THE EARTHWORMS OF BURMA. V.

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CONTENTS.

INTRODUCTION.

Since the publication of the preceding paper (Gates, 1933) the writer has been able, while on leave, to examine all Burmese earthworms in the collections of various European Museums as well as in the Indian Museum. As a result of this work it is now possible, for the first time, to present an account of the Burmese fauna based on a study of all the material. In addition, non-Burmese types of species that are present in Burma have also been examined, as well as other material, especially in the British Museum, that is involved in a consideration of the synonymy of certain species present in India and Burma. Several changes in the names of fairly common species are accordingly necessary. A considerable amount of new material, from the Indian Museum, from collections made by G. E. Blackwell in Toungoo district and the Pegu Yomas and by H. Young on the Shan Plateau as well as less important collections from other areas, has been worked out. The continuation of previous studies on the variation of characteristics of assumed or suspected, taxonomic importance has now rendered possible, especially in the genus *Pheretima* and certain other Megascolecine genera, the construction of specific diagnoses which characterize the species much more accurately than hitherto and which should be correspondingly more useful.

ACKNOWLEDGMENTS.

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SYSTEMATICS.

Family MEGASCOLECIDAE.

Subfamily *MEGASCOLECINAE.*

Genus **Pontodrilus** E. Perrier.

1874. *Pontodrilus*, E. Perrier, *C. R. Ac. Sci. Paris*, LXXVIII, p. 1582. (Genotype, *P. marionis* E. Perrier 1874 = *Lumbricus litoralis* Grube 1855.)

Pontodrilus sp.

Seven aclitellate specimens from the Indian Museum, collected at Port Blair in the Andaman Islands, are probably to be referred to *P. bermudensis* Beddard 1891, a species already known from the Burmese mainland.

Genus **Tonoscolex** Gates.

1933. *Tonoscolex*, Gates, *Rec. Ind. Mus.*, XXXV, p. 484. (Genotype, *Notoscolex birmanicus* Gates 1927).

Diagnosis.—Male pores on xvii, in seminal grooves that extend onto xvi or xviii. Female pores on xiii. Spermathecal pores on 6/7-7/8. Gizzard massive, in vi. Paired, stalked calciferous glands in ix-xii. Intestine begins in xiv. Last hearts in xii. Testes in ix and x; seminal vesicles in x and xi; ovaries in xii.

The excretory organs have not been carefully studied but are probably exonephric micronephridia and possibly also enteronephric micro- or meganephridia.

The Burmese species are all characterized, in addition to the generic characteristics, as follows: unpigmented; setae *a* and *b* of xvii lacking, even on aclitellate specimens; clitellum annular, with clitellar development the intersegmental furrows are obliterated and dorsal pores occluded but setae are retained on clitellar segments; female pores paired, in *aa*; spermathecal pores in or median to *a*; the single diverticulum passes into the anterior face of the spermathecal duct.

Worms belonging to the genus *Tonoscolex* are easily the most sluggish of all Burmese earthworms.

Tonoscolex depressus (Gates).

1929. *Notoscolex depressus*, Gates, *Proc. U. S. Nat. Mus.*, LXXV, (10), p. 14. (Type locality, Maymyo. Paratype in the U. S. Nat. Mus.).

1929. *Notoscolex choprai*, Stephenson, *Rec. Ind. Mus.*, XXXI, p. 230. (Type locality, Nyaungbin, Indawgyi Lake, Myitkyina District. Types in the Indian Museum).

1932. *Notoscolex depressus*, Gates, *Rec. Ind. Mus.*, XXXIV, p. 368.

1933. *Tonoscolex depressus* (part), Gates, *Rec. Ind. Mus.*, XXXV, p. 484. (Excluding var. *scutatus*).

Material examined.—From local collections:

"Leaf covered, rocky soil", Taungyi, Aug. 1935, 2 aclitellate specimens. H. Young.

"Leaf covered, sandy soil on wooded hillside", Nam Mang, Mang Lun State, Sept. 1935, 2 clitellate specimens. H. Young.

"In ground with tall grass", Loi Se Mt. ca 5,000 ft. Mang Lun State, Sept. 1935, 15 clitellate specimens. H. Young.

External characteristics.—The length varies from 75-110 mm., the diameter from 3-4 mm. The first dorsal pore is on 9/10. All specimens are setigerous.

There is a deep depression midventrally on the genital shield of the clitellate specimens, the seminal grooves are on the lateral walls of the depression. In some of the specimens the depression is continued anteriorly into the posterior portion of the protuberant clitellar region as a short, narrow invagination.

Internal anatomy.—The prostates are strap-shaped, with median margins smooth, the lateral margins incised and thinner than the median margins. The duct emerges from the median margin of the prostate near the anterior end, and passes straight forward to the point of entrance into the parietes.

The spermathecal duct is much shorter than the ampulla and is narrowed within the parietes, the ectalmost portion almost thread-like. In the aclitellate specimens the lumen of the duct widens gradually passing entally from the diverticular junction and the wall is smooth. In the clitellate specimens the lumen is more irregular in appearance and the wall is transversely or irregularly ridged. The spermathecal diverticulum is slightly longer than the duct, the shape variable,—slenderly club-shaped, thickly club-shaped, sausage-shaped. In the aclitellate specimens there is no spermatozoal iridescence within the diverticula, the lumen in each case empty, wide entally, slightly narrowed ectally and with only slight traces of ridges on the wall. In the clitellate specimens the spermatozoal mass extends, in each diverticulum, nearly to the duct, an ental portion of the sperm mass usually rather pear-shaped, as in the types, narrowing gradually, passing ectally, to a slender rod which is rather irregularly twisted. The sperm mass may not, however, be so much narrowed ectally in which case the margins are slightly incised as if by fine ridges.

Remarks.—Aclitellate specimens from Taungyi, described in a previous paper (Gates 1932, p. 373) under the designation " Forma prima " are evidently to be referred to *T. depressus*. The Taungyi specimens are quite definitely smaller than the types.

Diagnosis.—Male genital shield extends across xvii and xviii, each seminal groove f-shaped but without the crossbar, the posterior end in or just median to *c*, the anterior end turned towards the midventral line and terminating just lateral to the midventral line between the arms of a U-shaped tumescence, the male pore within a seminal groove and in or just behind the anterior bend. Setae lumbricine. Length 75-215 mm. Diameter 3-7 mm.

Prostates strap-shaped, in xvii-xxiv. Spermathecal duct much shorter than the ampulla, diverticulum slightly longer than the duct, club-shaped or sausage-shaped.

Tonoscolex lunatus (Gates).

1929. *Notoscolex lunatus*, Gates, *Proc. U. S. Nat. Mus.*, LXXV, (10), p. 16. (Type locality, Maymyo. Paratype in the U. S. Nat. Mus.).
1932. *Notoscolex lunatus*, Gates, *Rec. Ind. Mus.*, XXXIV, p. 369.
1933. *Tonoscolex lunatus*, Gates, *Rec. Ind. Mus.*, XXXV, p. 490.

Material examined.—From local collections :
" Leaf covered, sandy soil on wooded hillside ", Nam Mang, Mang Lun State, Oct. 1935, 1 clitellate specimen. H. Young.

The specimen which is about 95 mm. long has a genital shield with seminal grooves characteristic of *T. lunatus*. The spermathecae however

differ somewhat from those of the types. The spermathecal duct is slightly longer than the ampulla, the lumen widened slightly within the parietes. The diverticulum is slightly shorter than the duct and slenderly club-shaped; the lumen irregular ectally and with ridged wall, entally the lumen circular in section and with smooth wall. The diverticulum is invested with a thick layer of tissue which, in the cleared spermatheca, is much darker than the thinner, light, transparent layer that forms the wall of the lumen. As in the spermathecae of the types of this species the spermatozoa extend, within the diverticulum, from the ental end nearly to the duct; a spheroidal sperm mass in the ental-most portion connected by a straight, short, narrow, rod-like portion at the central axis of the diverticulum with a narrow but elongate portion that is twisted irregularly, almost in a spiral fashion.

Diagnosis.—Male genital shield extends across xvii and xviii, each seminal grove rather like an interrogation mark, the posterior end of the groove in or slightly lateral to *b*, a posterior portion of the groove concave, the concavity facing anterolaterally, anteriorly the groove bent laterally and then mesially to terminate near the midventral line between the arms of a U-shaped tumescence, male pores within the grooves, just behind the midventral bend. Setae lumbricine. Length 85-205 mm. Diameter 4-6 mm.

Prostates strap-shaped, in xvii-xxi. Spermathecal duct about as long as ampulla or longer, diverticulum slightly shorter than the duct to longer than combined lengths of duct and ampulla, club-shaped.

Tonoscolex montanus, sp. nov.

Material examined.—From local collections:
"Shady ravine", Taungyi, Sept. 1935, 3 aclitellate and 9 clitellate or partially clitellate specimens. H. Young.

External characteristics.—Length 140-265 mm. Diameter, in the clitellar region which is especially protuberant, 6-8 mm. Unpigmented.

All specimens are setigerous. The setae are fine and recognizable only with difficulty when retracted, lumbricine; on xxii, $ab<cd<aa<bc$.

The first dorsal pore is on 9/10 on each specimen but there is a more or less definitely pore-like but apparently non-functional marking on 8/9 in most of the worms.

The clitellum is yellowish, annular, extending from 13/14 to 16/17 or nearly to 16/17; intersegmental furrows lacking, dorsal pores present or occluded but positions indicated by small, pit-like depressions; setae present.

The spermathecal pores are transversely slit-like, narrow, closely paired, in *aa*.

The female pores are paired, each pore just anterior and median to *a*.

The male genital shield extends across xvii and xviii, both of which are only slightly elongated ventrally. The shield is of about the same width anteriorly as posteriorly, the length greater than the width. At the midventral line the shield is depressed, the depression rather slight or deep and longitudinally slit-like. Just lateral to the midventral

line on each side and extending across the lengthened postsetal secondary annulus of xvii and the presetal annulus of xviii there is a longitudinally oval area of especial protuberance with a glossy surface. On the specimen on which the midventral depression is the deepest, these oval areas form the lateral walls of the depression. Along the centre of each oval area and in line with *b*, *a*, or in *ab* is a deep seminal groove, parallel (or nearly so) to the midventral line. At the postsetal secondary furrow on xvii the seminal groove bends at a sharp angle towards the midventral line. This anterior portion of the groove is located on a slight but definite transverse ridge which terminates at the midventral line, in contact or almost in contact with the corresponding ridge of the other side, the ridges are protuberant above the surrounding portion of the parietes anteriorly, mesially and posteriorly but not laterally. The minute, transversely slit-like male pore is located in the short anterior bend of the seminal groove, near to but not quite at the anterior end.

On the aclitellate specimens seminal grooves are present but are slight, straight and in *ab* or *b* ; other portions of the male genital shield apparently undeveloped. A single specimen has, perhaps as a result of some unusual contraction or as an abnormality, a male shield with width much greater than the length. There is no trace whatever of a depression along the midventral line and the oval protuberant areas are almost in contact mesially.

Internal anatomy. —Septa 6/7-10/11 are thickened and muscular especially 6/7-8/9.

The hearts are arched closely around the calciferous glands. In xii vessels pass from the dorsal and ventral margins of the calciferous glands into the hearts. In xi to xvi there is a pair of longitudinal trunks on the ventral parietes parallel to the nerve cord, each of which gives off to the lateral parietes fairly large branches. An especially large branch from each of these trunks rises vertically in xii and after giving off one or two large branches to the ventral portion of the calciferous gland passes mesially underneath the gut to unite with the corresponding vessel from the opposite side.

The seminal vesicles of x and xi are medium-sized, in contact above the dorsal blood vessel. The prostates are rather strap-shaped, extending through xvi-xx or xxi, the lateral margins with 3-5 deep incisions. The prostatic duct is 2-2½ mm. long, soft, slender, without muscular sheen and bent into 2-3 tiny, U-shaped quirks ectally.

The spermathecal duct is shorter than the ampulla, with a thick wall, a transversely slit-like lumen which is gradually narrowed passing ectally. The diverticulum is shorter than the combined lengths of duct and ampulla, rather sausage-shaped or pear-shaped in appearance. The seminal chamber is however rod-shaped but looped, the looping approximating in part to a regular zigzag arrangement. A fairly thick layer of opaque tissue conceals from view, until after clearing, the looping and is responsible for the sausage-shaped or pear-shaped appearance. The diverticular lumen is wide and filled with spermatozoa to or almost to the point of entrance into the duct, so that a stalk portion is lacking.

Remarks.—Aclitellate specimens from Taungyi, described in a previous paper (Gates 1932, p. 373) under the designation "Forma secunda" are evidently to be referred to *T montanus.*

Diagnosis.—Male genital shield extends across xvii and xviii, each seminal groove bent anteriorly at a sharp angle towards the midventral line, the posterior limb of the groove in *a*, *b* or *ab* and parallel to the midventral line, the male pore in the shorter anterior limb of a groove, near the midventral line. Setae lumbricine. Length 140-265 mm. Diameter 6-8 mm.

Prostates strap-shaped, in xvi-xxi. Spermathecal duct shorter than the ampulla, diverticulum shorter than combined lengths of duct and ampulla, seminal chamber looped in a regularly zigzag fashion or in approximation thereto but covered over by a thick layer of opaque tissue so that the diverticulum has a sausage-shaped to pear-shaped appearance.

Tonoscolex oneili (Stephenson).

1914. *Megascolides oneilli*, Stephenson, *Rec. Ind. Mus.*, VIII, p. 377. (Type locality, Janakmukh in the Abor Country, East Himalayas. Type in the Indian Museum). *Vide* also Rec. Ind. Mus., XII, p. 314, "Remarks".

1923. *Notoscolex oneili* (part), Stephenson, *Oligochaeta*, in the *F. B. I. Series*, p. 212. (Excluding var. *monorchis* Stephenson 1916).

Material examined.—From the Indian Museum; one clitellate, dissected specimen labelled, "*Megascolides oneilli* Steph. Janakmukh (Abor Expdt.) Capt. J. S. O'Neil. Type. ZEV 5159/7." (The type is broken apart behind the male genital shield.)

From local collections:

"Jungle", Mayan, Myitkyina District, Sept. 1934, 1 clitellate specimen lacking the posterior end. K. John.

Description of the Burmese specimen.

External characteristics.—Length 168 mm. Diameter 5 mm. Unpigmented.

Just behind the clitellum the setal intervals are as follows, $ab<cd<bc=aa$, but posteriorly $bc<aa$.

The first dorsal pore is on 10/11.

The clitellum is dark redish, annular, extending from 12/13 to just behind the setae of xvi; dorsal pores and inter-segmental furrows lacking, setae present.

The spermathecal pores are tiny apertures in line *a*. The margins of intersegmental furrows 6/7-7/8 in *aa* are tumescent and lobulated.

There are paired female pores in *aa*.

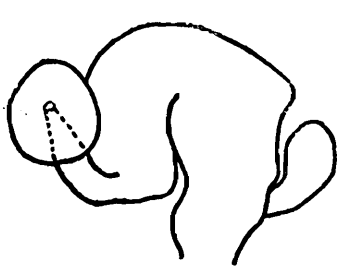
The male genital shield extends across xvii and the anterior portion of xviii, and has a straight posterior margin and a bluntly rounded (convex) anterior margin. The parietal thickening is probably more or less U-shaped as in other species of the genus but externally there appear to be three areas of especial thickening: an anterior, large, transversely oval area which has a rather translucent appearance and posterior and almost perpendicular to this area two smaller areas, whitish and opaque, each fairly sharply demarcated and longitudinally oval. On the anterior portion of the shield is a transverse depression and posteriorly, between the two longitudinally oval areas, the shield

is depressed midventrally. The seminal grooves are L-shaped, each groove with a long, longitudinal limb about in line *c*, nearly straight, passing anteriorly at the centre of one of the longitudinally oval areas. On xvii, just behind the transverse setal line, each groove bends, almost at right angles, and passes mesially, terminating slightly lateral to the midventral line. At the anterior and median end of each seminal groove is a conspicuous, wrinkled, soft, fluid-filled, thin-walled tumescence. The major portion of this tumescence is just anterior to the median end of the seminal groove but a posterior portion of the tumescence forms a sort of U-shaped ridge around the median end of the seminal groove with the limbs of the " U " directed laterally. The male pores are tiny slits in the angles of the seminal grooves.

Internal anatomy.—Septa 6/7-10/11 are thickly muscular.

The testis sacs are thin-walled, unpaired, median, anterior outpocketings of 8/9 and 9/10, the anterior sac reaching 7/8, the posterior sac not quite reaching to 8/9. The sacs rest on the ventral nerve cord and communicate with the coelomic cavities of ix or x by transverse apertures near the parietes. Both sacs are filled with testicular coagulum which does not extend into ix or x. The testes are vertical ridges at the sides of the sac just internal to the aperture. The seminal vesicles are fairly large, filling segments x and xi, in contact transversely above the dorsal blood vessel. The anterior vesicles are about twice the size of the posterior vesicles and are anteroposteriorly enlongated while the posterior vesicles have the long axis vertical.

The prostates extend through xvii-xx, the median margins thick and smooth, the lateral margins thin and incised. The prostatic duct emerges from the median margin of the gland and passes anteriorly, the ental portion thick, spindle-shaped and possibly muscular. In xvii the duct is slenderer, looped back and forth in a regularly zigzag fashion, the loops (6) short, all in the same plane, with the limbs of the loops in contact. The duct passes into the parietes just lateral to a transversely oval, thickened portion of the body wall which is protuberant into the coelomic cavity. In a midventral depression on this protuberance is the nerve cord. On the dorsal face of the protuberance and just lateral to the nerve cord, on each side, there is a deep pit. A needle passed into this pit penetrates into the interior of the ovoidal, anterior portion of the tumescence at the median end of the seminal groove.



TEXT-FIG. 1.—*Tonoscolex oneili* (Stephenson). Spermatheca.

The spermathecal duct is stoutish, much longer than the ampulla, looped, the limbs of the loops in contact. The ampulla is small and is bound down ectally around the narrowed entalmost portion of the

duct which is not visible until after removal of the ampulla. The duct is slightly narrowed within the parietes. The wall is thick, the lumen reduced by the protrusion into it of longitudinal ridges. The diverticulum is shortly club-shaped or pear-shaped to almost finger-shaped and passes into the anterior face of the duct close to the parietes. A very short, ectal portion has a narrow lumen with smooth wall, the thickness of the wall being greater than the width of the lumen. A longer, ental portion has a wide lumen also with a smooth wall, the thickness of the wall being much less than the width of the lumen. This part of the diverticulum is elongately sausage-shaped but looped irregularly. There is no sperm mass within the diverticulum. External to the light, translucent layer referred to above as the wall of the diverticulum is a layer of much darker tissue which is thicker ectally than entally and hence disguises the stalked condition of the diverticulum.

Parasites.—Nematodes are present in the coelomic cavities of ix and x and within the testis sacs of ix and x. There are also nematodes within spheroidal cysts in the ventral portions of the seminal vesicles.

The type of T oneili.—The Burmese specimen at first appeared to belong to a new species but the similarities to *T oneili* were sufficient to require an examination of the type of the latter before erecting a new species. As a result of this examination it is possible to correct the mistakes in the account of *T oneili* and thereby render a new species unnecessary.

The seminal grooves on the holotype of *T oneili* are L-shaped and as on the Burmese specimen. Other grooves described and figured by Stephenson are fortuitous and of no taxonomic significance. Anteriorly the grooves terminate lateral to the midventral line and are not continuous mesially. As in the Burmese specimen the male pores are in the angles of the seminal grooves. The structures mistaken by Stephenson for male pores are in reality deep, transverse, slit-like invaginations, produced as the result of retraction into the parietes of the tumescences visible externally on the genital shield of the Burmese worm. The margins of the pits and of the median ends of the seminal grooves are slightly tumescent.

The olive green colouration mentioned by Stephenson is no longer visible and quite possibly was the result of preservation with other material. The spermathecal pores, which are in line *a*, are about $1\frac{1}{2}$ mm. apart.

The spermathecal duct and ampulla are sharply demarcated but the tissue binding the ectal portion of the ampulla around the narrowed ental portion, of the duct is here almost opaque and continued over the zigzagged loops of the duct to the parietes. One diverticulum which is marked off externally into an almost spheroidal portion and a very short stalk was cleared. The ental portion contains spermatozoa which appear to be separated into four discrete, ovoidal masses.

Remarks.—Four small specimens of *Tonoscolex* from Mayan may be juveniles of *T oneili* but are too young to be identified. On these worms the male genital shield had not begun to develop. Setae *a* and *b* of xvii are lacking but in interval *ab*, on each side, is a tiny, diagonally

placed, greyish translucence which may represent the primordium of the male pore and seminal groove.

The so-called testis sacs are not completely closed off, as in *Pheretima* and the apertures are large but the restriction of the testicular material to the interior of the sac may perhaps indicate that the aperture to the sac can be closed. Curiously, no trace of these sacs is visible in the type.

Diagnosis.—Male genital shield extends across xvii and xviii; each seminal groove L-shaped, the longer longitudinal limb about in *c*, the shorter, anterior limb directed midventrally, the male pore at or near the angle of the groove. Just anterior to the median end of each seminal groove, a deep transversely slit-like invagination which is eversible as a thin-walled, wrinkled tumescence or "tag" Setae lumbricine. Length 185 mm. Diameter 5-6 mm.

Prostates strap-shaped, in xvii-xx. Spermathecal duct much longer than the ampulla and looped in a regularly zigzag fashion; diverticulum much shorter than the duct, club-shaped, pear-shaped or finger-shaped.

Tonoscolex parvus, sp. nov.

Material examined.—From local collections:
"Rocky soil near ravine", Taungyi, Sept. 1935, 1 aclitellate and 16 clitellate or partially clitellate specimens. H. Young.

External characteristics.—Length 65-130 mm. Diameter 3-4½ mm. Unpigmented.

All specimens are setigerous, including the aclitellate worm. The setae are fine and recognizable with difficulty when deeply retracted, lumbricine in arrangement, the ratios somewhat variable; on xx, *ab* slightly less than $cd<aa=or<or>bc$.

The first dorsal pore is on 9/10 but there is a rather pore-like but non-functional marking on 8/9 on several specimens.

The clitellum is protuberant, yellowish, extending from 12/13 or just behind 12/13 onto xvi, usually to include the setae of xvi. Intersegmental furrows are lacking, dorsal pores usually occluded but the positions indicated by small pits, setae present.

The spermathecal apertures are minute, median to *a*, rather closely paired, the distance between setal line *a* and the pore slightly less than the midventral distance between the two pores.

The female pores are paired, each pore slightly anterior and median to *a*.

The genital shield is wider anteriorly than posteriorly and extends across xvii and the posterior portion of xvi both of which are elongated ventrally. On the anterior portion of the shield there is a pair of especially protuberant areas with glossy surfaces. These areas are rather oval in outline but are not sharply demarcated peripherally and are diagonal in position with the posterior end always nearer to the midventral line. On one worm the oval areas are not protuberant or glossy but are level, translucent and finely wrinkled. On some of the specimens, each of the oval areas may be situated on a less protuberant but still slightly elevated area that is approximately circular in outline though not definitely demarcated peripherally. The midventral region on

the anterior portion of the shield is usually slightly depressed and with short, transverse and longitudinal wrinkles. The width of the wrinkled region varies according to the angle of divergence of the oval areas and may be narrow or quite wide. A deep seminal groove at the centre of each oval area, with the anterior end in the lateral portion of *bc* or in *cd*, passes posteriorly to terminate at or close to line *a*, and a short distance in front or 17/18, the groove more or less crescentic in shape and with the concave side facing anteromesially. Only the anterior portion of each groove is on an oval area, the posterior portion of each groove is on a rather definite, transverse ridge. Just behind the ridge is a deep, transverse groove that extends laterally on each side to *b* or slightly into *bc*. A transverse groove may be present just in front of the ridge but extends, on each side, only to *a*. The male pore is minute and within the seminal groove at or close to the posterior end. The male pores have been definitely identified only on a few specimens, included among which is the aclitellate individual, but the prostatic duct in other worms can be traced through the parietes to the region of the hind end of the groove.

Internal anatomy.—The prostates extend through xvi-xx or xxi and may be rather strap-shaped in appearance, with incisions of the lateral margin marking off several lobes, or shorter and much less strap-shaped in appearance—in one mass or in two, definitely separated lobes. The prostatic duct always bifurcates entally, the two branches being short, especially when the gland is in one mass. The prostatic duct is short, slender, without muscular sheen, softish, bent into one or two tiny, U-shaped quirks just prior to its entrance into the parietes.

The spermathecal duct is shorter than the ampulla, abruptly narrowed within the parietes, the lumen rather wide entally but abruptly narrowed ectal to the diverticular junction. The diverticulum is small, shorter than the combined lengths of duct and ampulla ; sausage-shaped, shortly pear-shaped or almost spheroidal, or club-shaped. The lumen is wide, even in the narrower ectal portion, the spermatozoal mass extending almost into the duct. There is therefore no differentiation into stalk and seminal chamber as in *Pheretima* though the narrower, ectal portion may have something of a stalk-like appearance externally.

Remarks.—Aclitellate specimens from Taungyi, described in a previous paper (Gates 1932, p. 373) under the designation " Forma tertia " are evidently to be referred to *T parvus*. The species is distinguished from *T conversus* (Gates) 1930, by the smaller size and the anterior divergence of the seminal grooves.

Diagnosis.—Male genital shield extends across xvi and xvii, each seminal groove rather crescentic and with the concave side facing anteromesially, the anterior ends more widely separated midventrally than the posterior ends, male pores within the grooves, at or near the posterior ends. Setae lumbricine. Length 65-130 mm. Diameter 3-4½ mm.

Prostates strap-shaped or in two separated lobes, in xvi-xx. Spermathecal duct shorter than the ampulla, diverticulum shorter than combined lengths of duct and ampulla, sausage-shaped, shortly pear-shaped, club shaped or almost spheroidal.

Genus **Megascolex** Templeton.

1844. *Megascolex*, Templeton, *Proc. Zool. Soc. London*, 1844, p. 89. (Genotype, *Megascolex caeruleus* Templeton 1844).

Megascolex mauritii (Kinberg).

1867. *Lampito mauritii*, Kinberg, *Öfv. Ak. Förh.*, XXIII, p. 103. (Type locality, Mauritius. Types in the Stockholm Museum).
1888. *Megascolex armatus*, Rosa, *Ann. Mus. Genova*, XXVI, p. 159.
1895. *Megascolex armatus*, Beddard, *Monog.*, p. 384.
1900. *Megascolex mauritii*, Michaelsen, *Das Tierreich*, X, p. 227.
1916. *Lampito mauritii*, Stephenson, *Rec. Ind. Mus.*, XII, p. 315.
1923. *Megascolex mauritii*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 259.
1926. *Megascolex mauritii*, Gates, *Ann. Mag. Nat. Hist.* (9), XVII, p. 440.
1926. *Megascolex mauritii*, Gates, *Rec. Ind. Mus.*, XXVIII, p. 151.
1930. *Megascolex mauritii*, Gates, *Rec. Ind. Mus.*, XXXII, p. 301.
1931. *Megascolex mauritii*, Gates, *Rec. Ind. Mus.*, XXXIII, p. 361.
1932. *Megascolex mauritii*, Gates, *Rec. Ind. Mus.*, XXXIV, p. 374.
1933. *Megascolex mauritii*, Gates, *Rec. Ind. Mus.*, XXXV, p. 491.

Material examined.—From the Genoa Museum: two undissected specimens, one probably aclitellate, the other probably clitellate, labelled, " *Megascolex armatus* (Beddard) Rosa, Ann. Mus. Civ. Genova, XXVI, 1888, p. 157. Mandalay. Nov. 1885. Viaggio di L. Fea. Cat. No. 2."

From local collections:

Bhamo and vicinity, Sept. 1934, 1 aclitellate and 11 clitellate specimens. K. John.

Myitkyina and vicinity, Sept. 1934, 5 aclitellate and 1 clitellate specimens. K. John.

External characteristics.—Setal circles are present on all the clitellar segments. There is always a wide, midventral gap in each setal circle. On the preclitellar segments there is almost always a fairly wide, mid-dorsal gap. On the postclitellar segments the mid-dorsal gap is definite, usually fairly wide though slightly variable in width from segment to segment. An occasional specimen has only very slight, mid-dorsal gaps on the preclitellar segments and almost no mid-dorsal gaps on the postclitellar segments. These specimens may have slightly larger setal numbers than the other worms. Seta *b* on xvii and xix is either just median to the male pore line or (often) actually on the male pore line. The setal formulae of ten specimens from the recent and earlier collections are shown below. The number of setae on xx was determined on six additional specimens: 32, 35, 33, 34, 30, 36.

vii	viii	xviii	xix	iii	viii	xii	xx
12	12	0	4	29	40	38	35
10	12	0	4	26	49	48	35
12	14	0	4	32	42	39	37
10	12	0	4	39	43	44	42
11	12	0	4	31	41	41	36
12	16	0	4	—	56	46	38
15	16	0	4	36	49	50	38
12	12	0	4	32	40	40	37
12	16	0	4	32	46	43	36
13	14	0	4	33	51	50	38

—not counted because of gaps.

The first dorsal pore is on 11/12 (7), or 12/13 (13).

The external apertures of the male genitalia are represented by tiny, transverse slits, each slit at or near the centre of a fairly large porophore. Through these slits the penial setae project. The porophores are slightly protuberant and are crossed by the secondary furrows marking off the three secondary annuli of the segment.

Internal anatomy.—The prostatic duct is straight, 2-3 mm. long, with muscular sheen.

The spermathecal ampulla is two to four times as long as the duct and is narrowed ectally. The duct is bulbous, with muscular sheen, abruptly narrowed prior to its entrance into the parietes. Into this narrowed portion but within the coelomic cavity pass the paired diverticula, one to the median and one to the lateral side of each duct. Each diverticulum comprises a shortly ovoidal to sausage-shaped seminal chamber and a very short, slender stalk, the length of the diverticulum less than that of the duct. The lumen in the bulbous portion of the duct is transversely slit-like. When the spermathecal duct is dissected out from the parietes the circular to transversely oval, translucent porophore on which the spermathecal pore is located is retained on the ectal end of the duct, leaving an aperture in the epidermis with a smooth margin.

One worm has one spermatheca partly doubled. There are two distinct ampullae, each with the characteristic, narrowed, ectal portion. The duct is single but in the bulbous portion with two cavities, each slit-like but diagonally placed. There are three diverticula, one passing to the median face of the duct in addition to the usual pair.

Diagnosis.—Sexthecal, spermathecal pores three pairs, on 6/7-8/9. Male pores tiny, transverse slits on large, nearly circular, slightly protuberant porophores that dislocate 17/18 and 18/19 slightly. Paired female pores. Setal rings interrupted midventrally, setal circles present on all clitellar segments, in the anterior part of the body setae *a-d* ornamented : vii/10-15, viii/12-16, xvii/4, xviii/0, xix/4, 26-39-iii, 40-51/viii, 38-50/xii, 30-42/xx. Clitellum annular, on xiv-xvii, often extending across the posteriormost annulus of xiii. First dorsal pore on (10/11) 11/12-12/13. Length 95-155 mm. Diameter 3-4 mm. Segments, 160-190.

Gizzard in v. Excretory organs ; open, enteronephric meganephridia and closed, exonephric micronephridia. Seminal vesicles in ix and xii. Spermathecal duct with transversely slit-like lumen, bulbous entally, abruptly narrowed prior to entrance into the parietes ; diverticula paired, into the lateral and median faces of the narrowed, coelomic portion of the duct, each diverticulum shorter than the duct and with a very short, slender stalk and ovoidal to ellipsoidal seminal chamber. Penial setae with horseshoe-shaped to scoop-shaped tip, ornamented by numerous rings of large, closely crowded spines or triangular teeth.

Genus **Pheretima** Kinberg.

1867. *Pheretima*, Kinberg, *Öfv. Ak. Förh.*, XXIII, p. 102. (Genotype, *Pheretima montana* Kinberg 1867).

Diagnosis.—Setae, perichaetine. Excretory organs, exonephric and enteronephric micronephridia. One gizzard, in viii or in the space

between 7/8 and 9/10 or 10/11. Prostates, racemose. Testes and male funnels in testis sacs.

A few words of explanation are necessary with regard to the diagnoses. A very large proportion of the species of *Pheretima* are characterized as follows :—setae begin on ii on which segment there is a complete setal circle ; clitellum annular and extending from 13/14 to 16/17, with development of clitellar glandularity the setae of the clitellar segments drop out, the intersegmental furrows between xiv and xv and xv and xvi disappear and the dorsal pores on 14/15 and 15/16 are occluded ; ventral reproductive apertures ; septa 8/9-9/10 lacking or quite rudimentary, septa 5/6-7/8 present and also from 10/11 posteriorly ; intestine begins in xv or xvi close to 15/16 ; last pair of hearts in xiii ; seminal vesicles two pairs in xi and xii ; testis sacs in x and xi. Since these characteristics are so very common throughout the genus, it scarcely seems to be necessary to repeat them in a specific diagnosis. Deviation from any of these characteristics, if specific and not merely individual, is important and is included in the diagnoses. The prostomium, colour, secondary annulation, female pores, prostates, prostatic ducts, ovaries and spermathecal ampullae as well as certain other structures are not of importance in the present connection, either as a result of wide intra-specific variation (colour), or because of a lack of inter-specific variation. To further shorten the diagnoses and thereby make them more readily useful, negative statements have been largely omitted, except when necessary in connection with list above. Thus, if a species is characterized by the presence of genital markings, the markings are briefly described, while mention of genital markings is omitted from the diagnosis of any species that lacks these structures. Similarly, if the anterior seminal vesicles are included within the posterior testis sacs, mention is made of this fact ; no mention of seminal vesicles being necessary if the anterior vesicles are *not* included within the posterior testis sac. Finally the diagnoses are Burmese, *i.e.*, based on studies of worms of Burma. No attempt has been made to bring these diagnoses into harmony with antiquated, inaccurate, or incomplete descriptions of the same worms (often with ?) from other places.

The setal counts in the specific descriptions are selective, as must necessarily be the case. Thus, so far as has been possible, setal counts have been made only when the setal ring of the segment concerned is uninterrupted. Interruptions in the setal circles are frequent, either as the result of external damage, parasitic activity, or (perhaps) senility. It must be obvious that no useful information, so far as specific characterization is concerned, can be obtained by a setal count on a segment from which as many as a half or even more of the setae have dropped out.

Pheretima aculeata, sp. nov.

Material examined.—From the Indian Museum : one partially (?) clitellate and 2 aclitellate specimens labelled, " Port Blair. Sta. B. 10 ".

External characteristics.—Length of the partially clitellate specimen 128 mm. Diameter 4 mm. Anterior to the clitellum the dorsum has a reddish pigmentation.

The setae begin on ii on which segment there is a complete circle. There are no definite gaps in the circles, the setae protuberant and readily visible. Formulae: vi/11, vii/10, viii/12, xvii/15, xviii/4, xix/16, 30/iii, 36/viii, 58/xii, 8/xiv, 10/xv, 15/xvi, 61/xx; vi/11, vii/12, viii/13, xvii/15, xviii/4, xix/14; vi/10, vii/9, viii/9, xvii/11, xviii/3, xix/13.

There is a functional dorsal pore on 13/14 (2) and a pore-like marking on 12/13 which may represent a functional dorsal pore.

The clitellum extends from 13/14 to 16/17 and is annular on xiv the clitellar glandularity lacking ventrally from 14/15 to 16/17; dorsal pores lacking, intersegmental furrows and setae present ventrally.

The spermathecal pores are minute and superficial, four pairs, on 5/6-8/9, each pore on a tiny, circular, slightly convex, glistening area.

There is, apparently, a single female pore on xiv, in a midventral gap in the transverse setal line.

The male pores are minute and superficial, each pore at the centre of a small, circular area that is surrounded by a slight furrow.

There is a single pair of genital markings. Each marking is a rather small but protuberant, slenderly conical, smooth-surfaced body from the rounded, ventral face of which a seta protrudes. At the base of each marking is a slight, circumferential furrow the appearance of which seems to indicate that the genital marking is retractile into the parietes. Each marking is slightly median to a male porophore and in the transverse setal line. On two of the specimens there is on each side, between the genital marking and the male porophore, a single seta. On one specimen this seta is lacking on one side. The rather wide, midventral space between the two genital markings lacks setae.

Internal anatomy.—Septa 8/9-9/10 are lacking; 12/13-13/14 are muscular and quite definitely thicker than 6/7-7/8; 10/11 very delicate.

On the oesophagus just behind the gizzard there is a very low, glandular collar. The intestine begins in xv (2). The intestinal caeca are simple, the margins smooth or with slight, septal constrictions.

The single heart of ix is on the right side (2). The last pair of hearts is in xiii (2). All hearts of ix-xiii pass into the ventral vessel.

The testis sacs are unpaired and ventral. Each seminal vesicle is provided with a long, finger-like, primary ampulla which is attached to a middle point of the median face of the ventral lamina. The prostates extend through xvii-xx. The prostatic duct is 2 mm. long, spindle-shaped, erect, with muscular sheen.

The spermathecae are small. The duct is bulbous, the coelomic portion shorter than the ampulla from which it is clearly demarcated. The diverticulum is elongate and passes into the duct within the parietes. An ectal portion of the diverticulum which may be longer than the combined lengths of duct and ampulla has a muscular sheen, a thick wall and narrow lumen. In the ental portion of the stalk the lumen is widened but with high, circular ridges projecting into it. The seminal chamber comprises a short, looped, ectal portion with thin wall and wide lumen that is constricted off from a terminal, thin-walled, ovoidal

to sausage-shaped portion. Each seminal chamber of the clitellate specimen is characterized by a spermatozoal iridescence which extends down into the looped portion of the diverticulum. When the spermathecal duct is dissected out from the parietes the spermathecal-pore papilla is removed at the end of the duct, leaving an aperture in the body wall with a smooth margin.

Slightly median to the ectal end of the prostatic duct there is a slender, rather columnar protuberance into the coelom. On or through the dorsal face of this column there are visible three dark circles, the bases of three setae. These setae are straight, 0·58-0·6 mm. long, and *ca* 0·085 mm. thick at the widest portion, the ental end or base. The tips are ornamented with numerous, short, transversely placed rows of fine spines or teeth. The tip of one of the setae from one follicle is slightly hollowed on one side.

Into the parietes immediately in front of the columnar setal follicle there passes the duct of the genital marking gland. The gland itself is in xvii where it is covered over with a friable layer of material that can easily be scraped off. Within the parietes the duct of the gland passes around to the median face of the setal follicle and after giving off a short, posteriorly directed diverticulum passes abruptly, deep down into the body wall. The gland is ovoidal in shape and the lumen is central and quite small.

Parasites.—On the dorsal wall of the gut in the first few intestinal segments there are nearly fifty, fairly large systs, probably protozoan.

Remarks.—*P. aculeata* resembles three other Andaman Island species in the possession of a stalked gland median to the prostate as well as modified setae that may be regarded as penial setae. From these other species, *andamanensis, harrietensis* and *osmatoni, aculeata* is distinguished by the number of spermathecae.

Diagnosis.—Octothecal: spermathecal pores minute and superficial, four pairs, on 5/6-8/9. Male pores minute and superficial, each pore at the centre of a small, circular, disc-shaped porophore. Genital markings one pair of small, slenderly conical protuberances, each marking in the transverse setal line and slightly median to the male porophore. Setae: vi/10-11, vii/9-12, viii/9-13, xvii/11-15, xviii/3-4, xix/13-16, 30/iii, 36/viii, 58/xii, 61/xx. Length 128 mm. Diameter 4 mm.

Intestinal caeca simple. Testis sacs unpaired and ventral. Spermathecal diverticulum with stalk longer than combined lengths of duct and ampulla, lumen widened entally and wall with high, circular ridges, seminal chamber comprising a short, looped portion and a terminal, ovoidal to ellipsoidal portion. Genital marking glands stalked and coelomic, in xvii. A follicle with penial setae passes into each genital marking.

Pheretima analecta Gates.

1932. *Pheretima analecta*, Gates, *Rec. Ind. Mus.*, XXXIV, p. 501. (Type locality, Ko Haw Der, Karen Hills, Toungoo District).

Material examined.—Paratypes from the Karen Hills, Toungoo District.

The setal formulae of eight specimens selected at random from an extensive series of paratypes are given below :—

ii	iii	viii	xii	xx
12	39	72	78	74
9	48	69	78	73
8	50	79	79	76
5	56	74	78	70
6	48	73	74	73
6	50	71	77	71
10	60	79	76	78
12	63	80	82	71

The ratio of the width of the genital marking to the length is 7 : 2.

The internal organs of a number of specimens were examined, but there is little to add to the previous account. The spermathecal diverticula of all specimens (8) examined are characterized by a spermatozoal iridescence but this iridescence does not extend ectally as far as in *promota*, so that the stalk appears, here, to be longer. An ental portion of the stalk is looped two or three times.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, on 5/6-8/9. Male pores minute and superficial, each pore on a disc-shaped porophore. One genital marking, transversely elliptical, on 19/20. Setae lacking dorsally on ii: vi/21-27, vii/20-27, viii/23-29, xvii/20-24, xviii/13-18, 5-12/ii, 39-63/iii, 69-80/viii, 74-82/xii, 69-81/xx. First dorsal pore on 12/13. Length 50-124 mm. Diameter 3-5 mm. Segments 92-102.

Intestinal caeca simple. Testis sacs unpaired and ventral. Spermatheca with short diverticular stalk, looped entally, seminal chamber elongate, slightly widened passing entally, looped in a more or less regularly zigzagged fashion. Genital marking gland sessile, protuberant into the coelomic cavity.

Pheretima andamanensis Michaelsen.

1907. *Pheretima andamanensis*, Michaelsen, *Mitt. Mus. Hamburg*, XXIV, p. 164. (Type locality, N. Cinque Island, Andamans. Type in the Indian Museum, two paratypes in the Hamburg Museum).
1909. *Pheretima andamanensis*, Michaelsen, *Mem. Ind. Mus.*, I, p. 194.
1923. *Pheretima andamanensis*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 292.
1932. *Pheretima andamanensis*, Gates, *Rec. Ind. Mus.*, XXXIV, p. 414. (Re-examination of the type).

Material examined.—From the Hamburg Museum: two paratypes, one dissected and one undissected, labelled, "*Pheretima andamanensis* Michlsn. V 7169".

External characteristics.—Setae : viii/11, xviii/10-12.

The first dorsal pore is on 12/13.

The clitellar glandularity is only slightly developed, setae visible on all three clitellar segments, at least ventrally.

The spermathecal pores are superficial (?), transverse, small, on the intersegmental furrows.

The male pores are invaginate, each pore within a copulatory chamber with a slit-like aperture.

The two genital markings are on xviii, one just median to each copulatory chamber aperture. The genital marking is thickly disc-shaped, almost shortly columnar, retracted into a slight parietal invagination. On each marking two pits or apertures are visible. The median pore appears to be the external opening of a stalked gland. Lateral to this aperture is a pit within which a seta is visible, the tip of the seta apparently broken off. On the undissected paratype the genital markings are not so well developed.

Internal anatomy.—The prostatic duct is slightly thicker than the stalk of the genital marking gland but is slender and passes into the lateral wall of an invagination which protrudes into the coelomic cavity and hence is to be termed a copulatory chamber. On the lateral wall of the chamber is a rather elongately flattened body one face of which is concave and which probably bears the male pore.

The genital marking gland has a long stalk and the gland itself is bound by connective tissue onto the prostate but anteriorly so that gland and prostate at first appear to be a single, elongate structure extending through several segments. On the lateral face of the stalk of the gland is a peni-setal follicle.

The spermathecal diverticulum passes into the median face of the duct close to the parietes but the junction of duct and diverticulam is covered over by glandular masses, one of which protrudes through the septum into the segment next anteriorly.

Remarks.—The external aperture of the genital marking gland was mistaken by Michaelsen for the male pore while the real male pore and the copulatory chamber were overlooked.

The modified setae, possibly to be regarded as penial setae, are, in this species, associated with a genital marking rather than the copulatory chamber.

P. andamanensis is known only from the types, none of which are fully clitellate.

Diagnosis.—Quadrithecal, spermathecal pores small, transversely placed, (superficial ?), two pairs, on 7/8-8/9. Male pores invaginate, each pore on the lateral wall of a copulatory chamber with a slit-like aperture. Genital markings one pair, each marking just median to the copulatory chamber aperture, thickly disc-shaped, retracted into a slight, parietal invagination, on the ventral face of each marking a median pore—the aperture of the gland, and laterally a penial seta, the latter ornamented and with a bifid tip. Setae: viii/11-12, xviii/10-15, 52/xii, 58/xix. First dorsal pore on 12/13. Length 108-120 mm. Diameter 6-6½ mm.

Intestinal caeca simple. Testis sacs unpaired and ventral. An annular gland around the spermathecal duct ectally; diverticular stalk slender, much longer than combined lengths of duct and ampulla, irregularly looped, seminal chamber small, ovoidal. Genital marking gland elongately stalked and bound to the anterior face of the prostate.

Pheretima andersoni Michaelsen.

1907. *Pheretima andersoni*, Michaelsen, *Mitt. Mus. Hamburg*, XXIV, p. 167. (Type locality, Amherst. Type in the Indian Museum. One paratype in the Hamburg Museum).
1909. *Pheretima andersoni*, Michaelsen, *Mem. Ind. Mus.*, I, p. 198.
1923. *Pheretima andersoni*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 293.
1930. *Pheretima andersoni*, Gates, *Rec. Ind. Mus.*, XXXII, p. 305.
1931. *Pheretima andersoni*, Gates, *Rec. Ind. Mus.*, XXXIII, p. 371.
1932. *Pheretima andersoni*, Gates, *Rec. Ind. Mus.*, XXXIV, p. 504.

Material examined.—From the Hamburg Museum: one clitellate and dissected paratype labelled, "*Pheretima andersoni* Michlsn. Birma, Amherst. W. Anderson. V 7167".
From local collections:
Kyaikmaraw, Aug. 1935, 18 aclitellate specimens. K. John.

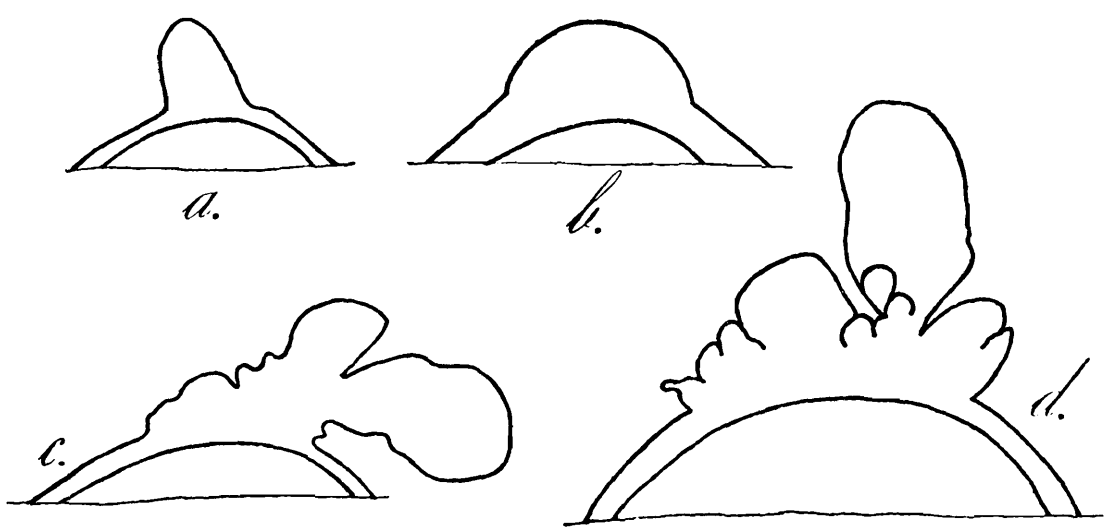
External characteristics.—The setal formulae of five specimens are shown below:—

vi	vii	viii	xvii	xviii	xix	iii	viii	xii	xx
35	38	38	33	28	35	74	117	116	111
30	33	33	31	25	34	70	119	113	105
38	39	38	36	33	30	77	118	115	113
32	31	33	35	24	30	80	112	109	100
25	26	28	28	21	27	83	114	111	103

The first three specimens are aclitellate, the first 150 × 8 mm., the third 260 × 10 mm., the second intermediate in size between the first and third. The last two specimens are from earlier collections and are clitellate but atypical, each specimen with two genital markings, on 20/21-21/22, and with transversely oval areas of epidermal thinness on vii and viii. The setae are deeply retracted on these oval areas but are recognizable with high powers of the binocular.

Internal anatomy.—(Opened 10 aclitellate specimens and five clitellate specimens of the atypical forms. The internal organs of the paratype had been partly removed.)

The intestinal caeca are simple, the margins smooth except for the septal constrictions. The glandular collar on the gut just behind the gizzard is well developed, some of the lobes 6 mm. high.



TEXT-FIG. 2.—*Pheretima andersoni* Michaelsen. *a-d.*, ental ends of four spermathecal diverticula. ×*ca.* 75.

In the aclitellate worms the seminal vesicles are well developed and the testis sacs are distended by testicular coagulum. The seminal

vesicles of xi are attached to the roof of the posterior testis sac with a conical protuberance from the ventral face of each vesicle fitting into a concavity in the roof of the testis sac like a ball and socket joint. In these specimens it is difficult to dissect out the seminal vesicles without opening the posterior testis sac. In the clitellate specimens the ball and socket joint is only slightly indicated or not present and the vesicles can be removed easily without opening the testis sac.

The spermathecal duct is shorter than the ampulla from which it is not sharply marked off, the ampulla narrowing gradually towards the duct. The lumen of the duct is wide, narrowing gradually passing ectally. The diverticulum is longer than the combined lengths of duct and ampulla and comprises a stalk and a longer, very slenderly club-shaped seminal chamber, the latter widest entally but even here not much wider than the stalk. On the ental end of the diverticulum (atypical, clitellate forms) there may be a solid body. This may be shortly ovoidal, and shortly stalked or otherwise shaped (*vide* figures). A very few of the 40 spermathecae examined lack this peculiar structure.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, on 5/6-8/9. Male pores minute and superficial, each pore at the centre of a small, transversely oval, disc-shaped porophore. Genital markings transversely placed, unpaired, intersegmental, 23-35 intersetal intervals wide, in a longitudinal row of 5-8 on 18/19-26/27 Setae : vi/25-46, vii/26-43, viii/28-50, xviii/25-46, xviii/19-34, xix/27-42, 70-80/iii, 112-119/viii, 109-116/xii, 100-113/xx. First dorsal pore on 12/13. Length 250-260 mm. Diameter 6-11 mm. Segments 120-124.

Intestinal caeca simple. Testis sacs unpaired and ventral. Spermathecal diverticulum longer than combined lengths of duct and ampulla, stalk short, seminal chamber slenderly club-shaped. Genital marking glands sessile, slightly protuberant into the coelomic cavities.

Remarks.—Local collectors have not been able to secure clitellate specimens of the typical forms but have secured clitellate specimens that are slightly aberrant. Atypical forms have only one, two or three genital markings and, in addition, transversely oval areas of epidermal thinness on some of segments vi-ix. Setae may be deeply retracted or lacking on these preclitellar areas.

Pheretima anomala Michaelsen.

1907. *Pheretima anomala*, Michaelsen, *Mitt. Mus. Hamburg*, XXIV, p. 167. (Type locality, Botanical Gardens, Sibpur, Calcutta. Type in the Indian Museum. Paratypes in the Hamburg Museum).
1909. *Pheretima anomala*, Michaelsen, *Mem. Ind. Mus.*, I, p. 189.
1923. *Pheretima anomala*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 294.
1925. *Pheretima anomala*, Gates, *Ann. Mag. Nat. Hist.* (9), XV, p. 538.
1925. *Pheretima* species, Gates, *Ann. Mag. Nat. Hist.* (9), XV, p. 543.
1925. *Pheretima insolita*, Gates, *Ann. Mag. Nat. Hist.* (9), XVI, p. 568. (Type locality, Rangoon).
1926. *Pheretima anomala*, Gates, *Rec. Ind. Mus.*, XXVIII, p. 151.
1926. *Pheretima insolita*, Gates, *Rec. Ind. Mus.*, XXVIII, p. 161.
1929. *Pheretima anomala*, Stephenson, *Rec. Ind. Mus.*, XXXI, p. 234.
1930. *Pheretima anomala*, Gates, *Rec. Ind. Mus.*, XXXII, p. 307.
1930. *Pheretima insolita*, Gates, *Rec. Ind. Mus.*, XXXII, p. 312.
1931. *Pheretima anomala*, Gates, *Rec. Ind. Mus.*, XXXIII, p. 372.

1932. *Pheretima anomala*, Gates, *Rec. Ind. Mus.*, XXXIV, p. 387.
1933. *Pheretima anomala*, Gates, *Rec. Ind. Mus.*, XXXV, p. 496.

Material examined.—From the Hamburg Museum: one clitellate and dissected and two clitellate, undissected paratypes labelled, "*Pheretima anomala* Michlsn. Sibpur bei Calcutta. V 7185". From local collections:
Bhamo and vicinity, Sept. 1934, 11 clitellate specimens. K. John.
Myitkyina and vicinity, Sept. 1934, 3 clitellate specimens. K. John.
"Rotting leaves under banyan tree", Mong Ko, Mang Lun State, Oct. 1935, 1 clitellate specimen. H. Young.
"Under mango tree", Tan Yang, Mong Yai State, Sept. 1935, 1 clitellate specimens. H. Young.
"Under trees", Taungyi, Sept. 1935, 29 clitellate specimens. H. Young.
"Open ground", Pa Mung Village, Tan Yang, Sept. 1935, 7 clitellate specimens. H. Young.
Kyaikmaraw, Aug. 1935, 1 clitellate specimen. K. John. (All local specimens are normal).

External characteristics.—The setae may be slightly zigzagged ventrally on some of the preclitellar segments. The setal formulae are shown below:—

vi	vii	xix	xx	iii	viii	xii	xx
21	22	17	17	61	—	91	61
21	22	16	16	62	93	89	64
18	19	17	16	63	96	93	70
19	18	16	15	60	92	95	63
22	23	18	15	68	93	87	69
20	19	18	17	64	90	94	68
19	19	16	16	68	95	88	68

The spermathecal pores are minute and invaginate, each pore at the centre of a vertically placed, oval, disc-shaped marking on the anterior wall of a parietal invagination. The marking is slightly raised, the outline often not regular, the pore readily recognizable though minute, open, surrounded by a definite, annular lip. The invagination is slightly bent in a posterior direction within the body wall so that the spermathecal duct appears to pass into the dorsal face of the invagination.

The male pores are minute and invaginate, each pore at the centre of a transversely oval, almost circular tubercle on the roof of a slight parietal invagination with a transversely slit-like aperture. The tubercle is indistinctly delimited peripherally but a fine, greyish line marks off a narrow rim from the central portion. The central portion may be slightly convex in a regularly rounded fashion. When the invagination is everted the male pore tubercle is at the ventral end of a shortly columnar porophore.

The genital markings are internal, each marking on the roof of a slight, parietal invagination with a transversely slit-like aperture. The genital markings are circular or almost circular, indistinctly delimited peripherally but with a fine, grey line marking off a narrow rim from the central portion. The latter may be level or slightly convex in a

regularly rounded fashion. At the centre of each marking is a minute but obvious pore. The invagination may be everted as a shortly columnar porophore with the genital marking on the ventral face.

Internal anatomy.—(Opened 10 specimens.) The intestinal caeca are simple, the margins deeply constricted by the septa through which the caeca pass.

The testis sacs are unpaired and ventral in each of the specimens. The anterior margin of the testis sac of x is very deeply depressed, so much so, in some of the specimens, that the worm appears to have a pair of completely separated sacs. In each of these worms a slender cord of testicular coagulum connects the two, large masses of coagulum in the lateral portions of the sac.

The spermathecal duct is elongate and slender, the transition from duct to ampulla gradual and rather indefinite. The lumen of the duct is transversely slit-like or rather irregular, with slight longitudinal ridges but ectal to the diverticular junction the lumen is narrow and with smooth wall. The diverticulum comprises a short, straight, stalk, a middle portion that is irregularly looped or twisted and a slenderly club-shaped seminal chamber. The middle portion of the diverticulum is distinguished from the stalk only by the looping and the gradual widening of the lumen entally. The seminal chamber may have slight traces of looping and is distinguished from the ental part of the middle portion only by the presence of spermatozoa. The entalmost portion of the seminal chamber is ovoidal and often constricted on one side, but the spermatozoa extend for some distance ectal to the constriction.

Diagnosis.—Sexthecal, spermathecal pores minute and invaginate, each pore at the centre of a vertically placed, oval marking on the anterior wall of an invagination with a transversely slit-like aperture ; three pairs, on 5/6-7/8. Male pores minute and invaginate, each pore at the centre of a transversely oval tubercle on the roof of a slight parietal invagination in the setal circle of xx. Genital markings internal, each marking on the roof of a slight parietal invagination with a transversely slit-like aperture ; three pairs, in the setal circles of xvii-xix. Setae present ventrally on xvi : vi/17-22, vii/17-23, xix/16-18, xx/15-21, 60-68/iii, 90-96/viii, 78-95/xii, 81-90/xiii, 6-26/xvi, 61-70/xx. First dorsal pore on 12/13. Length 80-180 mm. Diameter 4-5½ mm. Segments 119-130.

Intestinal caeca simple. Testis sacs unpaired and ventral. Spermathecal diverticulum with short stalk, looped middle portion in which the lumen is gradually widened and a slenderly club-shaped seminal chamber. Genital marking glands mushroom-shaped, the duct muscular, shortly spindle-shaped and coelomic.

Remarks.—In this species abnormal individuals are found more frequently than the normal. Aberrant forms may be athecal and with genital markings on xvii-xix and xxi-xxv, thecal but without male pores or genital markings, or intermediate between the form defined above and either of the two aberrant extremes. The types are all athecal.

Pheretima arboricola, sp. nov.

Material examined.—From local collections:

"Under bark of trees", Karen Hills, Toungoo District, Sept. 1935, one clitellate specimen, possibly lacking a portion of the tail. G. E. Blackwell.

External characteristics.—Length 49 mm (+?). Diameter 3 mm. Number of segments, 66 (+?). Pigmentation, reddish on the dorsum but fading out gradually on the posterior portion.

The setae begin on ii on which segment there is a complete circle, and are fine, retracted into the parietes so that accurate counting is difficult. Setal formula,—vi/21, vii/23, viii/22, xvii/19, xviii/0, xix/20, 51/viii, 46/xii, 44/xx.

The first functional dorsal pore is on 11/12 but there is a pore-like marking on 10/11.

The clitellum is annular, extending from 13/14 to 16/17; intersegmental furrows, dorsal pores and setae lacking.

Posterior to the clitellum the body wall is thickened mid-ventrally to form an approximation to the creeping sole which characterizes the group of species referred by Michaelsen to the subgenus *Planapheretima*. In *P. arboricola* this parietal thickening is not definitely demarcated but becomes gradually thinner passing laterally on each side. The sole is whitened, the setae smaller thereon than elsewhere and more closely crowded. The intersegmental furrows are deepened as they cross the sole. The sole is not, or only slightly, developed on the preclitellar segments and is wider on xvii than xix and on xix than xx, decreasing gradually in width passing posteriorly.

The spermathecal pores are minute and superficial, four pairs, on 5/6-8/9.

There is a single female pore.

The male pores are minute and superficial, each pore at the centre of a disc-shaped porophore, the latter approximating to circular in outline except mesially where the margin is almost straight.

The single genital marking is on xviii, transverse, extending laterally on each side almost to the male porophore, posteriorly to the level of 18/19 though the latter is not recognizable ventrally or laterally, and anteriorly to a level about in line with the anterior margins of the male porophores. The marking is demarcated peripherally by a fine grey line which appears to be a region of epidermal thinness and not a furrow.

Internal anatomy.—None of the septa are especially thickened; 8/9 represented by a ventral rudiment only; 9/10 lacking.

The intestine begins in xv. The intestinal caeca are compound, glove-shaped, the dorsalmost secondary caecum the shortest, the ventralmost secondary caecum the longest.

The single heart of ix is on the right side. The last pair of hearts is in xiii.

The testis sacs of x and xi are ventral and apparently unpaired. The anterior seminal vesicles push 10/11 forward so that the vesicles appear to lie in part alongside the gizzard. The posterior vesicles push 12/13 back into contact with 13/14. The vesicles of a segment are in

contact mesially above the dorsal blood vessel. The prostates extend through xvii-xxi. The prostatic duct is short and slender.

The spermathecal duct is slightly shorter than the ampulla from which it is not clearly demarcated, abruptly narrowed within the parietes. The diverticulum passes into the anterior face of the duct at the parietes and is elongately tubular and with no spermatozoal iridescence. Except for a very short, ectal portion the diverticulum is shortly looped, in part approximating to a regularly zigzagged arrangement. The lumen is small, the wall thick. Entally short passages open out from the central lumen into tiny peripheral chambers. In the entalmost portion of the diverticulum the lumen is arborescent, the ends of the branches terminating in small chambers.

The genital marking gland is sessile on the parietes and is large, extending through xvii-xx.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, in 5/6-8/9. Male pores minute and superficial, each pore at the centre of a disc-like porophore. One transversely placed genital marking posteriorly on xviii. A midventral region of the postclitellar portion of the body is thickened and with finer and more closely spaced setae. Setae: vi/21, vii/23, viii/22, xvii/19, xviii/0, xix/20, 51/viii, 46/xii, 44/xx. First dorsal pore on 11/12. Length 49 mm. Diameter 3 mm.

Intestinal caeca compound, glove-shaped, ventralmost secondary caecum the longest. Testis sacs unpaired and ventral. Spermathecal diverticulum elongately tubular, looped, with thick wall and narrow lumen. Entally the lumen opens out into numerous, small, peripheral chambers. Genital marking gland sessile on the parietes.

Remarks.—*P. arboricola* is distinguished from the Borneo species referred to *Planapheretima* by the smaller clitellum and the presence of well developed intestinal caeca.

The ventral sole with the associated crowding and modification of the setae now appears to be a development that has arisen independently in different parts of the *Pheretima* domain.

Pheretima austrina Gates.

1930. *Pheretima exigua* (part), Gates, *Rec. Ind. Mus.*, XXXII, p. 310. (Including specimens from Nyaungbinkwin only.)
1931. *Pheretima exigua*, Gates, *Rec. Ind. Mus.*, XXXIII, p. 378.
1932. *Pheretima exigua* var. *austrina*, Gates, *Rec. Ind. Mus.*, XXXIV, p. 514. (Type locality, Leiktho Circle, Toungoo District.)
1933. *Pheretima exigua* var. *austrina*, Gates, *Rec. Ind. Mus.*, XXXV, p. 525.

Material examined.—Four specimens collected in Myitkyina and Bhamo Districts, Sept. 1934, by K. John, as well as the earlier specimens.

External characteristics.—The length of the Myitkyina and Bhamo specimens varies from 28 to 57 mm., the diameter from 2 to 3 mm. Some of the types are 60 to 75 mm. long.

The setae begin on ii on which segment there is a complete circle. On each of the clitellar segments a complete circle of setae is visible with brilliant illumination, the setae deeply retracted on the dorsum and scarcely recognizable by dimmer light. Setae are totally lacking on

x on the Nyaungbinkwin specimens, but on other worms a few scattered setae or a complete circle may be present on this segment. The setal formulae are shown below :—

vi	vii	viii	xvii	xviii	xix	iii	viii	xii	xx
10	14	15	12	9	12	21	29	37	35*
10	10	11	10	8	10	15	24	28	30*
14	15	12	11	8	11	20	28	31	29*
12	14	16	12	8	11	20	33	34	31*
15	13	14	12	8	12	18	31	33	32*
12	12	14	11	8	12	20	28	34	34†
12	14	15	11	8	10	17	31	30	30†
9	11	11	11	8	12	16	28	30	28†
9	11	10	11	6	10	17	29	32	28†
11	11	13	11	9	11	16	29	33	32†

* From Nyaungbinkwin.
† Types.

The spermathecal pores are minute and superficial, four pairs, on the anterior margins of vi-ix.

The male pores are minute and superficial, each pore on a disc-like porophore which is slightly smaller than the genital markings.

The genital markings are transversely oval to almost circular, one pair, on 18/19, reaching anteroposteriorly nearly to the setae of xviii and xix and extending transversely from *a* to *c*, from *b* to *d* or within the region *ad*. Additional markings, rarely present, are also intersegmental, on 17/18 and 19/20.

Internal anatomy.—The intestinal caeca are simple, with smooth margins or constricted slightly by the septa through which the caeca pass, usually short, extending only through one or two segments.

The hearts of x are included within the anterior testis sac. The testis sac of xi was previously termed annular (Gates 1932, p. 516), but careful dissection of five specimens has failed to reveal more than a cylindrical sheet of tissue passing from 10/11 to 11/12 in such a way as to shut off a portion of xi containing the organs of the segment, including the gut. Testis sacs of this type, in which the gut is included, are now distinguished from annular testis sacs which do not include the gut by the term cylindrical.

The spermathecal duct is shorter than the ampulla, the diverticulum shorter to longer than the combined lengths of duct and ampulla, the diverticular stalk longer than the spheroidal to ovoidal or shortly ellipsoidal seminal chamber, the latter sharply marked off from the stalk.

Dorsal to each genital marking are several small, glandular bodies on the parietes, the ducts practically confined to the body wall.

Remarks.—With the collection of specimens of *austrina* in Myitkyina and Bhamo districts the maintenance of this form as a geographical variety of *exigua* is no longer possible. Although the differences between the two forms are small they appear to be numerous enough and so constant as to warrant the recognition of distinct species. *P. austrina* is distinguished from *P. exigua* by the segmental location of the spermathecal pores, the smaller size of the male porophores, the larger size, intersegmental location and smaller number of the genital

markings, the smaller setal numbers, the presence of setal circles on the clitellar segments, the larger number of discrete glands associated with each postclitellar genital marking, and possibly also by the smaller size of the seminal vesicles.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, on the anterior margins of vi-ix. Male pores minute and superficial, each pore on a circular, disc-shaped porophore that is slightly smaller than the genital markings. Genital markings transversely oval to nearly circular, intersegmental, on 18/19, in *ad.* Setal circles present on all clitellar segments : vi/9-15, vii/10-15, viii/10-16, xvii/8-13, xviii/6-10, xix/10-12, 15-21/iii, 24-33/viii, 28-37/xii, 24-38/xx. First dorsal pore on 12/13. Length 33-75 mm. Diameter 2-3 mm. Segments 73-103.

Intestinal caeca simple. Testis sacs unpaired : of x, annular ; of xi, cylindrical. Seminal vesicles of xi included within the posterior testis sac. Spermathecal duct shorter than the ampulla, diverticular stalk longer than the small, spheroidal to ovoidal or shortly ellipsoidal seminal chamber. Genital marking glands sessile on the parietes.

Pheretima balteolata Gates.

1932. *Pheretima balteolata*, Gates, *Rec. Ind. Mus.*, XXXIV, p. 425. (Type locality, Pang Wo, Mang Lun State.)

Material examined.—From local collections :

" Rotten leaves in dense jungle ", Peng Sai, Mang Lun State, Oct. 1935, 1 softened, clitellate specimen. H. Young.

External characteristics.—Length, 60 mm. Diameter 3 mm.

The setae are small, closely and regularly spaced : vi/22, vii/23, xvii/18, xviii/16, xix/16+. (The setal numbers of the type are : 75/iii, 108/viii, 110/xii, 99/xx.)

The spermathecal pores are minute and superficial.

The male pores are minute and superficial, each pore slightly lateral to the centre of a longitudinally oval porophore on xviii that does not reach either to 17/18 or 18/19.

Internal anatomy.—The prostatic duct is 5-6 mm long, bent into a hairpin loop.

The seminal chamber of the spermatheca may be ovoidal or an indistinctly marked off, club-shaped widening of the ental end of the diverticulum. The stalk and an ectal portion of the seminal chamber is looped in a rather loosely zigzagged fashion and bound by connective tissue to the duct and ampulla.

Diagnosis.—Spermathecal pores minute and superficial, three pairs, on 5/6-7/8. Male pores minute and superficial, each pore towards the lateral margin of a transversely or longitudinally oval porophore. Setae : vi/22-25, vii/23-28, xvii/18-24, xviii/10-16, xix/24-26, 75/iii, 108/viii, 110/xii, 99/xx. First dorsal pore on 12/13. Length 60-89 mm. Diameter 3 mm. Segments 110.

Intestinal caeca simple. Testis sacs unpaired and ventral. Spermathecal duct shorter than the ampulla, diverticular stalk and an ectal portion of the seminal chamber loosely looped, seminal chamber slenderly club-shaped to ovoidal.

Pheretima bellatula Gates.

1932. *Pheretima bellatula* Gates, *Rec. Ind. Mus.*, XXXIV, p. 427. (Type locality, Teung Cong, Mong Lem State, Yunnan.)

Material examined.—From local collections:

"Leaf covered sandy soil, on wooded hillside", Nam Mang Mang Lun State, Oct. 1935, 3 aclitellate specimens. H. Young.

External characteristics.—Length 37-50 mm. Diameter 2-2½ mm. The setae are small and deeply retracted on the dorsum and hence very difficult to identify but appear to be more widely separated than ventrally. As near as can be determined the setal numbers are as follows: vi/12, 8; vii/14, 11; xvii/12, 11, 10; xix/12, 12, 12; 30/iii, 41/viii, 44/xii, 42/xx. After removal of the cuticle from the type, setae are now visible on xvi ventrally and are probably also present ventrally on xv.

The first dorsal pore is on 11/12 (3).

As on the type the male pores are on an unpaired male porophore which is sharply demarcated by a circumferential groove, the porophore slightly protuberant, especially laterally, and probably extending onto xvii and xix though 17/18 and 18/19 are not visible ventrally or laterally. There is no glandular material visible in the coelomic cavity or within the parietes dorsal to the porophore which is merely a region of epidermal thickening.

Internal anatomy.—Septum 8/9 is complete but membranous (3); a membranous sheet extending ventrally to the parietes and laterally on each side from the oesophagus just in front of the testis sac of x may represent a rudiment of 9/10.

The testis sacs are distended by testicular coagulum, the seminal vesicles, prostates and prostatic ducts apparently fully developed. The spermathecae of two specimens are without spermatozoal iridescence and are, possibly, not fully developed. The diverticula of the spermathecae of viii of the third specimen have a spermatozoal iridescence.

The short stalk of the diverticulum has a narrow, central lumen and smooth or nearly smooth wall. A middle portion is of about the same thickness as the stalk but the lumen is gradually widened entally and is irregular due to the presence of low, thick, closely placed, annular ridges. The terminal portion of the diverticulum is not sharply marked off but is slightly widened and almost ovoidal, shorter than the middle portion and about as long as the stalk. The lumen is filled with spermatozoa which extend down into the ental part of the middle portion. The ectal part of the sperm mass has a longitudinally and finely striated appearance.

A spermatheca from the type has no iridescence. The ental half of the diverticulum is however filled with a whitish material in which are several vacuoles. This portion of the diverticulum is of about the same width as the ectal part but the lumen is wider and with smooth wall, the sperm mass elongately ellipsoidal. The ectal half of the diverticulum has a thick wall and an irregular lumen with the appearance of short, lateral branches due to the presence of thick but low, annular ridges. The lumen of the spermathecal duct is fairly wide entally and

with annular ridges on the wall. Ectal to the diverticular junction the lumen is narrow and with smooth wall.

Diagnosis.—Sexthecal, spermathecal pores minute and superficial, three pairs, on 5/6-7/8. Male pores minute and superficial, each pore near the lateral margin of an unpaired, transverse porophore with bluntly rounded corners that extends onto xvii and xix. Setae : vi/8-12, vii/11-14, xvii/10-12, xviii/0, xix/10-12, 30/iii, 41/viii, 44/xii, 38-42/xx. First dorsal pore on 11/12. Length 37-72 mm. Diameter 2-3½ mm.

Septum 8/9 present but membranous. Intestinal caeca simple. Testis sacs unpaired and ventral. Spermathecal diverticulum rod-like, shorter than combined lengths of duct and ampulla.

Pheretima californica Kinberg.

1867. *Pheretima californica* (part), Kinberg, *Öfv. Ak. Förh.*, XXIII, p. 102. (Excluding octothecal specimens. Type locality, Sausolita Bay, California. Type and two paratypes from San Francisco in the Stockholm Museum.)

1912. *Pheretima browni* (part), Stephenson, *Rec. Ind. Mus.*, VII, p. 274. (Type locality Tengyueh, Yunnan, China. Types in the Indian Museum and the British Museum. Excluding sexthecal specimens.)

1931. *Pheretima browni*, Gates, *Rec. Ind. Mus.*, XXXIII, p. 372. (Kutkai, Burma.)

1932. *Pheretima molesta*, Gates, *Rec. Ind. Mus.*, XXXIV, p. 420. (Type locality, Kutkai, Burma.)

Material examined.—From the Indian Museum : thirteen clitellate specimens labelled, " Dak Bungalow grounds, Kutkai, N. Shan States, Burma. *ca.* 4,500 ft., H. S. Rao, Nov. 1926 ", and 1 clitellate specimen labelled, " Namhpakka, N. Shan States, Burma. *ca.* 3,700 ft., H. S. Rao, Dec. 1926 ".

From local collections :
Kutkai, Sept. 1935, 155 aclitellate and 71 clitellate specimens. G. J. Geis.
Mogok, Sept. 1935, 47 clitellate specimens. Mrs. A. C. Hanna.

External characteristics.—The setal formulae of ten specimens from Mogok are shown below :—

viii	xvii	xviii	xix	iii	viii	xii	xx
15	18	17	18	23	34	45	51
16	18	14	19	23	34	46	48
14	18	14	19	22	34	44	51
15	18	11	18	22	36	46	48
15	19	14	20	24	36	50	56
14	16	15	18	20	32	42	46
16	19	16	20	22	36	43	50
13	17	13	19	24	35	47	49
13	19	10	19	20	34	44	52
15	19	15	20	23	35	48	50

The male pores are minute and invaginate, each pore at the centre of a transversely oval, tiny, greyish translucent tubercle located on the dorsal wall of a deep but vertical invagination with a transversely slit-like aperture. The tubercle may or may not be conspicuously protuberant into the lumen of the invagination.

Internal anatomy.—(Opened 20 specimens.) The intestinal caeca are simple with smooth dorsal and ventral margins.

The prostatic duct, at first glance, appears to pass into the lateral face of the roof of the male pore invagination but a narrowed ectal portion of the duct, bent into two tiny, u-shaped quirks, is covered over and entirely concealed from view, in most of the specimens by connective tissue. The narrowed portion of the duct passes into the centre of the dorsal face of the male pore invagination. Although all of the specimens selected for dissection appeared to have the male invaginations fully retracted, the internal appearance varies considerably. In some of the worms the roof of the invagination is just visible in the coelomic cavity and level with the peritoneal surface of the parietes. In other worms the roof of the invagination is protuberant into the coelomic cavity. In two specimens the roof of each invagination is still further protuberant into the body cavity—after removal of the connective tissue around the ectal loops of the prostatic duct. In these worms it is possible to place the scissors close against the parietes and snip off the roof of the invagination with the male pore tubercle. In these two worms the slit-like lumen of the invagination passes very slightly beyond (internal to) the peritoneal surface of the parietes. In these two specimens the invaginations are, presumably, in state of most complete retraction. The male pore invaginations in this species might almost be called copulatory chambers, but since the invaginations are almost confined to the parietes, the term " copulatory chamber " may be restricted to those structures which are more definitely coelomic. In specimens that are slightly relaxed or in which the invaginations have been very slightly everted, the roof of the chamber is no longer recognizable from the coelomic cavity.

The spermathecal duct is shorter than the ampulla but at first appears to be shorter than is actually, the case since the ampulla is bound down around the ectal end of the duct so that the latter has the appearance of being invaginated fairly conspicuously into the ampulla. In three worms in which the spermathecal ampullae are unusually large there is no invagination. The coelomic portion of the duct is usually rather spindle-shaped, narrowed below the diverticular junction and entally. The lumen in the entalmost portion of the duct is with smooth wall for a very short distance, then to the diverticular junction with high, thick, transverse ridges, the lumen abruptly narrowed at the diverticular junction from whence ectally it is very narrow and with straight, smooth wall. The diverticulum comprises a very short stalk with a narrow lumen which may be straight and with smooth wall or slightly irregular, and a longer, very slenderly club-shaped seminal chamber that is only slightly wider than the stalk at most. The seminal chamber is twisted, bent or looped, apparently in a quite fortuitous fashion.

One specimen has no spermathecal diverticula while one of the spermathecae is provided with two distinct ampullae.

Diagnosis.—Quadrithecal, spermathecal pores minute and superficial, two pairs, on 7/8-8/9. Male pores minute and invaginate, each pore on a tiny tubercle on the roof of a deep but vertical parietal invagination with a transversely slit-like aperture, the roof of the invagination protuberant slightly into the coelomic cavity. Setae:

viii/12-20, xvii/16-24, xviii/9-18, xix/15-23, 20-24/iii, 32-36/viii, 42-50/xii, 46-59/xx. First dorsal pore on 11/12. Length 65-132 mm. Diameter $2\frac{1}{2}$-4 mm.

Intestinal caeca simple. Testis sacs unpaired and ventral. Spermathecal diverticulum with short stalk and longer, slenderly club-shaped seminal chamber, twisted or looped.

Remarks.—*P. californica* is perhaps a native of China from whence it has been described under various names; *modesta* Michaelsen 1927, *kiangensis* Michaelsen 1931, *hesperidum* Chen 1931. The species has penetrated into Burma, on the Shan Plateau, as far as Kutkai and Mogok only.

Pheretima campanulata (Rosa).

1890. *Perichaeta campanulata*, Rosa, *Ann. Mus. Genova*, XXX, p. 115. (Type locality, Palon. Types in the Genoa Museum.)
1895. *Pheretima houlleti* (part), Beddard, *Monog.*, p. 424. (Excluding forms with only one stalked gland to each spermathecal invagination.)
1900. *Pheretima houlleti* (part), Michaelsen, *Das Tierreich*, X, p. 273. (Excluding all forms except those with trilobed penial bodies and two stalked glands to each spermathecal invagination.
1923. *Pheretima houlleti* (part), Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 304. (Excluding all forms except those with trilobed penial bodies and two stalked glands to each spermathecal invagination.
1925. *Pheretima wimberleyana*, Stephenson, *Rec. Ind. Mus.*, XXVII, p. 62. (Type locality, Wimberleyganj, Andaman Islands. Types in the Indian Museum.)
1926. *Pheretima houlleti* var. *tortuosa*, Gates, *Ann. Mag. Nat. Hist.* (9) XVII, p. 454.
1926. *Pheretima houlleti* var. *tortuosa*, Gates, *Rec. Ind. Mus.*, XXVIII, p. 157.
1927. *Pheretima campanulata*, Gates, *Ann. Mus. Genova*, LII, p. 230. (After examination of the types.)
1930. *Pheretima campanulata*, Gates, *Rec. Ind. Mus.*, XXXII, p. 307.
1931. *Pheretima campanulata*, Gates, *Rec. Ind. Mus.*, XXXIII, p. 373.
1932. *Pheretima campanulata* vars. *typica* and *penetralis* Gates, *Rec. Ind. Mus.*, XXXIV, p. 452, p. 460.
1933. *Pheretima campanulata* vars. *typica* and *penetralis* Gates, *Rec. Ind. Mus.*, XXXV, p. 511.

Material examined.—From the Genoa Museum: 2 softened specimens labelled, "*Perichaeta campanulata* Rosa *Ann. Mus. Civ. Genova*, XXX, 1890, p. 115, T. 1, f. 9-10. Typus! Pegù L. Fea. Cat. No. 47". From the Indian Museum: 3 clitellate specimens labelled, "Lashio, N. Shan States, Burma, H. S. Rao, Nov. 1926. *ca* 2,700 feet. In the grounds of the Dak bungalow". 11 clitellate specimens labelled, "Selan, N. Shan States, Burma. Dr. H. S. Rao, Dec. 1926. *ca* 2,500-2,700 feet", 3 clitellate and 3 aclitellate specimens labelled, "Port Blair, Sta. B. 10", 1 immature specimen labelled, "Viper Island, Andamans".

From local collections:

"Under clods in tea garden", Tan Yang, Mong Yai State, Sept. 1935, 3 clitellate specimens. H. Young.

"Open, grassy ground", Lashio, Sept. 1935, 11 clitellate specimens. H. Young.

"Open ground", Pa Mung Village, Tan Yang, Sept. 1935, 1 clitellate specimen. H. Young.

"Sandy soil, covered by leaves, on shady hillside", Loi Pang Pra, Mong Yai State, Sept. 1935, 1 clitellate specimen. H. Young.

Foot of Thandaung Hill, Sept. 1935, 4 aclitellate and 20 clitellate specimens. G. E. Blackwell.

Pegu Yomas, No. 1, Sept. 1935, 5 aclitellate specimens. G. E. Blackwell.

Pegu Yomas, No. 2, Sept. 1935, 8 aclitellate and 2 clitellate specimens. G. E. Blackwell.

Pegu Yomas, No. 3, Sept. 1935, 2 aclitellate specimens. G. E. Blackwell.
Pegu Yomas, No. 4, Sept. 1935, 6 aclitellate and 4 partially clitellate specimens. G. E. Blackwell.
Pegu Yomas, No. 5, Sept. 1935, 12 clitellate specimens. G. E. Blackwell.
Pegu Yomas, No. 6, Sept. 1935, 18 clitellate specimens. G. E. Blackwell.
Pegu Yomas, No. 7, Sept. 1935, 1 clitellate specimen. G. E. Blackwell.
" Rotting portions of trees mixed with earth ", on way to Thandaung, Sept. 1935, 21 aclitellate specimens. G. E. Blackwell.
" Under bark of trees ", rain forest, on way to Thandaung, Sept. 1935, 1 aclitellate specimen. G. E. Blackwell.
Moulmein, Aug. 1935, 8 aclitellate and 2 clitellate specimens. K. John.
Kyaikmaraw, Aug. 1935, 1 clitellate specimen. K. John.

External characteristics.—The setal formulae of ten specimens are shown below. For purposes of comparison with forma *rugosa* and also *P. houlleti*, the setal counts on all three forms, were made on specimens from one locality only.

vii	viii	xvii	xviii	xix	iii	viii	xii	xx
13	14	20	12	19	23	38	48	54
13	16	18	12	17	24	39	49	56
11	16	18	13	19	22	34	52	56
13	17	21	13	19	20	39	50	55
12	14	20	12	17	22	33	46	53
13	16	22	14	21	24	40	46	53
14	17	19	14	19	24	38	50	56
13	17	20	15	21	24	42	50	57
12	14	18	12	18	25	43	52	61
11	16	21	15	19	24	36	48	56

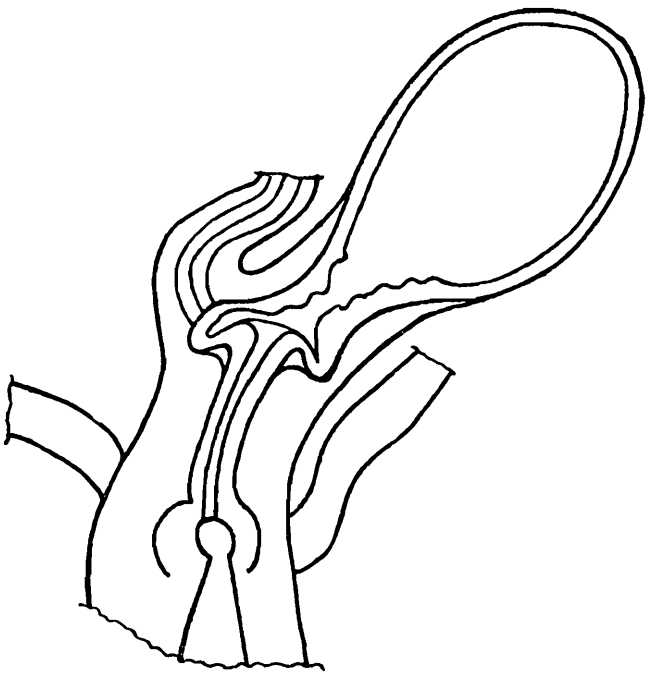
The external genital markings are recognizable on aclitellate specimens before the worms are sufficiently developed for the copulatory chambers to be visible in the coelomic cavity. Of thirty specimens from Toungoo district, 12 have no external genital markings. These worms might easily be mistaken for *P. meridiana*, but the internal characteristics are those of *P. campanulata*.

Internal anatomy.—(Opened all specimens from local collections.) The intestinal caeca are simple, with septal constrictions only (30). The right intestinal caecum of one specimen is withdrawn into the lumen of the gut and not visible in the coelomic cavity at all.

One gland is present on the posterior face of each copulatory chamber. There may be an additional gland on the posterior face of the chamber or the apparently single gland may in reality have two or even three stalks. Each copulatory chamber (60) contains a characteristic, trilobed, penial body. On the base or close to the base of the penial body there may be one or two, rarely three genital markings. In addition there is a further group of 3, 4 or (rarely) 5 markings.

The ental portion of the spermathecal duct has a wide lumen which opens into the lumen of the narrowed portion ectal to the diverticular junction through a tiny, slit-like aperture on the bluntly rounded summit of a smooth, rather conical papilla. The diverticular canal opens into

the duct lumen at the base of the papilla. Six spermathecal ducts were dissected open and no variation with respect to this characteristic was found.



TEXT-FIG. 3.—*Pheretima campanulata* (Rosa). Portion of a spermatheca of an aclitellate specimen, showing ampulla, duct, diverticular stalk, stalks of two glands and spermathecal invagination, × *ca.* 45.

Remarks.—In the dissected type the penial body is characteristically trilobed.

Diagnosis.—Sexthecal, spermathecal pores minute and invaginate, each pore on a tiny conical protrusion into an invagination with transversely slit-like lumen and aperture; three pairs, on 6/7-8/9. Male pores minute and invaginate, each pore on a penial body with a trilobed tip within a spheroidal, copulatory chamber, a genital marking on each of the two lateral lobes of the penial body. Genital markings tiny, circular, greyish, translucent areas, sharply demarcated by slight circumferential furrows, on the margins of segments near 6/7-8/9 or on the intersegmental furrows, median to the secondary spermathecal apertures, and in addition internally; one marking on the anterior wall and one on the posterior wall of each spermathecal invagination, a group of 3, 4 or 5 markings within in each copulatory chamber in addition to markings at the base and at the tip of the penial body. Setal circles present on all clitellar segments, clitellar setae with bifid tips, 1-2 penial setae within the wall of each copulatory chamber: vii/11-15, viii/14-19, xvii/18-22, xviii/9-17, xix/17-21, 20-25/iii, 33-43/viii, 44-52/xii, 50-61/xx. First dorsal pore on 11/12. Length 107-200 mm. Diameter 4-7 mm. Segments 107-136.

Intestinal caeca simple. Testis sacs unpaired and ventral. Lumen in ental part of the spermathecal duct large and communicating with the narrowed lumen of the ectal portion of the duct through a tiny, slit-like pore on the bluntly rounded, dorsal face of a conical papilla; diverticulum comprising a short, slender stalk and a elongate seminal chamber, the latter slightly widened entally and looped, often in an approxi-

mation to zigzag. One or more stalked glands on the posterior face of each copulatory chamber, three or more on the anterior face; one stalked gland to the anterior face and one to the posterior face of each spermathecal pore invagination. Glands of external genital markings stalked and coelomic.

Forma **rugosa** Gates.

1926. *Pheretima houlleti* var. *rugosa*, Gates, *Ann. Mag. Nat. Hist.* (9) XVII, p. 459.
1926. *Pheretima houlleti* var. *rugosa*, Gates, *Rec. Ind. Mus.*, XXVIII, p. 157.
1930. *Pheretima houlleti* var. *rugosa*, Gates, *Rec. Ind. Mus.*, XXXII, p. 311.
1932. *Pheretima rugosa*, Gates, *Rec. Ind. Mus.*, XXXIV, p. 398.
1933. *Pheretima campanulata* var. *rugosa*, Gates, *Rec. Ind. Mus.*, XXXV, p. 512.

Material examined.—From local collections :—

Pegu Yomas, No. 5, Sept. 1935, 14 clitellate specimens. G. E. Blackwell.
Pegu Yomas, No. 6, Sept. 1935, 19 clitellate specimens. G. E. Blackwell.
Pegu Yomas, No. 1, Sept. 1935, 1 aclitellate specimen. G. E. Blackwell.
Pegu Yomas, No. 2, Sept. 1935, 8 aclitellate and 15 clitellate specimens. G. E. Blackwell.
Pegu Yomas, No. 3, Sept. 1935, 30 partially clitellate or clitellate specimens. G. E. Blackwell.
Pegu Yomas, No. 4, Sept. 1935, 12 partially clitellate or clitellate specimens. G. E. Blackwell.
Foot of Thandaung Hill, Sept. 1935, 20 clitellate specimens. G. E. Blackwell.
Kyaikmaraw, Aug. 1935, 1 aclitellate and 3 clitellate specimens. K. John.

External characteristics.—The setal formulae of 10 specimens are shown below. The setal numbers, on xii, of 6 additional specimens were determined : 53 (1), 54 (2), 55 (1), 57 (1), 59 (1), the average number of setae on segment xii of 16 specimens, 55.

xvii	xviii	xix	iii	viii	xii	xx
11	7	11	24	44	50	60
10	6	10	25	42	54	58
12	8	11	24	47	56	62
12	5	11	23	44	53	57
12	9	13		40	56	62
11	6	11	25	50	58	52
12	8	11	26	45	55	57
11	7	11	23	44	54	58
11	5	12	24	44	52	54
13	7	13	24	48	60	62

Internal anatomy.—(Opened all specimens.) The intestinal caeca are simple, with septal constrictions only (23).

On the posterior face of each copulatory chamber (46) there is at least one gland. These glands are more obvious even than in normal specimens. The stalks of the anterior glands pass up onto the dorsal face of the copulatory chamber but instead of being bound down flat against the dorsal face of the chamber a stalk may be bent into a hair-pin loop with the limbs of the loop in contact and protuberant in a perpendicular fashion from the dorsal face of the chamber. In the majority of the specimens examined, one or more of the stalks are thus

looped. Penial setae are lacking in all of the chambers except in one specimen where a single penial seta is present in the wall of one chamber. The penial body is somewhat like that of the typical forms but instead of two genital markings on the slight preputial ring around the male pore tubercle at the tip of the penial body, there are here (46) three or four markings on the preputial ring, one of the markings especially protuberant and usually extending out nearly at right angles to the others. In addition to the markings on the penial body there is a group of three (rarely), four or five (usually) further markings.

In two specimens the penial bodies look much like the penial body of the typical forms except for the presence of one or two, extra, unusually small genital markings.

Definition.—As for the typical forms except as noted below. Athecal. Genital markings internal only, 3-6 markings at the tip of the penial body, on the wall of the copulatory chamber a group of 3-7 additional markings. Clitellar setae with irregularly transverse furrows; no penial setae: xvii/10-13, xviii/4-11, xix/10-13, 23-26/iii, 40-50/viii, 50-60/xii, 44-65/xx. Length 92-200 mm. Diameter 4-7 mm. Segments 92-140.

Remarks.—" Thecal " individuals are occasionally found, *i.e.*, individuals with one or more spermathecal invaginations and associated with each invagination a more or less rudimentary or abnormal spermatheca and one or more stalked glands. Characteristics of the spermathecae in similar individuals made possible the placing of the rugose forms in *P. campanulata*. Thecal individuals with spermathecae sufficiently developed to permit identification as *P. campanulata* are to be referred to as abnormal specimens of *P. campanulata* while thecal individuals with rudimentary or abnormal spermathecal structures will be referred to as thecal individuals of forma *rugosa*.

Several clitellate specimens collected in recent years are referred to *P. campanulata* rather than to *P. houlleti* merely because of the presence of the first dorsal pore on 11/12. In these worms spermathecae, prostates and prostatic ducts are entirely lacking and there are no traces of rudiments of male or spermathecal pores. The seminal vesicles are rudimentary. There is no coagulum in the testis sacs and the testes are disc-shaped and undischarged.

According to the Pickford-Stephenson hypothesis of secondarily evolved sexuality, these worms should be regarded as neuters, possibly a worker caste (!), as the worms can function neither as males or females. The male gonads are however present though juvenile and the ovaries are present and apparently normal.

In each of the worms there are numerous coelomic parasites, especially from the prostatic segments posteriorly.

Pheretima canaliculata Gates.

1932. *Pheretima canaliculata*, Gates, *Rec. Ind. Mus.*, XXXIV, p. 408. (Type locality, Blachi, Karen Hills, Toungoo District.)

Material examined.—From local collections:

Karen Hills, near Thandaung, Toungoo District, Sept. 1935. 1 clitellate specimen. G. E. Blackwell. (The worm is incomplete posteriorly.)

External characteristics.—The first dorsal pore appears to be on 7/8, the markings on 7/8-10/11 as pore-like in appearance as those on 11/12-12/13.

Setae: vi/30, xvii/27, xviii/20, xix/25, 82/viii, 85/xii, 86/xx. (On one of the types the numbers are 80/viii, 88/xii, 83/xx.)

The spermathecal pores are very short, transverse slits, superficial, each pore at the centre of a transversely oval, translucent area, the translucent areas on the anteriormost margins of vi and vii.

The male pores are minute and superficial, transversely slit-like, each pore at or near the centre of an indistinctly delimited, circular, small, smooth and translucent area.

Internal anatomy.—Septum 8/9 is complete though membranous. This septum was recognized on first opening the worm and was still visible dorsal to the gizzard after the specimen had been carefully pinned out, but on a mere touch of the forceps the tissue of the septum ruptured so that only a ventral rudiment is recognizable.

The intestine begins in xv. The intestinal caeca are compound and glove-shaped; the dorsalmost secondary caecum the shortest, the ventralmost the longest.

There is a pair of hearts belonging to ix. All hearts of ix-xiii pass into the ventral blood vessel.

The testis sacs are unpaired and ventral. The seminal vesicles are in contact mesially above the dorsal blood vessel, the posterior vesicles pushing 12/13 back into contact with 13/14 and the anterior vesicles pushing 10/11 forward into contact with 8/9. The anterior vesicles are attached to the roof of the posterior testis sac but can be detached without opening the sac. The prostatic ducts are short but stout and muscular, bent almost into an L-shape.

The spermathecal duct is not narrowed within the parietes, the lumen wide entally—the wall with longitudinal ridges, gradually narrowed in the region of the diverticular junction. The diverticulum comprises a short, straight stalk in which the lumen is very narrow and straight, a middle portion slightly thicker than the stalk and looped, the looping in part approximating to zigzag, the lumen wider than in the stalk though the width is less than the thickness of the wall, and an ovoidal to shortly ellipsoidal seminal chamber. The spermatozoa are present only in the seminal chamber. The lumen in the middle portion of the diverticulum is irregular and with the appearance of short fissures opening out from the central passage.

Remarks.—A septum 8/9 as delicate as in this species might readily be destroyed in the course of opening and pinning out the worm and accordingly described as lacking or rudimentary as in the case of at least one other Burmese species.

Diagnosis.—Quadrithecal, spermathecal pores superficial, small and transversely slit-like, two pairs, on the anteriormost margins of vi and vii. Male pores minute and superficial, each pore at or near the centre of a small, circular, translucent area and at the posterior end of a seminal groove. Genital markings one pair, each marking slightly median to a male pore, extending from the setae of xvii to the setae of xviii, 8-12 intersetal intervals wide and separated by a midventral space equal to

6-9 intervals. A seminal groove from each marking is continued postero-laterally to the male pore. Setae : vi/22-30, xvii/27, xviii/16-22, xix/25, 80-82/viii, 85-88/xii, 80-87/xx. First dorsal pore on 7/8-11/12. Length 147 mm. Diameter 5-7 mm. Segments 111.

Septum 8/9 present but membranous. Intestinal caeca compound, glove-shaped, dorsalmost secondary caecum the shortest. Testis sacs unpaired and ventral. Spermathecal diverticulum with short, straight stalk, a longer, slightly thicker and looped middle portion with wider lumen, and an ovoidal to shortly ellipsoidal seminal chamber. Genital marking glands sessile and within the parietes.

Pheretima diffringens (Baird).

1869. *Megascolex diffringens,* Baird, *Proc. Zool. Soc. London,* 1869, p. 40. (Type locality, Plas Machynlleth, North Wales. Types in the British Museum.)
1926. *Pheretima heterochaeta,* Gates, *Rec. Ind. Mus.,* XXVIII, p. 156.
1930. *Pheretima heterochaeta,* Gates, *Rec. Ind. Mus.,* XXXII, p. 310.
1931. *Pheretima heterochaeta,* Gates, *Rec. Ind. Mus.* XXXIII, p. 387 and p. 437.
1932. *Pheretima heterochaeta,* Gates, *Rec. Ind. Mus.,* XXXIV, p. 524.
1933. *Pheretima heterochaeta,* Gates, *Rec. Ind. Mus.,* XXXV, p. 529.

Material examined.—From local collections :

Mogok, Sept. 1935, 62 clitellate specimens. Mrs. A. C. Hanna.
" Under rocks ", North of Thandaung, Toungoo District, Sept. 1935, 7 aclitellate and 107 clitellate specimens. G. E. Blackwell.

External characteristics.—On many of the worms there is a definite banded appearance due to the absence of pigment on a fine stripe on which the setae are located.

The setal formulae are shown below.

vi	vii	viii	xvii	xviii	xix	iii	viii	xii	xx
9	12	12	14	12	12	26	35	41	44
8	11	12	16	14	17	21	38	40	48
8	10	11	16	13	16	26	38	41	47
6	12	13	17	10	17	25	37	39	52
8	11	12	18	14	13	22	39	42	44
8	10	12	15	12	15	25	36	43	49
8	10	11	16	12	15	..	36	40	48
9	10	12	14	12	16	27	38	44	45
10	11	13	14	14	16	22	40	46	46
9	11	11	16	14	17	24	37	44	43

Internal anatomy.—The intestinal caeca are simple, with smooth margins or slightly constricted by the septa through which the caeca pass.

The spermathecal duct is shorter than the ampulla but at first appears to be slightly shorter than is actually the case since the ampulla is bound down around the ental end of the duct so that the latter has the appearance of being slightly invaginated into the ampulla. In most of the spermathecae the lumen in the ental portion of the duct is narrow but slightly irregular while in the other spermathecae the lumen is much

wider but the wall is provided with thick, high, transverse ridges. Ectal to the diverticular junction the lumen is narrow, straight and with smooth wall. The diverticulum comprises a long stalk and a thicker but shorter, ovoidal seminal chamber. In the ectalmost portion of the stalk the lumen is usually straight and with smooth wall while entally the lumen is slightly widened and slightly more irregular.

Remarks.—Many of the specimens have the postsetal genital markings on some of v-viii, each marking located immediately in front of a spermathecal pore. The discovery of these markings on specimens from South India collected near the type locality of Bourne's *P. mirabilis* resulted in the suppression of the name *heterochaeta* (Gates 1934, p. 260). Unfortunately *mirabilis* must now in turn also be suppressed.

Some of the Kutkai specimens are very badly preserved. On these worms several closely crowded, minute pores are visible on the central part of each genital marking. The close crowding of these pores is doubtless responsible for the greyish translucent appearance of the centre of the marking on better preserved specimens, but on properly preserved worms the pores cannot be identified.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, on 5/6-8/9. Male pores minute and superficial, each pore at the centre of a transversely oval, disc-shaped porophore. Genital markings small, circular to oval tubercles, paired; presetal on vi-ix and just median to the spermathecal pore lines or (and) about in *bc*, postsetal on v-viii and just in front of the spermathecal pores. Setae: vi/6-11, vii/8-14, viii/10-16, xvii/13-18, xviii/9-16, xix/12-17, 21-27/iii, 26-36/vi, 35-42/viii, 39-44/xii, 42-52/xx. First dorsal pore on 11/12. Length 45-170 mm. Diameter 3-6 mm. Segments 90-113.

Intestinal caeca simple. Hearts of x lacking. Testis sacs unpaired and ventral. Spermathecal diverticulum with long stalk and shorter, thicker, ovoidal seminal chamber. Genital marking glands stalked and coelomic.

Pheretima elongata (E. Perrier).

1872. *Perichaeta elongata* E. Perrier, *N. Arch. Mus. Paris*, VIII, p. 124. (Type locality, " Peru ".) (Types in the Paris Museum.)
1926. *Pheretima elongata*, Gates, *Ann. Mag. Nat. Hist.* (9) XVII, p. 444.
1926. *Pheretima elongata*, Gates, *Rec. Ind. Mus.*, XXVIII, p. 153.
1929. *Pheretima elongata*, Stephenson, *Rec. Ind. Mus.*, XXXI, p. 237.
1930. *Pherctima elongata*, Gates, *Rec. Ind. Mus.*, XXXII, p. 309.
1931. *Pheretima elongata*, Gates, *Rec. Ind. Mus.*, XXXIII, p. 378.
1932. *Pheretima elongata*, Gates, *Rec. Ind. Mus.*, XXXIV, p. 391.
1933. *Pheretima elongata*, Gates, *Rec. Ind. Mus.*, XXXV, p. 525.

Material examined.—From local collections:]

Mogok, Sept. 1935, 8 aclitellate specimens. Mrs. A. C. Hanna.
Bhamo and vicinity, Sept. 1934, 76 aclitellate and 11 clitellate specimens. K. John.
Myitkyina and vicinity, Sept. 1934, 3 clitellate specimens. K. John.

External characteristics.—There is an unusually wide range of variation with regard to the setal numbers, especially those of viii and xii. Yet the setal circles on all of these specimens appear to be normal,

without gaps and with the setae regularly spaced. The setal formulae of several specimens are shown below.

xvii	xviii	xix	iii	viii	xii	xx	
12	12	15	58	85	56	61	T
12	11	14	65	102	80	72	A
13	14	13	62	83	68	63	T
12	11	13	66	104	80	69	A
14	10	12	50	67	54	55	T
15	13	12	52	73	65	56	A
17	12	15	51	81	66	55	A

A Athecal.
T Thecal.

The spermathecal pores are minute and superficial, on 5/6 and 6/7, or the posteriormost margins of v and vi or the anteriormost margins of vi and vii, close to 5/6-6/7.

Internal anatomy.—(Opened 7 specimens). In the first specimen that was dissected a large branch from the subneural trunk passes out from under the nerve cord to the right side in the posterior portion of xv. This branch passes anteriorly on the ventral parietes into xiii and then turns and passes dorsally on the anterior face of 13/14 giving off several large branches to the anterior face of the septum. Dorsally the vessel passes into the heart of xiii just prior to the junction of the latter with the supraoesophageal trunk. The subneural trunk passes out from under the nerve cord in the anteriormost portion of xv (but a very tiny branch continues anteriorly for a short distance under the nerve cord) and on the ventral parietes runs parallel to the nerve cord into xiii where it turns dorsally on the anterior face of 13/14 and after giving off several large branches to the anterior face of the septum passes into the heart of xiii just prior to the junction of the latter with the supraoesophageal vessel. In other specimens the anterior course of the subneural and its branches is subject to slight variations, the branch may pass out to the left side while the subneural turns to the right, and there is also some slight variation as to the point at which the vessels pass out from under the nerve cord. In worms lacking the hearts of xiii, the subneural and its main branch pass directly into the supraoesophageal trunk in xiii. The hearts of xiii are lacking in one athecal specimen, present in three athecal specimens, lacking in one thecal specimen, present in two thecal specimens. Each of the worms with large number of setae on viii has hearts in xiii.

From the ventral parietes in xii a fairly large vessel rises on the anterior face of 12/13, on each side, and passes into the heart of xii just prior to the junction of the latter with the supraoesophageal trunk. In some of the specimens this septal vessel is nearly as large as the heart of xii. The hearts of xi and x are included within the testis sacs. A large branch from the ventrolateral trunk passes into the heart of x just prior to the junction of the latter with the supraoesophageal vessel. The ventral trunk bifurcates, in each specimen, on the anterior face of the testis sac, the branches continued into the dorsal trunk as the hearts of ix, the ventral trunk not continued anteriorly.

The testis sacs are unpaired and annular. In the two worms with large numbers of setae on viii the testicular coagulum in each sac forms a completely continuous ring within which the dorsal blood vessel is imbedded. In the other specimens, although the outer wall of the testis sac passes over the dorsal blood vessel, the testicular coagulum terminates, on each side, against the dorsal blood vessel and a mesentery passing from the ventral side of the dorsal trunk to the dorsal face of the gut.

The spermathecal duct has a fairly wide lumen entally that is abruptly narrowed at the diverticular junction. The diverticular stalk is longer than the seminal chamber and has a narrow but quite irregular lumen which may be widened entally in some of the spermathecae. The seminal chamber is ovoidal to ellipsoidal.

Diagnosis.—Polythecal, spermathecal pores minute and superficial, in paired groups of 2-4, on or near to 5/6-6/7 Male pores minute and invaginate, each pore on the dorsal (lateral) margin of a disc-like porophore on the median wall of a parietal invagination with a crescentic aperture. Genital markings transversely oval, presetal, widely paired, on xix-xxiv. Setae: xvii/12-17, xviii/10-15, xix/12-15, 50-66/iii, 67-104/viii, 54-80/xii, 55-75/xx. First dorsal pore on 12/13. Length 85-300 mm. Diameter $3\frac{1}{2}$-6 mm. Segments 169-241.

Hearts of xiii present or lacking, the ventral blood vessel ending anteriorly with hearts of ix both of which are present, the hearts of x and xi included within the testis sacs. Testis sacs unpaired and annular, seminal vesicles of xi included within the posterior testis sac. Spermathecal diverticulum with stalk longer than the ovoidal to ellipsoidal seminal chamber. Genital marking glands sessile on the parietes.

Remarks.—*P. elongata* in Burma, is usually athecal, a condition which is doubtless to be regarded as an abnormality. Thecal specimens do not have a symmetrically paired arrangement of the spermathecae, the latter either asymmetrical or in groups. Until the species is studied in its native habitat it will be difficult to determine which of the peculiar characteristics are normal and which are abnormal.

Pheretima exigua Gates.

1929. *Pheretima minuta* (non Beddard 1901), Gates, *Proc. U. S. Nat. Mus.*, LXXV, (10) p. 18. (Type locality, Lashio.)
1930. *Pheretima exigua* (part), Gates, *Rec. Ind. Mus.*, XXXII, p. 310. (Excluding forms from Nyaungbinkwin.)
1932. *Pheretima exigua* var. *typica*, Gates, *Rec. Ind. Mus.*, XXXIV, p. 512.
1933. *Pheretima exigua* var. *typica*, Gates, *Rec. Ind. Mus.*, XXXV, p. 525.

Material examined.—From local collections:

Myitkyina and vicinity, Sept. 1934, 14 clitellate specimens. K. John.
Bhamo and vicinity, Sept. 1934, 23 clitellate specimens. K. John.
" Grassy ground near paddy flats ", Nawng Kham, Mang Lun State, Sept. 1935, 10 clitellate specimens. H. Young.
" Soil under banyan tree ", Lashio, Sept. 1935, 37 clitellate specimens. H. Young.

External characteristics.—The length of the Myitkyina and Bhamo specimens varies from 24-48 mm., the diameter from 2-3 mm.

The setae begin on ii on which segment there is a complete or nearly complete circle. Setae may be entirely lacking on the clitellum or there may be 2-8 setae ventrally on xvi. The setal formulae are shown below. The setal numbers of the Myitkyina and Bhamo specimens fall within the limits indicated.

vi	vii	viii	xvii	xviii	xix	iii	viii	xii	xx
14	14	14	15	11	15	24	37	35	41*
13	14	14	14	12	15	28	36	37	39*
13	15	14	15	10	16	29	38	38	46*
13	14	16	16	13	17	28	40	39	42*
14	15	15	15	13	16	26	36	36	40*
14	14	14	10	10	13	27	39	38	35†
12	13	13	12	10	14	*g*	34	35	36†
12	14	13	13	10	14	23	32	33	37†
14	15	15	11	10	11	25	36	40	36†
11	13	14	14	10	15	23	34	37	36†

* Nawng Kham.
† Lashio.
g gaps in the circle, no setal pits in the gaps.

The spermathecal pores are minute and superficial.

The male pores are minute and superficial, each pore at the centre of a (relatively) large, disc-like porophore, the porophores larger than the genital markings.

The genital markings on the Myitkyina and Bhamo specimens are located as follows :—

a. One marking immediately anterior to each spermathecal pore, on the posterior margins of v-viii. 37 specimens.
b. One pair of markings on viii, each marking in *b*, *ab*, or *bc*. 36 specimens.
c. One pair of markings on xix, each marking just median to the male pore line. 37 specimens.
d. One median marking on vii. 1 specimen.
e. One or two markings on xviii, in line with the markings on xix. 3 specimens.
f. One or two markings on xx, in line with the markings on xix. 8 specimens.

All of the Nawng Kham and Lashio specimens have the genital markings on viii and xix, and may have in addition paired markings on xvii, xx, or xxi in line with the markings of xix. One specimen has a single tubercle on xvi on the right side. In addition these worms may have one or two markings in the region of *ac* on vii, xviii or xix. Each worm may have a marking immediately in front of each spermathecal pore or a marking immediately behind each spermathecal pore or two markings in connection with each spermathecal pore, one just in front of the pore and one just behind. All of the genital markings except the tubercles immediately in front of the spermathecal pores are presetal including the single marking on xvi. The spermathecal pore tubercles may be conspicuously protuberant and readily recognizable, often

translucent, or recognizable only after removal of the cuticle and with brilliant illumination and high magnification.

Internal anatomy.—The intestinal caeca are simple, the margins smooth or with slight septal constrictions.

The hearts of x are included within the anterior testis sac.

The testis sac of xi was previously described as annular (Gates 1932, p. 514) but careful dissection of five specimens has failed to reveal more than a cylindrical sheet of tissue passing from 10/11 to 11/12 in such a way as to shut off a portion of xi containing the organs of the segment including the gut. Testis sacs of this type, in which the gut is included, are now distinguished from annular testis sacs which do not include the gut by the term cylindrical.

In connection with each genital marking there is a stalked, coelomic gland. These glands are small, the stalks fragile. The glands are often difficult to find especially when stuck to the parietes or imbedded in coelomic coagulum.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, on 5/6-8/9. Male pores minute and superficial, each pore at the centre of a disc-shaped porophore that is slightly larger than the genital markings. Genital markings small tubercles, about 1 intersetal interval wide; paired, presetal on viii (vii, xviii, xix) in *ac*, presetal on xix (xvii, xviii, xx, xxi) and just median to the male pore lines, postsetal on v-viii, immediately in front of the spermathecal pores or presetal on vi-ix, immediately behind the spermathecal pores; (unpaired, median and presetal on vii, xviii, xix). Setae may be present ventrally on xvi: vi/11-14, vii/11-15, viii/13-16, xvii/10-18, xviii/9-15, xix/11-17, 23-29/iii, 32-40/viii, 33-40/xii, 0-8/xvi, 35-46/xx. First dorsal pore on 12/13. Length 24-48 mm. Diameter 2-3 mm. Segments 86-90.

Intestinal caeca simple. Testis sacs unpaired; of x annular, of xi cylindrical. Seminal vesicles of xi included within the posterior testis sac. Spermathecae with diverticular stalk nearly as long as, to longer than the combined lengths of duct and ampulla; seminal chamber small, spheroidal to shortly ovoidal. Genital marking glands stalked and coelomic.

Pheretima hawayana (Rosa).

1891. *Perichaeta hawayana*, Rosa, *Ann. Hofmus. Wien*, VI, p. 396. (Type locality, Hawaii. Type in the Vienna Museum.)

1931. *Pheretima hawayana* var. *typica* (?), Gates, *Rec. Ind. Mus.*, XXXIII, p. 382.

1932. *Pheretima hawayana* var. *typica* (?), Gates, *Rec. Ind. Mus.*, XXXIV, p. 433.

Material examined.—From the Indian Museum: 1 clitellate specimen labelled, "In the grounds of the Dak Bungalow. Lashio, N. Shan States, Burma. *ca* 2,700 feet. H. S. Rao, Nov. 1926", 1 clitellate specimen labelled, "Hill streams above Kawngmu, N. Shan States, Burma. H. S. Rao, Dec. 1926", and 5 clitellate specimens labelled, "Under stones, Namkham, N. Shan States, Burma. H. S. Rao, Dec. 1926".

From local collections:

Kutkai, Sept. 1935, 434 clitellate specimens. G. J. Geis.

Mogok, Sept. 1935, 7 clitellate specimens. Mrs. A. C. Hanna.

External characteristics.—The setal formulae of ten specimens are shown below.

vi	vii	xvii	xviii	xix	iii	viii	xii	xx
7	11	17	12	17	19	38	49	53
8	12	17	13	18	20	39	48	56
7	11	15	11	16	20	36	44	50
8	14	20	12	20	18	39	48	51
7	13	19	11	18	21	39	47	53
7	15	17	12	19	20	38	45	48
6	13	18	14	19	19	39	45	52
5	10	16	12	18	19	40	48	50
7	12	16	12	19	20	37	44	52
7	10	15	14	17	17	36	48	50

The location of the genital markings on 80 specimens was recorded. On 2 of these specimens there are no markings at all. On each of the other worms there is a pair of markings on xviii, one marking just median to each male porophore and either in the setal circle or just behind the setae. Five specimens have an additional marking on xviii, on the right or the left side, just median to the marking previously mentioned and either in the setal line or postsetal. Five specimens have a pair of additional markings on xviii, in the setal line or postsetal. Six specimens have a pair of postsetal markings on vii, each marking just median to the spermathecal pore lines. One specimen has a postsetal marking on vii on the right side. On the Kawngmu specimen there are five postsetal genital markings on xviii, two on the left side and three on the right side.

Internal anatomy.—(Opened 86 specimens.) Septum 8/9 may be complete though membranous (10 specimens). In other worms, though preservation is good and in spite of considerable care in dissection, only a ventral rudiment of 8/9 is to be found.

The intestinal caeca are simple but with ventral margin slightly incised, the incisions marking off several very short lobes. In addition there are often 2-4 lobes on the dorsal margin posteriorly. One specimen has only one caecum, that of the other side completely lacking.

The testis sacs are unpaired and ventral. The anterior margin of the testis sac of x may be deeply indented so that the sac is almost completely divided into two. In a number of specimens the two lobes thus marked off by the indentation extend anteriorly for some distance on the floor of the coelomic cavity.

The spermathecal duct is elongate and slender. The lumen is unusually narrow ental to the diverticular junction but widens gradually in the entalmost portion. The diverticular stalk is longer than the seminal chamber and with a quite irregular lumen. The seminal chamber is very slenderly club-shaped and ectally is distinguished from the stalk only by the greater width of the lumen.

Several specimens were found to have extra or abnormal spermathecae as noted below. An octothecal specimen with spermathecal pores in 5/6-8/9 might be mistaken for *P. diffringens*.

a. An extra pair of spermathecae in ix with pores on 8/9, the diverticula with spermatozoal iridescence. 2 specimens.

b. An extra spermatheca in ix with pore on 8/9 on the right side, diverticulum with spermatozoal iridescence. 1 specimen.

c. An extra spermatheca in ix with pore on 8/9 on the right side, diverticulum with no spermatozoal iridescence (though diverticula of other spermathecae are iridescent). 1 specimen.

d. An extra spermatheca in ix with pore on 8/9 on the right side, no diverticulum. 1 specimen.

e. An extra spermatheca in ix with pore on 8/9 on the right side, diverticulum with no spermatozoal iridescence. Left spermatheca of vi lacking. 1 specimen.

f. Diverticulum of left spermatheca of vi lacking. 1 specimen.

g. An extra spermatheca in v with pore on 4/5 on the left side, no diverticulum. 1 specimen.

h. An extra pair of spermathecae in v, with pores on 4/5, no diverticula. An extra spermatheca in ix with pore on 8/9 on the right side, diverticulum slenderly tubular, no seminal chamber or spermatozoal iridescence. 1 specimen.

Diagnosis.—Sexthecal, spermathecal pores minute and superficial, three pairs, on 5/6-7/8. Male pores minute and superficial, each pore at the centre of a small, transversely oval, disc-shaped porophore. Genital markings small, paired tubercles; postsetal on vii-viii and slightly median to the spermathecal pore lines; on xviii in or just behind the setal circle and just median to the male pore lines. Setae present ventrally on xvi: vi/4-8, vii/10-15, xvii/15-20, xviii/10-15, xix/16-20, 17-21/iii, 36-40/viii, 44-49/xii, 48-56/xx. First dorsal pore on 10/11. Length 60-112 mm. Diameter 3-4 mm. Segments 71-91.

Intestinal caeca simple, with a few short lobes on the ventral margin. Testis sacs unpaired and ventral. Spermathecal diverticulum with stalk longer than the seminal chamber and with irregular lumen, seminal chamber slenderly club-shaped. Genital marking glands stalked and coelomic.

Pheretima houlleti (E. Perrier).

1872. *Perichaeta houlleti*, E. Perrier, *N. Arch. Mus. Paris*, VIII, p. 99. (Type locality, Calcutta. Types in the Paris Museum.)
1926. *Pheretima houlleti* var. *typica* (?), Gates, *Ann. Mag. Nat. Hist.* (9) XVII, p. 450.
1926. *Pheretima houlleti* var. *typica*, Gates, *Rec. Ind. Mus.*, XXVIII, p. 157.
1929. *Pheretima houlleti*, (part), Stephenson, *Rec. Ind. Mus.*, XXXI, p. 237 (excluding specimens with bilobed penial bodies).
1930. *Pheretima houlleti* var. *typica*, Gates, *Rec. Ind. Mus.*, XXXII, p. 311.
1931. *Pheretima houlleti*, Gates, *Rec. Ind. Mus.*, XXXIII, p. 289.
1932. *Pheretima houlleti*, Gates, *Rec. Ind. Mus.*, XXXIV, p. 464.
1933. *Pheretima houlleti*, Gates, *Rec. Ind. Mus.*, XXXV, p. 529.

Material examined.—From the Indian Museum; two clitellate specimens labelled, "Streams and pools on the north bank of the Shweli River, Namkham, N. Shan States. Burma. H. S. Rao, Dec. 1926. *ca.* 2,500 feet", and 1 aclitellate and 5 clitellate (1 dissected) specimens labelled, "*Pheretima houlleti* (E. Perr.). Lonton, a small village on the western shore of the Indawgyi Lake, Myitkyina Dist., U. Burma. B. Chopra. 18-31.x.26. W 3196/1."

From local collections:
Pegu Yomas, No. 2, Sept. 1935, 1 clitellate specimen. G. E. Blackwell.
Pegu Yomas, No. 7, Sept. 1935, 1 clitellate specimen. G. E. Blackwell.
" Under bark of tree, rain forest, on way to Thandaung ", Sept. 1935, 4 aclitellate and 2 partially clitellate specimens. G. E. Blackwell.
" Rotting portions of trees mixed with earth, on way to Thandaung ", Sept. 1935, 4 clitellate specimens. G. E. Blackwell.
Kutkai, Sept. 1935, 121 aclitellate and 673 clitellate specimens. G. J. Geis.
" Open marshy ground ", Taungyi, Aug. 1935, 6 aclitellate and 27 clitellate specimens. H. Young.
" Bamboo grove ", Tan Yang, Mong Yai State, Sept. 1935, 5 clitellate specimens. H. Young.
" Muddy spot near well, covered with water cress ", Tan Yang, Mong Yai State, Sept. 1935, 10 clitellate specimens. H. Young.
" Grassy ground near bank of small stream ", Nawng Lon, Mang Lun State, Sept. 1935, 9 clitellate specimens. H. Young.
" Bamboo thicket ", Nawng Lon, Mang Lun State, Sept. 1935, 2 clitellate specimens. H. Young.
" Grassy ground near paddy flats ", Nawng Kham, Mang Lun State, Sept. 1935, 2 clitellate specimens. H. Young.
" Sandy soil covered with leaves on wooded hillside ", Man Peng, Mang Lun State, Oct. 1935, 2 clitellate specimens. H. Young.
" Open grassy land ", Loise Village, Mang Lun State, Oct. 1935, 3 clitellate specimens. H. Young.
" Red soil, bamboo grove ", Lawng Meu, Mong Lem State, Oct. 1935, 12 clitellate specimens. Ca La (*per* H. Young.)
" Rich, dark soil, open, grassy ground ", Nam Shi Pan, Kengtung State, Oct. 1935, 8 clitellate specimens. Ca La (*per* H. Young.)
Bhamo and vicinity, Sept. 1934, 28 clitellate specimens. K. John.
Myitkyina and vicinity, Sept. 1934, 7 aclitellate and 114 clitellate specimens. K. John.
Kyaikmaraw, Aug. 1935, 1 aclitellate and 7 clitellate specimens. K. John.
Moulmein, Aug. 1935, 6 clitellate specimens. K. John.

External characteristics.—The setal formulae of ten specimens selected at random are shown below.

vii	viii	xvii	xviii	xix	iii	viii	xii	xx
15	19	13	9	15	28	43	52	56
15	21	14	10	13	28	37	50	52
14	20	16	9	14	28	44	..	53
13	18	14	9	13	27	40	51	57
16	21	12	7	12	29	39	50	51
17	24	13	10	14	26	55	61	60
14	20	15	8	13	24	41	46	53
15	20	16	9	15	29	45	53	56
16	23	15	9	13	29	48	54	53
15	23	14	10	15	31	51	51	51

The spermathecal pores are minute and invaginate, each pore at the tip of a very tiny, conical protrusion into the lumen of a transversely slit-like invagination from the roof or the lateral wall near the roof. On the anterior wall, near the roof, is a small, circular, greyish, translucent genital marking.

The male pores are minute and invaginate, each pore on a small, rather columnar or slenderly conical penis within a copulatory chamber.

Internal anatomy.—(Opened 10 specimens). The intestinal caeca are simple, slightly constricted by the septa through which they pass but otherwise without marginal incisions.

On the posterior face of each copulatory chamber is a single stalked gland; on the anterior face, one, two or three stalked glands. These glands may be covered over by connective tissue so that they are not at once visible. When fully retracted the copulatory chamber is approximately spheroidal and protuberant into the coelom. The penis may be retracted into the roof of the copulatory chamber or pendent into the lumen. On or near the base of the penis there may be one, two or three genital markings, the number varying from one chamber to the other or from one specimen to another. One of these markings is usually especially protuberant from the base of the penis. On the anterior face of the penis is a very slight ridge passing vertically from the base nearly to the tip. The penis is longer, relatively, than in *campanulata*, and without the preputial or annular lip near the tip. On the median wall of the chamber is a single genital marking which may be conspicuously protuberant into the lumen like the penis, for which it might be mistaken when the penis is retracted into the wall of the chamber.

The diverticulum passes into the spermathecal duct ental to the parietes and comprises a short, almost straight stalk and an elongate seminal chamber, the latter looped, the looping often in part approximating to zigzag. The ectal portion of the chamber is of about the same thickness as the stalk but the ental portion is widened. Ental to the diverticular junction the lumen of the duct is wide and with thin, smooth wall, the lumen completely filled by a whitish material. The ectal portion of the duct has a thick wall, the lumen narrow and with smooth wall, the lumen slightly widened towards the opening into the ental part of the duct.

The lumen in the ectal part of the duct is lined (in cleared objects) with a thin layer of transparent material in sharp contrast to the more opaque tissue forming the greater part of the thickness of the duct in this region. The transparent material is continued entally into a funnel (on a low papilla) on the floor of the chamber in the ental part of the duct, the transparent material also continuous with the lining of the ectal part of the diverticular stalk. The diverticulum passes straight through the tissue of the duct and opens just at the margin of the funnel. The spermathecal invagination is small, with transversely slit-like lumen, slightly coelomic, but indistinguishable from the spermathecal duct without further dissection.

Abnormality.—One of the specimens is characterized by an extensive series of spiral abnormalities extending from the anterior end to some distance behind the prostatic segments. There are eight spermathecal pores, five of which are on the left side. There are three copulatory chambers, two on the left side. The left intestinal caecum is seven segments behind the right caecum. The ovaries of the right and left sides are separated by two segments. On the right side there are two

testis sacs and two seminal vesicles, on the left side three testis sacs and three vesicles. One of the Lonton specimens is abnormal, lacking the anterior pair of spermathecae and the stalked glands of the spermathecal pore invaginations. The penial bodies are not normal.

Diagnosis.—Sexthecal, spermathecal pores minute and invaginate, each pore on the roof or lateral wall near the roof of an invagination with transversely slit-like lumen and aperture ; three pairs, on 6/7-8/9. Male pores minute and invaginate, each pore on a slenderly conical or shortly columnar penis on the roof of a spheroidal copulatory chamber. Genital markings tiny, circular, greyish translucent areas sharply demarcated by slight circumferential furrows, internal only ; one marking on the anterior wall of each spermathecal pore invagination, one marking on the median wall of each copulatory chamber, one, two or three markings on or near the base of each penis. Seta *a* and some of the ventral setae of the preclitellar segments enlarged, modified, ornamented ; setae present on all clitellar segments and with bifid or trifid tips : vii/11-17, viii/16-25, xvii/12-16, xviii/5-12, xix/12-15, 24-31/iii, 37-51/viii, 46-54/xii, 51-61/xx. First dorsal pore on 7/8-10/11. Length 55-110 mm. Diameter 3-4½mm. Segments 90-116.

Intestinal caeca simple. Testis sacs unpaired and ventral. Lumen in ental part of the spermathecal duct wide and communicating with the narrowed lumen of the ectal portion of the duct through a tiny, slit-like aperture at the centre of a low, disc-shaped papilla of a circular outline ; diverticulum with short, straight stalk and wider, elongate seminal chamber, the latter looped in part or in whole in an approximation to zigzag. One or more stalked glands to the anterior face of each copulatory chamber, one stalked gland on the posterior face ; one stalked gland to the anterior face of each spermathecal invagination.

NOTE.—The unusually high setal numbers found on viii and xii on one specimen are omitted for the present from the setal formula.

Pheretima inclara Gates.

1932. *Pheretima inclara,* Gates, *Rec. Ind. Mus.* XXXIV, p. 439. (Type locality, Peng Sai, Mang Lun State.)

Material examined.—From local collections :

" Dense jungle ", Peng Sai, Mang Lun State, Oct. 1935, three clitellate specimens. H. Young.

External characteristics.—Diameter, 8-10 mm. Pigmentation reddish, restricted to the dorsum, with a dark blueish tinge anterior to the clitellum, on one specimen also posteriorly for some distance.

The setae are small, closely and regularly spaced : vi/33, vii/32, xvii/31, xviii/15+, xix/30 ; vi/30, vii/33, xvii/34, xviii/15+, xix/36 ; vi/30, vii/29+, xvii/29, xviii/20, xix/27+. No setae are recognizable on ii on any of the specimens.

The spermathecal pores are minute and superficial.

The male pores are minute and superficial, each pore on a tiny, conical protuberance from the centre of a transversely oval, disc-shaped porophore which is surrounded by several concentric furrows.

There are no genital markings.

Internal anatomy.—Septa 6/7-7/8 are thickly muscular; 8/9-9/10 lacking; 10/11-11/12 muscular but not quite as thick as 6/7-7/8.

The glandular collar on the oesophagus behind the gizzard is high and deeply incised. The intestine begins in xv (2). The intestinal caeca are simple.

The single heart of ix is on the right side (1) or the left side (2). The last pair of hearts is in xiii (3). All hearts of ix-xiii pass into the ventral vessel.

The testis sacs of x and xi are unpaired and ventral. The seminal vesicles are large and fill their segments, covering over the dorsal blood vessel, the posterior vesicles pushing 12/13 back to 13/14. Each vesicle is provided with a large, dorsal ampulla. The prostates extend through xvi-xx. The prostatic duct is 12-13 mm. long, bent into a hairpin loop, with muscular sheen and extending through xvii-xviii or xviii-xix.

The spermathecal duct is slightly shorter than the ampulla. The diverticulum is longer than the combined lengths of duct and ampulla and is slender, slightly widened but only gradually, passing entally. Externally there is no indication of demarcation into stalk and seminal chamber. The stalk and an ectal portion of the seminal chamber is looped in a loosely zigzagged fashion and bound to the duct and ampulla. The seminal chamber is longer than the stalk portion of the diverticulum as indicated by the presence of the spermatozoal iridescence.

Remarks.—The specimens died shortly after collection, before the killing fluids could be secured and as a result are in bad condition, autotomized, ruptured in places, slightly decayed especially posteriorly. The anterior ends, fortunately, are on the whole in fairly good condition.

The type locality of this species was unknown. H. Young has looked at the type which he collected and is of the opinion that the specimen was obtained at Peng Sai. This may be regarded as confirmed by the more recent finding of the species at Peng Sai which is accordingly designated as the type locality.

Diagnosis.—Sexthecal, spermathecal pores minute and superficial, three pairs, on 5/6-7/8. Male pores minute and superficial, each pore on a tiny, conical protuberance from a disc-shaped porophore. Setae lacking on ii: vi/30-33, vii/30-33, xvii/27-34, xviii/20-24, xix/27-36, 125/xx. First dorsal pore on 12/13. Length 211 mm. Diameter 6-10 mm.

Intestinal caeca simple. Testis sacs unpaired and ventral. Spermathecal diverticulum longer than combined lengths of duct and ampulla, slender but slightly widened and gradually passing entally, stalk and an ectal portion of the seminal chamber looped in a loosely zigzagged fashion, stalk and seminal chamber not marked off externally.

Pheretima longicauliculata Gates.

1931. *Pheretima longicauliculata*, Gates, *Rec. Ind. Mus.* XXXIII, p. 395. (Type locality, Tolo Senca Village, Mong Yang District, Kengtung State.)

1932. *Pheretima longicauliculata*, Gates, *Rec. Ind. Mus.* XXXIV, p. 525.

1933. *Pheretima longicauliculata*, Gates, *Rec. Ind. Mus.* XXXV, p. 533.

Material examined.—From local collections:

" Grassy soil ", Taungyi, Aug. 1935, 16 aclitellate and 4 clitellate specimens. H. Young.

" Hard soil, open grassy space ", Taungyi, Sept. 1935, 7 clitellate specimens. H. Young.

" Grassy area under trees ", Taungyi, Sept. 1935, 1 aclitellate and 12 clitellate specimens. H. Young.

" Heavily manured soil in garden ", Pali Village, Mong Lem State, Oct. 1935, 10 clitellate specimens. Ca La (per H. Young).

" Red soil in bamboo grove ", Lawng Neu, Mong Lem State, Oct. 1935, 1 clitellate specimen. Ca La (per H. Young).

" Rich, dark soil, open, grassy ground ", Nam Shi Pan, Kengtung State, Oct. 1935, 5 clitellate specimens. Ca La (per H. Young).

External characteristics.—The dorsal setae are deeply retracted and exceedingly difficult to count. Near the mid-dorsal line the setae are slightly more widely separated than on previous specimens. Although setae are present on ii only ventrally, there is a row of empty setal pits recognizable laterally and dorsally on most of the present specimens. The setal formulae of 6 specimens are shown below :—

vi	vii	viii	xvii	xviii	xix	iii	viii	xii	xx
41	39	38	38	30	36	68	92	94	91
43	42	43	36	31	36	63	103	98	99
43	43	44	36	32	35	65	98	96	96
49	44	44	35	29	34	61	95	99	90
45	44	43	35	29	36	62	97	97	95
44	43	40	36	27	38	69	105	113	110*

* Clitellate specimen from an earlier collection. On this worm the setae are more protuberant and much more easily and accurately counted.

The peculiar areas (vii and viii) on which setae are absent, that characterized the earlier specimens are entirely lacking on the present worms.

Internal anatomy.—(Opened 10 specimens and several from earlier collections). The intestinal caeca are simple, the margins smooth or with slight septal constrictions only. The glandular collar on the oesophagus behind the gizzard is high but not as high as in *andersoni.*

The spermathecal duct is shorter than the ampulla. The lumen of the duct is wide entally but is abruptly narrowed in the region of the diverticular junction. The inner wall of the duct is usually ridged, the rugosities circular rather than longitudinal. The diverticulum is much longer than the combined lengths of duct and ampulla and comprises a short stalk with lumen only slightly irregular or with smooth wall, a middle section and a very slender, elongately club-shaped seminal chamber. In cleared spermathecae there appear to be two distinct passages running longitudinally through the middle portion of the diverticulum but this appearance seems to be due to the presence of high longitudinal ridges. The diverticular regions of especial thickness and of unusual thinness in the earlier specimens are, apparently, to be regarded as abnormalities.

The glands of the genital markings appear to be sessile on the parietes. The gland is very soft and readily falls away from a thickly columnar and very hard stalk which protrudes through the musculature slightly into the coelomic cavity. The stalk is transversely oval in section.

All of the Toungyi specimens have rather juvenile seminal vesicles and spermathecae without spermatozoal iridescence in the diverticula.

Parasites.—In each of the Kengtung and Mong Lem specimens there are numerous reddish, parasitic masses on the gizzard and blood vessels of viii to x.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, on 5/6-8/9. Male pores minute and superficial, each pore at the centre of a small, transversely oval, disc-shaped porophore. Genital markings intersegmental, transversely oval, 5-10 intersetal intervals wide, slightly median to the male pore lines, widely paired, midventral distance between the markings=18-24 intersetal intervals, on 18/19-29/30. Setae lacking laterally and dorsally on ii: vi/36-49, vii/39-44, viii/38-44, xvii/35-38, xviii/24-32, xix/34-38, 2-9/ii, 61-69/iii, 92-105/viii, 94-113/xii, 89-110/xx. First dorsal pore on 12/13. Length 140-244 mm. Diameter 7-10 mm. Segments 137-140.

Intestinal caeca simple. Testis sacs unpaired and ventral. Spermathecal diverticulum longer than combined lengths of duct and ampulla, stalk short, middle portion with high longitudinal ridges, seminal chamber elongate and slenderly club-shaped. Genital marking glands coelomic but resting on the body wall, with tough stalks which protrude through the parietes.

Pheretima lorella, sp. nov.

Material examined.—From local collections:

"Sandy soil, covered by leaves, on a hillside", Loi Pang Pra, Mong Yai State, Sept. 1935, 4 clitellate specimens. H. Young.

External characteristics.—Length 100-140 mm. Diameter 5-6 mm. Pigmentation reddish, restricted to the dorsum, much darker anterior to the clitellum and on some specimens with a blueish tinge; clitellum yellowish to brownish.

The setae begin on ii on which segment there is a complete circle. The setae are small and closely and regularly spaced, more protuberant and slightly larger ventrally than dorsally. The setal circles are without midventral gaps but there is usually a slight mid-dorsal gap the width of which is variable. The setae are often retracted, especially on the dorsum and exceedingly difficult to count: spermathecal setae on viii, -12, 15, 13, 14; no male setae visible on xviii; 91 setae on segment xii of one specimen.

The first dorsal pore is on 12/13 (3).

The clitellum is annular, extending from 13/14 to 16/17; intersegmental furrows and setae lacking, dorsal pores or pore-like markings present.

The spermathecal pores are minute, each pore within a very slight parietal invagination with small, shortly transverse, slit-like apertures two pairs, on 7/8-9/10.

There is a single female pore.

On segment xviii, on each specimen, there is a transversely placed, almost rectangular, fairly deep depression, the margins of which appear to be strengthened. On one specimen the anterior and posterior margins of the depression are almost in apposition; on the other specimens

the depression fully open, the aperture 8-11 intersetal intervals wide (as counted on xx). The roof of the depression lacks setae and is transversely and finely ridged. Dorsolaterally on each side the depression opens into an elongately ovoidal body which is completely concealed within the parietes, *i.e.*, does not project into the coelomic cavity. On two specimens the location of the ovoidal bodies is indicated externally by rather conspicuous longitudinal swellings, one on each side just lateral to the margins of the midventral aperture. From the roof there hangs down into the lumen of each ovoidal body a slenderly conical, smooth, firm penis, slightly over 1 mm. in length. The male pore is at the ventral tip of this penis. At the extreme tip of the penis there is a perfectly transparent region in the form of a tiny cone. This cone is continuous with the cuticular covering of the penis and is apparently a thickened portion of the cuticle. This cuticular tip may be sharply outlined or abraded.

There are no genital markings.

Internal anatomy.—Septa 8/9-9/10 are lacking; none of the septa thickly muscular though anteriorly some are slightly strengthened.

The intestine begins in xv (3). The intestinal caeca are simple, long enough to reach into xix, with 7-10 small lobulations of the ventral margin posteriorly.

The single heart of ix is on the right side (2) or the left side (1). The last pair of hearts is in xiii (3). All hearts of ix-xiii pass into the ventral blood vessel.

The testis sacs are unpaired and ventral (2). The posterior testis sac may or may not reach to 10/11, in the latter case the sac has a conspicuously bilobed, anterior margin, the lobes rather conical and with a strand of tissue passing from the pointed tip of the cone to 10/11. The seminal vesicles are fairly large and fill their segments, covering over the dorsal blood vessel, the posterior vesicles the larger and pushing 12/13-14/15 back into contact with 15/16. The prostates extend through some or all of xvi-xxi. The prostatic duct is 5-6 mm. long and is bent into a C-shape or into a spiral. The prostatic duct passes through the thickish wall of the ovoidal body within the parietes and into the base (dorsal portion) of the penis. There is no trace whatever of the penial invagination (ovoidal body) within the coelomic cavity but the ovoidal body can be easily dissected out after separating the strands of the longitudinal muscular layer. There are no markings within the invagination.

The spermathecal duct is about as long as or slightly shorter than the ampulla and is rather bulbous near the parietes where it receives the diverticulum, slightly narrowed within the inner portion of the body wall, abruptly narrowed further ectally. The ental portion of the duct has a rather wide lumen at the ectal end of which is a broadly conical, smooth papilla with a short slit at its centre. The diverticulum passes into the duct ectal to the papilla, the diverticular canal passing dorsally within the duct—and here wider than in the diverticular stalk—to open into the duct lumen at the margin of the papilla. Ectal to the papilla the lumen of the duct is very narrow. The diverticulum is longer than the combined lengths of duct and ampulla and is rather

club-shaped, without external indication of demarcation into stalk and seminal chamber, gradually widened passing entally. An ectal portion has a muscular sheen, the ental portion a spermatozoal iridescence. The diverticulum may be twisted in a helical fashion or variously bent but is not zigzag looped.

Parasites.—In the coelomic cavities of the anterior segments of three specimens there are numerous nematodes.

Remarks.—The male genital terminalia and the association of their apertures in a common midventral depression are very similar to a condition that characterizes an undescribed species from Singapore.

One spermatheca has a second diverticulum nearly as long as the normal diverticulum, the ental portion only very slightly widened and with no spermatozoal iridescence.

Diagnosis.—Quadrithecal, spermathecal pores minute and invaginate, each pore within a small, parietal invagination with a shortly transverse, slit-like aperture, two pairs, on 7/8-8/9. Male pores minute and invaginate, each pore at the ventral end of a slenderly conical penis on the roof of a thick-walled, longitudinally ovoidal invagination in the parietes opening to the exterior in the lateral portion of a transversely rectangular, unpaired, median depression. Setae : viii/12-15, xviii/0 91/xii. First dorsal pore on 12/13. Length 100-140 mm. Diameter 5-6 mm.

Intestinal caeca simple but with small lobulations of the ventral margin posteriorly. Testis sacs unpaired and ventral. The lumen in the ental part of the spermathecal duct large and communicating with the narrowed lumen of the ectal portion through a short slit at the centre of a broadly conical, smooth papilla ; diverticulum longer than combined lengths of duct and ampulla, club-shaped, without external differentiation into stalk and seminal chamber, twisted in a helical fashion or variously bent.

Pheretima luxa, sp. nov.

Material examined.—From the Indian Museum : 1 clitellate specimen labelled, " Mule track between Mao-Hsao and Namkham. N. Shan States, Burma. *ca* 3,700 ft. H. S. Rao. Nov. 1926 ".

External characteristics.—Length 190 mm. Diameter 10 mm. No traces of pigmentation visible.

The setae are unusually small, very closely spaced and ventrally, at least on some segments, with the appearance of being zigzagged so that the setal circle has a slightly serrate appearance. Formula : xvii/33, xviii/15, xix/36+. (The preservation is such that the cuticle cannot be removed without damage to the epidermis, hence the incompleteness of the formula.)

The first dorsal pore is on 12/13.

The clitellum is annular, extending from just behind the setae of xiii to just in front of the setae of xvii ; dorsal pores, intersegmental furrows and setae lacking, furrows 13/14 and 16/17 and the dorsal pores of these furrows also lacking.

The spermathecal pores are minute and superficial, four pairs, on 5/6-8/9, the margins of the segments in the vicinity of the pores rather protuberant.

There is a single female pore.

The male pores are minute and superficial, each pore on a tiny, conical swelling that is not distinctly demarcated basally.

The genital markings are on xviii, but slightly dislocating 17/18 anteriorly and 18/19 posteriorly, just median to the male pores, two pairs, one pair presetal and one pair postsetal. The markings are transversely oval, slightly depressed, the markings of a side separated by a fine, transverse ridge in line with the setae but on which no setae are visible. The ridge ends laterally against the base of the conical male porophore which in turn merges imperceptibly into the two genital markings at their lateral margins.

Internal anatomy.—Septum 5/6 is thickly muscular; 6/7-7/8 very thickly muscular; 8/9-9/10 lacking; 10/11-11/12 very thickly muscular; 12/13 and succeeding septa extremely delicate.

On the oesophagus just behind the gizzard is a high, glandular collar; deeply incised into 10 lobes. The intestinal caeca are simple, the margins smooth except for septal constrictions which may be fairly deep.

The last pair of hearts is in xiii. All hearts of ix-xiii pass into the ventral vessel.

The testis sacs are unpaired, ventral, and so placed that the nerve cord is within each sac; the floor of the sac apparently attached to the ventral surface of the cord as a needle cannot be passed between the two as in *P. sonella* sp. nov. The seminal vesicles of both xi and xii are vertical bodies, lateromesially flattened against the gut, reaching upwards to or nearly to the dorsal blood vessel. The prostates extend through xvi-xx. The prostatic duct is 14 mm. long, bent into a hairpin loop (on one side of the body), the ectal limb thicker than the ental limb and with pronounced muscular sheen. The duct extends through xvii and xviii.

The spermathecal ampullae are distended, the duct slender and much shorter than the ampulla. The diverticulum passes into the anterior face of the duct at the parietes, is longer than the combined lengths of duct and ampulla, slender, with muscular sheen ectally and spermatozoal iridescence entally but with little further external indication of differentiation into stalk and seminal chamber.

In xviii, on each side, is a sessile, glandular mass scarcely protuberant into the coelomic cavity, immediately median to the ectal end of the prostatic duct.

Remarks.—In the same tube as the types of *P. sonella* and the type of *P. luxa* is a worm that shares the common characteristics of the two species just mentioned. Length 280 mm. Diameter 10 mm. Male pores minute and superficial, each pore towards the lateral margin of a transversely rectangular area which is 2½ mm. wide and 1 mm. long, demarcated anteriorly, and posteriorly by a fairly deep, transverse furrow, laterally by a slight furrow and mesially not at all. There are no definite genital markings but 17/18 is bent anteriorly though only slightly while 18/19 is bent posteriorly, in both cases as in *P. luxa*. It is in this

region that the *luxa* genital markings should be located. The spermathecal diverticulum is bound firmly by connective tissue to the duct and ampulla and is bent into a more or less regular approximation to a zigzag looping. Except as noted above, and in so far as the condition of the specimen permits recognition, the worm is like the type of *P. luxa*.

P. luxa is very similar to *P. sonella* from which it is distinguished at present by the smaller number of male setae on xviii and differences in size, number and location of the genital markings, (possibly also by the smooth margins of the intestinal caeca, the differences in the shape of the seminal vesicles of xii, and the region of thickening of the prostatic duct).

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, on 5/6-8/9. Male pores minute and superficial. Genital markings transversely oval, median to the male pore lines, on xviii, one presetal and one postsetal pair. Setae very small and very closely spaced: xvii/33, xviii/15, xix/36. First dorsal pore on 12/13. Length 190 mm. Diameter 10 mm.

Intestinal caeca simple. Testis sacs unpaired and ventral. Spermathecal diverticulum longer than the combined lengths of duct and ampulla, slender. Genital marking glands sessile on the parietes.

Pheretima malaca, nom. nov.

1933. *Pheretima maculosa* (non *P. maculosus* Hatai 1930), Gates, *Rec. Ind. Mus.* XXXV, p. 534. (Type locality, Kamaungthwe River, Tavoy District.)

Material examined.—From local collections:

"Dense jungle near water", Lashio Sept. 1935, 3 clitellate specimens. H. Young.

External characteristics.—Length 55 mm. Diameter 2 mm. The first dorsal pore appears to be on 12/13 but there are pore-like markings on 11/12 on all specimens.

There are only four male setae on xviii on each of the specimens. Dorsally the setae are retracted so that accurate counts cannot be made. On one of the parasitized types the numbers are 56/iii, 77/viii, 61/xii, 50/xx.

The spermathecal and male pores are minute and superficial.

The genital markings are in two or three rather irregular, transverse rows in the region of 17/18, the rows reaching laterally nearly to the male pore lines. The markings are tiny, circular, sharply demarcated discs. On each of the two specimens there is a single marking on vii, on the right side, slightly median to the spermathecal pore line and just behind the setae. On one of these specimens there is in addition an unpaired, postsetal median each on x-xii.

Internal anatomy.—As in the original specimens, hearts belonging to x or xi have not been found. (One of the specimens was carefully dissected under the highest power of the binocular.) The pair of hearts immediately in front of the testis sac of x is regarded as belonging to segment ix. The dorsal blood vessel is either on or within the dorsal wall of the testis sac of x.

The testis sac of x is annular, the sac of xi U-shaped. The seminal vesicles of xi are included within the posterior testis sac.

The spermathecal duct is shorter than the ampulla from which it is sharply marked off. The diverticulum is shorter than the combined lengths of duct and ampulla and comprises a stalk, the ectal portion of which is smooth and regular while the ental portion is twisted or bent irregularly, and a small, shortly ovoidal, seminal chamber sharply marked off from, but only slightly thicker than the stalk. The chambers are clear and transparent, without spermatozoal iridescence. In the ectal part of the diverticulum the lumen is very narrow, the width less than the thickness of the wall. In the middle part the lumen is gradually widened.

Remarks.—The types were heavily parasitized and are probably somewhat abnormal. No parasites have been found in the new specimens which may be regarded as more nearly normal.

The species has been known hitherto only from the types and the type locality. The latter is in Tavoy district quite some distance south of Lashio. It is curious that the species has not been found in the region between these two localities, since considerable collecting has been done in this area.

Diagnosis.—Bithecal, spermathecal pores minute and superficial, one pair, on 6/7. Male pores minute and superficial, each pore on a large, circular, disc-shaped porophore. Genital markings tiny, circular discs; in transverse rows on or near 17/18 (18/19); postsetal, one or two median to the spermathecal pore lines on vii and viii, (median on xi-xii). Setae present ventrally on all clitellar segments : vii/26-31, xvii/10-12, xviii/4-10, xix/12-14, 56/iii, 77/viii, 61/xii, 4-9/xiv, 3-10/xv, 7-11/xvi, 50-57/xx. First dorsal pore on 10/11-12/13. Length 46-82 mm. Diameter 2-4 mm. Segments 109-119.

Intestinal caeca simple. Hearts of x and xi lacking. Testis sacs unpaired; of x annular, of xi U-shaped. Seminal vesicles of xi included within the posterior testis sac. Spermathecal diverticulum comprising a short stalk with narrow lumen, a twisted or irregularly bent middle portion in which the lumen is wider, and a small, ovoidal seminal chamber. Genital marking glands stalked and coelomic.

Pheretima mamillana Gates.

1931. *Pheretima mamillana,* Gates, *Rec. Ind. Mus.* XXXIII, p. 400. (Type locality, Ye.)
1932. *Pheretima mamillana,* Gates, *Rec. Ind. Mus.* XXXIV, p. 470.
1933. *Pheretima mamillana,* Gates, *Rec. Ind. Mus.* XXXV, p. 538.

External characteristics.—The setal formulae of twelve specimens are shown below :—

iii	viii	xii	xiii	xx
31	42	48	51	53
30	45	46	47	52
40	51	56	56	54
34	43	45	50	53
32	44	48	47	53
33	42	43	44	47
33	38	..	49	53
35	39	44	53	54
..	43	45	46	..
..	39	50	..	..
..	42	47	..	..
..	42	44	47	..

The primary spermathecal pores are large, superficial, transversely oval or slit-like.

Internal anatomy.—The glandular collar on the oesophagus behind the gizzard is broken into a series of isolated lobes. The intestinal caeca are simple, reaching into xviii to xx or long enough to do so when straightened out, the margins smooth. The intestine begins in xv (10).

The single heart of ix is on the left side (5) or the right side (5). The last pair of hearts is in xiii (10).

The testis sacs are paired and ventral (10). The ventral margins of the seminal vesicles of xi may be attached lightly to the roofs of the testis sacs but can be removed without opening the sacs. The prostatic duct is 2-4 mm. long, nearly straight, with muscular sheen, passing into the centre of the dorsal face of the copulatory chamber.

On the coelomic face of the copulatory chamber but always covered over by connective tissue are shortly stalked glands. There is always a pair of these glands on the median face of the chamber, the stalks passing into the wall near to but not at the parietes. On the lateral face of the chamber there is always glandular material. This material may be in one mass but with two groups of stalks passing independently into the wall of the chamber or with only one group of stalks, or the glandular material may be in two discrete masses each with its own group of stalks. The point of entrance into the chamber of the lateral glands is more dorsal than that of the median glands. The male porophore or penial body nearly covers the roof of the copulatory chamber and is transversely elliptical in outline and in most chambers may be described as a low but definite papilla. A transversely slit-like depression on the papilla is, however, so large and deep that the porophore has the appearance in most specimens of a thick annulus. On the wall of the depression (internal face of the ring) are two small, circular, greyish, translucent, definitely demarcated but not protuberant genital markings. The roof of the depression is very finely wrinkled and bears the minute, male pore. The condition just described is evidently that of complete retraction. Several specimens have the invagination at the centre of the porophore slightly everted to form a thin, wrinkled frill around the inner margin of the annulus. Presumably the invagination can be completely everted. In an everted condition the porophore might be expected to be conical with a firm base and softer, wrinkled ventral portion, the male pore at or near the tip, the markings on the side. On the median wall of each copulatory chamber, at the tip of shortly columnar protuberances into the lumen are two further, circular genital markings, each marking with a tiny, circular depression at the centre surrounded by a number of minute, greyish spots that may indicate the location of pores. Everted copulatory chambers have not yet been found in this species.

The spermathecal duct is slightly bulbous, the thickest portion within the parietes. The lumen of the duct is wide, slightly narrowed passing entally, the wall with longitudinal ridges. The diverticulum passes into the lateral face of the duct at or near to the parietes. The diverticular opening is recognizable as a minute pore on the lateral wall of the duct when the latter is slit open. The diverticular stalk is long and slender, looped entally, the looping in part approximating to zigzag. The stalk is

3-6 times as long as the ovoidal to shortly ellipsoidal seminal chamber, the latter marked off from the stalk by a slight but definite constriction. The wall of the lumen in the stalk is provided with longitudinal ridges. The wall of the seminal chamber is thin and smooth internally.

Parasites.—Coelomic parasites (cysts) in considerable numbers were found in seven specimens.

Diagnosis.—Sexthecal, spermathecal pores large and superficial, three pairs, on 6/7-8/9. Male pores minute and invaginate, each pore within a deep, transversely slit-like depression located on a transversely elliptical papilla on the roof of a copulatory chamber. Genital markings internal only ; two markings on the median wall of the copulatory chamber, two smaller markings within the depression on the male porophore. Setae : vii/20-25, viii/20-26, xvii/15-18, xviii/7-13, xix/14-19, 30-40/iii, 37-51/viii, 43-56/xii, 44-56/xiii, 47-56/xx. First dorsal pore on 12/13. Length 132-210 mm. Diameter 5-7 mm. Segments 141-157

Intestinal caeca simple. Testis sacs paired and ventral. Two shortly stalked glands on the median face of each copulatory chamber and two on the lateral face. The spermathecal diverticulum passes into the lateral face of the duct and comprises an ovoidal to shortly ellipsoidal chamber constricted off from a slender stalk, the latter looped entally and 3-6 times as long as the chamber.

Pheretima manicata Gates.

1931. *Pheretima suctoria* var. *manicata*, Gates, *Rec. Ind. Mus.* XXXIII, p. 414. (Type locality, Moulmein.)

1932. *Pheretima manicata* var. *typica*, Gates, *Rec. Ind. Mus.* XXXIV, p. 526.

Material examined.—From local collections :

Moulmein and vicinity, Aug. 1935, 46 aclitellate and 24 clitellate specimens. K. John.

Kyaikmaraw, Aug. 1935, 1 aclitellate and 41 clitellate specimens. K. John.

External characteristics.—The number of setae on xvi varies from 18 to 32 as follows : 31, 20, 29, 18, 32, 29, 28, 20, 21, 31, 19. The setal formulae of five specimens from Moulmein are shown below :—

vi	vii	viii	xvii	xviii	xix	iii	viii	xii	xx
28	28	25	26	6	25	48	60	66	64
28	29	27	26	8	23	58	72	71	70
25	25	25	23	7	24	47	63	60	60
24	24	25	24	4	23	46	69	73	73
23	26	24	26	5	28	47	60	67	70

The spermathecal pores are minute and superficial.

The male pores are minute and superficial, each pore on a small, circular, disc-shaped porophore.

The long axis of the genital markings is always longitudinal. Each specimen has one pair of markings only. On one specimen the genital markings pass through the setal circle of xix, and anteriorly reach onto xvii.

Internal anatomy.—(Opened 10 specimens.) The intestinal caeca are compound, glove-shaped, the dorsalmost secondary caecum always the shortest. The ventral, secondary caeca may be of about the same

length or the ventralmost may be the longest. In the first postcaecal segment or each of the first two or three post-caecal segments there is on each side of the gut a vertical, rather ridge-like protuberance. This ridge may be lateromesially flattened against the gut, in which case it looks much like an ordinary sacculation, or it may be anteroposteriorly compressed. In the latter case the lateral margin is usually lobed, the incisions marking off definitely finger-shaped but short, secondary caeca.

The seminal vesicles, possibly as a result of faulty preservation, are soft and sticky, adherent to the septa and to the testis sacs. The vesicles cannot be dissected out without removing part of the wall of the testis sac or tearing the outer membrane of the vesicle. The testis sacs of x and xi are pushed posteriorly so as to have the appearance of being within xi and xii. The seminal vesicles of xii are attached to the posterior testis sac just above the male funnels, the removal of the vesicles exposing the funnels. The vesicles of xi are similarly attached to the anterior testis sac. The testis sac of xi is unpaired and suboesophageal in all the specimens. The testis sac of x in most of the specimens is also unpaired and suboesophageal. In several worms the testicular coagulum is not continuous from one side of the sac to the other so that there results an appearance as of a pair of sacs.

The spermathecal diverticulum is longer than the combined lengths of duct and ampulla and may be twice as long. The diverticulum comprises a short stalk that is nearly straight and with a narrow, central lumen and an elongate seminal chamber. The latter is twisted into a more or less spheroidal mass and comprises two parts, an ectal portion which is of about the same thickness as the stalk but with wider lumen and an ental portion that is still thicker and with a still wider lumen, the two portions not sharply demarcated. The duct is much shorter than the ampulla, with a large lumen, and is abruptly narrowed within the parietes. The spermathecal ampullae are distended. The material in the ental portion of the ampulla is translucent, almost transparent and soft. The material in the ectal portion of the ampulla and reaching into the duct is opaque, white and hard.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, on 5/6-8/9. Male pores minute and superficial, each pore on a small, circular, disc-shaped porophore. Genital markings one pair, with long axis longitudinal, median to the male porophores, extending to or across 17/18 and 18/19. Setae present ventrally on xvi: vi/23-32, vii/24-32, viii/24-32, xvii/23-29, xviii/4-9, xix/23-30, 46-58/iii, 60-72/viii, 60-73/xii, 18-32/xvi, 64-73/xx. The clitellar glandularity ends posteriorly with the setae of xvi. First dorsal pore on 12/13. Length 56-111 mm. Diameter 4-6 mm. Segments 68-95.

Intestinal caeca compound, glove-shaped, dorsalmost secondary caecum the shortest. Testis sacs unpaired and ventral. Spermathecal diverticulum longer than combined lengths of duct and ampulla, with short, straight stalk, seminal chamber twisted irregularly into a roughly spheroidal mass, an ectal portion of the chamber of same thickness as the stalk but with wider lumen, the ental portion slightly thicker. Genital marking glands sessile, interrupting the musculature and slightly protuberant into the coelomic cavity.

Pheretima meridiana Gates.

1929. *Pheretima houlleti* (part), Stephenson, *Rec. Ind. Mus.* XXXI, p. 237.
1932. *Pheretima campanulata* var. *meridiana*, Gates, *Rec. Ind. Mus.* XXXIV, p. 457. (Type locality, Myittha, Tavoy District.)
1933. *Pheretima campanulata* var. *meridiana*, Gates, *Rec. Ind. Mus.* XXXV, p. 511.

Material examined.—From the Indian Museum : 1 dissected, clitellate specimen labelled, " *Pheretima houlleti* (E. Perr.). Nyaungbin, a village at the north end of the Indawgyi Lake, Myitkyina Dist., U. Burma. B. Chopra. 7-10.xi.26. W 3267/1."
From local collections :

Foot of Thandaung Hill, Sept. 1935, 14 clitellate specimens. G. E. Blackwell.
Pegu Yomas, No. 5, Sept. 1935, 4 clitellate specimens. G. E. Blackwell.
Pegu Yomas, No. 6, Sept. 1935, 2 clitellate specimens. G. E. Blackwell.
" Under clods in tea garden ", Tan Yang, Mong Yai State, Sept. 1935, 2 clitellate specimens. H. Young.
" Sandy soil covered with leaves on wooded hillside ", Man Peng, Mang Lun State, Oct. 1935, two clitellate specimens. H. Young.
" Grassy ground near bank of a small stream ", Nawng Lon, Mang Lun State, Sept. 1935, 3 clitellate specimens. H. Young.

External characteristics.—Complete circles of setae are present on all clitellar segments. A few of the clitellar setae have been examined ; all have a bifid tip, some with a web between the two prongs of the tip. The setal formulae of seven specimens are shown below :—

vii	viii	xvii	xviii	xix	iii	viii	xii	xx
13	17	18	14	17	20	30	50	53
13	18	17	12	17	25	38	45	53
14	18	17	12	16	..	38	44	49
16	17	21	16	19	21	40	54	60
14	17	16	13	16	24	36	44	55
14	19	20	16	20	26	31	48	55
15	19	17	12	15	..	38	48	50

The spermathecal pores are minute and invaginate, each pore on a tiny, conical protrusion into a slit-like invagination with a transversely slit-like aperture. The roof of the invagination projects slightly into the coelomic cavity. Into the roof of this invagination the spermathecal duct passes and in such a way that duct and invagination are indistinguishable, the appearance as of a rather thick duct passing through the parietes. The duct is actually short, bulbous, abruptly narrowed to a tiny, conical pointed portion within the roof of the spermathecal invagination. Into the anterior face of each invagination passes the duct of a stalked gland. A duct of a similar stalked gland passes into the posterior face of each invagination and like the duct of the anterior gland just at or slightly within the parietes. Within each spermathecal invagination there are two genital markings, one on the anterior wall and one on the posterior wall. These markings are small, circular, with a greyish translucent appearance and are sharply demarcated by a slight but evident circumferential furrow.

External genital markings have been found only on two specimens. On one of the exceptional worms there is a single genital marking of the *campanulata* type slightly median to each spermathecal pore, on or close to the intersegmental furrow. On the second specimen there is a genital marking on the posteriormost margin of vii, just median to each spermathecal aperture of 7/8.

Internal anatomy.—On the oesophagus just behind the gizzard there is a slight, interrupted, glandular collar. The intestinal caeca may be constricted by the septa through which they pass but definite lobulations of the dorsal or ventral margins have not been noted (20).

The last pair of hearts is in xiii (20). The single heart of ix is on the right side (9) or the left side (1); a pair of hearts belonging to ix in one specimen.

The testis sacs are unpaired and ventral. The testicular coagulum within the sacs may be in one continuous, transverse mass or may be separated into two discrete masses. In the latter case the roof and floor of the testis sac may be in contact just underneath the ventral blood vessel so that there appears to be two distinct testis sacs in a segment but it has been possible, in all of the specimens, to separate the roof and floor of the testis sac without, apparently, rupturing any tissue. If tissues were sticky the floor and roof of the sac might be so held together in the region of the ventral blood vessel that separation would be impossible without rupturing the delicate membranes involved. In such circumstances there would appear to be present a pair of testis sacs in a segment.

The seminal vesicles are smallish, quite definitely smaller than in *P. campanulata* and more like the seminal vesicles of *P. houlleti*. The primary ampulla is, relative to the size of the ventral lamina, larger than in *campanulata*.

The copulatory chamber appears to be slightly larger, thicker walled and tougher than in *campanulata*. The dorsal face has a much smoother appearance than in the latter species. On the anterior face of each copulatory chamber are two (usually) or three glands covered over by connective tissue. The number of the glands does not seem to be related to the number of the genital markings within the copulatory chamber. One glandular mass may have two or three stalks which can be readily separated, or the stalks of two separate glandular masses may pass to one genital marking. The stalks of the glands pass into the roof of the copulatory chamber median to the point of entrance of the prostatic duct. Glands were not found on the posterior face of any copulatory chamber. Penial setae are lacking in all specimens. The penial body has a distinctly bilobed appearance due to the presence of a genital marking. The male pore papilla at the ventral end of the penial body is somewhat conical in appearance but with a bluntly rounded tip and is surrounded by a preputial ring which bears the genital marking. The preputial ring can be cut back some distance from the male pore papilla the tip of which is alone visible, as a rule, without dissection. The penial body is slightly larger than in *campanulata* and may be rather conspicuously protuberant into the lumen of the copulatory chamber or retracted into the wall of the

chamber so deeply that it is not visible when the chamber is opened. On the median wall of the chamber there is always a single genital marking which may be at the end of a rod or column conspicuously protuberant into the lumen of the chamber. Fully everted copulatory chambers have not yet been found in Burma but have been noted on one specimen of this species from the Bahamas (The genus *Pheretima* in North America. In press.).

The stalk of the spermathecal diverticulum is slender and usually shorter than the seminal chamber and may be slightly curved but is never looped. The seminal chamber is elongate, thicker than the stalk, looped in a more or less regularly zigzagged manner or an approximation thereto, the limbs of the loops in contact and bound together. The ental end of the seminal chamber may be slightly widened. The diverticulum passes into the thickest portion of the duct, ental to the parietes The duct is shorter than the ampulla. The duct lumen is wide ental to the diverticular junction and communicates with the narrow lumen of the short portion of the duct within the wall of the spermathecal invagination through an aperture in a groove on a shortly conical, smooth papilla. The groove is on the side of the papilla towards the diverticulum, the diverticular canal opening into the duct lumen near the base of the groove.

Remarks.—Dissection is necessary for identification of this species and should include an examination of the interior of the copulatory chamber. Each copulatory chamber of fourteen specimens was opened. Of the remaining specimens of this year's collections one copulatory chamber of each worm was opened. In the preliminary sorting the two specimens with genital markings were originally placed with *campanulata* and were only discovered on dissection (all specimens of *campanulata* secured this year have been opened and the contents of the copulatory chambers examined). Presence of genital markings may have resulted in identification of earlier specimens as *campanulata*.

In the Nyaungbin specimen, which Stephenson referred to *P. houlleti*, there are two stalked glands to each spermathecal invagination and within the copulatory chamber a characteristic, *meridiana*, male porophore. The specimen is normal.

Diagnosis.—Sexthecal, spermathecal pores minute and invaginate, each pore within an invagination (with transversely slit-like lumen and aperture) that reaches into the coelomic cavity ; three pairs, on 6/7-8/9. Male pores minute and invaginate, each pore on the ventral end of a penial body within a spheroidal, copulatory chamber ; at the tip of the penial body an annular, preputial lip on which is a genital marking, the presence of the marking resulting in a bilobed appearance of the tip. Genital markings tiny, circular, greyish, translucent areas sharply demarcated by slight circumferential furrow, internal only—one marking on the anterior wall and one on the posterior wall of each spermathecal invagination, one marking on the median wall of each copulatory chamber in addition to the marking on the penial body. Setae present on all clitellar segments, clitellar setae with bifid tips : vii/11-17, viii/15-26 xvii/15-21, xviii/10-16, xix/15-20, 20-26/iii, 30-40/viii, 44-54/xii, 48-60/xx. First dorsal pore on 11/12. Length 110-200 mm. Diameter 3-8 mm. Segments 119-131.

Intestinal caeca simple. Testis sacs unpaired and ventral. The lumen in the bulbous ental portion of the spermathecal duct opens into the lumen of the narrowed ectal portion of the duct through an aperture in a groove on the side of a shortly conical papilla; diverticulum comprising a slender stalk and a wider, elongate seminal chamber, the latter slightly widened entally and looped, often in a regular zigzag or an approximation thereto. One or more stalked glands on the anterior face of each copulatory chamber, one stalked gland to the anterior face and one to the posterior face of each spermathecal invagination.

Pheretima morrisi (Beddard).

1892. *Perichaeta morrisi*, Beddard, *Proc. Zool. Soc., London*, 1892, p. 166. (Type locality, Penang. Type in the British Museum ?)
1912. *Pheretima browni* (part), Stephenson, *Rec. Ind. Mus.* VII, p. 273. (Paratypes with spermathecal pores in 5/6-6/7, in Indian Museum.)
1926. *Pheretima hawayana* var. *lineata*, Gates, *Rec. Ind. Mus.* XXVIII, p. 154. (Type locality, Taungyi.)
1931. *Pheretima hawayana*, var. *lineata*, Gates, *Rec. Ind. Mus.* XXXIII, p. 385.
1932. *Pheretima hawayana* var. *lineata*, Gates, *Rec. Ind. Mus.* XXXIV, p. 434.
1933. *Pheretima hawayana*, Gates, *Rec. Ind. Mus.* XXXV, p. 529.

Material examined.—From the Indian Museum: 56 clitellate specimens labelled, " Dak Bungalow grounds, Kutkai, N. Shan States, Burma. *ca* 4,500 feet. H. S. Rao. Nov. 1926 ", and 3 clitellate specimens labelled, " Hsenwi, N. Shan States, Burma. H. S. Rao. Dec. 1926".
From local collections:
Myitkyina, Sept. 1934, 2 clitellate specimens. K. John.
Kutkai, Sept. 1935, 331 clitellate specimens. G. J. Geis.
Mogok, Sept. 1935, 71 clitellate specimens. Mrs. A. C. Hanna.,
" Bamboo thicket ", Nawnglon, Mang Lun State, Sept. 1935 11 clitellate specimens. H. Young.
" Bare ground under banyan tree ", Nawng Kham, Mang Lun State, Sept. 1935, 1 clitellate specimen. H. Young.
" Bamboo grove ", Tan Yang, Mong Yai State, Sept. 1935, 12 clitellate specimens. H. Young.
" Red soil, bamboo grove ", Lawng Neu, Mong Lem State, Oct. 1935, 20 clitellate specimens. Ca La (per H. Young).

External characteristics.—Setae are present ventrally on xvi, number varying from 4 to 22 but usually 12 to 16. Setae may also occasionally be present ventrally on xiv and (or) xv. The setal formulae of ten specimens are shown below :—

vi	xvii	xviii	xix	iii	viii	xii	xx
24	18	12	18	33	48	54	53
19	17	14	17	30	49	51	53
24	19	16	17	30	47	54	56
22	20	12	20	29	51	56	51
26	16	13	16	36	51	52	56
25	21	14	22	39	49	55	59
23	19	12	17	34	50	48	54
16	18	14	18	31	46	51	57
23	17	13	17	..	50	54	51
17	23	15	21	32	50	56	58

The position of the genital markings was noted on 75 specimens. On one of these worms there are no postclitellar markings; of the other 74 specimens, each has a pair of genital markings just median to each male

porophore, one marking presetal and one postsetal. In addition postclitellar genital markings are present on 16 specimens as shown below :—

a. One median, on xviii. 3 specimens.
b. One median, right and left laterals, on xviii. 1 specimen.
c. Right and left laterals, on xviii. 1 specimen.
d. Two medians, on xviii. 1 specimen.
e. One lateral, left xviii ; one lateral, right xix. 1 specimen.
f. One lateral, right xix. 1 specimen.
g. One lateral, left xix. 2 specimens.
h. Right and left laterals, on xix. 4 specimens.
i. One lateral, right side, one median, on xviii ; one lateral, right xix. 1 specimen.
j. One presetal lateral, one postsetal lateral, on xviii ; the two extra markings forming, with the usual two, a longitudinal row of 4. 1 specimen.

(All additional postclitellar markings are presetal unless otherwise noted. All lateral markings are just median to the male pore lines.)

Preclitellar genital markings are located as shown below :—

k. One median, on vi. 1 specimen.
l. One median, on vii. 5 specimens.
m. One median, on viii. 1 specimen.
n. One median each on vi-vii. 4 specimens.
o. One median each on vii-viii. 2 specimens.
p. One median each on vi-viii. 3 specimens.
q. One median each on v-viii. 1 specimen.
r. One median each on vi-vii and laterals on vii. 2 specimens.
s. One median each on vi-viii and laterals on vii. 2 specimens.
t. One median and right and left laterals on vii. 14 specimens.
u. Right and left laterals only, on vii. 28 specimens.
v. No preclitellar genital markings. 12 specimens.

(All preclitellar genital markings are presetal, the laterals slightly median to the spermathecal pore lines.)

Many of the Mogok specimens have no preclitellar markings and also lack additional postclitellar markings.

Internal anatomy.—(Opened 77 specimens.) The intestinal caeca are simple but the ventral margin is always provided with several slight incisions marking off a series of very short lobes. The dorsoventral height of these lobes may be equal to the anteroposterior thickness or slightly greater. The dorsal margin may be slightly constricted by the septa.

The testis sacs are paired in both x and xi (10 specimens). The sacs of xi may not reach to 10/11, a slender cord from the posterior face of the septum passing to the anteriormost point of each sac. The sacs of x may be small and suboesophageal, larger and directed anterolaterally on the floor of the coelomic cavity, or one of the sacs may be unusually large and protuberant dorsally at the side of the gut. A large testis sac in this position might readily be mistaken for a seminal vesicle.

The spermathecal duct is slender and elongate, not clearly marked off from the ampulla which is gradually narrowed passing ectally. The lumen of the duct is abruptly narrowed slightly ental to the diverticular junction. The diverticulum comprises a very short stalk with a narrow, rather irregular lumen (with a slightly zigzagged appearance), a middle portion slightly wider than the stalk and in which the lumen is reduced by thick, high, transversely placed, almost annular ridges, and a slenderly club-shaped seminal chamber.

One worm has an extra pair of spermathecae in viii, with pores on 7/8. Two specimens have no spermathecae in vi. Specimens from Namkham referred with some doubt to *P. hawayana* (Gates 1933, p. 529) are in reality *P. morrisi*, each worm with one or two extra spermathecae in viii. Sexthecal specimens with spermathecal pores in 5/6-7/8 might readily be mistaken for *hawayana* but the positions of the genital markings and the number of spermathecal setae on vi enable identification as *morrisi*.

Diagnosis.—Quadrithecal, spermathecal pores minute and superficial, two pairs, on 5/6-6/7 Male pores minute and superficial, each pore on a tiny, transversely oval, disc-shaped porophore. Genital markings small, transversely oval to circular tubercles; two just median to each male porophore with one presetal and one postsetal; presetal and median on v, vi, vii and viii; presetal and just median to the spermathecal pore lines on vii and viii; presetal and just median to the male pore lines on xviii and xix; postsetal and just median to the male pore lines on xvii and xviii. Setae present ventrally on xvi: vi/16-28, xvii/16-23, xviii/10-17, xix/16-23, 23-29/iii, 46-51/viii, 48-56/xii, 4-22/xvi, 46-59/xx. First dorsal pore on 10/11. Length 40-150 mm. Diameter 2½-6 mm. Segments 87-95.

Intestinal caeca simple, with a few short lobes on the ventral margins. Testis sacs paired and ventral. Spermathecal diverticulum with short stalk—lumen narrow and irregular, a middle portion with high, thick, transverse ridges, seminal chamber slenderly club-shaped. Genital marking glands stalked and coelomic.

Pheretima nugalis Gates.

1931. *Pheretima nugalis*, Gates, *Rec. Ind. Mus.* XXXIII, p. 402. (Type locality, Kyaikmaraw, Amherst District.)
1932. *Pheretima nugalis*, Gates, *Rec. Ind. Mus.* XXXIV, p. 401.

Material examined.—From local collections:

Kyaikmaraw, Aug. 1935, 2 clitellate specimens. K. John.

External characteristics.—Length, 25-30 mm. Diameter, 2 mm. Segments, 85 and 87.

Setae: v/11, vi/15, xvii/12, xviii/6, xix/14; v/15, vi/16, xvii/13, xviii/8, xix/12.

The first dorsal pore is on 5/6, both specimens. On one worm the dorsal pores from 5/6-11/12 are wide open as on a part of the postclitellar region. The openings in the region anterior to 11/12 are not therefore the result of postmortem handling and are either functional dorsal pores or else weak spots in the integument that ruptured when the worm was killed.

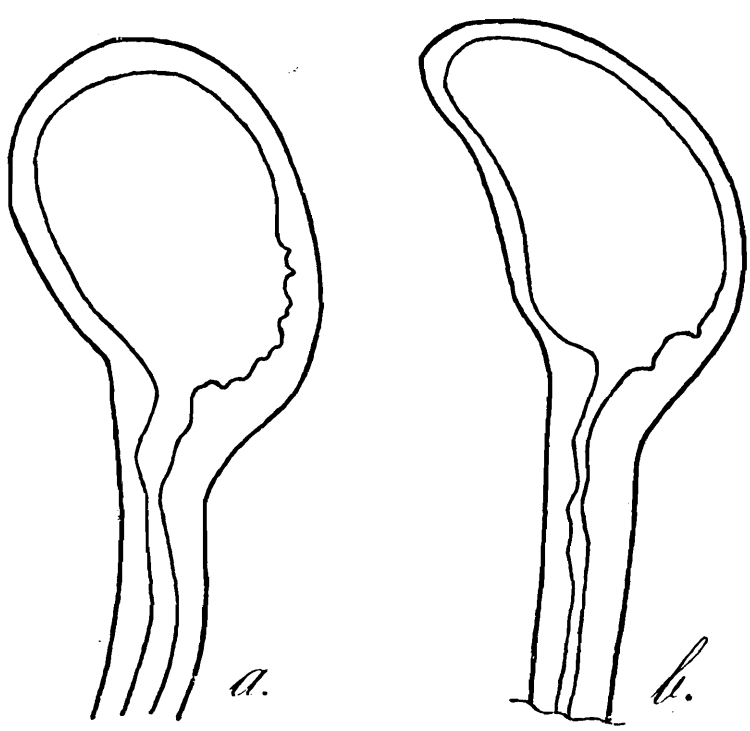
The spermathecal pores are minute and superficial.

The male pores are minute and superficial, each pore on a transversely oval, disc-shaped porophore that is demarcated peripherally by a slight circumferential furrow.

Genital markings are lacking.

Internal anatomy.—The intestine begins in xv. The caeca are simple and very short, reaching only into xxvi or xxv.

The testis sacs are unpaired and ventral. The seminal vesicles are large and those of a segment are in contact mesially above the dorsal blood vessel, the vesicles of xii pushing 12/13 back into contact with 13/14, the vesicles of xi pushing 10/11 anteriorly so that these organs appear to be in part alongside the gizzard. The anterior vesicles are attached to the roof of the testis sac of xi but can be removed without opening the sac. The prostatic duct is about 1½ mm. long and is bent into a shortly u-shaped loop.



TEXT-FIG. 4.—*Pheretima nugalis* Gates, *a*, *b*. Seminal chamber and ental portion of diverticular stalk of two spermathecae, ×*ca.* 80.

The spermathecal duct is shorter than the ampulla. The diverticulum is longer than the combined lengths of duct and ampulla or only very slightly shorter. In both specimens the seminal chamber is thicker and shorter than the stalk but in one worm both chambers are asymmetrical while in the other the chambers are nearly symmetrical.

Remarks.—The species is distinct from *P. zoysiae* Chen 1933.

Diagnosis.—Bithecal, spermathecal pores minute and superficial, one pair, on 5/6. Male pores minute and superficial, each pore at a centre of a large, transversely oval, disc-shaped porophore. Setae : v/11-15, vi/13-16, xvii/12-15, xviii/6-10, xix/12-14. First dorsal pore on 5/6. Length 25-30 mm. Diameter 2-2½ mm. Segments 70-87

Intestinal caeca simple, very short. Testis sacs unpaired and ventral. Spermathecal diverticulum with seminal chamber much thicker and shorter than the stalk, variable in shape, ovoidal, asymmetrical, bilobed or moniliform.

Pheretima pannosa, sp. nov.

Material examined.—From local collections:

Pegu Yomas No. 1, Sept. 1935, 1 clitellate specimen. G. E. Blackwell.

External characteristics.—Length 104 mm. Diameter 6 mm. Pigmentation, reddish on the dorsum.

The setae are small, closely and regularly spaced and begin on ii but on this segment are present only ventrally, three on one side and four on the other separated by a midventral gap. The circle on iii is complete. Formula: vii/31, viii/31, xvii/31, xviii/7+8, 62/iv, 85/viii, 93/xii, 89/xx.

The first dorsal pore is on 12/13 (?).

The clitellum does not quite reach either 13/14 or 16/17; intersegmental furrows, dorsal pores and setae lacking.

The spermathecal pores are minute and superficial, three pairs, on 6/7-8/9.

There is a single female pore.

The male pores are minute and superficial, each pore on a small, transversely oval, disc-like porophore which is 4-5 intersetal intervals wide transversely.

The single genital marking is nearly circular, extending from 17/18 to 19/20 and laterally to a point on each side about 4 setal intervals median to the median margins of the male porophores. The setal circles of xviii and xix are interrupted by the genital marking. The marking is slightly raised, with a smooth, level surface and with no differentiation into a rim and central portion.

Internal anatomy.—Septa 8/9-9/10 are lacking.

The intestine begins in xv. The intestinal caeca are simple, extending from xxvii into xxiv. The postgizzard glandular collar on the oesophagus is represented by a few scattered and small lobes, not in a continuous ring.

The single heart of ix is on the right side. The hearts of x are small. The last pair of hearts is in xiii. All hearts of ix to xiii pass into the ventral blood vessel.

The testis sacs are unpaired and ventral. The prostates are small, the duct S-shaped.

The spermathecae are not, apparently, fully developed and the diverticula are without spermatozoal iridescence. The duct is shorter than the ampulla from which it is not clearly marked off. The diverticulum passes into the anterior face of the duct at the parietes and is looped—except for a very short, ental portion, the looping in part zigzag, slightly widened passing entally but with no external demarcation into stalk or chamber. The lumen is wide throughout.

The genital marking gland is sessile on the parietes, the portion in the coelomic cavity softish and readily scraped off leaving a much harder part within the parietes.

Remarks.—*P. pannosa* is distinguished from *P. carinensis* by the ventral testis sacs and the excluded seminal vesicles, from *P. fucosa* Gates 1933 by the single genital marking.

Diagnosis.—Sexthecal, spermathecal pores minute and superficial, three pairs, on 6/7-8/9. Male pores minute and superficial, each pore on a small, transversely oval, disc-like porophore. The single genital marking extends from 17/18 to 19/20 and laterally to a point 4 intersetal intervals median to the median margin of the male porophore. Setae lacking dorsally on ii : vii/31, viii/31, xvii/27, xviii/7+8, 62/iv, 85/viii, 93/xii, 89/xx. First dorsal pore on 12/13. Length 104 mm. Diameter 6 mm.

Intestinal caeca simple. Testis sacs unpaired and ventral. Spermathecal diverticulum longer than combined lengths of duct and ampulla, looped, with no external demarcation into stalk and seminal chamber. Genital marking gland sessile on the parietes.

Pheretima pauxillula, sp. nov.

Material examined.—From the Indian Museum ; 15 clitellate specimens, labelled, " Kutkai, N. Shan States, Burma. ca 4,500 feet. Dak Bungalow grounds. H. S. Rao. Nov. 1926".

From local collections :

" Rotten leaves, dense jungle", Peng Sai, Mang Lun State, Oct. 1935, 3 clitellate specimens. H. Young. (Of these, two are macerated and one abnormal.)

External characteristics.—Length 25-47 mm. Diameter 1-2 mm. Segments 84-91. No trace of pigmentation visible.

The setae begin on ii and are small, closely and regularly spaced. There are no very definite mid-dorsal or midventral gaps in the setal circles. Formulae : xvii/12, xviii/10, xix/14 ; xvii/13, xviii/8, xix/14 ; xvii/13, xviii/11, xix/13 ; v/15, vi/19, xvii/12, xviii/7, xix/13 ; xvii/12, xviii/9, xix/13 ; xvii/14, xviii/10, xix/14.

The first dorsal pore is on 12/13 (5).

The clitellum is annular, extending from 13/14 to 16/17 ; intersegmental furrows and dorsal pores lacking ; setae probably lacking, though on one specimen there are slight indications of the presence of setae ventrally on xvi.

The spermathecal pores are not recognizable on any of the specimens but are obviously minute, and superficial ; three pairs, on 4/5-6/7, the intersegmental location determined by tracing the spermathecal ducts through the parietes. (The number of spermathecal setae in one of the formulae above was determined after the spermathecal ducts had been traced through the body wall.)

There is a single female pore.

The male pores are minute and superficial, each pore at the centre of a circular, protuberant area on xviii that extends to or almost to 17/18 and 18/19.

There are no genital markings on any of the specimens.

Internal anatomy.—Septa 4/5-7/8 and 10/11-12/13 are strengthened but membranous (transparent) ; 8/9-9/10 lacking.

The intestine begins in xvi (5). The intestinal caeca are simple, short, extending through two or three segments ; the margins occasionally constricted, and in one specimen deeply, by the septa through which they pass, but otherwise without marginal lobing.

The last pair of hearts is in xiii (5). All hearts of ix-xiii pass into the ventral vessel.

The testis sacs of both x and xi appear to be horseshoe-shaped. Ventrally the sacs appear to terminate just at the sides of the ventral blood vessel. If, however, the testis sacs are annular and the testicular coagulum is not continuous underneath the ventral blood vessel it might be impossible or very difficult to determine the annular character of the testis sacs, in such small specimens, and especially if the floor and roof of the sac were stuck together. The testicular coagulum is continuous throughout the sac from the ventral vessel clear around to the other side of the same vessel. The sacs pass over the dorsal blood vessel and can be lifted off therefrom without rupturing any tissue. The ventral ends of the testis sac of x pass anteriorly from and perpendicular to 10/11, on the parietes parallel to the nerve cord for some distance, before turning to pass dorsally and these ventral suboesophageal portions of the sac are noticeably thicker than the flattened, straplike, lateral and dorsal portions. The hearts of x and xi are excluded from the sacs, except ventrally and close to the ventral trunk. The sac of x is not attached to the anterior face of 10/11 as is usually the case but is some distance in front of that septum and between the hearts of ix and x. The sac of xi is anteriorly located, close to the posterior face of 10/11. The seminal vesicles of xi are very small and are included within the posterior testis sac. The seminal vesicles of xii are smallish, vertical bodies on the posterior face of 12/13. The prostates extend through some or all of segments xvi-xxi. The prostatic duct is $1\frac{1}{4}$ mm. long, straight, or almost so, with a tiny, short, twist or quirk in the narrowed, entalmost portion. The straight, almost spindle-shaped portion has a distinct muscular sheen.

The three pairs of spermathecae are in v, vi and vii (5) and pass into the parietes anteriorly so that the pores must be either in or close to 4/5-6/7 The duct is slender, at least as long as, usually longer than, the ovoidal ampulla. The diverticulum is shorter than the combined lengths of duct and ampulla, passes into the duct at or within the parietes and comprises a stalk and a slightly thicker, shorter, seminal chamber, which may be ovoidal, spheroidal, or irregular in shape, and may or may not be clearly marked off from the stalk. The spermathecal ampullae and the seminal chamber of the five dissected specimens are all translucent or transparent, no spermatozoal iridescence in the seminal chambers.

Remarks.—Three sexthecal species of *Pheretima* with spermathecal pores in 4/5-6/7 are known; *P. fida* Michaelsen 1913 from New Caledonia, *P. ophiodes* Michaelsen 1930 from the Philippines, and *P. flavarundoida* Chen 1935 from Hongkong. From all of these *P. pauxillula* is readily distinguished by its small size. The Burmese species is further distinguished from *ophiodes* by the presence of intestinal caeca; from *fida* by the absence of genital markings, the absence of 9/10 and the presence of intestinal caeca; and from *flavarundoida* by the absence of genital markings, exclusion of the hearts of x and xi from the testis sacs, and the shape of the spermathecal diverticulum.

The cuticle could not be removed without damage to the epidermis, hence the setal formulae are not as complete as is desirable.

Diagnosis.—Sexthecal, spermathecal pores minute and superficial, three pairs, on 4/5-6/7 Male pores minute and superficial, each pore at the centre of a large protuberant area reaching to or nearly to 17/18 and 18/19. Setae : v/15, vi/19, xvii/12-14, xviii/7-11, xix/13-14. First dorsal pore on 12/13. Length 25-47 mm. Diameter 1-2 mm. Segments 84-91.

Intestinal caeca simple. Testis sacs unpaired and horseshoe-shaped. Seminal vesicles of xi included within the posterior testis sac. Spermathecal diverticulum with spheroidal to ovoidal or irregular seminal chamber slightly thicker and shorter than the stalk.

Pheretima peguana (Rosa).

1890. *Perichaeta peguana*, Rosa, *Ann. Mus. Genova*, XXX, p. 113. (Type locality, Rangoon. Type in the Genoa Museum.)
1895. *Perichaeta peguana*, Beddard, *Monog.* p. 403.
1900. *Pheretima peguana*, Michaelsen, *Das Tierreich*, x, p. 292.
1923. *Pheretima peguana*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 308.
1925. *Pheretima peguana*, Gates, *Ann. Mag. Nat. Hist.* (9) XVI, p. 561.
1926. *Pheretima peguana*, Gates, *Rec. Ind. Mus.* XXVIII, p. 161.
1929. *Pheretima peguana*, Stephenson, *Rec. Ind. Mus.* XXXIX, p. 238.
1930. *Pheretima peguana*, Gates, *Rec. Ind. Mus.* XXXII, p. 318.
1931. *Pheretima peguana*, Gates, *Rec. Ind. Mus.* XXXIII, p. 404.
1932. *Pheretima peguana*, Gates, *Rec. Ind. Mus.* XXXIV, p. 481.
1933. *Pheretima peguana*, Gates *Rec. Ind. Mus.* XXXV, p. 504.

Material examined.—From local collections :

Mt. Popa, 4,500 feet, Oct. 1935, 2 clitellate specimens, F. G. Dickason.
Mogok, Sept. 1935, 135 clitellate specimens. Mrs. A. C. Hanna.
Kyaikmaraw, Aug. 1935, 11 clitellate specimens. K. John.
Moulmein, Aug. 1935, 38 clitellate specimens. K. John.
Bhamo and vicinity, Sept. 1934, 36 clitellate specimens. K. John.
Myitkyina and vicinity, Sept. 1935, 1 aclitellate and 74 clitellate specimens.

External characteristics.—The setal formulae of 10 specimens selected at random from the more southern collections are shown below. The number of setae on xx, of eight of the Bhamo and Myitkyina specimens, was also determined, and is as follows : 55, 57, 61, 62, 63, 62, 64, 58.

vii	viii	xvii	xviii	xix	iii	viii	xii	xx
15	17	11	9	13	34	45	56	60
21	23	13	8	13	37	54	63	62
16	22	12	8	13	39	52	57	60
23	24	16	14	17	38	53	61	65
20	19	15	9	14	40	48	58	60
16	17	13	8	12	36	45	55	56
24	24	16	9	16	34	52	62	65
19	24	16	11	15	37	55	59	64
21	23	16	8	16	32	51	60	64
19	21	14	9	11	30	49	56	62

The male pore is minute and invaginate, each pore at the centre of a tiny, circular area on the posterior wall, near the roof of a deep parietal invagination with a wide, transversely slit-like aperture and a transversely slit-like lumen. The invagination is vertical, not diagonal as in some of the Chinese species. The male pore tubercle has a greyish appearance, which clearly marks it off from the wall of the invagination. The surface of the male pore tubercle is very slightly convex,

Internal anatomy.—(Opened 10 specimens.) The intestinal caeca are simple, the dorsal and ventral margins smooth except for slight septal constrictions.

There are no hearts belonging to x (10).

The seminal vesicles of xi are attached to the roofs of the testis sacs but can be dissected off without opening the sacs.

The spermathecal duct is shorter than the ampulla but appears to be much shorter than is actually the case for the ampulla is bound ectally to the duct just above the duct-diverticulum junction. As a result the duct has the appearance of being invaginated into the interior of the ampulla, the ental end of the duct with a funnel-like appearance, the concave face of the funnel facing dorsally. The lumen of the duct is wide in the entalmost portion, narrowing gradually passing ectally, especially narrow ectal to the diverticular junction. The diverticular stalk is slender, with narrow but slightly irregular (not straight) lumen. The middle portion of the diverticulum is much longer than the stalk, slightly thicker to twice as thick as the stalk, irregularly looped. The lumen varies in width from one section to another and in the same section from one spermatheca to another but is usually not wider than the thickness of the wall, and in parts is quite narrow. The seminal chamber is spheroidal to shortly ovoidal, slightly constricted off from the middle portion of the diverticulum. The diverticulum is longer than the combined lengths of duct and ampulla.

The genital marking glands interrupt the longitudinal musculature and protrude slightly into the coelomic cavity and are provided with thickly muscular walls. The lumen is central, narrow, reduced by several vertical ridges, the wall with a smooth, shining appearance.

The roof of the parietal invagination containing the male pore protrudes slightly into the coelomic cavity but the lumen does not reach dorsally above the level of the inner face of the parietes. The prostatic duct which is slender and short passes into the lateral face of the invagination.

Abnormalities.—One of the Bhamo specimens has a number of abnormalities. Segments iv and v are not marked off from each other dorsally, the setal circles of iv and v uniting laterally on each side and passing across the dorsum as a single though slightly irregular setal line. The spermathecal pores are on 7/8-8/9 on the left side, on 6/7-7/8 on the right side. The male pore invaginations are everted as columnar porophores, one pair on xvii, and one each on the left sides of xviii, xix and xx. The genital markings are paired and postsetal on xvi, a single marking each on 17/18 (right side) and on 20/21 (left side). There are four prostates, each with a duct, on the left side. The vas deferens of the left side passes into the prostatic duct of xvii.

Remarks.—*P. peguana* has not hitherto been found on the Shan plateau in spite of fairly extensive collecting in the last few years. Yet it seems to be quite common in and around Mogok.

Diagnosis.—Sexthecal, spermathecal pores minute and superficial, three pairs, on 6/7-8/9. Male pores minute and invaginate, each pore on a tiny, translucent, circular area on the posterior wall near the roof of a deep, vertical, parietal invagination with transversely slit-like lumen and aperture. Genital markings transversely oval, with a firm

surface and conspicuous though small, central pore, two pairs, on 17/18 and 18/19. Setae : vii/15-24, viii/17-25, xvii/11-16, xviii/6-14, xix/11-17, 30-40/iii, 45-55/viii, 55-63/xii, 55-65/xx. First dorsal pore on 12/13. Length 140-240 mm. Diameter 5-8 mm. Segments 98-121.

Septum 10/11 and hearts of x lacking. Intestinal caeca simple. Testis sacs widely paired and ventral. Spermathecal diverticulum with slender stalk, long, thicker, middle portion with lumen variable in width, seminal chamber spheroidal to shortly ovoidal and small. Genital marking glands approximately spheroidal, with thick, muscular walls, slightly protuberant into the coelomic cavity, with small vertical, central lumen.

Pheretima planata Gates.

1926. *Pheretima planata*, Gates, *Ann. Mag. Nat. Hist.* (9) XVII, p. 411. (Type locality, Rangoon.)
1926. *Pheretima planata*, Gates, *Rec. Ind. Mus.* XXVIII, p. 162.
1929. *Pheretima planata*, Stephenson, *Rec. Ind. Mus.* XXXI, p. 238.
1930. *Pheretima planata*, Gates, *Rec. Ind. Mus.* XXXII, p. 320.
1931. *Pheretima planata*, Gates, *Rec. Ind. Mus.* XXXIII, p. 405.
1932. *Pheretima planata*, Gates, *Rec. Ind. Mus.* XXXIV, p. 411.
1933. *Pheretima planata*, Gates, *Rec. Ind. Mus.* XXXV, p. 541.

Material examined.—From the Indian Museum : one clitellate specimen labelled " In the grounds of the Dak Bungalow, Lashio, N. Shan States, Burma, *ca* 2,700 feet. H. S. Rao. Nov. 1926", and two aclitellate specimens labelled " Namkham, N. Shan States, Burma. H. S. Rao. Dec. 1926 ".

From local collections : Bhamo and vicinity, Sept. 1934, 11 aclitellate and 3 clitellate specimens. K. John.

Myitkyina and vicinity, Sept. 1934, 7 clitellate specimens. K. John.

Moulmein, Aug. 1935, 1 aclitellate specimen. K. John.

Foot of Thandaung Hill, Sept. 1935, 3 aclitellate and 1 clitellate specimens. G. E. Blackwell.

Pegu Yomas, No. 1, Sept. 1935, 9 aclitellate specimens. G. E. Blackwell.

Pegu Yomas, No. 2, Sept. 1935, 9 aclitellate specimens. G. E. Blackwell.

Pegu Yomas, No. 3, Sept. 1935, 20 aclitellate and 2 clitellate specimens. G. E. Blackwell.

Pegu Yomas, No. 4, Sept. 1935, 38 aclitellate specimens. G. E. Blackwell.

Pegu Yomas, No. 7, Sept. 1935, 1 clitellate specimen. G. E. Blackwell.

Pegu Yomas, No. 8, Sept. 1935, 1 aclitellate specimen. G. E. Blackwell.

External characteristics.—There is a complete circle of setae on ii. The setal formulae of ten specimens selected at random are shown below :—

vii	xvii	xviii	xix	iii	viii	xii	xx
39	18	11	18	60	78	77	57
35	17	10	18	63	76	63	56
35	18	10	18	62	75	73	59
38	20	12	17	62	81	68	58
42	18	12	18	69	82	72	60
36	17	12	19	61	76	72	56
40	22	13	18	60	87	76	61
37	18	9	16	66	78	74	61
41	20	11	20	67	86	78	64
40	21	13	20	—	84	77	65

The last five specimens are from Myitkyina, the first five from different localities in Lower Burma.

The spermathecal pore may be at the centre of a tiny, circular, sharply demarcated area with a smooth glistening surface, or the area may be indistinctly delimited or quite unrecognizable. The nearest genital marking usually indents the margin of the spermathecal pore area.

The genital markings are areas of greyish translucence, sharply demarcated, usually level, rarely slightly protuberant.

Internal anatomy.—(Opened 10 specimens.) The intestinal caeca are simple, with smooth margins or with margins slightly constricted by the septa through which the caeca pass. There is a low, glandular collar on the oesophagus behind the gizzards.

All hearts of ix-xiii pass into the ventral blood vessel.

The testis sacs are paired; ventral in x, vertical in xi and reaching upwards to or nearly to the dorsal blood vessel. The posterior testis sacs are not attached to the gut mesially. The anterior seminal vesicles are included within the posterior testis sacs, each vesicle at least partially surrounded by testicular coagulum.

The spermathecal duct is elongate, slender, and not sharply set off from the ampulla which is gradually narrowed ectally. The lumen of the duct is fairly wide, transversely slit-like or oval in section, abruptly narrowed in the region of the diverticular junction. The spermathecal diverticulum comprises a short stalk with narrow, slightly irregular, central lumen, a thicker middle portion with a somewhat wider lumen and a sausage-shaped or ellipsoidal seminal chamber with wide lumen and smooth, thin wall. The middle portion is not definitely marked off from the stalk ectally or from the seminal chamber entally and has a thick, opaque wall within which are small, closely crowded chambers opening into the central lumen. In the ental part of the middle portion each chamber is filled with a spheroidal or ovoidal mass of material similar to that within the seminal chamber. The material within the chambers may be dense and whitish or with numerous vacuoles. Ectally the chambers appear to be empty.

Diagnosis.—Quadrithecal, spermathecal pores minute and superficial, two pairs, on the anterior margins of vii and viii close to 6/7 and 7/8. Male pores minute and invaginate, each pore on the roof of a copulatory chamber with a transversely slit-like aperture. Genital markings tiny, circular, translucent areas; external markings on the posterior margins of vii and viii and the anterior margin of viii, 1-4 markings just median to each spermathecal pore; internal markings 8-12, on the roof and walls of each copulatory chamber. Setae: vii/35-42, xvii/17-22, xviii/9-14, xix/16-20, 60-69/iii, 75-87/viii, 63-78/xii, 56-65/xx. First dorsal pore on 11/12. Length 64-170 mm. Diameter 4-17 mm. Segments 115-142.

Intestinal caeca simple. Testis sacs paired; of x ventral, of xi vertical. Seminal vesicles of xi included within the posterior testis sacs. Spermathecal diverticulum longer than combined lengths of duct and ampulla and comprising a short stalk, a thicker middle portion with thick wall within which are numerous, small, spheroidal to ovoidal chambers opening into the central lumen, and a terminal, elongately ellipsoidal seminal chamber. Genital marking glands stalked and coelomic.

Pheretima posthuma (L. Vaillant).

1868. *Perichaeta posthuma* (part), L. Vaillant, *Ann. Sci. Nat.* (5) X, p. 228. (Type locality, Java. Types in the Paris Museum.)
1912. *Pheretima posthuma*, Stephenson, *Rec. Ind. Mus.* VII, p. 278.
1923. *Pheretima posthuma*, Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 309
1926. *Pheretima posthuma*, Gates, *Ann. Mag. Nat. Hist.* (9) XVII, p. 464.
1926. *Pheretima posthuma*, Gates, *Rec. Ind. Mus.* XXVIII, p. 162.
1930. *Pheretima posthuma*, Gates, *Rec. Ind. Mus.* XXXII, p. 321.
1931. *Pheretima posthuma*, Gates, *Rec. Ind. Mus.* XXXIII, p. 405.
1932. *Pheretima posthuma*, Gates, *Rec. Ind. Mus.* XXXIV, p. 487.
1933. *Pheretima posthuma*, Gates, *Rec. Ind. Mus.* XXXV, p. 543.

Material examined.—From local collections:
Moulmein, Aug. 1935, 7 aclitellate and 27 clitellate specimens. K. John.
Rangoon, Sept. 1935, 36 clitellate specimens. K. John.
Bhamo and vicinity, Sept. 1934, 5 aclitellate and 7 clitellate specimens. K. John.
Myitkyina and vicinity, Sept. 1934, 31 clitellate specimens. K. John.

External characteristics.—The setal formulae of five specimens are shown below. The number of setae on xx, of ten additional specimens, was found to be as follows: 64, 65, 68, 72, 76(2), 77, 78, 79, 86.

vi	vii	viii	xvii	xviii	xix	iii	viii	xii	xx
42	40	37	16	18	18	99	106	63	67
39	38	34	15	21	18	90	*	63	69
43	44	41	17	17	17	104	129	73	74
42	40	39	17	17	16	92	110	72	60
42	43	42	18	16	16	103	122	75	75

* Only 84, but several wide gaps in the circle.

The male pores are minute and invaginate, each pore transversely slit-like, at the centre of an oval or almost circular tubercle or papilla on the median wall near the roof of a small parietal invagination, the surface of the tubercle slightly convex. The male pore invaginations are usually partially everted, rarely fully everted. When fully everted the male pore tubercle is on the ventral end of a shortly columnar porophore. The lumen of the invagination is not completely obliterated even on full eversion for, on the ventral face of the male porophore, just lateral to the male pore tubercle, there is a slight, longitudinal or crescentic slit, opening into a small, slit-like cavity. Although the invagination (in state of full retraction) is small, the male pore tubercle cannot be regarded as filling or even largely filling the lumen.

Internal anatomy.—Septum 8/9 is present and slightly muscular in each specimen (45).

The intestinal caeca are short, extending through one or two segments only, simple; the ventral margin smooth, the dorsal margin smooth or with an appearance of very slight incisions, this appearance possibly the result of a wrinkling or slight folding rather than of the development of definite incisions.

Only one heart belonging to ix is present in each of the specimens and this heart is always behind the first post-gizzard septum. The hearts of x and xi are replaced by slender commissural loops connecting the supra-oesophageal and the sub-oesophageal trunks. In several specimens the commissural loops of x and xi are gorged with blood and

unusually large though still smaller than the hearts of xii and xiii. In these worms, just prior to the junction of the commissural loop with the sub-oesophageal trunk of its side, two small branches pass ventrally from the loop. In two specimens the mesial branch has been traced to its junction with the ventral trunk within the testis sac of x or xi. This connection of the commissural loop with the ventral trunk was not found in other specimens but possibly because the connecting vessel was empty and transparent. In three specimens the sub-oesophageal trunk of each side turns dorsally in the posterior portion of xiii and runs upwards on the anterior face of 13/14 nearly to the mid-dorsal line, then turns ventrally and running under the posterior bifurcation of the heart of xiii joins either the anterior bifurcation of the heart of xiii or unites directly with the supra-oesophageal vessel of its side. (The supra-oesophageal is continued, posterior to its junction with the hearts of xiii, as a pair of small vessels which rapidly decrease in size and shortly become unrecognizable.) In one worm each sub-oesophageal trunk divides posteriorly in xiii into two equisized branches, one of which passes dorsally into the anterior bifurcation of the heart of xiii, the other passing through 13/14 and 14/15 and then dividing into several equisized branches all of which pass to the parietes. Each heart of xii and xiii bifurcates close to the dorsal trunk, the bifurcations short and very slender, the anterior branch passing into the supra-oesophageal trunk in the anterior part of the segment, the posterior branch passing into the dorsal trunk at or within the posterior septum of the segment. The subneural trunk is practically invisible, represented only by a faint, whitish line on the parietes under the nerve cord.

The testis sacs are unpaired; the sac of x ventral in all specimens, the sac of xi U-shaped, the limbs of the U reaching dorsally into contact with the dorsal blood vessel. The limbs of the sac are not bound to the gut dorsally but are free.

The coelomic portion of the spermathecal duct is shorter than the ampulla, with a slight, whitish sheen which may be muscular. The diverticulum passes into the median face of the duct close to the parietes, the duct ectal to the diverticular junction gradually narrowed until deep within the parietes it becomes almost thread-like. The ental portion of the duct may be described as a chamber with a fairly large lumen which is slit-like to transversely oval in section. From the floor of the chamber there rises vertically a tiny, slenderly conical papilla with an almost pointed tip which does not reach to the dorsalmost portion of the duct. On the median face of the conical papilla is a vertical groove. At the ectal end of the groove is the opening into the diverticulum. Approximately at the centre of the groove is a slightly larger aperture which opens into the lumen of the narrowed portion of the duct. Passing ectally from the aperture on the conical papilla the lumen is narrow, very slightly widened for a very short distance and then very narrow in the parietal portion of the duct. The diverticulum comprises a short stalk which may be straight, or nearly so or with one or two very short loops, and a longer, ellipsoidal seminal chamber.

The last two pairs of spermathecae are usually in viii. In one specimen, one of the last pair of spermathecae is entirely in ix, in each of two

specimens one ampulla is in ix while in each of three further specimens one diverticulum is in ix.

Remarks.—Michaelsen (*Arch. Neerl. Zool.* I, p. 111, 1934) refers to the male pore tubercle as a penis and the invagination within which it is contained as a " Penistasche " If a tiny tubercle with only a very slightly convex surface is to be considered a penis, then this term is robbed of all significance and how then is one to characterize the elongately tubular and truly penis-like penis of such species as *P. montana* and *P. abdita* ? Michaelsen also maintains that the prostatic duct and the vasa deferentia open to the exterior individually on the " Penis" It is quite easy to slice off from the tip of the male porophore (*i.e.*, the everted parietal invagination) the tiny, male pore tubercle. A number of such tubercles have been examined microscopically, both before and after clearing with lactophenol. The only pore that has been found on any of these preparations is a transversely slit-like aperture at the centre of the tubercle. Other apertures are unrecognizable even with the higher powers of the microscope.

Perrier (1872, p. 106), Horst (1893, p. 61), Bahl (1926, p. 14) and Prashad (1916, p. 502) have maintained that septum 9/10 is present or may be present in place of 8/9. Michaelsen (1923, p. 2) mentions the presence of a muscular, post-gizzard septum but is not certain as to whether it is 8/9 or 9/10 though earlier (1897, p. 201) he had decided that the post-gizzard septum was 8/9. In view of the extensive use of *P. posthuma* as a type in zoological courses it is important to determine which of these two opinions is correct. During the last several years well over a hundred specimens of the species have been examined but in none of these has septum 9/10 been found. The first post-gizzard septum is always attached to the parietes at the region of 8/9, and between this septum and the first pre-gizzard septum there is always only one setal circle. Furthermore the heart of ix is always behind the first post-gizzard septum. Unless *P. posthuma* is much more variable elsewhere than in Burma or another species has been mistaken for *P. posthuma*, the confusion with regard to the numbering of the septum can be explained as the result of the presence of two pairs of spermathecae anterior to the first post-gizzard septum. The last pair of these spermathecae passes, however, posteriorly into the parietes at the ventral margin of 8/9 and not anteriorly as must be the case if the septum were 9/10.

Although the variation in setal numbers is greater than usual (20-23 per segment), this variation is definite and not abnormal for the setal counts were made only on specimens with normal setal circles in which the setae are regularly spaced. Nevertheless, in spite of this variation, the setal numbers for xii and xx are not so high as has been previously suggested.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, on the posterior margins of v-viii, each pore at the centre of a transversely oval, greyish, translucent area. Male pores minute and invaginate, each pore on a tiny tubercle on the median wall near the roof of a slight parietal invagination with a longitudinally crescentic aperture. Genital markings small, transversely oval, two pairs, in the setal circles

of xvii and xix. Setae present ventrally on the clitellar segments: vi/37-43, vii/38-44, viii/36-43, xvii/15-20, xviii/17-21, xix/16-20, 90-104/iii, 106-129/viii, 63-75/xii, 64-86/xx. First dorsal pore on 12/13. Length 60-140 mm. Diameter 4-8 mm.

Septum 8/9 present and muscular. Intestinal caeca simple, small. Hearts of x and xi replaced by commissural loops connecting the supraoesophageal and suboesophageal vessels. Testis sacs unpaired; of x ventral, of xi U-shaped. Seminal vesicles of xi included within the posterior testis sac. Lumen in ental part of the spermathecal duct large and communicating with the narrowed lumen of the ectal portion through a pore in a vertical groove on the median face of a dorsally directed, shortly conical papilla. Diverticular stalk shorter than the ovoidal to ellipsoidal seminal chamber. Genital marking glands sessile on the parietes.

Pheretima promota Gates.

1933. *Pheretima analecta* var. *promota*, Gates, *Rec. Ind. Mus.* XXXV, p. 494. (Type locality, Pegu Yomas, west of Letpadan, Tharrawaddy district.)

Material examined.—From local collections: one clitellate specimen labelled. "*Pheretima analecta* var. *promota*. Original specimen. Tharrawaddy Karen Hills. August, 1932. G. R. Anderson", and the following :—

Pegu Yomas, No. 5, Sept. 1935, 10 clitellate specimens, G. E. Blackwell.

Pegu Yomas, No. 6, Sept. 1935, 8 clitellate specimens. G. E. Blackwell.

External characteristics. Length 120-170 mm. Diameter 5-7 mm. Pigmentation restricted to the dorsum, light red or red, with a dark blue tinge anterior to the clitellum.

Setae are present on ii on all specimens but only ventrally, the number as follows; 10, 10, 13, 4, 6, 6, 6. On segment iii, there is a complete or nearly complete circle. The setae are small, closely and regularly spaced. The formulae of five specimens picked at random from Blackwell's two collections are given below :—

vi	vii	viii	xvii	xviii	xix	iii	viii	xii	xx
26	28	30	27	7	12	44	102	108	97
31	31	32	35	14	16	52	98	108	111
31	32	32	37	12	27	44	96	111	105
37	36	37	33	21	24	52	100	113	108
31	34	33	35	13	14	50	109	108	106
26	28	29	26	20	26	†	101	105	96*

* Original specimen of var. *promota*.
† Wide gap in the setal circle as result of damage.

The first dorsal pore is on 12/13 (14), or 11/12 (2), or 12/13 but with a definitely pore-like though apparently non-functional marking in 11/12 (2).

The spermathecal pores are minute and superficial, four pairs, on 5/6-8/9.

The male pores are minute and superficial, each pore at or near the centre of a small, transversely oval to circular, disc-shaped porophore.

There is a single genital marking on each worm. On Miss Anderson's specimen the marking extends anteriorly to the setae of xviii, with the

setae of xix on the posterior margin and is transversely elliptical—ratio of width to length 20 : 9, not protuberant, the central portion slightly concave. On the new specimens the marking extends anteriorly to or nearly to 17/18 and posteriorly to or nearly to 19/20, interrupting midventrally and widely the setal circles of both xviii and xix. The marking may be 20 intersetal intervals wide, is protuberant, flat, or with a central portion slightly concave, a fairly definite rim marked off, transversely oval, almost circular or longitudinally oval—ratio of width to length ; 7: 6, 5 : 4, 4 : 3, 3 : 2, 3 : 3, 3 : 4.

Internal anatomy.—None of the septa are thickly muscular ; 5/6-7/8 strengthened but translucent, 10/11-12/13 very slightly strengthened but transparent ; 8/9-9/10 lacking.

The intestine begins in xv (5). The intestinal caeca are simple and slightly constricted by the septa through which they pass. The post-gizzard glandular collar is very low and interrupted. The typhlosole begins in the caecal region and is low.

The single heart of ix is on the right side (3). Two specimens have a pair of hearts belonging to ix. All hearts of ix-xiii pass into the ventral blood vessel (5).

The testis sacs are unpaired and suboesophageal. The seminal vesicles are fairly large, filling segments xi and xii, in contact mesially above the dorsal blood vessel, 10/11 and 12/13 not especially dislocated. The prostates extend through some or all of xvii-xxi. The prostatic duct is 3-4 mm. long, rather slender but with muscular sheen, bent into a U-shaped loop.

The spermathecal duct is usually shorter than the ampulla, rather slender, abruptly narrowed deep within the parietes. The diverticulum which passes into the anterior face of the duct at the parietes is elongate, a large part looped, usually in an approximation to a regular zigzag with the limbs of the loops in apposition. The diverticulum is gradually widened passing entally, the entalmost portion the widest. As is, the diverticulum just reaches up onto the ampulla or part way up the ampulla, but straightened out is, at least, slightly longer than the combined lengths of duct and ampulla. The diverticula of four specimens are characterized by spermatozoal iridescence, the iridescence lacking only in the short, straight, ectalmost portion and the ectalmost loop. The spermathecae of the original specimen are small, probably not fully developed, the diverticula without spermatozoal iridescence.

The genital marking gland is sessile and only slightly protuberant into the coelomic cavity.

Remarks.—Blackwell's specimens differ from the originals of *promota* only in the slightly greater longitudinal extent of the genital markings and, on a few of the specimens, the ratio of the width to the length of the genital markings. The setal numbers are about the same.

P. promota is close to *P. analecta* from which it differs mainly, in the setal numbers and the location of the single genital marking.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, on 5/6-8/9. Male pores minute and superficial, each pore on a disc-shaped porophore. One genital marking on 18/19 or reaching to or nearly to 17/18 and 19/20. Setae lacking dorsally on ii : vi/26-37,

vii/28-36, viii/29-37, xvii/26-37, xviii/7-21, xix/12-27, 4-13/ii, 44-52/iii, 96-109/viii, 105-113/xii, 96-111/xx. First dorsal pore on 12/13. Length 94-170 mm. Diameter 5-7 mm.

Intestinal caeca simple. Testis sacs unpaired and ventral. Spermatheca with short diverticular stalk looped once entally, seminal chamber elongate, slightly widened passing entally, looped in a more or less regularly zigzag fashion. Genital marking gland sessile, slightly protuberant into the coelomic cavity.

Pheretima rimosa Gates.

1931. *Pheretima rimosa*, Gates, *Rec. Ind. Mus.* XXXIII, p. 409. (Type locality, Mong Ko, Kengtung State.)

1932. *Pheretima rimosa*, Gates, *Rec. Ind. Mus.* XXXIV, p. 534.

Material examined.—From the Indian Museum : 20 clitellate specimens labelled, "Dak bungalow grounds, Kutkai, N. Shan States, Burma. *ca* 4,500 feet. Nov. 1926. H. S. Rao."

From local collections :

"Rotting leaves under banyan tree", Mong Ko, Mang Lun State, Oct. 1935, 3 clitellate or partially clitellate specimens. H. Young.

"Sandy soil covered with leaves on wooded hillside", Man Peng, Mang Lun State, Oct. 1935, 6 clitellate specimens. H. Young.

"Leaf-covered, sandy soil on wooded hillside", Nam Mang, Mang Lun State, Oct. 1935, 1 aclitellate and 1 clitellate specimen. Y. Young.

External characteristics.—The specimens are all smaller than the types : length, 60-85 mm.; diameter, 3-4 mm.

Setae are present on ii ventrally only, on iii ventrally only or ventrally and laterally. The setal formulae are shown below.

vi	vii	viii	ii	iii	viii	xii	xx
15	17	16	4	13	35	37	49
16	18	17	4	12	38	40	52
12	12	14	4	5	33	35	48
17	17	19	4	9	38	38	50
16	18	19	3	10	38	42	50
13	12	14	4	13	34	43	55
16	16	17	5	14	38	41	53
15	18	18	4	13	38	43	52
12	12	15	7	13	28	35	42*
14	17	17	6	16	34	40	51†
13	15	14	3	4	34	39	50†

* Type.
† Paratype.

The first dorsal pore is on 11/12 on 3 specimens ; on the other worms the pores cannot be definitely identified anterior to 13/14.

The spermathecal pores are minute and superficial, four pairs, on the anterior margins of vi-ix.

The male pores are minute and superficial, each pore on a tiny conical protuberance from the lateral margin of the genital marking. The male pore protuberance is not especially marked off from the rest of the marking.

The genital markings are one pair, longitudinally placed, reaching at least to 17/18 and 18/19 and probably extending slightly onto xvii,

possibly onto xix, furrows 17/18 and 18/19 not visible ventrally. The anterior end of the genital marking is wider than the posterior end. On each marking there is a slight, transverse furrow or crease just behind the male pore and the setal line. The marking is sharply demarcated by a slight furrow and has a greyish translucent appearance.

Internal anatomy.—The intestinal caeca are simple, with septal constrictions only.

Each of four specimens lacks one or both of the prostates though the prostatic ducts are present. In these same worms the seminal vesicles are rudimentary or very small, the testes undischarged, and the seminal chambers of the spermathecae with no spermatozoal iridescence. The acitellate specimen, on the contrary, has large seminal vesicles, apparently fully developed testis sacs distended by testicular coagulum, normal but rather small, perhaps not fully developed prostates.

The lumen in the spermathecal duct is transversely oval in section in the coelomic portion, rather abruptly narrowed but in a funnel-like fashion in the region of the diverticular junction and from here ectally very narrow. The lumen in the ectal half of the stalk is very narrow and usually nearly straight but in the ental half is widened while the wall has a corrugated appearance due to the numerous, closely set, low, annular ridges. The lumen is usually narrowed again just ectal to the seminal chamber. Spermatozoa are present only in the seminal chamber.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, on the anterior margins of vi-ix, near 5/6-8/9. Male pores minute and superficial, each pore near the lateral margin of a genital marking. Genital markings one pair, on xviii but reaching slightly onto xvii and xix, longitudinally placed or with the anterior and posterior ends widened so that each marking is crescentic to U-shaped with the concave side directed mesially. Setae lacking dorsally on ii-iii: vi/10-18, vii/11-18, viii/13-19, xvii/14-19, xviii/6-11, xix/15-20, 1-7/ii, 5-16/iii, 28-38/viii, 35-43/xii, 42-56/xx. First dorsal pore on 10/11-12/13. Length 60-122 mm. Diameter 3-5 mm. Segments 104-119.

Septum 8/9 present but membranous. Intestinal caeca simple. Testis sacs unpaired and ventral. Spermathecal diverticulum with slender stalk—the lumen narrow ectally but widened entally, and an ovoidal to ellipsoidal seminal chamber. Genital marking gland sessile and within the parietes, underneath the longitudinal musculature.

Pheretima robusta (E. Perrier).

1872. *Perichaeta robusta*, E. Perrier *N. Arch. Mus. Paris*, VIII, p. 112. (Type locality, Mauritius. Type in the Paris Museum.)
1929. *Pheretima ornata*, Gates, *Proc. U. S. Nat. Mus.* LXXV, (10), p. 20. (Type locality, Lashio. Types in the U. S. Nat. Museum and the Indian Museum.)
1931. *Pheretima ornata*, Gates, *Rec. Ind. Mus.* XXXIII, p. 404.
1932. *Pheretima ornata*, Gates, *Rec. Ind. Mus.* XXXIV, p. 421.
1933. *Pheretima ornata*, Gates, *Rec. Ind. Mus.* XXXV, p. 538.

Material examined.—From the Indian Museum: one clitellate specimen labelled, "Chinese frontier opposite Kawngmu, Tengyueh, China. ca 2,500 feet. Dec. 1926. H. S. Rao."

From local collections:—

Kutkai, Supt. 1935, 40 softened, clitellate specimens. G. J. Geis,

External characteristics.—The setae begin on ii on which segment there is a complete circle, and are small, closely and regularly spaced. There may be a slight midventral gap in the setal circles or this gap may be lacking; a mid-dorsal gap may be lacking, but when present is small though variable in width. On a few of the specimens the setal circles are without gaps due to the falling out of setae and from five of these the formulae below were obtained.

viii	xvii	xviii	xix	iii	viii	xii	xx
25	30	22	28	36	52	58	63
26	30	22	28	35	50	56	64
25	28	23	28	38	52	54	67
25	30	23	27	40	53	59	69
24	31	24	29	34	51	57	67

The first dorsal pore is on 11/12 (40).

The spermathecal pores are minute and superficial, widely separated, transversely slit-like, two pairs, on 7/8-8/9. Each pore is on a small, longitudinally oval area that extends slightly onto the margins of vii and viii or viii and ix. Just behind each spermathecal pore and also on the porophore is a tiny, pore-bearing tubercle. One of these tubercles may be lacking, several specimens. All four tubercles are lacking on one specimen.

The male pores are minute and superficial, each pore on a tubercle that is surrounded by several concentric furrows, the innermost of which may be much deeper than the others. In the latter case the tubercle has the appearance of being within a very slight parietal invagination. No matter how deep the furrow around the male tubercle may be the male pore on the ventral face of the tubercle is practically at the general body level.

In addition to the tubercles located on the spermathecal porophores there may be additional tubercles present on xviii, or on one of the preclitellar segments as follows:—One pair of presetal tubercles on xviii, each tubercle close to the setae and slightly median to a male tubercle, within the region bearing the concentric furrows, 20 specimens. One presetal tubercle on xviii as previously and on the other side one postsetal tubercle, the latter slightly median to the male tubercle and just outside of the area of concentric furrows, 3 specimens. One presetal and one postsetal tubercle, on opposite sides (of xviii), both tubercles on the areas of concentric furrows, 5 specimens. One pair of presetal tubercles, one pair of postsetal tubercles (xviii), all within or close to the areas of concentric furrows, 2 specimens. No postclitellar tubercles, 10 specimens. One small, presetal tubercle on viii, 3 intersetal intervals median to the spermathecal pores, on the right or the left side, 5 specimens. No preclitellar tubercles aside from those on the spermathecal porophores, 35 specimens. Each tubercle is definitely demarcated by a peripheral furrow which is slight on viii, but on xviii may be as deep as the furrow around the male porophore.

Internal anatomy.—Septa 5/6-7/8 are muscular, 6/7 the thickest, 7/8 the thinnest; 10/11-12/13 are muscular; 13/14 slightly strengthened, translucent.

The seminal vesicles in the present specimens are small, vertically placed bodies at the sides of the gut, lateromesially flattened and leaf-like, each vesicle with a definite dorsal ampulla which, in xii, may be fairly large. The vesicles of xi are bound to the gut along with the heart of xi by delicate connective tissue from 10/11 and 11/12. When the worm is first opened the vesicles have the appearance of being within dorsally directed limbs of a U-shaped testis sac. It is, however, possible to clear off the delicate connective tissue and remove the seminal vesicles without opening the median, unpaired, suboesophageal testis sac. The prostates are small to almost rudimentary, in xvii-xviii or xvii-xix. The prostatic duct is 2-4 mm. long, muscular, straight or variously bent.

The spermathecal duct is shorter than the ampulla. The diverticulum is shorter than the combined lengths of the duct and ampulla and is not sharply marked off into stalk and seminal chamber. There is no spermatozoal iridescence and the diverticula of all of the specimens that were opened appear to be incompletely developed.

The glands of the genital markings are stalked and coelomic, the coelomic portion of the stalk rather short. The number of glands in segment xviii is equal to the number of the genital markings excluding the male pore tubercle, one less than in the Chinese specimens of this species examined by the writer.

Remarks.—*P. robusta* is a Chinese species reaching into Burma to Lashio, Kutkai, and Namkham, and into India in the Himalayas (Darjiling, *P. himalayana* Stephenson 1925) and has been carried, presumably by man, to Mauritius, the West Indies, and possibly also to the Philippines. The species has been described under various names from China : *siemsseni* Michaelsen 1931 (in part), *fokiensis* Michaelsen 1931, *lauta* Ude 1932, *ultoria* Chen 1935, and possibly also *corrugata* Chen 1931 and *lōhri* (Michaelsen) 1899. The latter is, at least, much closer to *robusta* than to *hesperidum* (=*californica*) with which it has been united by Beddard and Michaelsen. Chen's *corrugata* is based, apparently, on abnormal specimens, which, however, are distinguished from normal specimens of *robusta* by only slight differences.

Diagnosis.—Quadrithecal, spermathecal pores minute and superficial, two pairs, on 7/8-8/9. Male pores minute and superficial, each on a small, transversely oval tubercle surrounded by several concentric furrows. Genital markings small, circular to oval tubercles, about 1 intersetal interval wide ; on xviii presetal and postsetal, slightly median to the male pore lines (slightly lateral to the midventral line), presetal and postsetal on vii-viii, slightly median to the spermathecal pore lines ; on the spermathecal porophore, just behind the spermathecal pore. Setae : viii/19-31, xvii/24-31, xviii/18-24, xix/23-31, 35-40/iii, 50-53/viii, 54-58/xii, 65-70/xx. First dorsal pore on 11/12. Length 120-140 mm. Diameter 5-8 mm. Segments 106.

Intestinal caeca simple but with short lobes on the ventral margin. Testis sacs unpaired and ventral. Spermathecal diverticulum with spheroidal to ovoidal or ellipsoidal seminal chamber usually shorter than the slender stalk. Genital marking glands stalked and coelomic.

Pheretima scitula, sp. nov.

Material examined.—From the Indian Museum, one damaged, clitellate specimen and 6 aclitellate specimens labelled, "Port Blair, Sta B. 10."

External characteristics.—The clitellate specimen is about 100 mm. long. The largest of the aclitellate specimens is 120 mm. long with a maximum diameter of 5 mm. The pigmentation is reddish, restricted to the dorsum, with a darker, purplish tinge anterior to the clitellum.

The setae begin on ii on which segment there is a complete circle, except on the largest aclitellate specimen on which there is a wide dorsal gap in the circle of ii. The setae are fairly large, conspicuously protuberant; the circles with a definite but slight midventral gap behind the clitellum, a dorsal gap usually present but variable in width. The formulae are shown below.

vii	viii	xvii	xviii	xix	iii	viii	xii	xvi	xx
25	25	16	12	13	..	44	46	4	46*
19	19	14	12	16	29	37	44	..	44
18	20*	17	14	17	..	..	..	..	..
18	22	14	13	16	..	..	..	..	..
23	20	19	13	17	..	..	..	..	..

* Clitellate specimen.

The first dorsal pore is on 12/13 (3).

The clitellum is annular, extending from 13/14 to 16/17; dorsal pores and intersegmental furrows lacking; setae present only on xvi, midventrally (clitellate specimen). The clitellar region is not protuberant nor especially obvious and does not seem to be fully developed though the reproductive organs appear to be mature.

The spermathecal pores are minute and superficial, three pairs, on 6/7-8/9, each pore at the centre of a tiny, glistening, circular area. The pores are about at the mid-lateral line, but the pore on 7/8 is slightly dorsal to that on 6/7 while the pore on 8/9 is dorsal to the one on 7/8.

There is a single female pore.

The male pores are minute, each pore at the centre of a smooth, circular disc with slightly convex surface that is deeply retracted into a parietal invagination with a shortly transverse, slit-like aperture.

There are no genital markings.

Internal anatomy.—Septa 8/9-9/10 are lacking; some of the anterior septa slightly strengthened but membranous.

The intestine begins in xvi (3). The intestinal caeca are simple, slightly constricted by the septa through which they pass.

The single heart of ix is on the right side (3). The last pair of hearts is in xiii (3). All hearts of ix to xiii pass into the ventral vessel.

The testis sacs are unpaired and ventral. The seminal vesicles are each provided with a fairly large, primary ampulla. The prostates extend through xvii to xix. The prostatic duct is 2-3 mm. long, bent in a, u, or c shaped loop and with muscular sheen. The duct passes directly into the parietes, without any indication of the presence of a copulatory chamber in the coelomic cavity. The male pore marking forms the roof of the male invagination.

The spermathecae are small, the duct almost confined to the parietes within which it is fairly wide and readily traced. The diverticulum which passes into the anterior face of the duct within the parietes is longer than the combined lengths of duct and ampulla and may be as much as two to three times as long. An ectal portion with a muscular sheen has a thickish wall and a narrow lumen and is followed by a portion with wider lumen and thinner wall. This part is very shortly looped, the limbs of the loops in contact and in part in a zigzag. The entalmost portion of the diverticulum is slightly constricted off from the looped part and is spheroidal, ovoidal or ellipsoidal. When the spermathecal duct is dissected out from the parietes the spermathecal pore marking is removed at the end of the duct. In the two aclitellate specimens which were opened, a spermatozoal iridescence characterizes all of the seminal chambers, the iridescence extending down through a varying length of the looped part of the diverticulum. The seminal chambers of the clitellate specimen are filled with an opaque, whitish material but no spermatozoal iridescence is recognizable.

Remarks.—*P. scitula* appears to be near to *P. berhalana* Stephenson 1930 from pulau Berhala in the straits of Malacca but cannot be clearly distinguished at present as a result of the deficiencies in the description of the older species. Stephenson notes that the copulatory chamber of his species is "moderate sized." If copulatory chamber, in this connection, was used to denote, as it should, an invagination into the coelomic cavity, this characteristic will distinguish the Sumatran from the Andaman species.

Diagnosis.—Sexthecal, spermathecal pores minute and superficial, three pairs, on 6/7-8/9. Male pores minute and invaginate, each pore on the centre of a disc with a slightly convex surface on the roof of a deep parietal invagination with a transversely slit-like aperture. Setae present ventrally on xvi : vii/18-25, viii/19-25, xvii/14-19, xviii/12-14, xix/13-17, 29/iii, 37-44/viii, 44-46/xii, 44-46/xx. First dorsal pore on 12/13. Length 100-120 mm. Diameter 5 mm.

Intestinal caeca simple. Testis sacs unpaired and ventral. Spermathecal diverticulum much longer than combined lengths of duct and ampulla, comprising a stalk with thick, muscular wall, a looped middle portion with thinner wall and looping in part approximating to zigzag, and a spheroidal, ovoidal or ellipsoidal seminal chamber.

Pheretima sonella, sp. nov.

Material examined.—From the Indian Museum : 6 clitellate specimens labelled, "Mule track between Mao-Hsao and Namkham, N. Shan States, Burma. *ca.* 3,700 feet H. S. Rao. Nov. 1926." One of the specimens is damaged anteriorly.

External characteristics.—Length 130 to 180 mm. Diameter 7 to 8 mm. No traces of pigmentation visible.

The setae are unusually small, very closely spaced and ventrally, at least on many segments, with the appearance of being slightly zigzagged, so that the setal circle has a slightly serrate appearance. There are no very definite mid-dorsal or mid-ventral gaps in the circles but there are in most circles gaps of varying width at irregular intervals.

In these gaps there are usually visible one or more pits that appear to be setal pits from which the setae have dropped out, though in some cases the setae may be deeply retracted and not recognizable. (The cuticle cannot be removed without damaging the epidermis, hence determination of setal numbers is difficult, especially on the dorsum.) The setal numbers on the usual segments of one specimen are as follows: 90/iii, 56/viii, 116/xii, 118/xx. If each pit-like depression in a gap is counted as a seta, the numbers would be; 142/iii, 148/viii, 160/xii, 141/xx. Formulae; xvii/33, xviii/31, xix/32+; vii/48, viii/48+, xvii/34, xviii/37, xix/38; xvii/48, xviii/37, xix/43; vi/31+, vii/40, viii/31+, xvii/34, xviii/21+, xix/31+; vi/36+, vii/43+, viii/36+, xvii/46, xviii/41, xix/44. (+ indicates presence of one or more gaps, each wider than the normal interval between two successive setae).

The first dorsal pore is on 12/13 (3) or posterior to the clitellum (3).

The clitellum is annular, extending from just behind the setae of xiii to just in front of the setae of xvii; dorsal pores, intersegmental furrows and setae lacking, furrows 13/14 and 16/17 and the dorsal pores of these furrows also lacking.

The spermathecal pores are minute and superficial, four pairs, in 5/6-8/9. On one specimen the pores on the left side on 5/6-6/7 are lacking.

There is a single female pore (6).

The male pores are minute and superficial, each pore at the centre of a transversely oval to longitudinally oval, disc-like porophore.

On segment xxiii, on each specimen, there is a single genital marking which is circular to slightly oval (transversely placed) and which extends onto xxii and xxiv nearly to the setal circles (on one specimen slightly through the setal circle of xxiv) and laterally nearly to the male lines. The marking is smooth, flat, slightly elevated, a marginal rim marked off internally by a fine furrow or line but not clearly demarcated externally. Setae are lacking on the marking.

Internal anatomy.—Septa 5/6-7/8 are muscular; 8/9-9/10 lacking; 10/11-11/12 thickly muscular; 12/13 and succeeding septa exceedingly delicate.

Just behind the gizzard on the oesophagus there is a high, glandular collar which may be deeply incised into five large lobes and with several smaller lobes, or the lobes may be only slightly indicated. The intestine begins in xv. The intestinal caeca are simple, long and slender, with seven or more ventrally directed, shortly finger-shaped lobes on the ventral margin. These lobes are not closely crowded, the height (dorsoventral length) of each lobe less than the dorsoventral thickness of the main axis. In addition there may be further incisions or depressions of the ventral and dorsal margin, the incisions slight and the lobes thus marked off small. In one specimen the caeca are completely retracted into the lumen of the gut as the finger of a glove is pulled into the interior on drawing out the hand.

The last pair of hearts is in xiii (4). All hearts of ix to xiii pass into the ventral vessel.

The testis sacs are unpaired and ventral. The nerve cord is within each sac and so that a needle can be passed between the cord and the

floor of the testis sac. The sac of x is prolonged anteriorly as a short, finger-shaped pocket containing the cord which is surrounded by a thin layer of testicular coagulum. The seminal vesicles of xi are small, leaflike, flattened against the posterior face of 10/11, the combined mass of the two vesicles not as great as that of the testis sac. The vesicles of xii are flattened and straplike. In one specimen the vesicles are vertical, each extending across the dorsal blood vessel and then downwards on the opposite side. In other specimens the vesicles reach posteriorly rather than dorsally and are either doubled back on themselves within xii or else push 12/13 back into contact with 13/14 or extend through 12/13 to 13/14. From the median face of each vesicle a delicate sheet of connective tissue passes anteriorly to the posterior face of 11/12. The prostates extend through some or all of xvii-xx. The prostatic duct is 15 mm. long, usually bent into a hairpin shaped loop, with the limbs of the loop in contact, in xviii-xx or xxi. In one specimen the entalmost portion, about 4 mm. in length, is much thicker than the rest. In the other specimens the ental limb is quite definitely thicker than the ectal limb of the loop. The whole of the duct has a strong, muscular sheen.

The spermathecal duct is slender and much shorter than the ampulla. The lumen is wide entally, abruptly narrowed in the region of the diverticular junction, the lumen filled with a hard, whitish material which extends into the ectal portion of the ampulla. The ental part of the ampulla is filled with a translucent, soft material. The diverticulum is longer than the combined lengths of duct and ampulla and passes into the duct at or within the parietes. An ectal portion of the diverticulum has a noticeable muscular sheen but this gradually disappears passing entally, often accompanied by a slight decrease in diameter of the diverticulum. Still further entally the spermatozoal iridescence becomes visible and the diverticulum is usually slightly thickened. The diverticulum is best described as rod-like though not straight, twisted, looped or coiled. The ental half may be slightly wider or slightly narrower than the ectal half. In the ectalmost portion the lumen is narrow, the width less than the thickness of the wall. Passing entally the lumen is gradually widened, at first with numerous annular grooves marking off low, closely crowded, annular ridges but further entally the grooves are more widely separated.

The genital marking gland is a sessile, broad mass with a slightly convex surface, protuberant into the coelomic cavities of xxiii and xxiv.

Remarks.—In the abnormal specimen the left spermathecae of vi and vii are lacking. The right spermatheca of viii is abnormal ; ectally the diverticulum being thicker than the duct and tapering gradually at the entalmost portion to a fine filament.

P. sonella is distinguished from *P. labosa* Gates 1932 by the greater size, larger setal numbers, and the location of the genital marking on xxiii.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, on 5/6-8/9. Male pores minute and superficial, each pore on the centre of a transversely oval to longitudinally oval, disc-shaped

porophore. Genital marking median, circular to oval, on xxiii but extending onto xxii and xxiv nearly to the setal circles and reaching laterally nearly to the male pore lines. Setae very small and very closely spaced, on iii, viii, xii and xx well over 100 per segment; vii/40-48, xvii/33-48, xviii/31-41, xix/38-44. First dorsal pore on 12/13. Length 130-180 mm. Diameter 7-8 mm.

Intestinal caeca simple but with shortly finger-shaped lobes on the ventral margin. Testis sacs unpaired and ventral. Spermathecal diverticulum longer than combined lengths of duct and ampulla, rod-like but not straight, stalk muscular, seminal chamber not demarcated externally from rest of diverticulum. Genital marking gland sessile on the parietes.

Pheretima suctoria Michaelsen.

1907. *Pheretima suctoria*, Michaelsen, *Mitt. Mus. Hamburg*, XXIV, p. 165. (Type locality, Andaman Islands. Types in the Hamburg Museum and the Indian Museum.)
1909. *Pheretima suctoria*, Michaelsen, *Mem. Ind. Mus.* I, p. 196.
1923. *Pheretima suctoria* (part) Stephenson, *Oligochaeta*, in *F. B. I. Series*, p. 311. (Excluding *Pheretima suctoria* Stephenson 1922.)
1931. *Pheretima suctoria* var. *typica*, Gates, *Rec. Ind. Mus.* XXXIII, p. 412.

Material examined.—From the Hamburg Museum: 1 aclitellate and 3 clitellate specimens labelled, "*Pheretima suctoria* Michlsn. Andamans. V 7168". From the Indian Museum: 1 aclitellate specimen labelled, "Camorta Island, in jungle, creeping over ground. March 1925".

External characteristics.—(Camorta specimen) Length, *ca* 70 mm. Diameter, 4 mm. The purplish pigment which is confined to the dorsum is present in bands, one presetal and one postsetal on each segment, the two pigmented bands separated from each other by an unpigmented setigerous strip.

The setae begin on ii on which segment there is a complete circle and are small and closely and regularly spaced. There are no definite midventral gaps in the setal circles. Formula; vii/14, xvii/20, xviii/7, xix/22, 34/iii, 58/xii, 66/xx.

The spermathecal pores were not identified but are obviously minute and superficial, four pairs, on 5/6-8/9 (the intersegmental location determined by tracing the ducts through the parietes).

The male pores are minute and superficial, each pore on a very tiny, conical protuberance from the centre of a quite small, longitudinally oval area just lateral to each genital marking.

The genital markings are one pair on xviii, each marking seven intersetal intervals wide, transversely placed and with bluntly rounded ends, separated from each other by a midventral space containing 7 setae. A narrow peripheral part of each marking has a slightly different colouration from the central portion.

Internal anatomy.—Septa 8/9-9/10 are lacking.

The intestinal caeca are simple, constricted deeply by the septa through which they pass.

The last pair of hearts is in xiii.

The prostates are smallish, extending through xvii-xix. The prostatic duct is muscular, short, bent into a u-shaped loop.

The spermathecal duct is muscular. The diverticulum which is longer than the combined lengths of duct and ampulla, passes into the anterior face of the duct at the parietes and comprises a stalk with a slight, muscular sheen and an elongate seminal chamber that is looped in an irregular fashion, all of the loops pressed into a flattened mass.

The genital marking glands are sessile on the parietes.

Remarks.—The Nicobar specimen is in rather poor condition, macerated just behind segment xviii, the internal organs in part macerated and in part so brittle that important characteristics in the region of segments x-xiii could not be determined, as the organs broke into pieces on being manipulated. Although the gut is badly macerated from xiv posteriorly the intestinal caeca are in fairly good condition.

The only worms hitherto recorded from the Nicobar Islands have been peregrine species of the family Lumbricidae.

Diagnosis.—Octothecal, spermathecal pores minute and superficial four pairs, on 5/6-8/9. Male pores minute and superficial, each pore on a small, disc-shaped porophore. Genital markings one pair, on xviii, just median to the male porophores. Setae : vi/10, vii/10-14, viii/10, xvii/20, xviii/4-8, xix/22, 34/iii, 58/xii, 66/xx. First dorsal pore on 12/13. Length 75-140 mm. Diameter 4-7 mm. Segments 103-123.

Intestinal caeca simple. Testis sacs unpaired and ventral. Spermathecal diverticulum slender, longer than combined lengths of duct and ampulla, with short stalk portion not demarcated externally from the elongate and irregularly looped seminal chamber. Genital marking glands sessile, interrupting the longitudinal musculature and slightly protuberant into the coelomic cavity.

Pheretima vieta, sp. nov.

Material examined.—From local collections :
" Under rotten leaves, dense jungle," Peng Sai, Mang Lun State, Oct. 1935, 3 aclitellate and 13 clitellate specimens. H. Young.

External characteristics.—Length, 42-65 mm., but most of the specimens are 50-60 mm. long. Diameter 2 mm. Unpigmented ; clitellum yellowish or brownish.

The setae begin of ii, on which segment there is a complete circle, and are small, closely and regularly spaced. On some at least of the preclitellar segments the ventral setae are larger than the dorsal. There may be a slight mid-dorsal gap in the setal circles. There are no setae on xviii between the genital markings on any of the specimens, and the setal circle of xix is uninterrupted behind the genital markings on all specimens. Formulae : vi/1, xvii/8, xix/5, 49/iii, 63/viii, 51/xii, 47/xx ; vi/4, xvii/5, xix/6, 48/iii, 61/viii, 54/xii, 45/xx ; vi/3, xvii/5, xix/4, 44/iii, 58/viii, 48/xii, 39/xx. Number of male setae on xvii of other specimens : 6, 5, 7, 7, 4, 6, 7, 5, 7; of spermathecal setae on vi,-2, 0, 1, 0, 1, 2, 2, 1, 1, 3, on the aclitellate specimens,-3, 5, 4.

The first dorsal pore is on 12/13 (16).

The clitellum is annular and extends from 13/14 to 16/17 ; intersegmental furrows, setae and dorsal pores lacking.

The spermathecal pores are tiny, transverse slits, one pair, postsetal on vi, about halfway between the setal circle and 6/7. The epidermis around the spermathecal aperture is conspicuously protuberant as an annular lip. The pores and the annular lips are as well developed on the aclitellate as on the clitellate specimens.

There is a single female pore (13).

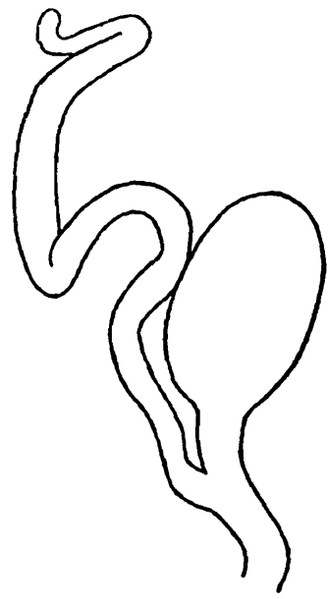
The male pores are minute and superficial, each pore within and near the posterior end of a seminal furrow.

The genital markings are one pair of elongate, slightly raised areas with bluntly rounded ends placed diagonally so that the posterior ends are slightly nearer to the midventral line, extending across xvii almost to 16/17 and 18/19 which is dislocated posteriorly. Along the middle of each marking is a seminal furrow, anteriorly hooked around slightly towards the midventral line. Posteriorly the furrow passes up onto the anterior face to the tip of a tiny, rather conical protuberance near the posterior end of the marking. The male pore is within the furrow on this protuberance. On one of the clitellate specimens the right genital marking is on xvi and xvii.

Internal anatomy.—Septa 5/6-7/8 are muscular; 8/9-9/10 lacking; 10/11 present.

The gut is slender in xiv-xviii, widened gradually or abruptly in xix, attaining full intestinal width only in xx or xxi. The intestinal caeca are small and short, extending through one to three segments only, constricted slightly by the septa through which they pass.

The last pair of hearts is in xiii (5). The heart of ix is on the left side (4) or on the right side (1). The hearts of xi are included within the testis sac, the hearts of x are included ventrally within the testis sac. All hearts of ix-xiii pass into the ventral vessel.

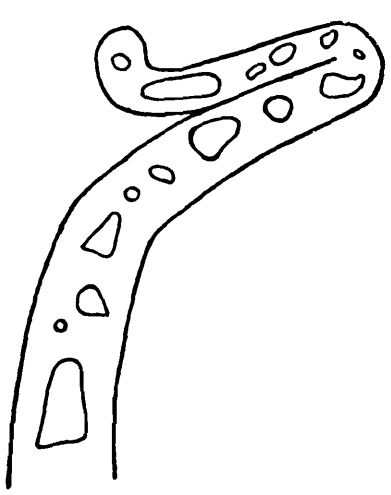


TEXT-FIG. 5.—*Pheretima vieta*, sp. nov. Spermatheca ×*ca.* 20.

The testis sac of x is probably U-shaped with the hearts of x contained within dorsally directed limbs of the sac but testicular coagulum is present only in the ventral part of each limb. In two specimens the ventral blood vessel is quite obviously within the median part of the

testis sac and underneath the blood vessel the coagulum forms a continuous band from one side of the sac to the other. In the other three specimens the coagulum is not continuous underneath the blood vessel and no connection between the two portions of the sac was discovered. It would appear in these three specimens as if there were a pair of vertical testis sacs belonging to x. The testis sac of xi is U-shaped, the limbs of the sac reaching to the dorsal blood vessel and enclosing the seminal vesicles and hearts which are embedded within the testicular coagulum. The vesicles of xi are very small, bilobed structures. The vesicles of xii are also small. The prostates extend through xvii to xix. The prostatic duct is muscular but whitish, bent into a U or a J-shape or twisted.

The spermathecal duct is slender, slightly shorter than the ampulla, and is not narrowed within the parietes. The diverticulum which passes into the duct at the parietes is slender and longer than the combined lengths of duct and ampulla. In the ental third of the diverticulum (5 specimens) there is a linear series of large, transparent areas. These areas may be vacuoles in an incompletely cleared sperm mass. In the ectal portion the lumen is very narrow and central. In a sixth specimen the diverticular lumen is widened slightly in a middle portion



TEXT-FIG. 6.—*Pheretima vieta*, sp. nov. Ental end of spermathecal diverticulum ×*ca.* 45.

and with a zigzagged appearance, a fissure opening out laterally from the apex of each angle of the zigzag, in the ental portion still wider and with smooth wall and here occupied by a whitish, non-iridescent mass. There is no spermatozoal iridescence in any of the spermathecae. The lumen of the diverticulum turns up dorsally within the duct for a very short distance before opening into the duct lumen. One spermatheca has two diverticula, arising from opposite sides of the duct. The extra diverticulum is long but lacks the transparent spaces in the ental portion.

The genital markings are thickenings of the body wall; there being no glandular material protuberant into the coelomic cavity.

Remarks.—*P. vieta* is close to *P. glabra* Gates 1932, from which it is distinguished as follows: by the presence of male setae on xvii, the absence of ventrolateral gaps in the setal circle of six behind the genital markings, the smaller intestinal caeca, the presence of 10/11 and the hearts of x, the U-shaped and unpaired testis sacs and the inclusion of

the seminal vesicles of xi within the posterior testis sac. Spermathecal characteristics of the two species cannot be compared as *P. glabra* is known only from athecal forms.

Diagnosis.—Bithecal, spermathecal pores superficial, shortly transverse slits, one pair, on vi, halfway between the setae and 6/7 Male pores minute and superficial, each pore within and near the end of a seminal furrow and on a tiny conical protuberance on a genital marking near the posterior end. Genital markings one pair, extending across xvii-xviii to 16/17 and 18/19. Along the middle of each marking a seminal furrow which is hooked midventrally at the anterior end. Setae: vi/0-4, xvii/4-8, xviii/0, xix/4-6, 44-49/iii, 58-63/viii, 48-54/xii, 39-47/xx. First dorsal pore on 12/13. Length 42-65 mm. Diameter 2 mm.

Intestinal caeca, simple, short. Testis sacs unpaired and U-shaped. Seminal vesicles of xi included within the posterior testis sac. Spermathecal diverticulum longer than combined lengths of duct and ampulla slender, not marked off externally into stalk and seminal chamber. Genital markings thickenings of the parietes, no glands, at least in the coelomic cavity.

Genus **Perionyx** E. Perrier.

1872. *Perionyx*, E. Perrier, *N. Arch. Mus. Paris*, VIII, p. 126, (Genotype, *P. excavatus* E. Perrier 1872).

Perionyx arboricola Rosa.

1890. *Perionyx arboricola*, Rosa, *Ann. Mus. Genova*, XXX, p. 119. (Type locality, Cobapo, Karen Hills of Toungoo District. Type in the Genoa Museum.)

Material examined.—From the Genoa Museum: 1 fully clitellate, dissected specimen from a tube labelled, "*Perionyx arboricola* Rosa. *Ann. Mus. Civ. Genova*, XXX, p. 119, T. 1. f. 11. Typus Cobapo (Carin Cheba) L. Fea. Cat. No. 41".

External characteristics.—The clitellum extends across xiv-xvi and looks much like a *Pheretima* clitellum.

The spermathecal porse are minute and widely separated.

On xviii there is a transversely placed, rectangular depression the lateral margins of which are not definitely demarcated but which are represented by flattened papillae that project into the depression towards the midventral line. Towards the median, pointed portion of each papilla there is a pit or pore which may be the male pore.

Internal anatomy.—The male funnels are possibly located in testis sacs. The prostatic duct is elongate and extends through several segments, bent into a hairpin-shaped loop, the ectal limb of the loop much thicker than the ental limb and muscular, the duct similar in appearance to a prostatic duct in certain species of *Pheretima.*

The spermatheca has a definite but short duct and an elongate diverticulum, the latter about as long as the combined lengths of duct and ampulla. There are slight indications of a zigzag looping and entally the diverticulum seems to be slightly widened. The spermathecae look like those of *Pheretima.*

Remarks.—The gut had been removed from the region of the testis segments to behind the prostatic region. As the type is unique it was

handled very carefully and none of the organs were removed for further study.

In addition to the type the tube contains six very small and aclitellate specimens.

Mr. Blackwell has been endeavouring for several years to find *P. arboricola* in the neighbourhood of the type locality. Although hundred of specimens of *Perionyx* have been collected none that can be referred to *arboricola* have yet been found. In addition to those listed below (*Vide P. excavatus* and *Perionyx* species) over five hundred clitellate and aclitellate specimens of *Perionyx* from the region about Leiktho, also collected by Mr. Blackwell, have been examined.

Perionyx excavatus E. Perrier.

1872. *Perionyx excavatus*, E. Perrier *N. Arch. Mus. Paris*, VIII, p. 126. (Type locality, Saigon, French Indo-China. Types in the *Paris* Museum.)
1888. *Perionyx excavatus*, Rosa, *Ann. Mus. Genova*, XXVI, p. 157.
1890. *Perionyx excavatus*, Rosa, *Ann. Mus. Genova*, XXX, p. 121.

Material examined.—From the Genoa Museum: 2 softened, clitellate specimens from a tube labelled, "*Perionyx excavatus* Perr. Rosa Ann. Mus. Civ. Genova XXX, 1890. p. 121. Teinzo (Moolay) Birmania. L. Fea, 1886. Cat. No. 40". From the Indian Museum: 3 clitellate specimens labelled, "Under stones, Namkham, N. Shan States, Burma. H. S. Rao. Dec. 1926".

From local collections:

Moulmein, Aug. 1935, 22 aclitellate and 1 clitellate specimens. K. John.

Mogok, Sept. 1935, 3 clitellate specimens. Mrs. A. C. Hanna.

"Under bark of trees", rain forest on way to Thandaung, Sept. 1935, 10 clitellate specimens. G. E. Blackwell.

"On epiphytic ferns," rain forest on way to Thandaung, 10 clitellate specimens. Sept. 1935, G. E. Blackwell.

One of the Genoa specimens is probably abnormal. The determination of the anteriormost segments is difficult, but if the male pores are on xviii, as is probable, then the clitellum is on xiii-xvii and the spermathecal pores are on 8/9-9/10.

The spermathecae of all specimens from local collections have been examined. The wart-like structures previously regarded as diverticula (*Vide* Stephenson 1923, p. 330) are probably not diverticula at all. Although present in some specimens on the ental end of the spermathecal duct, where diverticula might be expected to be located, there is never any spermatozoal iridescence and similar wart-like protuberances, likewise without spermatozoal iridescence, may also be present on the spermathecal ampullae. On several specimens slightly larger protuberances from the ental end of the spermathecal duct might also be mistaken for diverticula but are in reality only thinned out bulgings of the duct wall due to the crowding of several, large spermatophores in the ental portion of the duct. A collapsed bulging of the duct wall of this sort, after disappearance of the spermatophores, might have a wart-like and transparent appearance as in other specimens. In the ectal part of the ampulla and extending down into the duct or also in the duct there may be one or more spermatophores. Each spermatophore has a hard, nearly spheroidal head that is iridescent and to which is attached a transparent conical region narrowing almost to a fine thread.

Perionyx spp.

A.

Material examined.—From local collections :
Myitkyina, Sept. 1934, 8 aclitellate specimens. K. John.
Mogok, Sept. 1935, 46 aclitellate specimens, Mrs. A. C. Hanna.
" Under rocks," North of Thandaung, Sept. 1935, 82 aclitellate specimens. G. E. Blackwell.
" Under bark of trees," rain forest on way to Thandaung, Sept. 1935, 108, aclitellate specimens. G. E. Blackwell.
" On epiphytic ferns," rain forest on way to Thandaung, Sept. 1935, 22 aclitellate specimens. G. E. Blackwell.
" Rotting leaves in forks of trees," rain forest near Thandaung, 190 aclitellate specimens. G. E. Blackwell.

None of the specimens are sufficiently developed to enable identification, though some of the worms reach a length of 100-180 mm. and a diameter of 5-7 mm. Many are probably to be referred to *P. excavatus*.

B.

1933. *Perionyx excavatus*, Stephenson, *Proc. Zool. Soc. London*, 1932, p. 930.

Material examined.—From the British Museum : three specimens labelled, " *Perionyx excavatus*. Hills E. of Fort Hertz, Burmese Thibetan border. Capt. F. Kingdon-Ward. 1932, 6. 24. 1-3."

The worms are very dark blue, almost black.

The male pores were not definitely identified but are probably on whitish, shortly conical papillae which are widely separated. Between the papillae there is a short (anteroposteriorly), wide, fairly deep and whitened, rectangular depression.

In the seminal vesicles there are large masses of parasites. The prostatic ducts are slender, almost straight ; the dorsal end of a duct surrounded or almost so by prostatic tissue ; the prostates small and not fully developed. The penial setae are very similar to the penial setae of *P. excavatus*.

Remarks.—All of the specimens are aclitellate, one much larger than the others had been opened by Stephenson. The male genital field is not so well developed on the two smaller specimens, the rectangular depression here represented only by an unpigmented area which is, however, in sharp contrast to the rest of the ventrum.

Stephenson did not give any reasons for his identification of these worms as *P. excavatus* but presumably the main reason is the similarity of the penial setae to those of *P. excavatus*. Unfortunately several forms which appear to be specifically distinct all have setae very similar to if not actually identical with those of *P. excavatus*. The pigmentation, the wide separation of the conical male porophores, the rectangular and depressed male field provide very definite evidence against an identification as *P. excavatus*. The worms cannot be placed in any of the species of *Perionyx* at present known from Burma but in the absence of clitellate specimens the species cannot be adequately characterized. The pigmentation is similar to that of *P. m'intoshii* but the male field appears to be developing in a different fashion than in the latter species.

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APPENDIX.

Most of the place names mentioned in this paper have been included in appendices to previous papers. Some of the new localities, at which collections have been made for the first time, are mentioned below.

Ruby Mines District.

Mogok, 60 miles due east by motor road from the Irrawaddy River.

Pegu Yomas.

There are no names for areas from which collections were made. The collector went up into these hills from certain points on the railway, the direction, generally speaking, due west, the collections secured fifteen miles or more from the railway line.

No. 1. From the railway 8 miles south of Toungoo.

No. 2. From the railway 16 miles south of Toungoo.

No. 3. From the railway 24 miles south of Toungoo.

No. 4. From the railway 32 miles south of Toungoo and about opposite Pyu.

No. 5. From the railway 10 miles south of Pyu. Numbers 1-5 in Toungoo district.

No. 6. From the railway 15 miles south of Pyu.

No. 7. From the railway 20 miles south of Pyu. Numbers 6-7 in Pegu district.

No. 8. From the railway 5 miles south of Pyu.

ON A COLLECTION OF PARASITIC HYMENOPTERA FROM THE GOVERNMENT MUSEUM, MADRAS.

By M. S. MANI, *Assistant, Zoological Survey of India, Indian Museum, Calcutta.*

Dr. F. H. Gravely, Superintendent, Government Museum, Madras, recently sent me for identification a small collection of Parasitic Hymenoptera. The material comprises one new Proctoprypid and three new species of Chalcids. The species *Euchalcis myrmeleonae* and *Neochalcis myrmeleonae*, which are stated to have been bred from the cocoons of ant-lions, are of particular interest as the first records from India of any Hymenopterous parasites of Myrmeleonids.

My sincere thanks are due to Dr. Gravely for giving me an opportunity of studying this interesting collection. My thanks are also due to Dr. Baini Prashad, Director, and Dr. H. A. Hafiz, Officer in charge of the Entomological Section, Zoological Survey of India, Indian Museum, Calcutta, for giving me facilities for work.

Superfamily PROCTOTRYPOIDEA.

Hoploteleia gravelyi, sp. nov.

This species differs from all the others of the genus *Hoploteleia* Kieff. in that the lateral ocelli are situated close to the eye border, in the sculpture of abdomen and also in the unarmed metanotum. This last character shows affinity to the genus *Triteleia* Kieff.[1] but the short abdomen and the very distinctly edged stirnal impression behind the lateral ocelli place the species in *Hoploteleia*.

Female.—Length about 3·5-3·75 mm. Body black, densely clothed with whitish setæ. Head subquadrate, one and a half times as broad as long; ocelli arranged in the form of a triangle, front ocellus just above the deep antennal fovea, the lateral ocelli nearly touching the eye border. There is a deep, distinctly ridged impression behind the lateral ocelli, and a straight carina connecting the lower borders of the eyes with the base of the antennal fovea. Sculpture of head consisting of umbilicate punctation; antennal fovea transversely striate; pubescence dense, white and long. Eyes bare. Antennae about half the length of body; segments 12; scape yellow, about two thirds the length of flagellum, slender basally; pedicel and the first segment of funicle nearly equal; funicle yellowish brown, segments gradually growing shorter and stouter; club dark reddish brown, segments 6. Mesonotum umbilicately punctate, but less closely so than the head; the space between the punctae finely reticulate; in addition to the median and the parapsidal furrows there are also two other furrows at the lateral margin connected anteriorly by a transverse furrow with the parapsidal furrows.

[1] Kieffer, *Berlin. Ent. Zeit.*, L, p. 264, (1906); also see Kieffer, *Das Tierreich*, Lief. XLVIII, p. 364, (1926).

Scutellum coarsely and densely punctate. Femoral impression of mesopleura finely transversely striate. Mesepisternum closely umbilicately punctate. Metanotum distinctly unarmed. Propodeum unarmed. Legs, except the coxæ, yellowish brown. Abdomen oval, less than half the length of the rest of body; first apparent tergite with a close, longitudinally corrugated sculpture, second apparent tergite corrugated antero-medially and coarsely streaked behind; sculpture of the rest of the dorsal surface of abdomen fine punctation; third apparent tergite longest; terminal segment with a denser pubescence than the rest of abdomen.

Male.—Resembles the female, but differs in the following respects: Length 3·5 mm. Legs yellowish. Head more round than in female. Antennæ yellowish brown, about half the length of body; scape about one third the length of flagellum; pedicel much shorter than the first segment of funicle; the first two funicular segments long, equal; rest shorter than these two but equal to each other; terminal segment somewhat longer. Transverse striations of the femoral impression of mesopleura rather faint.

Type Series.—One female and male in spirit. No. 932/H3. In the collection of the Zoological Survey of India, Indian Museum, Calcutta.

" Bred from egg-cases of a long-horned grass-hopper, Madras. F. H. Gravely, viii-1925."

Superfamily CHALCIDOIDEA.

Euchalcis myrmeleonae, sp. nov.

This species differs from the only other Indian species *E. trichiocephalus* Cam.[1] mainly in the sculpture of mesonotum and propodeum.

Male.—Length 4 mm. Body black. Head closely umbilicately punctate; antennal fovea faintly developed only near the insertion of the antennæ, transversely striate; dense, silvery white pubescence on cheeks as in *E. trichiocephalus*; the pubescence on occiput not so dense; lateral ocelli separated from the eye border by a distance less than their diameters; eyes large, bordered black, projecting behind occiput. Antennae reddish brown; scape dark reddish; pedicel somewhat shorter than the first segment of funicle; ring joint broader than long, its breadth equal to that of pedicel; first segment of funicle longest; second and third segments equal, each about three fourths the length of first; fourth to sixth equal, each somewhat shorter than third; seventh somewhat shorter than sixth; club longest of all antennal segments, conically pointed apically, solid; there are two dark transverse lines at about one third and two thirds from the base but there are no sutures.

Pronotum closely, deeply, coarsely and umbilicately punctate; punctations on mesonotum and scutellum neither so close nor so deep; femoral impression of mesopleura transversely corrugated, corrugations not very deep. Propodeum with two median longitudinal carinæ at a distance from each other anteriorly but broadly connected posteriorly; there is also a lateral carina diverging from the posterior end of the

[1] Cameron, *Journ. Bombay Nat. Hist. Soc.*, XVII, p. 579, (1907).

median carina and connected with it in the middle by a transverse carina ; there are other carinæ interconnecting these in addition to a spiny one outside the lateral carina. All legs reddish, hind coxæ polished above, minutely punctured below, very dark reddish ; hind femur bright red, with one large sharp basal tooth and an apical lobular process in addition to being finely and pectinately denticulate ; hind tibiæ rather darker ; hind metatarsus slightly longer than the second tarsal segment. Tegulæ bright red. Abdomen oval, black ; first apparent tergite covering nearly half the dorsal area, glossy ; second apparent tergite closely punctate and pubescent ; rest of the tergites of the abdomen glossy in anterior half, punctate and pubescent in posterior half.

Type.—One male in spirit ; one antenna mounted in canada balsam. No. 933/H3. In the collection of the Zoological Survey, Indian Museum, Calcutta.

Bred from the cocoon of an ant-lion, 26-ix-1921. Coll. H. C., Madras.

Neochalcis myrmeleonae, sp. nov.

This species differs from the Indian species *N. forticaudis* Cam.[1] mainly in the sculpture of head and abdomen and the relative proportions of the antennal segments. The propodeum is also differently sculptured.

Female.—Length 1·5-2·0 mm. Body very dark reddish brown. Head about as broad as thorax, with a leathery sculpture, finely pubescent. Lateral ocelli separated from the eye border by a distance slightly greater than their diameters. Antennae yellowish brown ; scape a little more than half the length of funicle ; pedicel slightly longer than the first two segments of funicle ; other funicular segments gradually become broader and shorter ; club as long as pedicel, basal segment longer, middle segment broader than long, apical segment conical. Pro- and mesonotums coarsely umbilicately punctate, punctae not very close. Scutellum subreticulately sculptured, the reticulations rather close. Legs reddish brown. Abdomen reddish, shorter than the rest of body ; second tergite occupies nearly half the dorsal surface ; minutely sculptured.

Type series.—Three females in spirit ; one partly dissected ; one antenna mounted in canada balsam. No. 934/H3. In the collection of the Zoological Survey, Indian Museum, Calcutta.

Bred from the cocoon of an ant-lion. July, 1920. Coll. H. C., Madras.

Stomatoceroides indicus, sp. nov.

The genus *Stomatoceroides* was erected by Girault[2] for forms closely related to *Stomatoceras* Kirb. but having a ring joint in the antenna. About ten species, all from the Australian region, have so far been described and the present species is the first record of the genus from India. The Indian species differs from all the other species in having hyaline

[1] Cameron, *Journ., Bombay Nats. Hist. Soc.*, XVII, p. 96, (1906).
[2] Girault, *Mem. Queensland Mus.*, IV, p. 341, (1915).

wings, elongated abdomen, relatively shorter first segment of funicle of antenna, much longer club and in the relatively shorter post marginal vein.

Female.—Length about 4·75 mm. Body black. Head black, slightly broader than thorax ; sides of the facial impression ridged ; antennal fovea transversely striate ; rest of face irregularly punctate ; cheek densely setose ; occiput and back of head closely umbilicately punctate ; front ocellus within the facial impression ; lateral ones separated from the eye border by a distance equal to their diameters ; there is a deep impression between the lateral ocellus and the eye. Antennae reddish brown, short ; scape about as long as the pedicel, ring joint and first three segments of the funicle combined, stout, crooked and broadened apically ; pedicel short ; ring joint very much broader than long ; first three segments of the funicle equal ; fourth segment slightly shorter than third ; fifth nearly equal to fourth ; sixth and seventh each about three fourths the length of fourth ; club solid, conical, slightly more than twice the length of first segment of funicle. Thorax black, closely umbilicately punctate. Scutellum with a carinate margin ; apical spinous process broad, blunt and widely separated, sculpture as on the rest of thorax. Propodeum with a rugose sculpture, deepest in the middle ; there is a spinous carina on each side. Legs dark reddish brown. Hind femur somewhat lighter, finely ciliated and denticulate underneath from about the basal one fourth onwards. Wings hyaline, post marginal vein equal to or very slightly longer than the marginal vein. Abdomen conical, nearly equal to the rest of body in length, reddish ; second tergite occupies nearly half the dorsal area of abdomen, sparsely punctate ; other tergites closely punctate and pubescent ; style-like posterior prolongation about half the length of the rest of the abdomen.

Type.—One female in spirit ; one antenna mounted in canada balsam. No. 935/H3. In the collection of the Zoological Survey, Indian Museum, Calcutta.

Coll. Johnson, Waltair, Aug. 1920.

OBSERVATIONS ON THE RATE OF GROWTH AND LONGEVITY OF *TROCHUS NILOTICUS* LINN. IN THE ANDAMAN IS.

By H. Srinivasa Rao, *M.A., D.Sc., Assistant Superintendent, Zoological Survey of India, Calcutta.*

(Plate XIV.)

There is a considerable volume of literature on the rate of growth of various species of the Lamellibranchiata, but comparatively little attention seems to have been paid to the problems of growth in the Gastropoda. Russell (1909) and later Orton (1914) studied the rate of growth and other allied problems in *Patella vulgata* Linn. along the coasts of Great Britain. Sewell (1924) gave an account of his observations on growth in certain marine, fresh- and brackish-water forms of Mollusca of the Nicobar Is., India, and the Gulf of Suez respectively. Crofts (1929) in her memoir on *Haliotis tuberculata* Linn. recorded a few observations on the rate of growth of this species. Abe (1932) studied the age and growth of the Limpet, *Acmaea dorsuosa* Gould in the Japanese waters. In this paper are cited references to the works of Nomura, Ohue, Takano and others which are published in the Japanese language in journals not available in India. Moorhouse (1932) studied the rate of growth in *Trochus niloticus* Linn. on the Queensland coast of Australia. His is, perhaps, one of the few contributions to our knowledge of growth in a large species of marine Gastropod. The results of his study were based on (1) measurement of marked and numbered individuals confined in cages left in the sea, (2) monthly measurement of 600 free-living animals and (3) measurement of specially marked free-living animals. The individuals used in his studies were generally small, and the maximum diameter of the shells ranged between 2 and 5 centimetres with a few exceptions which measured up to 8·3 cms. The duration of his observations was between 4 and 8 months. His conclusions are that growth in the shell is continuous, though irregular, except for a short period in winter, and that the approximate monthly rate of growth is 0·23 cm., and that shells between 2·5 and 3·0 cms., 5·0 and 6·0 cms., and 7·0 and 8·0 cms. in maximum diameter are 1, 2 and 3 years old respectively.

While stationed in Port Blair as Officer-in-charge of the Andaman *Trochus* shell-fishery investigations from May 1932 to July 1935, I had the opportunity to make observations on the growth of the shell in *Trochus niloticus* in the vicinity of Port Blair, which are presented in this paper.

The first experiment on growth-rate in *T niloticus* with the maximum diameter of the shell as the criterion was started in April 1932 by Dr. C. Amirthalingam (then stationed in Port Blair as Research Officer of the Andaman Fisheries) with a hundred examples of various sizes. Thick copper tags with serial numbers deeply engraved on them were

secured to the outer lip of the shells by means of stout copper wire passing through holes bored in them. The measurements of the shells, namely, the maximum and minimum diameters and the height, were noted, and the shells were left under stones and coral reefs at low tide near the South Point Navigation Light, Port Blair. A search for the numbered individuals was made every month whenever the tides were favourable, and the measurements recorded. At the end of the first month, I continued the observations started by Dr. Amirthalingam, and found only 55 shells out of the hundred with which the experiment was started. At the end of the second month 20 living and 6 dead specimens were found. In September 1932, out of 34 numbered specimens recovered from the reefs, only 8 were living, and in December 1932 only 3 living specimens were found. The outer lip and spire of the shells were found damaged in many of the shells, and the copper tags and wire were very much worn. The stormy weather that prevailed in Port Blair during part of the monsoon resulting in the dislocation of the coral masses under which the shells were kept may have been partly responsible for the damage to the shell of the experimental specimens. Fresh regions of growth, along the margins of the mouth of the shell seen in several specimens, particularly where the shell had been bored for the passage of the copper wire, indicated that normal growth had in some way been retarded. But one of the causes of mortality among the animals may have, at any rate, been attack by their natural enemies.

In January 1933 the experiment was restarted with 200 examples below 7 cms. in diameter[1] collected along the eastern coast of Havelock I. of the Ritchie's Archipelago. The venue of the experiment was changed from S. Point to a long strip of coral shingle (pl. XIV, fig. 1) on the north-west of Ross I., Port Blair, uncovered by the sea at ordinary low tides, and somewhat protected from the monsoons. The shells were all numbered as before, and left in groups of 4 or 5 under marked boulders of coral rock. Ten days later, the area was searched for the numbered shells, but curiously, not even one out of the 200 shells was found in spite of a prolonged and careful search under and amongst coral rocks and slabs. On the following day a search for the numbered shells in the adjoining reefs up to a depth of about 4 fathoms was made from a row-boat with the help of a water-glass (a pyramidal, trumpet-shaped wooden structure with a plate-glass, fixed to the broader end, acting as the window), but failed to reveal any of the marked shells. They had apparently moved down to greater depths in search of food and shelter. It may be mentioned that on that side of the Ross I., there were abundant growths of branching Madreporarian corals which rendered examination of the bottom at depths below 4 fathoms extremely difficult.

The growth experiment was, however, recommenced about the end of February 1933 with another 100 specimens between 5·0 and 7·0 cms. in diameter collected on the reefs off Little Andaman. As the declivous

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[1] All the measurements in respect of the shell of *Trochus niloticus* given in this paper refer only to the maximum diameter unless otherwise stated.

nature of the bottom on Ross I. rendered the recovery of marked shells difficult, a large shallow pit near South Point with coral boulders and slabs heaped along its periphery was selected for the experiment, and the shells bearing a vertical file-mark, 5 mm. high and 2 mm. deep, on the outer lip one centimetre from the growing edge of the mouth were deposited in the crevices between the dead coral masses at the bottom of the pit. The diameter of the shells was recorded. It was observed that on a second visit to that place in April 1933 most of the marked shells had crawled out of the pit to the rocks and coral boulders below low-tide level, while a few were found under stones between tide-marks within a radius of 20 yards from the pit. No attempt to gather and confine them again in the pit was made, but on subsequent monthly visits paid to that locality at favourable low tides, as many of the file-marked specimens as could be collected were brought together, and the length of the intervening space between the original file-mark and the growing edge of the mouth was directly measured with the help of a measuring tape.[1] The diameter of the shells was also noted. A fresh file-mark one centimetre from the edge of the mouth was made on the periphery of the last whorl every time marked shells were recovered from the reefs so that the number of occasions on which they were measured could be noted. The actual total growth along the whorls from the initial date of the experiment indicated by the first file-mark to the final date can be computed by subtracting 1 cm. from the measurement taken along the whorls from the first file-mark to the extreme edge of the growing outer lip of the mouth of the shell. During the S. W. monsoon season of 1933 no measurements could be taken on account of unfavourable weather conditions, and in October of that year it was found that there were less than a dozen specimens of the 100 marked shells with which the experiment was started, all the remaining individuals having either migrated into deeper waters or been killed by adverse conditions in their environment. For want of adequate funds, the fencing off of a part of the experimental area with a view to prevent the migration of the animals into the deeper parts of the reef could not be arranged. The observations were, however, continued till July 1935 on the few individulas that remained in the accessible parts of the reef, in addition to a fresh set of observations which was commenced in February 1934.

The results obtained from a study of growth in the file-marked shells appeared to be of some interest. There was a more or less definite correlation between growth along the whorls and growth in diameter of the shell, and it became evident that the relationship between the two types of growth could be expressed by the formula $\frac{W}{D} = C$, where W represents the length of whorls of a shell measured from the outer edge of the mouth along the periphery of the last whorl and thence along the suture to the topmost point of the spire, and D the maximum diameter of the shell, and C the constant. This constant, which is based on the average of a large series of (nearly 400) measurements of shells

[1] This measurement less 1 cm. gives the extent of growth along the whorls in the period between the dates of the original and subsequent measurements.

of all sizes, is 8·7.[1] In the absence of serial numbers on the shells which would enable the identification of individuals at various stages of this study, it seemed to me that this formula would have a practical application in determining the diameter of a shell at given stages or dates of the study from data relating to growth along the whorls. A concrete example would explain the application better. On a given date the diameter of a shell under observation is 9·9 cms. as measured directly by callipers, and the actual growth along the periphery of the last whorl (from a previous recorded date) as measured directly by a graduated tape from the first file-mark to the edge of the outer lip of the mouth is 30·0 cms. The diameter of the shell on the previous date which is unknown can be calculated as shown below:

The length of the entire whorls of a shell 9·9 cms. in diameter can be found by the use of a variant of the formula given above, *e.g.*, $D \times C = W$; thus the length of whorls of this shell should be $9{\cdot}9 \times 8{\cdot}7 = 86{\cdot}03$ cms.; the actual growth along the whorls, 30·0 cms.—1·0 cm. (being the distance between edge of lip and the latest file-mark)=29·0 cms. The length of the entire whorls on the previous date should have been therefore 86·13 cms.—29·0 cms.=57·13 cms. Using another variant of the formula, *e.g.*, $\frac{W}{C} = D$, the diameter of the shell at the time of previous observation should have been $\frac{57{\cdot}13}{8{\cdot}7} = 6{\cdot}56$ cms. Now that the present and previous diameters are known, the total growth in diameter between the two given dates of observation is, in this example, 9·90—6·56 cms.=3·36 cms. The agreement in results between the indirect method of calculating the growth in diameter of a shell as outlined above, and the direct method of measuring growth in diameter from a record of growth of numbered shells to be detailed in another paragraph, has been verified in respect of two shells which bore a series of file-marks and a serial number. The error between the two methods was in one case 0·02 and in the other 0·10.

A series of observations on growth of shell in reference to length of whorls was taken from the 27th February, and again from the 20th October, of the year 1933, but owing to the gradual decrease in the number of file-marked shells due to loss of specimens, and to the involved manner of calculating the rate of growth in diameter, this method of observation was abandoned. The data obtained are, however, given in Tables I and II which show that there is a considerable variation in the rate of growth of individuals of approximately the same size.[2] Even so, the results indicate clearly that the monthly rate of growth declines as the shell increases in diameter.

The occurrence of certain oblique lines of growth (pl. XIV, figs. 3-5) on the periostracum of the whorls of shells suggested another line of investigation of the rate of growth which has often been followed with

[1] The indices or constants for different sizes of shells from 2·0 cms. to 12·99 cms. in maximum diameter, on statistical analysis, showed that the means of indices for the different sizes were significantly different from one another. For the purpose, however, of a rough estimate of the rate of growth in *T. niloticus*, a single index or constant based on observations for all sizes of shell was deemed sufficient.

[2] Russel (*loc. cit.*, p. 243) observed similar variations in the rate of growth of *Patella vulgata* on the British coasts, and Moorhouse (*loc. cit.*, p. 153, 1932) in that of *Trochus niloticus* on the Queensland coast.

success in the study of growth in certain Lamellibranchs. The oblique lines of growth were found usually on the membranous organic periostracal layer, but in some shells they extended down to the pearly layer (pl. XIV, fig. 3). Closer examination of a large series of shells above 7 cms. in diameter revealed the fact that the lines of growth were spaced irregularly and clearly discernible only on the last two whorls of the shell and that in young shells with a diameter of 5 cms. and below, they were either absent, or, if present, not so clearly seen as in adult shells.[1] The lines of growth, each representing what was at one time the growing edge of the shell, seen on shells of *Trochus niloticus* of 7-10 cms. diameter are at varying distances from one another, but usually under 1 cm. along the periphery of the whorls. In fresh shells in which the periostracal layer is intact there are minute but distinct breaks at intervals in the continuity of this layer indicating the positions in which growth has been interrupted. Along these oblique lines, the periostracal layer is also slightly turned up. There are usually 12-14 lines on the last whorl of shells of the 7 cm. group, and more than 20 lines on that of shells of the 10 cm. group. It is fairly obvious from the results of the study of growth in this species by other methods, that a single line does not represent a break or interruption in growth once a year, that is to say, that the lines do not correspond to the annual rings observed on the shells of Lamellibranchs, and on the scales and otoliths of Fish in temperate waters where the physical conditions of growth during winter are such as to stop growth for a period. The lines on the shell of *T niloticus* may represent rhythmic or periodic interruptions in growth, oftener than once a year correlated with an internal rhythm characteristic of the species, with the phases of the moon or with other factors little understood at present. The value of the annual ring method in estimating the age of various Molluscs is discussed by Weymouth (1923), who shows that there is no unamity on the part of workers in regard to the reliability of the method. So far as *T niloticus* is concerned the study of the rate of growth and of age by using the lines of growth on the shell as the criterion does not seem to give satisfactory results. The attempt, therefore, to study the rate of growth in the shell with the oblique lines of growth present on the whorls as the criterion, was given up.

A fresh set of observations was commenced in February 1934 to study the rate of growth of the shell with its maximum diameter as the criterion for growth. 77 specimens of various sizes from 3 to 9 cms. in diameter collected in the vicinity of South Corbyn's Cove, Port Blair, and in North Andamans, were serially numbered with Indian ink on the periostracum of the base of the body whorl and on the surface of the mouth and the umbilicus. After recording the diameter of each of the numbered shells, they were left in the crevices between coral masses covered with growths of algae in the area immediately north of the pier bearing the South Point Navigation Light, Port Blair (pl. XIV, fig. 2). The area was more or less protected from wind and currents by Ross I. on the east and by the solid rocky pier on the south ; and the

[1] In adult shells over 10·0 cms. in diameter, the lines of growth were frequently masked by algae, and animals such as limpets, barnacles, worms and boring molluscs, and in scraping these off the periostracal layer bearing the lines of growth could not be preserved.

sandy bay on the west and north prevented the migration of individuals in these two directions. Once or twice a month the area was visited at favourable low-tide periods, and as many numbered shells as could be recovered from under the stones and rocks before the rise of the tide were collected, and their diameter recorded. It was sometimes found necessary to re-write the numbers on some shells as the ink-marks were rubbed off by the mechanical action of the rough surfaces of rocks and boulders coming into contact with the lower surface of the last whorl of the shell of the animals in the course of their migrations. Foreign organisms such as algae, worms, molluscs, barnacles, etc., which attach themselves to the surface of the whorls of the spire in a very short time prevented the marking of shells on the whorls. The numbers marked in Indain ink on the nacreous surface of the mouth and the umbilicus of the shell were, however, often preserved permanently by a thin layer of nacre covering the original surface on which the ink-marks had been made at the commencement of the observations. Owing to the thinness and transparency of the overlying nacre, however, the marks were quite visible. In young shells where growth was rapid the marks on the mouth of the shell were hidden from view by the growing last whorl, and the numbers had to be re-written from time to time on the nacreous layer of the fresh growing parts of the mouth of the shell. To make up for the loss of experimental individuals due to migration into deeper waters, to death, or to other causes, fresh individuals obtained from other localities and numbered serially with the original lot of 77 shells were added from time to time. Thus at the conclusion of the growth observations in July 1935 the total number of shells marked for the experiment had increased from 77 to 635. On different visits to the area at intervals of 2 weeks to one month, the percentage number of marked shells recovered from under the rocks and boulders between tide-marks varied from as low a figure as 5 to 45. A large number of shells which was never recovered may have migrated into deeper waters or fallen a prey to their natural enemies. Some were found almost every month, while others were found at intervals varying from one to five months. When shells were found after a period of 4 or 5 months the ink-marks, except where protected by a thin layer of nacreous deposit, were undecipherable, and the shells could not be used again in the experiment unless they were regarded as fresh individuals and marked with new numbers. A continuous record of growth in the shell was obtained in the case of only 2 or 3 individuals.

With the closing of the *Trochus* Fishery investigations in July 1935 under orders of the Government, the growth observations were also stopped. A thorough search on the reefs near South Point, Port Blair, between tide-marks, and at depths upto 3 to 4 fathoms with the assistance of professional divers was made for the numbered shells, and as many of them as could be collected on the days of search were brought ashore. After recording the maximum diameter of the shells obtained each of them was broken open and the contents of the gonads examined to determine the sex. In doubtful cases where the sex elements were not fully developed, the gonads were suitably preserved and later sectioned for microscopic examination.

A careful study of the data[1] thus collected seemed to confirm what has been stated in a previous paragraph (*vide* p. 476), that the rate of growth in the shell bears a definite relation to the age of the specimen which may be expressed in terms of the maximum diameter of the shell. At what stages in the life-period of the species the rate of growth changes cannot be determined satisfactorily, but for purposes of this study it may be assumed that the rate of growth falls when an individual passes from one size-category to the next higher, whatever the length of the period intervening between the two consecutive stages. Thus two shells 2·99 cms. and 2·74 cms. in diameter respectively (falling within the group 2·00 cms.—2·99 cms.) which pass to the next higher stage, *e.g.*, 3·23 cms. and 3·27 cms. respectively (within the group 3·00 cms.—3·99 cms.) in approximately $\frac{1}{2}$ to $1\frac{1}{2}$ months respectively, will have their rate of growth lowered when passing from the lower size-category to the next higher.

Growth in marine animals is governed by various physical, chemical and biological conditions in their environment. A study of the habits of *Trochus niloticus* has shown that it feeds almost exclusively on marine algae and bottom deposits.[2] The growth of marine algae of the littoral zone is in turn governed by several factors such as light, the salinity of water, the nature of the bottom, strength of currents, etc., but amongst these light is known to be the most important factor. In the Andamans and Nicobars with a heavy annual rainfall distributed over the two monsoons of nearly 7 months' duration the amount of sunlight received, and the quantities of freshwater drained into the sea from tho adjoining steep hill-sides are apt to vary and influence the growth of algae in the littoral zone. It was, therefore, thought that, in studying the growth of this species, it would be of value to take into consideration the influence of the seasons, as with the abundant growth of algae during the sunny months the increased availability of food may enhance the chances of growth of the individuals of the species.[3] The mean monthly figures for cloud amount, rainfall, and number of rainy days for Port Blair and for Indian Standard Time, given in the monthly weather reports of the Indian Meteorological Department for 1935, provided convenient criteria for dividing a year into two seasons, namely, the period of heavy rainfall from May to November, and the period of a comparatively scanty rainfall and of bright sunshine from December to April. The latter season is also the more favourable from the point of view of the divers for whom visibility of the bottom is one of the prime factors for success in their operations.

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[1] Although the records of measurements of 510 numbered shells over a period of growth of 18 months were available, the number of shells recovered at the conclusion of the study, the sex of which was known, was only 119. But as each of these 119 specimens had passed through 2 to 4 stages or categories of shell-size (*vide* Table III) in the course of growth, there were actually 301 readings of the rates of growth for analytical study.

[2] The habits of *Trochus niloticus* are dealt with more fully in another paper to be published in this journal shortly.

[3] Orr, A. P. (*Sci. Rep. Great Barrier Reef Exped.* 1928-29, II, No. 3, pp. 37-86, 1933), comparing the results of his hydrographical investigations in the seas in the neighbourhood of the Great Barrier Reef with those of other parts of the tropics, came to the conclusion that there is a considerable uniformity in the physical and chemical conditions of tropical seas, and that seasonal variations, if any, are negligible.

In assigning each of the 301 examples of various sizes and of both sexes under observation to its appropriate season, a certain degree of overlapping of the period of growth over the two consecutive seasons has been inevitable (see Table III). For instance, a shell of 9·32 cms. diameter numbered in the month of August and left for growth in the experimental area which passed on to the 10 cm. size group in about 12 months will have its growth period distributed over both the seasons, and as, in this case, the greater part of the growth period was in the rainy season, from August to November and again from May to July, it was assigned to the season of heavy rainfall from May to November.

The monthly rate of growth of a shell was calculated by dividing the difference in diameter between two consecutive growth stages by the total period in fractions of months in which growth between these stages was completed.[1] The data of monthly rate of growth thus calculated in respect of the growth stages of all the numbered shells (see Tables IV and V) were statistically analysed to determine the influence of each of the factors of age, sex, and season on growth. The results of this study by Dr. K. C. K. E. Raja and myself which are embodied in a separate note following this paper indicate that while the mean rates of growth vary inversely with age, and the female grows faster than the male, the seasons do not seem to have a significant influence on growth. The present investigation seems to bear out Orr's (1933) conclusions that seasonal variations in the tropical seas are negligible.

The mean rates of growth of *Trochus niloticus* of both sexes as derived from statistical analyses are given below, but they pertain, however, to the six age-groups, 4·00–4·99 cms. to 9·00—9·99 cms. only, the growth data obtained for the smaller (below 4·00 cms.) and the larger (above 10·00 cms.) size- or age-groups being inadequate for purposes of statistical analysis.

Mean monthly rates of growth of Trochus niloticus.

Size- or Age-groups. (Max. diam. in cms.)	Males.		Females.	
	Dec.-Apr.	May-Nov.	Dec.-Apr.	May-Nov.
4—4·99	0·3155	0·3205	0·3342	0·3362
5—5·99	0·3079	0·3044	0·3122	0·3539
6—6·99	0·2609	0·2824	0·2694	0·2934
7—7·99	0·2053	0·2140	0·2329	0·2129
8—8·99	0·1331	0·1460	0·1485	0·1592
9—9·99	0·0916	0·0900	0·1072	0·0945

Another problem to which a solution has been sought in the course of this study is that of the age up to which the species lives in the Andaman waters. The exact period[2] and frequency of breeding, the dura-

[1] Moorhouse (*Rep. Great Barrier Reef Committee*, IV, pt. i, p. 26, 1933) calculated the yearly rate of growth of two individuals of *T. niloticus* which had been found after 2½ years from the date of the commencement of his study. One had passed from the 5·0 cm. stage to the 9·0 cm. stage and the other from the 4·0 cm. stage to the 10·0 cm. stage, skipping over 4 and 6 growth stages respectively. He did not apparently take into consideration the difference in the rates of growth between the successive stages within that period.

[2] Amirthalingam (1932) concluded from his observations that *Trochus niloticus* begins to spawn in the Andamans in April, while Moorhouse (1932) observed the same species in Low Isles spawning from March to July.

tion of development of the egg after fertilisation,[1] the length of larval life, the rate of growth of the very young animal between the close of larval life and the stage at which it reaches a diameter of 2 cms., and lastly the rate of growth of shell between the 11 and 14 cm. size-groups[2] would provide the requisite additional data to estimate the longevity of the species. But as the early and late history of its life is not fully known, a very approximate estimate alone is possible.

In the following table are given the average monthly rates of growth of shells of all sizes from 2·0 to 11·99 cms. in diameter irrespective of sex :—

Size- or Age-group.	No. of shells from which the average was derived.	Average monthly rates of growth in cms.[3]
2—2·99	19	0·39
3—3·99	61	0·33
4—4·99	43	0·33
5—5·99	57	0·32
6—6·99	61	0·28
7—7·99	61	0·22
8—8·99	40	0·15
9—9·99	19	0·10
10—10·99	18	0·06
11—11·99	7	0·04

Starting for example, with a shell of 2·0 cms. diameter, and applying the data given above in regard to growth, it would be easy to estimate the approximate period in which the shell will pass through each of the successive higher categories of sizes to the last 11 cm. age-group.

The 2 cms. shell will grow to (2+0·39×3) 3·17 cms. in 3 months.

The 3·17 cms. shell will grow to (3·17+0·33×3) 4·16 cms. in 3 months.

The 4·16 cms. shell will grow to (4·16+0·33×3) 5·15 cms. in 3 months.

The 5·15 cms. shell will grow to (5·15+0·32×3) 6·11 cms. in 3 months.

The 6·11 cms. shell will grow to (6·11+0·28×4) 7·23 cms. in 4 months.

The 7·23 cms. shell will grow to (7·23+0·22×4) 8·11 cms. in 4 months.

The 8·11 cms. shell will grow to (8·11+0·15×6) 9·01 cms. in 6 months.

The 9·01 cms. shell will grow to (9·01+0·10×10) 10·01 cms. in 10 months.

[1] Moorhouse (1932, p. 154) observed the first division of the fertilised egg in 4 hours, and ciliated embryos in 20 hours after fertilisation.

[2] Although large shells exceeding 12 cms. in diameter are very rare, a few of 14 cms. diameter have occasionally been fished in the Andaman and Nicobar seas.

[3] The mean rates of growth for the 2 and 3 cm., and 10 and 11 cm. categories of size of shell have been calculated from the available data on growth which were considered inadequate for statistical study.

The 10·01 cms. shell will grow to (10·01+0·06×17) 11·03 cms. in 17 months.

The 11·03 cms. shell will grow to (11·03+0·04×25) 12·03 cms. in 25 months.

The 2 cms. shell will therefore reach the 11—11·99 cms. stage in 78 months or 6½ years. Owing to the inadequacy of laboratory and aquarium facilities at Port Blair, it was not possible to study the growth of the shell below 2 cms. diameter under controlled conditions. Previous work by European authors on the smaller species of *Trochus* in temperate seas shows that the rate of growth in the early stages is subject to considerable variation. Robert (1903) showed that in the case of certain European species of *Trochus*, such as *T magus*, *T conuloides*, and *T striatus*, the veliger stage is reached in about 18 hours to one day, and found that the period of hatching from the eggs varied a great deal, from one day to about a week. He also observed that the young of *T magus*, developed in aquaria from eggs deposited on 24th June 1898, had attained a diameter of 2 cms. at the end of September of the following year. Pelseneer (1934) observed that in *T umbilicalis* the development of the egg takes place in 2 hours after fertilisation, and the 1·0 cm. stage is reached in 6 months. In regard to *Trochus niloticus* the rate of growth of the shell prior to the 2 cms. stage can only be guessed approximately from the results obtained for the higher age-groups between the 2·0 and 5·0 cms. stages. Allowing a period of about 2 or 3 months for the stages intervening between the shedding of the eggs and their fertilisation, and their subsequent development and growth up to 2 cms. in diameter, and a period of about 4 years for the stages intervening between the 12·0 and 14·0 cms. categories, the approximate longevity of the species under normal conditions of growth would exceed 10 years. Therefore a shell in its first year of growth will have a diameter up to 5·0 cms., in its second year a diameter ranging from 5·0 to 8·0 cms., in its third year a diameter ranging from 8·0 to 10·0 cms., in its fourth and fifth years a diameter ranging from 10·0 to 11·0 cms., in its sixth and seventh years a diameter ranging from 11·0 to 12·0 cms., and in its eight to eleventh years a diameter ranging from 12·0 to 14·0 cms. Pelseneer (1933) on the authority of Yonge (1930)[1] stated that *T niloticus* lives for 4 years, while his own observations on *T umbilicalis* led him to the conclusion that the latter species lives for about 5 years. Yonge's estimate was presumably based on the rate of growth studies by Moorhouse (*loc. cit.*) in the Low Isles of the Great Barrier Reef. The great disparity between Yonge's estimate and mine may be due to the differences in the environmental conditions in the Great Barrier Reef and in the Andaman seas which, presumably, influence the rate of growth. Moorhouse observed that in the Low Isles females of *Trochus niloticus* with shell-diameter between 4·0 and 8·0 cms. were laying eggs, and that conditions for normal growth were not favourable in some parts of the islands. Shells of diameter below 6·0 cms. observed to lay eggs were regarded by him as instances of retarded growth. In the Andamans, however, sexual maturity in females was, as a rule, observed

[1] This reference was not available to me in Calcutta.

in individuals with shell-diameter exceeding 9·0 cms., and although no actual instance of egg-laying was observed, only shells above 10 cms. diameter were often known to have eggs in the genital passages ready to be discharged.[1] Under these circumstances, it seems probable that the conditions for growth in the two regions, *e.g.*, the Queensland coast and the coasts around the Andamans are not similar. The difference in the estimates of longevity of the same species under, presumably, different conditions is, therefore, to be expected.

In conclusion, I take this opportunity to offer my sincere thanks to Mr. K. S. Misra who gave me ungrudging assistance throughout the period of this investigation in collecting and arranging the data of growth, and to my friend, Dr. K. C. K. E. Raja of the All-India Institute of Hygiene, Calcutta, for readily agreeing to analyse the results of my study from the statistical point of view.

Summary.

1. The paucity of literature on the rate of growth in the Gastropoda is referred to.
2. The methods adopted in the study of the rate of growth in *Trochus niloticus* Linn. with the length of the whorls and the maximum diameter of the shell as the criteria for growth are described.
3. The relationship between growth in diameter and growth along the whorls of the shell expressed by a formula which suggested itself in the course of this study is explained.
4. The approximate agreement in the results obtained by the methods referred to in (2) above is pointed out.
5. A third method of studying growth in this species, using the lines of growth occurring on the lower whorls of the shell as the measure of the rate of growth, proved to be unsatisfactory because of the irregularity in their occurrence on the various whorls of the shell, and of the lines not representing any known seasonal interruption in growth.
6. From the records of the maximum diameter of individual shells, male and female, at each stage of their growth, and from the records of the season in which growth has taken place between each set of consecutive stages, the monthly rate of growth is derived. The monthly rates of growth thus obtained are statistically analysed.
7. The rate of growth of the shell varies inversely with age as determined by the maximum diameter of the shell between certain stages, and the female grows faster than the male, but seasons do not seem to have a significant influence on growth.
8. The longevity of *T niloticus* in the Andaman seas, estimated from the monthly rates of growth at each stage, and from other known facts of its life-history, appears to exceed 10 years. A shell in its first year of growth will have a diameter upto 5·0 cms., in its

[1] In another paper on the habits of *Trochus niloticus* which is to be published shortly, the sexual maturity of the gonads at various ages is fully discussed.

second year a diameter ranging from 5·0 to 8·0 cms., in its third year a diameter ranging from 8·0 to 10·0 cms., in its fourth and fifth years a diameter ranging from 10·0 to 11·0 cms., in its sixth and seventh years a diameter ranging from 11·0 to 12·0 cms., in its eighth to eleventh year a diameter ranging from 12·0 to 14·0 cms.

9. The variability in the rate of growth of various species of the Trochidæ is inferred from the existing works on the subject by other authors.
10. The noticeable variance in the estimates of longevity of *T niloticus* on the Queensland Coast of Australia and on the coasts of the Andamans in the Bay of Bengal is attributed to the difference in the conditions of growth in the two seas.

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TABLE I.

DATA OF GROWTH IN *Trochus niloticus* OF 27TH FEBRUARY, 1933, MEASURED IN TERMS OF THE LENGTH OF THE WHORLS, BUT CONVERTED TO REFER TO THE MAXIMUM DIAMETER OF THE SHELL.

(*Measurements in Centimetres.*)

Months in which growth readings were taken.	Original diameter calculated with the help of formula.	Present diameter.	Actual growth in diameter.	Monthly rate of growth.
August 1934	8·31	11·42	3·11	0·172
September ,,	8·31	11·42	3·11	0·166
October ,,	8·22	11·44	3·22	0·161
November ,,	8·22	11·44	3·22	0·158
December ,,	8·21	11·50	3·29	0·154
January 1935	8·32	11·54	3·22	0·144
February ,,	8·17	11·60	3·43	0·147
March ,,	8·17	11·60	3·43	0·143
April 1933	7·55	7·94	0·39	0·212
June ,,	7·24	8·30	1·06	0·318
August ,,	7·27	8·88	1·61	0·301
October ,,	7·37	9·48	2·11	0·275
November ,,	7·07	9·09	2·02	0·233
December ,,	7·36	9·71	2·35	0·243
February 1934	7·13	9·80	2·67	0·232
March ,,	7·14	9·87	2·73	0·216
April ,,	7·18	10·07	2·89	0·214
May ,,	7·17	10·00	2·82	0·192
June ,,	7·09	10·43	3·34	0·208
July ,,	7·11	10·57	3·46	0·207
August ,,	7·11	10·44	3·33	0·186
September ,,	7·28	10·86	3·58	0·191
October ,,	7·16	10·85	3·69	0·188
November ,,	7·26	11·00	3·74	0·184
December ,,	7·16	11·05	3·89	0·182

TABLE I—*contd.*

Months in which growth readings were taken.	Original diameter calculated with the help of formula.	Present diameter.	Actual growth in diameter.	Monthly rate of growth.
January 1935	7·85	10·84	2·99	0·133
April „	7·92	11·55	3·63	0·143
May „	7·98	11·67	3·69	0·140
June „	7·94	11·80	3·86	0·138
April 1933	6·54	7·06	0·52	0·285
June „	6·36	7·59	1·23	0·368
August „	6·41	8·13	1·72	0·324
September „	6·60	8·44	1·84	0·293
October „	6·51	8·53	2·02	0·269
November „	6·40	8·97	2·57	0·321
December „	6·49	8·75	2·26	0·223
January 1934	6·45	9·28	2·83	0·296
March „	6·58	9·44	2·86	0·224
April „	6·63	9·29	2·66	0·196
May „	6·58	9·66	3·08	0·207
June „	6·72	9·93	3·21	0·200
July „	6·55	10·01	3·46	0·205
August „	6·65	10·03	3·38	0·189
September „	6·56	10·08	3·52	0·187
October „	6·44	10·13	3·69	0·186
November „	6·49	10·23	3·74	0·183
December „	6·62	10·38	3·76	0·175
January 1935	6·70	10·18	3·48	0·155
February „	6·41	10·35	3·93	0·168
March „	6·49	10·54	4·05	0·168
April „	6·48	10·62	4·14	0·163
May „	6·32	10·67	4·35	0·165
June „	6·25	10·68	4·43	0·159

Table I—*contd.*

Months in which growth readings were taken.	Original diameter calculated with the help of formula.	Present diameter.	Actual growth in diameter.	Monthly rate of rowth.
April 1933	5·58	6·10	0·52	0·284
June „	5·68	6·80	1·12	0·336
August „	5·23	7·07	1·84	0·345
November „	5·40	6·88	1·48	0·170
December „	5·50	7·14	1·64	0·169
January 1934	5·42	7·49	2·07	0·195
June „	5·99	9·39	3·40	0·212
September „	5·99	9·71	3·72	0·202
December „	5·97	10·00	4·03	0·188
February 1935	5·97	10·29	4·32	0·185
April 1933	4·59	5·10	0·51	0·280
June „	4·40	5·51	1·11	0·333
August „	4·73	6·39	1·66	0·310

TABLE II.

Data of Growth in *Trochus niloticus* of 20th October, 1933, measured in terms of the length of the Whorls, but converted to refer to the maximum diameter of the Shell.

(*Measurements in Centimetres.*)

Months in which growth readings were taken.	Original diameter calculated with the help of formula.	Present diameter.	Actual growth in diameter.	Monthly rate of growth.
November 1933	9·40	9·52	0·12	0·120
January 1934	9·61	9·96	0·35	0·123
November 1933	8·72	8·90	0·18	0·180
December „	8·78	9·04	0·26	0·130
January 1934	8·65	9·23	0·58	0·204

TABLE II—*contd.*

Months in which growth readings were taken.	Original diameter calculated with the help of formula.	Present diameter.	Actual growth in diameter.	Monthly rate of growth.
March 1934	8·64	9·51	0·87	0·180
April „	8·62	9·60	0·98	0·168
May „	8·51	9·80	1·29	0·176
August „	8·57	10·10	1·53	0·150
September „	8·55	10·17	1·62	0·144
October „	8·57	10·27	1·70	0·139
November „	8·55	10·28	1·73	0·137
December „ .	8·48	10·33	1·85	0·136
January 1935 .	8·44	10·38	1·94	0·132
February „	8·56	10·46	1·90	0·121
December 1933	7·16	7·74	0·58	0·292
April 1934	7·14	9·10	1·96	0·336
November 1933	6·62	6·90	0·28	0·285
December „	6·37	6·99	0·62	0·310
February 1934 .	6·12	7·40	1·28	0·365

TABLE III.

Table showing the history of growth of the numbered shells of *Trochus niloticus* between February 1934 and July 1935.

Mark or No. of shell of *Trochus*.	Maximum diameter in cms. of the shell at each stage of its growth.	Months in which the original and final measurements were taken.	Total period of growth in fractions of months.	Total growth in maximum diameter in cms. in this period.	Monthly rate of growth in cms.	Sex of individuals.
218	2·90	Aug.-Sept.	$1\frac{1}{3}$	0·57	0·427	♀
	3·47	Sept.-Jan.	$4\frac{1}{3}$	1·22	0·281	
	4·69	Jan.-May	4	1·19	0·297	
	5·88	May-July	$2\frac{1}{2}$	0·82	0·328	
290	2·88	Oct.-Nov.	$1\frac{1}{2}$	1·07	0·713	♂
	3·95	Nov.-Feb.	3	0·80	0·266	
	4·75	Feb.-May	$2\frac{2}{5}$	0·75	0·312	
	5·50	May-June	$1\frac{5}{6}$	0·61	0·332	

TABLE III—*contd.*

Mark or No. of shell of *Trochus.*	Maximum diameter in cms. of the shell at each stage of its growth.	Months in which the original and final measurements were taken.	Total period of growth in fractions of months.	Total growth in maximum diameter in cms. in this period.	Monthly rate of growth in cms.	Sex of individuals.
310	3·78	Oct.-Jan.	3½	1·18	0·337	♀
	4·96	Jan.-April	2⅖	0·96	0·400	
	5·92	April-June	2	0·74	0·370	
	6·66	June	1	0·40	0·400	
318	3·95	Oct.-Feb.	3⅜	0·90	0·250	♂
	4·85	Feb.-May	3	1·01	0·336	
	5·86	May-June	2	0·53	0·265	
7A	3·26	Nov.-Feb.	3	1·08	0·360	♀
	4·34	Feb.-June	4⅓	1·39	0·320	
13A	3·50	Nov.-Mar.	3½	1·37	0·391	♀
	4·87	Mar.-July	4	1·03	0·257	
16A	3·30	Nov.-May	5⅖	1·61	0·298	♀
	4·91	May-June	1⅚	0·77	0·420	
19A	3·10	Nov.-May	5⅖	1·62	0·300	♂
	4·72	May-June	1⅚	0·65	0·354	
35A	3·99	Dec.-Mar.	3	0·85	0·283	♀
	4·84	Mar.-May	2	0·58	0·290	
	5·42	May-July	2	0·79	0·395	
36A	3·40	Dec.-April	4	1·30	0·325	♀
	4·70	April-May	1	0·47	0·470	
	5·17	May-July	2½	0·93	0·372	
38A	3·64	Dec.-Apr.	4	1·26	0·315	♀
	4·90	Apr.-June	2	0·74	0·370	
	5·64	June	⅚	0·60	0·720	
39A	3·23	Dec.-Apr.	4	1·61	0·402	♀
	4·84	Apr.-June	2⅔	1·04	0·390	
56A	3·84	Dec.-June	5⅓	1·09	0·204	♂
	4·93	June	⅚	0·29	0·348	
61A	3·88	Dec.-Apr.	3⅓	1·02	0·306	♀
	4·90	Apr.-June	2⅔	0·88	0·330	
62A	3·93	Dec.-Feb.	1⅔	0·39	0·278	♀
	4·32	Feb.-June	4	1·65	0·412	
	5·97	June	⅚	0·26	0·312	
68A	3·54	Jan.-Apr.	3	0·93	0·310	♀
	4·47	Apr.-July	3	1·39	0·463	
85A	3·63	Jan.-May	3⅔	1·22	0·365	♀
	4·85	May-June	1⅚	0·52	0·283	
4	4·86	Feb.-May	3½	1·15	0·328	♂
	6·01	May-Jan.	7⅓	1·81	0·246	
	7·82	Jan.-June	5⅘	1·06	0·182	

TABLE III—*contd.*

Mark or No. of shell of *Trochus.*	Maximum diameter in cms. of the shell at each stage of its growth.	Months in which the original and final measurements were taken.	Total period of growth in fractions of months.	Total growth in maximum diameter in cms. in this period.	Monthly rate of growth in cms.	Sex of individuals.
125	4·70	May-Sept.	3½	1·20	0·343	♀
	5·90	Sept.-Dec.	3	1·02	0·340	
	6·92	Dec.-Mar.	3	0·92	0·306	
	7·84	Mar.-June	3⅔	1·00	0·272	
144	4·86	June-Sept.	3½	1·11	0·317	♀
	5·97	Sept.-Dec.	3	0·96	0·320	
	6·93	Dec.-Mar.	2⅓	0·80	0·343	
	7·73	Mar.-July	4½	0·96	0·213	
147	4·72	June-Oct.	3⅖	1·16	0·341	♂
	5·88	Oct.-Jan.	3	0·99	0·330	
	6·87	Jan.-May	4	1·10	0·275	
	7·97	May-July	2½	0·52	0·208	
180	4·72	July-Nov.	4	1·10	0·275	♂
	5·82	Nov.-Feb.	2½	0·82	0·328	
	6·64	Feb.-June	4	1·08	0·270	
	7·72	June-July	1½	0·36	0·240	
183	4·41	July-Jan.	5½	1·54	0·280	♀
	5·95	Jan.-Apr.	3	0·86	0·286	
	6·81	Apr.-July	3	1·04	0·346	
184	4·51	July-Jan.	5½	1·40	0·254	♀
	5·91	Jan.-May	4	1·04	0·260	
	6·95	May-June	2	0·43	0·215	
186	4·74	July-Nov.	3½	1·03	0·294	♂
	5·77	Nov.-Feb.	3	1·00	0·333	
	6·77	Feb.-June	4⅚	1·17	0·242	
200	4·99	July-Oct.	2½	0·91	0·364	♀
	5·90	Oct.-Jan.	3	1·04	0·346	
	6·94	Jan.-June	5⅗	1·69	0·301	
203	4·90	July-Nov.	3⅖	1·06	0·311	♂
	5·96	Nov.-Feb.	3	0·79	0·263	
	6·75	Feb.-June	4	1·06	0·265	
	7·81	June-July	1½	0·39	0·260	
246	4·13	Sept.-Mar.	6	1·74	0·290	♀
	5·87	Mar.-June	3	1·06	0·353	
	6·93	June-July	1	0·33	0·330	
291	4·21	Oct.-Apr.	6	1·77	0·295	♂
	5·98	Apr.-July	3	0·99	0·330	
248	4·96	Sept.-Dec.	3⅗	0·98	0·272	♀
	5·94	Dec.-June	5⅓	1·84	0·345	
	7·78	June	1	0·24	0·240	
311	4·25	Oct.-Mar.	4⅚	1·69	0·349	♀
	5·94	Mar.-Apr.	1	0·34	0·340	
	6·28	Apr.-July	3½	1·21	0·345	

TABLE III—*contd.*

Mark or No. of shell of *Trochus.*	Maximum diameter in cms. of the shell at each stage of its growth.	Months in which the original and final measurements were taken.	Total period of growth in fractions of months.	Total growth in maximum diameter in cms. in this period.	Monthly rate of growth in cms.	Sex of individuals.
316	4·50	Oct.-Mar.	$4\frac{4}{5}$	1·34	0·279	♂
	5·84	Mar.-June	3	1·03	0·343	
	6·87	June-July	$1\frac{1}{2}$	0·46	0·306	
346	4·52	Nov.-Mar.	$3\frac{1}{2}$	1·13	0·323	♀
	5·65	Mar.-May	2	0·84	0·420	
	6·49	May-June	2	0·75	0·375	
350	4·34	Nov.-Apr.	$4\frac{1}{2}$	1·54	0·342	♂
	5·88	Apr.-July	3	1·10	0·366	
352	4·11	Nov.-Apr.	$4\frac{1}{2}$	1·49	0·331	♀
	5·60	Apr.-June	$2\frac{5}{6}$	1·16	0·409	
378	4·64	Dec.-Apr.	$3\frac{1}{3}$	0·96	0·288	♂
	5·60	Apr.-July	$2\frac{5}{6}$	1·05	0·370	
379	4·75	Dec.-Apr.	$3\frac{1}{3}$	1·03	0·309	♂
	5·78	Apr.-July	$3\frac{1}{2}$	1·18	0·337	
393	4·63	Jan.-May	$3\frac{1}{3}$	0·92	0·276	♀
	5·55	May-June	$1\frac{5}{6}$	0·62	0·356	
383	4·57	Jan.-Apr.	3	0·92	0·306	♂
	5·49	Apr.-July	3	0·66	0·220	
407	4·57	Feb.-May	$2\frac{5}{6}$	0·90	0·317	♀
	5·47	May-July	$2\frac{1}{2}$	0·91	0·364	
40A	4·70	Dec.-Feb.	$2\frac{1}{2}$	0·85	0·340	♀
	5·55	Feb.-May	$2\frac{2}{5}$	0·97	0·404	
	6·52	May-July	$2\frac{1}{2}$	0·81	0·324	
42A	4·41	Dec.-Mar.	3	1·08	0·360	♂
	5·49	Mar.-June	3	1·11	0·370	
	6·60	June-July	$1\frac{1}{2}$	0·57	0·380	
95A	4·20	Feb.-June	4	1·60	0·400	♀
	5·80	June-July	$1\frac{1}{2}$	0·41	0·273	
58	5·57	Feb.-Aug.	$5\frac{5}{6}$	1·32	0·226	♂
	6·89	Aug.-Dec.	$3\frac{5}{6}$	0·97	0·253	
	7·86	Dec.-June	$6\frac{1}{3}$	1·02	0·157	
65	5·91	Feb.-May	$2\frac{4}{5}$	0·74	0·264	♀
	6·65	May-Sept.	$4\frac{1}{2}$	1·20	0·266	
	7·85	Sept.-Jan.	$2\frac{2}{5}$	1·01	0·297	
	8·86	Jan.-June	$5\frac{2}{5}$	0·85	0·151	
127	5·55	May-Oct.	$4\frac{2}{5}$	1·31	0·297	♀
	6·86	Oct.-Feb.	4	0·93	0·232	
	7·79	Feb.-July	$5\frac{2}{5}$	0·82	0·152	
129	5·60	May-Nov.	$5\frac{1}{3}$	1·29	0·242	♂
	6·89	Nov.-June	$7\frac{4}{5}$	1·01	0·129	

TABLE III—*contd.*

Mark or No. of shell of *Trochus*.	Maximum diameter in cms. of the shell at each stage of its growth.	Months in which the original and final measurements were taken.	Total period of growth in fractions of months.	Total growth in maximum diameter in cms. in this period.	Monthly rate of growth in cms.	Sex of individuals.
135	5·10	June-Nov.	$5\frac{2}{3}$	1·89	0·333	♀
	6·99	Nov.-Feb.	$2\frac{1}{2}$	0·70	0·280	
	7·69	Feb.-June	$4\frac{3}{5}$	1·01	0·220	
139	5·48	June-Oct.	$4\frac{5}{6}$	1·44	0·298	♂
	6·92	Oct.-Feb.	$3\frac{2}{5}$	0·93	0·273	
	7·85	Feb.-July	5	1·12	0·224	
140	5·15	June-Nov.	$5\frac{2}{3}$	1·67	0·294	♂
	6·82	Nov.-Mar.	$3\frac{1}{2}$	0·93	0·265	
	7·75	Mar.-June	$3\frac{2}{3}$	0·71	0·193	
143	5·11	June-Dec.	6	1·73	0·288	♂
	6·84	Dec.-Apr.	4	1·07	0·267	
	7·91	Apr.-July	$3\frac{1}{2}$	0·65	0·185	
169	5·72	July-Nov.	$4\frac{1}{3}$	1·22	0·281	♀
	6·94	Nov.-Apr.	$4\frac{1}{2}$	0·98	0·217	
	7·92	Apr.-July	3	0·49	0·163	
174	5·65	July-Nov.	$4\frac{1}{3}$	1·12	0·281	♀
	6·77	Nov.-Feb.	$2\frac{1}{2}$	0·58	0·232	
	7·35	Feb.-July.	$5\frac{2}{5}$	1·10	0·203	
178	5·43	July-Nov.	$4\frac{1}{3}$	1·51	0·348	♂
	6·94	Nov.-Feb.	$2\frac{1}{2}$	0·81	0·324	
	7·75	Feb.-July	5	1·19	0·238	
199	5·86	July-Nov.	$3\frac{2}{5}$	1·11	0·326	♀
	6·97	Nov.-Feb.	3	0·92	0·302	
	7·89	Feb.-June	$4\frac{5}{6}$	1·05	0·217	
220	5·22	Aug.-Mar.	$6\frac{1}{3}$	1·56	0·246	♂
	6·78	Mar.-June	$3\frac{2}{3}$	1·04	0·283	
221	5·11	Aug.-Jan.	5	1·83	0·366	♀
	6·94	Jan.-Apr.	$2\frac{2}{5}$	0·78	0·300	
	7·72	Apr.-June	$2\frac{2}{3}$	0·76	0·285	
254	5·48	Sept.-Jan.	4	1·21	0·302	♂
	6·69	Jan.-May	4	1·16	0·290	
	7·85	May-June	$1\frac{2}{3}$	0·29	0·174	
256	5·81	Sept.-Jan.	4	1·16	0·290	♀
	6·97	Jan.-Apr.	3	0·96	0·320	
	7·93	Apr.-July	$3\frac{1}{2}$	0·97	0·277	
267	5·56	Sept.-Feb.	5	1·41	0·282	♂
	6·97	Feb.-May	$2\frac{2}{5}$	0·76	0·316	
	7·73	May-June	2	0·47	0·235	
275	5·41	Sept.-Mar.	$5\frac{1}{3}$	1·45	0·271	♂
	6·86	Mar.-June	$3\frac{2}{3}$	1·05	0·286	
308	5·12	Oct.-Apr.	$5\frac{5}{6}$	1·82	0·312	♂
	6·94	Apr.-June	2	0·75	0·375	
	7·69	June-July	$1\frac{1}{2}$	0·33	0·220	

TABLE III—*contd.*

Mark or No. of shell of *Trochus.*	Maximum diameter in cms. of the shell at each stage of its growth.	Months in which the original and final measurements were taken.	Total period of growth in fractions of months.	Total growth in maximum diameter in cms. in this period.	Monthly rate of growth in cms.	Sex of individuals.
314	5·93	Oct.-Jan.	3	0·93	0·310	♀
	6·86	Jan.-Apr.	3	0·92	0·306	
	7·78	Apr.-June	$2\frac{2}{3}$	0·75	0·281	
323	5·60	Oct.-Feb.	$3\frac{3}{5}$	1·12	0·311	♂
	6·72	Feb.-June	4	1·16	0·290	
	7·88	June-July	$1\frac{1}{2}$	0·40	0·266	
349	5·77	Nov.-May	$5\frac{1}{2}$	1·02	0·185	♀
	6·79	May-July	$2\frac{1}{2}$	0·69	0·276	
380	5·50	Dec.-Mar.	$2\frac{1}{3}$	0·80	0·342	♂
	6·30	Mar.-July	$4\frac{1}{2}$	1·63	0·362	
41A	5·37	Dec.-May	5	1·54	0·308	♀
	6·91	May-June	$1\frac{5}{6}$	0·56	0·305	
44	6·17	Feb.-Oct.	$8\frac{1}{3}$	1·81	0·217	♂
	7·98	Oct.-Jan.	$2\frac{2}{5}$	0·59	0·245	
	8·57	Jan.-June	$5\frac{3}{5}$	0·68	0·121	
136	6·15	June-Jan.	$7\frac{1}{3}$	1·61	0·219	♀
	7·76	Jan.-June	$5\frac{3}{5}$	1·13	0·201	
137	6·64	June-Oct.	$4\frac{5}{6}$	1·28	0·265	♂
	7·92	Oct.-Mar.	$4\frac{1}{3}$	1·02	0·235	
	8·94	Mar.-June	$3\frac{2}{3}$	0·52	0·142	
152	6·81	June-Nov.	$4\frac{2}{5}$	1·17	0·266	♀
	7·98	Nov.-Feb.	3	0·67	0·223	
	8·65	Feb.-June	$4\frac{3}{5}$	0·79	0·171	
157	6·37	June-Feb.	$7\frac{1}{3}$	1·52	0·207	♂
	7·89	Feb.-June	$4\frac{3}{5}$	0·80	0·174	
193	6·99	July-Nov.	$3\frac{5}{6}$	0·97	0·253	♀
	7·96	Nov.-Feb.	$2\frac{1}{2}$	0·78	0·312	
	8·74	Feb.-June	$4\frac{3}{5}$	0·64	0·139	
196	6·51	July-Jan.	$5\frac{2}{5}$	1·28	0·237	♀
	7·79	Jan.-June	5	1·08	0·216	
	8·87	June-July	1	0·17	0·170	
197	6·75	July-Dec.	$4\frac{2}{5}$	1·04	0·236	♂
	7·79	Dec.-June	$6\frac{3}{5}$	1·14	0·172	
222	6·13	Aug.-Apr.	$7\frac{1}{3}$	1·75	0·238	♂
	7·88	Apr.-June	$2\frac{2}{3}$	0·56	0·210	
224	6·60	Aug.-Mar.	$6\frac{1}{3}$	1·28	0·202	♂
	7·88	Mar.-June	$3\frac{2}{3}$	0·67	0·182	
198	6·75	July-Dec.	$4\frac{2}{5}$	1·20	0·272	♂
	7·95	Dec.-Apr.	4	0·90	0·225	
	8·85	Apr.-June	$2\frac{2}{3}$	0·24	0·090	

TABLE III—*contd.*

Mark or No. of shell of *Trochus*.	Maximum diameter in cms. of the shell at each stage of its growth.	Months in which the original and final measurements were taken.	Total period of growth in fractions of months.	Total growth in maximum diameter in cms. in this period.	Monthly rate of growth in cms.	Sex of individuals.
223	6·61	Aug.-Jan.	$4\frac{2}{5}$	1·31	0·297	♀
	7·92	Jan.-Apr.	3	0·96	0·320	
	8·88	Apr.-June	$2\frac{2}{3}$	0·62	0·232	
255	6·02	Sept-Apr.	6	1·86	0·272	♂
	7·88	Apr.-July	3	0·63	0·210	
250	6·80	Sept.-Apr.	7	1·14	0·162	♀
	7·94	Apr.-June	$2\frac{2}{3}$	0·45	0·168	
257	6·75	Sept.-Mar.	$5\frac{}{6}$	1·00	0·171	♀
	7·75	Mar.-June	$3\frac{2}{3}$	0·61	0·166	
272	6·75	Sept.-Feb.	$4\frac{1}{2}$	1·20	0·266	♀
	7·95	Feb.-July	5	0·80	0·160	
279	6·58	Sept.-Apr.	$6\frac{1}{3}$	1·40	0·221	♀
	7·98	Apr.-June	$2\frac{3}{5}$	0·41	0·153	
348	6·24	Nov.-Apr.	$4\frac{1}{2}$	1·52	0·337	♀
	7·76	Apr.-June	$2\frac{2}{3}$	0·72	0·270	
357	6·42	Dec.-June	$5\frac{1}{2}$	1·54	0·280	♀
	7·96	June	$\frac{2}{3}$	0·04	0·060	
68	7·02	Feb. 1934-Feb. 1935.	$11\frac{2}{3}$	1·96	0·168	♂
	8·98	Feb.-June	$4\frac{1}{2}$	0·21	0·046	
71	7·70	Feb.-Nov.	$9\frac{1}{6}$	1·28	0·139	♂
	8·98	Nov.-Feb.	$2\frac{1}{2}$	0·30	0·120	
	9·28	Feb.-July	$5\frac{2}{5}$	0·73	0·135	
86	7·74	Apr.-Sept.	5	0·99	0·198	♂
	8·73	Sept.-Apr.	$6\frac{}{6}$	1·19	0·174	
	9·92	Apr.-June	$2\frac{3}{5}$	0·14	0·054	
88	7·45	Apr.-Oct.	$6\frac{2}{5}$	1·51	0·236	♂
	8·96	Oct.-May	$6\frac{1}{3}$	0·98	0·154	
	9·94	May-June	$1\frac{3}{5}$	0·15	0·093	
172	7·32	July-Jan.	5^{5}	1·47	0·252	♀
	8·79	Jan.-July	6	0·76	0·126	
181	7·14	July-Mar.	$7\frac{2}{5}$	1·85	0·250	♀
	8·99	Mar.-July	4	0·55	0·137	
187	7·77	July-Feb.	$6\frac{2}{5}$	1·16	0·181	♀
	8·93	Feb.-June	$4\frac{3}{5}$	0·54	0·117	
116	7·74	May-Oct.	5	1·19	0·238	♀
	8·93	Oct.-Apr.	$5\frac{5}{6}$	1·01	0·173	
	9·94	Apr.-June	$2\frac{3}{5}$	0·20	0·077	
194	7·13	July-Apr.	$8\frac{1}{3}$	1·60	0·192	♂
	8·73	Apr.-June	$2\frac{3}{5}$	0·30	0·112	

TABLE III—*contd.*

Mark or No. of shell of *Trochus.*	Maximum diameter in cms. of the shell at each stage of its growth.	Months in which the original and final measurements were taken.	Total period of growth in fractions of months.	Total growth in maximum diameter in cms. in this period.	Monthly rate of growth in cms.	Sex of individuals.
226	7·82	Aug.-Mar.	$6\frac{1}{3}$	1·09	0·172	♀
	8·91	Mar.-June	$3\frac{2}{3}$	0·37	0·101	
228	7·49	Aug.-Feb.	$5\frac{2}{5}$	1·34	0·248	♂
	8·83	Feb.-June	$4\frac{5}{6}$	0·82	0·169	
230	7·79	Aug.-Mar.	$6\frac{1}{3}$	1·09	0·172	♂
	8·88	Mar.-July	$4\frac{1}{2}$	0·53	0·117	
251	7·33	Sept.-Mar.	6	1·55	0·258	♂
	8·88	Mar.-June	4	0·66	0·165	
258	7·39	Sept.-Apr.	$6\frac{5}{6}$	1·40	0·205	♀
	8·79	Apr.-July	$3\frac{1}{2}$	0·40	0·114	
271	7·59	Sept.-Feb.	$4\frac{1}{2}$	1·08	0·240	♂
	8·67	Feb.-June	$4\frac{5}{6}$	0·67	0·138	
302	7·95	Oct.-Jan.	3	0·73	0·243	♂
	8·68	Jan.-July	$6\frac{2}{5}$	1·12	0·143	
387	7·95	Jan.-May	4	0·91	0·227	♀
	8·86	May-June	$1\frac{2}{3}$	0·32	0·192	
404	7·86	Feb.-May	$2\frac{5}{6}$	0·66	0·233	♂
	8·52	May-July	$2\frac{1}{2}$	0·48	0·192	
74	8·75	Feb.-Jan.	$10\frac{2}{3}$	1·07	0·100	♂
	9·82	Jan.-June	$5\frac{3}{5}$	0·43	0·076	
93	8·50	Apr.-Dec.	$7\frac{5}{6}$	1·42	0·181	♀
	9·92	Dec.-June	$6\frac{1}{2}$	0·64	0·098	
96	8·54	Apr.-Jan.	$8\frac{5}{6}$	1·43	0·162	♂
	9·97	Jan.-June	$5\frac{3}{5}$	0·42	0·075	
111	8·62	May-Mar.	$9\frac{5}{6}$	1·31	0·133	♀
	9·93	Mar.-June	$3\frac{3}{5}$	0·31	0·086	
112	8·12	May-Apr.	$10\frac{5}{6}$	1·86	0·171	♂
	9·98	Apr.-July	$3\frac{1}{2}$	0·28	0·080	
114	8·93	May-Oct.	$5\frac{1}{2}$	0·99	0·180	♂
	9·92	Oct.-June	8	0·91	0·113	
115	8·76	May-Dec.	7	1·05	0·150	♂
	9·81	Dec.-June	$6\frac{1}{2}$	0·76	0·117	
150	8·00	June-Apr.	$9\frac{1}{3}$	1·87	0·200	♂
	9·87	Apr.-June	$2\frac{3}{5}$	0·23	0·088	
155	8·47	June-Apr.	$9\frac{1}{3}$	1·52	0·163	♀
	9·99	Apr.-June	$2\frac{2}{3}$	0·33	0·123	
170	8·92	July-Feb.	$6\frac{5}{6}$	0·80	0·117	♂
	9·72	Feb.-June	$4\frac{1}{2}$	0·35	0·077	

TABLE III—*concld.*

Mark or No. of shell of *Trochus*.	Maximum diameter in cms. of the shell at each stage of its growth.	Months in which the original and final measurements were taken.	Total period of growth in fractions of months.	Total growth in maximum diameter in cms. in this period.	Monthly rate of growth in cms.	Sex of individuals.
188	8·27 9·39	July-Feb. Feb.-July	$6\frac{2}{5}$ $5\frac{2}{5}$	1·12 0·84	0·175 0·155	♀
192	8·61 9·80	July-Mar. Mar.-June	$7\frac{1}{3}$ $3\frac{2}{3}$	1·19 0·37	0·162 0·073	♀
270	8·65 9·94	Sept.-May May-June	$7\frac{2}{5}$ $1\frac{2}{3}$	1·29 0·10	0·173 0·060	♀
154	9·73 10·72	June-Mar. Mar.-June	$8\frac{1}{3}$ $3\frac{3}{5}$	0·99 0·33	0·118 0·091	♀
243	9·93 10·84	Aug.-Apr. Apr.-June	$7\frac{1}{3}$ $2\frac{3}{5}$	0·91 0·22	0·124 0·084	♀

TABLE IV.

MONTHLY RATES OF GROWTH OF *Trochus niloticus* IN CENTIMETRES.

(*Males.*)

Size-groups (Max. diam. in cms.).	Season—December to April.	Season—May to November.
2—2·99	....	(1) 0·713.
3—3·99	(1) 0·300 (2) 0·266 (3) 0·250 (4) 0·204.	....
4—4·99	(1) 0·312 (2) 0·336 (3) 0·328 (4) 0·342 (5) 0·309 (6) 0·306 (7) 0·360 (8) 0·295 (9) 0·279 (10) 0·288.	(1) 0·354 (2) 0·348 (3) 0·341 (4) 0·311 (5) 0·275 (6) 0·294.
5—5·99	(1) 0·330 (2) 0·328 (3) 0·333 (4) 0·343 (5) 0·312 (6) 0·311 (7) 0·342 (8) 0·263 (9) 0·246 (10) 0·271.	(1) 0·332 (2) 0·330 (3) 0·366 (4) 0·370 (5) 0·337 (6) 0·370 (7) 0·348 (8) 0·302 (9) 0·265 (10) 0·220 (11) 0·226 (12) 0·242 (13) 0·298 (14) 0·294 (15) 0·288 (16) 0·282.
6—6·99	(1) 0·324 (2) 0·316 (3) 0·275 (4) 0·270 (5) 0·242 (6) 0·273 (7) 0·265 (8) 0·267 (9) 0·290 (10) 0·290 (11) 0·238 (12) 0·202 (13) 0·272 (14) 0·129.	(1) 0·306 (2) 0·380 (3) 0·375 (4) 0·362 (5) 0·246 (6) 0·265 (7) 0·253 (8) 0·283 (9) 0·286 (10) 0·217 (11) 0·265 (12) 0·207 (13) 0·236 (14) 0·272.

TABLE IV—*contd.*

Size-groups (Max. diam. in cms.).	Season—December to April.	Season—May to November.
7—7·99	(1) 0·245 (2) 0·235 (3) 0·225 (4) 0·258 (5) 0·233 (6) 0·182 (7) 0·157 (8) 0·174 (9) 0·172 (10) 0·172.	(1) 0·208 (2) 0·240 (3) 0·260 (4) 0·224 (5) 0·238 (6) 0·235 (7) 0·220 (8) 0·266 (9) 0·210 (10) 0·210 (11) 0·236 (12) 0·248 (13) 0·240 (14) 0·243 (15) 0·193 (16) 0·185 (17) 0·174 (18) 0·182 (19) 0·168 (20) 0·139 (21) 0·198 (22) 0·192.
8—8·99	(1) 0·121 (2) 0·120 (3) 0·174 (4) 0·154 (5) 0·169 (6) 0·138 (7) 0·143 (8) 0·046.	(1) 0·200 (2) 0·142 (3) 0·112 (4) 0·117 (5) 0·165 (6) 0·192 (7) 0·100 (8) 0·162 (9) 0·171 (10) 0·180 (11) 0·150 (12) 0·117 (13) 0·090.
9—9·99	(1) 0·113 (2) 0·117 (3) 0·076 (4) 0·075 (5) 0·077.	(1) 0·135 (2) 0·093 (3) 0·088 (4) 0·080 (5) 0·054.
Total number of shells under observation in each season.	61	77

TABLE V

MONTHLY RATES OF GROWTH OF *Trochus niloticus* IN CENTIMETRES.

(*Females.*)

Size-groups (Max. diam. in cms.).	Season—December to April.	Season—May to November.
2—2·99	....	(1) 0·427
3—3·99	(1) 0·402 (2) 0·360 (3) 0·391 (4) 0·325 (5) 0·315 (6) 0·306 (7) 0·310 (8) 0·366 (9) 0·298 (10) 0·283 (11) 0·278.	(1) 0·470 (2) 0·337 (3) 0·281.
4—4·99	(1) 0·400 (2) 0·412 (3) 0·400 (4) 0·320 (5) 0·349 (6) 0·323 (7) 0·331 (8) 0·317 (9) 0·340 (10) 0·297 (11) 0·290 (12) 0·290 (13) 0·276.	(1) 0·420 (2) 0·463 (3) 0·370 (4) 0·390 (5) 0·330 (6) 0·343 (7) 0·317 (8) 0·364 (9) 0·364 (10) 0·257 (11) 0·283 (12) 0·280 (13) 0·254 (14) 0·272.
5—5·99	(1) 0·404 (2) 0·420 (3) 0·340 (4) 0·345 (5) 0·310 (6) 0·308 (7) 0·286 (8) 0·260 (9) 0·264 (10) 0·185.	(1) 0·720 (2) 0·409 (3) 0·328 (4) 0·370 (5) 0·395 (6) 0·372 (7) 0·312 (8) 0·340 (9) 0·320 (10) 0·346 (11) 0·353 (12) 0·356 (13) 0·364 (14) 0·333 (15) 0·326 (16) 0·366 (17) 0·273 (18) 0·297 (19) 0·281 (20) 0·281 (21) 0·290

TABLE V—*concld.*

Size-groups (Max. diam. in cms.).	Season—December to April.	Season—May to November.
6—6·99	(1) 0·306 (2) 0·343 (3) 0·301 (4) 0·306 (5) 0·300 (6) 0·320 (7) 0·306 (8) 0·337 (9) 0·232 (10) 0·280 (11) 0·217 (12) 0·232 (13) 0·266 (14) 0·221 (15) 0·280 (16) 0·162 (17) 0·171.	(1) 0·400 (2) 0·346 (3) 0·330 (4) 0·345 (5) 0·375 (6) 0·324 (7) 0·305 (8) 0·215 (9) 0·240 (10) 0·266 (11) 0·276 (12) 0·219 (13) 0·266 (14) 0·253 (15) 0·237 (16) 0·297.
7—7·99	(1) 0·312 (2) 0·320 (3) 0·220 (4) 0·201 (5) 0·223 (6) 0·216 (7) 0·205 (8) 0·227 (9) 0·172.	(1) 0·272 (2) 0·213 (3) 0·297 (4) 0·203 (5) 0·217 (6) 0·285 (7) 0·277 (8) 0·281 (9) 0·270 (10) 0·252 (11) 0·250 (12) 0·238 (13) 0·152 (14) 0·163 (15) 0·168 (16) 0·166 (17) 0·160 (18) 0·153 (19) 0·181 (20) 0·060.
8—8·99	(1) 0·151 (2) 0·151 (3) 0·126 (4) 0·117 (5) 0·173 (6) 0·173.	(1) 0·232 (2) 0·171 (3) 0·139 (4) 0·170 (5) 0·137 (6) 0·101 (7) 0·114 (8) 0·192 (9) 0·181 (10) 0·133 (11) 0·163 (12) 0·175 (13) 0·162.
9—9·99	(1) 0·155 (2) 0·124 (3) 0·098 (4) 0·086 (5) 0·073.	(1) 0·123 (2) 0·118 (3) 0·077 (4) 0·060.
Total number of shells under observation in each season.	71	92

EXPLANATION OF PLATE XIV.

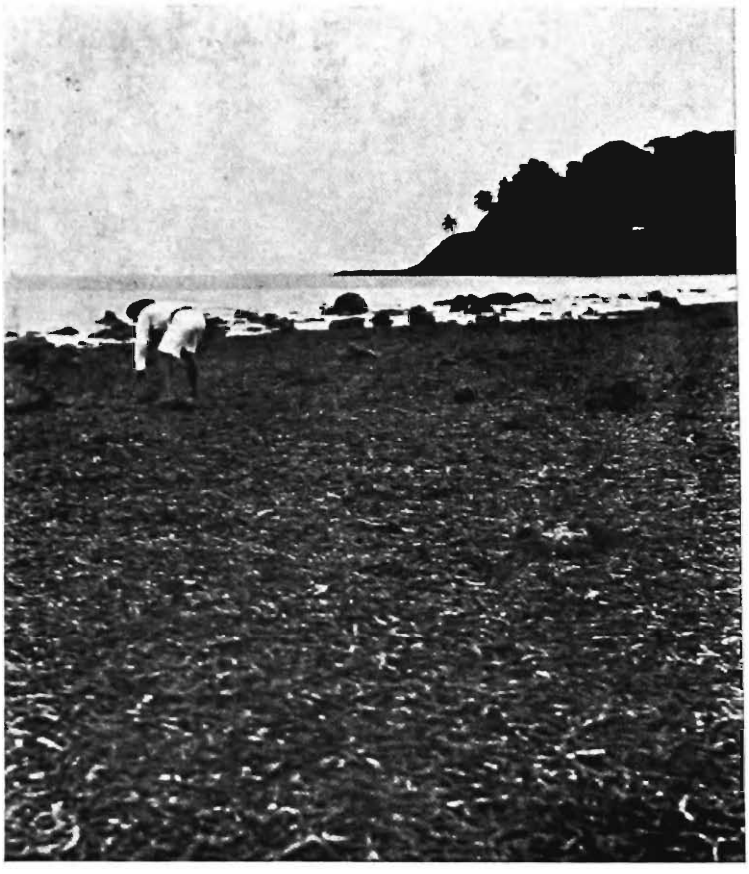
FIG. 1.—North-west corner of Ross Island, Port Blair, Andamans, where the marked shells in the second set of observations on growth were liberated. In the foreground of the photograph is a long stretch of coral shingle, and at a little distance, the rocks projecting above the surface of water indicate the position of the inner edge of the reef of madreporarian coral.

FIG. 2.—Reefs and coral boulders near the South Point Navigation Light, on the mainland of Port Blair, where the fourth and final set of observations on the rate of growth of *T niloticus* was taken. In the left background is the southern end of Ross I., and in the right background the rocky pier of S. Point Light. At a depth of about 3 to 4 feet on the reefs are seen convict labourers being directed to look for marked shells under the boulders and rocks.

FIG. 3.—View of the base of shell of *T niloticus*, 10·57 cms. diameter in which the lines of growth on the nacreous layer are seen numbered.

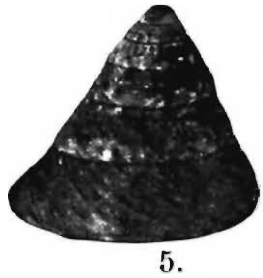
FIG. 4.—View of the base of another shell of *T niloticus*, 10·14 cms. diameter in which the lines of growth on the periostracum are seen as white streaks.

FIG. 5.—Side view of an entire shell of *T niloticus*, 7·91 cms. diameter showing the faint oblique lines of growth on the periostracum of the last two whorls.

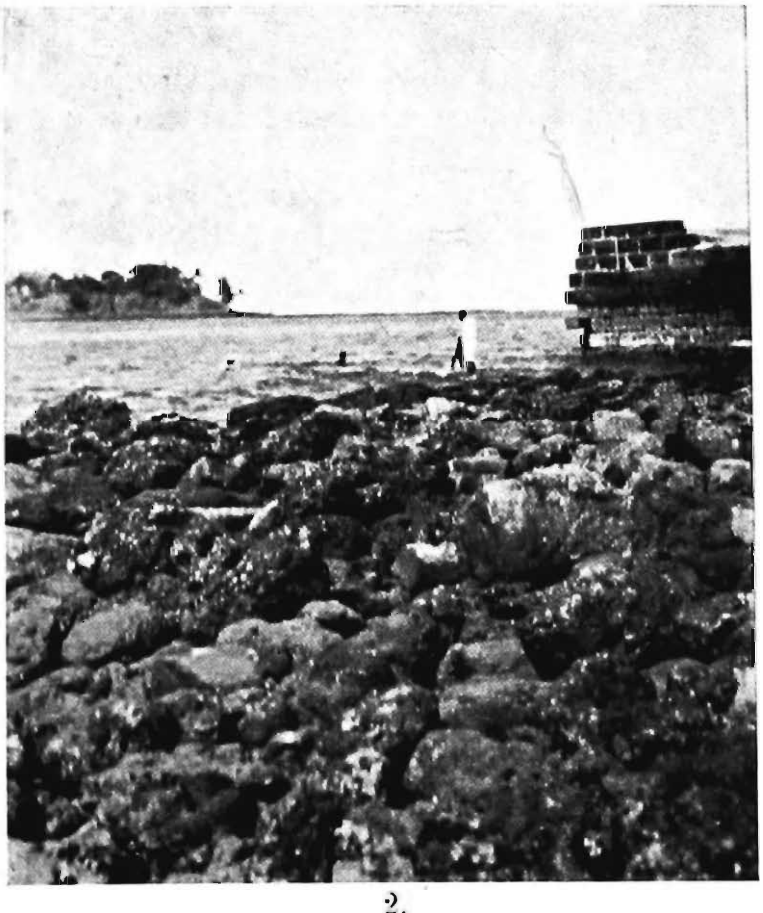


1.

3.



5.



2.

4.

H. S. R. & S. M. Photo.

Habitat etc. of Trochus niloticus.

A STATISTICAL STUDY OF THE DATA OF GROWTH IN SHELL OF *TROCHUS NILOTICUS* LINN. IN ANDAMAN WATERS.

By H. SRINIVASA RAO, *Zoological Survey of India, and* K.C.K.E. RAJA, *All-India Institute of Hygiene, Calcutta.*

For examining the rate of growth in *T. niloticus* the following three points have been considered :—

(1) The rates of growth at specific age-periods as defined by the size of the shell (maximum diameter).

(2) The effect of seasonal factors in stimulating or retarding growth.

One such seasonal factor may be the variability of the food supply available to these organisms. As sunshine plays an important part in regard to the growth of aquatic vegetation, the criteria for classifying the seasons that suggested themselves were the monthly values for (1) cloud amount, (2) the rainfall and (3) the number of rainy days. These data for the twelve months of the year are set out below.[1] The readings are for Port Blair and for Indian Standard Time.

Mean monthly figures for cloud amount, rainfall and number of rainy days.

Month.	Cloud amount.	Rainfall.	No. of rainy days.
January	5·2	1·63″	2·0
February	3·6	0·87″	1·2
March	3·5	0·74″	1·0
April	4·6	2·48″	3·9
May	9·2	15·86″	16·0
June	10·0	19·34″	20·1
July	8·9	15·25″	19·5
August	9·8	14·69″	19·3
September	8·4	18·07″	20·0
October	8·5	11·07″	15·7
November	7·0	9·51″	12·2
December	6·3	6·91″	7·7

[1] They represent 'normals' calculated from the figures given in the Monthly Weather Reports for 1935 of the Indian Meteorological Department.

On the basis of these figures it was decided that, from our point of view, the seasons could be classified into two (1)—December-April and (2) May-November.

(3) The effect of sex.

The available data relating to the monthly rates of growth of these animals were, therefore, classified according to the three factors, size or age, season and sex. The data are given in a statement attached to this note.

In carrying out a statistical analysis to evaluate the separate influences of age, sex and season on growth there are two difficulties. One is that, for particular ages, no figures are available. This will not justify us in assuming that the rates of growth at these ages are zero. The blank areas merely indicate failure to secure specimens falling into these age groups during the experiment. Under the circumstances, two lines of treatment are open, namely, either to put in expected mean values in the missing places on the information afforded by the table as a whole or to confine our statistical analysis to those age groups in which the data are complete for the two sexes. The latter procedure was adopted on the assumption that the general picture of the relationship of these three factors to growth will be adequately expressed by taking into consideration the age groups for which complete data are available.

The second difficulty is that inequality of frequencies in the different classes renders the application of the usual methods of analysis of variance unsuitable. Hence the treatment adopted was an approximate analysis of variance suggested by Yates, as given by Snedecor[1] (1934). The results of analyses are given below.

Mean monthly rates of growth classified according to size or age, season and sex.

Size in centimetres (Age).	Males.		Females.	
	December to April.	May to November.	December to April.	May to November.
4—4·99	0·3155	0·3205	0·3342	0·3362
5—5·99	0·3079	0·3044	0·3122	0·3539
6—6·99	0·2609	0·2824	0·2694	0·2934
7—7·99	0·2053	0·2140	0·2329	0·2129
8—8·99	0·1331	0·1460	0·1485	0·1592
9—9·99	0·0916	0·0900	0·1072	0·0945

[1] Snedecor, G. W.—Calculation and Interpretation of Analysis of Variance and Covariance, p. 52, (Collegiate Press Inc. Ames, Iowa, U. S. A.), 1934.

Univariate Analysis of Variance.

Source of variation.	Degrees of freedom.	Sum of squares.	Mean squares.
(1) Between the 24 class means	23	1·617,562,9	0·070,328,8
(2) Within the classes	257	0·697,890,1	0·002,715,5
TOTAL	280	2·315,453,0	

The harmonic mean of the frequencies in the classes-0·107,975
Experimental error=0·107,975 × 0·002,715,5=0·000,293

Bivariate Analysis of Variance of Mean Rates of Growth.

(Males).

Source of variation.	Degrees of freedom.	Sum of squares.	Mean squares.
(1) Between season means	1	0·000,154,09	0·000,154
(2) Between age means	5	0·085,847,81	0·017,170
(3) Residual .	5	0·000,217,99	0·000,044

The mean rates of growth are significantly different from age to age while the two seasons show no significant difference.

Bivariate Analysis of Variance of Mean Rates of Growth.

(Females).

Source of variation.	Degrees of freedom.	Sum of squares.	Mean squares.
(1) Between season means	1	0·000,174,23	0·000,174
(2) Between age means	5	0·092,970,52	0·018,594
(3) Residual	5	0·001,323,10	0·000,265

Here again the influence of the season is not significant while that of age is.

Trivariate Analysis of Variance of Mean Rates of Growth.

(Both sexes).

Source of variation.	Degrees of freedom.	Sum of squares.	Mean squares.
(1) Between season means	1	0·000,327,82	0·000,328
(2) Between age means	5	0·178,616,42	0·035,723
(3) Between sex means	1	0·001,393,85	0·001,394
Interactions.			
(4) Season and age .	5	0·000,789,09	0·000,158
(5) Sex and age .	5	0·000,201,72	0·000,040
(6) Season and sex	1	0·000,000,31	0·000,000,31
(7) Residual	5	0·000,752,19	0·000,150
Experimental error	257	..	0·000,293

The trivariate analysis shows that season has no effect on the rate of growth, that age has a definite effect and that sex may have an effect as the probability for the observed difference in the mean rates of growth(0·0153) of the two sexes or something higher lies between 0·05 and 0·01. The rate of growth is higher in the female.

UEBER EINIGE MYRIAPODEN UND ISOPODEN AUS DEKAN, GESAMMELT VON HERRN S. JONES, MADRAS.

Von Dr. K. W. Verhoeff, *Pasing bei München.*

(Tafeln XV and XVI).

A.—Diplopoda.

Die Spiromimidae eine indisch-madagassische Brücke.

Erythroprosopon, gen. nov.

In ihrem bekannten Madagaskar Werk haben Saussure und Zehntner zwei Spiroboloidea Gattungen beschrieben, *Spiromimus* und *Pygodon* von Madagaskar und Nossi Bé, welche später von Brölemann und Attems zu Vertretern einer Familie Spiromimidae gemacht worden sind. Ausser den Autoren scheint aber bis heute niemand eine dieser Formen wieder untersucht zu haben, und musste diese Familie als eine endemische des Madagassischen Gebietes betrachtet werden.

Im 4 Bd. von Kükenthals *Handbuch der Zoologie*, Leipzig 1926, hat C. Attems die beiden Familien der Trigoniulidea wie folgt umschrieben:

(*a*) " Das Coxit der hinteren Gonopoden besteht aus zwei im rechten Winkel zu einander stehenden stärkeren Stäben und dazwischen gespannten Membranen. Die Tracheentaschen sind gelenkig abgesetzt. Das Telopodit ist deutlich vom Coxit getrennt. Eine deutliche Gliederung des Telopodits ist selten sichtbar. Der Innenarm ist als Tibialfortsatz aufzufassen, die Partie distal von ihm als Tarsus, zwei Blasen im hinteren Gonopod und ein fingerförmiger *Zapfen* meist vorhanden. Coxit und Telopodit der vorderen Gonopoden kurz und breitblattig. selten einzelne Teile länger und schlanker." Trigoniulidae.

(*b*) " Coxit der hinteren Gonopoden ganz chitinisirt, eng mit dem Telopodit verbun den. Der ganze Gonopod bildet ein breites, in der Mitte stark eingeschnürtes C. In der Basis nur eine Blase am Beginn der Samenrinne, kein fingerförmiger Zapfen. Alle Teile der vorderen Gonopoden lang und schlank ausgezogen." Spiromimidae.

Die Abbildungen, welche Saussure und Zehntner 1902 in ihrem schönen Madagaskar Werk auf Taf. XIII für *Spiromimus* und *Pygodon* geliefert haben, sind für die damalige Zeit recht gut und wenn sie für die Gonopoden auch keine vergleichend-morphologische Erklärung versucht haben, so lassen sich diese Abbildungen doch für eine solche verwerten. Ganz unzweifelhaft geht aus denselben hervor, dass eine im Folgenden mitgeteilte neue Gattung aus Dekan mit den madagassischen so nahe verwandt ist, dass sie ebenfalls zu den Spiromimidae gestellt werden muss, womit zugleich eine neue indisch-madagassische Brücke erwiesen wird.

Aus den citirten Characteristiken von Attems geht deutlich hervor, dass ein durchgreifender Gegensatz zwischen den beiden Familien in den vorderen Gonopoden kaum besteht, vielmehr auf den hinteren Gonopoden beruht. Aber auch für diese ist die vergleichende Morphologie keineswegs genügend geklärt, um so weniger, als Saussure und Zehntner über die Verbindung der hinteren Gonopoden nichts angegeben haben

und auch die Beschaffenheit der Basalteile derselben nicht ausreichend klar ist.

Die hinteren Gonopoden von *Erythroprosopon* (Spiromimidae) besitzen zwischen einander keine zweiteilige Verbindung wie die der Trigoniuliden, sondern (wie Tl. XV, Abb. 4 zeigt) ein einfaches, ungeteiltes Querband. Vergleichend-morphologisch sehr wichtig ist die Stelle, an welcher die Stütze (=Tracheentasche) mit der Basis der hinteren Gonopoden drehbar verbunden ist.

An diese Verbindungsstelle schliesst sich nämlich in *beiden* Familien ein Gerüst an, welches ich *Basalspange* nenne. Diese besitzt einen, inneren (*bi*) und einen *äusseren Arm* (*be*, Tl. XV, Abb. 4). Während aber bei den Trigoniuliden die Basalspange nicht nur eine gewisse Selbständigkeit besitzt, sondern auch vermittelst des inneren Armes in der Mediane mit der der andern Seite direkt oder indirekt verbunden ist, hängt sie bei den Spiromimiden fest mit der Basis des hinteren Gonopoden zusammen und die Innenarme beider Basalspangen bleiben durch die genannte Brücke (*po*) weit *getrennt*. Während bei den Trigoniuliden die Coxaldrüsen ausserhalb der Gonopoden liegen und daher ihr Kanal vom Rumpfinnern her nach der Basalgrube des Spermaganges zieht, (siehe bei Attems a. a. *O*, auf S. 195, Abb. 24z, *dr*) befinden sie sich bei den Spiromimiden in den Coxiten selbst und hier zieht der Kanal in grossem Bogen (*dk*, Tl. XV, Abb. 1) nach der Basalgrube. Den genann ten Gegensätzen entsprechend haben die *Coxite* der hinteren Gonopoden bei den Trigoniuliden nicht nur eine bestimmte Selbständigkeit bewahrt, sondern erscheinen auch zugleich mehr aufgelockert, während sie bei den Spiromimiden vollständig mit den Telopoditen verwachsen sind, so dass die hinteren Gonopoden bei ihnen ein einheitliches Gepräge haben. Hiernach komme ich zu den folgenden neuen Definitionen:

Trigoniulidae.	Spiromimidae.
Coxite und Telopodite der hinteren Gonopoden deutlich gegen einander *abgegrenzt*. Kein einheitliches Querband zwischen den hinteren Gonopoden. An den *Basalspangen*, unter deren Mitte der Anfang der Stütze ansitzt, bilden die in der Mediane zusammenrückenden inneren Aeste derselben entweder durch Verwachsung einen Haken, oder sie verbinden sich in der Mediane terminal durch einen Nebenast (So bei *Ainigmabolus* Verh. aus Kalifornien). Die Basalgrube wird vom *Embolus* (=*Zapfen* Attems) geschützt und dieser ist zapfen-bis keulenförmig, im letzteren Falle vor den inneren Aesten der Basalspangen terminal mit dem der andern Seite verbunden durch jenen Nebenast.	Coxite und Telopodite der hinteren Gonopoden mit einander *verwachsen*. Beide hintere Gonopoden durch ein einheitliches Querband verbunden. An den Basalspangen, unter deren Mitte der Anfang der Stütze ansitzt, sind die inneren Aeste durch das Querband weit *getrennt* (*po*, *bi*, Tl. XV, Abb. 4). Der Embolus ist hufeisenförmig (*em*) und beide Enden des Hufeisens sind mit der inneren Coxitbasis verbunden.
Basalspangen und mit ihnen der Ansatz der Stützen, sowie der Embolus sind also von dem eigentlichen hinteren Gonopod ganz getrennt.	*Basalspangen und damit der Ansatz der Stützen, sowie der Embolus sind mit der Basis des hinteren Gonopod verwachsen.*

Das Verhältnis der neuen Gattung zu den bekannten zeigt folgende, Uebersicht:

Spiromimidae.

(*a*) Fortsatz am Sternit der vorderen Gonopoden gegen das Ende dünn auslaufend. Endteil der vorderen Gonopoden einfach. Coxite schlank, Telopodite nicht in zwei Abschnitte geteilt. Endhälfte der hinteren Gonopoden nicht in zwei Aeste gespalten.

Telopoditglieder am 1-7. Beinpaar des ♂ ohne Erweiterungen. Hüften am 3. B. des ♂ in spitzen Fortsatz ausgezogen, am 4. B. mit einem das Präfemur weit überragenden Fortsatz, 5. B. ebenso, aber der Hüftfortsatz kürzer. Sternite zwischen den Hüften des 1 und 2. Beinpaares des ♂ mit kleinem Fortsatz. Poren der Wehrdrüsen[1] *vor* der Naht gelegen. ..... *Spiromimus* und *Pygodon* Saussure und Zehntner.

(*b*) Fortsatz am Sternit der vorderen Gonopoden keulig (Tl XV, Abb. 5). Endteil der vorderen Gonopoden *zweiästig* (Tl. XV, Abb. 6). Coxite breit, Telopodite aus zwei Abschnitten bestehend (*tt* 1 und tt 2). Endhälfte der hinteren Gonopoden in Solänomerit und Tibiotarsus gespalten (Tl. XV, Abb. 2). Am 1-7. Beinpaar des ♂ Präfemur, Femur, Postfemur und Tibia (Tarsus) nach unten in einen Buckel oder Lappen *erweitert*. Hüften am 3. B. des ♂ in breit abgestutzten Fortsatz ausgezogen (Tl. XV, Abb. 8). 4. B. mit Hüftfortsatz der das Praefemur nur wenig überragt, am 5. nicht überragt. Sternite am 1 und 2. Beinpaar ♂ zwischen den Hüften einfach (Tl. XV, Abb. 7). Poren *vor* der Naht gelegen. ..... *Erythroprosopon*, gen. nov.

Erythroprosopon phoenix, sp. nov.

♂ 55 mm. mit 50 Rumpfringen. ♀ 54 mm. mit 50 R.

Körper grauschwarz. Vorderhälfte des Kopfes, Collum, Telson und ein ziemlich breites, über den ganzen Rücken ziehendes Längsband *kirschrot*, eine bei Diplopoden selten vorkommende grelle Farbe (Schreckfärbung!). Beine und Antennen rötlich. Antennen kürzer als der Kopf, mit 4 Riechzapfen, Labrum mit 3 sehr stumpfen Zähnen, über dem Labrum 2+2 Gruben. Ocellen von vorn nach hinten aus 8 Reihen bestehend, schwer zählbar, grosse Dreiecke bildend, wenig convex, die äusserste Reihe ist gegen die andern etwas nach aussen gedreht, weil sie am Rande einer weiten und tiefen *Grube* liegt, die sich unterhalb der Antennengrube befindet und halb von den Seiten der Kopfkapsel, halb von den Backen gebildet wird. Diese bilden einen kantigen unteren Rand für die Grube und springen beim ♂ nach unten dreieckig stark heraus. Labrum in der Mediane mit einer Furche, welche zwischen den Antennen aufhört. Kopfkapsel glänzend, mit sehr feinen, queren Einritzungen, vorn auch ausserdem zerstreut punktirt.

Collum mit abgerundet dreieckigen Seitenlappen, die nur *eine* Furche dicht hinter dem Vorderrand besitzen und welche hinter den Ocellen aufhört.

Poren der Wehrdrüsen verhältlich *gross* und am 6. Ring beginnend. Ihr Sekret hinterlässt einen lackartigen Niederschlag. Diplosomite zerstreut und ziemlich kräftig punktirt. Die Poren liegen fast in der Mitte zwischen Vorder-und Hinterrand der Ringe, aber *vor* der Naht. Nähte können leicht verkannt worden (und sind auch wahrscheinlich bei verschiedenen Vertretern der Spiroboloidea verkannt worden!) denn an den meisten Ringen sieht man weit vor den Poren eine deutliche *Ringfurche* ausgeprägt, welche *eine Naht vortäuscht, während die wahre Naht als Furche grösstenteils erloschen ist*, aber doch noch dadurch angedeutet wird, dass die Prozonite etwas enger sind als die Metazonite, daher im Profil etwas niedriger gelegen erscheinen.

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[1] Betrachtet man in Saussure's Madagaskar-Werk auf Taf. XI, Abb. 47, *a*, *b*, *c*, dann kann der Eindruck entstehen, als ob die Poren hinter der Naht liegen würden. Sie stimmen aber in ihrer Lage mit denen von *Erythroprosopon* überein (Siehe unten).

Es sind aber auch noch Teile der wahren Nahtfurche vorhanden und diese befinden sich versteckt unten am Bauch neben den Sterniten, bedeckt von den Beinen. Hier im Bereich der Beine besitzen die Metazonite auch noch Längsfurchen, die sich auf die Prozonite fortsetzen und nach einer kürzeren oder längeren Strecke im Bogen nach oben abbiegen. Je weiter nach unten, desto mehr biegen die Furchen in grossem Bogen nach unten heraus und dann entschieden nach oben, nämlich weiter vorn.

Telson zerstreut aber noch deutlicher punktirt wie die Diplosomite. Pränalsegment oben in stumpfen Winkel vortretend, aber ohne eigentlichen Fortsatz. Analplatten mit wulstigem Endrand, auch tiefer Furche vor ihm. Sogar das Telson ist borstenlos.

Das 1.—7. Beinpaar des ♂ sind vor denen der beiden Madagaskar—Gattungen sehr ausgezeichnet. Während diese, wie man aus einer Reihe von Abbildungen in dem Werke von Saussure auf Taf. XIII ersieht, nur an den Hüften Fortsätze bilden, sind bei *Erythroprosopon* fast alle Glieder des 1.—7. B. ♂ mehr oder minder durch Fortsätze oder Lappen ausgezeichnet.

Am 1. und 2. Beinpaarsegment des ♂ ist ein *Coxosternum* ausgebildet, denn die Hüften sind zwar (Tl. XV, Abb. 7) gegen ihr Sternit abgegrenzt geblieben, haben aber die Gelenke verloren. Am 1. B. sind die Hüften dicht an einander gerückt, alle 5 Telopoditglieder nach unten in Lappen oder Buckel erweitert, obenso am 2. B. doch bleiben an ihm die Hüften durch eine tiefe Bucht weit getrennt (Tl. XV, Abb. 7). Der Lappen ist am Femur am breitesten, am Postfemur am schmälsten, fast dreickig. Vom 3. B. an sind die Hüften vom Sternit gelenkig getrennt und die Erweiterungen der Telopoditglieder gegen ihre Glieder am 3. und 4. B. stufig abgesetzt (Tl. XV, Abb. 8). Nur am 3. und 4. B. ragen die, Hüftfortsätze über das Präfemur hinaus, am 5. kaum noch, auch sind nur noch Präfemur und Femur nach unten lappig erweitert. Am 6. und 7. B, sind die Hüftfortsätze kurz, aber breit am Ende abgestutzt, Präfemur und die drei folgenden Glieder unten am Ende mit nach, endwarts gerichteten Zapfen schwächer auch noch am Ende des Tarsus. Hinter den Gonopoden bleiben die Beinpaare einfach.

Die Gonopoden sind vergleichend-morphologisch und in Beziehung zu den Verwandten oben besprochen worden. Es bleibt mir noch übrig die Merkmale von Gattung und Art zu erörtern.

Die vorderen Gonopoden (Tl. XV, Abb. 6) sind durch breites Sternit und sehr schlankes Telopodit ansgezeichnet. An die Grundhälfte des Telopodit lehnt sich das Coxit mit einem breiten, in eine Spitze ausgezogenen Fortsatz (*pr*) und stützt sie mit einem breiten Wulst (*w*). Das Telopodit zerfällt deutlich genug in einen basalen Teil, der mit einem dicken Höcker vorragt (*tt* 1) und einen viel schlankeren terminalen, welcher in zwei Aeste gegabelt ist (*tt* 2). Der spitzere Ast ist hakig, zurückgebogen, der stumpfere, gewundene ganz nach endwärts heraus gereckt. Das mit seinen hakig umgebogenen Stützen verwachsene Sternit der vorderen Gonopoden (Tl. XV, Abb. 5) wird durch eine hufeisenförmige, starke Spange im Innern versteift (*Dr*) besitzt vorn in der Mediane einen kräftigen Grat (*mg*) und läuft am Ende hinter diesem Grat in einen langen Fortsatz aus, dessen Keule fast pfeilspitzartig gestaltet.

Die hinteren Gonopoden erinnern zwar sehr an die der madagassischen Gattungen, unterscheiden sich von ihnen aber auffallend dadurch, dass der Endteil in zwei Aeste gespalten ist (Tl. XV, Abb. 1-3) ein kürzeres Solänomerit mit dem Spermagang und einen längeren Tibiotarsus. Eine ziemlich tiefe *Schrägrinne* (*ss*) betrachte ich als Grenze zwischen Tibiotarsus und dem übrigen Telopodit (Postfemur). Der Tibiotarsus endigt mit einer hakig zurückgebogenen Keule (Tl. XV, Abb. 3) die mit vielen Zähnchen verschiedener Grösse bewehrt ist. Am Solänomerit ragen hinter der Mitte gegen den Tibiotarsus ein Haken und eine kleinere Spitze heraus. Am Ende hinter der letzteren *mündet* der Spermagang (*r*, *re*) in einem durch Läppchen geschützten Grübchen. In dem durch Abb. 1 erlauterten Falle enthält die basale Erweiterung des Spermaganges eine dunkle Spermamasee (*sp*) die auch noch eine Strecke weit im Spermagang zu erkenmen ist. Die Gestalt der Spermamasse zeigt, dass die Spermagrube der Gestalt des oben besprochenen Embolus (*em*, Tl. XV, Abb. 4) angepasst ist. In die Spermagrube mündet auch der Kanal der Coxaldrüse, welche das Sperma feucht hält und bei Bedarf ausspült.

Vorkommen.—Madras.

Polydesmopeltis (Ceylonpeltis) xanthotrichus hamuligerus m.

Die Prionopeltiden-Gattung *Polydesmopeltis* stellte ich auf in meinem 144. Dipl.-Aufsatz " über einigen indische Chilognathen " *Rec. Ind. Mus.*, Vol. XXXVIII, 1936, und teile sie jetzt in folgende 2 Untergattungen:

Polydesmopeltis s. str.	*Ceylonpeltis* m.
Seitenflügel sehr *breit* etwa 2/3 so breit wie die Pleural-cylinder. Querfurchen der Metazonite seicht, Knötchen des Rückens alle fein. Antennen *lang*, das 6. Glied etwa 4 mal länger als breit und 6 mal langer als das 7. Seitenflügel des Collum noch etwas breiter wie der tergale Teil, die Backen weit überragend. (*kelaarti* Att.).	Seitenflügel schmal, nur etwa ¼ der Breite der Pleural-cylinder erreichend. Querfurchen der Metatergite tief, Knötchen des Rückens so kräftig, dass sie an den Hinterrändern eine Zähnchenreihe bilden. Antennen ziemlich *kurz*, das 6. Glied nur 2½ mal länger als breit, nur 3 mal länger als das 7. Seitenflügel des Collum 3/5 so breit wie der tergale Teil, die Backen kaum überragend. (*xanthotrichus* Att.)

Die hier in Betracht kommende Art wurde 1899 von Attems in seinem System der Polydesmoidea, (*Akad. d. Wiss. Wien*) als *Prionopeltis xanthotrichus* auf S. 139 von Ceylon beschrieben und die Gonopoden stellte er dar in Abb. 115 auf Taf. V Mir liegen zwei Formen vor, welche zu *xanthotrichus* gehören und im Körperbau unter einander und mit jenem übereinstimmen, aber in den Gonopoden nicht unbeträchtliche Unterschiede aufweisen, so dass sich 3 Unterarten unterscheiden lassen. Zum nachfolgenden Schlüssel derselben sei noch vorwegbemerkt, dass bei den beiden mir vorliegenden Formen unten hinter der Basis des Femur am 4.—7. oder 8. Beinpaar des ♂ ein Höcker

vorragt, der mit einigen Drüsenzellen verbunden zu sein scheint. Leider hat Attems über diese Höcker *a. a. O.*, nichts mitgeteilt.

(*a*) Tibiotarsus der Gonopoden fast *halbkreisförmig* gebogen, an seinem Ende zwischen zwei Spitzchen mit halbkreisförmigem Läppchen. Der zurückgebogene und dem Solänomerit entgegengesetzte Nebenast ist keulig. Das Femur springt unter ihm eckig vor, ebenso unter der Basis des Solänomerit (Femur am 4.-8. B. ♂ ?). ♂ 17-18 mm. Ceylon.

xanthotrichus Att. (genuinus).

(*b*) Tibiotarsus *hufeisenförmig* und an seiner Biegung etwas eingeknickt, am Ende kein halbkreisförmiges Läppchen. Der Nebenast ist nicht keulig. Femur am 4.-7. (8.) B. unten hinter der Basis mit deutlich und mehr oder minder dreieckig vorragendem Höcker... .. ..c, d.

(*c*) Femur der Gonopoden von innen gesehen am Ende breit abgestutzt (Tl. XVI, Abb. 9) an der Basis des Solänomerit (*sl*) nur eine schwache Einbuchtung, der zurückgebogene Ast (*h*) endigt stumpf. Am Ende des Tibiotarsus zwischen 2 Spitzen ein kleines Knötchen (Tl. XVI, Abb. 10). Femur auch am 8. B. ♂ mit drüsigem *Höcker*, ♂ 24 mm. Madras.

xanthotrichus, hamuligerus subsp. nov.

(*d*) Femur der Gp, von innen gesehen am Ende unter stumpfem Winkel abgegrenzt (Tl. XVI, Abb. 11) schmäler und kürzer, an der Basis des Solänomerit eine tiefe Einbuchtung, der zurückgegobene Ast endet spitz, am Ende des Tibiotarsus zwischen 2 Läppchen ein zweispitziger Fortsatz (Tl. XVI, Abb. 12). Am 8. B. ♂ bleibt das Femur *einfach*. ♂ 17-18 mm. Ceylon.

xanthotrichus, hirsutus Verh.

Als Ergänzung zu diesem Schlüssel will ich noch Folgendes erwähnen:

An den Gonopoden der *xanthotrichus* Rassen sind Präfemur und Femurabschnitt gut abgegrenzt, die Grenze zwischen diesen beiden Gliedern (Tl. XVI, Abb. 9 und 11) ist aussen schräg und scharf ausgeprägt, innen weniger deutlich, aber die Femurbasis ist keilartig in das Präfemur eingesenkt. Das Solänomerit und der Tibiotarsus sind an einander angepasst, letzterer im Sinne des schon früher von mir bei, Strongylosomiden besprochenen *Solänophors*. Daher machen beide Endäste eine gleichgerichtete, starke Biegung und der *rinnenartig* ausgehöhlte Tibiotarsus nimmt in dieser Rinne die schlankere und geisselartig fein auslaufende Endhälfte des Solänomerit auf. Der breite, Grundteil des letzteren wird durch eine quere Leiste mit dem des Hakenfortsatz (*h*) verbunden. Beide betrachte ich als Aequivalente eines Postfemurabschnittes. Die Endgebilde des Tibiotarsus (Tl. XVI, Abb. 10 und 12) sind ausserordeutlich zart und deshalb darf systematisch auf dieselben kein besonders grosser Wert gelegt werden. Eine starke Makrochäte am Ende des allein borstentragenden Präfemurs ist allen 3 Rassen gemeinsam.

B.—Chilopoda.

SCUTIGERIDAE.

Thereuopodina adjutrix, sp. nov.

Die Gattung *Thereuopodina* wurde in meinem 5. Scutigeriden-Aufsatz, *Zool. Anzeiger* 1905, S. 102-106 fur *tenuicornis* Verh. gegründet und 1925 beschrieb ich in meiner Bearbeitung der australischen Chilopoden Mjöberg's, (Arkiv for Zoologi, Stockholm, Bd. 17, A, N. 3, auf S. 29-31) zwei weitere *Thereuopodina* Arten und gab für alle 3 bekaunten einen Schlüssel. Die beiden australischen Formen sind durch die Haarspitzen der Tergite (Spiculae) besonders ausgezeichnet vor der neuen

Art, denn bei ihnen sind die " kurzkegeligen Haarspitzen nur spärlich zerstreut da sich zwischen den paramedianen Reihen der Stachelborsten in der Querrichtung nur 1-2 Haarspitzen vorfinden."

Bei der *adjutrix*, sp. nov. sind dagegen die Haarspitzen viel zahlreicher, indem man z. B. an der 5. Stomaplatte zwischen den paramedianen Reihen der Dornen und Stachelborsten in der Querrichtung 8-9 Haarspitzen zählen kann. Diese Spiculae haben sich abr bei den Scutigeriden als systematisch wichtige, vor 30 Jahren von mir zuerst verwendete Charactere erwiesen, so unscheinbar sie im Einzelnen auch sein mögen. Leider ist über Haarspitzen—Verteilung bei der zuerst beschriebenen *tenuicornis* Verh. nichts bekannt, so dass ich mich bei dieser an andere Merkmale halten muss:

Tenuicornis Verh. ♂ 24½ mm.	*Adjutrix* sp. nov. ♀ 14½ mm.
1. Flagellum der Antennen 76-85 gl. Tarsus am 3. Beinpaar 14+37 gl. Femurdornen unten 11. Bedornung der Tibia oben und unten am 7. B. 22/5; 9. B. 41/5;	1. Flagellum 40 gliedrig. Tarsus am 3. B. 8+45 gl. Femurdornen fehlen. Bedornung der Tibia oben und unten am 7. B. 9/0; 9. B. 41/5;
7 Stomaplatte jederseits mit 27-30 Dornen, davon 2-3 am Stomasattel.	7 Stomaplatte jederseits mit 24-26 Dornen, davon 6-7 am Stomasattel.

Die Gonopoden des *adjutrix* ♀ sind durchaus entwickelt und der Umstand, dass Zähnelung an den Endgliedern derselben fehlt, spricht durchaus nicht dagegen, weil solche bei vielen reifen Weibchen fehlt.

Grundglieder des Gonopoden—Syntelopodit deutlich etwas nach endwärts *erweitert*, die Bucht zwischen den Endgliedern abgerundet-dreieckig.

Wenn man durch den hinteren Endpunkt der Mediannaht der Grundglieder des Syntelopodit eine senkrechte Ebene sich gelegt denkt, dann schneidet sie in der Unterwand von den Grundgliedern durch eine Querlinie einen längeren vorderen von einem kürzerer hinteren Abschmitt ab. Diese Querlinie ist bei *adjutrix* ebenso lang wie der hinter ihr liegende äussere Rand des Grundgliedes, bei *queenslandica* Verh. dagegen ist diese Querlinie fast 1½ mal länger als jener Aussenrand.

Sättel der 6. Stomaplatte mit 10 Dornen jederseits, aber die Sättel sind nicht deutlich abgegrenzt. Ränder der 6. und 7. Stomaplatte, *zerstreut bedornt*, nur hinter den Sätteln etwas dichter. 15. Tergit nur noch mit wenigen Dörnchen.

Tarsus gliederung: 1. Beinpaar 12+25. 7. B. 5+21
3. „ 8+25 9. B. 5+21
5. „ 6+22.

Bedorunng am.	*Praefemur.*		*Femur.*		1. *Tarsus* hinten.
	oben.	unten.	oben.	unten.	
1.-5. Beinpaar	..	..	..	..	..
7. Beinpaar	0	1	0	1	4+0
9. Beinpaar	0	6	7	1	6+1

(10.-15. B. sind nicht erhalten).

Präfemur am 1.-5. B. *ohne* Dornen in der Borstenkammreihe. Tibialendstachel 1. Beinp. $\frac{0}{1}$ 3. und 5. B. $\frac{1}{1}$; 7. und 9. B. $\frac{1}{2}$; Tibia—Dornen oben: 5. B. 0; 7. B. 9; 9. B. mit 20.

Bei dem Grössen—und Geschlechtsunterschiede zwischen *tenuicornis* von Ceylon und *adjutrix* von Madras können meine Angaben selbstverständlich nur als Provisorium gelten. Die Unterschiede sind aber so beträchtliche, dass sie nicht einfach als epimorphotische betrachtet werden können, um so weniger, als die kleinere *adjutrix* teilweise höhere Dornenzahlen aufweist.

Vorkommen.—Madras.

Anmerkung.—Hier will ich noch darauf hinweisen, dass ich zwischen *Thereuopodina* und *Thereuopoda* einen wichtigen Unterschied in der Gestalt der *Präfemora* der meisten Laufbeine gefunden habe, denn in der Profilansicht erscheinen diese Präfemora bei *Thereuopoda* länger und vorwiegend parallelseitig, bei *Thereuopodina* dagegen kürzer und nach unten mehr oder minder bogig erweitert. Auf diesen Gegensatz werde ich später zurückkommen.

C.—Isopoda.

PORCELLIONIDAE.

Nagara (Nagara) clavigera, sp. nov.

In meinem 56. Isopoden—Aufsatz "über einige Isopoden aus Südindien" *Rec. Indian Mus.* Vol. XXXIII, 1936, dazu Taf. IV, habe ich kürzlich aus Dekan eine *Nagara travancoria* beschrieben und einen Schlüssel der besser bekannten *Nagara*—Arten gegeben. Die hier zu besprechende neue Art steht *travancoria* nahe, unterscheidet sich bera von allen im männlichen Geschlecht bekannten Arten durch das Ischiopodit am 7. Beinpaar des ♂ (Tl. XVI, Abb. 14).

♂ $3\frac{2}{3}$—$4\frac{1}{3}$ mm., ♀ $4\frac{1}{2}$ mm. lang (♀ mit Marsupium).

Stimmt in der grauen Farbe, sowie der Körnelung von Kopf und Pereion mit *travancoria* überein, ebenso in der Gestalt der Tergite, aber die Hinterecken des 3. Tergit sind *rechtwinkelig.* Stirnbildung auch wie bei *travancoria,* also die Seitenlappen des Kopfes aussen gerade und innen im Bogen begrenzt, abweichend von *teretifrons* und *incisa.* Die beiden südindischen Arten unterscheiden sich wie folgt:

travancoria Verh.	*clavigera,* sp. nov.
Rücken weniger gewölbt, die Epimeren des Pereion mit schwacher, aber deutlicher Anlage zur *Aufkrämpung.* Telson mit *abgerundetrechtwinkeligem* Dreieck. Uropoden Propodite etwas über das Telson hinausragend. Am 7. Beinpaar des ♂ ist das obere, terminale Ende des Ischiopodit *eckigrechtwinkelig* mit 3 Stachelborsten (Tl. XVI, Abb. 13).	Rücken höher *gewölbt,* daher die Epimeren gänzlich *ohne* Aufkrämpung. Telson mit *spitzwinkeligem* Dreieck. Uropoden—Propodite *nicht* über das Telson hinausragend. Am 7 B. ♂ bildet das keulige Ischiopodit oben gegen das dorsale Ende einen abgerundeten *Buckel* mit 4+2 Stachelborsten (Tl. XVI, Abb. 14).
1. Pleopoden—Exopodite des ♂ hinten *stumpfwinkelig* eingebuchtet, Spitzen der 1. Endopodite ganz *gerade* nach hinten gerichtet.	1. Pleopoden—Exopodite des ♂ hinten aussen ganz *ohne* Einbuchtung, Spitzen der 1. Endopodite leicht nach *aussen* gebogen.

Die Stirn beider Arten besitzt eine deutliche, gebogene, feine Leiste, welche die Seitenlappen aber nicht verbindet, sondern jederseits oberhalb derselben endet. In der Mitte ist sie nicht unterbrochen.

Vorkommen.—Innerhalb der Stadt Madras.

ARMADILLIDAE.

Armadillo (Armadillo) elevatus, sp. nov.

In Sarasin's und Roux's Werk *Nova Caledonia*, Vol. IV, S. II habe ich mich in meiner Bearbeitung der *Isopoda terrestria* auf S. 314 über meine neue Auffassung der Gattung *Armadillo* ausgesprochen und für die neukaledonische Art *rouxi* Verh. die Untergatt. *Pseudosphaerillo* aufgestellt. Diese unterscheidet sich von den typischen *Armadillo* u. a. durch die kurzen, aber breiten Pinsel an den Innenästen der 1. Maxillen. Bei ihr ragen ferner an den 1. Epimeren die Innen lappen unter den Hinterecken etwas vor, im Gegensatz zu Abb. 15 für *elevatus*.

In meinem 38. Aufsatz, *Zool. Anzeiger*, 1928, Bd. 76, H. $\frac{1}{6}$ habe ich ferner für Südamerikaner eine Untergatt. *Venezillo* aufgestellt, welche sich von *Armadillo s. str.* namentlich dadurch unterscheidet, dass an den 2. Epimeren des Pereion der Innenlappen " unten vollkommen durch tiefen Spalt getrennt " ist vom Aussenlappen und bei der Innen ansicht vorn beträchtlich über den letzteren hinausragt entgegen Abb. 16 für *elevatus*.

1931 hat W Herold, " Land-Isopoden von den Sunda-Inseln ", bearbeitet (*Archiv f. Hydrobiol.* Suppl., Bd. IX tropische Binnengewässer, Bd. II, S. 306-393). Daselbst gab er auf S. 315 einen Schlüssel über 7 Armadilliden—Gattungen, den ich besonders deshalb erwähne, weil *Armadillo* in ihm nicht vertreten ist.

A. elevatus, sp. nov. ♂ 5-6 mm., ♀ $5\frac{1}{2}$ mm. lg., mithin eine in dieser Gruppe ungewöhnlich kleine Art.

Körper schieferfarben, die Epimeren besonders am 1.-5. Pereionsegment weisslich abstechend. Rücken matt, ohne Höcker, aber an den Seiten der Pereiontergite etwas uneben rauh, daher sind auch Noduli laterales nicht zu sehen. (Bei *A. officinalis* mit seinem glatten Rücken sind sie bekanntlich scharf abgesetzt).

Stirnleiste wie bei *officinalis*, aber gleichmässig gebogen und in der Mitte *nicht* zurückgebogen. Ocellen 14 (3. 4. 4.3). Während bei *officinalis* die Ocellen ungefähr um die Lange ihres Haufens von der Stirnleiste entfernt sind, rücken sie hier fast bis an die Leiste heran, daher erscheint der Ocellenhaufen auffallend gross.

1. Tergit in der Mitte mit einem flachen, V förmigen Eindruck, sein Hinterrand jederseits schwach aber deutlich eingebuchtet, die 1. Epimeren mit ihrem Randgebiet *schaufelartig aufgekrämpt*. Der tiefe Spalt unten in den 1. Epimeren läuft unter allmähliger Abschwächung bis in den Vorderzipfel (Tl. XVI, Abb. 15). Der durch den Spalt abgetrennte Innenlappen ist hinten abgerundet-abgestutzt und endigt ein beträchtliches Stück *vor* dem Hinterrande des Tergit. An den 2. Epimeren ist ein ungefähr seine halbe Länge erreichender Innenlappen abgespalten, der weit hinter dem Seitenrand zurückbleibt, aber vom Vorderrand nur wenig abgerückt ist (Tl. XVI, Abb. 16).

Von den Zwei Pinseln an den Endopoditen der 1. Maxillen ist der innere sehr dünn, der aüssere breiter und kegelig, Exopodite mit 4, aüsseren stärkeren (davon einer verkürzt) und 5 inneren schwächeren Zähnchen. (Wie schon in Nova Caledonia besprochen, kann ich geringfügigen Unterschieden wie diesen an 1. Maxillen nicht die systematische Bedeutung beilegen, welche Budde—Lund ihnen zugesprochen hat.)

Uropoden (Tl. XVI, Abb. 17) am Aussenrand fast gerade, der Basalsockel innen neben dem Endopodit halb so lang wie das Propodit unten. Exopodit so kurz, dass es kaum $\frac{1}{4}$ der Entfernung zwischen seinem Gelenk und dem Hinterrand des Propodit erreicht. Decklappen (*d*) vor dem Exopodit schwach entwickelt, das ganze Propodit zellig—warzig. Telson dem von *officinalis* sehr ähnlich, der Hinterrand nur schwach gebogen.

1. Pleopoden des ♂ denen des *officinalis* im Ganzen recht ähnlich, die 1. Exopodite (Tl. XVI, Abb. 18) bei beiden am inneren Ende des Trachealfeldes stumpfwinkelig eingebuchtet, in der Mitte des Trachealfeldrandes bei beiden eingeknickt. Der *elevatus* besitzt spitze, schräg nach aussen gebogene Endopodite, während sie bei *officinalis* fast gerade nach hinten gerichtet sind.

Grosse Aehnlichkeit besteht zwischen beiden auch im 7. Bein des ♂. Das Meropodit ist bei beiden oben an der Basis eingeschnürt und nur wenig länger als breit. (Das 7. B. ♂ scheint bei *Armadillo* überhaupt von einfachem Bau zu sein.)

Vorkommen.—Madras, im Innern der Stadt auscheinend haüfig.

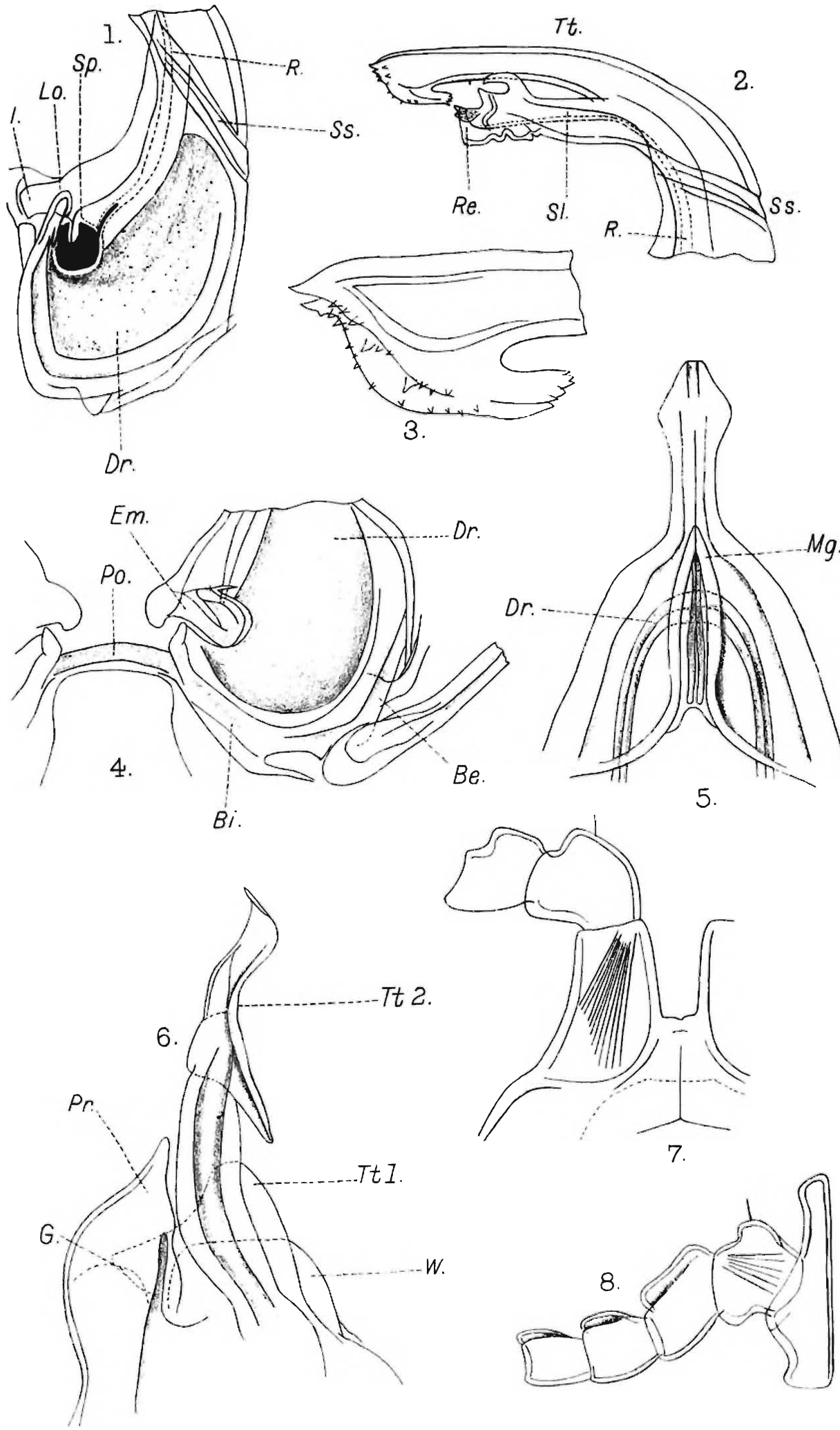
Die in diesem Aufsatze behandelten südindischen Formen übermittelte mir Herr Dr. S. Jones in Madras (University, Zoology Research Laboratory) dem ich für seine Freundlichkeit auch hier meinen besonderen Dank ausspreche.

Erklärung der Tafel XV.

ABB. 1-8.—*Erythroprosopon phoenix*, gen *et* sp. nov. ♂.

1. Grundhälfte eines hinteren Gonopod. *dk*, Kanal desselben; *dr*, Coxaldrüse; *i*, innerer Basallappen des Telopodit; *lo*, Läppchen neben der Basalgrube; *r*, Spermagang; *sp*, Spermamasse in der Basalgrube; *ss*, Schrägrinne des Telopodit. ×37.
2. Endhälfte eines hinteren Gonopod. *r*, Spermagang; *re*, terminales Stück desselben; *sl*, Solänomerit; *ss*, Schrägrinne; *tt*, Tibiotarsus. ×37
3. Endkeule des Tibiotarsus. ×125.
4. Grundhälfte eines hinteren Gonopod und Brücke (*po*) zwischen den hinteren Gonopoden. *be*, aüsserer Arm der Basalspange; *bi*, innerer Arm; *dr*, Coxaldrüse; *em*, Embolus; *s*, proximale, mit der Basalspange verwachsene Hälfte der Stütze (Tracheentasche). ×37

   (Abb. 4 allein ist nach Macerationspräparat gezeichnet, alle andern nach natürlichen Objecten.)
5. Sternit der vorderen Gonopoden. *Dr*, Versteifungsbogen; *mg*, Mediangrat. ×37.
6. Ein vorderer Gonopod ohne die coxale Basis. *g*, Gelenk zwischen Coxit und Telopodit; *pr*, coxaler Fortsatz; *tt* 1, basaler, *tt* 2, terminaler Abschnitt des Telopodit; *w*, Wulst. ×56.
7. Coxosternum des 2. Beinpaares, sowie ein Präfemur und Femur. ×37.
8. Ein 3. Bein ohne seinen Tarasus. ×37.


1.
Sp.
Lo.
I.
R.
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Dr.
Tt.
2.
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3.
Em.
Po.
Dr.
4.
Be.
Bi.
Mg.
Dr.
5.
Tt 2.
6.
Pr.
Tt 1.
G.
W.
7.
8.

Erklärung der Tafel XVI.

ABB. 9 UND 10.—*Polydesmopeltis xanthotrichus hamuligerus*, subsp. nov.

9. Gonopod von innen gesehen. *sl*, Solänomerit; *tt*, Tibiotarsus. ×56.

10. Endteil vom Tibiotarsus desselben. ×84.

ABB. 11 UND 12.—*Polydesmopeltis xanthotrichus hirsutus*, subsp. nov.

11. Gonopod von innen gesehen. ×56.

12. Endteil vom Tibiotarsus desselben. ×125.

ABB. 13.—*Nagara travancoria* Verh. Ischiopodit aus dem 7. Beinpaar des ♂, Seitenansicht. ×100.

ABB. 14.—*Nagara clavigera*, sp. nov. Dasselbe.

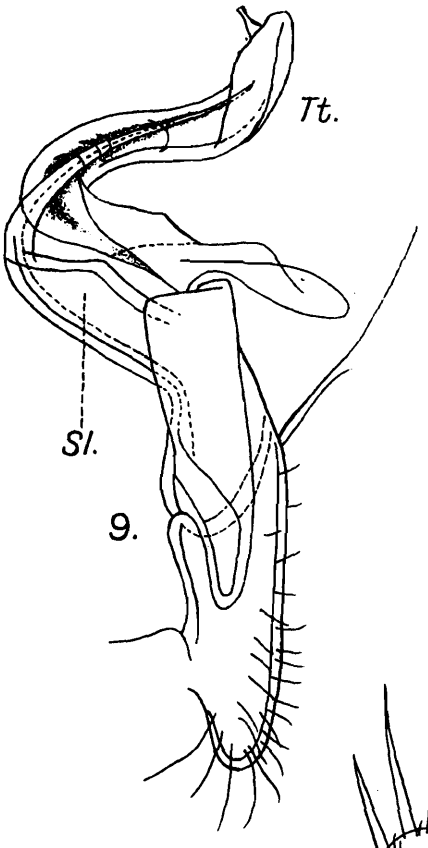
ABB. 15-18.—*Armadillo* (*Armadillo*) *elevatus*, sp. nov.

15. Epimere des 1. Pereionsegmentes, Ansicht von unten. ×56.

16. Epimere des 2. Pereionsegmentes, ebenso. ×125.

17. Isolirter linker Uropod von oben gesehen. *d*, Decklappen. ×125.

18. Linkes 1. Pleopoden—Exopodit des ♂, Ansicht von unten, links daneben das Endstück des 1. Endopodit. ×125.



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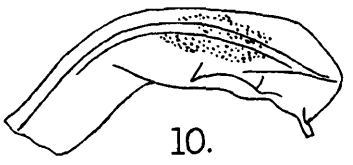

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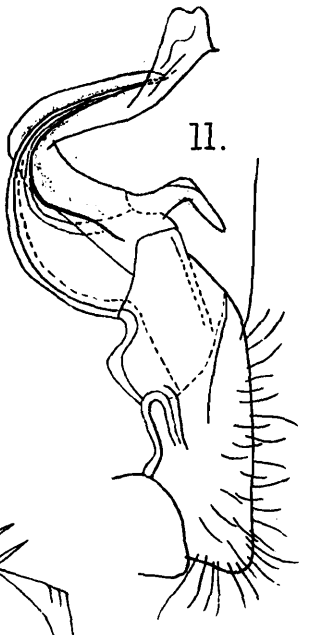

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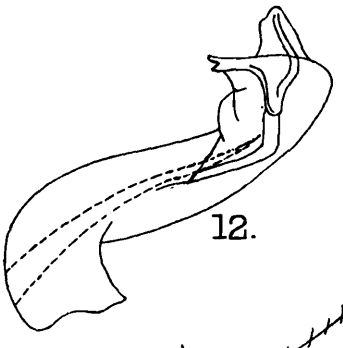

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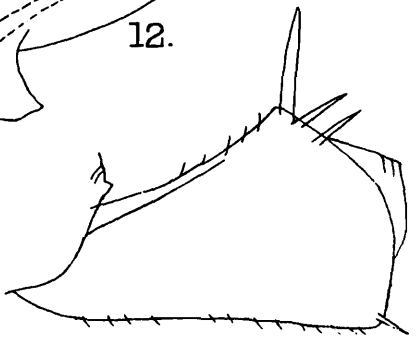

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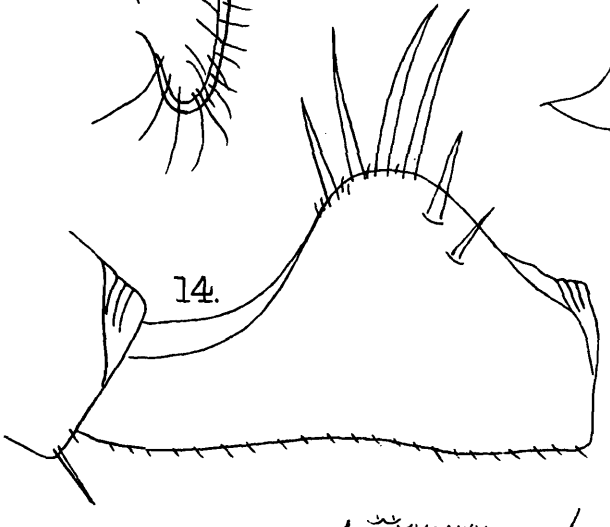

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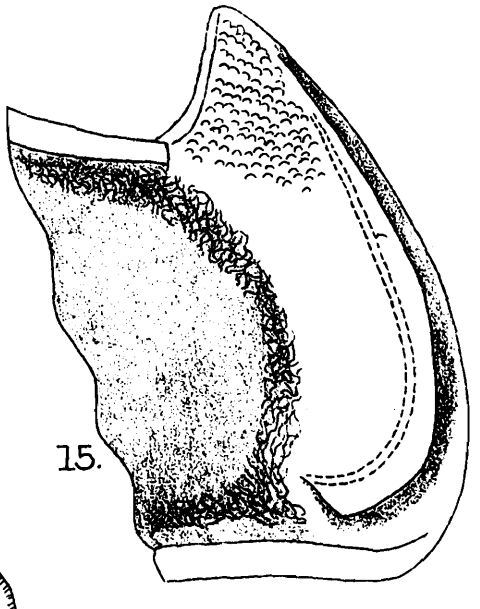

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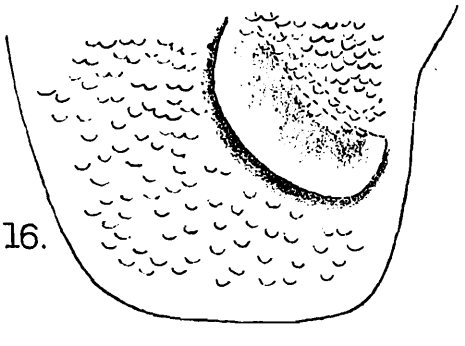

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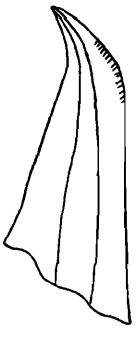

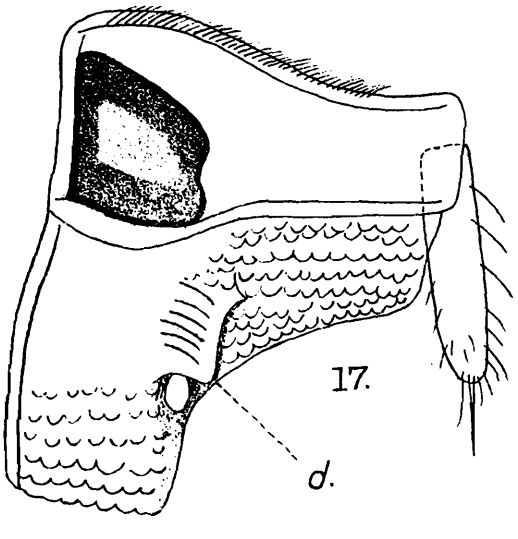

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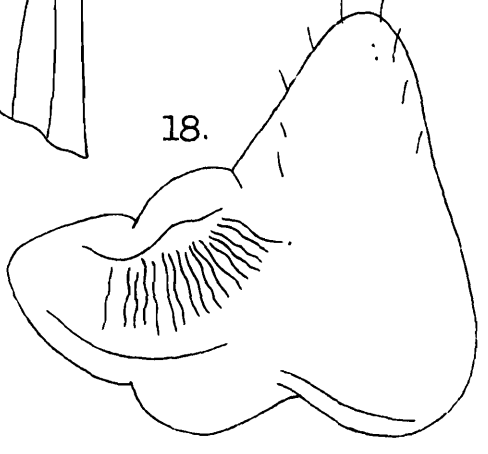

18.

ON A SPECIES OF *EUTYPHOEUS* FROM CALCUTTA.

By MAUNG HLA KYAW AND G. E. GATES.

Eutyphoeus masoni (Bourne) 1889.

Material examined.—From the Indian Museum: 3 aclitellate and 174 clitellate specimens labelled, "Collected from the lawn of the Museum House. October 1932." These worms are rather poorly preserved; the intersegmental furrows not clear especially ventrally in the post-clitellar region, the body wall adherent to the gut in the postprostatic region, the gut wall and certain other structures softened.

External characteristics.—Length to 200 mm. Diameter to 10 mm. No pigmentation now visible (alcoholic preservation).

The setae begin on segment ii. The setal distances are variable but the setal formula of xx can usually be represented as follows: $ab < cd < bc < aa$, $dd > \frac{1}{2}$ the circumference. The tips of the ventral setae of the clitellar segments are ornamented with short, transverse rows of fine teeth, with the rows more widely separated than on the penial setae.

The first dorsal pore is usually on 11/12 but functional pores may be lacking anterior to the clitellum, and possibly also, occasionally, for some distance behind the clitellum.

The clitellum is annular and extends from 13/14 or just behind the setae of xiii to or nearly to 17/18; dorsal pores and intersegmental furrows lacking, setae present. On a few specimens (7) the clitellum has a somewhat saddle-shaped appearance due to the slight development of the clitellar glandularity in the midventral region.

The spermathecal pores are small, slit-shaped to shortly elliptical, transversely placed apertures, the centres just lateral to *b*, in mid *bc*, or just median to *c*. The anterior and posterior margins of each aperture are usually slightly tumescent, protuberant and finely wrinkled. Just behind the posterior lip, there is, on many of the specimens, a transversely slit-like depression. This depression may be entirely lacking, slight, or of about the same size as the spermathecal pore. In the latter case the depression is continued as an invagination that is recognizable internally in the spermathecal duct when the latter is cut across horizontally fairly close to the parietes. On some of the specimens the opening of the posterior invagination might be mistaken for a spermathecal pore especially when the latter is tightly closed.

There is usually a single female pore, on the left side, presetal, in or about in *a*. Occasionally a second pore or rudiment of a pore is visible on the right side.

The vestibular apertures are shortly elliptical, transversely placed, in *ab*, often reaching slightly median to *a* and usually extending slightly lateral to *b*, on the average about $1\frac{1}{4}$ mm. wide and 1 mm. long (transverse and longitudinal diameters). On several specimens the vestibular roof has fallen so that the vestibular aperture is represented only by a crescentic, almost slit-shaped opening, the concave side of which faces anteromesially. The body wall is never depressed midventrally between

the two vestibular apertures. The vestibular lumen is wider than the aperture, deepest laterally, but does not extend internally, as a rule, above the general peritoneal level of the body wall. On the vestibular roof posterolaterally there is a rudimentary penis, nothing more than a low but fairly large annulus of soft, whitish tissue. A considerable number of specimens have been examined but in none of these do the penes attain a more definite development though the penial annulus is always present. The location of the penis seems to be variable, just lateral to *b*, in mid *bc*, or just median to *c*. This apparent variation may be the result of differences in contraction of the animal when killed. From the concavity within the annulus there may protrude two penial setae. These setae may be entirely lacking but there are never more than two.

The genital markings are paired, in *ab*, but often extending into *bc* or slightly median to *a*. The postclitellar genital markings appear to be intersegmental though on some specimens, (and those on which 18/19 is most clearly visible across the ventrum), 18/19 at least appears to pass behind a pair of genital markings. The intraclitellar markings on the aclitellate specimens are segmental and postsetal, extending posteriorly just to the intersegmental furrow. On the clitellate specimens the segmental location is not obvious but the markings usually are nearer to the anterior setae than to those next behind. The preclitellar markings (rarely present, 10 specimens) are, like the intraclitellar markings, segmental, first visible on the postsetal portion of the segment, but when fully developed dislocating the intersegmental furrow posteriorly though apparently not crossing that furrow. These markings are less sharply defined than the intra- and postclitellar markings. On each marking, when the specimen is well preserved, is visible a whitish, opaque, marginal rim or band surrounding a greyish, translucent, central area. The latter may have its long axis placed transversely (usually) or longitudinally. The markings are present on ix-x, xiii-xvi, and 18/19-26/27 as indicated below. The smallest number of markings noted is two pairs, on xv and 18/19 ; the largest number twelve pairs, on xiv-xvi and 18/19-26/27

Segment or Furrow.	Number of specimens.
xiii	1
xiv	54
xv	174
xvi	159
18/19 (or xviii)	174
19/20	158
20/21	84
21/22	38
22/23	6
23/24	4
24/25	3
25/26	2
26/27	1

Note.—On some of the specimens, one marking of a pair is lacking but this is not shown above, the asymmetrical marking being counted as if a pair were present.

Internal anatomy.—The intestine begins in xv (25). Lateral intestinal caeca have not been found in any of the specimens that were dissected (25). Unpaired, median and ventral caeca have been observed but the number and segmental locations are difficult to determine because of the poor preservation. In one specimen these caeca are present in segments xxxiv-lxvi. The supra intestinal glands are in four (1 specimen), five (5), or six (1) successive segments as follows : lxxxvi-xc, lxxxvii-xci (2), lxxxviii-xcii, lxxxviii-xciii, lxxxix- xcii, lxxxix-xciii. There may be only one pair of glands per segment or some or all of the glands may be crossed dorsally by a deep transverse groove which thus marks off two pairs of glands per segment. The dorsal wall of the gut in the segment next in front of the first gland segment may be thickened and whitened and may even be raised into a pair of rounded protuberances that look like rudimentary glands. The typhlosole is a low ridge, V-shaped in section. It begins in xxviii and extends into the last supra intestinal gland segment, apparently enlarged in the gland segments, smallest through a region in front of the gland segments.

The dorsal blood vessel terminates anteriorly with the hearts of vii (25). The last pair of hearts is in xiii (25). The hearts of xi are bound down to the gut and are not usually visible or their positions recognizable until the connective tissue has been dissected off.

There is an unpaired and suboesophageal testis sac into which the hearts of xi pass beneath the gut. The seminal vesicles are fairly large and extend from 10/11 to 12/13, pushing 12/13-13/14 back into contact with 14/15. The prostates are in xvii-xix or xx. The prostatic duct is 9-14 mm. long. There is a fairly well-developed and coelomic bulbus ejaculatorius, spindle-shaped, about 1 mm. long.

The spermathecal duct is rather short, only about 0·8 to 1·5 mm. long, muscular but without sheen, thick, longitudinally oval in horizontal section, the lumen fairly large, transversely slit-like to crescentic in section, eccentric and much nearer to the anterior than the posterior wall. On the posterior wall of the lumen is a rather conspicuous, smooth, vertical ridge. On this ridge is a fairly deep vertical groove. The spermathecal diverticula open into the lumen of the duct at the sides of the ridge. The duct is rather abruptly narrowed entally, the narrowed portion very short, not readily recognizable as the ampulla is bound down firmly around the entalmost portion of the duct. The diverticula are paired, median and lateral, the shape varying according to the number, size and arrangement of the small, ovoidal, seminal chambers. Each diverticulum is attached to the entalmost portion of the duct and may be posteriorly directed on both sides so that the two diverticula are separated from each other only by a slight gap, in contact with each other, or even grown together. In every worm dissected the diverticula, even when united posteriorly, open separately into the duct. After carefully dissecting off the ampulla, the narrowed portion of the duct may appear to be almost completely surrounded, except anteriorly, by the diverticula. The seminal chambers have a spermatozoal iridescence. The spermathecal ampulla is small, usually rather anteroposteriorly elongated, an anterior portion marked off from the larger posterior part by a deep dorsal groove. The anterior portion is lobed,

the lobes small, quite similar in appearance and often in size to the seminal chambers of the diverticula. Each of these lobes opens through a small aperture into the large, undivided lumen of the posterior portion of the ampulla. The small, anterior, ampullary lobes might very readily be mistaken for diverticula but (all specimens examined) no spermatozoal iridescence has been observed within any of these lobes which are almost always empty. Masses with spermatozoal iridescence, possibly spermatophores, have occasionally been noted in the spermathecal ampullae. Each of these masses is rather top-shaped, the bulbous, almost spheroidal portion resting on the opening from the ampulla into the duct, the narrowed, pointed portion within the duct lumen. Only one spermatophore is to be found within an ampulla and when present is always in the position indicated.

The genital marking glands are sessile on the parietes, each gland rather flat and usually slightly larger than its marking.

Though only two penial setae protrude simultaneously to the exterior through the penial annulus each penisetal follicle contains 5-9 setae (including the two functional setae). (Setae protruding to the exterior are considered functional setae while those within the follicle but not protuberant to the exterior are termed reserve setae.) The following numbers were noted : 5 setae (7 follicles), 6 setae (2), 7 setae (5), 8 setae (3), 9 setae (4). Length of the reserve setae varies from 2·4 to 4·5 mm. as follows : 2·4 mm. (1 seta), 3 mm. (4), 3·3 mm. (1), 3·5 mm. (3), 3·6 mm. (1), 3·9 mm. (1), 4 mm. (2), 4·1 mm. (1), 4·2 mm. (3), 4·5 mm. (1) —measurements made to nearest tenth mm. The functional setae are usually 4-5 mm. long. The thickness varies : at the ental end 0·055-0·060 mm. ; near the middle of the shaft, 0·032-0·035 mm. ; tip, when thickened (rarely) about 0·040 mm. The shape and appearance of the tip varies. Often the tips are obviously softened, wrinkled irregularly, folded back on or bent around the shaft, rarely split or cracked, more rarely with a short cavity at or near the centre of the shaft. The tips of the functional setae are often lacking, the seta having been broken squarely across. On those setae of which the tips appear to be least softened or modified the shape is again variable. The seta may narrow gradually to a bluntly rounded point, or the shaft may be slightly widened just behind the point in such a way as to produce a spear-head-like appearance, or the tip may be spoon-shaped. The hollowed-out portion is small and shallow but quite definite. The spoon-shaped tip may perhaps represent the state of least post-mortem modification, but is rare, usually found only once or twice in a follicle and occasionally not at all. The spoon-shaped tip has been noted more frequently on reserve than on functional setae but this frequency has little if any significance since so many tips of the functional setae are lacking. The ornamentation extends ectally nearly to the terminal point, ending in case of spoon-shaped tips just behind the hollowed or bowl portion and consists of closely crowded, transverse rows of fine spines. The rows may be short, rather irregularly placed and with but few teeth (fish-scale appearance) or the rows may be longer, less irregular, at times almost straight and approximating to circumferential rings. Although the short rows present a somewhat ' fish-scale ' appearance, the rows

are not as evenly spaced or regularly placed with reference to each other as figured by Michaelsen for *bastianus* (1909, pl. xiv, fig. 59). In one particular follicle one seta has a tip much like that figured by Stephenson for *orientalis* (1922, p. 438, fig. 3, right seta), another seta has a tip very like that figured for *bastianus* by Michaelsen (1909, pl. xiv, fig. 61) while two other setae, one reserve and one functional, have spoon-shaped tips. The second functional seta lacks the tip while the tips of other reserve setae are softened.

Remarks.—According to Stephenson's key (1923, p. 423) the worms from Calcutta described above must be referred to *E. masoni.* However it is necessary to point out that certain characteristics of taxonomic importance have never been studied in any of the specimens hitherto referred to that species.

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A NEW SPECIES OF *OLIGODON* FROM THE UNITED PROVINCES (INDIA).

By M. N. ACHARJI, *M.Sc., and* H. C. RAY, *M.Sc., Assistants, Zoological Survey of India, Indian Museum, Calcutta.*

In June 1936, an interesting snake of the genus *Oligodon* (=*Simotes*)[1] was received for identification by the Zoological Survey of India from the Deputy Conservator of Forests, North Kheri Division, Eastern Circle in the United Provinces. After a very careful examination of the specimen we came to the conclusion that it represented a species hitherto unknown to science. With a view to having our identification confirmed, the snake was sent to Dr. Malcolm A. Smith of the British Museum (Nat. Hist.), London, who favoured us with the following remarks :—

"I cannot identify it with any description or specimen in this Museum. It therefore appears to be new. It is almost identical in scalation with *Oligodon purpurascens cyclurus* from the Malay Peninsula, the only difference between your Indian specimen and the specimens from the Malay Peninsula being slight variations in the size of the head shields and very distinctly in colouration. If your specimen really came from the United Provinces it can hardly be associated with species that exist in Indo-China and Malay Peninsula."

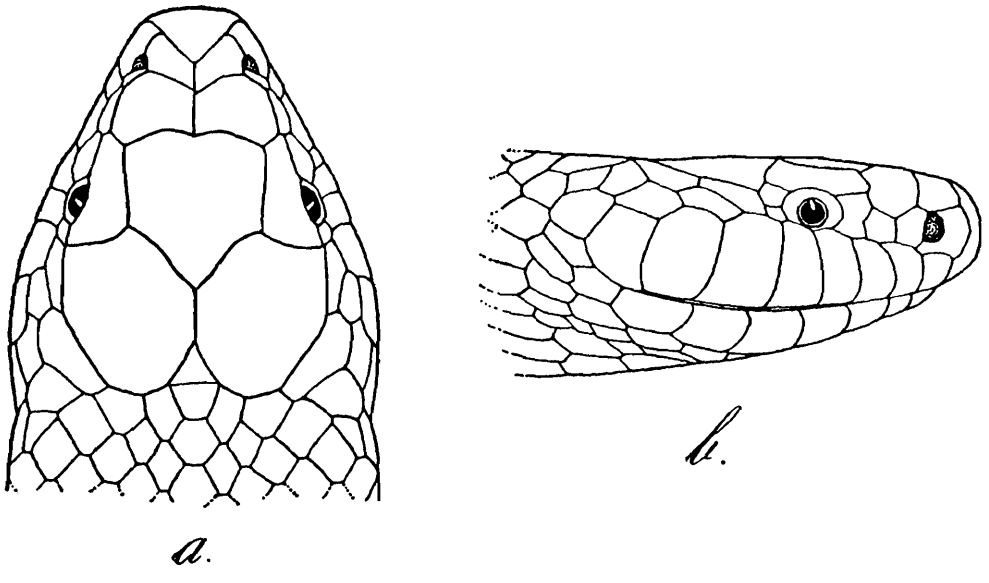
We take this opportunity to offer our grateful thanks to Dr. Malcolm A. Smith for the trouble he took in examining the snake for us.

To Dr. B. Prashad we are grateful for going through the manuscript and making useful suggestions.

Mr. B. Bagchi has kindly prepared the drawings under our supervision for which we are thankful to him.

Oligodon kheriensis, sp. nov.

Nasal divided ; portion of the rostral seen from above nearly as long as its distance from the frontal ; suture between the internasals much



TEXT-FIG.—*Oligodon kheriensis*, sp. nov. *a*. dorsal view of head ×*ca*. 3 ; *b*. lateral view of head ×2.

[1] Wall, F.—*Rec. Ind. Mus.*, XXV, p. 305, (1923).

shorter than that between the praefrontals ; frontal very slightly shorter than its distance from the end of the snout, and larger than the parietals ; loreal single, as long as deep ; praeocular single (large), no subocular ; postoculars two ; temporals 2+2 (anterior ones superimposed) ; upper labials 8, of these 4th and 5th enter the eye ; lower labials 1-4 in contact with the anterior chin-shields, which are greatly larger than the posterior ones ; anal entire ; ventrals 197 ; subcaudals 38 in two rows ; scales in rows, two head-lengths behind the head 19, middle of the body 19, two head-lengths before the vent 17.

Shape of the pupil of the eye round. Head not distinct from the neck. Body cylindrical. Colouration coral red above, yellowish below.

Measurements.—Total length 3 ft. 1 inch ; from snout to vent 2 ft. 9 inches ; from vent to the tip of tail 4 inches.

Locality.—*Oligodon kheriensis* was killed in a forest camp in North Kheri Division, Eastern Circle, Kheri-Lakhimpur, in the United Provinces.

Type specimen.—No. 20391 in the collection of the *Zoological Survey of India* (*Ind. Mus.*), *Calcutta.*

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