On the clitellar specimen the male pore fissures and genital markings of xvii are all on a transversely placed, smooth, whitish area of dumb-bell-shaped outline.

On the 1935 specimens, on xvii, each side of each worm, there is a longitudinally placed, conspicuous protuberance. On the anterior and posterior declivities of each of these protuberances is a transversely placed tubercle, of elliptical outline. The posterior tubercle or genital marking certainly has the appearance of being presetal on xviii but 17/18 is not visible ventrally. At the summit of each protuberance is the peni-setal tubercle or tumescence, the tips of the penial setae just barely visible. Just behind the tumescence is a very shallow, transverse slit. On the roof of this slit and in line with or just lateral to the lateral penial seta is a minute crescentic aperture. Just median to this opening there is visible a minute, greyish translucent marking which may indicate the site of a second pore though no definite opening has been identified. The transversely slit-like fissure of the types obviously is partially everted on these specimens and along with the eversion there is a protrusion of the body wall immediately in front and behind. As

on the types, the genital markings are paired, postsetal, on x, in *ab*, but reaching on most of the specimens to or nearly to the midventral line.

Internal anatomy.—The supra-intestinal glands are in lxvi-lxix, rudimentary in lxvi (1), lxvi-lxx (1), lxvii-lxx (2), lxviii-lxx (1).

The testis sac is probably annular. The ventral blood vessel is within the testis sac and suspended therein by a longitudinal mesentry. There appears to be a small opening between the two halves of the sac underneath the ventral trunk but the testicular coagulum is in a horse-shoe-shaped mass.

The spermathecal duct is only slightly narrowed within the parietes and after removal of the ampulla has the appearance of a transversely placed, ellipsoidal body sessile on the parietes. The wall is rather thin, the lumen large, transversely elliptical in cross section entally, transversely slit-like within the parietes. The duct is abruptly marked off from the ampulla but there is no definite neck region. The lumen is filled with a hard, transparent to translucent material. The diverticula are rather digitiform and characterized by a spermatozoal iridescence (also partially clitellate types).

The genital marking glands interrupt the longitudinal musculature and protrude into the coelomic cavity (no capsule).

Diagnosis.—Avestibulate and apenile: male pores on or near *b* in the lateral portions of slight, transversely placed fissures, the latter extending from *a* into *bc*. Genital markings paired, about in *ab*, postsetal on x and xvii (? presetal on xviii ?), presetal on xvii. Female pores paired. Spermathecal pores with centres on or lateral to *b*. First dorsal pore on 7/8-10/11. Unpigmented. Length to 120 mm. Diameter 4-6 mm.

Lateral intestinal caeca in xxiv; ventral caeca in xxx-xxxvii. Supra-intestinal glands in lxvi-lxviii: : lxix-lxx. Dorsal blood vessel continued into iii with hearts in v and vi. Metandric; testis sac annular or horseshoe-shaped. Spermathecal diverticula digitiform, paired, median and lateral. Genital marking glands interrupting the longitudinal musculature and protuberant into the coelomic cavity.

Distribution.—Known only from the type locality, Ramechap district, Nepal.

***Eutyphoeus manipurensis* Stephenson.**

1921. *Eutyphoeus manipurensis*, Stephenson, *Rec. Ind. Mus.*, XXII, p. 763. (Type locality, Thanga Island, Loktak Lake, Manipur. Types in the Indian Museum.)

1923. *Eutyphoeus manipurensis*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 441.

1934. *Eutyphoeus manipurensis*, Gates, *Rec. Ind. Mus.*, XXXVI, p. 276. (Examination of the types.)

Material examined.—From the Indian Museum: 1 undissected and 2 dissected specimens labelled, "*Eutyphoeus manipurensis* Steph. Type. Swamps around Thanga Island in Loktak lake, Manipur. Manipur Survey. W 555/1."

External characteristics.—The setae begin on ii (3) and on this segment are readily visible. The setal ratios (noted on xxvii) are variable, $ab < cd < bc < aa$ or *aa* and *bc* may be about equal or *aa* may be smaller than *bc*.

The clitellum is not protuberant, the clitellar glandularity not obvious, though the clitellar thickening of the epidermis is recognizable at the dorsal incision, intersegmental furrows at least in part present. As the spermathecal diverticula are iridescent the clitellum would appear to be in a post-sexual stage of regression.

The spermathecal pores are in *ab* (3).

There are paired female pores (2).

On the almost circular male pore area (of parietal thickening ?) there is a posterior, conspicuous, almost spheroidal, tag-like tumescence and an anterior smaller tumescence both *ca* in *ab*, the male pore area depressed slightly in a concave fashion so that the ventral end of the posterior tag is at the general epidermal level. The male pores have not been seen but possibly are on the region between the two tags.

On one worm the genital markings are restricted to xvi and xvii. On xvi, a presetal pair in *aa*, a presetal marking in *ab* on each side (or slightly more lateral), one postsetal median in *aa*, and one postsetal in *ab* on each side; on xvii, a presetal pair in *aa* (?). On another worm there is a presetal marking on viii just behind the right spermathecal pore, a median marking on the middle annulus of viii, and markings on xvi and possibly xvii (on xvi, a median presetal in *aa*, a postsetal transverse row of four; on xvii, a presetal pair in *aa* ?). On the third worm there is a median unpaired marking each on viii and ix (?), a pair of markings on viii, on each side, just lateral to *a* and on the middle annulus, further markings on xvi and xvii (on xvi, one presetal median in *aa*, a postsetal transverse row of four; on xvii, a presetal pair in *aa* ?).

Internal anatomy.—Septum 11/12 is delicate but complete or nearly so, attached dorsally to the posterior face of 10/11.

In the hitherto undissected specimen the intestinal caeca are in xxvii, ventrally directed, digitiform. The supra-intestinal glands are in lxxiii-lxxvi, lxxiv-lxxvi, and lxxv-lxxviii (rudimentary glands in lxxiv). On one worm with 162 segments that is 120 mm. long the first gland segment is at 60 mm. On the other specimens the first gland segment is at mm. 60 (length 110 mm.), or mm. 65 (length 118 mm.).

The prostatic duct is about 6 mm. long. The bulbus ejaculatorius is rather small, adherent to the parietes and covered over by tissue.

The spermathecal duct is nearly circular in cross section, the wall fairly thick, on the wall anteriorly as well as posteriorly a rather thick vertical ridge. The diverticulum opens into the duct laterally. Iridescent material is present within the diverticulum though not recognizable until after the diverticulum has been opened because of the thickness of the diverticular wall.

Genital marking glands sessile but interrupting the longitudinal musculature and protuberant into the coelomic cavity, each gland with a thin, transparent but tough capsular wall and a soft, whitish content.

Remarks.—The cuticle is still adherent to the types and cannot be removed at present without damaging the epidermis, hence the uncertainty with regard to the number and location of the genital markings.

Diagnosis.—Avestibulate and apenile: each male pore on or close to *b*, between (?) two tag-like tumescences, the posterior tag much larger, tags about in *ab* and on a circular area of parietal thickening (?). Genital markings small; unpaired and median on viii and ix, presetal on viii

and just behind the spermathecal pore, presetal and postsetal on xvi in *aa* and *ab*, and presetal on xvii in *aa*. Spermathecal pores with centres in *ab*. Female pores paired. First dorsal pore on 10/11. Unpigmented (?). Length 120 mm. Diameter 5 mm.

Lateral intestinal caeca in xxvii; ventral caeca? Supra-intestinal glands in lxxiii-lxxiv : lxxvi-lxxviii. Dorsal blood vessel continued into iii with hearts in v and vi. Holandric; testis sac annular, formed by the peripheral apposition, at least dorsally, of 10/11 and 11/12. Spermathecal diverticula unpaired, lateral. Genital marking glands sessile, interrupting the longitudinal musculature, each gland with a thin, transparent capsule.

Distribution.—Loktak Lake, Manipur. Burmese specimens from Tiddim and Falam in the Chin Hills district are distinguished by several characteristics that may be of sufficient importance to warrant specific separation. (The diagnosis is based on Indian specimens only.)

***Eutyphoeus nainianus* Michaelsen.**

1907. *Eutyphoeus nainianus*, Michaelsen, *Mitt. Mus. Hamburg*, XXIV, p. 177.
(Type locality, Naini Tal, Kumaon district, Western Himalayas.
Type in the Indian Museum.)
1909. *Eutyphoeus nainianus*, Michaelsen, *Mem. Ind. Mus.*, I, pp. 111, 218 and 225.
1910. *Eutyphoeus nainianus*, Michaelsen, *Abh. Nat. Ver.*, XIX, (5), p. 13.
1923. *Eutyphoeus nainianus*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 444.

Material examined.—From the Indian Museum : 1 clitellate dissected specimen labelled, "*Eutyphoeus nainianus* Michlsn. Typc. Naini Tal, Kumaon. Dr. N. Annandale. ZEV 2842/7."

External characteristics.—The setae begin on ii and on this segment are readily visible. On xxiii, $ab < cd$, cd nearly $= bc < aa$, but posteriorly $ab < bc < cd < aa$.

The clitellum is reddish brown and protuberant, extending from 12/13 to 17/18, the clitellar colouration lacking ventrally on xvii behind the genital markings and between the male porophores.

The spermathecal pores are transversely slit-like, in mid *bc*, the centres of the pores slightly nearer to *c* than to *b*.

There is a pair of female pores.

The male porophores are shortly elliptical in outline, transversely placed, clearly demarcated, slightly elevated, the centre of the porophore on or just lateral to *b*, the median margin of the porophore lateral to *a*. At the centre of each porophore is a slight fissure with a very slightly tumescent margin.

The genital markings are in *aa* and are closer to the setae of xvi than to the transverse setal line of xvii and hence are regarded as post-setal (?) on xvi. Each marking has a greyish, translucent central area surrounded by a fairly wide, whitish rim, the rim definitely marked off peripherally as well as from the central area, the rims of the two markings united midventrally.

Internal anatomy.—There is a pair of relatively large, dorsally directed, digitiform, lateral intestinal caeca, possibly belonging to xxiii or xxiv. (The gut had been removed in previous dissection from the anterior portion of the body. On this gut fragment constrictions, presumably segmental, are recognizable, and also at the anterior end

a segmental portion that is narrow, thick-walled and similar to that portion of the gut usually present in xiv. Just behind this narrow portion the gut is abruptly widened as is usual in xv, at the beginning of the intestine. Assuming that the narrow portion is that part of the gut belonging to xiv and counting the segmental portions between the supposedly intersegmental constrictions gives the approximate location of the caeca.) There are four ventral caeca beginning just behind the (lateral) caecal segment. The typhlosole begins in the segment next behind the (lateral) caecal segment. The supra-intestinal glands are in lxvi-lxix.

The dorsal blood vessel passes into the pharyngeal region (?), with hearts at least in vi and probably also in v.

The bulbus ejaculatorius is large, on the parietes but covered over by soft tissue. The prostatic duct is about 5 mm. long.

Only one spermatheca is present. The duct is circular in cross section, with a rather thick wall. In the ental portion of the duct the lumen is widened laterally and mesially and longitudinally H-shaped in section. Into the longitudinally directed lateral and median limbs of the lumen there open individually the pores of the iridescent seminal chambers, two laterally and four mesially.

Small patches of whitish material slightly protuberant into the coelomic cavity from between separated strands of the longitudinal musculature may represent genital marking glands.

Peni-setal follicles were not found (within the parietes ?).

Remarks.—As the type is ruptured in a region just in front of the supra-intestinal glands, the location of the glands is possibly not exact. The damage to the vascular system by the removal of the gut is responsible for the doubt as to the anterior extent of the dorsal blood vessel and the presence of the anterior hearts.

Diagnosis.—Avestibulate and apenile : male pores in slight fissures on transversely placed areas of elliptical outline with centres on or just lateral to *b*. Genital markings paired, on xvi (?), postsetal, in *aa*, rims united midventrally. Paired female pores. Spermathecal pores in *bc*, centres slightly nearer to *c* (?). First dorsal pore ? Pigmentation ? Length 60 mm. Diameter $4\frac{1}{2}$ mm.

Lateral intestinal caeca in xxiii or xxiv (?); ventral caeca in xxv-xxix (?). Supra-intestinal glands in lxvi-lxix (?). Dorsal blood vessel continued into iii (?), with hearts in v (?) and vi. Metandric; testis sac annular (?). Seminal chambers in an interrupted circle around the duct, opening into the duct individually. Genital marking glands interrupting the longitudinal musculature and slightly coelomic (?).

Distribution.—Known only from the type locality, Naini Tal (Kumaon district), United Provinces.

***Eutyphoeus nepalensis* Michaelsen.**

1907. *Eutyphoeus nepalensis*, Michaelsen, *Mitt. Mus. Hamburg*, XXIV, p. 176.
(Type locality, Chitlong, Nepal. Types in the Indian and Hamburg Museums.)
1909. *Eutyphoeus nepalensis* Michaelsen, *Mem. Ind. Mus.*, I, pp. 111, 218 and 223.
1910. *Eutyphoeus nepalensis* Michaelsen, *Abh. Nat. Ver. Hamburg*, XIX, (5), p. 13.

1923. *Eutyphoeus nepalensis*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 445.

1934. *Eutyphoeus nepalensis*, Gates, *Rec. Ind. Mus.*, XXXVI, p. 276. (Re-examination of the types.)

Material examined.—From the Indian Museum: 1 dissected and two undissected, clitellate specimens labelled, "*Eutyphoeus nepalensis* Michlsn. Type. Chitlong, Nepal. Mus. Coll. (R. Hodgart). ZEV 2880/7."

Not examined.—In the Hamburg Museum (4 ?) specimens from the type series.

External characteristics.—The setae begin on ii and on this segment are readily visible (3). On xxvi, $ab < cd < or = or > bc < aa$. The ratio between bc and cd also is variable from one region to another on the same worm.

The first dorsal pore is on 10/11 (3).

The clitellum extends from just in front of the setae of xiii to 17/18; annular, protuberant, brownish red, the reddish colouration lacking midventrally on xvii and on the genital markings.

The spermathecal pores are transversely slit-like, large, the centres about on c (3).

There is a pair of female pores (3).

The male porophores are shortly elliptical in outline, transversely placed, extending from mid ab or from b to mid bc , sharply demarcated, elevated, surface convex and (if undamaged) smooth. At the centre of each porophore is a slight, transversely slit-like depression, the margin of the slit slightly tumescent. In the anterior wall of the slit are two penial setae. On the roof of the slit, in line with the more lateral of the penial setae or slightly lateral, is a minute aperture, possibly the male pore.

The clitellar genital markings are much closer to the setae in front than to those next behind and hence are to be considered postsetal even though the intersegmental furrows are lacking (on xv 3 specimens; on xiv 1 specimen). The markings are protuberant, sharply outlined but with no indication of demarcation into central area and marginal rim.

Internal anatomy.—The lateral caeca, in one of the hitherto unopened specimens are in xxiv and are small, dorsally directed, shortly conical. The supra-intestinal glands are in lxxvii-lxxx (3).

The spermathecal duct is short, stout, with thickiy muscular wall, longitudinally elliptical in cross section, the lumen transversely slit-like in section and central, with three or four equi-sized vertical ridges each on the anterior and posterior walls. On each spermatheca there is a lateral and a median row of seminal chambers. Of these chambers one may open directly into the duct, or two neighbouring chambers may unite and open into the duct by one aperture. On one spermatheca there are four seminal chambers on the median side and five on the lateral side but there are only three openings on the lateral wall of the duct and three on the median wall. On another spermatheca there are two shortly but definitely stalked diverticula on the median side and two on the lateral side, each diverticulum with two or more seminal chambers. Within the duct there are only two openings on each side. (Both spermathecae had been removed from the previously dissected specimen.)

The genital marking glands interrupt the longitudinal musculature and protrude slightly into the coelomic cavity as soft, whitish masses apparently without definite capsules.

Remarks.—The spermatheca described and figured by Michaelsen (*vide* Stephenson 1923, p. 446) is probably abnormal. Possibly the ampulla had been deeply constricted into one large, middle lobe and two smaller lobes that looked like diverticula. Nothing of the sort is visible in either of the two specimens examined by the author.

Diagnosis.—Avestibulate and apenile: each male pore on or just lateral to *b*, on the roof of a transverse fissure, the latter on paired, transversely placed porophores. Genital markings paired, in *ab*, but nearly reaching the midventral line, postsetal on xiv and xv, and on 18/19-21/22. Female pores paired. Spermathecal pores with centres on *c*. First dorsal pore on 10/11. Unpigmented? Length 110-140 mm. Diameter 6 mm.

Lateral intestinal caeca in xxiv; ventral caeca? Supra-intestinal glands in lxxvii-lxxx. Dorsal blood vessel continued into iii with hearts in v and vi. Metandric; testis sac annular. Seminal chambers in median and lateral rows on the spermathecal duct, at least 2 apertures into the duct lumen on each side. Genital marking glands sessile, interrupting the longitudinal musculature and protuberant into the coelomic cavity.

Distribution.—Known only from the type locality, Chitlong, Nepal.

***Eutyphoeus nicholsoni* (Beddard).**

- 1901. *Typhoeus nicholsoni*, Beddard, *Proc. Zool. Soc. London*, 1901, pp. 195 and 206. (Type locality, Calcutta. Types probably no longer in existence.)
- 1903. *Eutyphoeus nicholsoni*, Michaelsen, *Geogr. Verbr.*, p. 109.
- 1907. *Eutyphoeus khani*, Michaelsen, *Mitt. Mus. Hamburg*, XXIV, p. 182. (Type locality, Katwari Bazar in Basti district, U. P. Types in the Indian and Hamburg Museums (?).)
- 1909. *Eutyphoeus khani*+*E. nicholsoni*+*E. provincialis* (*lapsus*)+*E. waltoni* (part only, one specimen from Fyzabad), Michaelsen, *Mem. Ind. Mus.* I, pp. 111, 112, 218, 219, 229, 233.
- 1910. *Eutyphoeus nicholsoni*, Michaelsen, *Abh. Nat. Ver. Hamburg*, XIX, (5), pp. 13 and 92.
- 1914. *Eutyphoeus nicholsoni*, Stephenson, *Rec. Ind. Mus.* X, p. 354.
- 1916. *Eutyphoeus nicholsoni*, Stephenson, *Rec. Ind. Mus.* XII, p. 342.
- 1923. *Eutyphoeus nicholsoni*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 446.
- 1926. *Eutyphoeus nicholsoni*, Stephenson, *Rec. Ind. Mus.* XXVIII, p. 265.
- 1934. *Eutyphoeus khani*, Thapar, *Ann. Mag. Nat. Hist.* (10), XIII, p. 276. (Supra-intestinal glands).

Material examined.—From the Indian Museum: 1 clitellate, dissected specimen labelled, "*Eutyphoeus khani* Michlsn. Katwari Bazar, Basti dist. U. P. Dharam Khan. ZEV 2841/7."; 9 clitellate specimens labelled, "*Eutyphoeus nicholsoni* (Beddard). Buzru Kurme, Basti dist. U. P. Dunnu Khan. ZEV 4170/7."; 1 dissected and 1 undissected, aclitellate (?) specimens labelled, "*Eutyphoeus nicholsoni* (Bedd). Rajmahal, Bengal. 31/vii. 07. Mus. Coll. ZEV 4165/7."; 3 aclitellate and 10 clitellate (1 dissected) specimens labelled, "*Eutyphoeus nicholsoni* (Bedd). Saharanpur, U. P. 21. viii. 1912. B. Das. W 386/1."; 2 aclitellate (?), and 3 clitellate (2 dissected) specimens labelled, "*Eutyphoeus nicholsoni* (Bedd). Lucknow. Aug. 1913. Ibrahim. W 390/1."; 10 clitellate (1 dissected) specimens labelled, "*Eutyphoeus nicholsoni* (Beddard). Rajmahal, Bengal. Mus. Coll. (R. Hodgart) ZEV 4165/7. Buzru Kurme, Basti dist., U. P.

Dunnu Khan. ZEV 4170/7. Mowaie, Bara Banki, U. P. Md. Mohsin Khan. ZEV 7197/7 and 6523/7."; 3 acitellate and 6 clitellate specimens labelled, "*Eutyphoeus nicholsoni* (Beddard). Cawnpore, U. P. Prof. J. P. Mullan. W 3147/1,"; and 1 macerated, clitellate specimen from a tube labelled, "*Eutyphoeus waltoni* Michl. Fyzabad, United Provinces. Capt. F. Wall. ZEV 2848/7." From Prof. K. N. Bahl: 2 splendidly preserved specimens with no indication as to locality.

Not examined.—In the British Museum: 2 specimens from Mowaie and 1 specimen from Saharanpur. In the Hamburg Museum: 1 specimen of *khani* (type) and specimens of *nicholsoni*.

External characteristics.—The setae begin on ii (15) but on that segment are usually deeply retracted and apparently in part lacking. The setae of ii-iii appear to be smaller than those of succeeding segments but this appearance may be the result of the retraction. On xx, $ab < cd < bc < aa$ (15).

The first dorsal pore is on 11/12 (16), on 11/12 but with a pore-like though apparently non-functional marking on 10/11 (1), on 12/13 (1).

The clitellum is annular, usually dark reddish, extending from a presetal portion of xiii to 17/18 (3), a presetal portion of xiii onto a presetal portion of xvii (5), a postsetal portion of xiii onto a postsetal portion of xvii (5), from 13/14 to a postsetal portion of xvii (1).

The spermathecal pores are small, transversely slit-like, with centres on *a* (23), in *ab* (10), just median to *b* (2).

There is a single female pore on the left side (24), a female pore on the left side and in addition an apparently rudimentary pore on the right side (3).

The vestibular apertures are small, transversely slit-like, and about in *ab* though occasionally the slits appear to extend slightly median to *a* or slightly lateral to *b*. No definite lips are marked off, but the anterior and posterior margins of the apertures are often in contact. The penes are $1\frac{1}{4}$ - $1\frac{1}{2}$ mm. long, perhaps a trifle thicker than in *waltoni*. At the ventral end of each penis is a tiny, transversely placed, slit-like to crescentic aperture. One or two penial setae may protrude through the aperture. The anterior margin of the aperture is almost always especially protuberant. The penes are completely retracted (20) and invisible externally when the anterior and posterior margins of the vestibular apertures are in contact. On one specimen, one penis is slightly protuberant, the other completely retracted and concealed from view by the apposition of the anterior and posterior margins of the vestibular aperture. On 2 specimens the tips of the penes only are visible within the open vestibular apertures. On four specimens both the penes are almost completely protruded to the exterior, the vestibular apertures on these worms circular or nearly so. The vestibulum is deep, well-like and almost filled by the penis. In most of the dissected specimens the vestibula do not protrude, at least conspicuously, into the coelomic cavity, but in one worm which is strongly contracted, each vestibulum protrudes rather conspicuously into the coelomic cavity of xvii as a rather conical bulb but with a bluntly rounded end.

The genital markings are paired, on 15/16. On one specimen there is an extra genital marking on 14/15 on the right side only, of the same size and appearance as the right marking 15/16. Another worm has

an extra genital marking on 16/17 on the left side. One specimen (fully clitellate) has no genital markings. The markings are sharply demarcated, each marking with a rather wide, whitish, band-like rim and a greyish translucent area. In outline the markings are usually elliptical and transversely placed but may be nearly circular (1) or longitudinally placed (1). The markings extend into *bc*, on some specimens reaching nearly to *c*, and mesially to or nearly to the midventral line. On 11 worms the two markings are separated midventrally by a very narrow but definite band on which the epidermis is thin. On one of these worms the markings are in contact but only because of a slight midventral depression. On four specimens the markings are united but a fine greyish line midventrally marks the region of union. On other specimens (5) the margins are united midventrally but with deep incisions at the midventral line anteriorly and posteriorly that mark the double origin. On still other worms the margins are more completely fused so that there is only a very slight trace of an indentation at the midventral line anteriorly and posteriorly. The greyish translucent central areas are never united midventrally.

Internal anatomy.—The wall of the gut from the gizzard to the intestine is provided internally with several, low, closely crowded, longitudinally placed, whitish ridges. The intestine begins in xv (11). There are no lateral intestinal caeca (11). The ventral intestinal caeca are in xxxv-xlii (1), xxxv-xlix (+?, 1), xxxvi-lx (1), the apertures on the floor of the gut longitudinally slit-like and readily recognizable (Bahl's specimens). The typhlosole begins abruptly in xxviii and in Bahl's specimens is continued through the supra-intestinal gland segments, ending abruptly in the last gland segment. Anterior to xxviii there is only a very slight trace of a mid-dorsal ridge. Anteriorly the typhlosole is just over 1 mm. high, decreasing slightly in height passing posteriorly but in the supra-intestinal gland segments about $1\frac{1}{2}$ mm. high. The supra-intestinal glands are located as follows: lxxxii-lxxxvi (1), lxxxiii-lxxxvii (2), lxxxiv-lxxxvii (1), lxxxiv-lxxxviii (4), lxxxiv-lxxxix (1), lxxxv-lxxxviii (1), lxxxv-lxxxix (1). (According to Beddard, 1901, p. 199, in lxxxiv-lxxxviii; in lxxxiii-lxxxvii. Thapar, 1934, p. 276.) The apertures into the glands are probably in longitudinal rows, one on each side of the typhlosole. On the floor of the gut, beginning in the segment next behind the last supra-intestinal gland segment and gradually decreasing in size passing posteriorly, there is a marked midventral ridge containing a large blood vessel.

The dorsal blood vessel terminates with or just in front of the hearts of vii (13). In one worm the dorsal blood vessel is continued anterior to the gizzard where it passes ventrally on the right side as a heart of vi. The last pair of hearts is in xiii (9).

The testis sac is ventral and unpaired (8). No male funnels have been found in x. The prostatic duct is 5-10 mm. long. The bulbous ejaculatorius is large and coelomic.

The functional penial setae are 3.6-4.4 mm. long, diameter (Bahl's specimens) 40-50 micra at the thickened base, 26-33 micra just ectal to the specially thickened region, 21-28 micra further ectally; the shaft nearly straight or gently curved ectally, the tip bluntly rounded. The tip of each of two reserve setae from one of Bahl's specimens is

provided with a small, terminal claw or curved spine. On the shafts of a few of the reserve setae a sparse ornamentation is recognizable, tiny pits the ental margins of which have a jagged appearance as of a short row of unusually fine spines.

The spermathecal duct is long (for a *Eutyphoeus*) and is usually more than 2 mm. in length, nearly circular in cross section, somewhat narrowed ectally before passing into the parietes. The lumen is transversely slit-like in section but on the walls are 8-14 high, vertical ridges which become smaller ectally. The seminal chambers are usually bound to the duct by connective tissue, in two distinct groups separated by a slight hiatus posteriorly or in a single semicircular ridge. If in two groups, each may have a berry-like shape. The number of diverticular apertures into the lumen of the duct appears to be variable but quite possibly some of the apertures were not recognized (usually spermathecae of macerated specimens only were dissected). In each of six spermathecae, 6 openings are present, in groups of 3, the two groups separated by 3 or 4 closely crowded vertical ridges while the pores of a group are separated only by single ridges. In 11 spermathecae but four openings were found, in groups of two; each aperture of a pair separated from the other aperture by a single, low, vertical ridge, the pairs of apertures separated from each other by 3 or 4 unusually high, vertical ridges. In another 7 spermathecae only 2 apertures were definitely identified in each duct.

The genital marking glands interrupt the longitudinal musculature and protrude conspicuously into the coelomic cavity (8). Each gland has a rather smooth though not glistening, convex ental surface and is enclosed (?) in a rather delicate, translucent capsule.

Remarks.—On the type of *E. khani* the penes are completely retracted and concealed from view by apposition of the margins of the vestibular apertures though penial setae are visible externally. The single female pore is on the left side.

On a few specimens a tiny greyish area is visible at the site of the right female pore. If the specimen is contracted the marking may easily be mistaken for a female pore. When the worm is macerated the left female pore is easily identified as a minute, circular (open) aperture while no such opening is visible at the site of the right pore.

Aclitellate specimens from Cawnpore show early stages in the development of the male genital terminalia. On one of these worms there is on each side of xvii, in the region of line *a*, a greyish translucent, indistinctly demarcated epidermal area. From the centre of this area protrude the tips of two penial setae, very closely paired. Just behind the lateral penial seta is a minute greyish marking which is pore-like in appearance and may be the rudiment of a male pore. On this worm there is not the slightest rudiment of a penis visible but the genital markings are represented by small, greyish translucent areas on 15/16, the centre of each area about on *a*. On another specimen there are no vestibula or penes but the genital markings are demarcated into marginal bands and central areas, the centre of each marking in mid *ab*. On a third worm the penis is represented by a tiny tubercle with convex surface; no penial setae visible but the genital markings well developed,

the centres about in *b*. The markings on each of these juvenile specimens are located symmetrically across 15/16.

The vestibular apertures are never united or even in contact (Stephenson, 1923, p. 448), as can be determined after removal of the cuticle.

Bahl's specimens are unusually large, one being 347 mm. long and 7 mm. thick; probably preserved in a relaxed condition. The specimens appear to be densely pigmented.

Parasites.—In the coelomic cavities of one specimen there are protozoan parasites very similar to *A. singularis* Gates 1926. The smallest branches of each parasite terminate in funnel-shaped structures, the margin of each funnel fringed with delicate, bristle-like processes.

Diagnosis.—Bivestibulate and penile: vestibula deep and well-like, apertures transversely slit-like with anterior and posterior margins in apposition, about in *ab*; penes $1\frac{1}{4}$ - $1\frac{1}{2}$ mm. long, each penis with a transversely slit-like to crescentic aperture at the tip, the anterior lip protuberant. Genital markings paired, on 15/16; approximated, in contact or margins united at the midventral line, reaching laterally into *bc* and anteroposteriorly nearly to the setae of *xv* and *xvi*. Female pore on the left side. Spermathecal pores on or just lateral to *a*. First dorsal pore on 11/12. Pigmentation dense? Length 145-185 mm. Diameter $5-5\frac{1}{2}$ mm.

Ventral intestinal caeca in xxxv-lx. Supra-intestinal glands in lxxxii-lxxxv: : lxxxvi-lxxxix. Dorsal blood vessel terminates with the hearts of *vii*. Metandric; testis sac ventral. Seminal chambers in one or two clusters or a semicircular row on the posterior face of the duct, (2-?) 4-6 openings into the duct; latter more than 2 mm. long. Genital marking glands interrupting the longitudinal musculature, protuberant into the coelomic cavity, with translucent capsule (?).

Distribution.—Calcutta and Rajmahal, Bengal; Katwari Bazar, Buzru Kurme (Basti district), Mowaie (Bara Banki district), Saharanpur, Lucknow, Cawnpore, and Fyzabad, United Provinces.

Eutyphoeus orientalis (Beddard).

- 1883. *Typhaeus orientalis*, Beddard, *Ann. Mag. Nat. Hist.* (5), XII, p. 219. (Type locality, Calcutta. No types.)
- 1888. *Typhaeus orientalis*, Beddard, *Quart. J. Mic. Sci.* XXIX, p. 117.
- 1889. *Typhaeus orientalis*, Vaillant, *Hist. Nat. Annel.*, III, (1), p. 182.
- 1889. *Typhaeus masoni*, Bourne, *J. Asiatic Soc. Bengal*, LVIII, p. 112. (Type locality, Dehra Dun. No types.)
- 1895. *Typhaeus orientalis*+*T. masoni*, Beddard, *Monog.*, pp. 473 and 474.
- 1898. *Typhaeus orientalis*, Fedarb, *Proc. Zool. Soc. London*, 1898, p. 445.
- 1900. *Eutyphoeus orientalis*+*E. masoni*, Michaelsen, *Tier.*, X, pp. 322 and 323.
- 1901. *Typhoeus masoni*+*T. orientalis*, Beddard, *Proc. Zool. Soc. London*, 1901, pp. 202, 205 and 206.
- 1903. *Eutyphaeus masoni*+*E. orientalis*, Michaelsen, *Geogr. Verbr.*, p. 109.
- 1907. *Eutyphoeus paivai*+*E. bastianus*+*E. andersoni*, Michaelsen, *Mitt. Mus. Hamburg*, XXIV, 1 p. 178, 183 and 185. (Type locality of *paivai*, Pusa; of *bastianus*, Katwari Bazar, Basti district, U. P.; of *andersoni*, Rajshahi, Bengal. Types in the Indian Museum.)
- 1909. *Eutyphoeus andersoni*+*E. bastianus*+*E. masoni*+*E. orientalis*+*E. paivai*, Michaelsen, *Mem. Ind. Mus.*, I, pp. 111, 112, 218, 219, 228, 236 and 238.
- 1910. *Eutyphoeus bastianus*+*E. masoni*+*E. orientalis*+*E. paivai*, Michaelsen, *Abh. Nat. Ver. Hamburg*, XIX, (5), pp. 12, 13 and 91.
- 1914. *Eutyphoeus bishambari*, Stephenson, *Rec. Ind. Mus.*, X, p. 355. (Type locality, Pusa. Type in the Indian Museum.)

1916. *Eutyphoeus bastianus*+*E. waltoni* (part, two specimens from Siripur, Saran), Stephenson, *Rec. Ind. Mus.* XII, p. 342.
 1920. *Eutyphoeus waltoni* (part), Stephenson, *Mem. Ind. Mus.*, VII, p. 243. (Specimens from bank of Hughli River, Calcutta.)
 1922. *Eutyphoeus orientalis*, Stephenson, *Rec. Ind. Mus.*, XXIV, p. 437.
 1923. *Eutyphoeus bislambari*+*E. masoni*+*E. orientalis*+*E. paivai*+*E. waltoni* (part, including only specimens with genital markings on xvi), Stephenson, *Oligochaeta*, in *F. B. I. Series*, pp. 431, 442, 448, 449 and 455.
 1926. *Eutyphoeus masoni*, Stephenson, *Rec. Ind. Mus.*, XXVIII, p. 264.
 1936. *Eutyphoeus masoni*, Hla Kyaw and Gates, *Rec. Ind. Mus.*, XXXVIII, p. 513.

Material examined.—From the Indian Museum: 1 clitellate, dissected specimen labelled, "*Eutyphoeus paivai* Michaelsen. Type. Pusa, Bengal. Mr. C. A. Paiva. ZEV 2836/7."; 1 clitellate, undissected specimen labelled, "*Eutyphoeus bastianus* Michlsn. Type. Katwari Bazar, Basti district. Dharam Khan. ZEV 2850/7."; 1 clitellate, dissected specimen labelled, "*Eutyphoeus bastianus* Michlsn, Sirsiah, Bihar. E. Bergtheil, ZEV 2851/7."; 1 clitellate, undissected specimen labelled, "*Eutyphoeus andersoni* Michaelsen. Type. Rajshahi, N. E. Bengal. Major. A. R. S. Anderson, I. M. S. ZEV 2840/7."; 3 macerated, clitellate (2 dissected) specimens labelled, "*Eutyphoeus bastianus* Mich. Village Buzru Kurme, Basti district, U. P. Dunnu Khan. ZEV 4164/7."; 1 clitellate specimen labelled "*Eutyphoeus bastianus* Mich. Calcutta. Nov. '07. Capt. R. E. Lloyd, I. M. S. ZEV 4189/7."; 1 a clitellate and 1 clitellate specimens labelled, "*Eutyphoeus bastianus* Mich. Calcutta. 6.9.08. Crawling on surface, wet weather, at midday. N. Annandale. ZEV 4161/7."; 1 clitellate, dissected specimen labelled, "*Eutyphoeus bishambari* Stephenson. Type. Pusa, Bihar. Lt. Col. J. Stephenson, I. M. S., W 22/1."; 3 clitellate specimens labelled, "*Eutyphoeus bastianus* Michlsn. Mowaie, Bara Banki, U. P. 11.iv.10. Md. Mohsin Khan. ZEV 6568/7."; 13 clitellate specimens (3 dissected) labelled, "*Eutyphoeus bastianus* Michlsn. Mowaie, Bara Banki, U. P. 11.x.10. Md. Mohsin Khan. ZEV 7209/7."; 1 clitellate undissected specimen labelled, "*Eutyphoeus bastianus* Michlsn. Dehra Dun. 3rd Sept. 1911. S. Maulik. ZEV 6555/7."; 2 clitellate specimens from a tube labelled, "*Eutyphoeus waltoni* Michlsn. Saripur, Saran. R. Hodgart. 27.9.10. ZEV 6569/7."; 4 a clitellate specimens labelled, "*Eutyphoeus waltoni* Michlsn. (not fully mature). Calcutta, banks of River Hugli, in partly saltish water. B. Prashad. 23.viii.18. 2 clitellate (1 dissected), macerated specimens labelled, "*Eutyphoeus orientalis* (Bedd.). Compound of Forest Research Institute, Dehra Dun. 20.viii.21. W 691/1."; and 38 clitellate and partially clitellate (3 dissected) specimens labelled, "*Eutyphoeus masoni* (A. G. Bourne) Ballygunj, Calcutta. R. Hodgart. W 3156/1."

Not examined.—In the British Museum: 1 specimen of *masoni* from Mowaie and 1 specimen also of *masoni* from Calcutta (Beddard's collection). In the Hamburg Museum: specimens (type series) of *andersoni* and *bastianus*, specimens of *masoni*.

The types of *orientalis*, even in 1883, were macerated and doubtless are no longer in existence. Even if extant it is unlikely that the specimens would now be of any taxonomic value. The original description and accompanying figures permit the following characterization of the species. Bivestibulate (? "male pores" shown by Beddard probably apertures of paired vestibula) and penile (?). Genital markings small, transversely placed, shortly elliptical in outline, paired, in about *ab*, on (or near) 14/15, 15/16, 16/17, 18/19 and 19/20 (an asymmetrical marking with central perforation, said to be on 12/13 but shown, in fig. 1, pl. viii, as presetal on xiv on the left side, is almost certainly a female pore area). Female pore on the left side. Spermathecal pores in *ab*

or *bc* (exact site unknown). Length 250 mm. Diameter 8 mm. Metandric. Spermathecal diverticula paired, duct short. Penial setae with chevron-like markings.

Fedarb's specimen from Dehra Dun (1898) has genital markings on 15/16, 16/17, 18/19 and 19/20 and penial setae with chevron-like markings. Fedarb notes that the supra-intestinal glands are in xci-xcv. Stephenson's specimens (1922), likewise from Dehra Dun, also have chevron-like markings on the penial setae, but the spermathecal pores have their centres slightly nearer to *c*. Stephenson did not mention genital markings but notes that the spermathecal duct is very short and stout. These specimens have been re-examined. Though much macerated, genital markings can be recognized on or close to 16/17 and 18/19 on each worm. Penes on these specimens though extremely softened are definitely of the annular type. As a result of the maceration scarcely a trace of the vestibular invaginations is now recognizable.

Of other species of *Eutyphoeus* known from Calcutta (type locality of *orientalis*), *incommodus*, *nicholsoni* and *quadripapillatus* can at once be eliminated by the restriction, on these three species, of the genital markings to the clitellum, leaving for further consideration in relation to *orientalis* only *masoni* and *waltoni*. Examination of the entire Indian Museum series of *waltoni* shows that on this species genital markings are always lacking on or near the region of 16/17. On the contrary genital markings are almost always if not always present on or near 16/17 in both *masoni* and *orientalis*. (Failure to recognize markings on xvi on 15 specimens from Calcutta, Hla Kyaw and Gates, may have been due to condition which often was poor.)

In 1901, Beddard distinguished *orientalis* from *masoni* by the presence of genital markings on 13/14 and 14/15 and the more median location (in *ab*) of the spermathecal pores. Neither of these supposed differences is of any value in this connection. Stephenson in 1923 distinguished *orientalis* from *masoni* (*vide* key on p. 425) by the chevron-like ornamentation, in spite of the fact that this ornamentation had also been found in a type of *masoni* as well as on reserve setae of *gammiei*. The chevron-like markings almost certainly are the result of a fibrillar disintegration of the tip of the setal shaft (as Stephenson apparently suspected, 1922, p. 438), and having been found in several distinct species cannot be used as evidence of specific distinctness. Morphologically, it is impossible to distinguish *orientalis* and *masoni* from each other, by any characteristics known to be of taxonomic value. The distribution of the two forms is much the same, Calcutta to Dehra Dun. In these circumstances and in view of the lack of types of both species, there is no longer any justification for the retention of the two names and *masoni* is accordingly reduced to a synonym. *E. andersoni*, *bastianus*, *bishambari* and *paivai* must be similarly reduced as an examination of the types completely fails to reveal any evidence for specific distinction.

An account of the external characteristics and internal anatomy has been given recently by Hla Kyaw and Gates (1936) and need not be repeated. A few notes concerning the types of the synonymized forms and on the variation in certain important characteristics are subjoined.

External characteristics.—The vestibula of one of the Mowaie specimens are partially everted, the everted portion of a conical shape and with a broad base. At the ventral tip of the cone is the penial annulus, distinguishable from the rest of the cone only by slightly more whitish appearance. On the type of *paivai* the vestibular region is strongly contracted, the vestibular apertures small, the vestibula deep, the roofs of the vestibula protrude into the coelomic cavity. A similar strong contraction characterizes the vestibular region of the types of *andersoni* and *bishambari*. On the types of both of these species the anterior portion of the penial annulus is somewhat thickened and with a shortly ellipsoidal appearance.

One of the Calcutta specimens (Hodgart) has an unusually large number of genital markings ; on ix, xii, xiii, xiv, xv, xvi, and 18/19-20/21. The intra-clitellar markings of the type of *bishambari* are just behind the setae of xvi while on the types of *paivai*, *andersoni* and *bastianus* the markings are quite clearly nearer to the setae in front than to those behind. The grooves leading from the genital markings of xvi to the vestibular apertures on the types of *bastianus* (*vide* Michaelsen, 1909, p. 237, fig. 33) are the result merely of a peculiar contraction and are of no systematic importance. The V-shaped depression of *bishambari* (*vide* Stephenson, 1914, pl. xxvi, fig. 10) similarly is of no systematic importance, scarcely a trace of it is now visible. The location of the genital markings is shown in the table below.

On the type of *paivai*, the anterior margins of the postclitellar genital markings are nearer to the transverse setal lines than are the posterior margins. On the types of *bishambari*, the greyish, translucent central portions of the postclitellar markings are segmental and postsetal, dislocating posteriorly and slightly the intersegmental furrow or slightly crossing the furrow. On this worm the peripheral rims of the genital markings quite obviously belong to two segments. The centres of the postclitellar markings are on or slightly median to *b* (*paivai* and *bishambari*). The preclitellar markings on the type of *andersoni* do not reach posteriorly to 9/10.

The spermathecae had been removed from the type of *paivai*, and in dissecting the duct out from the parietes, large apertures with smooth margins had been left on 7/8, the margins of the aperture reaching to *b* and *c*. On the anterior margin of viii (type of *bishambari*), behind each spermathecal pore, is a transverse slit similar to those noted by Hla Kyaw and Gates (1936, p. 513).

The single female pore of *andersoni* is on the left side.

Internal anatomy.—The supra-intestinal glands are located as follows : lxxxviii-xcii (types of *paivai* and *bishambari*, lxxxix-xcii (type of *bastianus*), lxxxix-xciv (type of *andersoni*). In the type of *bishambari* the glands are lacking in lxxxviii on the left side and are unusually small on the right side.

In the type of *bishambari* one spermathecal diverticulum does appear to be posterior. It is posteriorly directed but opens into the duct lumen just median to the vertical ridge on the posterior wall. Removal of the duct from the parietes leaves an aperture on 7/8 as on the type of *paivai*. As the spermathecae had been removed from the type of *paivai* it is now impossible to determine the number of true diverticula,

Michaelsen noted that the three of four (apparent) diverticula were united into a single group. Doubtless there were three or four fairly large seminal chambers but if the spermathecae were normal there should have been only two apertures into the duct lumen, one at each side of vertical ridge. The apparently single posterior diverticulum occasionally found is in reality two spermathecal diverticula posteriorly directed and bound together by connective tissue. There are always two distinct openings into the duct lumen.

Three of the penial setae of the type of *bastianus* have very slight traces of bowl-like concavity at the tip. No blister-like protuberances, such as were described and figured by Michaelsen from the penial setae of the type of *andersoni*, have been found on the remaining setae that were examined. The blisters are certainly not characteristic and may have been disintegration artefacts. Some further information regarding the penial setae is shown in tabular form below.

Parasites.—On the lateral wall of the gut in segment xii of one of the Saripur specimens are 5 individuals of *Aikinetocystis* sp., possibly *A. singularis* Gates 1926. In the coelomic cavities of xii-xiv of the same worm are several cysts.

Location of the genital markings.

Segments.	Hla Kyaw and Gates. (<i>masoni</i>).	of Specimens <i>bastianus</i> .	Calutta specimens of <i>masoni</i> .	Calcutta and Saripur specimens of <i>waltoni</i> .	Totals.
ix	X	2	9	0	11
x	X	0	0	0	..
xi	0	0	0	0	0
xii	0	0	1	0	1
xiii	1	0	2	0	3
xiv	54	5	9	0	68
xv	174	23	38	5	240
xvi	159	24	38	6	227
xviii or 18/19	174	24	38	4	240
19/20	158	20	32	3	213
20/21	84	10	10	1	105
21/22	38	2	5	0	45
22/23	6	0	2	0	8
23/24	4	0	1	0	5
24/25	3	0	0	0	3
25/26	2	0	0	0	2
26/27	1	0	0	0	1

X present on several specimens but number not noted, probably less than ten specimens with preclitellar markings.

Location of the supra-intestinal glands.

Segments.	Hla Kyaw and Gates (<i>masoni</i>).	Specimens of <i>bastianus</i> .	Calcutta specimens of <i>masoni</i> .	Specimens misidenti- fied as <i>waltoni</i> .	Others.	Totals.
86—90	1	0	2	0	0	3
86—91	0	0	1	0	0	1
87—91	2	1	0	0	0	3
87—92	0	0	1	0	0	1
88—92	1	2	2	2	3	10
88—93	1	0	0	2	0	3
89—92	1	0	1	0	0	2
89—93	1	2	1	2	0	6
89—94	0	0	0	0	1	1
90—94	0	1	0	0	0	1
91—94	0	2*	0	0	0	2
91—95	0	1	0	0	0	1
TOTALS	7	9	8	6	4	34

* One specimen with rudiments of glands in 90.

Penial Setae.

Specimens.	Number of Setae examined.	Tip simple, rounded or bluntly rounded point.	Tip lacking.	Tip with Spoon-like concavity.	Ectal portion with chevron- like markings.	Ornamentation recognizable under low power.	Remarks.
Type of <i>paivai</i>	4	2	1	1	0	4	
Type of <i>bishambari</i>	2	2	0	0	0	2	
Type of <i>andersoni</i>	4	3	0	1	2	4	
Type of <i>bastianus</i>	10	1	1	4 ¹	0	4	
Dehra Dun specimen of <i>orientalis</i> .	8	8	0	0	8	0	
Saripur specimen of <i>wal-</i> <i>toni</i> .	28	22	0	6	..	28	
Calcutta specimen of <i>wal-</i> <i>toni</i> .	10	7	0	3	..	10	
Sirsiah specimen of <i>basti-</i> <i>anus</i> .	8	7	0	1	1	0	All softened and vacuolated.
Bazru Kurme specimen of <i>bastianus</i> .	12	11	1	0	8	2	Tips softened, 1 with brush- like termina- tion.

¹ Possibly 3 more.

Diagnosis.—Bivestibulate and penile: penes annular, each penis on the roof of a deep vestibulum, vestibular apertures circular to transversely elliptical or slit-like and in *ab*. Genital markings paired, *ca*. in *ab*, postsetal on xv-xvi (xiii-xiv and ix-x) and on 18/19-20/21 (21/22-26/27). Female pore on the left side. Spermathecal apertures with centres in *bc*. First dorsal pore on 11/12. Pigmentation dense? Length, ?-220 mm. Diameter, 5-10 mm.

Ventral intestinal caeca in xxxiv-lxvi. Supra-intestinal glands in lxxxvi-xci: xc-xcv. Dorsal blood vessel terminates with hearts of vii. Metandric; testis sac ventral. Spermathecal diverticula paired, median and lateral. Genital marking glands interrupting the musculature and sessile on the parietes.

Distribution.—Calcutta, Rajshahi, Bengal; Sirsiah (Muzaffarpur district), Saripur, (Saran district), Pusa, Bihar; Katwari Bazar, Buzru Kurme (Basti district), Mowaie (Bara Banki district), Dehra Dun, United Provinces.

***Eutyphoeus pharpingianus* Michaelsen.**

1907. *Eutyphoeus pharpingianus*, Michaelsen, *Mitt. Mus. Hamburg*, XXIV, p. 177. (Type locality Pharping, near Katmandu, Nepal Valley. Type in the Indian Museum).
 1909. *Eutyphoeus pharpingianus*, Michaelsen, *Mem. Ind. Mus.* I, pp. 112, 218 and 226.
 1910. *Eutyphoeus pharpingianus*, Michaelsen, *Abh. Nat. Ver. Hamburg*, XIX, (5), p. 13.
 1923. *Eutyphoeus pharpingianus*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 450.

Material examined.—From the Indian Museum: 1 clitellate, dissected specimen labelled, "*Eutyphoeus pharpingianus* Michaelsen. Type. Pharping, Nepal. Museum Collector (R. Hodgart). ZEV 2863/7."

External characteristics.—The setae begin on ii and on this segment are readily recognizable. On xxi, $ab < cd < bc < aa$, but *bc* is only a trifle smaller than *aa*.

The first dorsal pore is on 11/12.

The clitellum is reddish brown and protuberant, extending from just in front of the setae of xiii to 17/18, the clitellar colouration lacking ventrally behind the genital markings of xvi and between the male porophores.

The spermathecal pores are transversely slit-like, with their centres about on *b*.

There is a pair of female pores.

The male porophores are almost circular but the transverse axis is slightly longer than the longitudinal; sharply demarcated by a fairly deep, circumferential furrow; extending from very slightly lateral to *a* into *bc*. The peni-setal pits, on or very close to *b*, are, presumably, on the roof of a slight, transversely slit-like fissure, the margin of which may be slightly protuberant or tumescent.

The genital markings are on xiii, xiv, xv, and xvi, in *ab*, each marking close to the setae of its segment, the posterior margins quite some distance from the setae next behind (the markings accordingly considered as postsetal though the intersegmental furrows are not visible). Each marking has a greyish, translucent, depressed, central area surrounded

by a definitely demarcated, whitish rim that is in sharp contrast to the reddish colouration of the clitellum.

Internal anatomy.—The intestine begins in xv. Lateral intestinal caeca, if present, are unrecognizable. The supra-intestinal glands are in lxviii-lxxi.

The dorsal blood vessel may be continued into the pharyngeal region with hearts in v and vi. The last pair of hearts is in xiii.

The testis sac is probably annular. In x there is a pair of rudimentary male funnels. On the left side a vas deferens can be traced posteriorly from x to unite with the other deferent duct of the same side in xvi though in contact through xiv and xv. From the union posteriorly the vas is unusually thick so that the anterior portion of the bulbous is not as abruptly marked off as usual. The prostatic duct is *ca.* 5 mm. long.

Both spermathecae had been removed. The spermathecal duct is probably circular in cross section.

Genital marking glands not definitely identified, whitish masses just dorsal to the markings possibly nephridial.

Remarks.—The gut wall, in the postclitellar segments, is macerated, hence the uncertainty as to the lateral caeca. The anterior extent of the dorsal blood vessel cannot be determined or the hearts of v and vi recognized because of the condition of the specimen.

The considerable posterior extent of the seminal vesicles (into xxxiii) may possibly be a specific characteristic. Only one other species, *E. quadripapillatus*, is known to have such long vesicles.

Metandric specimens are occasionally found in holandric species of *Eutyphoeus*. Thus in the normally holandric *E. montanus* Gates 1933 (Burma), 2 individuals have been found in which the anterior testes and seminal vesicles are lacking, though the anterior male funnels are present. *E. bullatus* Gates 1933 (Burma), apparently a metandric species, often has vestigial, rudimentary or normal seminal vesicles in ix but testes are lacking in x though the male funnels of segment are present. Furthermore, male funnels may persist in x after total disappearance of the anterior seminal vesicles and testes, as in *E. falcifer* Gates 1933 and *E. peguanus* Gates 1925 (Burma), while a pair of well developed male funnels may very rarely be present in a species in which these structures are almost always lacking (1 in a series of 40 specimens of *E. gigas* from Burma). In these circumstances is *pharpingianus* to be characterized as holandric or metandric? and if the latter, is the presence of male funnels in x a specific characteristic as in *bullatus*, *falcifer* and *peguanus* or merely a rare variation as in *gigas*?

If the type of *pharpingianus* is an abnormally metandric specimen of a holandric species, *pharpingianus* could probably be reduced to a synonym of *incommodus* (providing that the lateral caeca are really lacking). The only contra-indication against such a procedure is furnished by the unusual length of the seminal vesicles. But in abnormally metandric specimens of a holandric species the vesicles may extend posteriorly further than usual though not so far as in the type of *pharpingianus* (in *montanus* into xvii). From the other species with elongated seminal vesicles, *quadripapillatus* is distinguished by the location of the spermathecal pores, the presence of genital markings

on xv-xvi, the location of the supra-intestinal glands, and possibly also the absence of penial setae.

At present abnormality (of the type under discussion) can be recognized as such only after comparison with normal individuals (normality being the condition that characterizes the majority of the specimens), as there is no "hall-mark", so far as is known, to indicate that any particular specimen is abnormal or variant. Assuming that a chance specimen of any species is much more likely to be normal than abnormal, *pharpingianus* is regarded for the present as metandric. From all of the metandric species *pharpingianus* is clearly distinguishable by characteristics that appear to be of greater taxonomic value than the length of the seminal vesicles, closest relationship perhaps with *nepalensis*.

Metandric and vestibulate Indian species of *Eutyphoeus* have a fore-shortened dorsal blood vessel while metandric and avestibulate species with the exception of *gigas* do not have a fore-shortened dorsal blood vessel. It is therefore more than likely that the avestibulate *pharpingianus* has the dorsal blood vessel continued into iii and on such an assumption the species has been entered in the key. A further assumption, that the lateral intestinal caeca are lacking, has also been made, though really without justification. (Absence of mention of lateral intestinal caeca in Michaelsen's descriptions of *Eutyphoeus* species is not evidence as Michaelsen did not refer to the caeca when present.)

Diagnosis.—Avestibulate and apenile: each male pore within a transverse fissure on a nearly circular porophore, latter with centre on or close to *b*. Genital markings paired, postsetal, in *ab*, on xiii-xvi. Female pores paired. Spermathecal pores with centres on *b*. First dorsal pore on 11/12. Pigmentation? Length 130 mm. Diameter $4\frac{1}{2}$ mm.

Lateral intestinal caeca? Ventral caeca? Supra-intestinal glands in lxviii-lxxi. Dorsal blood vessel continued into iii (?) with hearts in v (?) and vi (?). Metandric (?) but with male funnels in x; testis sac annular (?). Seminal chambers in an interrupted circle around the spermathecal duct, with more than 2 openings into the duct (?). Genital marking glands?

Distribution.—Known only from the type locality, Pharping, Nepal.

***Eutyphoeus quadripapillatus* Michaelsen.**

- 1907. *Eutyphoeus quadripapillatus*, Michaelsen, *Mitt. Mus. Hamburg*, XXIV, p. 175. (Type locality Saraghat, Bengal. Types in the Indian and Hamburg Museums.)
- 1909. *Eutyphoeus quadripapillatus*, Michaelsen, *Mem. Ind. Mus.*, I, pp. 111, 218, and 221.
- 1910. *Eutyphoeus quadripapillatus*, Michaelsen, *Abh. Nat. Ver. Hamburg*, XIX, (5), pp. 13 and 90.
- 1923. *Eutyphoeus quadripapillatus*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 451.

Material examined.—From the Indian Museum: 1 a clitellate and 3 clitellate, undissected specimens labelled, "*Eutyphoeus quadripapillatus* Michlsn. Types. Saraghat. 3.12.06. Mus. Coll. (R. Hodgart) ZEV 2846/7," 2 undissected, (clitellate?) specimens labelled, "*Eutyphoeus quadripapillatus* Michlsn. Type. Sirsiah, Mozaffarpur, Bihar. E. Bergtheil, Esq. ZEV 2845/7," and 1 undissected, a clitellate specimen labelled, "*Eutyphoeus*

quadripapillatus Mich. Calcutta. Nov. 07. Capt. R. Lloyd, I.M.S. ZEV 4138/7." The Saraghat specimens are in fairly good condition, the Sirsiah specimens macerated in the postclitellar region. The body wall of the Calcutta specimen is hardened but the gut is macerated.

Not examined.—In the Hamburg Museum : ? specimens (part of type series) and others (?).

External characteristics.—The setae begin on ii and on this segment are readily visible (6). On xx or the next segment posteriorly on which the setal ratios are recognizable, $ab < cd < bc < aa$ (3).

The first dorsal pore is on 11/12 (6).

The clitellum is annular, reddish, scarcely or slightly protuberant, extending from 12/13 or an anterior portion of xiii to 17/18. Dorsal pores may be lacking, present but occluded, or present and functional.

The spermathecal pores are transversely slit-like, small, the centres slightly median to *b* (3), or slightly lateral to *a* (3), or in mid *ab* (1).

There is a pair of female pores (4).

The male porophores (best preservation) are rather disc-shaped, shortly elliptical in outline and transversely placed, sharply demarcated, slightly elevated, the centre of the porophore on or slightly lateral to *b*, the median margin about on *a*. At the centre of each porophore is a tiny, teat, or nipple-like protuberance on the ventral end of which is a minute pore. No penial setae, peni-setal pits or pores are visible within the aperture.

The genital markings are two pairs (7), postsetal on xiii and xiv, at the centre of each marking on (4) or very slightly lateral to *b* (1). The markings are quite obviously postsetal, even on the clitellate specimens where they are much nearer to the anterior than the posterior setae. Each marking has a rather wide, whitish, marginal band and a greyish, translucent, central area.

Internal anatomy.—The intestine begins in xv (4). The supra-intestinal glands are in lxii-lxiv (1), lxiii-lxvi (1), lxiii-lxvii (1), lxiv-lxvii (2), lxv-lxviii (1).

The dorsal blood vessel is continued into iii with hearts at least in v and vi (4). The last pair of hearts is in xiii (4).

Segment xi was opened in each dissection but except ventrally no parietal attachment (or evidence of such attachment) for 11/12 is visible. Presumably 11/12 is attached peripherally to the posterior face of 10/11 to form an annular testis sac. The seminal vesicles of xi are continued posteriorly to, nearly to or even posterior to xxx, constricted by the septa through which they pass (4). In one of the Saraghat specimens the vesicles of xi are crossed in xiv-xv so that the right vesicle passes posteriorly on the left side and the left on the right side. The prostates are small, confined to xvii-xix. The prostatic duct is slender, 2-4 mm. long. The bulbus ejaculatorius is (relatively) large.

The spermathecal duct is rather short, circular in cross section, with a transversely slit-like lumen, the wall with several vertical ridges. The seminal chambers form an interrupted circle around the spermathecal duct. Each chamber usually does not open directly into the duct lumen but first unites with one or two other chambers to communicate with the duct lumen by a single aperture. One spermatheca with the seminal chambers in a 3-2-2-1 grouping has four openings into the duct lumen.

Another spermatheca with a 2-1-3-2 grouping also has 4 openings into the duct lumen. One spermatheca which at first glance appears to have a complete circle of seminal chambers actually has four, shortly stalked diverticula. The diverticula of the Calcutta and Sirsia specimens are without spermatozoal iridescence.

Within the parietes, on the median face of the prostatic duct, is a setal follicle. Three of these follicles were dissected out. One follicle contains no setae; a second contains only fragments; a third contains 2 small fragments and a complete, sigmoid seta. No ornamentation is visible on this seta the form and size of which are much like that of an ordinary seta.

The longitudinal musculature is uninterrupted dorsal to the genital marking glands.

Remarks.—The minute apertures on the tips of the tiny protuberances from the male porophores are so small that at first glance they were interpreted as male pores. There are however no other Indian species with external and superficial male pores for even in the apparently avestibulate *gigas* the penes can be sunk into the male porophores. Furthermore no species of *Eutyphoeus* is known with conjoined prostatic and deferent duct pores. Possibly the teat-like protuberances represent everted though very small, slit-like invaginations. It is to be hoped that properly preserved specimens can be made available at an early date for microscopic investigation of the male genital terminalia in this species. This is of especial importance in view of the fact that *quadripapillatus* may be more primitive than any other species (note presence of apparently unmodified, sigmoid setae in association with the prostatic duct).

E. quadripapillatus is close to *incommodus* from which it is distinguished by the slightly more median location of the spermathecal pores, the restriction of the genital markings to xiii-xiv, the more anterior location of the supra-intestinal glands, the greater length of the posterior seminal vesicles, and the absence (?) of penial setae.

Diagnosis.—Avestibulate and apenile: each male pore (?) on or within a tiny protuberance from the centre of a transversely placed, disc-shaped porophore, the latter with centre on or close to *b*. Genital markings paired, postsetal, on xiii-xiv, small, centres on or just lateral to *b*. Paired female pores. Spermathecal pores in *ab*. First dorsal pore on 11/12. Unpigmented? Length 60-70 mm. Diameter $3\frac{3}{4}$ mm.

Ventral intestinal caeca? Supra-intestinal glands in lxii-lxv: lxiv-lxviii. Dorsal blood vessel continued into iii with hearts in v and vi. Holandric; testis sac annular (?). Seminal chambers in a circle around the spermathecal duct, with four openings into the duct lumen. Longitudinal musculature uninterrupted above the genital markings.

Distribution.—Saraghat and Calcutta, Bengal; Sirsia, Bihar.

***Eutyphoeus scutarius* Michaelsen.**

1907. *Eutyphoeus scutarius*, Michaelsen, *Mitt. Mus. Hamburg*, XXIV, p. 186 (Type locality, Comillah, Chittagong district, Bengal. Types in the Indian and Hamburg Museums.)

1909. *Eutyphoeus scutarius*, Michaelsen, *Mem. Ind. Mus.* I, pp. 112, 219 and 240.

1910. *Eutyphoeus scutarius*, Michaelsen, *Abh. Nat. Ver. Hamburg*, XIX, (5), p. 13.

1923. *Eutyphoeus scutarius*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 452.

Material examined.—From the Indian Museum : 1 clitellate, dissected specimen, labelled, “*Eutyphoeus scutarius* Michaelsen. Type. Comillah, E. Bengal. Maj. A. R. Anderson. ZEV 2844/7.”

Not examined.—In the Hamburg Museum : 2 (?) specimens, part of type series.

External characteristics.—Setae are lacking or invisible on ii-v. On the postprostatic segments, $ab < cd < bc < aa$.

The first dorsal pore is on 11/12.

The spermathecal pores are small, transversely slit-like, about in mid *bc*.

There is a pair of female pores.

The male porophores extend from *b* or slightly median to *b* into mid *bc* and are small, transversely placed, rather indefinitely demarcated areas, smooth, probably shortly elliptical in outline. On each porophore there is a transversely slit-like, rather slight depression within which there can be recognized only the tips or broken ends of the penial setae or the two peni-setal pits. The margin of the slit is very slightly tumescent.

On 15/16 and reaching anteroposteriorly almost to the setae of xv and xvi and extending laterally on each side to just beyond *b*, is a single, transversely placed genital marking of elliptical outline. The marking has a greyish translucent appearance and is surrounded by a fine, whitish, marginal strip that is demarcated peripherally by a very slight furrow. The hexagonal male pore area described by Michaelsen is not visible on this specimen but there is an area of epidermal translucence on 16/17 which looks something like a genital marking though not as large or as sharply demarcated as the marking on 15/16. On 17/18 there is also an appearance of epidermal translucence but not as clearly visible as that on 16/17, the translucent appearance almost lacking midventrally. In outline, these two areas (on 16/17 and 17/18) are about the same as that on 15/16.

Internal anatomy.—The intestine begins in xv. There are no lateral intestinal caeca. The supra-intestinal glands are in segments cxxxiii-cxxxvii.

The dorsal blood vessel is continued at least into v with paired hearts in v and vi. The last pair of hearts is in xiii.

The testicular coagulum is in a horseshoe-shaped mass (relationships of 10/11 and 11/12 ?). The prostatic duct is about 10 mm. long. There is a large bulbus ejaculatorius on the parietes but covered over.

The spermathecal duct is fairly long, over 1 mm. in length, nearly circular in cross section, with a rather large lumen. On the posterior wall is a slight, vertical ridge. On each duct is a pair of diverticula, each diverticulum with a single seminal chamber characterized by a spermatozoal iridescence, the diverticulum shortly ellipsoidal and sessile.

One penial seta was examined. The tip is softened and fibrillated. The whole of the shaft has a cross striate appearance, the dark bands much thicker than the light bands. No ornamentation visible.

Remarks.—The type is broken in two in the region of segment xxxix and is ruptured in other places, hence the segmental locations of the supra-intestinal glands may not be exact.

In the tube of types of *E. comillahnus* there is an acitellate specimen that is probably to be referred to *scutarius* rather than *comillahnus*. This worm is broken in two in the region of xlvi so that the location of the supra-intestinal glands may not be exact.

Length, 115 mm. Setae lacking or invisible on ii-v. First dorsal pore on 11/12. Spermathecal pores in mid *bc.*, perhaps a trifle nearer to *b*. Avestibulate and apenile, no male porophores recognizable, two penisal pits on each side of xvii, the median pit on or just lateral to *b*. No genital markings.

No lateral caeca. Supra-intestinal glands in cxxvi-cxxx. Dorsal blood vessel continued into iv at least, hearts of v and vi present, probably also of iv. Parietal attachment of 11/12 (?) visible ventrally but not dorsally. Male funnels small, testes fan-shaped. Prostates rudimentary, in xviii-xxii. Seminal vesicles rudimentary, also spermathecae which have no diverticula. Bulbus ejaculatorius visible but rest of deferent duct not seen.

Six penial setae from one side were examined. The entire shaft of each is characterized by a striate appearance. Ectally the setae have been eroded, the margins with a corrugated appearance, the indentations corresponding to the light bands or stripes. No ornamentation recognizable, the tip of one seta with chevron-like ridges. Two setae are quite short, with unusually thick bases, almost thorn-like.

Diagnosis.—Avestibulate and apenile: each male pore in a slight transversely placed fissure, the latter on small transversely placed porophores of shortly elliptical outline with centres slightly lateral to *b*. Genital markings on 15/16, in *bb*. Female pores paired. Spermathecal pores in or near mid *bc*. First dorsal pore on 11/12. Pigmentation? Length 140-180 mm. Diameter 5 mm.

Ventral intestinal caeca? Supra-intestinal glands in cxxvi-cxxxiii: cxxx-cxxxvii. Dorsal blood vessel continued into iii (?) with hearts in v and vi. Metandric; testis sac annular (?), formed by peripheral apposition of 10/11 and 11/12 dorsally. Spermathecal diverticula paired, median and lateral. Longitudinal musculature uninterrupted above the genital markings.

Distribution.—Known only from the type locality, Comillah, Chittagong district, Bengal.

***Eutyphoeus turaensis* Stephenson.**

1920. *Eutyphoeus turaensis*, Stephenson, *Mem. Ind. Mus.*, VII, p. 244. (Type locality Tura, Garo Hills, above Tura, Assam. Types in the Indian Museum.)

1923. *Eutyphoeus turaensis*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 453.

Material examined.—From the Indian Museum: 1 dissected and 3 undissected acitellate specimens labelled, "*Eutyphoeus turaensis* sp. nov. Above Tura, Garo Hills, Assam. 3500-3900 ft. July-Aug. 1917. S. Kemp. W 181/1", and 3 acitellate specimens labelled, "*Eutyphoeus turaensis* Stphson. Immature. Above Tura, Garo Hills, Assam. 2,500-3,900 ft. Under bark. July-Aug. 1917. S. Kemp. W 178/1."

External characteristics.—On xx, $ab < cd < bc < aa$, $dd > \frac{1}{2}U$. The first dorsal pore in on 11/12 (1). The spermathecal apertures are small, slit-like, just lateral to *b*.

Avestibulate; in best development, on each side of xvii, a slight depression at the centre of which is a tiny, almost circular tumescence in the form of an annulus, from the centre of which a single penial seta may be protuberant, the annulus on or slightly median to *b*.

Genital markings are small, rudimentary, in best development almost circular and with greyish translucent central areas and opaque whitish

rims. On the dissected specimen the markings are postsetal on xiv-xvi, the markings of xiv-xv with their centres on *a*, the markings of xvi with centres in *ab* and probably slightly crossing 16/17 which is not visible ventrally. On xviii there is a further pair of markings, presetal, also in *ab*, probably reaching slightly anterior to 17/18. On a second specimen the markings are on xv-xvi and xviii; on the third, recognizable on xvi only; on the ruptured specimen, on xv-xvi. Two specimens from the second tube have markings on xv-xvi while the third has them on xiv-xvi.

Internal anatomy.—The gizzard is more or less deformed, as in *E. strigosus* Gates 1933, the anterior opening dorsal, the posterior opening ventral, the deformation especially marked on one specimen, less obvious on the other two. Lateral intestinal caeca were not found. The supra-intestinal glands are located as follows: lxv-lxvii (1), lxv-lxix, rudimentary in lxv (1), lxvi-lxxi, abnormal on the left side (1), lxv-lxix (1 from the second tube).

Hearts of vi are present on one (1) or both sides (2). The dorsal blood vessel is adherent to the dorsal parietes, ruptured in opening each specimen and cannot be traced anterior to 5/6 (terminating with or behind 5/6?).

The spermathecae are juvenile. The duct is short, almost confined to the parietes, longitudinally elliptical in cross section, lumen central, and slit-like, a vertical ridge on the posterior wall. Diverticula paired, median and lateral.

The thickening of the tip of the penial setae (noted by Stephenson) is lacking on all setae examined. The ornamentation is of fine teeth or spines in circles that are so closely crowded towards the tip as to have an appearance of "fur", entally the circles more widely separated from each other and the spines slightly larger.

Parasites.—Protozoa rather like *Aikinetocystis* but unbranched are present in the coelomic cavities, associated with pseudonavicellae cysts.

Remarks.—The types are juvenile. The species cannot be adequately characterized.

If the dorsal blood vessel is continued into iii, *turaensis* may be distinguished from *assamensis* by the presence of genital markings on xiv-xv and the anterior location of the supra-intestinal glands, and from *festivus* by the presence of clitellar genital markings. If the dorsal blood vessel is not continued into iii, *turaensis* may be distinguished from all of the metandric species with a fore-shortened dorsal trunk by the continuation of the dorsal blood vessel to or nearly to 5/6. The species has been entered in the key on an assumption that the dorsal blood vessel is not continued anterior to 5/6.

Specimens of *Eutyphoeus* have been found under bark of erect trees in Burma. Although some of the Tura worms were found under bark, there is no indication as to whether the tree was erect.

Diagnosis.—Vestibulate? and penile: penes annular? Genital markings paired, centres on *a* or in *ab*, postsetal on xiv-xvi, presetal on xviii. Female pores? Spermathecal pores just lateral to *b*. First dorsal pore on 11/12. Pigmentation? Length 100 mm. Diameter $3\frac{1}{2}$ mm.

Ventral intestinal caeca ? Supra-intestinal glands in lxxv-lxxvi : lxxvii-lxxi. Dorsal blood vessel continued into (?), hearts of vi present. Metandric ; testis sac ? Spermathecal diverticula paired, median and lateral. Genital marking glands ?

Distribution.—Known only from the type locality, Tura, Garo Hills, Assam.

Eutyphoeus waltoni Michaelsen.

1907. *Eutyphoeus waltoni* (part, excluding specimens of *nicholsoni* from Fyzabad and possibly also specimens with genital markings (?) on 16/17) + *E. bengalensis*, Michaelsen, *Mitt. Mus. Hamburg*, XXIV, pp. 179 and 183. (Type locality of *waltoni* Mainpuri, United Provinces ; of *bengalensis* Saraghat, Bengal. Types of *waltoni* in the Indian and Hamburg Museums ; of *bengalensis* in the Indian Museum).
1909. *Eutyphoeus bengalensis* + *E. waltoni* (part, as above), Michaelsen, *Mem. Ind. Mus.*, I, pp. 111, 112, 218, 219, 229 and 235.
1910. *Eutyphoeus bengalensis* + *E. waltoni*, Michaelsen, *Abh. Nat. Ver. Hamburg*, XIX, (5), pp. 12, 13 and 91.
1914. *Eutyphoeus waltoni* + *E. ibrahimi*, Stephenson, *Rec. Ind. Mus.* X, pp. 352 and 357. (Type locality of *ibrahimi* Kapurthala, Punjab. Type in the Indian Museum).
1916. *Eutyphoeus waltoni* (part), Stephenson, *Rec. Ind. Mus.*, XII, p. 342. (Excluding 2 specimens from Siripur, Saran).
1917. *Eutyphoeus waltoni*, Stephenson, *Rec. Ind. Mus.*, XIII, p. 408.
1919. *Eutyphoeus waltoni*, Stephenson and Ram, *Trans. R. Soc. Edinburgh*, LII, p. 447. (Prostates).
1919. *Eutyphoeus waltoni*, Stephenson and Prashad, *Trans. R. Soc. Edinburgh*, LII, p. 457. (Also vide p. 465. Calciferous glands).
1920. *Eutyphoeus waltoni* (part), Stephenson, *Mem. Ind. Mus.*, VII, p. 243. (Excluding specimens of *orientalis* from Calcutta).
1922. *Eutyphoeus waltoni*, Stephenson, *Rec. Ind. Mus.*, XXIV, p. 438.
1923. *Eutyphoeus ibrahimi* + *E. waltoni*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, pp. 438 and 455.
1923. *Eutyphoeus waltoni*, Hertling, *Zeit. Wiss. Zool.*, CXX, p. 187. (Typhlosole).
1926. *Eutyphoeus waltoni*, Stephenson, *Rec. Ind. Mus.*, XXVIII, p. 265.
1927. *Eutyphoeus waltoni*, Bahl, *Quart. J. Mic. Sci.*, LXXI, p. 483. (Copulation).
1933. *Eutyphoeus waltoni*, Bahl and Lal, *Quart. J. Mic. Sci.*, LXXVI, p. 110. (Supra-intestinal glands).
1934. *Eutyphoeus waltoni*, Thapar, *Ann. Mag. Nat. Hist.* (10), XIII, pp. 275 and 277. (Supra-intestinal glands).
1933. ? *Eutyphoeus* sp. Thapar, *Current Science*, I, pp. 129 and 258. (Alimentary glands. Said to begin in lxxx, hence may be *waltoni*).

Material examined.—From the Indian Museum : 5 clitellate specimens labelled, "*Eutyphoeus waltoni* Michlsn. f. *typica*. Mainpuri, United Provinces. Sept. 1906. Capt. H. J. Walton, I.M.S. ZEV 2849/7." ; 4 clitellate and macerated specimens labelled, "*Eutyphoeus waltoni* Michlsn. Fyzabad, United Provinces. Capt. F. Wall. ZEV 2848/7." ; 7 clitellate specimens labelled, "*Eutyphoeus waltoni* Michlsn. *typica*. Pusa. C. A. Paiva Esq. ZEV 2847/7." ; 23 clitellate specimens labelled, "*Eutyphoeus waltoni* Mich. Rajmehar, Bengal. 31.7.07. Mus. Coll. (R. Hodgart). ZEV 4146/7." ; 1 clitellate and 2 a clitellate (1 dissected) specimens labelled, "*Eutyphoeus waltoni*. Pusa. viii. 11. B. Das. W 382/1." ; 2 a clitellate and 6 clitellate specimens labelled, "*Eutyphoeus waltoni* var. *longisetosus* Stephenson. Pusa, Bihar. 10.ix.1912. B. Das. (Lt. Col. J. Stephenson). W 23/1." ; 3 a clitellate, 2 clitellate and 7 juvenile specimens labelled, "*Eutyphoeus barodensis* n. sp.=*Eutyphoeus waltoni*. Baroda, B. Das. (Lt. Col. J. Stephenson, I.M.S.) 2.viii.1912." ; 1 avestibulate juvenile and 2 juveniles with rudiments of vestibula labelled, "*Eutyphoeus waltoni*. Basi Muda, Hoshiarpur Dist. Aug. 1913. Ibrahim. W 25/1." ; 2 dissected clitellate and 1 undissected juvenile specimens labelled, "*Eutyphoeus waltoni*. Lucknow.

Aug. 1913. Ibrahim. W 381/1." ; 2 a clitellate specimens labelled, "*Eutyphoeus waltoni* Mich. Tollygunge near Calcutta. Dr. N. Annandale and F. H. Gravely. 30.7.11. ZEV 6546/7." ; 1 clitellate specimen labelled, "*Eutyphoeus waltoni* Michlsn. Siripur, Saran, Bihar. R. Hodgart. 27.9.10. ZEV 6569/7." ; 1 macerated, clitellate specimen labelled, "*Eutyphoeus waltoni*. Lucknow. 1916. Ibrahim. W 391/1." ; 3 clitellate (1 dissected) specimens labelled, "*Eutyphoeus waltoni* Michlsn. Delhi. 15.vii.17. B. Prashad. W 345/1." ; 8 juvenile specimens (1 dissected) labelled, "*Eutyphoeus waltoni* Michlsn. Gwalior, bank of a stream. 17.vi.17. B. Prashad. W 245/1." ; 20 juvenile specimens of which 14 are avestibulate and 6 with rudiments of vestibula, labelled, "*Eutyphoeus waltoni* Michlsn. Ahmedabad, Bombay Presy. 11.vii.17. B. Prashad. W 256/1." ; 1 dissected partially clitellate and macerated and 1 juvenile specimens labelled, "*Eutyphoeus waltoni*. Baroda, W. India. Dr. B. Prashad. W 414/1." ; 9 avestibulate juveniles labelled, "*Eutyphoeus waltoni* Mchlsn. Baroda, in a garden. 9.vii.17. B. Prashad. W 255/1." ; 4 juveniles of which 1 is avestibulate, the others with only rudiments of vestibula, labelled, "*Eutyphoeus waltoni* Mchlsn. Baroda, By the banks of a tank. 9.vii.17. B. Prashad. W 257/1." ; 1 juvenile, 1 a clitellate, 3 partially clitellate specimens labelled, "*Eutyphoeus waltoni* Mchlsn. Baroda, on a small hillock. 10.viii.17. B. Prashad. W 342/1." ; 4 avestibulate juveniles labelled, "*Eutyphoeus waltoni* Mchlsn. Navli. 10.vii.17. B. Prashad. W 343/1." ; 1 avestibulate juvenile and 1 partially clitellate and macerated specimens labelled, "*Eutyphoeus waltoni* Michlsn. Baroda. 9.vii.17. B. Prashad. W 344/1." ; 4 macerated, clitellate specimens labelled, "*Eutyphoeus waltoni* Mich. Compound of the Forest Research Institute, Dehra Dun. 20.viii.21. W 692/1." ; 2 undissected specimens, 1 clitellate, labelled, "*Eutyphoeus waltoni* Mich. Cawnpore. ix.24. J. P. Mullan. W 3212/1." ; 1 juvenile specimen labelled, "*Eutyphoeus ibrahimi* Stephenson. Type. Kapurthala, Punjab. Lt. Col. Stephenson, I.M.S. W 21/1." ; 1 a clitellate specimen labelled, "*Eutyphoeus bengalensis* Michlsn. Type. Sara Ghat, E. Bengal. Museum Collector (Hodgart). ZEV 2843/7." From the Hamburg Museum : 2 clitellate specimens labelled, "*Eutyphoeus waltoni*. Rajmehal. Hodgart. Or." There is a mistake in this label as the specimens collected by Hodgart in Rajmehal are not the originals.

Not examined.—In the British Museum : 2 specimens from Rajmehal and 1 specimen from Pusa. In the Hamburg Museum : part of type series and others.

External characteristics.—A number of clitellate specimens are small, 140 mm. or less in length and 4-5 mm. in diameter. Even smaller specimens (aclitellate) may have fully developed genital markings, penes and vestibula. No pigmentation recognizable (alcoholic preservation), the clitellum yellowish brown.

The setae begin on ii (60) but may occasionally be lacking or invisible on that segment. On xx the setal ratios are somewhat variable but may usually be indicated as follows : $ab = \text{or} < cd < bc < aa$, $dd \text{ ca.} = \frac{1}{2}U$. The ventral setae of the clitellar segments are ornamented, near the tip, with short transverse rows of fine spines (5).

The first dorsal pore is on 11/12 (53), occasionally on 12/13, or lacking or unrecognizable anterior to the clitellum.

The clitellum is annular and extends from just behind the setae of xiii or from 13/14 to or nearly to 17/18 ; intersegmental furrows and dorsal pores lacking, setae present. The clitellar glandularity usually appears to be lacking or only slightly developed midventrally on xvii.

The spermathecal pores appear to be smaller than on *orientalis* but this may be due in part to the fact that to many of the specimens

examined are small or immature. The pores are transversely slit-like to shortly elliptical, the centres in line with or just lateral to *c* (55) but often just median or quite definitely median to *c* (on 12 specimens the lateral margin of the aperture just on or almost reaching to *c*). The anterior and posterior margins of the pores may be slightly tumescent and finely wrinkled.

There is usually but one female pore (58), on the left side, just anterior and slightly median to *a*. Occasionally a right pore or rudiment of the pore is recognizable.

The vestibular apertures are shortly elliptical, transversely placed openings, occasionally slit-like, in *ab* or reaching laterally to or nearly to *c*. On some worms the midventral region between the two vestibular apertures is slightly depressed in such a way as to produce an appearance of a single, transversely placed vestibular aperture, but none of these worms is definitely univestibulate, the penes always located in the much deeper lateral portions which represent the real vestibula. On some specimens the body wall appears to be thickened in a u-shaped fashion around each vestibular aperture, the limbs of the u directed mesially. The penes are slender, almost tubular, occasionally slightly thickened basally and hence rather slenderly conical in appearance, about 1 mm. long. The penes usually are retracted into the vestibula but on one worm one penis is almost fully protruded to the exterior while on another both penes are fully protruded. After especially strong contraction each penis is contained within a deep pit on the vestibular roof and is invisible from the vestibular lumen. In such worms cutting across a small projection into the coelomic cavity of xvii, close to the parietes, reveals the penis.

A number of juveniles are characterized by rudimentary vestibula and penes while others are avestibulate. On the latter specimens there is visible on or just median to line *a*, on each side of xvii, a minute pore. Through this pore, on some worms, the tips of two penial setae protrude. Just posterior to this pore there may be recognizable a minute, greyish translucent marking which may represent the male pore.

The genital markings are small, paired and transversely placed, usually shortly elliptical in outline. With best preservation a greyish translucent, slightly depressed central area and an opaque, whitish, fine but still slightly protuberant rim can be recognized. On macerated specimens the rims may be quite unrecognizable. On acelitellate specimen the rudiments of the intra- and postclitellar genital markings appear to be symmetrically placed across the intersegmental furrows (when the latter are visible). The preclitellar genital markings are definitely segmental and postsetal, at least so far as the greyish central portions are concerned, but the rim, when present, appears on some specimens to be formed in part from the anterior region of the segment next behind. The posterior markings are about in *ab* but may reach median to *a* and lateral to *b*. The centres of the preclitellar markings are on or slightly lateral to *b*, the markings usually reaching to *a* and to an equal amount into *bc*. Markings have not been found on xvi or 16/17. (Worms with definite markings on xvi or 16/17 can be referred by other characteristics to *orientalis*.) One specimen, quite obviously *waltoni*, at first appeared to have a pair of very faintly indicated genital markings on the region

of 16/17 but no corresponding glands can be found (glands of real markings quite obvious and protuberant into the coelomic cavities). On 2 specimens from Cawnpore an area in *ab*, across 16/17 is swollen and protuberant on each side. On the clitellate specimen there are similar swellings on 17/18. These areas are not genital markings.

The markings are located as shown below.

Segment or furrow.	Number of specimens.
viii	1
ix	80
x	1
14/15	65
15/16	81
18/19	82
19/20	17
20/21	4
21/22	1
22/23	1

Occasionally one marking of a pair is lacking but this is not indicated above, the asymmetrical marking is counted as if a pair were present.

Internal anatomy.—The intestine begins in xv (2). There are no lateral intestinal caeca (12). Median caeca are present as follows: xxxiii-lx (1), xxxiv-xlix (1), xxxiv-lxi (1). The supra-intestinal glands are in 4 segments (7) or five segments (8). The glands are located as follows: lxxviii-lxxx (1), lxxix-lxxxii (2), lxxx-lxxxiii (3), lxxx-lxxxiv (4), lxxx-lxxxv (1), lxxx-lxxxvi (3), lxxxii-lxxxvi (1). The typhlosole begins in xxviii (3). In some specimens the typhlosole appears to end in the segment in front of the first supra-intestinal gland segment. In others the typhlosole appears to be continued, somewhat enlarged, through the gland segments.

The dorsal blood vessel ends anteriorly with the hearts of vii (12). The last pair of hearts is in xiii (12). The hearts of xi are bound down to the gut but are readily recognizable in all of the dissected specimens.

There is an unpaired, suboesophageal, testis sac, the hearts of xi passing into the sac beneath the gut (12). The seminal vesicles extend through 12/13 to 13/14 or dislocate 12/13 posteriorly along with 13/14 to 14/15. The prostates extend through xvi or xvii to xix or xx. The prostatic duct is 5-8 mm. long. There is a coelomic bulbus ejaculatorius, 1-1½ mm. long.

The spermathecal duct is about 2 mm. long, slender (compared with that of *orientalis*), nearly circular in cross section, very abruptly narrowed at the ental end but the narrowed portion concealed by the ampulla which is bound down firmly to the duct. Often the ental portion of the duct is twisted round in a rather spiral fashion. The lumen is small, transversely slit-like in section and nearly central. The diverticula are paired, lateral and median but are often directed posteriorly and in this condition may be almost or actually in contact, occasionally bound together by connective tissue. However such united diverticula have separate openings into the duct lumen. The ampulla is not constricted as in *orientalis* (*vide* Hla Kyaw and Gates, 1936, p. 516). The right spermatheca of a specimen from Pusa (Das) has one lateral diverticulum only.

The genital marking glands are sessile on the parietes.

Only 2 penial setae protrude to the exterior simultaneously through a penis though each penisetal follicle contains 8-14 setae (including the two functional setae). The following numbers were noted : 8 (1 follicle), 9 (1), 12 (2), 14 (3). The functional setae may reach a length of 4.5 mm. The diameter of the shaft, at the region of greatest thickness, the extreme ental end, varies from 0.022-0.030 mm. The setae usually have a c-shaped or u-shaped appearance when flattened out on the slide by the cover glass, the ectal half of functional and reserve setae often twisted slightly in a rather spiral fashion somewhat similar to that of *E. foveatus* (Rosa) 1890. The tips are spoon-shaped, the hollowed out portion of the shaft 0.050-0.065 mm. in length. Of the 83 setae in the follicles mentioned above, less than a dozen do not have the spoon-shaped tip. This conformation of the ectal end of the penial setae therefore appears to be much more characteristic of *waltoni* than of *orientalis*. Penial setae from avestibulate juveniles and from juveniles with rudimentary vestibula and penes also are usually provided with a spoon-shaped tip. Penial setae from much macerated specimens may or may not show the excavation of the tip. The ornamentation is difficult to see, even with oil immersion, as Stephenson has already pointed out, but consists of fairly closely crowded, somewhat irregular, circumferential circles of teeth. The circles perhaps usually with several breaks. The ornamentation extends, at least on some setae, down onto the outer side of the bowl.

Remarks.—Michaelsen (1909, p. 230) mentions genital markings on 16/17, "just before, and with the hinder part drawn back into the slits of, the male pores." Bahl, (1927, p. 484) also notes that genital markings are often present on 16/17. Definite genital markings with internal glands on 16/17 have not been found on any of the specimens just examined. An occasional specimen, as has already been noted, may have swollen areas on or near xvii that look somewhat like genital markings but which have no greyish translucent portion and are without glandular material internally. In view of these differences the swollen areas are not considered to be genital markings, for whatever their nature they appear to be a distinctly different sort of structure from those epidermal modifications to which the term genital marking is applied in this genus.

Stephenson (1923, p. 456) mentioned "Intestinal caeca about the middle of the body," presumably a *lapsus calami* for the supra-intestinal glands.

Some of the specimens are too juvenile for identification. The Basi Muda worms probably are correctly identified. The Gwalior, Ahmedabad and Navli records require confirmation though there is no reason for suspecting that *waltoni* is not present at those places.

A few notes on the types of *bengalensis* and *ibrahimi* are subjoined.

A.

The type of *E. bengalensis*. After removal of the cuticle, rudiments of genital markings are visible ; postsetal on ix, just anterior to 9/10, centres on *b*, and on 18/19 on *ab*. Vestibula represented by transversely slit-like depressions. Penes deeply retracted into vestibular roofs, probably not fully developed but longer than in *orientalis*, rather conical, anteroposteriorly flattened,

Supra-intestinal glands in lxxx-lxxxiv. Spermathecae removed in a previous dissection. Four penial setae from one follicle were examined. Each seta has a spoon-shaped tip and sparse ornamentation recognizable with difficulty under high power.

B.

The type of *E. ibrahimi*. Spermathecal pores minute, on *c*. Avestibulate, rudiments of vestibula indicated by very slight, concave depressions, at the centre of each of which is a slight, whitish tumescence, the rudiment of a penis. Genital markings not definitely recognizable.

Supra-intestinal glands are either in lxxix-lxxxiii or lxxx-lxxxiv (uncertainty due to rupture across segment xxxi and maceration of segments just behind the rupture). Spermathecae juvenile. Four penial setae from one follicle were examined. Shafts slender, ornamentation difficult to recognize under high power, tips spoon-shaped (3).

Diagnosis.—Bivestibulate and penile: vestibula deep and well-like with circular to transversely slit-like apertures in *ac*, penes 1 mm. long. Genital markings paired, *ca.* in *ab*, postsetal on ix (viii and x), intersegmental on 14/15—15/16, 18/19 (19/20—22/23). Female pore on the left side. Spermathecal pores with centres on or median to *c*. First dorsal pore on 11/12. Pigmentation? Length 90-230 mm. Diameter $4-6\frac{1}{2}$ mm.

Ventral intestinal caeca in xxxiii-lxi. Supra-intestinal glands in lxxviii-lxxxii : : lxxxi-lxxxvi. Dorsal blood vessel ends with hearts of vii. Metandric; testis sac ventral. Spermathecal diverticula paired, median and lateral. Genital marking glands interrupting the longitudinal musculature and sessile on the parietes.

Distribution.—Calcutta, Rajmehal, Saraghat, Bengal; Siripur (Saran), Pusa, Bihar; Gwalior (?), Central India; Baroda, Navli (?), Ahmedabad (?) (Bombay Presidency), Western India; Mainpuri, Fyzabad, Lucknow, Agra, Cawnpore, Dehra Dun, United Provinces; Basi Muda and Hoshiarpur (Hoshiarpur district), Kapurthala, Delhi, Punjab.

Eutyphoeus sp.

Not examined.—In the British Museum: 1 specimen from Darjiling, 1 specimen from India, and 17 specimens from Dehra Dun, all of which are from Beddard's collection.

APPENDIX TO THE GENUS *Eutyphoeus*.

The references listed below cannot be placed in any of the synonymies.

I.

1923. *Eutyphoeus quadripapillatus*, Hertling, *Zeit. Wiss. Zool.*, CXX, p. 186. (Typhlosole).

According to Hertling the typhlosole (of a specimen from Saraghat) is in segments xxiii-cxiii. The number of segments in the species is only 120-155 (Michaelsen, 1909, p. 221).

If supra-intestinal glands mark the posterior limit of the typhlosole, as in other species of *Eutyphoeus*, the glands must end in ciii or begin in cxiv. But in the Indian Museum specimens the supra-intestinal glands are in lxii-lxviii. It is unlikely that there should be so much variation in the location of the glands in any species and especially one that is holandric. For the present it is not feasible to offer any suggestion as to the actual condition in the worm or the species to which it may belong.

II.

1927. *Eutyphoeus gigas*, Bahl, *Quart. J. Mic. Sci.*, LXXI, p. 485. (Penes in specimen from Lucknow).

It is unlikely that *E. gigas*, known only from Chittagong and the Arakan division of Burma, has been found in Lucknow. Quite possibly Bahl's worms should be referred to *orientalis*. Although the latter species has not yet been recorded from Lucknow it probably is to be found there.

III.

1927. *Eutyphoeus incommodus*, Bahl, *Quart. J. Mic. Sc* LXXI, p. 485. (Penes in specimen from Lucknow).

E. incommodus probably is to be found in Lucknow (though there is at present no valid record of its presence there) but quite definitely is apenile. Since *incommodus* is holandric and all of the holandric species are apenile it is not possible to make any suggestion as to the species mis-identified by Bahl.

IV

1933. *Eutyphoeus* sp. Bahl, *Current Science*, I, p. 258. (Alimentary glands).

No species mentioned.

V

1934. *Eutyphoeus* sp. Bahl, *Quart. J. Mic. Sci.*, LXXVI, p. 561 et al. (Habits, in particular feeding and formation of castings.)

No species mentioned.

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ON TWO CHALCIDOID PARASITES OF LEPIDOPTERA WITH A DESCRIPTION OF *EUELMUS TERMINALIAE*, SP. NOV.

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The officer in charge of the Horticultural Station, Krishnagar, Bengal, sent to me for identification a few live caterpillars infesting pomegranate fruit. The infested pomegranates were kept in a rearing cage on 24th March, 1936 with a view to rearing the caterpillars and on 6th April, 1936 the adults of the common Lycaenid butterfly *Virachola isocrates* F. emerged. Along with these a specimen of the Chalcidoid *Brachymeria euploae* (Westw.) also emerged. Although *B. euploae* is known to parasitise caterpillars, the present observation is, so far as I know, the first record of it as a parasite of *V. isocrates*.

Some eggs of a Lasiocampid moth found on the leaves of a country almond (*Terminalia catappa*) tree in Calcutta were brought to the laboratory and were kept in a bottle with a view to rearing caterpillars should any hatch out. After about a week, a number of specimens of a Chalcidoid parasite of the genus *Eupelmus* Dalm. were found in the breeding cage. These parasites do not agree with any of the known species of the genus and I, therefore, describe them below under the name *E. terminaliae*, sp. nov.

***Eupelmus terminaliae*, sp. nov.**

This new species somewhat resembles *E. amphitus* Walk.¹ but differs from it by the abdomen being shorter than the thorax. It is distinguished from the other species of the genus by its very pronounced metallic green colouration.

♂—Length 2.5 mm.

General colouration metallic green. Head somewhat broader than thorax; sculpture minutely punctate; ocellocular space less than the diameter of ocellus. Antennae inserted just above the lower borders of eyes, brownish basally and darker apically; scape about $\frac{1}{4}$ the length of flagellum; scapal furrow deeper than in the female. Wings hyaline. Fore-femur very dark brown; fore-tibia and tarsus light brown. Middle leg dirty white except for the femur above where it is dark brown. Hind-femur dark brown; hind-tibia lighter; hind tarsus dirty white. Abdomen about $\frac{3}{4}$ the length of thorax, black.

♀—Length 2.75-3.0 mm.

General colouration very dark metallic green. Head slightly wider than thorax, metallic green and finely sculptured; ocelli small forming an equilateral triangle; lateral ones situated very close to the eye border; ocellocular space less than the diameter of the ocellus. Eyes dark brown, pubescent; interocular space about $\frac{1}{3}$ the width of head; malar space about $\frac{1}{3}$ the height of head; frons finely shagreened. Antennae

¹ Walker, F., *Ann. Mag. Nat. Hist.*, XVII, p. 114 (1846).

inserted just below the lower borders of eyes, scape reaching to the front ocellus and yellowish brown, rest of antenna very dark brown, about twice the length of scape. Thorax twice as long as broad; middle lobe of mesonotum with a coppery red iridescence; mesopleura from metallic blue to metallic violet. Wings dusky, apically and basally lighter, with a purplish iridescence; veins black; submarginal and marginal veins nearly equal; postmarginal as long as stigmal. Abdomen about half as long as thorax. Ovipositor not exerted. Fore-legs dark metallic green; its tibia dark testaceous; middle and hind legs dark testaceous; mid-tarsi light aeneous; mid-tibial spur as long as meta-tarsus; tarsal dentations black; hind coxae metallic blue.

Holotype.— $\frac{1581}{H3}$, one male in spirit, Zoological Survey of India (Ind. Mus.).

Allotype.— $\frac{1580}{H3}$, one female in spirit, Zoological Survey of India (Ind. Mus.).

Paratypes.— $\frac{1582}{H3}$, six females, one dissected, in spirit, Zoological Survey of India (Ind. Mus.).

Host.—Lasiocampid Moth eggs, Coll. H. A. Hafiz, Calcutta, 24th August, 1936.