THE EARTHWORMS OF BURMA. III.

THE MEGASCOLECINAE.

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CONTENTS.

INTRODUCTION.

Most of the earthworms collected in 1931 came from the central and eastern sections of the province. In the southern portion of the Central Basin Region, Miss Anderson arranged for the collection of worms in the Pegu yomas near Tharrawaddy, while K. John, the laboratory collector, travelled through the Southern Deltas Section and as

far north as Pyinmana during August and September. In the eastern section of the Peripheral Hill Region Mr. Sutton secured collections from the northern and southern portions of Tavoy District, from the northern and middle portions of Mergui District and in addition arranged with Saw Nelson for the collections from Victoria Point, the southernmost extremity of Burma. Further north in the Tenasserim Division K. John collected during October in a region extending from Ye north to Thaton. Mr. Blackwell secured collections from the Toungoo Karen Hills of the Shan Plateau to the north of Thaton. Further north H. B. Gates collected at Taungyi, while H. Young made collections at a number of localities near the Sino-Burman border. Still further north, Mr. Woodbury sent worms from Bhamo and Mr. Dudrow sent a collection from Myitkyina.

From two other sections worms were also secured. Mr. Bruce of Sandoway sent in several bottles of the worms that he was able to find in the vicinity of that village on the west coast, while Dr. Amirthalingam made collections at various localities in the Andaman Islands from July throughout the rest of the year.

In these collections there are between ten and fifteen thousand earthworms. An adequate treatment of this mass of material will necessarily extend through several rather bulky contributions. This paper has accordingly been limited to the consideration of a single subfamily, the Megascolecinae.

Material belonging to each species of the subfamily recorded from Burma has been examined or re-examined with the exception of the following species :—*Plutellus inflexus*, the two species of *Woodwardiella*, *Perionyx m'intoshi*, *P. ditheca*, and *P. arboricola*. Whenever possible the original specimens have been examined.

The results of the years work on the Megascolecinae may be briefly summarized as follows :—*N. choprai* is a synonym of *N. depressus*. *P. browni* Gates 1930 has to be replaced by *P. molesta*, nom. nov. *P. pinguis* is reduced to a variety of *P. carinensis*. *P. wimberleyana* is relegated to the synonymy of *P. campanulata typica*. Variety *manicata* of *P. suctoria* is raised to the status of a species. Variety *choprai* of *P. andersoni* is raised to the status of a species. *Perionyx fulvus* is probably a synonym of *P. excavatus*. One new species each of the genera *Plutellus* and *Notoscolex* and 21 of the genus *Pheretima* are described, and 15 new varieties of the already known species of the genus *Pheretima* are also recorded.

Zoogeography and Distribution.—The number of species of *Pheretima* in the Tenasserim Division and the Shan Plateau is much larger than was previously thought. Endemic species of *Pheretima* are confined to the northern and eastern portions of the Peripheral Hill Region and to the Andaman Islands. The genus *Notoscolex* extends through Burma in a southerly direction as far as Pyinmana and Toungoo and in an eastern direction across the Shan Plateau and into the province of Yunnan.

Especial attention is invited to the introduction to the genus *Pheretima* and to the discussion of abnormality and parasitism in the appendix to *P. alexandri*.

As the publication of papers on other subfamilies of the Burmese Oligochaeta may be delayed for several years, I wish to call attention

to several points in connection with two of the sub-families. The Moniligastrine genus *Drawida* extends throughout a very large part of the province of Burma, reaching in a southerly direction to the southernmost extremity and in an eastern direction extending across the Shan Plateau into the province of Yunnan. The Octochaetine genus *Eutyphoeus* extends throughout the western and central sections of the province and in the eastern portion reaches in the Tenasserim Division as far south as the Mergui District. The genus penetrates into the western edge of the Shan Plateau at the Karen Hills of Toungoo but has not been found elsewhere in the Plateau. *Octochaetus lunatus* is a synonym of *O. fermori.*

ACKNOWLEDGMENTS.

The writer wishes to express his sincere appreciation of the labours of those individuals mentioned in the introductory paragraphs who have rendered invaluable assistance by the collection of earthworms from remote and out of the way places that are practically inaccessible to the author. Especial mention is due to Mr. Young who not only made collections from a number of localities in a very remote and interesting portion of the province but who also took considerable pains to see that the specimens from the various localities were not mixed. Mr. Young also furnished notes as to the altitudes of the localities concerned and the types of soil in which the worms were found. The Director of the Zoological Survey of India loaned a number of specimens from the Indian Museum and also very kindly arranged with Dr. Amirthalingam for the collection of worms in the Andaman Islands. Maung Kyaw Zan has continued his assistance with the illustrations.

The author is again indebted to the authorities of the University of Rangoon for a grant from the research funds of the University sufficient to pay for a large share of the expenses of collection.

ADDITIONAL NOTES.

Types of new species and, whenever possible, specimens of old species are to be deposited in the Indian Museum. The figures of the genital markings are free-hand sketches. The figures of the spermathecae and other internal structures are camera lucida drawings. Titles of papers containing descriptions of Burmese species have not, as a rule, been repeated in the bibliography which contains only the titles of papers referred to in the text.

SYSTEMATICS.*

Family MEGASCOLECIDAE.

Sub-family *MEGASCOLECINAE.*

Genus **Plutellus** E. Perrier.

Three species of this genus have been recorded from the province of Burma, two from the Chindwin Valley and one, *P. pratensis*, sp. nov.,

* Except in special cases, references to original specific descriptions are given only for species founded subsequent to the publication of Stephenson's Oligocha ta in the Fauna of British India Series (1923). Reference may be made to that monograph for other specific descriptions or for lists of previous accounts.

from Toungoo. These worms are all small, but not quite so diminutive as those of the genus *Woodwardiella*. Both *Plutellus* and *Woodwardiella* may be more common and widely distributed than the records show :— collectors almost always overlook such small earthworms.

The nearest *Plutellus* area is in India, Stephenson's North-eastern Frontier Region, from which two species have been recorded (Darjiling District and the Abor Country).

Plutellus ambiguus Gates, 1931.

1931. *Plutellus ambiguus*, Gates, *Rec. Ind. Mus.* XXXIII, p. 357, figs. 5—7.

The preclitellar genital markings are in *aa*. The spermathecal pores are minute, in the region of *ab*, but do not appear to have a definite relationship to the setal lines, being sometimes nearer to the line of setae *a* than to *b*, sometimes *vice versâ*. The spermathecal diverticulum passes into the mesial face of the duct.

While the description of this species was in the press a paper by Stephenson was published containing a description of *P. inflexus*. The latter is therefore the first species of the genus *Plutellus* to be described from Burma.

On first comparing the accounts of *P. inflexus* and *P. ambiguus*, the differences between these two forms appeared to be so few and unimportant that the two forms were thought to be identical or at most distinct varieties of the same species. The points of difference may be summarized as follows :—

1. *P. ambiguus* lacks the characteristic " hooking " of the anterior end. This may not at first appear to be important but the bending must be correlated with some special internal structure or structures. An almost exactly similar hooking always characterizes Burmese specimens of *P. corethrurus* which like *P. inflexus* cannot be straightened out. Several attempts have been made to anesthetize and kill worms of the former species so that they will be straight but all have failed. Many hundreds of specimens of various genera and species have been killed in the exact manner as the *P. corethrurus* and without showing any signs of the hooking.

2. *P. ambiguus* is more than one half again as long as the longest specimens of *P. inflexus*, the length of the latter 40—55 mm., of the former 85 mm. *P. inflexus* is thicker, 1·5—2 mm., maximum diameter, while *P. ambiguus* is 1 mm. thick throughout. The single specimen of the latter species lacks clitellar glandularity which may be taken to indicate that it is immature. Maturity may further accentuate these differences.

3. The preclitellar genital markings of *P. ambiguus* are large, more clearly demarcated and more protuberant than in *P. inflexus*.

4. The midventral region of xviii of *P. inflexus* has a slightly different appearance from that of the same region of other segments which may be taken to indicate a special glandularity. This region however is only faintly indicated and may extend slightly onto xix. On segments xvii and xviii of *P. ambiguus* there is a much more clearly outlined area which bears a pair of small but quite definite tubercles.

5. The last pair of hearts is in xii in *P. inflexus*, in xiii in *P. ambiguus*.

6. The penial setae of *P. ambiguus* have two slight bends, one at each end of the shaft, the two bends or curvatures in opposite directions. The shaft of the penial setae of *P. inflexus* is " only slightly bowed but the proximal end is considerably curved," the bending of the proximal end of the same side of the shaft as the slight bowing of the distal end.

As the single specimen of *P. ambiguus* is probably immature while the specimens of *P. inflexus* are apparently fully mature it is quite possible that some of these differences will be found to be even more significant when mature specimens of the former species can be taken into consideration. Therefore and until the extent of variation of those characteristics that are of systematic significance has been determined, the two forms are regarded as specifically distinct.

Plutellus pratensis, sp. nov.

Toungoo, September, 1 specimen, K. John.

External characteristics.—Length 63 mm. Greatest diameter 3 mm. Number of segments ca. 167. Unpigmented; clitellum, greyish.

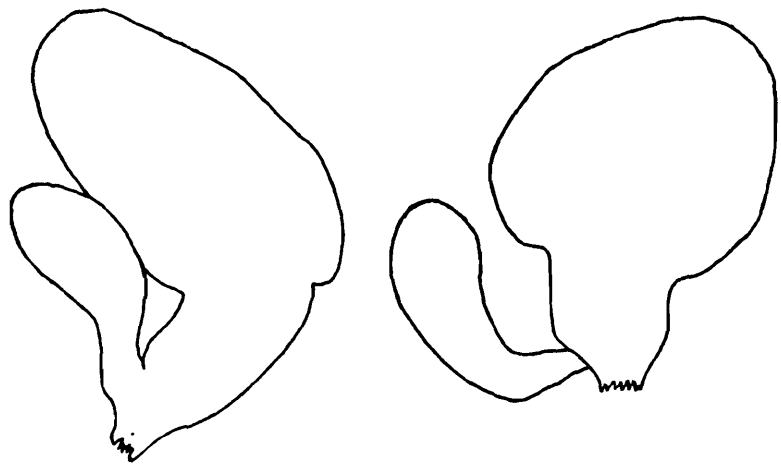
The prostomium is prolobous, the posterior dorsal furrow separating the prostomium from the peristomium very slight, not deep as in *Drawida.*

There are two secondary furrows per segment from v posteriorly, except on xii, the clitellar segments and the posterior-most segments; one secondary furrow presetal, the other postsetal.

The setae are four pairs per segment and begin on ii. Behind the clitellum *ab* is smaller than *cd*, *bc* smaller than or about equal to *aa*.

The first functional dorsal pore seems to be in 7/8 but there is a distinct pore-like marking in 6/7

The clitellum is saddle-shaped and extends dorsally from 12/13 to 17/18, reaching ventrally to or nearly to setal line *b*. There is a dorsal pore in the region of 13/14 but otherwise dorsal pores and intersegmental furrows are lacking; ventral pairs of setae visible but lateral pairs not recognized.



TEXT-FIG. 1.—*Plutellus pratensis.* Spermathecae × ca. 32·5.

The spermathecal pores are two pairs, anteriorly on viii and ix, near to but not actually in contact with the intersegmental furrows which are dislocated anteriorly by a small distance just in front of the pores. The latter are slightly medial to the line of setae *b*.

The female pores are on xiv slightly anterior and medial to *a*.

The male pores are on xviii about in line with *b*.

The genital markings are small, faintly demarcated, transversely oval areas, paired on viii and ix and on 16/17 and 19/20. The preclitellar markings are presetal and so placed that their centres are about in line with *a* from which they extend transversely into mid *ab* and to a similar distance median to *a*. The posterior markings are slightly larger and extend laterally nearly to *b* and medially nearly to the midventral line. In addition there is a pair of round, greyish depressions on xviii, each depression delimited on three sides by a slightly protuberant whitish ridge in the shape of a u with the aperture of the u facing the midventral line. Immediately anterior to the anterior limb and immediately posterior to the posterior limb of the u-shaped ridge is a tiny transversely oval greyish marking. Each of these tiny markings

seems to be provided with a pore. The male pores are located in the depressions just medial to the base of the u-shaped ridge.

Internal anatomy.—There is a well developed gizzard in v.

The last pair of hearts is in xii.

The nephridia pass into the parietes about in line with *b*.

In x a pair of small, round, whitish bodies was attached apparently to the anterior face of 10/11 immediately under the oesophagus and medial to the hearts of the segment but were broken off in clearing out the coelomic coagulum from the segment.

Testes were not seen but the paired male funnels are readily visible in x and xi. There are paired, lobulated, small seminal vesicles in xi and xii. The prostates are cylindrical, contorted, extending through xviii and several additional segments posteriorly. The prostatic duct is short, bent into the shape of a u and bound to the parietes by strands of connective tissue.

The ovaries are in the usual locations in segment xiii but the oviduct funnels were not seen. The spermathecae are in viii and ix ; the duct shorter than the ampulla, the single diverticulum is club-shaped.

Remarks.—The single specimen is not in good condition, having been considerably flattened out by the pressure of much larger worms from above in the jar in which it was transported ; also the clitellar region is cracked. The spermathecal pores, male pores and right female pore were not visible when the specimen was first examined. But after opening the worm and clearing out the masses of coelomic coagulum which filled the anterior segments all of these pores could be definitely recognized with a high power of the binocular. The coagulum in segments x-xiv was of a more sticky nature than elsewhere and in removing this material the seminal vesicles were damaged and the very fragile septa 13/14 and 14/15 were destroyed. For these reasons the account above is not as satisfactory as is desired.

The nearest locality from which *Plutellus* has been recorded in Burma is the Chindwin Valley. The present species is quite distinct from both *P. ambiguus* and *P. inflexus* from that region. *P. pratensis* resembles *P. aquatilis* and *P. kempi* from the Nilgiri and Palni Hills of South India in having two pairs of spermathecal pores on viii and ix but may be readily distinguished from them by the genital markings as well as other characteristics.

Genus **Pontodrilus** E. Perrier.

Pontodrilus bermudensis Beddard 1891.

This species is littoral and widely distributed throughout the world. In Burma it has been found near the seashore at the mouth of the Irrawaddy River.

Genus **Woodwardiella** Stephenson.

Two species of this genus have been recorded from Burma, *W burkilli* Michaelsen 1907 from Buthidaung in Akyab on the Western Coast and *W pumila* Stephenson 1931 from Bhamo in the northern portion of the peripheral hill region. The nearest regions in which species of this genus have been found are Java and Cochin in South India.

The Burmese species are small, about 1 mm. in diameter and reaching a length of only 36—50 mm. *W burkilli* has no penial setae, *W pumila* has penial setae.

Genus **Notoscolex** Fletcher.

All Burmese worms assigned to this genus are much alike, having the following characteristics in common :—

1. Lack of pigment.
2. Spermathecal pores in 6/7—7/8, either in line with *a* or median to *a*.
3. Paired female pores on xiii.
4. Male pores on xvii in seminal grooves which extend across xvi and xvii or xvii and xviii.
5. Well developed gizzard in vi.
6. Intestine begins in xiv.
7 Paired, stalked, calciferous glands in ix—xii.
8. Last pair of hearts in xii.
9. Paired male funnels (and presumably testes) in ix and x. No testis sacs.
10. Paired seminal vesicles in x and xi.
11. Prostates elongate, flattened, with smooth median margin and lobed lateral margin, the lobulations due apparently to lateral constrictions of the margin of the gland by the septa. The glands thicker towards the median margin than at the lateral margin.
12. The prostatic ducts soft and whitish.
13. Spermathecae pass into the parietes in close contact with the nerve cord.
14. Each spermatheca has a single diverticulum which passes into the anterior face of the spermathecal duct.
15. Ovaries and oviduct funnels in xii.

The three species of the genus that have been recorded from Northern India, *N. oneilli*, *N. stewarti* and *N. striatus* are like the Burmese worms with respect to many if not all of these characteristics. A single, immature earthworm from Cherrapunji, Assam, which Stephenson placed in the genus *Megascolex* has also many of the characteristics listed above and is, apparently, much more like the Burmese-North Indian species of *Notoscolex* than the Indian species of *Megascolex*. The only justification for placing this worm, *M. horai*, in the genus *Megascolex* is the possession of perichaetine setae (26—32 per segment).

Adequate taxonomic characterization of the Burmese forms, so similar with respect to many of their structures, is a matter of some difficulty as has been obvious in previous accounts. The difficulty is enhanced by the inability to use the other characteristics ordinarily employed for systematic purposes. Thus the setal relationships are of little if any use in this connection. Numbers of specimens lack setae. Other specimens have setae only on a few scattered segments. When setae are present they may be minute and so deeply retracted into the parietes as to be scarcely visible. When the full eight ranks of setae

are present along the whole length of a specimen and a number of such specimens are available for comparison it is often found that the setal intervals vary, not only from one individual to another but also from one segment to another on the same worm. Characteristics of the prostates and their ducts and of the spermathecae have been used but are subject to some variation and until the extent of this variation can be determined in the various forms must be employed with considerable caution.

A further hindrance to the work on this genus has been the lack of fully mature specimens. This applies especially to the giant forms. No fully mature specimens of *N. birmanicus* have been available for study as yet. The three giant forms from the Chindwin Valley were obtained in aclitellate stages only. Individuals of other species, with clitella fully developed have been found but not in large numbers. Furthermore many of these mature individuals have been, for reasons not now clear, in rather poor condition.

Aclitellate individuals can however be secured readily at almost any *Notoscolex* locality. A number of such specimens have been collected and examined. On many of these worms the genital area containing the seminal grooves is well developed. The shape of these grooves varies so that it is sometimes possible by use of this characteristic to separate the specimens from a particular locality into several groups (*vide* Chindwin Valley forms, Gates 1930, p. 300, and " Taungyi forms " hereinafter). But is such a characteristic of taxonomic significance and if so can it be used to identify immature specimens ?

It so happens that *N. birmanicus* is fairly well characterized. It is the only giant form to be found in the vicinity of Maymyo. In addition it is distinguished from all other Burmese forms, giant or otherwise, by a pair of transversely ovoid, stalked bodies on the anterior portion of the male genital field. Furthermore these ovoid bodies are recognizable before the clitellar glandularity begins to develop. All specimens of this species—previously identified by the size and possession of ovoid bodies—have been re-examined. On each specimen the seminal grooves are characteristic in shape, regardless of stage of development. There is no significant variation from one individual to another.

Specimens previously assigned to the species *N. depressus* and *lunatus* have also been re-examined. In each of these two species there is no significant variation in the shape of seminal grooves which are characteristically different in each case from those of *N. birmanicus*. Immature specimens from a *depressus-lunatus* locality that can hardly belong to other species have grooves like those of the adult specimens. *N. triquetrus*, sp. nov. from the Karen Hills also has characteristic seminal grooves without appreciable variation in shape. Immature specimens of Notoscolex from the *triquetrus* localities have seminal grooves identical with those of the adult worms.

The shape of the seminal grooves, because of this diversity of form and absence of individual variation, is therefore a characteristic of utmost importance when dealing with forms otherwise so much alike. Furthermore it should be noted that the conformations of the seminal grooves are more readily recognizable in aclitellate stages than in later stages

after the grooves have been more or less concealed as the result of the development of ridges and depressions. With proper precautions the identification of immature specimens should be possible.

Other characteristics of the male genital field such as the presence of ovoid bodies, u-shaped ridges, additional grooves and " tag-like processes " may all be of especial significance and should be carefully described.

Parasites.—In many of the specimens there are numbers of flattened " brown discs " in the anterior segments. These discs are composed of masses of granular material and of pseudonavicellae cysts. Setae are almost always lacking, one disc contained three, slightly eroded setae. Gregarine trophozoites have not been found. It may be noted that discs with pseudonavicellae cysts were found in immature specimens in which the seminal vesicles were but just recognizable.

While examining a specimen of one of the giant forms from the Chindwin Valley, a quite definite widening of the entalmost portion of the prostatic duct was noticed. A similar widening characterizes all specimens examined, not only of this particular form but also of the two other forms from the same locality. In some specimens the appearance of this portion of the prostatic duct is that of a well developed, highly muscular bulbus ejaculatorius. The duct in this region is, however, merely distended by the accumulation within the lumen of masses of nematode ova. In one duct there was found, in addition to the ova, a gravid female nematode. The vasa deferentia of some of the worms are larger than usual, due also to distension as a result of the presence of the nematode ova. In segments ix and x of these specimens there are always numbers of rather attenuated nematodes.

Additional notes.—The vasa deferentia of a side are not in contact but are widely separated in all of the giant forms.

A misprint in my earlier paper (1930) requires correction. The first two sentences on page 301 should read as follows :—The male funnels in ix and x are larger than the female funnels and slightly more dorsal in position. There are paired seminal vesicles in x and xi.

Notoscolex birmanicus Gates.

1927. *Notoscolex birmanicus,* Gates, *Anns. Mag. Nat. Hist.* (9) XIX, p. 609.
1929. *Notoscolex birmanicus,* Gates, *Proc. U. S. Nat. Mus.* LXXV, 10, p. 14, fig. 5.
1931. *Notoscolex birmanicus,* Gates, *Rec. Ind. Mus.* XXXIII, p. 360.

The first dorsal pore is in 10/11.

The clitellar glandularity, only faintly indicated on the best developed specimens, extends from 12/13 to 16/17 dorsally and to just behind the setae of xvi ventrally.

The spermathecal pores are fairly large, anteroposteriorly elongated slits, closely paired in the middle region of *aa.*

On segments xvii and xviii there is a deep midventral depression, the body wall lateral and anterior to this depression protuberant as a U-shaped ridge extending across xviii and xvii and onto the posterior portion of xvi with the limbs of the U directed posteriorly. The deep seminal groove, for there is only one, is also U-shaped and located on

the lateral and anterior walls of the depression. Posteriorly on each side the groove begins in mid *bc*. Anteriorly the two limbs of the groove bend towards the midventral line on the presetal half of segment xvii. The male pores are located in the seminal groove, one on each side just at or just behind the region of the midventral bend. Attached to the posterior margin of the seminal groove, at a point just lateral to the midventral line, there is on each side a transversely ovoid, whitish body attached by the median end or by a short stalk from the median end.

On specimens without the slight clitellar glandularity the midventral depression and the U-shaped ridge are also lacking. There is however a fairly large, slightly protuberant but poorly demarcated median genital area extending across segments xvii and xviii. On this genital area the U-shaped seminal groove is clearly visible. The whitish ovoid bodies are much smaller on these specimens but are readily recognizable.

The spermathecal ampulla has a warty or papillated appearance. The duct is short and stout, almost confined to the parietes within which it is hardly narrowed. The diverticulum is a small, wart-shaped protuberance from the anterior face of the duct near the ampulla.

The prostates are long, extending from segment xvii or xviii into the region of xxviii-xxxv. The prostatic duct emerges from the median margin of the prostate in xviii and passes anteriorly in a straight line into xvii and then into the parietes. The prostatic duct is 5—8 mm. in length and may be perfectly straight or with one or two small u-shaped bends of the ectal-most portion. The vas deferens passes posteriorly through xvii and into the prostatic duct in xviii as the latter emerges from the prostate.

Notoscolex depressus Gates.

1929. *Notoscolex depressus*, Gates, *Proc. U. S. Nat. Mus.* LXXV, 10, p. 14, figs. 6, 7.

1929. *Notoscolex choprai*, Stephenson, *Rec. Ind. Mus.* XXXI, p. 230, figs. 3, 4.

Material examined. Two tubes from the Indian Museum labelled " W1560/1. *N. Choprai.* Lonton, 18-31 x 26″ (5 specimens) and " *N. choprai* sp. nov. Nyaungbin, 7—10 xi 26. (2 specimens). Judson College Collection. Several tubes of specimens collected at Maymyo. The type specimen.

The first dorsal pore is in 9/10.

The clitellar glandularity extends from just behind the setae of xii or from 12/13 to 16/17 dorsally and to just behind the setae of xvi ventrally.

The spermathecal pores are more rounded than on *N. birmanicus*, smaller, and further apart, each pore in setal line *a* or very slightly median to *a*. (Due to a typographical error the pore was said to be in line *c* in the original description.)

There is a deep, midventral depression on xvii and xviii, the body wall protuberant as a U-shaped ridge on three sides of this depression. The ridge extends across xviii and xvii and onto the posterior portion of xvi with the open end of the " U " facing posteriorly. The seminal grooves are located on the anterior and lateral walls of the depression. Each groove is somewhat like a letter f without the cross bar. Anteriorly each groove ends abruptly on the presetal portion of xvii just before the midventral line is reached. Around the anterior end of each groove

is a specially protuberant but short, u-shaped ridge with the limbs of the " u " directed laterally. The limbs of the " u " are thickish, the appearance of the ridge as a whole like that of a transversely ovoid genital marking interrupted on the lateral margin by the penetration of the seminal groove. In most specimens the anterior and median-bent portion of each seminal groove is on the floor of the depression rather than on the anterior wall. In Stephenson's specimens the depression and the U-shaped ridge are much less sharply marked off.

The male pore is in the seminal groove just at or just behind the anterior bend towards the midventral line and not at the anterior end of the groove as shown on Stephenson's figure.

There are calciferous glands in ix-xii in the Indawgyi as well as in the Maymyo specimens.

The surface of the spermathecal ampulla is smooth. The spermathecal duct is stout but is narrowed in the parietes. The coelomic portion of the duct is about as long as the ampulla. The diverticulum is shorter than, of the same length as, or very slightly longer than the ampulla ; it may be straight, or bent once or twice ; the ental end may or may not be slightly widened. The diverticulum passes into the anterior face of the duct.

The prostates extend from xvii into xxi-xxiv. The prostatic duct is 4—8 mm. in length. It emerges from the median margin of the prostate in xviii and passes directly forward into xvii where the ectal-most portion may be bent into one or two shortly U-shaped loops fastened to the parietes.

Remarks.—Stephenson's specimens quite evidently belong to the same species as the Maymyo worms. Gates' paper was published either in July or August 1929, so that *N. depressus* has priority over *N. choprai.*

Notoscolex lunatus Gates.

1929. *Notoscolex lunatus*, Gates, *Proc. U. S. Nat. Mus.* LXXV, 10, p. 16, figs. 8-9.
1930. *?Notoscolex lunatus*, Gates, *Rec. Ind. Mus.* XXXII, p. 299.

The first dorsal pore is in 9/10.

The clitellum extends from just behind the setae of xii or from 12/13 to 16/17 dorsally and to just behind the setae of xvi ventrally or to just behind the setae of xvi both dorsally and ventrally.

The spermathecal pores are small, rounded apertures. Each pore is in setal line *a* or very slightly median to *a*.

On immature specimens of this species there are two, protuberant, oval, diagonally placed genital markings extending across segments xviii and xvii. The anterior end of each genital marking is nearer the midventral line than is the posterior end. On each of these areas there is a crescentic seminal groove, the concavity of the groove directed antero-laterally, *i.e.*, slightly diagonal with respect to the midventral line. In some specimens the seminal groove is continued anteriorly beyond the front margin of the marking in a lateral direction. It should be noted that the concavity of the seminal groove on these specimens faces in a direction opposite to that of immature specimens of *N. depressus*,

In mature specimens there is a deep midventral depression which is narrower than on *N. birmanicus* and *N. depressus* and with a much more abrupt posterior margin than on the two species just mentioned. Around three sides of the depression is a U-shaped ridge extending across xviii and xvii and onto the posterior portion of xvi with the limbs of the " U " directed posteriorly. The oval genital markings are on the median faces of the limbs of the ridge and on the lateral walls of the depression. Anteriorly and deep within the depression the seminal groove of each side passes beyond the oval marking in a lateral direction and then turns and passes directly towards the midventral line, ending a short distance from that line between the thickish arms of a small u-shaped ridge much like the ridge in the same position on *N. depressus.*

The male pores are in the anterior portion of the seminal grooves just behind the midventral bend.

The spermathecal duct is narrowed within the parietes, the coelomic portion is stout and of about the same length as the ampulla. The diverticulum is longer than the combined lengths of the duct and ampulla and passes into the anterior face of the duct close to the parietes.

The prostates extend through xvii to xx or xxi. The prostatic duct emerges from the anterior margin of the prostate or from the median margin close to the anterior end and usually passes straight forward without bending.

Remarks.—The small u-shaped ridges at the anterior ends of the seminal grooves are similar to the ridges in the same locations on N. depressus, but the conformation of the seminal grooves is characteristic on all specimens mature or immature and is distinctly different from the conformation of the grooves of *N. depressus.*

On specimens of other species there may be a region of special tumescence or glandularity around the posterior end of each seminal groove but such areas are not as well developed or as clearly demarcated as on *N. lunatus.*

Notoscolex triquetrus, sp. nov.

1930. *?Notoscolex depressus,* Gates, *Rec. Ind. Mus.* XXXII, p. 299

Karen Hills, Toungoo District, September, G. E. Blackwell, 7 specimens.

Leiktho Circle, September, G. E. Blackwell, 2 specimens.

Description of the type specimen. External characteristics.—(Notes in parentheses refer to other specimens.)

Length 148 mm. (up to 167 mm.). Greatest diameter 5 mm. Number of segments 312. Unpigmented ; clitellum, dark reddish.

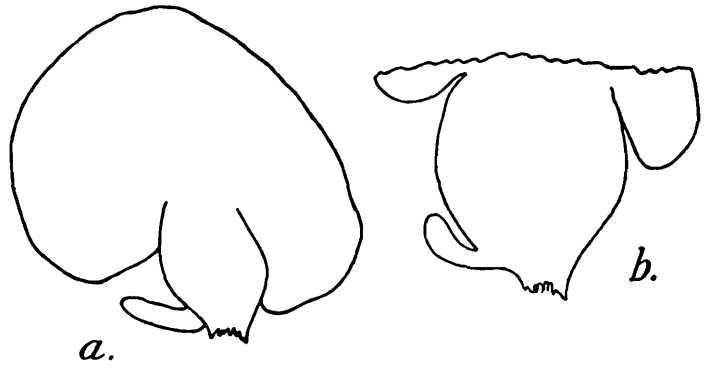
There is a single, deep, postsetal, secondary furrow on each of segments v and vi. On each of segments vii-xii there is a similar, deep, postsetal secondary furrow and in addition two much slighter furrows. One of these furrows is presetal in position and hence corresponds to a presetal secondary furrow while the other furrow is on the posteriormost secondary annulus and hence is a tertiary furrow. (Both the presetal secondary and the postsetal tertiary furrows appear as a rule to be of about the same depth although the presetal secondary is sometimes the more sharply marked of the two. Neither of these furrows is as deep on any specimen as the postsetal secondary furrow.)

Setae are present. They can be seen on segment ii but have not been recognized on some of the preclitellar segments. The setal intervals vary but *ab* and *cd* are both smaller than *aa* or *bc*.

The first dorsal pore is in 9/10 (all). There is a greyish dot in 8/9 in the mid-dorsal line.

The clitellum extends from 12/13 to 16/17 both dorsally and ventrally.

The spermathecal pores are minute, rounded apertures. Each pore is about in setal line *a* (or slightly median to *a*).



TEXT-FIG. 2.—*Notoscolex triquetrus*. *a*. Spermatheca × ca. 11. *b*. Spermathecal duct and diverticulum flattened.

Segments xvii and xviii are much longer ventrally than dorsally with the result that 16/17 is dislocated anteriorly and 18/19 posteriorly. Intersegmental furrow 16/17 though slight is recognizable as an unbroken completely circumferential groove. The ventral portions of xvii and xviii are occupied by a slightly protuberant genital area which is wider transversely on xviii than anteriorly on xvii. The seminal grooves are practically straight but diagonally placed, the posterior ends about in mid *bc*, the anterior ends slightly lateral to the midventral line. The midventral region between the two seminal grooves thus has a distinctly triangular appearance. Anteriorly on xvii, just behind 16/17, there is a short but deep transverse furrow. The seminal grooves end abruptly just behind this transverse furrow. There are no u-shaped ridges or ovoid bodies associated with the anterior ends of the grooves. On the triangular area between the seminal grooves, about in the region of the midventral line there is a short anteroposterior groove across the posterior half of xvii and the anterior half of xviii. Secondary furrows extend transversely across the male genital area. (There may be two or three anteroposterior grooves in the region of the midventral line instead of one. The midventral triangular area is quite deeply depressed on a single specimen but the seminal grooves are characteristic.)

The male pores are minute, each pore on a small, rounded, but not sharply demarcated protuberance in the anterior most portion of the seminal groove.

Internal anatomy.—Septa 6/7—10/11 are strongly thickened, 11/12 is slightly thickened.

The prostates extend through segments xvii to xxv (xxvi, or xxvii). The prostatic duct emerges from the median margin of the prostate in xviii about 4 mm. from the anterior margin. (The duct is 5—7 mm. in length with two small u-shaped loops in the ectalmost portion which is closely bound down to the parietes by numerous muscular cords.)

The spermathecal duct is narrowed within the parietes. The coelomic portion of the duct is stout, shorter than the ampulla. The diverticulum is small and short, finger-shaped, and passes into the anterior face of the duct.

The Taungyi Forms.

Taungyi, August, H. B. Gates, 212 specimens, all aclitellate.

Greatest length 120 mm. Greatest diameter 5 mm. Greatest number of segments 189. Unpigmented.

The secondary annulation was worked out and carefully checked on fifteen specimens which happened to be non-setigerous. The determinations thus made were checked and found to be correct when setigerous specimens were examined later on. The secondary annulation is as follows :—

i-iii. No secondary furrows.

iv-v. One deep, postsetal secondary furrow.

vi. Two deep secondary furrows, one presetal, and one postsetal. Frequently a single tertiary furrow on the posteriormost secondary annulus, this furrow shallower than the two preceding furrows on the same segment.

vii. Three furrows. On non-setigerous specimens these furrows at first appear to be all of the same depth but on the setigerous specimens the first two are clearly secondary furrows, the third a tertiary furrow, on the posteriormost secondary annulus.

viii-ix. As on vii.

x. Usually as on vii except that the tertiary character of the third furrow is frequently more evident here than on the preceding segments.

xi. As on x or vii.

xii-xvi. Two secondary furrows, more or less clearly marked.

Additional furrows are sometimes visible on some of the segments vii-xi but these are either incompletely circumferential or so slight that they will not be confused with the secondary or tertiary furrows.

The setae when present are, as a rule, readily visible, protruding noticeably from the epidermis, and recognizable from ii on throughout the whole length of the individual. On a few specimens, only scattered setae or empty setal invaginations in the epidermis can be made out. On a considerable number of the specimens setae are entirely lacking. There are no setal follicles visible either on the external or coelomic faces of the parietes. There are no follicular invaginations of the cuticle. Nor are setae or setal follicles visible in portions of the body wall soaked in lactophenol or caustic potash solution.

The setae of fully setigerous individuals are on the whole in fairly regular longitudinal lines but exceptions are found. Thus seta *d* for two, three, or several segments may be dorsal or ventral to its normal position. Such dislocations may occur on any particular region of the body behind the clitellar region.

The positions of the spermathecal pores are faintly indicated.

The female pores are visible.

None of the specimens are clitellate although on several individuals of each type the clitellar segments have a slightly creamier, more glandular appearance than other segments.

There are no midventral depressions or ridges on any of the specimens but each worm has a slightly protuberant but poorly demarcated, midventral genital marking on xviii and xvii or xvii and xvi. On these markings are seminal grooves which are clearly visible. The markings and grooves are indicated on the smallest specimens of 50—60 mm. in length and 3½—4 mm. in diameter. The worms can be separated into four groups according to the characteristics of the seminal grooves.

Forma **prima.**

130 non-setigerous specimens.
7 fully setigerous specimens.
3 specimens with scattered setae or setal pits.

The largest specimens are non-setigerous. The largest setigerous specimen is $80 \times 3\frac{1}{2}$ mm.

The genital marking extends across xviii and xvii. The seminal grooves are crescentic, with the concavity of the groove facing midventrally. The anterior ends of the seminal grooves are nearer to the midventral line than the posterior ends are. On the setigerous specimens the posterior end of the seminal groove is in mid *bc*, the anterior end median to *a*. The male pores are in the seminal grooves towards the anterior end.

The grooves are much like the seminal grooves of *N. depressus*. There are no indications of the development of the u-shaped ridges characteristic of that species.

Forma **secunda.**

26 non-setigerous specimens.
1 fully setigerous specimen.
1 specimen with indications of setal pits on a few post-clitellar segments.

The genital marking extends across xviii and xvii. The seminal grooves are almost but not quite straight and practically parallel to the midventral line. The grooves may be very slightly bowed at one or both ends. In the setigerous specimen the grooves are in setal line *a* on each side. The male pores are in the seminal grooves towards the anterior end.

Forma **tertia.**

15 non-setigerous specimens.
21 fully setigerous specimens.

The genital marking extends across xvii and xvi. The seminal grooves are crescentic with the concavity ot each groove facing anteroventrally, *i.e.*, the posterior end of the groove on xvii is much nearer the midventral line than is the anterior end on xvi. On the setigerous specimens the posterior end of each seminal groove is slightly median to *a* while the anterior end is in *bc* nearer to *c* than to *b*. The male pores are at the posterior ends of the seminal grooves.

Forma **quarta.**

1 non-setigerous specimen.
4 fully setigerous specimens.

The genital marking extends across xvii and xvi. The seminal grooves are V-shaped, the point of the V directed laterally, the open end of the V facing the midventral line. The male pores are at the posterior end of the seminal grooves.

Remarks.—In forma *prima* the transverse width of the genital marking is greater on xviii than on xvii. In forma *secunda* the transverse width of the genital marking is about the same on both xviii and xvii. In forma *tertia* the transverse width of the genital marking is less on xvii than on xvi. In forma *quarta* the transverse width of the genital marking is about the same on both xvii and xvi.

The donor of these specimens reported that the worms, when brought in by the cooly who dug them, appeared to be lifeless. When one of the worms was dropped into the preservative it "moved slightly." The worms which were about to be thrown away were therefore preserved. This sluggishness seems to be characteristic of all specimens of the genus, that have been found in Burma.

The male pores of these specimens could not be definitely identified until a very bright artificial light was focused on the genital region. Such bright light is very trying to the eyes but enables definite recognition of certain structures such as pores that might otherwise be missed completely or dubiously identified. Thus, for instance, the spermathecal pores of *P. planata* were not definitely seen until this type of illumination was used.

Genus **Megascolex** Templeton.

This genus is represented in the fauna of Burma by a single, rather widely spread, peregrine form, *M. mauritii.*

Megascolex mauritii (Kinberg) 1867.

Middle Point, Port Blair, Andaman Islands, August, C. Amirthalingam, 11 specimens.
Mt. Harriet, Andaman Islands, July, C. Amirthalingam, 8 specimens.
Jinghighat, Andaman Islands, July, C. Amirthalingam, 29 specimens.
Minnie Bay, Andaman Islands, July, C. Amirthalingam, 14 specimens.
Minnie Bay, Andaman Islands, September, C. Amirthalingam, 3 specimens.
Mt. Harriet, Andaman Islands, September, C. Amirthalingam, 47 specimens.
Coomzamu, September, K. John, 2 specimens.
Kochi, September, K. John, 10 specimens.
Bassein, September, K. John, 30 specimens.
Pyigyaung, September, K. John, 20 specimens.
Bhamo, September, N. Woodbury, 12 specimens.
Minnie Bay, Andaman Islands, February, C. Amirthalingam, 12 specimens.
Mt. Harriet, Andaman Islands, February, C. Amirthalingam, 1 specimen.

This species is widely spread in the Central Basin Region of Burma, extending as far north as Kindat in the Chindwin Valley, and to Bhamo in the Irrawaddy Valley. It has also been found through the Tenasserim Division and on the Western coast near Sandoway. The species has not been found in the Shan Plateau.

Genus **Pheretima** Kinberg.

In a recent paper Stephenson (1931, p. 36) began a discussion of some problems of nomenclature in the family Enchytraeidae with this statement " It is often difficult, or impossible, to be certain as to which, out of the species of Enchytraeids now known to us, are those described under various names by the older authors." If, in this quotation *Pheretima* be substituted for " Enchytraeids " the accuracy of the statement will not be impaired.

A number of instances can be cited to support this contention but as a typical case consider *P. hesperidum.* In the original description of this species there is available with regard to characteristics of importance only the following brief statement, " The external characteristics are those of *Perichaeta barbadensis*, excepting that there are no setae upon the clitellum and that there are no genital papillae." There is no point in a similar quotation *in extenso* of the description of the internal organs but it may be noted in passing that the account of the internal structures is of about the same value as that of the external characteristics. Furthermore the first portion of the sentence just quoted is incorrect :—*P. hesperidum*, for instance has two pairs of spermathecal pores in 7/8—8/9 while *P. barbadensis* has two or three pairs of spermathecal pores in 5/6—7/8 or 5/6—6/7. Again, the three specimens on which *P. barbadensis* was based differed among themselves with respect to several characteristics of such importance that it is fairly certain that the three specimens belong to two distinct categories which may have a taxonomic status of varieties, subspecies, or species. Two of the specimens of *P. barbadensis* have in fact been since considered to be identical with *P. morrisi*, described on the preceding page of the same paper. The third specimen has been considered to be identical with *P. bermudensis* also described in another portion of the same paper.

In the Monograph on the Oligochaeta, Beddard (1895) retained *P. bermudensis*, *P. morrisi*, *P. barbadensis*, and *P. hesperidum* as valid species (For a discussion of the status of each of the first three mentioned species since 1895, *vide P. hawayana* hereinafter). In the definition of *P. hesperidum* in this Monograph there were included the following statements " Length 105 mm. ; breadth 4 mm. ; number of segments, 78. Male pores quite lateral in position, separated by the diameter of the body." taken over *in toto* from the description of *P. barbadensis* without re-examination of the specimens involved.

Shortly afterwards Beddard (1896) published a description of *P. sandvicensis* from the Hawaiian Islands, with the remark that " The only species with which it would be possible to confuse the present are *Perichaeta annulata* and *Perichaeta japonica.*" Neither of these two latter species, it may be noted, had been seen by the author.

Several years later, after study of further worms from the Hawaiian Islands and from Hongkong and after a re-examination of the two original specimens of *P. hesperidum* Beddard (1900, p. 419) united his *P. sandvicensis* with his *P. hesperidum* and redefined the latter as follows :

Size small, 100 mm. Number of segments, 105. Dorsal pores from 11/12. Number of setae per segment up to 53 on xvii. Clitellum xiv-xvi without setae. No papillae. Septum 8/9 missing. Caeca present. Last heart in xiii. Sperm sacs xi, xii. Spermiducal glands not very large ; duct without end sac. Spermathecae vii, viii, with twisted tubular diverticulum.

In this paper the number of setae on segment i is said to be 21, and the number of setae on xvi is said to be 53. Segment i does not have setae and according to the definition setae are lacking on the clitellum, so for i it is necessary to read ii and for xvi it is necessary to read xvii. But, should 12/13 be similarly read for the position of the first dorsal pore ? Elsewhere in the same paper it is stated that there are 18 setae between the male pores which are conspicuous transverse slits. Copulatory chambers formerly thought to be present are now definitely said to be lacking. Yet the protrusion of the end of the prostatic duct (probably a penial body of some sort) through what is called the male pore is recorded.

Leaving out of consideration trivial details of little or no importance, *P. hesperidum* is now a species to be defined as follows :—First dorsal pore in 11/12 (?) Male setae on xviii, 18 ; number of setae on xvii, 53. Spermathecal pores two pairs in 7/8—8/9. Genital markings lacking. Spermathecal diverticulum twisted. This characterization is quite evidently inadequate, yet in a revision of the genus *Pheretima*, Beddard (1900) united with *P. hesperidum*, *P. lohri* from Hupei Province, China. Michaelsen's species is smaller, $70 \times 3\frac{1}{2}$ mm., and differs from Beddard's species in several ways, as for instance (1) The first dorsal pore is in 12/13. (2) Setal numbers on xii, 62 ; on xxvi, 72 (not comparable of course with the numbers given by Beddard but possibly indicating some difference). (3) The male pores are about 2/7 of the circumference apart and on " mittelgrossen Papillen." (4) The prostates extend through 10 segments instead of three. (5) Median to each prostate is a stalked, copulatory gland. (6) A similar gland beside each spermatheca.

In passing it may be noted that *P. hesperidum-lohri* can now be differentiated from *P. aeruginosus* only by " the comparative shortness of the spermathecal appendix." The latter species according to the same revision has about a dozen synonyms and varies in length from 180—570 mm.

In the Oligochaete volume of the " Tierreich " series Michaelsen (1900) retained *P. lohri* and *P. sandvicensis* as valid species but placed *P. hesperidum* as a doubtful species " Vielleicht mit *P. californica* zu vereinen."

Several years later Ude (1905), accepting the fusion of *P. hesperidum*, *sandvicensis* and *lohri*, redescribed under the name *P. hesperidum* earthworms from the Hawaiian Islands. Ude's account is more detailed in some respects than the previous descriptions. According to Ude there are about 60 setae on xvii, and 16 male setae on xviii. The first dorsal pore is in 11/12 or 12/13. The male pores are large slits " auf niedrigen Papillen." The spermathecal pores are " in den siebenten Borstenlinien." The prostates extend through three segments. No mention is made by Ude of stalked glands in either the prostatic or the spermathecal region.

In the literature available in Rangoon nothing more can be found concerning this species until 1931. In a list of the Oligochaeta of China published in that year Michaelsen includes *P. hesperidum* with the distribution of his own *P. lohri* and Beddard's Hongkong record of *P. hesperidum*. In this same paper a new species (from Soochow, Kiangsu Province) *P. kiangensis* is described. This species has, among others,

the following characteristics:—First dorsal pore in 11/12. Male pores on the tips of smooth, moderately large, ball-shaped, visibly uncontractible porophores. The prostate extends through four segments. No mention is made of the presence of stalked glands.

Some months later Chen (1931) included not only *P. lohri* and *P. sandvicensis* but also *P. kiangensis* in the synonymy of *P. hesperidum.* Chen gives a description of the species based on 34 specimens collected in Chengtu, Szechuan, Province. In the Chengtu specimens the first dorsal pore is always in 11/12. The male pore is on a protrusible nipple-like pad contained within a small copulatory chamber, the lip of the aperture into the chamber lobulated. The male setae on xviii are 12—16 the spermathecal setae on vii, 16—17 ; number of setae on xxv, 42—54. No mention is made of the presence of stalked glands in the prostatic or spermathecal regions, but there is said to be a thick, whitish cushion of connective tissue around the terminal part of the prostatic duct.

It may also be noted that Beddard's description of *P. hesperidum* is without illustrations. The figure of the spermatheca of *P. lohri* is too sketchy to be of much value.

Ude figured the genital organs of x-xiii in a diagrammatic fashion but the characteristics of these structures are of little if any importance in this connection.

It should be quite clear from the foregoing account that no adequate specific definition or diagnosis can be dug out of Beddard's descriptions of *P. hesperidum.* Also that there is little evidence that any of the forms later included in *P. hesperidum* have actually belonged to that species.

As an illustration of confusion in synonymy somewhat similar to that above, but which has been partially cleared up, may be mentioned *P. houlleti.* This species was first described by Perrier in 1872, and be it noted, this description is much more satisfactory than many of the descriptions of later years of other species. Horst (1893) placed *P. campanulata* (Rosa) 1890 in the synonymy of *P. houlleti.* This fusion was accepted by Beddard in 1895 and by Michaelsen in 1900. Two additional forms, *P. udekemi* and *P. guillelmi* were also placed in the synonymy of *P. houlleti* by both Beddard and Michaelsen. Recently (Gates, 1927) it has been shown, after examination of the types of *P. houlleti* and *P. campanulata,* that each of these species is valid. Furthermore, *P. guillelmi,* if Michaelsen's original description of this form be correct, is at least not *P. houlleti,* whatever else it may be. *P. houlleti* was thus for more than 30 years and until quite recently a composite of three or possibly more species.

Like *P. hesperidum* many other species are incompletely or inadequately described. On the basis of such incomplete and inadequate accounts the species have been variously combined and recombined, practically always (as in *P. houlleti*) without reference to the specimens involved. New material has been identified as belonging to earlier species likewise without examination of type specimens. Furthermore definitions and diagnoses have been revised and extended also in total disregard of the type specimens. In these circumstances it hardly seems necessary to further prolong this argument in order to show that the genus is in urgent need of revision.

Any attempt at revision must be based upon examinations of actual specimens. The continuation of procedures that rely only on inadequate descriptions without illustrations can only result in perpetuation of previous mistakes, the promulgation of new errors and the increase of confusion and disorder. The tracing of much of the older material will prove to be a matter of some difficulty as in many papers there is no indication as to where the specimens had been or were to be deposited. If the original material of inadequately described species cannot be found or if when found is too badly macerated, then such species should be treated as invalid and disregarded entirely. There seems to be no justification for the perpetuation of ghostly names that cannot be associated with live earthworms as they actually are.

It is also important in dealing with the specimens of older species as well as of new forms, that considerable attention should be paid to what may be called "the extent of variation." Too frequently in the past it has been assumed quite without proof or attempt at proof that certain characteristics are invariable and specific. Some of these characteristics are not only variable but may be variable within rather wide limits.

As large a series of specimens as is possible should therefore be examined and the full extent of variation in all characteristics of systematic importance should be determined. This is of particular importance in a genus supposedly very recent and containing a large number of species.

As a preliminary contribution towards a revision of the genus I wish now to present a few, more specific considerations that have grown out of the examination during the last year of several thousand specimens of *Pheretima* from Burma and the Andaman Islands.

Number of segments.—It has been thought that "the number of segments is not fixed for the species" Earthworms are especially liable to mutilation, either as a result of the activities of the hosts of carnivorous animals that feed on them, or as a result of autotomy. Such mutilated animals, lacking a larger or smaller portion of the tail region are found in large numbers. In some collections examined during the past year nearly every worm has been so mutilated. In the event of mutilation two things happen. The wound may heal over without regeneration or the lost portion may be regenerated. There is obviously no point in determining the number of segments in mutilated specimens. Whether or not the number of segments regenerated is as a rule equivalent to the number lost remains to be demonstrated. But if mutilated and regenerating individuals, or worms with evidences of regeneration or mutilation be excluded from consideration and the number of segments determined only on fully mature specimens that appear to be normal, evidence is obtained that the number of segments of a particular species falls within certain limits, as the following illustrations clearly show.—

1. In 100 specimens of *P. anomala typica* the number of segments varies from 119-130.
2. In 25 specimens of *P. houlleti* the number varies from 90—105.
3. In 11 specimens of *P. composita* the number varies from 97—119.
4. In 6 specimens of *P. glabra* the number varies from 114—119.
5. In 6 specimens of *P. tenellula* the number varies from 114—122.

The first dorsal pore.—The location of the first dorsal pore has long been considered a specific characteristic but no attempt has apparently been made to determine the extent of variation in the location of this pore. In connection with this characteristic two difficulties arise. First, there may be in one or more intersegmental furrows anterior to the furrow containing the first functional pore, one or more pore-like but non-functional markings. The significance of these markings is yet to be determined. Secondly, there may be difficulty in determining whether or not a quite definitely pore-like marking is actually functional. In many cases a slight bending of the worm in a ventral direction in the region of the segments involved will exert sufficient pressure to force out fluid from the marking in question and thus demonstrate the existence of a functional pore. In some individuals such pressure is not sufficient to demonstrate the presence of a functional pore. If additional pressure be placed on the worm it may be sufficient to rupture a weak spot in the parietes with a resultant forcing out of fluid when no functional pore is present. In one Burmese species there is a longitudinal series of weak spots in the mid-dorsal line at the region of the intersegmental furrows anterior to the location of the first dorsal pore. Exertion of pressure on the worm easily ruptures these weak spots with a resultant escape of fluid. Examination of the coelomic face of the body wall shows however that the weak spots represent merely gaps in the muscular layers and not functional apertures through the epidermis. A certain amount of caution should therefore be observed in determining the location of the pore in circumstances of these sorts.

The extent of variation in the position of the first dorsal pore may be considerable or there may be no variation at all. Thus in 100 specimens of *P. anomala typica* the first dorsal pore is in 12/13 in every specimen, while in 188 specimens of *P. houlleti* the first functional dorsal pore is in 7/8 in 8 specimens, in 8/9 in 53 specimens, in 9/10 in 102 specimens, and in 10/11 in 25 specimens. It is noteworthy that in *P. campanulata* which has been confused with *P. houlleti*, the first functional dorsal pore is either in 11/12 or posterior to 11/12.

Setae.—Considerable emphasis has been placed on certain setal characteristics, such as the presence or absence of clitellar setae, the presence or absence and width when present of breaks in the setal circles. This emphasis has not, as a rule, been justified.

Beddard stressed in particular the value of the presence or absence of setae on the clitellar segments. Complete setal circles are apparently always present on all clitellar segments of immature specimens. With the onset of maturity and the beginning of the development of the clitellar glandularity the setae on the clitellar segments are lost. In many species the loss appears to be complete. Careful examination shows in many of such specimens a faint, whitish stripe at the equator of each of the clitellar segments where the setal circle should be located if present. With very bright artificial light and high magnification no setae could be definitely recognized in these stripes yet after soaking in lactophenol a very limited number of setae were sometimes to be found. Otherwise the gaps in the body wall where the setal follicles had formerly been located were filled with a sort of granular debris. Occasionally

in a species in which the setae all disappear normally, a few specimens are to be found with setae on segments xvi or more rarely also on the other clitellar segments. In *P. posthuma* setae are apparently always present at least on xvi. When clitellar setae are present they should be examined microscopically. The clitellar setae of *P. campanulata*, *P. houlleti* and *P. rugosa* are modified. In many specimens of *P. houlleti* clitellar setae though not recognizable externally are present.

The presence or absence of a dorsal gap in the setal circles are characteristics of slight value. The dorsal setae of many species are more widely separated than the ventral setae. When this is so it is often impossible to determine whether or not an apparent gap in the setal circle that is of considerable width is due to the deep retraction of setae or to the loss of setae, or to a characteristic absence of setae.

When the dorsal setae are all visible interval *zz* may vary quite considerably in width, not only from one segment to another on the same worm but from one worm to another. In species with large numbers of small, closely crowded setae both dorsally and ventrally, a mid-dorsal break is usually lacking. The midventral setae are less liable to be retracted or lost than the mid-dorsal setae but the midventral interval *aa* is subject to variation. One individual may have a recognizable midventral break for a considerable number of segments behind the clitellum. The next individual of the same species may lack such a gap or have a gap on a very limited number of post-clitellar segments. In *P. elongata* there is always present and throughout the whole length of the worm a distinctly recognizable midventral gap.

The number of setae per segment has been considered to be an important systematic characteristic. In most cases when two or more persons have counted the setae, the determinations have been made on different segments. The results of such determinations are not comparable. Furthermore, students of the group have contented themselves with the determination of setal numbers of a single worm for each species. The number of setae on a particular segment may vary by as much as 10—20. The enumeration of setae on a single individual is therefore of little if any systematic value. The extent of variation should be determined by counting the numbers of setae on a number of specimens. For this purpose one segment from a favourable region may perhaps prove to be sufficient. In this laboratory the usual practice is to count the setae on segment xx. Setae can be more easily counted on this than on more posterior segments and there are less likely to be genital markings in the setal circle of xx than on preceding segments. Two other types of setal enumerations have been found to be useful. The first of these has to do with the spermathecal segments. An imaginary line is considered to pass through the successive spermathecal pores of a side. The number of setae between the two spermathecal pore lines on the spermathecal segments are counted. If the spermathecal pores are large, the spermathecal pore lines are assumed to pass across the spermathecal pores at their centres. When there is but one pair of spermathecal pores the lines are passed across the spermathecal pores parallel to the midventral line. To avoid constant repetition of the rather clumsy phrase, " number of setae between the spermathecal pore

lines" the term spermathecal setae is used to refer to the setae between the pore lines. Specially modified setae in the spermathecal region are referred to as copulatory setae so there should be no occasion for confusion should such copulatory setae be found in any species of *Pheretima*. The extent of variation in the spermathecal setae should of course be determined. When so determined the spermathecal setae numbers can be compactly expressed in a sort of formula that should be useful in cases where abbreviated diagnoses or definitions are required. It must, of course, be recognized that to be strictly comparable setal numbers must be from the same segment.

The other enumeration has to do with segments xvii-xix. The number of ventral setae on xviii between the male pores are counted. To avoid the use of the phrase "number of setae between the male pores" these setae are referred to as the male setae of segment xviii. As specially modified setae in the region of the male pores are referred to as penial setae there should be no confusion between the terms. Further, a line is considered to pass across the male pore on each side parallel to the midventral line and across segments xvii and xviii. If there are on xviii large apertures of copulatory chambers or parietal excavations, the lines are taken to pass across these apertures at their centres. The setae on xvii and xix between these two lines are counted and referred to as the male setae of segments xvii and xix.

The setae of segments ii-iv should be especially noted. Setae may be entirely lacking on segment ii, or present only ventrally. In some species extensive dorsal gaps are constantly present also on segments iii-iv.

Enlargement of setae anteriorly and ventrally should also be noted. Enlarged setae are often ornamented.

Spermathecal pores.—In connection with the external apertures of the spermathecae several characteristics have been found to be of systematic value. In the past it has been customary to note very carelessly the position of the spermathecal pores together with some such statement as "in line with the male pores" or external to the position of the male pores" or "three sevenths of the circumference apart." Statements of the sort just quoted are of little assistance as a rule to the systematist and may as well be discontinued. The use of the word carelessly in a preceding sentence may seem rather critical but is actually correct. The tacit assumption that the spermathecal pores are almost always in the intersegmental furrows is without justification. In the well known species *P. posthuma* the spermathecal pores are not in intersegmental furrows 5/6—8/9 as has been constantly iterated. The pores are actually on the posterior margins of segments v-viii. Similarly the spermathecal pores of *P. planata* are not in intersegmental furrows 6/7—7/8 as was stated by two different authors but on the anterior margins of segments vii and viii. In this species the pores are located much nearer the intersegmental furrows than in species like *P. bournei* and *P. faceta*, n. sp. so that this characteristic may perhaps not appear at first to be important. A considerable number of specimens of *P. planata* have been examined with reference to the location of the pores and the segmental location of the pores has been found to be constant,

without variation. The spermathecal pores of a number of Burmese species are segmentally rather than intersegmentally located and likewise without variation. Possibly there are other species in which a similar situation will be found to prevail. Rarely the pores may be dorsal in position.

Not only are the locations of the spermathecal pores of importance but also the size and shape of the pores may be characteristic. In *P. heterochaeta* and *P. alexandri* the pores are very small round apertures to which the term minute is applied. In other species the pores may also be minute but definitely slit-shaped as in *P. planata*. Or the pores may be large as in *P. campanulata, houlleti, mamillana*, etc. ; in this connection large is used relative to size of the pores in *P. heterochaeta* and not relative to the size of the worm. Or the pores may be intermediate in size between those of *P. campanulata* and those of *P. heterochaeta* and either rounded or slit-shaped. In some species where the spermathecal pores at first appear to be rather large, the aperture in the body wall opens merely into a parietal excavation containing a disc or papilla on which is borne the minute, true spermathecal pore.

Male pores and associated structures.—The ectal end of the male deferent apparatus has not been studied in most species and yet characteristics of structure, in the male pore region are capable of considerable exploitation for taxonomic purposes. The male pores are probably always minute or very small. They may be located on the genital markings or on areas of special modification of the epidermis. In these cases the male pores are often at the general level of the external epidermal surface. Or the male pores may be on small but definitely demarcated "discs" which are round or elongately or transversely oval. Such discs appear as a rule to be slightly retractile. In a large number of species the male pore is not normally visible externally, the large slit-like or rounded apertures which have been referred to as male pores in these species are not male pores at all but merely the apertures that op n into copulatory chambers. If the chamber is small and confined to the parietes it is referred to hereinafter as a parietal excavation. If the chamber is larger so that its walls project into the coelom it is referred to as a copulatory chamber. In either case the excavation or chamber should be cut open and examined. The male pore may be located directly on the wall of the chamber without especial markings. Usually however the male pore is located on a special marking, disc, papilla or in the case of true copulatory chambers on a protuberant structure of the nature of a penial body. In *P. gemella* the copulatory chamber which is eversible contains a tubular penis. These male-pore bearing discs, papillae, or penial bodies are often, perhaps always, characteristic and should be carefully described and when possible figured. In addition to a male porophore of some sort, copulatory chambers may contain other papillae, discs, or markings, that are also pore-bearing and which require attention.

A copulatory chamber or parietal excavation may be partially or completely everted. The characteristics of such protruded chambers should be noted. There is considerable ground for a belief that some species said to lack copulatory chambers but which do have protuberant

male porophores really have chambers which happened to be completely everted in all of the specimens examined.

When copulatory chambers are present there are very frequently stalked glands with ducts passing through the walls of the chambers to open to the exterior by pores on the discs or other special markings. The number, size, shape and relationship of such glands to each other and to the chamber should be noted. Glands may be present and yet not visible in the coelom. In some cases it is necessary to strip off the longitudinal musculature from the coelomic face of the parietes in order to find these glands. Penial setae are probably more common in the genus than has previously been thought. If the copulatory chambers are examined carefully these special setae that have been overlooked in the past will be found.

Genital markings.—The various types of genital markings referred to as copulatory papillae, genital papillae, etc., have long been considered of considerable systematic importance. It does not appear to have been recognized as yet that these markings may be of such a character that exact verbal delineation is exceedingly difficult if not impossible. For example,—the genital markings of *P. suctoria* from the Andamans and *P. suctoria mullani* from Bombay may be said to have been fairly well described. From the descriptions, the markings of the two forms appear to be similar. Yet, actually, the markings of these two forms are totally different, the markings of *P. s. mullani* differing in no important point from the markings of *P. alexandri.* It is obvious that if the markings of *P. suctoria* had been figured the worms from Bombay would never have been identified as belonging to the Andaman species. When illustrations are not feasible especial attention should be given to the description of the markings.

The position of the markings relative to the spermathecal pore lines, to the male pore lines, to the setal circles, and to the midventral line as well as to intersegmental furrows should be carefully noted. The size of the markings should also be indicated but in some more definite way than merely by use of terms large or small. The markings of Stephenson's variety *choprai* have a characteristically different size from the markings of the typical variety of *P. andersoni.* Size may be variously expressed; one way is by measuring or determining the width of the marking transversely in number of intersetal distances of the setal circle next to the genital marking. Such measurements show fairly well an important difference between the two worms just mentioned above, *P. andersoni* and *P. choprai.*

Glands in the spermathecal region.—The numbers, positions, and characteristics of glands in the spermathecal region require more careful attention than has been given to them previously. Such glands may not be visible in the coelom in which case it is necessary to strip off the longitudinal musculature from the coelomic face of the parietes. If there are glands associated with the spermathecal duct the number should be carefully determined, removing if necessary the longitudinal musculature. The number of such glands may not only be characteristic but different in two closely related forms such as *P. campanulata* and *P. houlleti.*

Spermathecae.—That portion of the spermathecal duct contained within the body wall requires study. The duct may be narrowed or widened or may remain unchanged in diameter within the parietes. The lumen of the duct may be of the same diameter throughout the duct or it may be widened or narrowed in particular regions. The point at which the diverticulum passes into the duct should be noted; it may be of value in some species. In two somewhat similar Burmese forms the diverticulum passes in one into the lateral face of the duct while in the other form the diverticulum passes into the median face of the duct.

Pseudo-vesicles.—Paired, stalked bodies may be present in one or both of segments xiii and xiv on the posterior faces of 12/13 and 13/14. These structures have been referred to as vesicles, seminal vesicles, and receptacula ovorum. The contents of the vesicular body at the dorsal end of the stalk have been examined from a number of earthworms. No spermatozoa or earthworm ova have been found. Parasites and setae have been found. The functions of these structures are not clear at present but it seems very doubtful if they can be considered either as vestigial seminal vesicles or receptacula ovorum. The term pseudo-vesicles has been used in this paper to refer to these curious organs.

Seminal vesicles and testis sacs.—The lobulation of the seminal vesicles is sometimes referred to in systematic descriptions. This lobulation is often brought about by the presence of muscular trans-segmental cords and is not therefore of importance.

The relationship of the testis sacs to the seminal vesicles is important and should be carefully noted. Perhaps more often than has been realized the vesicles of xi are included within the testis sacs of that segment. This is true at least of *P. posthuma*, an old and very familiar species in which this characteristic has not hitherto been noted.

Ude has stressed (1905) the characteristics of the testis sacs. These sacs may not have the importance that Ude has thought. In some of the Burmese species there is considerable intra-specific variation with regard to the characteristics of the testis sacs, they may be paired in both x and xi, fused in both x and xi, or paired in one segment and fused in the other.

Immature specimens.—Whenever possible immature specimens should be studied. Long before the clitellar glandularity begins to develop the locations of the male and the spermathecal pores are marked out and the primordia of the genital markings are indicated. It is thus, often, possible, contrary to past belief, to identify aclitellate individuals. In such individuals it is sometimes possible to recognize the essential characteristics of certain organs with greater ease than in the adult forms. This is especially true of the testis sacs at a stage before these sacs have become distended by the masses of whitish material of mature specimens.

Aclitellate individuals furnish however more interesting information with regard to the seminal vesicles. These organs are first recognizable as small structures on the posterior faces of the vesicular septa, very similar to the pseudovesicles of xiii and xiv. Each vesicular primordium consists of a septal stalk at the dorsal end of which there is a mass of

tissue varying in shape, size, and texture. This dorsal portion of the vesicular primordium is referred to hereinafter as the primary ampulla. The definitive seminal vesicle is derived from the early rudiment by growth, not of the dorsal ampulla, but of the stalk.

The growth may take place in various ways. The lateral and median margins may grow simultaneously and equally, or the growth at one margin may be slower than at the other margin. Or the growth may take place chiefly on the posterior face of the stalk. As growth continues the primary ampulla may also grow, usually more slowly than the ventral portion of the vesicle and reaching its greatest development before the ventral portion of the vesicle is fully formed. With further development the primary ampulla may become buried in the tissues of the main portion of the vesicle so that it is no longer definitely recognizable, but in the adults of many species the primary ampulla is still recognizable as a distinct portion of the vesicle with a characteristic shape, colour or texture. It may even protrude conspicuously in a dorsal direction as a finger-like or cone-like or pyramidal appendage.

Septa.—Thin, transparent septa are referred to in this paper as membranous. Such membranous septa may be strengthened without loss of transparency. Or the septa may be strengthened in such a way as to be translucent. With greater strengthening so that the septa are perfectly opaque the term muscular is used. There may be various degrees of thickness of such muscular septa but ordinarily only the characterizations of muscular or thickly muscular are used.

The prostomium, secondary annulation, gizzard, ovaries and oviduct funnels.—These characteristics or structures do not ordinarily seem to be capable of taxonomic use in connection with the species of the genus *Pheretima*. Unless otherwise stated prostomium, gizzard, ovaries and oviducal funnels may be assumed to be present, normal and in the usual locations.

Number of species.—The most recent revisions of the genus as a whole were published independently in 1900 by Beddard and Michaelsen. Although at that time these two authors disagreed with respect to the validity and relationships of numbers of species, no thorough attempt has since been made, either to reconcile these differences or to solve the problems they raised. New species have been added in large numbers, in fact the number of species at present has been said to be more than double that of 1900, whatever that number may have been! The genus now comprises according to Stephenson (1930, p. 939) "two hundred and ninety-three species, together with about twenty doubtful" According to Michaelsen in a paper published two years earlier (1928, p. 110) there are 339 species. In view of the lack of information as to validity of so many of the older species such statements are to be regarded as nothing more than estimates.

Distribution and Zoogeography.—Much has been written about the distribution and zoogeographical relationships of *Pheretima*. Much of this discussion has been based on a very unsound taxonomic foundation. It has already been pointed out that at least three species have been confused for over 30 years under the name of *P. houlleti*. Records of the distribution of this species are in many cases valueless as it is

impossible to determine which one if any of the confused species are involved. Inadequately described forms from widely separated regions have been fused and then the fused species have been said to be peregrine, or somewhat peregrine, or otherwise characterized. Peregrine or endemic are words with very little significance at present so far as many species of the genus are concerned. There is therefore no point at the present in an extended discussion of distribution, but as the Burma forms and their relationships have been mentioned several times lately a short statement with regard to the distribution of the Burmese forms seems to be necessary.

Pheretima has been found in every section of the province in which collections have been made. *P. alexandri*, *anomala*, *campanulata*, and *houlleti* have been found in all of these regions that have been studied. *P. elongata* has a similarly wide range of distribution though found much more infrequently. *P. rugosa* may be left out of consideration as its status is doubtful. *P. planata* and *posthuma* have been found everywhere except in the Shan Plateau on the east. *P. peguana* has been found throughout the central basin region and throughout the Tenasserim Division. Of these species, *P. alexandri*, *elongata*, *houlleti* and *posthuma* are undoubtedly peregrine. *P. peguana* is probably slightly peregrine; it has been reported from Siam, Java, and Lombok. *P. planata* has been found in Assam, the Malay Peninsula and the Andaman Islands. *P. campanulata* has been collected in the Himalayas, the Malay Peninsula, the province of Yunnan, and in the Andaman Islands. Both *P. planata* and *P. campanulata* must therefore be regarded as in some degree peregrine. Stephenson's suggestion (1931) that these two species are essentially Burmese cannot be accepted. *P. anomala* may also be peregrine to some extent. It has been recorded from Siam and Calcutta, and extends into Yunnan.

The Burmese species which have not yet been mentioned are limited, so far as intra-provincial distribution is concerned, to three special portions of the Peripheral Hill Region, *i.e.*, to the Tenasserim Division on the south, to the Shan Plateau on the East, and to the hilly region of the far north. *P. hawayana* has been found only in the Shan Plateau and the northern hills. *P. heterochaeta* has been reported only from the Shan Plateau. Both of these species are admittedly peregrine forms. *P. birmanica* has been collected in the northern hills and the Shan Plateau and extends across the Sino-Burmese boundary into the province of Yunnan.

P. exigua is widely spread through the Shan Plateau and the Tenasserim Division but has characteristic northern and southern varieties. *P. choprai* has been found only in the northern hills. All other species are limited, according to our present information, to the Shan Plateau or to the Tenasserim Division. Very little however is known of the earthworm fauna of those portions of the Asiatic continent immediately beyond Burma to the east and south :—the Malay Peninsula, Siam, French Indo-China, and China. When these regions are studied there will probably be found therein many if not all of the species that now appear to be characteristic of the eastern half of the Peripheral Hill Region of Burma.

Of the eleven species of *Pheretima* that have been found in the Andaman Islands, five, *P. alexandri, cam panulata, elongata, planata* and *posthuma*, are peregrine to a greater or less extent. The remaining five, *P. andamanensis, faceta, harrietensis, osmatoni* and *suctoria*, according to our present knowledge, are endemic. Furthermore, these five species of *Pheretima* are the only earthworms that are limited to the Andamans. This group of islands is accordingly the only portion of the Burma region of Stephenson which may be called a purely *Pheretima* area. Too much importance is not however to be attached to this statement as the few collections that have been made in the Andamans were secured from a limited number of easily accessible localities. There is yet much work to be done on the Oligochaetes of these Islands.

Additional Notes.—As there are so many varieties and species to be dealt with hereinafter, the previous custom of arranging species alphabetically has been abandoned and instead the species have been grouped into sections according to the number of spermathecae. In order that all varieties and forms of a species may be treated at one time it has been necessary to violate this plan to some extent. Thus the thecate varieties of *P. anomala* are included in the section A. The quadrithecate variety of *P. hawayana* is included with variety typica (?) in section D. *P. sulcata* and *P. porrecta* have also been included in section D though the specimens of these species do not have three complete pairs of spermathecae. Similarly the variety of *P. exigua* with segmentally located spermathecal pores is placed in part II of Section E along with variety *typica* which has intersegmental spermathecal pores.

Variety is used throughout this paper to refer to a definitely recognizable subspecific form—without further connotations. A discussion of the taxonomic significance of these varieties is reserved for a future paper.

A word of explanation is also necessary with reference to the tables. In columns under headings of preclitellar segmental numbers are indicated the numbers of spermathecal setae on the segments mentioned. The setal numbers in columns headed xvii, xviii and xix, unless otherwise indicated, refer to the male setae on those particular segments. The numbers in the columns headed xx refer to the number of setae on that segment.

SECTION A.

No spermathecae.

Pheretima anomala Mich. 1907.

Pheretima anomala was erected by Michaelsen for eight worms collected in the Botanical Gardens of Sibpur near Calcutta. The species was next found in Burma (Gates, 1925). Along with *P. anomala* in Burma there were found other worms which were described in the original manuscript as a distinct but related species. As there was at that time no literature on the genus *Pheretima* in Rangoon a specific name was not suggested for the related species. Just as the paper was being sent to press a specimen of *P. anomala* was found which had structures supposedly lacking in that species but characteristic of the related species. The

particular specimen led the writer to believe that the two worms were more closely related than had previously been thought, but as no further specimens of these forms could be secured for months no change was made in the manuscript except to add an extra paragraph at the end of the account of the related species. By the time that specimens of the forms in question could again be secured other interests had intervened and nothing further was done for the time being except to suggest a name, *insolita*, for the related form.

The particular specimen to which reference was just made had rudimentary seminal vesicles, structures absent from *P. anomala* but well developed in *P. insolita*. Furthermore *P. insolita* had hitherto been found only much later in the collecting season than *P. anomala*. These two considerations indicated a possibility that *anomala* and *insolita* might be seasonal forms of the same species. In other words, in the early portion of the rainy season the species would be in the condition described as for *anomala*, later on, with the disappearance of the extra male funnels and testes together with a development of testis sacs, spermathecae and seminal vesicles, the stage described as Form F would be reached. This latter, by disapperance of the male pores, prostates and mushroom glands as indicated by the various forms described as types B to E, would end up in a condition as described for *insolita*. During the course of the last seven years a considerable number of specimens of the various forms concerned were examined with the hope of finding further evidence for such a series of transformations. No such evidence was found but on the contrary slowly accumulating fragments of information, obtained mostly, it must be admitted from other species, tended to show that there is another explanation of the origin of the various forms involved, *i.e.*, parasitically induced abnormality of the reproductive structures. This is outlined briefly in the appendix to *P. alexandri* hereinafter.

In the meanwhile Miss Pickford (1929) in dealing with specimens of *P. speiseri* from the New Hebrides had referred to an A-form of the species as a " functional female " and to a B-form as a " functional male " form. The main portion of Miss Pickford's paper is concerned with the description of a C-form or a " normal hermaphrodite." Stephenson (1929) following Miss Pickford's suggestion, united *P. anomala* and *P. insolita*, interpreting *anomala typica* as a male form and *anomala insolita* as a female form, both of which had diverged from a fully functional hermaphroditic form (Type F) to which the name *centralis* was given. For systematic purposes Stephenson's classification is accepted and the worms will be referred to hereafter as varieties *typica*, *insolita* and *centralis* of *P. anomala*.

There are however a number of objections to the Pickford-Stephenson theory of the evolution of secondary bi-sexuality from the characteristic Oligochaete hermaphroditism. A few of these may be briefly mentioned. In the first place in the supposed male forms there are normal ovaries, oviduct funnels and female pores. In the second place there are in the supposed female forms fully developed seminal vesicles and testis-sacs. In these testis sacs there are not only testes and male funnels but masses of loose spermatozoa. Curiously enough there are no seminal vesicles

in the supposed male forms nor are there ripe spermatozoa. The disc-shaped testes which are present in such numbers in *anomala* are like those characteristic of very young specimens of other species, before the appearance of the masses of loose spermatozoa.

Variety **typica.**

1925. *Pheretima anomala*, Gates, *Ann. Mag. Nat. Hist.* (9) XV, p. 538.
1929. *Pheretima anomala typica*, Stephenson, *Rec. Ind. Mus.* XXXI, p. 236.

Taungyi, August, H. B. Gates, 45 specimens.
Henzada, August, K. John, 5 specimens.
Kyangin, August, K. John, 4 specimens.
Pegu, August, K. John, 1 specimen.
Coomzamu, September, K. John, 3 specimens.
Maubin, September, K. John, 3 specimens.
Yandoon, September, K. John, 3 specimens.
Tantabin, September, K. John, 9 specimens.
Toungoo, September, K. John, 4 specimens.
Pyigyaung, September, K. John, 3 specimens.
Pyinmana, September, K. John, 5 specimens.
Blachi, September, G. E. Blackwell, 5 specimens.
Leiktho Circle, September, G. E. Blackwell, 42 specimens.
Bhamo, September, N. Woodbury, 3 specimens.
Kawkareik, October, K. John, 6 specimens.
Thaton, October, K. John, 3 specimens.
Ye, October, K. John, 2 specimens.
Kengtung, September, R. S. Buker, 15 specimens.
Southern Mergui, September, W. D. Sutton, 2 specimens.
Northern Tavoy, October, W. D. Sutton, 119 specimens.
Myitkyina, September, L. A. Dudrow, 7 specimens.
" Manure," Mong Mong Valley, August, H. Young, 1 specimen.
Mong Mong, August, H. Young, 1 specimen.
" Dry, grassy mound," Loi Se, October, H. Young, 4 specimens.
Ko Haw Der, September, G. E. Blackwell, 12 specimens.
Shoko, September, G. E. Blackwell, 3 specimens.

(The records in Gates 1931, page 372, refer to this variety only.)

The genital markings are paired, transverse slits in the setal circles on some or all of segments xvii-xxiv. Each slit opens into a slight parietal excavation within which is a single rounded papilla on which is a pore. Some or all of the parietal excavations may be everted to form thickly columnar, whitish protuberances from the ventral surface of the body. At the end of each of these columns is the pore-bearing tubercle.

The male pores are minute, each pore on a rounded tubercle in the parietal excavation.

The caeca arise from the intestine in xxvii as in other species of the genus, the previous statement that the caeca arise from the intestine in xxvi (Gates 1925, p. 541) is a typographical error.

Definition of variety *typica*. Paired parietal excavations protrusible as columnar porophores on most or all of segments xvii-xxiv, in the setal circles. Paired testes and male funnels in segments v-xi. Seminal vesicles lacking as a rule. No spermathecae. Mushroom glands paired in xvii-xix and xxi-xxiv.

Variety **centralis** Stephenson.

1925. *Pheretima species*, Type F, Gates, *Ann. Mag. Nat. Hist.* (9), XV, p. 548.
1929. *Pheretima anomala*, forma *centralis*, Stephenson, *Rec. Ind. Mus.* XXXI, p. 234, fig. 6.

* Moulmein, August, a number of specimens.
* Martaban, August, a number of specimens.

* Maymyo, August, K. N. Sharma, 7 specimens.
* Paung, September, several specimens.
* Namsamkyin, Pantha, Mawleik, Kalewa in the Chindwin Valley, July, a number of specimens from each locality.
* Myitkyina, August, U. Devasar, a number of specimens.
Taungyi, August, H. B. Gates, 4 specimens.
Henzada, August, K. John, 1 specimen.
Pegu, August, K. John, 17 specimens.
Thanatpin, August, K. John, 7 specimens.
Toungoo, September, K. John, 7 specimens.
Kengtung, September, R. S. Buker, 24 specimens.
Myitkyina, September, L. A. Dudrow, 5 specimens.

*Collected in 1929 or 1930.

The spermathecal pores are large, transverse slits, three pairs in 5/6—7/8. These slits are, however, not the real spermathecal pores, each slit merely opening into a parietal excavation. On the dorsal wall of the excavation is a small, round marking at the centre of which is the real spermathecal pore, a minute, round aperture.

The male pores are minute as in variety *typica*.

The genital markings are as in variety *typica* but are confined to segments xvii-xx.

The spermathecal duct is thickened in the parietes, not narrowed.

Definition of variety *centralis*. Paired parietal excavations protrusible as columnar porophores on segments xvii-xx, in the setal circles. Testis sacs in x and xi. Well developed seminal vesicles present. Three pairs of spermathecae opening to the exterior in 5/6—7/8. Mushroom glands paired in xvii—xix.

Variety **insolita** Gates.

1925. *Pheretima species*, Gates, *Ann. Mag. Nat. Hist.* (9) XV, p. 543.
1925. *Pheretima insolita*, Gates, *Ann. Mag. Nat. Hist.* (9) XVI, p. 568.
1929. *Pheretima anomala*, forma *insolita*, Stephenson, *Rec. Ind. Mus.* **XXXI**, p. 236.

* Kya In, August, several specimens.
* Moulmein, August, a number of specimens.
* Martaban, August, a number of specimens.
* Kyaikmaraw, August, a number of specimens.
* Maymyo, August, K. N. Sharma, 9 specimens.
Henzada, August, K. John, 3 specimens.
Kyangin, August, K. John, 4 specimens.
Coomzamu, September, K. John, 13 specimens.
Maubin, September, K. John, 3 specimens.
Yandoon, September K. John, 3 specimens.
Kochi, September, K. John, 1 specimen.
Pyigyaung, September, K. John, 5 specimens.
Kawkareik, October, K. John, 1 specimen.
Thaton, October, K. John, 3 specimens.
Kengtung, September, R. S. Buker, 67 specimens.
" Dry, grassy mound," Loi Se, H. Young, 3 specimens.

* Collected in 1929 and 1930.

(Records in Gates 1930, page 312 refer to this variety only.)

The spermathecal pores are as in variety *centralis*.

Definition of variety *insolita*. Male pores, genital markings, prostates and mushroom glands lacking. Three pairs of spermathecae, opening to the exterior in 5/6—7/8. Testis sacs and seminal vesicles present.

Appendix to **Pheretima anomala.**

* Moulmein, August, several specimens.
* Kya In, August, several specimens.
* Ye, August, one specimen.
* Maymyo, August, K. N. Sharma, 1 specimen.
* Tavoy, October, 1 specimen.
* Labaw, October, 5 specimens.
* Ngapoli, October, 8 specimens.
* Myitkyina, August, U. Devasar, several spcimens.
* Toungoo, September, 7 specimens.
Kochi, September, K. John, 2 specimens.
Tantabin, September, K. John, 3 specimens.
Pyigyaung, September, K. John, 6 specimens.
Thaton, October, K. John, 6 specimens.
Ye, October, K. John, 1 specimen.
Kengtung, September, R. S. Buker, 16 specimens.
Northern Tavoy, October, W. D. Sutton, 1 specimen.
" Dry, grassy mound," Loi Se, October, H. Young, 2 specimens.

* Collected in 1929 or 1930.

These worms are intermediate between varieties *insolita* and *centralis* and are the same as or similar to the forms described as Types B to E in a previous paper (Gates, 1925, pp. 546-548).

Pheretima defecta Gates.

1930. *Pheretima defecta*, Gates, *Rec. Ind. Mus.* XXXII, p. 308.

The male setae on xvii are 24 ; on xviii, 13 ; on xix, 23 ; there are about 80 setae on xx.

The genital markings are about 4—5 intersetal distances wide transversely and are longer than wide. The male pore is minute, on a smooth, glistening tubercle of hemispherical shape, the tubercle contained within a slight parietal excavation at the centre of the genital marking.

The intestinal caecum of the left side is compound and may be more accurately described as composed of at least four elongate, anteriorly directed, finger-like processes, the dorsal-most process or secondary caecum the longest and with lobulations of both dorsal and ventral margins and towards the anterior end two longer, ventral tertiary caeca.

The testis sacs are paired in x and xi and apparently without transverse communications. A portion of the body wall in the region of the genital markings is thickened, but the thickened region does not project through the longitudinal musculature into the coelom.

The single specimen on which this species was based is probably abnormal, either with respect to the absence of spermathecae or of the prostates or both, but unless the genital markings are also abnormal this form may be regarded as distinct from other Burmese worms of the genus.

Pheretima elongata (E. Perr.) 1872.

Mt. Harriet, Andaman Islands, July, C. Amirthalingam, 1 specimen.
Minnie Bay, Andaman Islands, August, C. Amirthalingam, 2 specimens.
" Black earth," Maubin, September, K. John, 69 specimens.
" Black earth," Pyapon, September, K. John, 3 specimens.
Bhamo, September, N. Woodbury, 39 specimens.
" Muddy bank of stream," Nawng Kaw Mang Lun State, October, H. Young, 8 specimens.

The intestinal contents of all of the Bhamo worms are dark black, indicating probably that these worms, like the southern specimens, were

found in black soil. The college collector, K. John, maintains that this species can always be found in black earth but only very rarely elsewhere.

The length of the worms varies from 150—265 mm. The greatest diameter varies from 4—6 mm. The number of segments of five specimens selected at random is as follows :—218, 175, 214, 215, 230.

The position of the first dorsal pore is as follows —

11/12	1 specimen.
12/13	119 specimens.
13/14	2 specimens.

In each of the last two specimens there is a non-functional pore-like marking in 12/13.

Anterior to the clitellum there is no mid-dorsal break in the setal circles. Posterior to the clitellum there may or may not be a middorsal break, the break when present variable in width but usually small. Beginning from iv or v there is a very definite midventral break in the setal circles throughout practically the remainder of the length of the worm. On iv or v to xiii there are four much enlarged and conspicuously protuberant setae (*a* and *b* of each side). From xvii posteriorly there are two much enlarged and conspicuously protuberant setae on each segment (seta *a* of each side). The number of the setae on segment xx of eleven specimens varies from 60—75 as follows :—64, 63, 65, 60, 67, 75, 65, 62, 65, 67, 65. The number of the male setae on xviii varies from 7—15 as follows :—

7	1 specimen.
10	13 specimens.
11	24 specimens.
12	25 specimens.
13	31 specimens.
14	13 specimens.
15	1 specimen.

The male setae are continued onto the male genital markings of xviii where they are small and easily overlooked. The number of the spermathecal setae on vi has been estimated on a few of the specimens having symmetrically placed spermathecal pores in 5/6 with the following results :—13, 14, 17, 16, 15, 14, 16.

In the setal circle of xviii on each side there is a crescentic aperture with the concavity of the crescent towards the midventral line. This aperture opens into a narrow but relatively deep parietal excavation, on the median face of which is either a single oval area, or a lobulated ridge continuous with the elevated portion of the segment that bears the setae. The male pore which is minute, is located on the lateralmost portion of the oval area or on the lateralmost lobulation of the ridge. Each of the remaining lobulations of the ridge has a single seta. The condition just described is that of complete retraction. When fully everted the male pore is at the tip of a roughly conical protuberance from xviii with the parietal excavation practically obliterated. Most of the specimens show various stages between the two extremes of retraction or eversion.

In Burma *P. elongata*, as a general rule, does not have spermathecae. During the last ten years of collecting hundreds of specimens of this species (exact number not recorded) have been secured but only one

worm has been found with symmetrically paired spermathecal pores in 5/6—6/7, and only 51 specimens have been found with any spermathecal pores. The number and locations of the spermathecal pores on 48 of these specimens are shown in the table below. The spermathecal pores are minute.

5/6		6/7		7/8		Number of specimens.
Left.	Right.	Left.	Right.	Left.	Right.	
1	..	..	..	..	..	1
..	1	..	..	..	..	3
1	1	..	..	..	..	1
1	1	1	..	..	..	3
1	..	1	..	..	..	2
..	1	1	..	..	..	1
1	..	1	1	..	..	2
1	1	1	1	..	..	1
..	1	1	1	..	..	1
..	..	1	1	..	..	1
..	..	..	1		..	1
1	2	1	..	..	..	2
..	1	1	2	..	..	2
1	1	2	..	..	..	1
..	1	3	2	..	..	1
..	..	1	2	..	..	2
..	2	..	..	..	..	6
2	..	..	..	..	..	9
..	..	2	1	..	..	1
3		..	..	..	..	1
..	3	..	..	..	..	1
..	..	3	..	..		1
..	..	3	3		..	1
3	3	..	..	..	..	1
1	3	..	1	..	..	1
..	..	1	..	1	..	1

The figures under headings left and right indicate the number of the spermathecal pores in the particular intersegmental furrow to the right or left of the midventral line. For each pore there is an apparently normal spermatheca.

In addition to the above there are three specimens, of which two have a single spermathecal pore each, the pore located on the anterior margin of vi on the left side. The third specimen has a pore on the posterior margin of v on the right side, and three pores on the posterior margin of vi on the right side.

The genital markings are transversely oval areas, presetal in position and about 3—4 intersetal distances wide transversely, two not closely paired markings per segment. The markings are located on segments xix-xxiv as follows :—

xix-xxi	1 specimen.
xix-xxii	39 specimens.
xix-xxiii	77 specimens.
xix-xxiv	34 specimens.
xix-right xxiv	2 specimens.
xix-left xxiv	3 specimens.
xix-right xxii, right xxiii	2 specimens.
xix-left xxiii, left xxiv	1 specimen.
Left xix-right xxiii	1 specimen.
Left xix, left xx	1 specimen.
Left xix, left xx, left xxi, left xxii	1 specimen.

(Left or right indicates the presence of a single marking on the side mentioned. Intervening segments not mentioned have a pair of markings.)

Internal anatomy.—(Thirty specimens opened.)

Both hearts of xiii are present in each of the Nawng Kaw worms but are lacking in many of the specimens from other localities. When the hearts of xiii are absent the subneural vessel passes directly into one of the supra-oesophageal vessels, on the right or the left side. In several specimens the subneural trunk bifurcates into two equal vessels each of which passes up around the right or the left side of the oesophagus and into a supra-oesophageal trunk.

The intestine begins in xv, usually in the posterior portion of the segment. There are no intestinal caeca.

In about half of the specimens the latero-dorsal prolongations of the testis sacs of x and xi come into contact and end against the dorsal blood vessel. In the remainder of the specimens the latero-dorsal prolongations of the testis sacs in both x and xi are fused mid-dorsally so that a portion or all of the dorsal trunk belonging to the segment is included within the sac and surrounded by the testicular material.

Each seminal vesicle consists of a dorsal and a ventral portion, the two parts constricted off from each other and connected only by a narrow stalk. The dorsal portion which may perhaps be regarded as the equivalent of the primary ampulla of other species may be much larger than the ventral portion, of the same size, or definitely smaller. The dorsal portion has an irregular shape and a roughened, finely granular, whitish appearance, while the lower portion is usually flattened with surfaces and margins smooth. The ventral portion of a vesicle can be pulled away from the septum leaving the dorsal portion still attached and with a slight vertical cord of tissue passing ventrally on the septum.

Every specimen has also a pair of pseudo-vesicles in xiii on the posterior face of 12/13. The pseudo-vesicle consists of an ovoid mass which in

many worms is as large as an entire vesicle of xii, and a vertical stalk of finely granular tissue passing ventrally on the posterior face of the septum from the ovoid portion. The latter appears to be the equivalent of the primary ampulla. There is also in each specimen in xiv a pair of minute, irregularly spheroid pseudo-vesicles.

The prostates extend through some or all of segments xvi-xx, each prostate broken up into a large number of lobules which are closely aggregated. The prostatic ducts are bent into hairpin loops with the limbs of the loop in contact, the ectal limb of the loop much thicker than the ental limb.

Pheretima glabra, sp. nov.

"Manure," Nam Hpen Noi, August, H. Young, 20 aclitellate and 4 clitellate specimens.

Description of the type specimen. External anatomy.—(Statements in parentheses refer to other specimens.)

Length 75 mm., (to 110 mm.). Greatest diameter 4 mm., (to 5 mm.). Number of segments 114 (119, 117, 119, 116, 116). Unpigmented, clitellum reddish.

The setae begin on ii, on which segment there is an unbroken circle. A midventral break is usually lacking in the setal circles but a slight mid-dorsal break of variable width may be present. Setae are lacking ventrally on xvii and xviii and laterally on xix in a region just behind each genital marking. Setal numbers are indicated below.

xix	xx
9	54*
8	55*
8	53*
7	48*
6	53*
8	50*
10	51
9	54
8	54
8	51†

* Immature specimen.
† Type specimen.

The first dorsal pore is in 12/13. (The first dorsal pore is in 12/13 in all of the specimens, but one worm has a pore-like marking in 11/12.)

The clitellum is annular, extending from 13/14 to 16/17, intersegmental furrows lacking; no setae recognized; pore-like markings in the region of 14/15 and 15/16.

There is a single female pore.

The male pores are tiny transverse slits at the posterior ends of the grooves on the genital markings.

The genital markings are two, each marking elongate, with rounded ends, flattened, but protuberant from the surface of the body (especially anteriorly), placed diagonally with the posterior end slightly nearer the midventral line than the anterior end, and extending antero-posteriorly from mid xvii to the region of 18/19. (The markings may be diagonal in position or parallel to the midventral line). Each marking is provided

with a central, antero-posterior groove, the posterior end of which turns laterally to pass into the male pore. (The genital markings are about 4—6 intersetal distances wide transversely. There is a smooth glistening region midventrally extending from 16/17 to the setae of xix on which intersegmental furrows and setae are lacking.)

Internal anatomy.—(Opened 24 specimens.)

Septa 4/5—7/8 are present, 5/6—7/8 slightly thickened and muscular, 8/9 is a ventral rudiment only, 9/10 and 10/11 apparently are lacking (a sheet of tissue attached peripherally to the anterior face of 11/12 which covers over ventrally both pairs of testis sacs may represent a rudiment of 9/10 or 10/11), 11/12 is thin, 12/13—13/14 and several succeeding septa are slightly strengthened.

The intestinal enlargement of the gut begins in xx (xix-xx). (The gut is narrow and light coloured through xviii even in the smallest specimens.) The intestinal caeca are simple, extending from xxvii into xviii (xviii-xx).

There are masses of nephridia in v and vi.

The single commissure of ix is on the left side. (The single commissure of ix is on the left side in 11 specimens, on the right side in 11 specimens ; a pair of commissures belonging to ix in one specimen.) The last pair of hearts is in xiii. There are no hearts belonging to segment x. (All the commissures of ix, xi-xiii pass into the ventral vessel. The commissures of xi pass through the posterior testis sacs.)

There are two pairs of testis sacs ; the sacs of a side are in contact and project anteriorly in a diagonal fashion from the anterior face of 11/12 so that the anterior sac is further from the nerve cord than the posterior sac. The sacs of a segment are widely separated from each other and without transverse communication or connection. The seminal vesicles of xi and xii are large, covering over the dorsal blood vessel in those segments, the anterior vesicles extending forward into contact with the gizzard, the posterior vesicles pushing 12/13 posteriorly into contact with 13/14. The prostates extend through segments xvii-xix (xvii-xx) but push 19/20 posteriorly and 16/17 anteriorly into contact with 15/16. The prostatic duct is about $4\frac{1}{2}$ mm. long ; an ental portion about $1\frac{1}{2}$ mm. in length is narrow but pinkish and firm while the ectal two thirds or three quarters is much thickened.

There are no spermathecae. (There are no traces of the presence of spermathecae in the parietes even after removal of the longitudinal musculature.)

Remarks.—The prostatic ducts, the prostates, the seminal vesicles and the testis sacs are characteristically formed and well developed even in the smallest specimens. All specimens, even very short worms 40—50 mm. in length have the genital markings.

This worm may be merely an athecal variety but the thecal form does not appear to have been found. There are some resemblances to *P. doliaria* but the genital markings and the testis sacs are quite different, while *P. doliaria* has paired hearts belonging to x as well as ventral setae on xvii and xviii. For these reasons *P. glabra* has not been regarded as a variety of *P. doliaria*.

Pheretima illota, sp. nov.

" Village manure heap ", To Noi, September, H. Young, 2 mature specimens.

Description of the type specimen. External characteristics.—(Notes in parentheses refer to the second specimen.)

Length 149 (160) mm. Greatest diameter 6 (5) mm. Number of segments 110, incomplete posteriorly (120). The dorsum is very light greyish, the clitellum reddish.

The setae begin on segment ii but are present only dorsally and dorso-laterally on that segment. The setal circles are without a mid-ventral break but there may be a slight mid-dorsal break of variable width. The setae are small and closely crowded. The setal numbers are :—

ii.	xvii.	xviii.	xix.	xx.	
16	18	9	19	103	
17	20	6	18	94	Type.

The first dorsal pore is in 12/13.

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

There is a single female pore.

The male pores are minute, at the centres of the genital markings and about 2 mm. apart.

The genital markings are paired on xviii, each marking a slightly protuberant, circular area extending antero-posteriorly just across 17/18 and 18/19. A central portion of the marking, transversely oval in shape, is delimited from the rest of the marking by a slight furrow. (The markings are 11-13 intersetal distances wide transversely and are more closely approximated midventrally than the markings of other species from the same locality.)

Internal anatomy.—Septa 5/6—7/8 are present and muscular, 8/9 is present as a ventral rudiment only, 9/10 is lacking, 10/11—11/12 are muscular, 12/13 and 13/14 and several succeeding septa are slightly strengthened and translucent.

The intestine begins in xv. The intestinal caeca are simple, extending from xxvii into xxii.

The single commissure of ix is on the right side. The last pair of hearts is in xiii. (The hearts of ix-xiii all pass into the ventral trunk.)

There are blood glands in v and masses of nephridia in v and vi.

(There is a single median testis sac on the anterior face of 10/11 and a similar sac in xi.) The seminal vesicles are small, vertical bodies deep down in segments xi and xii, each vesicle with a conspicuous indentation or cleft in the dorsal margin, within which is seated a large (relative to the size of the vesicle) spherical primary ampulla. The prostates extend through xvii-xxi (and are cleft into 6—10 major lobes). The prostatic duct is on the parietes, bent into a shape like an interrogation mark, 3—4 mm. in length, of about the same thickness throughout.

There are no spermathecae (nor traces thereof buried in the parietes).

Pheretima rugosa Gates.

1926. *Pheretima houlleti rugosa*, Gates, *Ann. Mag. Nat. Hist.* (9) XVII, p. 459.

* Shwegyin, September, K. John, several specimens.
* Paung, September, K. John, several specimens.
* Maymyo, August, K. N. Sharma, 1 specimen.
Maubin, September, K. John, 2 specimens.
Ngapugale, August, G. R. Anderson, 2 specimens.
Toungoo, September, K. John, 2 specimens.
Pyigyaung, September, K. John, 2 specimens.
Blachi, September, G. E. Blackwell, 1 specimen.
Bhamo, September, N. Woodbury, 150 specimens.
Kawkareik, K. John, 11 specimens.
Ye, October, K. John, 1 specimen.
Thaton, October, K. John, 3 specimens.
Kengtung, September, R. S. Buker, 42 specimens.
Victoria Point, Saw Nelson, 35 specimens.

P. rugosa is similar in some respects to *P. houlleti*, in other ways it is like *P. campanulata*. As there are still several questions with regard to this form that cannot be answered at present, a detailed account will not be given at this time.

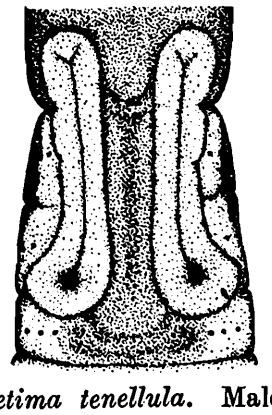
Pheretima tenellula, sp. nov.

" Dry, sunny hill top ", Kwang Yeh, Mang Lun State, October, H. Young, 4 clitellate specimens.
" Wet leaves ", Ang Lawng Mt., September, H. Young, 1 aclitellate and 2 clitellate specimens.
" Wet, shady ravine ", Pang Wo, Mang Lun State, October, H. Young, 3 clitellate specimens.
" Hard earth in pine grove ", Bana, September, H. Young, 17 aclitellate and 22 clitellate specimens.

Description of the type specimen. External characteristics.—Length 77 mm. Greatest diameter 3 mm. Number of segments 121. Unpigmented, clitellum bright yellowish.

The setae begin on ii, on which segment there is a complete circle of setae. The setal circles are without mid-dorsal or midventral breaks. Setae are lacking ventrally on xvii and there is a break in the setal circle of xix just behind each of the genital markings. There are 3 male setae on xviii, 8 male setae on xix.

The clitellum is annular, extending from 13/14 to 16/17, intersegmental furrows, dorsal pores and setae lacking. A midventral region of the



TEXT-FIG. 3.—*Pheretima tenellula.* Male genital area.

body between the genital markings on xvii and xviii and anteriorly on xix has exactly the same colour and appearance as the clitellum, as if

the clitellar glandularity were continued posteriorly as a narrow strip between the genital markings onto xix where the region of special glandularity is slightly widened to extend laterally on each side just behind the genital markings. The posterior and lateral boundaries on xix of this modified epidermal region are not sharply delineated.

The first dorsal pore is in 13/14 but there is a definitely pore-like marking in 12/13.

There is a single female pore.

The male pores are minute, transverse slits or depressions on the posterior ends of the genital markings.

The genital markings are elongate, longitudinal, raised,, whitish areas each area sharply delimited by a definite circumferential furrow, the ends of the markings rounded, the median margins straight, the lateral margins concave, the posterior ends slightly wider than the anterior ends, both ends wider than the middle portion of the marking on xvii. Each marking extends antero-posteriorly from 18/19 to about the region of 15/16 and is about 8 intersetal distances wide transversely on xviii. Along the middle of each marking there is an antero-posterior groove which on the posterior portion of the marking turns laterally to pass into the male pore. Intersegmental furrows 17/18 and 18/19 are lacking ventrally but 17/18 seems to be continued across the genital markings.

Internal anatomy.—Septa 5/6—7/8 are muscular, 9/10—10/11 are lacking, 11/12 is thin, 12/13—15/16 are slightly strengthened but are membranous.

The intestine begins to widen in xxi. The intestinal caeca are simple, extending forward nearly into xviii.

The single vascular commissure of ix is on the left side ; hearts of x are lacking. The last pair of hearts is in xiii. All of the hearts ix, xi-xiii pass into the ventral blood vessel.

There are masses of nephridia in v and vi.

The seminal vesicles of xii are much larger than the vesicles of xi and cover over the dorsal blood vessel in xii and push 12/13 back into contact with 13/14 and at the same time displace 11/12 anteriorly. The anterior pair of seminal vesicles is on the anterior face of 11/12. The prostates are relatively large and extend through xvii-xxiii. The prostatic ducts are long and extend through xviii-xx or xxii. Each duct is bent into a hairpin loop, the ental limb of the loop slender, the ectal limb much thicker.

Remarks.—The number of segments of five specimens :—114, 121, 119, 122, 121. The type specimen happens to be the longest specimen. The greatest diameter varies from 1½—3 mm.

None of the worms are pigmented but the clitellum is always vividly coloured, bright yellowish, reddish yellow, or orange.

A definite but very slight midventral break may be present in the setal circles from xx-xxii throughout the posterior portion of the worm, or this break may be lacking. A mid-dorsal break of varying width but slight may or may not be present. The ventro-lateral gaps in the setal circle of xix are always present. Setae are usually lacking on xvii and rarely also on xviii midventrally. The setae on xx vary from 50—66.

The setal numbers of 15 worms including both mature and immature specimens are as follows :—

xvii.	xviii.	xix.	xx.
0	2	7	53
0	4	7	..
0	1	5	..
0	2	7	..
0	3	7	..
0	3	8	..
0	2	8	66*
1	4	11	54†
0	2	9	57
2	4	8	54
0	4	6	52
0	5	6	54
2	4	8	53
1	5	10	50
2	5	9	55

* The next but the smallest specimen, genital markings on xvii-xviii only.
† The smallest specimen, $30 \times 1\frac{1}{2}$ mm.

The first functional dorsal pore is in 12/13 in all specimens except the type. In a few of the worms the dorsal pores in a short region behind 17/18 are not functional.

There is ordinarily a single female pore, but three worms have a pair of female pores on xiv.

The genital markings are characteristic and about as described above in all specimens, even on the very smallest. In several of the smallest aclitellate specimens the genital markings extend only across xvii-xviii. In all others the markings extend across xvi-xviii. The median margins of the genital markings are often slightly concave instead of straight. In all of the clitellate worms the midventral strip of epidermis and a slightly wider bit on xix anteriorly has an apperance like that of the clitellar segments, the ventral strip of coloured epidermis continuous with the clitellum without break or definite line of demarcation.

(All but two of the worms opened.) Septum 10/11 is either absent or modified. The anterior pair of seminal vesicles are bound to the anterior face of 11/12 by very delicate, transparent, connective tissue which may represent a modification of 10/11.

The gut remains narrow through segments xix or xx, the widening to a characteristic saccular intestine gradual. This is true of the smallest specimens as well as the largest.

No hearts belonging to x have been found in any of the specimens. The most anterior pair of hearts is considered to belong to segment xi as they pass into the ventral vessel near the testis sacs of xi. There is a pair of commissures belonging to ix in one specimen ; the single commissure of ix is on the left side in 25 worms, on the right side in 21 worms. The last pair of hearts is always in xiii. All of the vascular commissures of ix, xi-xiii always pass into the ventral blood vessel.

There are two pairs of small testis sacs on the anterior face of 11/12, transverse communications between the testis sacs lacking, the sacs of x slightly more separated from each other than the sacs belonging to

xi. The male funnels are small. The seminal vesicles of xii are always larger than those of xi. The prostates extend through xvi or xvii to xxii-xxiv. The prostatic ducts are as in the type specimen save that they may be turned anteriorly through xvii-xviii instead of posteriorly. The duct varies in length from 6—8 mm. in the clitellate specimens.

Spermathecae were looked for carefully in all dissected specimens but no traces were found, either in the coelom, or in the parietes after removal of the longitudinal musculature.

SECTION B.

One pair of spermathecae.

Pheretima nugalis Gates.

1931. *Pheretima nugalis*, Gates, *Rec. Ind. Mus.* XXXIII, p. 402, fig. 34.

The spermathecal setae on vi are about 13 ; male setae on xvii 15—14 ; on xviii 6—10 ; on xix 13—14.

The prostatic duct is slender throughout.

The spermathecal diverticulum passes into the anterior face of the duct.

Pheretima papilio Gates.

1930. *Pheretima papilio*, Gates, *Rec. Ind. Mus.* XXXII, p. 317, fig. 11,

Variety **typica.**

Southern Mergui, September, W. D. Sutton, 45 specimens.
Ye, October, K. John, 4 specimens.
Kawkareik, October, K. John, 5 specimens.

The worms from Ye are small, the greatest diameter 3—4 mm.

The first dorsal pore in many of the specimens collected this year is in 12/13. In the original description the first dorsal pore was said to be in 5/6 in all specimens. The original worms have been re-examined. The first dorsal pore in these worms is probably also in 12/13. There is however a weak spot in the mid-dorsal line in each of the intersegmental furrows 5/6—11/12 which looks much like a dorsal pore when viewed from the exterior. When the coelomic face of the parietes is examined these spots have a squarish appearance quite different from that of the real dorsal pores which are distinctly rounded. In the previous examination the pressure placed on the worms was probably sufficient to rupture the tissues in the regions of these weak spots. A few of this years specimens have the pore-like markings in 5/6—11/12.

The setal numbers of a few of the specimens are indicated below.

v.	xvii.	xvii.i	xix.
27	..	8	..
27	..	11	..
27	..	9	..
26	19	12	16
..	19	13	21
..	21	12	21
26	19	13	21
26	18	13	21

The male pores are tiny, transverse slits on the genital markings, slightly nearer to the lateral than the median margins of the markings. Furrows 17/18 and 18/19 are not visible ventrally.

The spermathecal pores are short, transverse slits on the anterior margin of vi. The integument in the immediate vicinity of these pores is not usually modified but in the Kawkareik specimens a portion of the body wall on which the spermathecal pore is located is protuberant as a sort of conical tumescence but without definite demarcation by furrows or grooves.

The number of secondary finger-like outgrowths from the dorsal and ventral margins of the intestinal caeca varies quite considerably. The size of the secondary caeca is also quite variable but usually the dorsal secondary caeca are longer than the ventral.

The single vascular commissure of ix is on the right or the left side of ix in about equal numbers of specimens.

Each seminal vesicle has a more or less conical primary ampulla in a cleft of the dorsal margin of the vesicle. The dorsal cleft divides the upper margin of the ventral portion of the vesicle into two lobes, one of which is usually larger than the other. The prostates extend through some or all of segments xvi-xx and may or may not be separated into two distinct portions. The prostatic ducts are $2\frac{1}{2}$—4 mm. in length, bent into a U-shape, the ectal limb of the U thicker than the ental limb.

There is no distinct projection into the coelom over the genital markings in this variety, though the genital markings do represent thickenings of the outer layers of the body wall. The thickenings are not however visible from the inside until after removal of the longitudinal musculature. Further thickening of the genital marking and invagination into the coelom would doubtless produce a condition not unlike that characteristic of variety *hiulca*. The genital markings of *typica* must however be regarded as fully developed so far as individuals of this variety are concerned for the dissected worms are mature with spermatozoa in their spermathecae.

The greater part of the spermathecal diverticulum is looped, the loops usually in one plane and within a delicate sac. The diverticulum passes into the anterior face of the duct which does not seem to be narrowed or constricted within the parietes.

Variety **hiulca**, var. nov.

Blachi, September, G. E. Blackwell, 7 specimens.

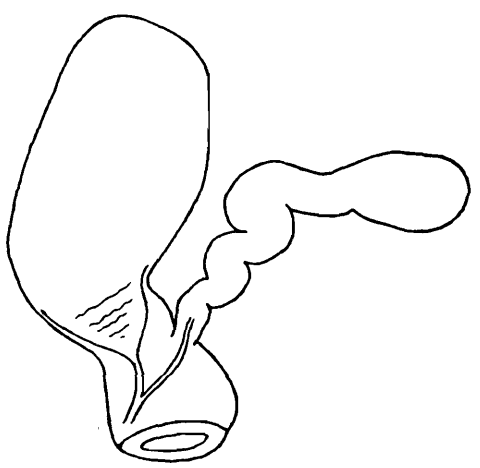
External characteristics.—Length up to 138 mm. Greatest diameter 6 mm. Number of segments of the largest specimen 114 ; other specimens probably incomplete posteriorly.

The setae are small and closely crowded, the setal circles without ventral break and usually without a dorsal break. There are however

gaps of varying width ventrally in the setal circle of vi. The setal numbers are indicated below.

v.	xviii.	xx.
35	4	72
36	9	..
36	4	..
36	11	80
34	10	..
32	9	..
34	10	74

The first dorsal pore is in 11/12 in one specimen, in 12/13 but with a definitely pore-like marking in 11/12 in one specimen, in 12/13 in five specimens. There are small, black " dots " in the mid-dorsal line at some of the more anterior intersegmental furrows but these dots are smaller than the anterior pore-like markings of the preceding variety.



TEXT-FIG. 4.—*Pheretima papilio hiulca.* Spermatheca xca 11.

On four specimens in the region of the intersegmental furrow laterally on each side there is a deep, transverse depression. The wall of this depression is tumescent and marked into whitish swellings of varied sizes. The spermathecal pore is usually not within this depression but is located on the anterior margin of vi at the brink of the depression or just within the depression, the pore small, but not minute, rounded or transversely slit-like. A whitish thread projects to the exterior through some of the pores. In three specimens the depressions are not well developed, the spermathecal pores transverse slits on hard rounded tumescences on the anterior margin of vi.

The genital markings are paired and somewhat similar in external appearance to those of variety *typica ;* they are elongate with rounded ends, extending from just behind the setae of xvii to just in front of the setae of xix, not so sharply delimited as in the previous variety nor depressed. In the region of the setal circle of xviii on each of these markings there is a deep (about 1½—2 mm.), transverse or somewhat diagonal, slit-like depression. The depressions are filled with fine particles of soil.

Internal anatomy.—The intestine begins in xv. The intestinal caeca have a varying number of dorsal only or dorsal and ventral lobulations which are well marked but the marginal incisions are not so deep as in the preceding variety.

All the vascular commissures pass into the ventral trunk. The last pair of hearts is in xiii.

The testis sacs of x and xi are single and median. The dorsal margin of each seminal vesicle is deeply cleft in such a way as to produce two large dorsal lobes, in the cleft between the dorsal lobes a small, more or less conical primary ampulla. The prostates extend through some or all of segments xvii-xxi. The prostatic duct is 5—8 mm. in length, bent into a hairpin loop, the ectal limb much stouter and longer than the ental limb, a slight constriction between the thicker ectal portion and the ental part of the duct. The vas deferens is large and readily visible on the parietes ; it passes into the prostatic duct below the margin of the prostate. Projecting conspicuously into the coelom over each genital marking is a large, glistening, whitish, conical structure, into the peak of which the prostate duct passes. The wall of this body is thick and tough, the cavity slight. There is a tiny, usually conical projection into the cavity on the side of which there is a distinct groove. The male pore may be within this groove but has not actually been seen.

The spermathecal diverticulum is elongate and looped, the loops as a rule arranged in a zig-zag pattern, but ectally the looping may be irregular. The diverticulum is tubular, wider entally than ectally and passing into the anterior face of the spermathecal duct in the thickened posterior wall of the parietal invagination of 5/6. The luminal face of the ampulla and especially the ectal portion is corrugated which may be the result of strong contraction.

Variety **insignis,** var. nov.

Thaton, October, K. John, 15 specimens.

All of these worms had lost more or less of the posterior portions of their anatomy sometime before collection, the posterior ends healed over but blunt with no trace of regeneration. The greatest diameter is only 4½ mm.

The first dorsal pore is in either 12/13 or 13/14 but there are two or more pore-like markings on each specimen anterior to what appears to be the first functional pore.

The setal numbers are given in the table below.

v.	xvii.	xviii.	xix.	xx.
24	*g*	8	21	..
28	20	11	24	..
g	22	9	18	..
g	21	9	20	..
g	22	9	20	65
24	*g*	7	20	60
27	22	11	20	..
g	21	9	19	..
26	*g*	4	*g*	..
27	*g*	8	20	..
27	21	8	23	..
g	*g*	8	17	..
g	*g*	10	20	..
28	20	8	20	..
g	*g*	9	21	..

g indicates that there are gaps in the setal circles in the region where the setae were to have been counted. In the majority of cases the setal pits can still be seen in these gaps.

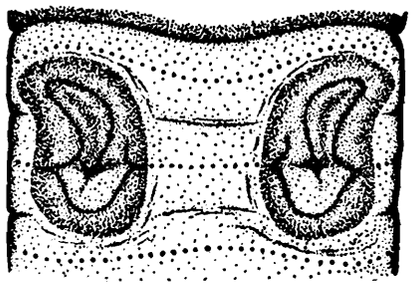
The male pores are short crescentic slits on the genital markings, the concavities of the slits directed posteriorly.

The genital markings are two elongate areas with bluntly rounded ends extending from the setal circle of xvii or just behind the setal circle of xvii to 18/19 or to slightly posterior to 18/19. The markings are diagonal, the anterior ends nearer the midventral region in nine worms, the posterior ends nearer the midventral line in the remaining six worms.

There is a fine but readily recognizable groove on the genital marking as shown in the figure.

The spermathecal pores are fairly large, transverse slits on the anterior margin of vi. The anterior lip of the pore, the region between the slit and intersegmental furrow 5/6 is swollen and protuberant as three small lobes.

Internal anatomy.—(Opened 11 specimens.)



TEXT-FIG. 5.—*Pheretima papilio insignis.* Male genital area.

The intestine begins in xv. The secondary caeca are always better developed on the dorsal margin than on the ventral margin of the intestinal caeca.

There is a pair of commissures belonging to ix in 2 specimens ; the single commissure of ix is on the right side in eight specimens, on the left side in one specimen. The last pair of hearts is in xiii. All the commissures of ix-xiii pass into the ventral vessel.

There are two median testis sacs, each with a conspicuously bilobed anterior margin. The seminal vesicles of xii are large, covering over the dorsal blood vessel and displacing 12/13 posteriorly. On the septal face of each vesicle in this segment there is a more or less conical primary ampulla. The dorsal margin of the vesicle is cleft down to the point of attachment of the primary ampulla. The vesicles of xi are also large, covering over the dorsal blood vessel in this segment and pushing 10/11 forward, sometimes so far as to come into contact with 7/8. No primary ampullae have been found on the vesicles of xi. The prostates extend through xvii-xix. The prostatic ducts are about 3 mm. in length, each duct bent into a sort of U-shape with the ectal limb very much the stouter. The thickening of the parietes over the genital marking does not protrude conspicuously into the coelom, but the region of the body wall into which the prostatic duct passes is very slightly elevated into a sort of hardly distinguishable cone that is slightly reminiscent of the condition in variety *hiulca*.

The ental portion of the spermathecal diverticulum is widened but not looped, the ectal portion is looped, the loops few and short. The diverticulum passes into the anterior face of the duct as in *typica* but

the ectal portion of the diverticulum is shorter and narrower than in *typica*. The spermathecal duct is almost confined to the body wall and is not constricted therein.

Pheretima referta Gates.

1931. *Pheretima referta*, Gates, *Rec. Ind. Mus.* XXXIII, p. 405, figs. 35-36.

There is a complete circle of setae on ii ; the setal circle of xvii is uninterrupted ventrally.

The narrow, lateral strip connecting the two crescentic areas of each genital marking is not so protuberant as the crescentic areas.

For a discussion of the status of this form *vide* Gates 1931, page 407. It should however be noted that the genital markings may be more variable both as to conformation and location than previous work had indicated. *Vide* for example, *P. carinensis*, *P. velata*, and other species hereinafter.

SECTION C.

Two pairs of spermathecae.

I. Spermathecal pores dorsal.

Pheretima youngi, sp. nov.

" Wet, shady ravine", Pang Wo, October, H. Young, 4 specimens.
" Wet leaves in ravine", Teung Cong, October, H. Young, 1 specimen.

Description of the type specimen. External characteristics.—(Statements in parentheses refer to the cotype specimens.)

Length 68 (77—90) mm. Greatest diameter 4 mm. Number of segments 71, last segment setigerous, tail portion probably lost previous to collection (89, 97, 77-last segment setigerous). Colour of dorsum, reddish brown anteriorly to light yellowish brown posteriorly ; clitellum greyish (or brownish).

The setae begin on segment ii, the setal circles with dorsal break of varying width but without ventral break. The setal numbers and positions of the first dorsal pore are indicated in the table below.

V.	vi. D.	xvii.	xviii.	xix.	xx.	First dorsal pore.	Male pores.	
25	8	18	4	18	48	10/11	l	Type.
24	9	9*	4	8*	..	10/11	m	Cotype.
24	5	17	7	15	40	13/14	m	,,
a	*a*	13	5	10*	..	10/11	m	,,
20	*a*	..	5	..	..	10/11	l	Teung Cong.

V. Number of setae between the spermathecal pores ventrally.

D. Number of setae between the spermathecal pores dorsally.

a Setae lacking, setal pits visible.

* Gaps in the setal circle just behind or just in front of the genital markings.

l. Male pores towards lateral margins of genital markings.

m. Male pores towards median margins of genital marking.

The clitellum is annular, extending from 13/14 to 16/17 ; positions of the dorsal pores indicated by non-functional pore-like markings ; no intersegmental furrows or setae visible.

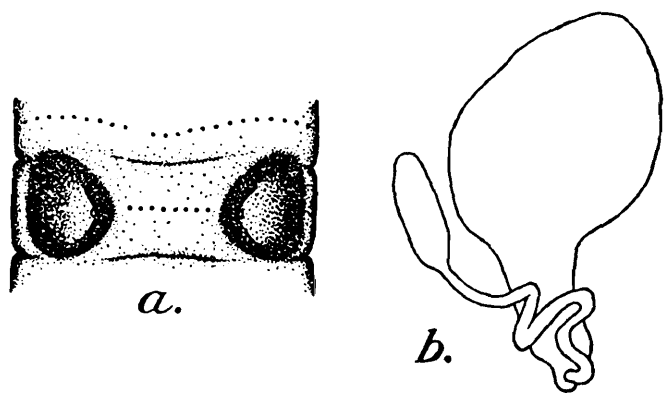
The spermathecal pores are dorsal, very small, transverse slits ; two pairs, one pair in the setal circle of vi, the other pair in 6/7, the anterior pores about 2 intersetal distances lateral to the posterior pores. The pores are on tiny, whitish, conical protuberances which are readily visible to the unaided eye against the pigmentation of the dorsum. (In the cotypes the anterior pores are only very slightly lateral to the posterior pores.)

There is a single female pore on xiv.

The male pores are small, antero-posterior slits, on the genital markings. (Both pores are near the median margins of the genital markings or near the lateral margins of the markings.)

The genital markings are a single pair on xviii, each marking anteroposteriorly elongated with bluntly rounded ends and even lateral margin but with a single slight notch or indentation of the median margin about in line with the setae of xviii, extending slightly anterior to 17/18 and slightly posterior to 18/19. The marking is sunk into the parietes ; around the depression there is a slightly protuberant and glistening whitish rim. The surface of the genital marking is not level but rises slightly into a small, not sharply demarcated, somewhat conical protuberance on which is the male pore. The markings are about 6—8 intersetal distances wide transversely.

Internal anatomy.—(4 specimens opened.)



TEXT-FIG. 6. *a. Pheretima youngi.* Male genital markings. *b. Pheretima youngi.* Spermatheca ×ca. 11.

All septa are present from 4/5 posteriorly ; none are especially thickened.

The intestine begins in xv but is not much wider than the oesophagus until xxi. The intestinal caeca are simple, extending from xxvii into xxv (or xxiv).

There are masses of nephridia in v and vi and blood glands in iv and v.

The last pair of hearts is in xiii ; the single commissure of ix is on the left side (right side in three cotypes). (All the hearts of ix-xiii pass into the ventral blood vessel.)

(There are two, median testis sacs, in x and xi). The seminal vesicles are large, covering over the dorsal blood vessel in xi and xii, the anterior

vesicles pushing 10/11 forward into contact with 9/10, the posterior vesicles pushing 12/13 into contact with 13/14. The prostates extend through xvii-xx, displacing slightly 16/17 and 20/21. The prostatic ducts are bent into a short, u-shaped loop, the closed end of the loop towards the nerve cord, the ectal limb posterior to the ental limb. (The length of the duct varies from 2—3 mm.)

The spermathecal duct is shorter than the ampulla, the diverticulum longer than the combined lengths of duct and ampulla. The ental portion of the diverticulum is looped, the loops pressed together and against the anterior face of the spermatheca, the looping may or may not be regularly zig-zag. The entalmost portion of the diverticulum is widened. The diverticulum passes into the anterior face of the duct within the parietes ; the duct ectal to this junction abruptly narrowed.

In the body wall dorsal to the genital marking there is a tough mass of whitish tissue which does not project into the coelom.

Remarks.—This species somewhat resembles *P. sulcata* from the Tenasserim division of the province. *P. youngi* and *P. sulcata* are the only Burmese species of the genus with dorsal spermathecal pores.

II.

Spermathecal pores anteriorly on vi and vii.

Pheretima canaliculata, sp. nov.

Blachi, September, G. E. Blackwell, 7 specimens.

Description of the type specimen. External characteristics.—Length 147 mm. Greatest diameter 7 mm. Number of segments about 111. Colour of dorsum anterior to the clitellum, bluish ; posterior to the clitellum, reddish ; clitellum greyish.

The setae begin on ii and are small and closely crowded, slightly further apart laterally and dorsally than ventrally. The setal circles are without ventral break and usually without a dorsal break. Male setae on xviii, 19 ; spermathecal setae on vi, 7+ (other setae have either been dropped out or retracted deeply into the parietes). There are about 83 setae on xx.

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

There is a single female pore on xiv.

The male pores are small, transversely slit-like depressions in the setal circle of xviii, each pore about in line with the lateralmost region of the genital markings.

The spermathecal pores are two pairs, anteriorly on vi and vii. Each pore is small, transversely slit-like and is located on a small transversely oval tumescence of the epidermis immediately behind the intersegmental furrow.

The genital markings are a single pair, each marking extending from just behind the setae of xvii nearly to the setae of xviii, with rounded ends, slightly depressed below the general level of the epidermis, with a whitish, glistening rim and a central area which at first appears to be finely granular. With high magnification the appearance of granulation

is seen to be due to the presence of small, diamond-shaped areas, each area surrounded by a distinct groove and with a central depression which appears to contain a pore. A furrow runs diagonally and laterally across the posterior part of the genital marking and is continued beyond the marking into the setal circle of xviii where it passes laterally into the male pore. Each marking is about 8—10 intersetal distances wide transversely.

Internal anatomy.—Septa 4/5—7/8 are present and slightly thickened but membranous, 7/8 thicker than the preceding septa ; 8/9—9/10 are lacking ; 10/11 is very fragile, 11/12—13/14 are thicker than the succeeding septa but are membranous.

The intestine begins in xv. The intestinal caeca extend from xxvii into xxv, each caecum a mass of finger-like lobes, some of which have tertiary lobulations.

There are masses of nephridia in v and vi. There are small masses (of blood glands ?) consisting of one or more rounded bodies on antero-posterior muscular cords in v and vi.

The last pair of hearts is in xiii.

The seminal vesicles are large and in contact dorsally over the dorsal blood vessel in xi and xii. The vesicles of xii push 12/13 and 13/14 back into contact with 14/15. The anterior vesicles push 10/11 forward so that these vesicles appear to be in contact with the gizzard. The prostates extend through xviii-xix or xx. The prostatic duct is short, stout and practically straight, erect. The vasa deferentia are large, readily visible on the parietes, those of a side in contact but not united at least until into segment xvii.

The spermathecae are in vi and vii. The diverticulum is longer than the rest of the spermatheca, coiled or looped, with an ovoid enlargement of the ental end.

Remarks.—The six cotype specimens are all anterior fragments. The epidermis is eroded in places, especially around the male pores. The setal numbers are as follows :—

vi.	xviii.	xx.
27	18	80
22	16	..
26	21	87
29	22	86
23	20	81

The first dorsal pore is in 11/12 in 3 specimens, in 12/13 in two specimens, in 13/14 in one specimen. There are dark, squarish, pore-like markings anteriorly as far forwards as 7/8 or 8/9 but none of these are functional pores, although slight pressure is sufficient to rupture the epidermis in these regions ; the squarish appearance is the result of a gap in the muscular layers.

The spermathecal pores are all slit-like and of the same size as in the type specimen. The pore tubercles are protuberant in all specimens.

The genital markings are consistently as described for the type specimen. Each marking is 9—12 intersetal distances wide transversely. The markings are separated from each other by a midventral region which is about 6—9 intersetal distances wide transversely.

The intestine begins in xv in all specimens. The intestinal caeca have a varying number of secondary caeca, directed anteriorly, or both anteriorly and dorsally. Some of the secondary caeca have lobulated margins or even tertiary caeca.

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

There are two median testis sacs. The seminal vesicles are as in the type specimen. No primary ampulla was definitely recognized. The prostatic duct is characteristically short, stout, erect ; straight or bent at right angles. The vasa deferentia are conspicuous, double on each side at least as far as xvii, and pass into the prostatic duct below the margin of the prostatic gland.

The spermathecal duct is either confined to the body wall or is only slightly coelomic and is not narrowed within the parietes. The luminal face of the ampulla is corrugated, entally the corrugations are longitudinal, ectally the corrugations are transverse. The diverticulum is always longer than the duct and ampulla together, is variously looped ; the looping often more complicated than that shown in the figure. The diverticulum is contained within a delicate, connective tissue sac, but this sac is recognizable as a rule only around the ectalmost loops. The diverticulum passes into the anterior face of the spermathecal duct.

There is a pad of tissue dorsal to the genital marking that extends posteriorly to and around the ectal end of the prostatic duct, but this tissue does not project into the coelom and can be seen only after the longitudinal musculature has been stripped off from the parietes.

The genital markings are somewhat similar in appearance to those of *P. papilio typica* from which *P. canaliculata* is distinguished by the larger number of spermathecae.

III.

Spermathecal pores in 6/7 and 7/8.

Pheretima immerita Gates.

1931. *Pheretima immerita*, Gates, *Rec. Ind. Mus.* XXXIII, p. 389, fig. 27.
" Wet, shady ravine," Pang Wo, October, H. Young, 1 specimen.

P. immerita was founded on eight quite immature specimens from Kengtung state. Like the originals the present specimen is without trace of clitellar glandularity. Like the previous specimens the Pang Wo worm has meridional yellowish stripes on which the setae are located, the first dorsal pore in 12/13, and two pairs of spermathecal pores in 6/7 and 7/8.

The spermathecal setae on vii are 26 ; the male setae on xviii are 25.

The anlage of the genital markings are very slightly protuberant, transversely oval, glistening patches ; one pair on xviii nearer to the setae than to the intersegmental furrow, each patch 1—1½ intersetal distances wide transversely and about 4 intersetal distances median to the male pore ; a single, median, preclitellar marking on vii, about 3 intersetal distances wide transversely. Both pre- and post-clitellar genital markings are postsetal.

The seminal vesicles are flattened, narrow, strap-like, vertical bodies on the posterior faces of the vesicular septa, each vesicle with a (relatively) well developed primary ampulla projecting dorsally from a slight notch in the mid-dorsal margin.

IV

Spermathecal pores anteriorly on vii and viii.

Pheretima planata Gates.

1926. *Pheretima planata*, Gates, *Ann. Mag. Nat. Hist.* (9) XVII, p. 411.
Thanatpin, August, K. John, 2 specimens.
Pegu, August, K. John, 5 specimens.
Coomzamu, September, K. John, 1 specimen.
Yandoon, September, K. John, 3 specimens.
Sandoway, September, F. R. Bruce, 128 specimens.
Myittha, September, W. D. Sutton, 4 specimens.
Myitkyina, September, L. A. Dudrow, 4 specimens.
Northern Mergui District, September, W. D. Sutton, 126 specimens.
Tantabin, September, K. John, 3 specimens.
Toungoo, September, K. John, 1 specimen.
Pyigyaung, September, K. John, 5 specimens.
Pyinmana, September, K. John, 1 specimen.
Ye, October, K. John, 3 specimens.
Kawkareik, October, K. John, 2 specimens.
Ngapugale, August, G. R. Anderson, 1 specimen.

External characteristics.—The first dorsal pore is usually in 11/12, sometimes in 10/11.

A midventral break in the setal circles is almost always lacking; a dorsal break is usually lacking but may occasionally be present, due apparently to the dropping out of one or more of the mid-dorsal setae.

The male setae on xviii are 8—14; the spermathecal setae on vii are 35—42; there are 57—65 setae on segment xx.

The spermathecal pores are not readily visible and cannot be definitely recognized as a rule with the lower powers of the binocular. With higher powers of the binocular (32 and 25 mm.) it is possible to recognize the positions of the pores as indicated by minute, creamy-opalescent spots. In a few specimens definite but minute pores with whitish lips can be made out. The pores are not located in the intersegmental furrows but on the anterior margins of segments vii and viii, the pores quite definitely closer to the furrows in some specimens than others. Each pore is always very close to one of the genital markings, the lateral-most, and is always slightly lateral to that marking. The spermathecal duct passes into the parietes together with the duct of one of the stalked glands. After removal of the longitudinal musculature from the coelomic face of the parietes it is possible to separate the duct of the spermatheca from the duct of the gland and holding down the gland duct to pull out the spermathecal duct so that a portion of the epidermis bearing the spermathecal pore remains attached to the end of the spermathecal duct. This operation always leaves a hole in the epidermis on the anterior margin of the segment just lateral to the lateralmost genital marking.

The genital markings are minute, round, brownish or greyish, translucent spots in the epidermis with definite margins. The markings are always median to the spermathecal pore lines on the anterior margins of vii and viii and the posterior margin of vii. There are one to four of

these markings in the immediate vicinity of each spermathecal pore. After removal of the longitudinal musculature from the coelomic face of the parietes the stalks of the glands can be pulled out leaving an evenly rounded hole in the epidermis. Each marking is the external evidence of the presence of one of the stalked glands ; none of these glands have been found to pass into the spermathecal duct. The marking just median to the spermathecal pore is almost always a trifle smaller than the other markings.

The following table shows the extent of variation in some of the external characteristics of the Burmese worms of this species.

				vii.				viii.	
vii.	xviii.	xx.	First dorsal pore.	Anteriorly.		Posteriorly.		Anteriorly.	
				l.	r.	l.	r.	l.	r.
38	11	60	11/12	*—	—	—	—	—	—
35	12	64	11/12	2	2	0	0	2	2
36	10	65	11/12	2	2	0	0	2	2
39	11	58	11/12	1	1	0	0	1	1
38	12	60	?11/12	1	1	0	0	1	1
37	10	60	11/12	1	1	0	0	1	1
38	12	61	11/12	2	2	0	0	2	2
35	12	..	?11/12	1	1	1	1	1	1
42	13	..	11/12	*—	—	—	—	—	—
39	12	..	†11/12	2	1	0	0	1	1
35	11	..	?11/12	2	1	0	0	1	2
37	10	..	10/11	1	1	0	0	2	2
35	14	..	10/11	1	2	1	2	2	2
35	12	..	?11/12	1	1	0	0	3	2
38	11	..	11/12	1	1	0	0	2	2
36	11	..	?11/12	2	1	1	0	2	2
35	11	..	10/11	1	2	0	0	2	2
37	10	..	11/12	1	2	0	0	2	2
37	11	..	?11/12	2	2	0	0	2	2
42	11	..	10/11	2	1	1	1	2	2
40	12	..	11/12	1	2	0	0	2	2
38	11	..	11/12	1	2	0	0	2	2
38	11	..	†11/12	2	2	0	0	2	2
40	12	..	11/12	2	1	0	0	2	2
41	12	..	11/12	1	2	0	0	2	2
35	8	..	11/12	1	1	0	0	2	2
38	11	..	11/12	1	1	1	0	2	2
40	11	..	11/12	1	1	0	0	2	2
40	12	57	?11/12	2	2	0	1	3	2
39	11	60	?11/12	1	1	0	0	2	2
38	11	..	?11/12	1	1	0	0	1	2
36	12	57	11/12	1	1	1	0	2	2
42	12	58	?11/12	1	1	0	0	1	2
36	10	62	?11/12	2	2	0	0	2	2
42	14	61	?11/12	1	1	0	0	1	1

*Aclitellate, genital markings not visible.

† A somewhat pore-like depression anteriorly on xi, less pore-like than the marking indicated by ?

Internal anatomy.—(15 specimens opened.)

The intestine always begins in xv. The intestinal caeca are simple, usually with septal constrictions, rarely with slight additional marginal incisions.

The seminal vesicles of xi are contained within the testis sacs of that segment. The dorsal margin of each vesicle of xii is marked off by a slight groove into two lobes. Between these two lobes there is always a small protuberance, the primary ampulla. This ampulla is usually finger-shaped, but occasionally the free end of the ampulla is minutely lobed instead of bluntly rounded or pointed. The testis sacs of x and xi are paired and without transverse communication. The copulatory chambers are well developed. Within each chamber there are small, round, translucent markings, very similar to those on the parietes near the spermathecal pores. There are usually 8—12 of these markings in each chamber. Passing into the wall of each chamber are the stalks of the glands in xvii and xix. These glands are more or less spherical or ovoid, projecting into the coelom or partially buried within the longitudinal musculature. The stalks or ducts of these glands are almost always entirely concealed within the musculature. When the longitudinal muscle strips are removed from the coelomic face of the parietes the ducts of the glands may not be at once visible but concealed within a mass of non-muscular tissue. In this case the appearance is of a bilobed copulatory chamber, or of two large glands opening into the copulatory chamber, or of a single large bilobed gland connected by a large stalk to the copulatory chamber. If the tissue be carefully loosened the individual stalks can be found and traced to the markings within the copulatory chamber. In aclitellate specimens this connective tissue seems to be largely lacking and the removal of the musculature shows clearly the separate stalks of the glands passing independently to the chamber. When the copulatory chamber is everted there is visible externally a vertical, thickly columnar body about 1—1½ mm. high, but with a slight depression either at the central axis or towards the lateral margin. When most completely everted the lumen is reduced to a slight slit towards the lateralmost portion of the column. The flat end of the column is covered with small markings of three sizes, the largest marking bears the male pore which is minute. The smallest markings are usually in a group of 2, 3 or 4 close to the male pore marking. When the copulatory chamber is everted the prostatic duct passes directly into the parietes without coelomic evidence of the presence of a chamber. Certain species of *Pheretima* from which conspicuously protuberant porophores have been reported but which are said to have no copulatory chambers may in reality have such chambers but completely everted and without coelomic evidence of their presence as in the specimens just mentioned.

The spermathecal diverticulum is characteristic throughout, but may reach a length twice that of the combined lengths of duct and ampulla.

Though the stalk of one gland always passes into the parietes together with the spermathecal duct, the stalk has never been found to pass into the spermathecal duct as do one or more stalks of the glands of *P. houlleti* or *P. campanulata.*

V.

Spermathecal pores in 7/8 and 8/9.

Pheretima andamanensis Michaelsen 1907.

One specimen from the Indian Museum with the following label, " ZEV 2823/7, P. andamanensis Mich. Type. N. Cinque Island, Andamans, B. B. Osmaton."

Examination of this specimen has resulted in little of value as many of the internal organs have been removed. There is no clitellar glandularity in the region of segments xiv-xvi ; intersegmental furrows, secondary annuli, dorsal pores and setae visible in that region. There are at least 13 male setae on xviii and there are probably about 12 spermathecal setae on viii.

In the setal circle of xviii there are two slight parietal excavations. Each contains a single structure somewhat like the male pore disc of *P. andersoni*, but here quite definitely thicker, retracted into the excavation and partially concealed by lips of the aperture of the excavation. The ventral face of this disc is slightly concave and on the centre of the concavity there is a minute pore. Whether or not this is the male pore cannot be decided without resort to sections as the prostates and their ducts had been removed. Immediately lateral to each of these excavations is a narrow antero-posterior slit opening into a deep parietal excavation. The walls of this excavation are continued into the coelom as a conical projection which may have been continuous either with the prostatic duct or with the duct of the accessory gland mentioned by Michaelsen. In xviii in the body wall on each side of the segment there is a tubular structure that resembles the ectal end of a prostatic duct in other species of *Pheretima* and which is continued through the thickened disc in the slight parietal excavation to open to the exterior by the pore previously mentioned. Among the tissues of the parietes between this body and the more lateral conical protrusion into the coelom is a setal follicle containing a single penial seta which passes through the body wall with the tip projecting externally in the slight parietal excavation beside the pore-bearing disc. This seta was pulled out from the follicle but fell off from the forceps into the worm where it was not at first visible. After tedious search a seta was found in the vicinity of the setal follicle which may or may not have been the penial seta. This seta is sigmoid with a central nodulus and apparently a bifid tip, the latter not very clear due to swelling and softening of the extreme end. There are short transverse rows of fine teeth around the shaft towards the tip.

The seminal vesicles of xii and the left vesicle of xi are present. Each of these vesicles has a long, slender, dorsal, primary ampulla which is slightly or only very slightly swollen at the dorsal end and which arises from the anterior or septal face of the vesicle just below a mid-dorsal cleft or groove.

All spermathecae had been removed.

Michaelsen did not mention the deeper of the two parietal excavations on xviii nor the penial setae.

Pheretima doliaria Gates.

1931. *Pheretima doliaria*, Gates, *Rec. Ind. Mus.* XXXIII, p. 374, fig. 18-20.

Variety **typica.**

The original specimens have been re-examined. There is an unbroken circle of setae on segment ii. The setal circle of viii may or may not have one or more ventral gaps due to the falling out of some of the spermathecal setae.

The genital markings are protuberant, the surfaces roughened. In addition to the markings previously described there may be a pair of indistinctly outlined, slightly tumescent areas, anteriorly on xix as figured (1931, p. 375) or (and) posteriorly on xvii.

The hearts of x are present.

Variety **armillata,** var. nov.

" Wet, shady ravine," Pang Wo, October, H. Young, 1 clitellate specimen.

External characteristics.—Length 103 mm. incomplete posteriorly. Greatest diameter 6 mm. Colour of dorsum, light greyish ; of clitellum, dark bluish grey.

The setae begin on ii, on which segment there is a complete setal circle. There is no midventral break in the setal circles, there may be a slight mid-dorsal break of variable width. The setal circle of xix is interrupted on each side just posterior to the genital markings. The setal numbers are as follows :—spermathecal on viii, 26 ; male on xvii, 24 ; on xviii, 6 ; on xix, 19 ; number of setae on xx, 57.

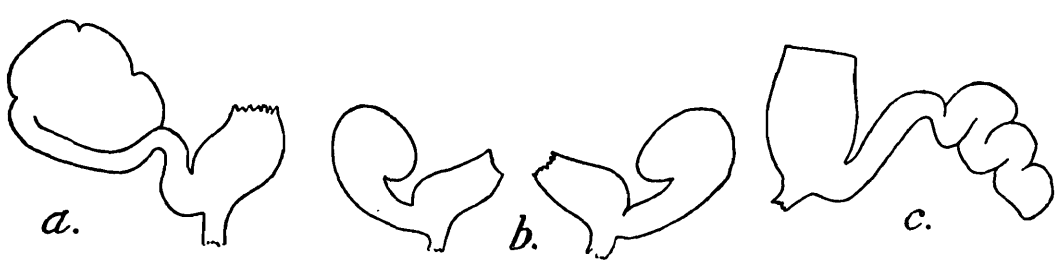
The clitellum is annular, extending from 13/14 to 16/17 ; setae, dorsal pores and intersegmental furrows lacking.

The first dorsal pore is in 12/13.

The spermathecal pores are minute ; two pairs, located anteriorly on viii and ix but close to the intersegmental furrows.

There is a single female pore on xiv.

The male pores are very short, transverse slits ; each close to the lateral margin of the genital marking.



TEXT-FIG. 7. *a. Pheretima doliaria armillata.* Spermatheca × ca. 11. *b. Pheretima doliaria dolosa.* Spermatheca × ca. 11. *c. Pheretima doliaria stercoraria.* Spermatheca × ca. 11.

The genital markings are of 3 sorts. (1) A pair of roughly circular areas on xviii ; each about 5—6 intersetal distances wide transversely, slightly depressed below the general body surface, flattened except towards the lateral margin where there is a slight elevation bearing the

male pore. (2) Two pairs of crescentic areas ; one pair posteriorly on xvii, one pair anteriorly on xix ; the crescents just anterior to or just posterior to the markings of xviii, with the concavity of the crescent towards the male-pore marking. Each crescent has a slightly concave surface with a pore at the centre of the concavity. (3) Four pairs of preclitellar markings on vii, viii and ix. Each marking a specially whitened and slightly wrinkled area in shape like a half-moon. A pair of these markings is associated with each spermathecal pore, the bases of the half moons at the intersegmental furrow, the spermathecal pore located on the posterior marking of each pair and towards its lateral margin.

Around each of the male-pore areas is a ring of whitish tissue which is separated from the central male-pore area by a deep furrow. Lateral to the rim on each side there are 8—10 short, slightly crescentic, antero-posterior furrows, with the concavities of the crescents towards the genital marking.

Internal anatomy.—Septa 5/6—7/8 are thickly muscular, 8/9 is a ventral rudiment only, 9/10 is lacking, 10/11 is present but thin, 11/12—14/15 are slightly strengthened and translucent.

The oesophagus is swollen in xiv and xv but is narrow and whitish and laterally flattened through the prostatic segments. The intestinal caeca are simple but with slight marginal incisions both dorsally and ventrally.

There are masses of nephridia in v and vi.

The single commissure of ix is on the left side. No hearts belonging to x were found. The last pair of hearts is in xiii. All hearts, ix and xi-xiii pass into the ventral trunk.

There are two median testis sacs. The seminal vesicles are large, covering over the dorsal blood vessel in xi and xii. The anterior pair push 10/11 forward into contact with the sides of the gizzard. The posterior pair push 12/13 back into contact with 13/14. The prostates are large, extending through segments xvii-xxii. The prostatic duct is about 5 mm. in length, with a short, flabby, ental portion, a much thickened middle portion bent almost at right angles, and a narrower but firm and pinkish ectal portion. The much thickened middle portion is about 3 mm. long.

The spermathecal ampulla is very large, the duct short and stout ; the diverticulum passes into the median face of the duct and has a much widened ental end.

Variety **dolosa**, var. nov.

One softened specimen from the Young collection without label.

External characteristics.—Length 52 mm. incomplete posteriorly. Greatest diameter 6 mm. Colour of dorsum, bluish grey to brownish grey ; clitellum, reddish.

The setae begin on ii, on which segment there is a complete circle. There are no midventral breaks in the setal circles but there may be a mid-dorsal break of varying width. There are ventro-lateral breaks in the setal circles of xvii and xix, just behind or just in front of the genital

markings. The setal numbers are :— spermathecal on viii, 22 ; male on xvii, 10 ; on xviii, 5 ; on xix, 11.

The first dorsal pore is in 12/13.

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

The spermathecal pores are two pairs ; minute, in 7/8 and 8/9.

There is a single female pore on xiv.

The genital markings are two pairs, one pair anteriorly on xix and one pair posteriorly on xvii. (The locations are approximate, as furrows 17/18 and 18/19 are not visible ventrally and ventro-laterally). Each marking is slightly depressed, about 4—5 intersetal distances wide transversely, the lateral margins of the markings about in line with the male pores.

Internal anatomy.—None of the septa are especially thickened, 8/9 —9/10 are lacking, 10/11 is present but thin.

The intestinal caeca are simple.

The single commissure of ix is on the right side. Hearts of x are lacking. The last pair of hearts is in xiii. The commissures of ix, xi-xiii all pass into the ventral trunk.

There are masses of nephridia in v and vi.

The seminal vesicles are large, covering over the dorsal blood vessel in xi and xii. The anterior pair push 10/11 forward at the sides of the gizzard. The posterior pair push 12/13 posteriorly into contact with 13/14. The anterior vesicles are fused dorsally above the dorsal blood vessel, the fused portion a narrow strip just anterior to 11/12. The prostates are large, extending through xvii-xx. The prostatic duct is about 4 mm. in length, curved into a c-shape, pink and firm throughout, the middle portion thicker than the entalmost or ectalmost portions.

The spermathecal diverticulum passes into the median face of the duct which is short and stout. The diverticulum has a characteristic shape as shown in the figure.

Variety **stercoraria,** var. nov.

"Manure," Nam Hpen Noi, August, H. Young, 1 clitellate and 8 aclitellate specimens.

"Wet earth in ravine," Nam Shi Pan, July, H. Young, 4 aclitellate specimens.

Length to 100 mm. Greatest diameter to 5 mm. Number of segments of 5 specimens :—126, 133, 135, 133, 131. Colour of dorsum anterior to clitellum, greyish blue ; posterior to clitellum, brownish ; clitellum reddish brown.

The setae begin on ii on which segment there is a complete setal circle. Dorsal and ventral breaks in the setal circles are either lacking or so slight that they are noticeable only with high powers of the binocular. In two specimens practically all of the spermathecal setae of viii have

dropped out, the setal circles of vii and ix unbroken ventrally. The setal numbers are indicated in the table below.

viii.	xvii.	xviii.	xix.	xx.
23	17	9	18	66
20	18	8	17	66
21	19	8	19	67
20	18	9	18	59
1*	17	11	20	63
21	17	6	16	58
22	16	8	15	68
21	17	11	15	..
1*	16	6	15	63
13†	18	8	16	61
16†	16	6	15	60
..	..	8	15	57
18†	15	8	15	61‡

* Positions of setal follicles indicated by minute dark dots in epidermis.
† Some of the spermathecal setae have dropped out, positions of follicles indicated.
‡ This specimen is mature.

The first dorsal pore is in 12/13 in all specimens.

The clitellum is annular, extending from 13/14 to 16/17 ; intersegmental furrows and dorsal pores lacking, pits of setal follicles indicated but no setae recognizable.

The spermathecal pores are minute ; two pairs, in 7/8 and 8/9.

There is a single female pore on xiv.

The male pores are on xviii, each pore minute and on the centre of a genital marking.

There is a single pair of genital markings on xviii. Each marking is a transversely oval or (rarely) circular, dark reddish area, depressed slightly in a concave fashion, about 7—10 intersetal distances wide transversely, and extending antero-posteriorly nearly to 17/18 and 18/19.

Internal anatomy.—(13 specimens opened.)

Septa 5/6—7/8 are muscular, 8/9—9/10 are lacking, 10/11 is present but very thin, 12/13—14/15 are slightly thickened but translucent.

The gut begins to widen into a characteristic intestine only in xx or xxi. The intestinal caeca are simple, extending from xxvii into xx-xxii.

The single commissure of ix is on the left side in 5 specimens, on the right side in 4 specimens ; there is a pair of commissures belonging to ix in 4 specimens. The last pair of hearts is in xiii. All commissures of ix-xiii pass into the ventral trunk.

There is a single, median testis sac on the anterior face of 10/11 and a similar sac in xi. The seminal vesicles are large covering over the dorsal blood vessel in xi and xii. The anterior vesicles push 10/11 forward into contact with the sides of the gizzard. The posterior vesicles push 12/13 posteriorly into contact with 13/14. The prostates are large, extending through xv or xvi to xxi-xxiii. The prostatic ducts are 4—7 mm. in length. In the mature specimen the duct consists of a thin, whitish portion about 3 mm. in length and a pinkish muscular portion about 4 mm. in length. Of this latter portion about 3 mm. is

much thickened. Removal of the longitudinal musculature shows the prostatic duct passing into the centre of a slightly protuberant mass of whitish, non-muscular material.

The spermathecal duct is short and stout and invaginated into the ampulla which is pressed down against the parietes around the duct, the duct and diverticulum enveloped by connective tissue within which is a softish coagulum. The straight ectalmost portion of the diverticulum passes into the median face of the duct ; the entalmost portion of the duct looped, the loops short and thickish.

Each of the Nam Hpen Noi specimens is parasitized by nematodes. The nemas were found in the coelomic cavities of segments xi-xiv. No nematodes were found in the Nam Shi Pan specimens.

ADDENDUM.

Three immature specimens collected at Taungyi in August by H. B. Gates probably belong to this species. The spermathecal setae on viii are 22—24 ; male setae on xviii, 12—15 ; setae on xx, 50—56. The genital markings are only faintly indicated.

Pheretima insulanus Gates.

1930. *Pheretima insulanus*, Gates, *Rec. Ind. Mus.* XXXII, p. 312, fig. 10.

The apertures of the copulatory chambers are small.

The spermathecal apertures are small transverse slits in the intersegmental furrows.

The male setae on xvii are 18 ; on xviii, 16 ; on xix, 17.

Each seminal vesicle of xi and xii has a small primary ampulla sunk slightly into the dorsal face of the vesicle.

On the anterior face of the hitherto unopened copulatory chamber there are three, ovoid, whitish masses of tissue, projecting slightly into the coelom, but from these three masses of tissue only two stalks or ducts were found to pass into the median face of the copulatory chamber. On opening the chamber there was at first visible in the upper portion of the chamber only a protuberant ring of tissue, but when this ring is pushed back there is visible on the roof of the chamber a series of roughenings on which are located two, tiny, round, greyish tubercles, and a single, slightly flattened, conical structure tapering to a fine point on which is located the minute male pore.

The spermathecal diverticulum passes into the anterior face of the duct which is narrowed slightly below this junction. In the parietes ventral to the diverticular junction the stalk of a small gland passes into the anterior face of the spermathecal duct. Careful search was made for glands with stalks to the posterior face of the spermathecal ducts but none were found. If present they were destroyed in separating the strands of the longitudinal musculature.

The stalked gland to the anterior face of the spermathecal duct is reminiscent of the condition characteristic of the spermathecae of *P. houlleti*.

Pheretima kengtungensis Gates.

1931. *Pheretima kengtungensis*, Gates, *Rec. Ind. Mus.* XXXIII, p. 394, fig. 29.

The spermathecal diverticulum passes into the median face of the duct which is narrowed slightly before passing into the parietes.

This worm may be distinguished from all other Burmese species of the genus *Pheretima* having spermathecal pores in 7/8—8/9 by the characteristic copulatory chambers.

Pheretima molesta nom. nov.

1931. *Pheretima browni*, Gates, *Rec. Ind. Mus.* XXXIII, p. 372, fig. 16.

The identification of the Kutkai specimens referred to in the previous paper was based on Stephenson's paper of 1912. Examination of the types of *P. browni* from the Indian Museum has shown that Stephenson's specimens are in reality *P. hawayana lineata*. Unfortunately only one of the Kutkai specimens and that incomplete posteriorly and partially destroyed by previous dissection is now available. The account below is, therefore, based on previous notes and a re-examination of the specimen just mentioned.

External anatomy.—No trace of pigment is now visible; the clitellum is reddish.

The setae begin on ii. The spermathecal setae on viii are 12 (12—14); the male setae on xvii are 16; on xviii, 9 (9—11); on xix, 15. There are about 41 setae on xx.

The first dorsal pore is in 11/12.

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

The spermathecal apertures are minute, two pairs in intersegmental furrows 7/8 and 8/9.

There is a single female pore on xiv.

The apertures in the setal circle of xviii open into rather deep parietal excavations. The margin of each aperture is minutely lobulated.

There are no genital markings.

Internal anatomy.—Septa 6/7—7/8 are muscular, septa 5/6 and 10/11—13/14 are strengthened but translucent, 8/9 is represented by a ventral rudiment only, 9/10 is lacking.

The intestine begins in xv. The intestinal caeca are simple but the dorsal and ventral margins are slightly lobulated.

There are nephridial masses in v and vi.

There is a single commissure belonging to ix on the left side. The last pair of hearts is in xiii. All the hearts ix—xiii pass into the ventral vessel.

There is a single median testis sac on the anterior face of 10/11 and a single median testis sac in xi. In the other two specimens dissected last year according to the notes made at that time "The testis sacs of x appear to be entirely distinct from each other but the testis sacs of xi meet in the midventral line." The seminal vesicles of xi and xii are medium-sized and just reach dorsally to the dorsal blood vessel which is not covered over. The prostates extend through segments xvi—xxi or xxii. The prostatic duct is nearly straight or slightly curved

into a sort of crescent shape and is 1½-2 mm. in length. The excavation in the parietes containing the male pore does not probably extend into the coelom and is not therefore referred to as a copulatory chamber. The " small portion visible in the coelom " of what was previously mistaken for the coelomic termination of a copulatory chamber is, at least in the specimen under consideration, only a tiny quirk of an ectal portion of the prostatic duct covered over by a small mass of connective tissue which protrudes slightly into the coelom in a sort of conical fashion. There is a small, softish, shortly columnar projection into the parietal excavation, on the end of which is the minute male pore.

The spermathecal duct is shorter than the ampulla and is gradually narrowed in the body wall. The diverticulum is longer than the combined lengths of duct and ampulla and passes into the anterior face of the duct. The diverticulum consists of a nearly straight, narrow ectal portion and a wider ental portion part of which is usually bent or looped; a few of the loops may be arranged in a more or less regular zigzag. The ental-most portion is not looped or bent but is nearly straight.

P. modesta Mich. 1927 from Yunnan has been recently placed by Michaelsen in the synonymy of *P. browni*. *P. molesta* is similar in some respects to *P. modesta* with which it may be identical. There are however discrepancies between Michaelsen's description and the account given above as well as contradictions within the description itself. Thus, for instance, 9/10 is said to be " schwach verdickt " and " fehlend " in the same sentence. The Yunnanese worms are smaller than the Burmese forms and have the male pores on " der Kuppe dick warzenförmiger, fast knopfförmiger, mit einigen Kreisfurchen versehener porophoren " which may of course represent everted parietal excavations of copulatory chambers. A re-examination of the Yunnanese specimens might yield some information of value, as for instance the number of spermathecal setae.

Pheretima ornata Gates.

1929. *Pheretima ornata*, Gates, *Proc. U. S. Nat. Mus.* LXXV, 10, p. 70, fig. 11

The few specimens that were retained in the college collection have all been re-examined.

The setal numbers are given below :—

viii.	xvii.	xviii.	xix.
19	29	21	30
21	28	22	29
25	31	24	31
25	28	21	28*
20	30	22	27

* This specimen is aclitellate.

The male pores are minute, each on a small tubercle in a parietal excavation.

The spermathecal pores are minute, transverse slits in line with the intersegmental furrows but located on elongately oval, glistening tumescences which extend across the intersegmental furrows on to the anterior

and posterior margins of the segments involved. The location of the spermathecal pores has been confirmed here as in *P. planata* by pulling out the spermathecal duct from the parieties without removing the associated gland. On the posterior half of the tumescence bearing the spermathecal pore there is a very small, hard, round tubercle. On this tubercle there is a fine pore, smaller than the spermathecal pore. To the posterior of these two pores the stalk of the gland behind the spermatheca has been traced.

The genital markings, aside from those just mentioned, are the tubercles bearing the pores of the glands of the spermathecal and the prostate regions. The preclitellar tubercles are presetal in position on vii and viii nearer to the midventral than to the spermathecal pore lines. The postclitellar tubercles are on xviii, very slightly median to the male-pore tubercles. Each of the post-clitellar tubercles is retractile into a slight parietal excavation similar to that containing the male-pore tubercle.

There is a single, median testis sac on the anterior face of 10/11 and a similar median sac in xi. The seminal vesicles of xi are smaller than those of xii. Each vesicle has a primary ampulla with a narrowed base sunk into the dorsal margin of the vesicle, more deeply sunk into the vesicles of xii than into the vesicles of xi. There is a pair of small pseudo-vesicles on the posterior face of 12/13, each of these structures with an irregularly roughened stalk. The prostates are rudimentary and confined to xviii. The prostatic ducts are S-shaped and 3—4 mm. in length.

The spermathecal diverticula pass into the anterior faces of the spermathecal ducts, the duct narrowing gradually ectal to this junction. Immediately behind the duct of each spermatheca is a stalked gland projecting into the coelom and passing into the parietes together with the spermathecal duct. The stalk of this gland passes to the exterior independently of the spermatheca as can easily be shown by removing one or the other of these two structures after dissecting off the longitudinal musculature from the coelomic face of the body wall.

VI.

Spermathecal pores anteriorly on viii and ix.

Pheretima faceta, sp. nov.

John Lawrence Island, Andaman Islands, October, C. Amirthalingam, 4 clitellate specimens.

Description of the type specimen. External characteristics.—(Statements in parentheses refer to the other three specimens of the species.)

Length 113 (75-109) mm. Greatest diameter 4 mm. Number of segments 93. Colour of dorsum, bluish to greyish brown; clitellum, reddish.

There is a circle of setae on segment ii with a slight mid-dorsal break. There is a slight mid-dorsal break in the setal circle of some segments behind the clitellum. There is a slight midventral break in the setal

circles of xix and a few succeeding segments. The setal numbers are indicated below.

viii.	xvi.	xvii.	xviii.	xix.	xx.
22	3*	17	15	17	52
18	0	14	12	14	52
20	0	17	14	18	54
20	0	17	14	16	56†

* Midventrally.
† Type specimen.

The first dorsal pore is in 12/13.

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

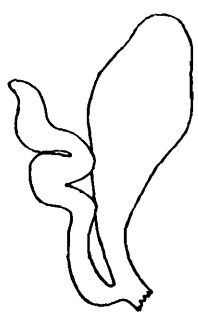
The spermathecal pores are two pairs, anteriorly on viii and ix; each pore a small transverse slit not quite one half of the distance from the intersegmental furrow to the setae posterior to the intersegmental furrow.

There is a single female pore on xiv.

The male pores are minute transverse slits, each pore at the centre of a transversely oval, greyish, poorly demarcated, slightly depressed area.

There are no genital markings.

Internal anatomy.—None of the septa are especially thickened; 8/9 is lacking; 9/10 is present, very thin, attached peripherally to the anterior face of 10/11.



TEXT-FIG. 8.—*Pheretima faceta.* Spermatheca × ca. 11.

The intestine begins in xv. The intestinal caeca are simple, short, extending through xxvi in which segment they are bent ventrally but long enough to reach through xxv. (The intestinal caeca arise in xxvii and extend through xxvi only or through xxvi and into xxv.)

The single commissure of ix is on the right side. (Three specimens have a single commissure on the right side, one specimen has a pair of commissures belonging to ix.) The hearts of x are present. The last pair of hearts is in xiii. (All the hearts of ix—xiii pass into the ventral vessel.)

There are masses of nephridia in v and vi and blood glands in v and vi.

(There is a single, median testis sac on the anterior face of 10/11 and a similar sac in xi.) The seminal vesicles are relatively large, covering over the dorsal blood vessel in xi and xii and pushing 12/13 posteriorly into contact with 13/14 and displacing 10/11 anteriorly. Each

vesicle is provided with a fairly large primary ampulla of distinctly different texture from that of the remainder of the vesicle. The prostates are small, extending through segments xvii—xix. The prostatic duct is nearly straight and about 1 mm. in length.

The spermathecal duct is shorter than the ampulla and not sharply marked off from the ampulla. The diverticulum is longer than the combined lengths of duct and ampulla and is bent into several regularly zigzagged loops. (The diverticulum may be a nearly straight, slender tube, or the ental two thirds to three quarters may be widened and variously bent or looped into a regular zigzag arrangement.) The diverticulum passes into the anterior face of the duct which is not noticeably narrowed within the parietes.

Remarks.—On each of the specimens there is visible on the dorsal side of segment i, approximately in the middle of the antero-posterior length of the segment, a row of five to nine black spots. Each of these black spots looks very much like the tip of a seta that has been deeply retracted into the parietes. I did not succeed in dissecting out any setae on two specimens. The first segment of the third specimen was cut off, flattened out, and the longitudinal musculature removed. The circular muscle and epidermal layers were then soaked in lactophenol and examined with the microscope. A row of holes could be made out dorsally just behind the prostomium, each of these holes resembling the rounded aperture through the outer layers of the parietes through which the seta reaches to the exterior. No setal follicles or setae were found.

The location of the spermathecal pores distinguishes this form from all other Burmese or Indian species of the genus *Pheretima*.

SECTION D.

Three pairs of spermathecae.

I.

Spermathecal pores dorsal.

Pheretima sulcata, sp. nov.

Kawkareik, October, K. John, 1 specimen.

External characteristics.—Length 96 mm. Greatest diameter about 3 mm. Colour of dorsum anterior to the clitellum, bluish; posterior to the clitellum, reddish; clitellum, greyish.

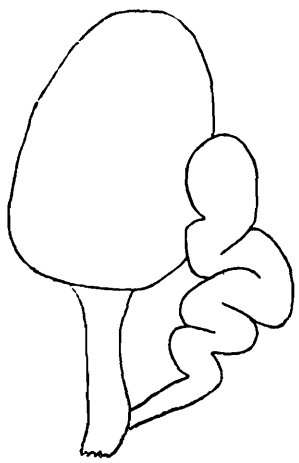
The setae are retracted and in the softened condition of the worm may not have been accurately determined. The spermathecal setae on vii are 38; the male setae on xviii are 12.

The first dorsal pore is in 11/12.

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

The spermathecal pores are minute and transversely slit-like, anteriorly on vi—viii, paired on vii and viii, a single pore on vi on the right side. Each pore is on a slight whitish cone which is well above the

lateral margin of the pigmented area and readily recognizable against the dark pigmentation of the dorsum.



TEXT-FIG. 9.—*Pheretima sulcata.* Spermatheca × ca. 27.

There is a single female pore on xiv.

The male pores are minute, in the setal circle of xviii.

The two genital markings are on 17/18, each marking nearly round, about 6 intersetal distances wide transversely, and separated from the other marking by a midventral space about 9 intersetal distances wide. From the depressed margin of each genital marking there extends posteriorly and laterally into the setal circle of xviii a special, narrow, epidermal strip which is also sunk below the general epidermal level. In the setal circle of xviii this special strip is widened and rounded with the male pore at the centre of the widened region which is also depressed. Along the centre of the depressed strip is a fine groove like a seminal furrow.

Internal anatomy.—The intestinal caeca are simple.

The last pair of hearts is in xiii.

There appear to be present two pairs of testis sacs. The seminal vesicles are small, those of segment xii about half the size of the vesicles of xi. The prostates are fairly large and extend through several segments. The prostatic duct is short and is enlarged into a spherical bulb just before it passes into the parietes. The outer layers of the body wall are thickened in the region of the genital markings but the thickenings do not project into the coelom.

The spermathecae are small. The duct is slightly shorter than the ampulla. The diverticulum is irregularly looped and with a slight, ovoid-shaped, ental widening. The diverticulum passes into the anterior face of the spermathecal duct.

II.

Spermathecal pores in 5/6—7/8.

Pheretima balteolata, sp. nov.

"Ravine, in wet leaves," Teung Cong, October, H. Young, 1 clitellate specimen.

"Wet, shady ravine," Pang Wo, October, H. Young, 2 clitellate and 2 aclitellate specimens.

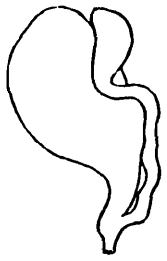
Description of the type specimen. External characteristics.—(Statements in parentheses refer to other specimens.) Length 89 mm.; this happens to be the longest specimen. Greatest diameter 3 mm. Number of segments 110. Unpigmented; clitellum, yellowish.

There are a few scattered setae on segment ii (2—8). There are no midventral breaks in the setal circles but there may be a slight mid-dorsal break on some of the segments behind the clitellum; posteriorly no mid-dorsal break. The setal numbers are:—spermathecal on vi, 25 (22, 24, 23); on vii, 28 (23, 23, 24); male on xvii, 24 (24, 22, 23); on xviii, 12 (11, 10, 14, 11); on xix, 25 (24, 26, 25); there are about 96 setae on segment xx.

The first dorsal pore is in 12/13.

The clitellum is annular, extending from 13/14 to posterior to the dorsal pore of 16/17, intersegmental furrow 16/17 lacking (to the setae of xvii on the Pang Wo specimens). Setae, dorsal pores (except for the dorsal pore of 16/17) and intersegmental furrows are lacking. The posterior border of the clitellum is not sharply demarcated.

The spermathecal pores are minute; three pairs in 5/6—7/8.



TEXT-FIG. 10.—*Pheretima balteolata.* Spermatheca × ca. 11.

There is a single, minute, transversely slit-like female pore on xiv.

The male pores are minute, on xviii, towards the lateral margins of the genital markings.

The genital markings are transversely oval areas of slight tumescence, not sharply demarcated, extending antero-posteriorly about to 17/18 and 18/19 and about 12 intersetal distances wide transversely. Although there are 12 male setae between the genital markings on xviii the mid-vetral region between the two markings is narrow.

Internal anatomy.—Septa 5/6—7/8 are muscular; 8/9—9/10 are lacking; 10/11 is muscular; 11/12—12/13 are slightly strengthened and translucent.

There is a small, whitish, glandular collar on the oesophagus just behind the gizzard. The intestine begins in xv. The intestinal caeca are simple, extending from xxvii into xxii.

There are blood glands in v. There are masses of nephridia in v and vi.

The single commissure of ix is on the left side (on the right side, 1; on the left side, 3). The last pair of hearts is in xiii. (All hearts of ix—xiii pass into the ventral trunk).

There are two, unpaired, median testis sacs. The seminal vesicles are large, covering over the dorsal blood vessel in xi and xii; the posterior pair of vesicles pushing 12/13 posteriorly into contact with 13/14. The prostates extend through segments xvii—xx. The prostatic duct is slender, looped, about 2—2½ mm. in length.

The spermathecal duct is slender, shorter than the ampulla which is elongately saccular. The diverticulum which is fastened by very delicate connective tissue to the lateral or median margin of the duct and ampulla (median margin in all spermathecae of all other specimens) is a slender tube, slightly widened at the ental end. The diverticulum passes into the anterior face of the spermathecal duct; the duct constricted within the parietes..

Remarks.—The spermathecae, seminal vesicles, prostates, and prostatic ducts are characteristically developed in two of the aclitellate specimens.

Pheretima bellatula, sp. nov.

"In wet leaves, ravine," Teung Cong, October, H. Young, 1 clitellate specimen.

External characteristics.—Length 72 mm., incomplete posteriorly. Greatest diameter $3\frac{1}{2}$ mm. The dorsum is very light brownish; the clitellum is yellowish brown.

The setae begin on ii on which segment there is a nearly complete setal circle, a slight mid-dorsal gap present. A midventral break in the setal circles is lacking throughout but the mid-dorsal break is present constantly. The setal numbers are:—spermathecal on vi, 9; on vii, 11; male on xvii, 12, on xviii, 0; on xix, 10; number of setae on xx, 38.

TEXT-FIG. 11.—*Pheretima bellatula.* Spermatheca × ca. 11.

The first dorsal pore is in 11/12.

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

The spermathecal pores are minute; three pairs in 5/6—7/8.

There is a single female pore on xiv.

The male pores are minute, on xviii.

There is a single, transversely elongate, genital marking with slightly rounded ends on xviii, extending antero-posteriorly slightly onto xvii and xix (approximately, intersegmental furrows 17/18 and 18/19 not visible ventrally and laterally). The marking is protuberant and is circumscribed by a definite circumferential furrow. On this marking there are two lateral regions of especial prominence, not sharply delineated, separated from each other by a less protuberant midventral region. The male pores are towards the lateral margins of these two prominences.

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

The intestine begins in xv. The intestinal caeca are simple, short and blunt; extending from xxvii into xxv or xxiv.

The single commissure of ix is on the left side. The last pair of hearts is in xiii.

There are two, relatively large, median testis sacs ; the anterior sac with a bilobed anterior margin ; the posterior sac with a bilobed posterior margin, the two posterior lobes pushing 12/13 into two pocket-like invaginations into xiii. The seminal vesicles are large, covering over the dorsal blood vessel in segments xi and xii. The posterior vesicles push 12/13 into contact with 13/14. The prostates extend through segments xvii—xx. The prostatic duct is slender, looped, the ectal portion slightly thicker than the ental portion ; length about 2 mm.

The spermathecal duct is shorter than the ampulla. The diverticulum passes into the anterior face of the duct and has a slender ectal portion in which the lumen is narrow and a wider ental portion in which the lumen is wider. The widest part of the diverticular lumen is slightly more than one half of the length from the duct.

Pheretima birmanica (Rosa) 1888.

Taungyi, August, H. B. Gates, 7 aclitellate specimens.
Bhamo, September, N. Woodbury, 10 specimens.
Kengtung, September, R. S. Buker, 90 specimens.
Bana, September, H. Young, 3 specimens.
Myitkyina, September, L. A. Dudrow, 4 specimens.

External characteristics.—The setal circles lack a midventral break and are usually also without a mid-dorsal break. The variation in the setal numbers is shown in the table below—

vi.	vii.	xviii.	First dorsal pore.	Locality.
29	30	15	12/13	Kengtung.
27	32	14	12/13	
28	29	14	12/13	
28	31	14	12/13	
24	29	13	12/13	
30	31	16	? 12/13	
27	29	13	12/13	
28	30	15	12/13	
27	29	14	12/13	
28	30	13	12/13	
28	30	14	12/13	
29	30	14	12/13	
28	31	14	12/13	
30	29	14	12/13	
25	28	15	12/13	
28	29	14	12/13	
28	31	14	13/14	
29	31	14	12/13	
28	31	14	12/13	
28	30	14	12/13	
27	29	15	12/13	
28	29	14	? 12/13	
27	31	15	12/13	
28	29	13	12/13	

vi.	vii.	xviii.	First dorsal pore.	Locality.
29	30	15	12/13	Bhamo.
27	30	13	12/13	
29	32	16	12/13	
25	30	15	12/13	
26	31	14	12/13	
27	30	14	12/13	
27	31	14	12/13	
29	29	15	12/13	
30	29	13	12/13	
27	29	15	12/13	Taungyi.
28	28	15	12/13	
29	28	15	12/13	
27	25	15	12/13	
29	28	16	12/13	
28	30	16	12/13	
25	26	14	12/13	
26	27	12	12/13	Unknown.
28	30	14	12/13	
31	33	15	12/13	
30	31	12	12/13	

The first functional dorsal pore is in 12/13 in all but one of the specimens; on the exceptional specimen the pore is in 13/14. A very few specimens have a non-functional pore-like marking in 11/12 or anteriorly on xii.

What at first appear to be the spermathecal pores are but rounded apertures leading into parietal concavities, each of which contains a rounded tubercle. On the ventral face of this tubercle is the real or primary spermathecal pore, a minute, transverse slit. The parietal invagination is pushed into the ectal end of the spermathecal duct. After removal of the longitudinal musculature the spermathecal duct can be pulled out from the body wall with the parietal invagination within the end of the duct. After dissecting off the tissue around the tubercle the real spermathecal pore can be readily made out with the binocular.

Internal anatomy.—Septum 8/9 is recognizable as a distinct ventral rudiment in many of the specimens. A sheet of tissue which may represent 9/10 but which is attached peripherally to the anterior face of 10/11 is recognizable in some specimens after slight drying.

The intestine begins in xv in all specimens. The intestinal caeca are compound, each with 3—6 anteriorly directed secondary caeca, the dorsal most secondary caecum the longest.

There are masses of nephridia in v and vi.

The last pair of hearts is always in xiii. All of the vascular commissures of ix—xiii always pass into the ventral trunk. The single vascular commissure belonging to segment ix is on the right or the left side in approximately equal numbers of specimens.

The seminal vesicles are small, vertical, flattened bodies on the posterior faces of septa 10/11 and 11/12. The dorsal margin of each vesicle is notched or cleft and in the notch there is a small, rounded

primary ampulla of a colour different from the remainder of the vesicle. The appearance of the seminal vesicle as a whole is strikingly like that of a vesicle of *P. rugosa* but the primary ampulla is here smaller, more spherical and more deeply sunk into the dorsal margin of the vesicle. Each vesicle of xi is enclosed in a connective tissue sac which binds the vesicle to septum 10/11 and from this sac there pass strands of tissue posteriorly to the anterior face of septum 11/12. Each vesicle of xii is similarly bound to the posterior face of 11/12 but the posterior strands of tissue are lacking in segment xii. The posterior face of a seminal vesicle may have a straight groove passing ventrally from the dorsal cleft. The prostates extend through some or all of segments xvi—xx and are deeply incised. The prostatic ducts are looped, the limbs of the loop apposed, the loop flat on the parietes or erect in the coelom. The prostatic duct may extend into xix or through xix and xx. The copulatory chambers project only slightly into the coelom. Projecting into the cavity of each chamber there is a single, usually conical structure with an elongate groove on one side from tip to the base. In this groove a minute male pore can sometimes be recognized.

The spermathecal duct in the parietes is widened and in this thickened portion of the duct lies the invagination containing the pore papilla. The diverticulum is somewhat similar to the diverticulum of *P. campanulata* but in *P. birmanica* the loops are usually not all in the same plane, although perfectly zigzag-looped diverticula have been noted. The diverticulum passes into the duct at right angles, ectal to this junction the lumen of the duct is fine and almost straight.

Remarks.—In the Taungyi specimens the copulatory chambers had not yet developed, but in the setal circle of xviii there is a pair of slight greyish depressions, each depression containing a slight tubercle. The spermathecal pores are short transverse slits in the intersegmental furrows.

Pheretima composita, sp. nov.

Kengtung, September, R. S. Buker, 1 specimen.
" Dry, grassy mound," Mong Mong Valley, August, H. Young, 27 specimens.

Description of the type specimen. External characteristics.—Length 67 mm. Greatest diameter 5 mm. Number of segments 118. Unpigmented ; very light greyish both dorsally and ventrally ; clitellum, bluish grey.

The setae begin on ii. A midventral break is lacking but there may be a mid-dorsal break of varying width on the segments immediately posterior to the clitellum. The setal numbers are :—spermathecal on vi, 15 ; on vii, 15 ; male on xvii, 17 ; on xviii, 12 ; number of setae on xx, 59.

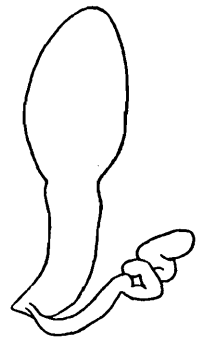
The first dorsal pore is in 12/13.

The clitellum is annular, extending from 13/14—16/17 ; no dorsal pores or intersegmental furrows are visible ; there are 6 setae ventrally on xvi, and one or two setae belonging to the circles of xiv and xv are still visible.

The spermathecal pores are minute, on tiny tubercles in intersegmental furrows 5/6—7/8.

There is a single female pore on xiv.

The male pores were not recognized but are probably on small, greyish crescents located in the setal circles of xviii with the concavities of the crescents facing midventrally. The crescents are on very slight swellings of the parietes.



TEXT-FIG. 12.—*Pheretima composita.* Spermatheca × ca. 11.

The genital markings are quite small, circular, greyish areas, each area with a central pore. The markings are in transverse rows on viii, xvii, xviii and xix; the rows on viii do not reach to the spermathecal pore lines, the rows on xvii extend, laterally, slightly beyond the male pore lines. There are two rows of markings on viii, one presetal row of 10 markings, one postsetal row of 8 markings, the rows nearer to the setae than to the intersegmental furrows. The markings on xvii are in four rows, two presetal and two postsetal. There are 11 markings in a single presetal row on xviii. There are two presetal markings near the midventral region on xix. There is probably also a single, presetal marking on vii near the setae, but the epidermis in that region as well as near the male pores is eroded.

Internal anatomy.—Septa 5/6—7/8 are muscular; 8/9—9/10 are lacking; 10/11—12/13 are slightly muscular.

The intestine begins in xv. The intestinal caeca are simple.

There are masses of nephridia in v and vi.

The last pair of hearts is in xiii. All commissures of ix—xiii pass into the ventral trunk.

The single testis sac belonging to segment x has the shape of a horseshoe, the sac surrounding the œsophagus so that the open end of the horseshoe is directed ventrally, the lower ends of the sac apparently without transverse midventral connection. In each ventral terminus of the sac is a funnel and a testis. The testis sac of xi is formed by a sheet of tissue passing from 10/11 to 11/12 in such a way as to enclose the œsophagus, the dorsal blood vessel and the seminal vesicles as well as the testes and male funnels. The seminal vesicles, the dorsal blood vessel and the hearts are surrounded by testicular material. The bounding membrane of the sac is contracted about this testicular material in such a way as to produce the appearance of an annular testis sac. The testis sac should be described however as cylindrical rather than annular; there is no inner bounding membrane as in other species.

The seminal vesicles are small, vertical bodies each vesicle with a small, dorsal, pyramidal primary ampulla. The prostates extend

through segments xvi—xix and are in two major portions. The prostatic ducts are bent into e-shaped loops, the ectal portion of the duct thicker than the ental portion.

The spermathecal duct is elongate, as long as or longer than the ampulla. The diverticulum is slender, looped in a zigzag fashion and passes into the anterior face of the spermathecal duct.

A small, stalked, glandular body projects into the coelom from the parietes over each of the genital markings.

Remarks.—After the completion of the preceding account the Young collections were received. The Mong Mong worms belonging to this species are all smaller than the type specimen, the length varying from 52—78 mm. The greatest diameter varies from 3—4½ mm. The number of segments of 10 specimens :—116, 117, 113, 113, 114, 100, 106, 97, 107, 119.

The first dorsal pore is in 12/13 in all specimens but two worms have each a non-functional, pore-like marking in 11/12.

Clitellar setae are always present ventrally on xvi, the number varying on the majority of the specimens from 6—11, rarely a few more or less. A number of the worms also have several ventral setae on xv or xiv and xv. The clitellar setae are straight or sigmoid, the tip ornamented with short, transverse rows of very fine spines. The setae of xvi vary in length from ·28—·35 mm. The setal numbers of several specimens are indicated in the table below.

vi.	vii.	xvii.	xviii.	xix.	xx.
14	16	16	11	22	..
15	15	19	11	19	..
13	14	19	12	20	60
16	17	17	14	19	..
15	16	17	11	16	..
15	15	15	13	19	57
15	16	17	12	20	..
14	16	14	12	19	67
15	16	15	12	18	..
13	15	16	13	20	..

The genital markings, the circular, pore-bearing discs are in transverse series located as follows :—

Single, presetal row on vii,
Single, postsetal row on vii,
Single, presetal row on viii,
Single, postsetal row on viii,
Single, presetal row on ix,
Two or three presetal rows on xvii,
Two or three postsetal rows on xvii,
One presetal row on xviii or none,
One postsetal row on xviii or none,
Single, presetal row on xix.

The presetal rows on viii, xvii, and xix and the postsetal rows on viii and xvii are present on every one of the Mong Mong specimens. The other rows may be entirely lacking or represented by only two or three

discs. The preclitellar rows do not quite reach to the spermathecal pore lines. Of the postclitellar markings the rows on xvii usually extend slightly lateral to the male pore lines while the rows on xviii and xix do not reach to the male pore lines.

The intestine begins with 15/16 or in the posteriormost portion of xv. The intestinal caeca are simple, extending from xxvii into xxv or xxiv.

The last pair of hearts is always in xiii.

In some of the immature specimens the seminal vesicle is represented by a vertical, septal cord of whitish tissue with a small, more or less ovoid, primary ampulla at its dorsal end. In the majority of the specimens the vertical cord has developed into a flattened leaf-like body, chiefly by growth of the oesophageal margin of the cord, the cord and primary ampulla whitish, the other parts of the vesicle yellowish. In one specimen the vertical cord is on the middle of the anterior or septal face of each vesicle, the primary ampulla projecting dorsally from a slight indentation in the dorsal margin of the vesicle. The vesicles of both xi and xii are small, vertical bodies on the posterior faces of 10/11 and 11/12, the vesicles of xi surrounded by loose testicular material. The prostates extend through segments xvii—xix. The prostatic ducts are bent into e-shaped loops and are 3—4 mm. in length.

The spermathecal diverticulum passes into the anterior face of the duct which is considerably narrowed ventral to this junction.

The genital markings and their arrangement in this species are somewhat similar to those of *P. osmastoni* from the Andamans, *P. pulauensis* Bedd. from the Malay Peninsula and *P. paraglandularis* Fang from China, but from all of these *P. composita* is distinguished by the number of the spermathecae and the locations of the spermathecal pores.

Pheretima hawayana (Rosa) 1891.

Variety **typica.** (?).

The spermathecal pores are minute and in the intersegmental furrows.

The male pore discs are transversely oval and about 1—2 intersetal distances wide transversely. The male pores are minute.

The male setae on xvii are 16—20; on xviii, 10—15; on xix, 16—20; there are 50—56 setae on xx.

The preclitellar genital markings are smaller than the postclitellar genital markings and are located 1—2 intersetal distances median to the spermathecal pore lines.

The intestinal caeca are short, with a broad, blunt base, with ventral only or ventral and dorsal marginal lobulations. The caeca extend only through xxvi or through xxvi and xxv.

Each seminal vesicle has a more or less spherical primary ampulla which is completely or almost completely sunk into the dorsal face of the vesicle. There are small, but characteristically developed, paired pseudo-vesicles in xiii and xiv.

The spermathecal diverticulum passes into the anterior face of the spermathecal duct.

This form was not represented in this year's collections and has been found but once in Burma, on the Yunnanese border near Namkham.

Variety **lineata** Gates.

1926. *Pheretima hawayana lineata*, Gates, *Rec. Ind. Mus.* XXVIII, p. 154.
1912. *Pheretima browni*, Stephenson, *Rec. Ind. Mus.* VII, p. 273.

Taungyi, August, H. B. Gates, 27 specimens.
Kengtung, September, R. S. Buker, 14 specimens.
Myitkyina, October, L. A. Dudrow, 20 specimens.

The present specimens like the previous worms from Burma are all characterized by the presetal positions of the preclitellar genital markings, both medians and paired laterals. One worm has four markings on segment vii ; one on the anterior margin of the segment on each side, about 3 intersetal distances median to the spermathecal pore lines, and another on each side, nearer to the setae and about 5 intersetal distances median to the spermathecal pore lines.

The male setae on xvii and xix are 18—23.

The intestine always begins in xv. The intestinal caeca of this variety are slightly longer and, in a dorso-ventral direction, narrower than in variety *typica*. In about half of the specimens the caeca are constricted dorsally only by the septa through which they pass. There are a few additional dorsal incisions on the caeca of the other specimens. The ventral margins of the caeca have more numerous incisions.

The single vascular commissure of ix is on the left side in 6 specimens, on the right side in 14 specimens ; one specimen has a pair of commissures belonging to ix. The vascular commissures of x are usually narrow but in several specimens they are as wide as in xiii. The last pair of hearts is in xiii in all the specimens. All commissures of ix—xiii pass into the ventral trunk.

The seminal vesicles, of immature specimens in both xi and xii, are somewhat like the vesicles of *P. rugosa*, each vesicle with a primary ampulla seated in a mid-dorsal cleft. In older specimens the median half of the vesicle appears to have grown considerably while the lateral half has not, with the result that the median half covers over and conceals the primary ampulla which in some specimens has become fused with the hypertrophied median portion. The primary ampulla can, however, always be recognized as it differs in colour and texture from the remainder of the vesicle. In some specimens the primary ampulla projects slightly from the midlateral margin of the vesicle. There are small, paired pseudo-vesicles on the posterior faces of 12/13 and 13/14, the vesicles of xiii slightly smaller than the vesicles of xiv. Each vesicle is composed of a ventral, septal stalk and a dorsal more or less spherical body with a finely granular surface.

The prostatic duct is nearly straight, stoutish, 2—3 mm. in length.

The spermathecal diverticulum passes into the anterior face of the duct which is narrowed in the parietes ventral to this junction

Well over 200 specimens of this variety have been examined. Of this number only one specimen has been found to have more than two pairs of spermathecae. The exceptional specimen has a single spermathecal pore in 7/8 on the right side. The extra spermatheca is abnormal, lacking a diverticulum. This specimen is not to be regarded as a link between the two varieties of *P. hawayana* as the worm is, with the exception of the spermatheca in viii, characteristically *lineata*. The

presence of the single abnormal spermatheca in this worm is regarded merely as an individual aberration.

I examined three specimens in a tube from the Indian Museum with the following label, " *Pheretima browni* Stephenson. Tengyueh, Yunnan. J. Coggin-Brown. Ex 4891/7 Z. E. V Types." The specimens are very much softened, one fell apart on attempting to remove it from the tube. The other specimens are perhaps not quite so decayed but the body wall is transparent except in the clitellar region and the gut wall behind the clitellum is also transparent. In spite of the softened condition of the specimens it has been possible by very careful manipulation and with proper illumination to make out the characteristics mentioned below.

The male pores are minute, each on a small, round, depressed, disc-like area, just median to which are two rounded genital markings of about the same size as the male-pore discs, one of the markings presetal, the other postsetal.

The spermathecal pores are two pairs in 5/6—6/7.

The intestinal caeca are simple. The prostatic ducts are straight and about 2 mm. in length. The spermathecae, except for appearances produced by decay cannot be distinguished from those of variety *lineata*.

So far as can be determined when dealing with such rotten specimens, these worms do not differ in any respect from *P. h. lineata*.

The Kutkai specimens previously identified as belonging to *P. browni* are described elsewhere in this paper with the new name *P. molesta*.

CONCERNING THE SYNONYMY OF *P. hawayana*.

There seems to have been no agreement hitherto as to the status of certain forms more or less closely related to *P. hawayana*. In his 1900 revision Beddard placed the following in the synonymy of *P. hawayana* :—

P. pallida Mich. 1892.
P. mandhorensis Mich. 1892.
P. bermudensis Bedd. 1892.
P. morrisi Bedd. 1892.
P. barbadensis Bedd. 1892.
P. mauritiana Bedd. 1892.
P. amazonica Rosa 1894.
P. sancti-jacobi Bedd. 1895.
P. carnosa Goto et Hatai 1899.
P. insulae Bedd. 1896.
P. cupulifera Fedarb 1895.

Michaelsen in his Tierreich monograph (1900) retained *P. barbadensi* as a valid species placing in its synonymy—

P. pallida.
P. amazonica.
P. sancti-jacobi.
P. cupulifera.

In the same monograph Michaelsen placed *P. bermudensis* in the synonymy of *P. hawayana* but retained *P. mandhorensis* [1], *P. morrisi*, *P. carnosa*, and *P. insulae* as valid species. *P. mauritiana* was considered to be a dubious species Vielleicht mit *P. hawayana* oder *P. barbadensis* zu vereinen"

Ude (1905) retained *P. morrisi* as a valid species but with *P. barbadensis*, *P. pallida*, *P. amazoniza*, *P. sancti-jacobi*, *P. cupulifera* as synonyms. *P. hawayana* was considered to be specifically distinct from *P. morrisi*.

Michaelsen in 1909 accepted Beddard's fusion of *P. barbadensis* and *P. hawayana* but retained *barbadensis* as a distinct sub-species, remarking that " Till now I have not seen a specimen—and I have examined many—which aroused any doubt as to whether it should be placed in the typical form or in the sub-sp. *barbadensis*"

Stephenson (1912 and 1913) had specimens from Ceylon and the province of Yunnan in China which he regarded as intermediate between *P. hawayana* and *P. barbadensis*. He therefore united the two, denying them even the value of distinct varieties.

Prashad (1916) disagreeing with Stephenson, retained the two subspecies. Prashad's account is however somewhat confused and contradictory as Stephenson pointed out (1923, p. 302).

Gates (1926) thought that certain worms collected in the Shan Plateau of Burma differed so much from the more typical specimens of *P. hawayana* from India as to belong to a distinct variety. Since much of the literature on the species was not available at that time in Rangoon, it was not possible to determine whether or not the variety was new but the name *lineata* was tentatively suggested for the Burmese forms. Later (1931) Gates pointed out further differences between variety *typica* (?) and his variety *lineata*.

In the meanwhile Chen (1931) had described certain specimens from the province of Szechuan, China as *P. hawayana* and other specimens " very similar " to *P. hawayana* as *P. morrisi*.

So far as can be learned from the literature mentioned in the preceding portion of this discussion, no attempt has been made to trace and examine the actual specimens to which the various names previously mentioned were given. Many of the descriptions are obviously incomplete, especially the older accounts, and in particular those of Beddard. Systematic decisions based merely upon the inadequate data afforded by such incomplete accounts must be regarded as very dubious. This failure to examine the actual specimens before making systematic decisions has been the cause for most of the confusion with regard to this species.

Referring now to the Burmese worms:—No forms intermediate between the groups called *typica* (?) and *lineata* as recently defined have been found. Examination of several hundred specimens from India, Burma and China has shown that (1) Any individual worm has either two or three pairs of spermathecae. (2) If a worm has three pairs of spermathecae it has only 4—8 spermathecal setae on segment vi. (3) If

[1] Later Michaelsen considered this a synonym of *P. hawayana*.

a worm has only two pairs of spermathecae it always has a much larger number of spermathecal setae on vi, 22—28. (4) Similarly, but with some caution, the locations of the genital markings can also be used to discriminate between the two forms when such markings are present. (5) Other characteristics such as the extent of the clitellum, the presence or absence of setae on the clitellum, the *inter-se* relationships of the testis sacs, the conformation of the seminal vesicles, the prostates and the prostatic ducts are of less or little value in this connection because of individual variation within each group.

The two groups now distinguished by two and possibly three important characteristics must, in the absence of new evidence to the contrary, be regarded as distinctly different. The Indian and Chinese worms with three pairs of spermathecal pores appear to be the same as Rosa's *P. hawayana*, but as Rosa's account of this species is also incomplete and as his specimens cannot be obtained for examination at the present time there must remain some slight doubt as to the identity of the two forms. In the meanwhile and until further information is available with regard to Rosa's specimens the Indian and Chinese form with the three pairs of spermathecae will be referred to as variety *typica* but with the following designation—(?) to indicate that the identity is not yet established with certainty. The form with two pairs of spermathecal pores, larger number of spermathecal setae and pre-setal, pre-clitellar genital markings will be designated *lineata*.

But what systematic value is to be assigned to each of the two distinct forms? In both the genital papillae are almost the same, if not actually identical in appearance. In both the spermathecal conformations are similar. Since the two forms are so closely similar with respect to two characters of first importance for purposes of systematic discrimination in the genus *Pheretima* and since the most important differences between the two forms have to do only with the number of the spermathecal pores, the number of spermathecal setae and the positions of the genital markings it seems preferable to regard both as subgroups of the same species. Should further investigation indicate that the differences already pointed out are consistent throughout, the value of the sub-group may be taken as that of a sub-species. In the meantime the term variety will be used, merely to indicate a sub-specific group but without any indication of exact value.

P. hawayana typica of Chen is apparently the same as *P. hawayana typica* (?) from Burma and India, although Chen gives no information with regard to the number of spermathecal setae. Otherwise the two agree. *P. morrisi* of Chen is apparently identical with *P. hawayana lineata*. The spermathecal setae of the former are said to be 24, of the latter 22—28 on vi. Similarly Ude's *P. hawayana* appears to be the same as *typica* (?) and his *P. morrisi* identical with *lineata*. It should be noted that Ude pointed out that the pre-clitellar genital markings of his *P. hawayana* are post-setal while the pre-clitellar genital markings of his *P. morrisi* are pre-setal. It should also be noted that Ude's *P. hawayana* has 6 spermathecal setae on segment vi, 12—14 spermathecal setae on segment vii, while his *P. morrisi* is said to have its spermathecal pores "in der 10. Borstenlinie jederseits"

As has been pointed out above and elsewhere there is some confusion in Prashad's account of the species. According to this author the spermathecae may be two or three pairs in both sub-species *typica* and *barbadensis*. Prashad presumably confused two distinct forms by attempting to distinguish them by characteristics which vary similarly within both varieties. So far as can be determined from Stephenson's descriptions the specimens which he regarded as intermediate between *P. hawayana* and *P. barbadensis* appear to be similar to variety *typica* (?). (Note setal characteristics and positions of genital papillae.) Michaelsen on the other hand seems to have had variety *lineata* (*vide* Michaelsen 1909, p. 187, and note position of spermathecal pores and genital markings). Fedarb's *P. cupulifera* may have been *lineata*.

Beddard's *P. morrisi* may possibly also be the same as *lineata*; the indications for this are the pre-setal, median position of the pre-clitellar genital markings and the two pairs of spermathecal pores. The account which Beddard gave of this species is however so incomplete that there is very little therein apart from the two characteristics just noted that is of systematic value. In 1900 Beddard had two further specimens which he himself was unable to distinguish from his *P. morrisi*. These later specimens had three pairs of spermathecae and enlarged ventral setae on segments iii—vii. In the later paper of 1900 Beddard speaks of *P. morrisi* having spermathecae in " vi, vii, or in vii, viii "

P. barbadensis appears on the basis of our present information to be composite. Beddard based this species on three specimens remarking " It may be that I am wrong in associating all these individuals together under one specific name " Two of the three specimens *a* and *c* have two pairs of spermathecae while *b* has three pairs. Specimen *a* has a median, pre-setal genital papilla on vii; specimens *b* and *c* have no pre-clitellar genital markings. The description of *P. barbadensis* is mainly concerned with the clitellar setae and other characteristics of no systematic value. Similarly the description of *P. mauritiana* in the same paper is so incomplete that the status of this form likewise cannot be determined. It should be noted however that *P. mauritiana* has two pairs of spermathecae in vii and viii and presumably spermathecal pores in 6/7 and 7/8.

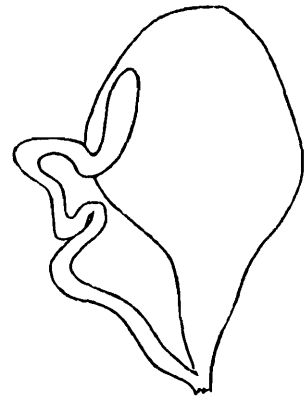
It is to be hoped that Beddard's specimens can be found and that they are in such a state of preservation that the data required to settle the questions connected with these forms can still be obtained. If this can be done it may be possible to show that *P. morrisi* and at least specimen *a* of *P. barbadensis* are the same as *P. hawayana lineata*. In that event the variety with the two pairs of spermathecae must be called *morrisi*. Otherwise the name *morrisi* having been used for an invalid species or else mistakenly used by Ude will have to be rejected. Similarly it is to be hoped that other forms that have been connected with the *hawayana* tangle can be re-examined and their exact status cleared up (Ude in his " Beitrage zur Kenntnis der Gattung *Pheretima* und ihrer geographischen Verbreitung " which was received after the completion of this paper refers on page 155 to *P. hawayana f. typica* and *P. hawayana* sub-species *barbadensis*. The latter is probably not only identical with *P. h. lineata* but also with *P. morrisi* of Ude's 1905 paper).

Pheretima inclara, sp. nov.

1 specimen from the Young collections without indication as to locality.

External characteristics.—Length 211 mm. Greatest diameter 6 mm. Number of segments 123. The dorsum anterior to the clitellum is a light bluish grey; the clitellum is brownish grey.

The setae begin, apparently, only on segment iii and are small and closely crowded; the setal circles without dorsal or ventral breaks. The spermathecal setae on vi are 30; on vii, 30; the male setae on xvii are 27; on xviii, 24; on xix, 31; there are about 125 setae on segment xx.



TEXT-FIG. 13.—*Pheretima inclara.* Spermatheca × ca. 11.

The first dorsal pore is in 12/13.

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

The spermathecal pores are minute; three pairs in 5/6—7/8.

There is a single female pore on xiv.

The male pores are minute, each at the end of a tiny cone which probably represents a protuberance from a very small, male-pore disc; the disc surrounded by five complete or nearly complete concentric, circular furrows, external to which are additional shorter furrows.

There are no genital markings.

Internal anatomy.—Septa 5/6—7/8 are muscular, 6/7—7/8 thicker than 5/6; 8/9 is present ventrally; 9/10 is lacking; 10/11 and 11/12 are thickly muscular; 12/13—13/14 are strengthened and translucent.

There is a small, post-gizzard, glandular, oesophageal collar; lobulated. On this collar are ovoid, whitish, parasitic bodies, each of which is nearly surrounded by a reddish coagulum (blood ?). The intestine begins in xv. The intestinal caeca are simple, extending from xxvii into xxiii.

There are masses of nephridia in v and vi and blood glands in v.

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

There is probably a single median testis sac for each of segments x and xi. The seminal vesicles of xi are small, flattened, leaf-like bodies, each with a well developed, ovoid, mid-dorsal, primary ampulla. The vesicles of xii are also small but are slightly more elongated in a vertical

direction; each vesicle is also provided with a well developed primary ampulla. The prostates are large, extending through xvi—xx. The prostatic ducts are about 7 mm. in length, looped, the ectal half slightly thicker than the ental half. The looping on one side is in the shape of a figure 8, on the other side in the shape of a double v, one v smaller than the other and between the arms of the larger v.

The spermathecal duct is shorter than the ampulla, the diverticulum is tubular and passes into the anterior face of the duct within the parietes.

Pheretima jacita Gates.

1931. *Pheretima jacita*, Gates, *Rec. Ind. Mus.* XXXIII, p. 391, fig. 28.

This species was erected for five specimens, none of which were fully mature, collected in the month of August. The laboratory collector, K. John, was sent especially to Ye, the type locality, in October to secure fully mature specimens. But the worms were not found though a number of specimens of other species were collected.

There is only one Burmese *Pheretima* with which *P. jacita* might be confused and that is *P. birmanica*. From the latter *P. jacita* is distinguished " by the absence of copulatory chambers" (Gates, 1931, p. 393). Among the worms collected at Taungyi during August were immature specimens of *P. birmanica* in which the copulatory chambers had not been formed. The appearance of the male pore regions on xviii of these specimens was similar in some ways to the appearance of the male pore regions of *P. jacita*. It is therefore possible that the characterization of the male pore region in the previous paper does not apply to mature specimens which may be provided with copulatory chambers. But, whatever the characteristics of adults of *P. jacita* may be, it is possible to distinguish this species from *P. birmanica* by the characteristics of the seminal vesicles. In *P. jacita* even in the immature specimens the seminal vesicles of both xi and xii are large, completely covering over the dorsal blood vessel, and displacing septa 10/11 and 12/13—13/14. The seminal vesicles of *P. birmanica*, even in fully mature individuals, are small, flattened, leaf-like bodies with a small but characteristic, rounded primary ampulla. Characteristics of the seminal vesicles have not been used hitherto in systematic work on *Pheretima*, at least so far as can be determined from the literature available locally, and the validity of a species based on such distinctions may appear to some to be questionable. The dissection of hundreds of immature and mature *Pheretima*s during the last few months has shown quite conclusively that seminal vesicles may be characteristic and that they can be used for purposes of taxonomy as successfully as some other characteristics that have been employed in the past. Fully mature specimens of *P. jacita* will doubtless be differentiated from *P. birmanica* by further characteristics which cannot be clearly made out in the immature individuals.

The type and cotype specimens have been re-examined but there appears to be nothing of importance to add to the previous account.

III.

Spermathecal pores anteriorly on vi, vii and viii.

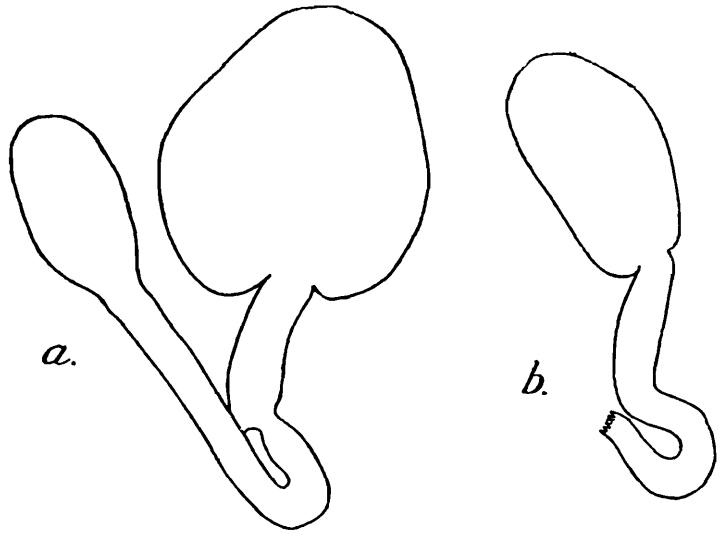
Pheretima bournei (Rosa) 1890.

Blachi, September, G. E. Blackwell, 2 specimens.
Leiktho Circle, September, G. E. Blackwell, 2 specimens.

The two Leiktho specimens are without trace of clitellar glandularity. The identification rests upon the positions of the spermathecal pores which are characteristic and the similarity of the setal numbers. The subsequent account is based on the mature specimen; the notes in parentheses refer to the immature specimens. The Blachi specimen is probably incomplete posteriorly and is badly eroded in places as a result of friction while being carried about over the hills.

External characteristics.—Length 117 mm. Greatest diameter 6½ mm. Number of segments 93. Colour of dorsum anterior to the clitellum, blueish; posterior to the clitellum, reddish to brownish; the clitellum is greyish.

The setae begin on segment iii. The setal circles are without a mid-ventral break; a mid-dorsal break of varying width is present anteriorly but posteriorly the setal circles are also closed dorsally. The setae are small and closely crowded ventrally; more widely separated dorsally on the anterior half but on the posterior half also closely crowded dorsally. The spermathecal setae on vi are 19 (20); on vii, 18 (17); male setae on xvii, 24 (20, 19); on xviii, 15 (16, 14): there are about 63 setae on segment xx.



TEXT-FIG. 14. *a. Pheretima bournei.* Spermatheca × ca. 11. *b. Pheretima bournei.* Diverticulum of another spermatheca × ca. 11.

The first dorsal pore is in 12/13 (12/13, 11/12).

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

The spermathecal pores are minute, on tiny round tubercles, each tubercle at the bottom of a slight depression, the depressions pre-setal and about half way between rows of setae and the anterior intersegmental furrows. Immediately behind each spermathecal pore is a second pore of about the same size and appearance.

The male pores are minute, at the centres of the lateralmost markings in the setal circles of xviii.

There are eight, quite small, postclitellar genital markings, all on xviii, four in the setal circle, two presetal, and two postsetal; four markings closely grouped in each male pore region and rather widely separated from the patch of markings of the other side. The lateral-most marking is transversely oval, flat, and not protuberant. It is in a slight concave depression. Just median to this male-pore marking is a slightly smaller, also transversely oval, but slightly protuberant area. Just anterior and just posterior to this latter are the presetal and the postsetal markings which are of about the same size and appearance as the marking between them. None of the markings are conspicuous, the male-pore area the only marking that is sharply delineated. Just lateral to each male-pore marking is a slight suggestion of a crescentic ridge with the horns of the crescent directed midventrally. There are three further pairs of presetal, preclitellar markings on the spermathecal segments. Each marking is small, round, whitish, not sharply delimited, with a central pore and situated slightly median and slightly posterior to the spermathecal-pore tubercle.

Internal anatomy.—Septum 8/9 is present as a ventral rudiment; (septum 9/10 is present, at least ventrally but is attached peripherally to the parietes with 10/11).

The intestine begins in xv. The intestinal caeca are simple, constricted by the septa through which they pass with additional, slight, dorsal and ventral marginal incisions.

The last pair of hearts is in xiii. The hearts of x—xiii all pass into the ventral blood vessel.

There are masses of nephridia in v and vi. There are blood glands in v.

There are paired testis sacs in x and xi, the sacs of a segment not in contact with each other and without transverse communication. (In the immature specimens there are no testis sacs, the male funnels projecting freely into the coelom. The testes, button-like discs, also are free in the coelom, on 9/10 and 10/11 opposite the male funnels). The vasa deferentia are large and readily visible. The seminal vesicles of xi and xii are large, covering over the dorsal blood vessel in both segments but do not displace the septa 10/11 and 12/13 noticeably. The prostates extend through xvii or xviii—xx. The prostatic duct is bent into an elongate, hairpin loop; the ectal limb thicker and longer than the ental limb. Slightly median to the parietal end of the prostatic duct there is a glandular mass which projects slightly into the coelom.

There is a curiously lobed, vesicular structure on the posterior face of 12/13 on each side where an ovary should be located. This structure contained a few ova, numerous pseudonavicella cysts, and whitish bodies that appear to be the trophozoites of some sort of Monocystid Gregarine.

The spermathecae are in vi, vii and viii. The duct is shorter than the ampulla. The diverticulum which passes into the anterior face of the duct has a single short loop in the ectal portion near the spermathecal duct. (The spermathecae of the immature specimens are small rudiments buried in the parietes).

Remarks.—This species was erected by Rosa for specimens collected by Fea in Cobapo village in the Leiktho circle, in the Karen Hills of the Toungoo district. The species has not been re-examined or recollected since 1890 until this year. Beddard accepted the species in his Monograph (1895) but in 1900 he stated " I am much disposed to think that this species is really *hawayanus*." Michaelsen regarded the species as valid in this Tierreich volume and included it in his later lists of Indian Oligochaetes. Stephenson also recognized the species in his F. B. I. monograph (1923) but gave the position of the spermathecal pores as near the posterior borders of the spermathecal segments.

Rosa's specimens are in the Genoa Museum for which Fea made his collections. The director of the museum was asked to submit the specimens for re-examination but the request was refused. The specimen described above agrees so closely with Rosa's description that there can be very little doubt as to the identity of the two groups of worms.

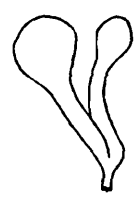
In spite of careful search no trace of a membrane that might constitute the wall of a testis sac could be found in the immature specimens.

Pheretima dolosa, sp. nov.

" In wet leaves in ravine," Teung Cong, October, H. Young, 1 clitellate specimen.

External anatomy.—Length 84 mm., incomplete posteriorly. Greatest diameter 4 mm. The dorsum is light brownish ; clitellum, reddish.

There are 7 setae ventrally and ventro-laterally on ii ; none dorsally. There are no midventral breaks in the setal circles but there are middorsal breaks for some segments posterior to the clitellum. The setal numbers are :—spermathecal on vi, 19 but with a midventral gap ; on vii, 18 but with ventro-lateral gaps ; male on xvii, 15 ; on xviii, 6 ; on xix, 15 ; there are 42 setae on segment xx.



TEXT-FIG. 15.—*Pheretima dolosa.* Spermatheca × ca. 11.

The first definitely functional dorsal pore is in 12/13 but there is a distinctly pore-like marking in 11/12 filled with a sort of whitish coagulum.

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

The spermathecal pores are minute, three pairs, anteriorly on segments vi—viii, close to the intersegmental furrows.

There is a single female pore on xiv.

The male pores are minute, on small, widely separated, transversely oval discs, each disc about 1½ intersetal distances wide transversely.

There are two pairs of presetal preclitellar genital markings, one pair on vii, the other pair on viii. Each marking is transversely oval, flat, slightly raised and about 2 intersetal distances wide transversely ; about 4—6 intersetal distances median to the spermathecal pore and about 5—6 intersetal distances apart from the other marking of the same

segment. There are two pairs of postclitellar markings on xviii. The circular presetal markings are closely paired, almost in contact at the midventral line, each marking protuberant, about 2 intersetal distances wide transversely and about 4 intersetal distances median to the male pore.

The transversely-oval, protuberant, postsetal markings are slightly smaller than the presetal markings and are more widely separated, the lateral margin of each marking reaching about to the male pore line. Each marking, pre- or post-clitellar, has a greyish central portion and a peripheral region of more whitish appearance.

Internal anatomy.—Septa 5/6—7/8 and 10/11—11/12 are muscular; 12/13—13/14 are strengthened and translucent; 8/9—9/10 are lacking.

The intestine begins in xv. The intestinal caeca are simple, extending from xxvii into xxiv.

There is a pair of commissures belonging to segment ix. The last pair of hearts is in xiii. All of the hearts of ix—xiii pass into the ventral blood vessel.

The testis sacs are two pairs, each sac nearly spherical; the sacs of a segment separated from each other and apparently without transverse communication. The seminal vesicles cover over the dorsal blood vessel in both xi and xii. The prostates extend through xvii—xix or xx. The prostatic duct is bent into a u- or c- shape, is about $2\frac{1}{2}$ mm. in length, the ectal two-thirds slightly thicker than the entalmost portion.

The spermathecal ampulla is round to ovoid; the duct longer than the ampulla and slender. The diverticulum may be longer or shorter than the combined lengths of the duct and ampulla; is slender, widened entally, and passes into the anterior face of the duct which is much narrowed in the parietes.

There are glandular masses projecting into the coelom from the parietes over the genital markings.

Remarks.—The genital markings of this species are somewhat like the smaller genital markings of *P. exigua typica*. The preclitellar and the presetal markings of xviii correspond roughly to similarly placed markings in *P. e. typica*. The latter species however never has postsetal genital markings while *P. dolosa* has a pair on xviii.

Pheretima porrecta, sp. nov.

One specimen from the Young collection without indication as to locality.

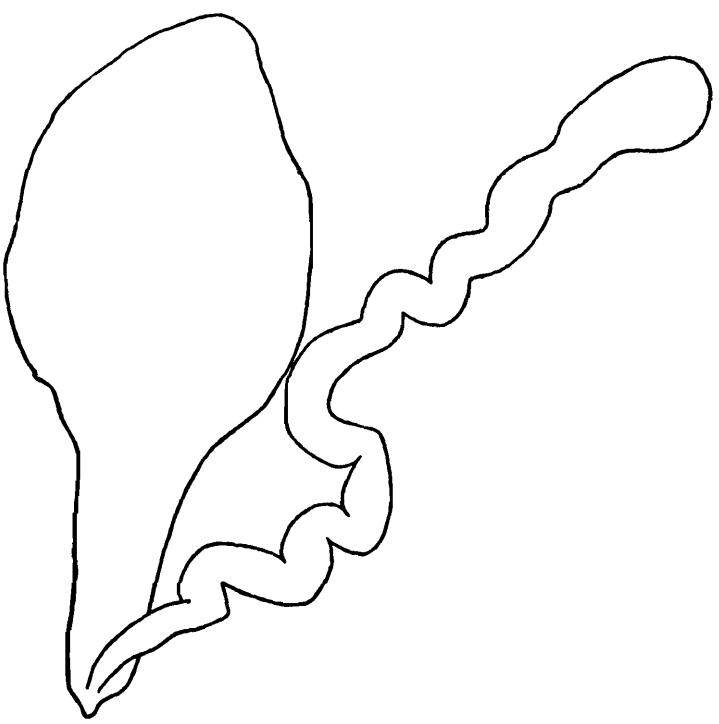
External characteristics.—Length 254 mm. Greatest diameter 9 mm. Number of segments 127. Colour of dorsum, bluish grey.

The setae begin on ii and are small and closely crowded; the setal circles without ventral break, a mid-dorsal break of varying width present on xvii and a few succeeding segments but lacking posteriorly. The spermathecal setae on vi are 27; on vii, 28; male setae on xviii, 15.

The first dorsal pore is in 12/13.

The clitellar glandularity is not developed; intersegmental and secondary furrows visible on the clitellar region; the positions of the dorsal pores indicated by non-functional pore-like depressions; setae lacking.

The spermathecal pores were not actually seen but are in or very close to intersegmental furrows 5/6—7/8. In the groove between segments v and vi there is on each side a tiny, transverse, whitish ridge, as if cut off from the anterior margin of segment vi. There are similar ridges in the grooves between segments vi and vii and between vii and viii. When the spermathecal duct is pulled out from the parietes an aperture is left on this ridge. There is an extra spermathecal pore in or near 8/9 on the left side slightly lateral to the other spermathecal pores of that side.



TEXT-FIG. 16.—*Pheretima porrecta.* Spermatheca × ca. 11.

There is a single female pore on xiv.

The male pores are tiny transverse slits in line with the setae of xviii, on the genital markings, nearer to the lateral than to the median margins of the markings.

The genital markings are elongately oval areas with glistening rims and central portions of a finely roughened appearance. Each marking is about 10 intersetal distances wide transversely and extends anteroposteriorly just on to xvii and xix.

Internal anatomy.—Septa 5/6—7/8 are muscular, 6/7 thicker than 5/6 and 7/8 thicker than 6/7; 8/9—9/10 are lacking; 10/11—11/12 are thickly muscular but 10/11 is thicker than 11/12; 12/13—13/14 strengthened and translucent.

There is a much lobulated, brownish, post-gizzard, glandular collar on the oesophagus. The intestine begins in xv. The intestinal caeca are simple, constricted by the septa through which they pass, extending from xxvii into xxiii.

There are large masses in segments v and vi, presumably of nephridia but there is little eivdence of the existence of the nephridial tubules, the masses mainly composed of protozoa and cysts. There are blood glands in v.

There is a single commissure belonging to ix on the right side. The last pair of hearts is in xiii. All the hearts of ix—xiii pass into the ventral vessel.

The seminal vesicles cover over the dorsal blood vessel in xi and xii, the posterior vesicles pushing 12/13 and 13/14 posteriorly into contact with 14/15 ; each vesicle with a well-developed primary ampulla. The vesicles of xi appear to be quite distinct from the testis sacs, even after the removal of the oesophagus but removal of the vesicle exposed the testis and a small portion of testicular material through an aperture in the roof of the testis sac. While manipulating the other seminal vesicle of xi the roof of the testis sac was again ruptured leaving the testis attached to the base of the seminal vesicle. The testis is however attached to the posterior face of 10/11 by a short cord passing along the ventral margin of the seminal vesicle. The testicular material is confined to the single midventral chamber containing the male funnels. There is a single, median testis sac with conspicuously protuberant, bilobed anterior margin on the anterior face of 10/11. The testes within this sac are oval discs, thinner but longer than the button-shaped testes of xi. The male funnels are large and iridescent. The prostates are confined to xvii and xviii but push 16/17 and 15/16 forward into contact with 14/15 and 18/19 and 19/20 posteriorly into contact with 20/21. The prostatic ducts are stout, about $8\frac{1}{2}$ mm. in length ; each duct bent into a sort of hairpin loop, both limbs of the loop of about the same thickness.

The spermathecal duct is shorter than the ampulla, the diverticulum longer than the combined lengths of duct and ampulla. The diverticulum is bent, especially ectally into more or less regular, zig-zag loops ; the entalmost portion is nearly straight with a very slight widening of a short portion. The diverticulum passes into the anterior face of the duct which is considerably narrowed below this junction. The single spermatheca of ix has a rudimentary diverticulum. The presence of this deformed spermatheca is regarded as an abnormality.

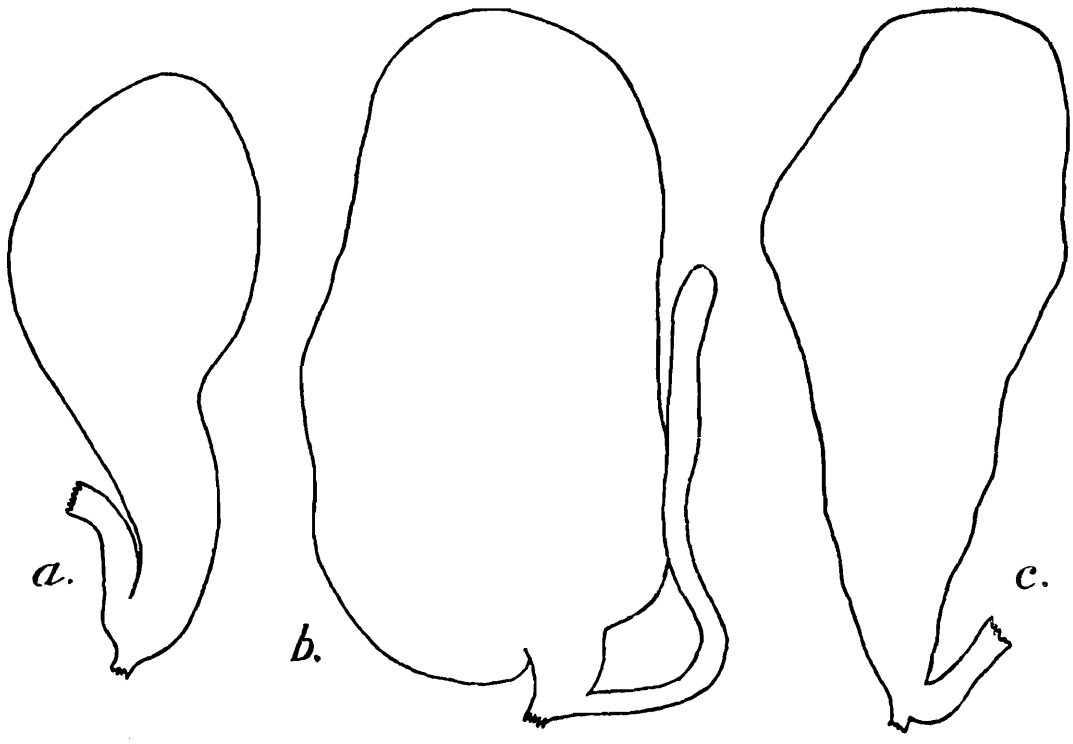
IV.

Spermathecal pores in 6/7—8/9.

Pheretima carinensis (Rosa) 1890.

P. carinensis like *P. bournei* was erected by Rosa for specimens collected by Fea in the Karen Hills of the Toungoo district. Like *P. bournei* the species has not been re-examined or re-collected since the publication of Rosa's paper, but unlike *P. bournei* the status of *P. carinensis* has never been questioned. A number of worms collected in the Toungoo district not far from Metelindaung (*Villaggio di Meteleo* according to Rosa) cannot be specifically distinguished from *P. carinensis* although they differ in several slight but rather significant ways from Rosa's worms. As Fea's specimens cannot be examined without making a special trip to Genoa it is necessary for the present at least to assume that Rosa's description and illustrations of this worm are as

accurate as they have been found to be in the case of other Burmese species and treat his worms as a distinct form which must be referred



TEXT-FIG. 17.—*Pheretima carinensis.* Spermathecae × ca. 11.

to as variety *typica*. The definition of variety *typica* herewith is abstracted from Rosa's paper of 1890.

Variety **typica.**

"Pori dorsali presenti sin dall' intersegmento 11—12 o 12—13. Aperture delle spermateche in direzione della 10. a setola. Aperture ♂ al 18° segmento in forma di papille circondate da una specie di occhiello poste in direzione della 15a setola un po' posteriormente al ciclo di setole. Papille copulatrici due al 18° segmento fra le aperture ♂ in forma di areole o scudetti di forma variabile, per solito più o meno quadrangolari e a contorno chiaro. Il loro centro, in cui non si vede un poro è collocato un po' anteriormente al ciclo di setole."

In Rosa's figure of the genital markings the male-pore areas are shown as quite definitely posterior to the setal circle which is unbroken in their vicinity. The other genital markings, according to the figure, extend from about 17/18 (not shown) just through the setal circle of xviii. Setae are lacking on the genital markings but are shown mid-ventrally between the markings. The number of setae between the markings, 6.

The New Varieties.

External characteristics.—Length varies up to 205 mm. The greatest diameter varies up to 7·5 mm. Number of segments 146—155. Colour of dorsum anterior to clitellum, bluish; posterior to the clitellum, brownish to reddish brown; clitellum, bluish grey or greyish.

There is no mid-ventral break in the setal circles. Dorsally the setae are deeply retracted so that it is sometimes difficult to determine whether the setae are present or whether the minute black spots represent setal

follicles from which the setae have fallen out, but there appears to be a mid-dorsal break for some segments posterior to the clitellum. Posteriorly the setal circles are unbroken dorsally, both ventral and dorsal setae closely crowded.

The first dorsal pore is in 12/13 without exception.

The clitellum extends from 13/14 on to segment xvi.

The spermathecal pores are three pairs in intersegmental furrows 6/7—8/9; the pores minute, often on tiny tubercles, sometimes with tumid lips marked off from the margins of the segment immediately adjacent to the pore.

There is a single female pore on xiv.

The male pores are minute.

Internal anatomy.—Septum 8/9 is recognizable as a ventral rudiment in many of the specimens.

The intestine begins anteriorly in xvi or with 15/16. The intestinal caeca are simple, long, slender, reaching into xvii or xviii or long enough to do so when straightened out. On the ventral margin of each caecum there are 2—3 short finger like lobulations in each of two or three segments xxvi—xxiv.

There is a pair of commissures belonging to ix in each worm. The last pair of hearts is in xiii. All the hearts ix—xiii pass into the ventral blood vessel, but the commissures of ix do not pass into the ventral vessel opposite each other as do the commissures of the other segments, for one commissure always passes into the ventral vessel anterior to the other.

There is a single, median testis sac on the anterior face of 10/11 with a dorsal extension at each side of the oesophagus containing a heart. These extensions may or may not be continued dorsally as far as the dorsal blood vessel. There is also a single, median testis sac in xi with dorsal extensions which come into contact with the dorsal blood vessel and which are attached to the sides of the oesophagus by shreds of connective tissue. The male funnels are large. The vasa deferentia are large and can be easily traced; the vasa of a side come into contact and unite in segment xii. The seminal vesicles of xi are large but are contained within the testis sac of xi. The vesicles of xii are long, quadrangular bodies covering over the dorsal blood vessel in xii and xiii at least, penetrating through 12/13 and often through 13/14, rarely through 14/15, constricted by the septa through which they pass. The posterior vesicles appear to be in contact with the prostates but are actually separated therefrom by several posteriorly displaced septa. On the posterior end of each vesicle of xii is a small, more or less cone-like body constricted off from the remainder of the vesicle and attached thereto by a short stalk. This body has a tougher texture and a different colour from the rest of the vesicle and is presumably the equivalent of the primary ampulla of other species. The prostates are not large, relative to the size of the worm and are, as a rule, smaller than the posterior vesicles, extending usually through xviii—xx or xxi. In one specimen, one prostate penetrates through 17/18 into xvii. The prostatic duct is elongate, confined to xviii or extending through one or two septa into xix—xx.

The spermathecal ampulla is large and is not constricted off or sharply differentiated from the duct. The wall of the ental portion of the duct is thin and like that of the ampulla so that the coelomic portion of what appears to be the duct is in reality a gradually narrowing part of the ampulla. What appears to be the coelomic portion of the duct varies considerably in length from vii posteriorly but is always shorter than the wider portion of the ampulla. Within the parietes the duct narrows gradually without constriction. The portion of the duct within the body wall has an appearance of being compressed and flattened. The diverticulum is almost always longer than the other portions of the spermatheca, is not coiled or looped and always passes into the anterior face of the duct. The diverticulum is narrow; the ental half, two-thirds or three-quarters is a trifle wider than the more ectal portion.

Variety **mota**, var. nov.

Ko Haw Der, September, G. E. Blackwell, 3 specimens.
Shoko, September, G. E. Blackwell, 11 specimens.
Leiktho circle, September, G. E. Blackwell, 2 specimens.

The setal numbers of these specimens are shown in the table below.

vii.	viii.	xvii.	xviii.
20	*	30	0
19	*	29	0
19	16†	30	8
19	20	29	3
18	16†	32	5
17	13†	31	6
20	22	32	5
20	22	29	1
20	20	30	2
20	21	32	0
19	22	33	0
20	21	31	0
20	18†	33	6
21	19†	22†	0

* Epidermis eroded so that the setae cannot be counted.
† One or more gaps present in the setal circle where setae have dropped out, setal pits often visible.

Each male-pore is at the centre of a small, round or transversely oval or elongately oval disc about 3—4 intersetal distances wide transversely, in the setal circle of xviii. The marking is not protuberant and is delimited by a slight furrow, external to which there may be one or more complete or incompletely circumferential furrows.

There is a pair of genital markings on xviii; 17/18 and 18/19 are not visible ventrally and laterally but the markings probably do not extend anteroposteriorly beyond these furrows. The marking may be nearly round, elongately oval, or almost quadrangular but is always larger than the male-pore marking; it is about 7—8 intersetal distances wide transversely and has a greyish green appearance with a whitish boundary external to which the ventral body wall is greyish. There is always room for setae between the genital markings midventrally and between

the genital markings and the male-pore markings but setae have only been found midventrally and may be lacking in that region.

In the body wall dorsal to each of the genital markings is a mass of glandular material projecting slightly into the coelom and bulging out in all directions so that the coelomic face of this mass has a greater area than the genital-marking. The glandular mass comes into contact with the median face of the ectal end of the prostatic duct but does not surround it. After stripping off the longitudinal musculature from the parietes the mass can be pulled out from the body wall leaving an aperture with a smooth margin.

The primary ampulla of a posterior vesicle may project posteriorly from the posterior margin of the vesicle or dorsally from the postero-dorsal margin.

The prostatic ducts are 9-13 mm. in length, the ectal portion quite noticeably thicker than the ental portion.

The seven dissected specimens had nematodes in the coelomic cavities of segments xiii—xx. One specimen which probably belongs to this variety had a large number of nematodes in the coelomic cavities. The median genital markings of this specimen are smaller than the male-pore markings.

Variety **sectilis,** var. nov.

Blachi, September, G. E. Blackwell, 12 specimens.

The setal numbers are given below.

vii.	viii.	xvii.	xviii.
22	22	29	15
18	19	29	13
21	23	30	15
23	24	30	11
18	20	27	15
22	23	31	18
20	21	28	10
19	21	28	17
25	24	30	20
22	22	26	9
18	18	27	13
20	22	31	15

The male-pore markings are a pair of small, transversely placed, more or less hour-glass shaped areas in the setal circle of xviii; each marking 3—6 intersetal distances wide transversely. The anterior and posterior margins may each be slightly incised, one incision in the middle of each margin; or the incision may be deeper and the connection between the two equal halves of the marking narrow. In one specimen there are two distinct markings on each side; a median, transversely oval, male-pore area of the same size and appearance as in variety *pinguis* and lateral to this and separated from it by a strip of unmodified epidermis, a similar round marking without a pore. There are no setae between the two markings of a side in this specimen. Another specimen has, in addition to the paired hour-glass areas, a single transversely oval

marking on 17/18 in line with the lateral portion of the marking of the left side.

There is glandular material in the body wall dorsal to the genital marking and into this material the ectal end of the prostatic duct passes.

The primary ampulla of the vesicle of xii is always flattened and always protrudes from the posterior margin of the vesicle. On the oesophageal face of the seminal vesicle there is a horizontal groove in which there is a thickish cord passing from the primary ampulla anteriorly to the posterior face of 11/12.

The prostatic ducts are 8—11 mm. in length; twisted into several loops, the number and appearance of the loops varying from one side of an individual to the other and also from worm to worm.

Only one of the six worms that were opened was found to be parasitized by coelomic nematodes, but three worms had a large number of cysts in the peripheral portions of the nerve cord in segments x—xxxv.

Variety **pinguis** Gates.

1930. *Pheretima pinguis*, Gates, *Rec. Ind. Mus.* XXXII, p. 319, fig. 12.
Ko Haw Der, September, G. E. Blackwell, 4 specimens.
Shoko, September, G. E. Blackwell, 7 specimens.

The setal numbers are indicated below.

vii.	viii.	xvii.	xviii.
20	20	..	19
20	18	29	20
16*	15*	33	13
20	20	30	8
19	21	29	11
18	22	34	9
20	18	26	21
22	22	30	17
16	20	30	17
17	18	26	12
19	21	19*	12

* Gaps due to falling out of setae indicated by presence of setal pits.

Each male pore is at the centre of a male pore disc which is transversely oval and 3—5 intersetal distances wide transversely. There are no additional markings as in the preceding varieties.

The seminal vesicles of xii are like those of variety *sectilis*. The prostatic ducts are 9—13 mm. in length. There is a small amount of glandular material in the parietes around the ectal end of the prostatic duct.

Each of the seven dissected specimens contained large numbers of nematodes in the coelomic cavities of segments xiii—xx. Rarely these parasites were also found further anteriorly or posteriorly. Four specimens have cysts in the nerve cord. These cysts are yellowish in appearance and so stand out clearly from the whitish nerve cord tissue. In two of the specimens the cysts are small and peripheral. In the other two specimens the cysts extend much deeper into the nerve cord. In one worm the nerve cord from segment viii to lxvi is a solid mass of cysts without trace of nerve cord tissue but in the other worm there are still traces of nerve cord tissue in the region of the cysts. The speci-

men with cord tissue interrupted appeared to be perfectly normal in all other respects.

Pheretima campanulata (Rosa) 1890.

Variety **typica.**

1925. *Pheretima wimberleyana*, Stephenson, *Rec. Ind. Mus.* XXVII, p. 62, pl. iii, fig. 12.

Minnie Bay, Andaman Islands, August, C. Amirthalingam, 1specimen.
Pegu, August, K. John, 4 specimens.
Coomzamu, September, K. John, 2 specimens.
Kochi, September, K. John, 1 specimen.
Bassein, September, K. John, 2 specimens.
Tantabin, September, K. John, 1 specimen.
Toungoo, September, K. John, 2 specimens.
Pyigyaung, September, K. John, 1 specimen.
Blachi, September, G. E. Blackwell, 5 specimens.
Thaton, October, K. John, 13 specimens.
Ye, October, K. John, 5 specimens.
Kawkareik, October, K. John, 14 specimens.
Moulmein, October, K. John, 5 specimens.
Sandoway, September, F. R. Bruce, 3 specimens.
Kengtung, September, R. S. Buker, 5 specimens.
Southern Mergui, September, W. D. Sutton, 10 specimens.
Northern Mergui, September, W. D. Sutton, 17 specimens.
Myittha, September, W. D. Sutton, 11 specimens.
Northern Tavoy, October, W. D. Sutton, 21 specimens.
Bhamo, September, N. Woodbury, 4 specimens.
Victoria Point, October, Saw Nelson, 3 specimens.
" Open grassy spot on Ang Lawng Mt.," September, H. Young, 25 specimens.
" Bamboo grove, Mong Ma," September, H. Young, 14 specimens.
" Under log in grassy spot," Kat Pang, Mang Lum State, October, H. Young, 12 specimens.
" In wet leaves " Ang Lawng Mt., September, H. Young, 14 specimens.

External characteristics.—The length varies up to 200 mm. The greatest diameter varies from 4—7 mm. The number of segments lies between the limits previously noted; 107—136. The colour of the dorsum is variable but is most often a bluish grey.

The first dorsal pore or pore-like marking is in 11/12 in every worm examined in this connection. In some cases, as is indicated in the table, the first pore that can be definitely said to be functional is in 12/13; the pore-like marking in 11/12 may or may not indicate the presence of a functional pore.

A ventral break in the setal circles is either entirely lacking or when present very slight; a dorsal break is present but of varying extent throughout. The ventral setae on iii—viii or ix are usually enlarged and conspicuously protuberant from the parietes. The spermathecal setae on vii are 11—15; on viii 14—18; the male setae on xviii are 11—16; the number of setae on xx 50—58.

The clitellum is annular and completely covers segments xiv—xvi, extending from 13—14 to 16—17; dorsal pores and intersegmental furrows lacking; setae present.

The female pore is always single and is located in the midventral line on xiv. The spermathecal pores are large, transverse slits in intersegmental furrows 6/7—8/9.

The apertures of the copulatory chambers are rounded rather than slit-like and the chambers are never found everted.

The genital markings are minute, round, translucent, greyish areas on the margins of the segments; almost if not actually in contact with the intersegmental furrows; always medial to the spermathecal pore lines; in a large majority of the worms on the anterior margins of the segments; rarely present on vii, practically always present on viii and ix. Several specimens have been found with markings on the posterior margins of vii or viii. One specimen was found to have a single marking on the anterior margin of x on the left side, in line with one of the markings of that side on ix. The largest number of markings found in the vicinity of a single spermathecal pore is 5.

The variation in some of the external characteristics is indicated in the table below.

vii.	viii.	xviii.	xx.	First dorsal pore.	Genital markings anteriorly on vii. l.	vii. r.	viii. l.	viii. r.	ix. l.	ix. r.	Locality.
13	15	13	55	11/12	0	0	2	2	2	2	Andamans.
13	16	14	..	11/12	2	3	2	3	1	4	Pegu.
12	16	14	..	11/12	0	0	2	2	2	2	
14	18	14	..	11/12	0	0	3	5	3	4	
12	15	13	..	11/12	0	0	2	2	2	3	
12	16	13	..	11/12	0	0	2	2	3	2	Rangoon.
13	15	13	..	11/12	0	0	2	2	3	3	
12	17	12	..	11/12	0	0	2	2	2	2*	
12	17	15	..	11/12	0	0	2	2	3	3	
12	15	12	..	11/12	0	0	2	3	2	4	
13	16	14	..	11/12	0	0	3	3	2	2	
13	15	12	..	? 12/13	0	0	3	1	1	1	Toungoo.
14	16	16	58	? 12/13	0	0	1	2	2	2	
12	14	13	55	? 12/13	0	0	2	2	2	3	
13	17	13	56	? 12/13	0	0	3	3	2	2	
11	15	13	55	? 12/13	0	0	2	3	3	2	Mergui.
12	16	12	56	11/12	1	1	3	3	2	3	
13	16	12	53	11/12	2	0	3	3	3	4	
11	15	12	54	? 12/13	1	1	3	2	2	3	
12	15	13	56	? 12/13	3	2	3	2	2	2	
11	15	14	50	11/12	0	0	3	2	2	2	
12	15	12	51	11/12	1	1	3	3	3	3	
12	17	13	54	? 12/13	0	1	1	3	3	3	
13	17	11	58	? 12/13	0	2	3	3	2	2	
11	14	13	..	? 12/13	0	0	3	3	2	2	
..	..	..	56	11/12	0	0	3	2	3	3	Various
..	..	..	54	11/12	0	2	3	4	4	2	other
..	..	..	55	11/12	0	0	2	2	3	4	localities.
..	..	..	56	11/12	0	0	1	1	3	3	
..	..	..	56	11/12	0	0	2	1	2	0	
..	..	..	51	11/12	0	0	2	3	2	3	
..	..	..	55	11/12	0	0	2	3	3	3	
..	..	..	54	11/12	1	1	2	2	1	3	
..	..	..	53	11/12	0	0	3	2	3	2	
..	..	..	52	11/12	0	0	2	3	1	1	
..	..	..	53	? 12/13	0	0	2	2	2	2	
..	..	..	54	11/12	1	1	3	2	2	3	
..	..	..	56	11/12	0	0	2	2	3	3	
..	..	..	54	11/12	0	0	3	3	2	3	
..	..	..	54	11/12	0	0	2	2	1	2	

l. indicates left side.
r. indicates right side.
* this specimen immature, without clitellar glandularity.
? indicates presence of a pore-like marking in the next intersegmental furrow anterior to the one mentioned.

Internal anatomy.—Of these worms 121 specimens were opened and examined more or less thoroughly: the numbers in parentheses indicate the number of specimens in which a particular characteristic was especially noted and recorded.

A ventral rudiment of septum 8/9 is recognisable in a fair proportion of the specimens examined.

The intestinal caeca are simple and extend usually from xxvii into xxiii or xxii; the caeca usually constricted slightly by the septa through which they pass, occasionally with slight additional marginal incisions dorsally and (or) ventrally. The intestine begins in xv (35).

All the vascular commissures of ix—xiii pass into the ventral vessel in every specimen. In two worms there is a well developed vascular commissure on the right side of ix as well as on the left side. There is a single vascular commissure in ix in 119 worms, on the left side in 58, on the right side in 61. The specimens on which these observations were made were collected in three rather widely separated districts. To enable comparison with other species the figures are given according to the district.

	1.	2.	3.
Vascular commissure of ix on right side only	11	16	34
Vascular commissure of ix on left side only	12	15	31
A pair of vascular commissures in ix	1	1	..

The relationships of the testis sacs vary. In some specimens there is quite evidently a distinct and apparently unconnected pair of testis sacs in each of segments x and xi. In other worms the sacs of a segment appear to be in communication with each other, while in others, and these a majority of the specimens in which this characteristic was noted, there is a single median testis sac with bilobed anterior margin in each of segments x and xi.

The seminal vesicles are fairly well developed and are in contact dorsally with the dorsal blood vessel. In just one specimen the seminal vesicles of xi extend so far dorsally as to cover over the dorsal blood vessel, in all the others the dorsal trunk is visible on opening the worm. The dorsal margin of each vesicle is divided by a cleft into two lobes. If these lobes are carefully separated a rather small primary ampulla of slightly different texture from that of the rest of the vesicle can be made out in most cases. Occasionally the primary ampulla is fused with one or the other of the dorsal lobes, rarely scarcely recognizable. In immature specimens of this form the primary ampulla is much more readily recognizable. In two of these specimens the seminal vesicles of xii are smaller than the vesicles of xi and similar in appearance to the vesicles of variety *meridiana*. The anterior face of the vesicle is attached to the posterior face of the funnel-shaped vesicular septum by a double sheet of connective tissue which passes ventrally in a vertical direction from the base of the dorsal cleft.

The prostates extend through some or all of segments xvi—xxi; broken into a number of elongate, flattened lobes. The prostate duct varies in length from 5—10 mm., each duct looped into a sort of c or u

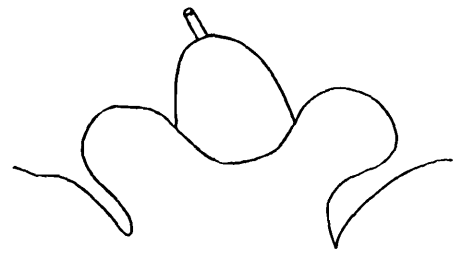
shape, resting on the top of the copulatory chamber or erect in the coelom between the prostate and the gut.

The copulatory chambers do not project conspicuously into the coelom but are rather flattened and give the impression on first view of being almost entirely buried within the longitudinal musculature. This is not quite correct for they become more readily visible when a thin layer of connective tissue which covers over the stalks of the accessory glands is dissected off. The top or dorsal surface of the copulatory chamber is not smooth for there project therefrom into the coelom three connective tissue sacs (25) each of which contains a penial seta. Every one of the worms opened has penial setae. These were removed from a number of specimens and measured to the nearest hundredth of a millimeter. The lengths are as follows :—

75	76	80	86	78	81	86	87	79	82	68	80
86	81	81	74	88	68	76	66	76	74	75	62
79	76	72	70	87	88	81	78	86	87	72	72
90	72	87	69	71	70	79	75	84	82	77	69
79	86	76	80	86	78	81	86	76	88	71	87

All of these setae are provided, towards the outer tip with a few, short, transverse rows of fine teeth. The tips of the setae are usually either enlarged and softened or bluntly rounded and worn. Nine setae have a distinct terminal spine of the sort figured previously (Gates 1926, p. 456) but not quite as long; three more setae have a slight trace of a terminal spine, while three other setae show slight indications of the presence of a bifid termination similar to that figured for variety *penetralis* (Gates 1931, p. 436).

Projecting into the lumen of each copulatory chamber is a characteristic and curious structure somewhat in the nature of a penis. This may be described as a tiny papilla on the tip of which there is sometimes visible a very fine transparent tubular projection bearing a pore which is probably the male pore. Around the base of this papilla is a slender ring of tissue which represents a thickening of a short column to which the base of the male papilla is attached. Seated on the ring are two papillae, each of which is about the same size as or slightly smaller than the male papilla, but without the tubular projection of that papilla, the three papillae in a straight row, *i. e.*, the two ring papillae



TEXT-FIG. 18.—*Pheretima campanulata typica.* Penial body × ca. 80.

are located at opposite ends of the long diameter and in line with the male papilla which is between them. This penial body though minute is readily visible in most specimens on first opening the copulatory

chamber, but in some worms it appears to be lacking. In such cases there projects from the ceiling of the copulatory chamber into the lumen a thickish (relative to size of other copulatory chamber structures) ring of tissue surrounding a small depression. On this ring there are located papillae similar to those of the penial body but without definite arrangement. The penial body is withdrawn into the depression and is not visible until the ring is cut or folded back. Within the stalk of the penial body are three, elongate, narrow, transparent areas, two of these areas pass to the penial ring papillae, the other to the male papilla; the two lateral areas appear to be continuations of stalks of two of the glands on the coelomic face of the copulatory chamber, while the middle transparent area appears to be the ectal continuation of the prostatic duct. As has just been pointed out there are papillae on the luminal face of the copulatory chamber wall in addition to and similar to those of the penial body. These papillae are sometimes surrounded by circular rings of tissue projecting as " wrinkles " from the chamber wall but these papillae are never aggregated into trilobed structures similar to the penial body.

On the posterior face of each copulatory chamber (65) there is an ovoid, glandular mass, apparently with a single stalk passing into the wall of the copulatory chamber. This gland is in reality often composed of two, rarely three, distinct masses each with its own stalk, but the stalks pass into the copulatory chamber wall simultaneously and the glands are enclosed within a common connective tissue sac. In three worms the glandular mass is much reduced in size and was found only after careful search. On the anterior face of the copulatory chamber there are additional ovoid, glandular masses, usually two, three or four. These glands may be visible in the coelom or may be buried within the longitudinal musculature.

The spermathecal duct is elongate, from its mesial face arises the diverticulum which consists of a narrow stalk and a thicker portion which is either transparent or filled with an opaque whitish material, and looped. The loops are usually all in the same plane, the loops arranged in a quite regular zigzag fashion.

Into each spermathecal duct within the parietes there pass the stalks of two glands, one stalk into the anterior face of the duct, the other into the posterior face (65). The number is always two, neither more nor less. This condition is not however at once recognizeable in some of the worms and when this is so it becomes necessary to carefully remove the longitudinal musculature strand by strand in order to demonstrate this characteristic. One or both of the stalked glands may be entirely buried within the musculature, or the ectalmost portion of the stalk of the gland may be concealed within the musculature while the remaining portion of the stalk emerges from the parietes into the coelom together with the stalks of the parietal glands, or (rarely) the stalk and gland may both be more or less rudimentary and represented by a sort of wart-like projection from the posterior face of the spermathecal duct. Within the spermathecal duct the ectalmost portion of the stalk of the gland is represented by a transparent ovoid area. If the stalks are broken off from the spermathecal duct in the course of dissection these

transparent areas may be taken to indicate the presence of the glands. There are additional and apparently quite similar stalked glands passing into the parietes in this variety, mesial to the spermathecal duct, the number of these glands corresponding to the number of genital markings.

Paired, minute, stalked bodies are present on the posterior faces of 12/13 and 13/14 (30).

Remarks.—Variety *typica* may be recognized by the external genital markings and the parietal stalked glands medial to the spermathecal ducts.

The constancy of the biglandular arrangement on the spermathecae is rather striking when compared to the variation in the similar parietal glands in other species.

I have examined 1 tube from the Indian Museum containing 10 worms, labelled "*P. wimberleyana* Steph. Wimberleyganj, Andamans. B. Prashad. Types." These worms cannot be distinguished from variety *typica*.—For purposes of comparison with the preceding account and as correction to Stephenson's description a few notes are subjoined.

A dorsal pore or pore-like marking can be made out in 11/12 in at least four of the specimens. The spermathecal setae on vii are 12—15; on viii 16—18; the male setae on xviii are 9—12.

Septum 9/10 is present ventrally. The intestine begins in xv. There are copulatory chambers with setae, glands, and penial bodies as in *typica*. The points of the penial setae are softened the lengths of three setae:—0·75, 0·74, 0·70 mm. The spermathecae have the characteristic biglandular apparatus on the spermathecal duct.

Variety **meridiana**, var. nov.

Myittha, September, W. D. Sutton, 1 specimen.
Northern Mergui, September, W. D. Sutton, 2 specimens.
Southern Mergui, September, W. D. Sutton, 8 specimens.
Northern Tavoy, October, W. D. Sutton, 41 specimens.
Blachi, September, G. E. Blackwell, 32 specimens.
Victoria Point, October, Saw Nelson, 16 specimens.
Ye, October, K. John, 1 specimen.
Thaton, October, K. John, 4 specimens.

External characteristics.—Length up to 200 mm. Greatest diameter 4—8 mm. Number of segments of five mature and complete specimens:—128, 119, 119, 131, 122.

The first dorsal pore or pore-like marking is in 11/12 in every specimen.

A ventral break in the setal circles is either lacking or trifling, a dorsal break of varying width present. The spermathecal setae on vii are 11—14; on viii 15—18; the male setae on xviii are 10—14; the number of setae on xx 48—56. No clitellar setae were seen but no attempt was made to find them within the tissues of the clitellum, they may or may not be present.

There are no genital markings on any of the specimens. The variation in some of the external characteristics is indicated in the table below :—

vii.	viii.	xviii.	xx.	First dorsal pore.
12	17	11	56	11/12
13	17	10	48	11/12
11	17	10	55	11/12
12	16	12	50	11/12
13	16	11	49	? 12/13
14	17	13	52	11/12
14	18	14	54	11/12
13	16	13	56	11/12
14	17	14	56	?12/13
11	15	11	55	11/12
13	16	11	55	11/12
14	18	14	55	11/12
13	17	12	53	11/12
12	15	11	50	11/12
12	16	10	48	11/12

Internal anatomy.—All the specimens were opened as dissection is necessary to distinguish between this variety and variety *penetralis.*

Septum 8/9 is always present; a ventral rudiment at least was recognized in all specimens, in some worms the septum could be traced laterally and even dorsally; it is however very thin. In most of the worms a very delicate but definitely septal sheet of tissue is attached to the oesophagus and dorsal blood vessel immediately behind the commissure of ix. Peripherally this septum passes onto the anterior face of 10/11 to which it is fused. The septum can be dissected off from 10/11 ventrally and ventrolaterally without opening the testis sacs of x. The septum cannot as a rule be recognized in wet specimens but after the opened worm has dried slightly the septum becomes more readily visible.

The intestine begins in xv in all specimens. The intestinal caeca are similar to those of *typica.*

The vascular commissures of ix—xiii all pass into the ventral trunk. The commissure of ix is found on the left side less frequently in this variety than in typica as is shown below :—

	1.	2.
Vascular commissure of ix on the left side only	4	9
Vascular commissure of ix on the right side only	13	19
A pair of vascular commissures in ix	3	..

1. Specimens from Victoria Point.
2. Specimens from Blachi.

There is a single median testis sac with bilobed anterior margin in each of segments x and xi. The seminal vesicles are much like those of *P, rugosa,* each vesicle with a dorsally protuberant primary ampulla which is ovoid, flattened and oval, conical or pyramidal in shape; the ventral portion of the ampulla is constricted off from the rest of the

seminal vesicle to which it is attached by a short slender stalk; the base of the ampulla is in a slight dorsal cleft so that the two dorsal lobes of *typica* are only faintly indicated here. There may be a slight furrow on the posterior face of the vesicle passing ventrally in a vertical fashion from the dorsal cleft. The main portion of the vesicle can be pushed off from the posterior face of its septum leaving the primary ampulla attached as in *P. rugosa.*

The prostates are similar to those of *typica* and extend through some or all of segments xvi—xx. The prostatic duct is bent into a sort of c shape and rests on the parietes in such a way as to nearly surround the chamber which projects into the coelom through the loop. The space between the limbs of the loop is wider here than in *typica.* The copulatory chambers appear to be larger than in *typica* and certainly project more conspicuously into the coelom. The dorsal face of the chamber is smooth and shiny and without setal follicles; penial setae entirely lacking in all the specimens. Similarly the glandular mass on the posterior face of the copulatory chamber is also lacking in all of the specimens. In several worms whitish masses were found that looked like the posterior glands but there were no stalks and on microscopic examination the masses proved to be of parasitic origin. On the anterior face of the copulatory chamber there are one, two or three ovoid and stalked glandular masses. These glands are buried in the longitudinal musculature, the strands of which must be separated in order to find the glands; the stalks of these glands pass dorsally and then into the wall of the copulatory chamber.

Projecting into the copulatory chamber are two or more bodies, one or more papillae, and a penial structure somewhat similar to that already described for variety *typica.* In the present variety the central papilla which appears to bear the male-pore is larger while on the circumferential ring of tissue around its base there is but a single papilla. The copulatory chambers of all the specimens were opened and this characteristic condition of the penial body was found in each worm.

The spermathecae are similar to those of variety *typica,* and as in that variety every spermatheca of *meridiana* has the two stalked glands passing anteriorly and posteriorly into the spermathecal duct. There are no stalked glands in the parietes, and additional stalked glands on the spermathecal duct as in *penetralis* are lacking. In several specimens one or more of the glands is double with the ental portion of the stalk double for a varying distance but with the ectalmost portion of the stalk always single. As in the preceding variety the glands may be entirely buried within the parietes, especially the glands associated with the spermathecae of segment vii. The spermathecal diverticulum is similar to that of *typica* but the number of the zigzag loops in *meridiana* is apparently smaller.

The paired club-shaped structures on the posterior faces of 12/13 and 13/14 are slightly larger in this variety than in *typica.*

One specimen from Blachi is abnormal, having an additional but perfectly normal and characteristic copulatory chamber on the right side in segment xvii.

Remarks.—This variety is readily distinguished from variety *penetralis* by the absence of penial setae and the smooth appearance of the dorsal, coelomic face of the copulatory chamber. Externally variety *meridiana* is quite similar to *P. mamillana* but the latter can as a rule be readily distinguished from the former by the more posterior position of the first dorsal pore and the transversely slit-like appearance of the copulatory chamber apertures.

Variety **penetralis** Gates 1931.

1931. *Pheretima campanulata penetralis*, Gates, *Rec. Ind. Mus.* XXXIII, p. 435, figs. 46-47.

Leiktho Circle, September, G. E. Blackwell, 51 specimens.
Blachi, September, G. E. Blackwell, 16 specimens.
Bhamo, September, N. Woodbury, 4 specimens.

External characteristics.—The first dorsal pore or pore-like marking is in 11/12 in every specimen. Ten of the worms have a functional pore in 12/13 but the pore-like marking in 11/12 may or may not represent a functional pore; in the remaining worms the first functional pore is in 11/12.

The spermathecal setae on vii are 11—14; on viii 15—18; the male setae on xviii are 9—13. The number of male setae on xviii is slightly greater than on the Indian specimens but the difference does not appear to be sufficiently large to be of importance. The number of spermathecal setae is practically the same.

vii.	viii.	xviii.
11	15	9
13	16	12
11	16	11
12	15	12
12	16	11
14	17	12
12	18	10
14	17	13
13	16	10
13	16	11

Internal anatomy.—53 specimens opened.

Septum 8/9 is present as a ventral rudiment in all the specimens; 9/10 was definitely recognized in four worms. In one of these 9/10 is attached to the parietes normally, in two others it passes to the parietes together with 10/11, in the fourth it is fused peripherally to the anterior face of 10/11. In other specimens more or less extensive sheets of connective tissue can be found on the anterior face of 10/11 covering over the hearts of x and the testis sacs of x and which can be removed from 10/11 without opening the testis sacs; doubtless these sheets represent rudiments of 9/10.

The intestine begins in xv in all specimens.

The single vascular commissure of ix is on the left side in 17 specimens, on the right side in 19 specimens.

The seminal vesicles of xi and xii are all of approximately the same size, each vesicle with a well developed primary ampulla constricted

off from the ventral portion of the vesicle and seated in a slight concavity in the dorsal margin of the vesicle. The primary ampulla is usually conical in shape; in 13 specimens the ampullae of a segment cover over the dorsal trunk within their segment while in the rest of the specimens the ampullae just reach dorsally to the dorsal blood vessel. The prostates extend through some or all of segments xvi—xx and are cut up into a number of finger-like lobes. The protatic ducts are u-, c- or e-shaped; across the roofs of the copulatory chambers.

The copulatory chambers do not project conspicuously into the coelom. The prostatic duct passes into the lateral face of the chamber. There are always penial setae in the roof of the chamber. As a rule there is a single, ovoid glandular mass on the posterior face of the copulatory chamber; the glandular mass lacking on both chambers of one worm, on one chamber of nine worms. There are three or four ovoid glandular masses on the anterior face of each chamber. Within each copulatory chamber is a tripapillate penial body similar to the penial body of *typica*. One or two of the other papillae on the luminal wall of the copulatory chamber appear to be more closely associated with the penial body in this variety than in *typica*.

The penial setae have the bifid tip previously described and figured. A number of these setae were measured, the lengths to the nearest hundredth of a millimeter as follows:—

60	49	63	60	56	55	58	62	64
58	62	59	61	58	58	58	59	61
63	58	61	61	57	66	50	66	61
68	61	51	53	58	66	58	62	51

The diverticulum passes into the mesial face of the spermathecal duct in the coelom, the diverticulum looped in a regular zigzag fashion. Each spermatheca has the biglandular apparatus as in *typica*. The stalks of the glands associated with the spermathecae of vii are usually short, sometimes the glands almost sessile on the spermathecal duct. There are no parietal stalked glands in any of these specimens. Thirteen worms have more than two glands passing into the duct of one or more spermathecae as follows:—

(*a*) An additional gland to the mesial face of duct of one spermatheca of segment ix, five specimens.
(*b*) An additional gland to the mesial face of ducts of right and left spermathecae of viii, two glands to anterior face of duct of right spermatheca of ix.
(*c*) An additional gland on mesial face of duct of right spermatheca of viii.
(*d*) Two glands to anterior face of duct of right spermatheca of ix.
(*c*) Two additional glands to mesial face of duct of right spermatheca of ix.
(*d*) Two glands to anterior face of duct of left spermatheca of viii.
(*e*) Two glands to posterior face of duct of right spermatheca of ix.

(*f*) One additional gland to mesial face of duct of right spermatheca of viii, one additional gland to mesial face of duct of right spermatheca of ix.

(*g*) One additional gland to mesial face of duct of right spermatheca of ix, two additional glands to lateral face of duct of left spermatheca of viii.

Remarks.—A few of the original specimens of this variety are still at hand and have been examined. Aside from the number of male setae on xviii to which attention has already been called only two differences between the two groups of worms were observed. (1) The seminal vesicles of xi of the Indian worms are large and cover over the dorsal blood vessel in that segment while the vesicles of xii are smaller vertical bodies. (2) There are two ovoid glandular masses on the posterior face of each copulatory chamber instead of one, as in the Burmese worms.

Additional Notes on *P. campanulata.*

The last pair of hearts is in segment xiii in each of the 279 specimens that were opened.

The number of the glands associated with the spermathecae was noted in 223 specimens. Every one of the 1338 spermathecae is characteristically biglandular, the only variations found in this connection being in the length of the stalks of the glands and the presence or absence of a bifurcation of the ental end of a stalk. However there were found 16 spermathecae, all in one variety, which have in addition to the usual anterior and posterior glands one or two additional glands variously placed. To be compared with the conditions just outlined are the spermathecae of *P. houlleti.* In this species the number of glands associated with the spermathecae was noted in 100 specimens. (*vide* account of *P. houlleti*). Every one of 222 spermathecae certainly have, and every one of 376 additional spermathecae probably have only one stalked gland passing into the spermathecal duct.

Two of the 600 spermathecae examined, do have more than one gland passing into the spermathecal duct. It should be noted that in neither of these spermathecae is the arrangement of the glands as in *P. campanulata* but the two or three additional glands also pass into the antero-mesial face of the spermathecal duct.

The distinction between the spermathecae of the two forms may be briefly summarized as follows :—the spermathecal duct of *P. campanulata* always has a posterior gland which is always lacking in *P. houlleti.*

Though *P. campanulata* and *P. houlleti* are similar to each other in many respects this constant difference in the spermathecal apparatus—when taken together with other differences of taxonomic importance—shows quite conclusively that the two forms are distinct. Unless there be much greater variation in the characteristics of these two worms elsewhere there is no further justification for a continuation of the confusion of the two species.

The fusion of the two forms dates back to Horst (1892) whose suggestion as to the indentity of these two worms was adopted by Beddard and Michaelsen. The Sumatran specimens studied by Horst are quite evidently not *P. houlleti* and are either *P. campanulata* or some other

species more like the latter than the former. Beddard also had a specimen from the Bahamas with paired glands on the spermathecae which likewise cannot be *P. houlleti* and which like Horsts worms may be either *P. campanulata* or a third species.

P. campanulata has been found throughout the province of Burma wherever collections have been made. It extends over the Chinese border into the province of Yunnan and has been found in the Himalayas near Darjiling and presumably will also be found in Assam and Bengal. It is also fairly common in the Andaman Islands which have, except for the peregrine species, a *Pheretima* fauna distinctly different from that of Burma. Stephenson recently recorded the species from the Malay Peninsula. Beddard's and Horsts accounts indicate a possibility if not a probability that the species occurs in Sumatra and elsewhere. *P. campanulata* is then no more characteristic of Burma than *P. houlleti* or *P. alexandri.* Stephenson's statement that this form " is a specially Burmese species " (Stephenson 1931, p. 263) cannot therefore be accepted.

Pheretima harrietensis Steph.

1925. *Pheretima harrietensis,* Stephenson, *Rec. Ind. Mus.* XXVII, p. 59, pl. 3, fig. 11.

Material examined.—One tube from the Indian Museum labelled, " W. 1222/1. P. harrietensis Steph. Mt. Harriet, Andamans. N. Annandale ". This tube contained two fragments, both presumably from the same worm.

The spermathecal setae on vii are 24 ; on viii, 25 ; male setae on xvii, 31 ; on xviii, 30.

In the setal circle of xviii there are two slight parietal excavations each of which contains a small, protrusible, glistening, conical papilla. This papilla doubtless bears the male pore though the pore was not definitely recognized.

The spermathecal pores are transverse slits in the intersegmental furrows ; these pores might be considered small relative to the size of the worm, but when compared with the spermathecal pores of such species as *P. heterochaeta* or *P. andersoni* must be regarded as large.

The genital markings are small, circular discs ; each disc with a central pore ; the discs retractile slightly into the body wall. The discs are not exactly in straight lines but give the impression of being arranged in somewhat irregular transverse rows, about nine rows in each patch. There are two patches of these markings, the anterior extending from the setae of xviii onto the posterior third of xvii, the posterior patch from the setae of xviii onto the anterior third of xix. Each patch is about 29—30 intersetal distances wide transversely. Intersegmental furrows are lacking on the region occupied by the genital markings.

The hearts of x are covered over by a thin sheet of tissue which may represent septum 9/10.

The glands which Stephenson calls lymph glands are attached to the dorsal blood vessel by long and narrow stalks.

On the septal face of each seminal vesicle is a long columnar appendage, the appendages of xi projecting dorsally above the margins of the vesicles, the appendages of xii reaching only to the dorsal margins of

the vesicles. The dorsal end of each of these appendages is slightly swollen. These appendages may perhaps be regarded as the equivalents of the primary ampullae of other species.

There are stalked glands in xvii, xviii and xix. In the parietes just median to the ectal end of the prostatic duct there is on each side a special glandular mass of tissue. Imbedded in the parietes between this mass and the ectal end of the prostatic duct is a setal follicle containing a single penial seta. This seta is about one millimeter long, practically straight except for a slight bend at the parietal end, with a bluntly rounded end which is ornamented by short transverse rows of fine spines or teeth.

Around the base of the coelomic portion of the spermathecal duct is a thickish ring of tissue which does not appear to be organically attached to the duct as it can be easily removed therefrom merely by rupturing a thin connective tissue that binds it to the duct. After removal of the glandular ring the diverticulum can be seen passing into the anterior face of the duct which below this junction is sharply narrowed. The ventral margin of the ring of tissue is attached to the parietes; the dorsal margin is slightly lobed.

There is a pair of structures in xiv, each of which consists of a vertical cord on the posterior face of septum 13/14 and at its dorsal end an elongately ovoid body which is not attached to the septum. The dorsal portion of the structure was removed and found to be a thin-walled, transparent sac. On opening the sac in a drop of water the contents were found to be as follows (arranged in order of size of the particles):—

1. Flattened corpuscular discs (haemocytes ?) with smooth margins; single, in pairs, or in clumps.
2. Corpuscular bodies with irregular outlines (amoebocytes ?); singly or in clumps.
3. Monocystid pseudonavicellae of three different sizes.
4. Nematode ova.
5. Setae.

The sac contained no earthworm ova. The structure is therefore not a receptaculum ovorum but an organ similar in function to those described hereinafter from *P. osmatoni*.

Pheretima houlleti (E. Perr.) 1872.

Tharrawaddy, August, G. Anderson, 1 specimen.
Kyangin, August, K. John, 2 specimens.
Mt. Harriet, Andaman Islands, July, C. Amirthalingam, 1 specimen.
Minnie Bay, Andaman Islands, July, C. Amirthalingam, 3 specimens.
Tharrawaddy, August, K. John, 9 specimens.
Pegu, August, K. John, 9 specimens.
Coomzamu, September, K. John, 6 specimens.
Maubin, September, K. John, 5 specimens.
Thanchitaw, September, K. John, 8 specimens.
Yandoon, September, K. John, 10 specimens.
Pyapon, September, K. John, 6 specimens.
Kochi, September, K. John, 1 specimen.
Bassein, September, K. John, 13 specimens.
Tantabin, September, K. John, 9 specimens.
Toungoo, September, K. John, 14 specimens.
Pyigyaung, September, K. John, 14 specimens.
Blachi, September, G. E. Blackwell, 1 specimen.

Loiktho Circle, September, G. E. Blackwell, 1555 specimens.
Taungyi, August, H. B. Gates, 68 specimens.
Kawkareik, October, K. John, 20 specimens.
Thaton, October, K. John, 12 specimens.
Ye, October, K. John, 19 specimens.
Sandoway, September, F. R. Bruce, 7 specimens.
Kengtung, September, R. S. Buker, 203 specimens.
Nam Hpen Noi, August, H. Young, 16 specimens.
Kwang Yeh, Mang Lum State, October, H. Young, 20 specimens.
Loi Se, Mang Lum State, H. Young, 9 specimens.
Myitkyina, October, L. A. Dudrow, 26 specimens.

External characteristics.—Length up to 130 mm., greatest diameter up to 5 mm. These dimensions are not however commonly attained by specimens of this species, the worms usually much smaller. In the Young collections the greatest length is 85 mm., the greatest diameter 3 mm.

The number of segments of 25 specimens selected at random from this year's collections are as follows :—

94	98	103	101	99
102	98	97	95	103
98	104	101	90	97
104	105	103	100	101
99	104	101	103	100

Determination of the location of the first dorsal pore has been a matter of some difficulty owing to the fact that there may be one, two or three markings which are more or less definitely pore-like in appearance. Some of these markings quite definitely do not indicate the presence of functional dorsal pores for no amount of pressure that can be exerted by bending or squeezing the worms is sufficient to force fluid through the body wall at these points. On the other hand the pressure exerted may be sufficient to rupture the body wall in a thin but imperforate region so that fluid is forced out when there is actually no functional pore. Examination of the coelomic face of the parietes of opened worms that have been subjected to heavy pressure shows that this rupturing of a thin but imperforate region did occur at least in a few specimens. Yet a certain amount of pressure is necessary in order to recognize a functional dorsal pore as the specimens are strongly contracted as a result of the method employed in killing the worms so that as a rule the dorsal pores are not represented by patent apertures in the parietes.

When worms are subjected to slight pressure by bending the specimens a little towards the ventral side fluid spurts out from the pores of the region that is so compressed. A series of worms was subjected to slight pressure in this fashion and the first pore from which fluid spurted was recorded as the first dorsal pore with the following results :—

First dorsal pore in 7/8	2 specimens.
First dorsal pore in 8/9	39 specimens.
First dorsal pore in 9/10	75 specimens.
First dorsal pore in 10/11	22 specimens.

Fifty worms, a different series, were then subjected to stronger pressure by bending further ventrally or by lateral compression and the

first dorsal pore was taken as the first pore-like marking from which fluid spurted or oozed with the following results :—

First dorsal pore in 7/8	6 specimens.
First dorsal pore in 8/9	14 specimens.
First dorsal pore in 9/10	27 specimens.
First dorsal pore in 10/11	3 specimens.

These results show that whatever may be the position of the first functional dorsal pore on an individual worm, in the species the location of this structure is variable and may be on any of the intersegmental furrows 7/8—10/11.

Non functional pore-like depressions in the region of intersegmental furrows 14/15 and 15/16 are indicated in many specimens but functional pores have been found in these locations in clitellate individuals only in the early part of the rainy season.

A ventral break is usually present in the setal circles but may be gradually closed passing posteriorly. A dorsal break of varying width is usually present from xvii posteriorly for a varying number of segments but is usually lacking on the segments of the last third or quarter of the body. The spermathecal setae on vii are 11—16, on viii 16—24 ; the male setae on xviii are 5—12 ; the number of setae on xx, 51—61.

During the preliminary sorting out of the specimens of the various collections the spermathecal pores of one side of every worm were examined. No genital markings of the *P. campanulata typica* sort were ever found in this species. This may be taken to indicate that if there is more than one stalked gland associated with a spermatheca, the extra gland opens into the spermathecal duct.

The variation in some of the external characteristics is indicated in the table below :—

vii.	viii.	xviii.	xx.	First dorsal pore.	Locality.
13	21	9	52	7/8	Rangoon.
14	19	8	..	? 9/10	
14	20	9	..	7/8	
14	19	6	..	? 9/10	
13	20	5	..	8/9	
14	21	8	..	? 9/10	
16	22	7	..	9/10	
12	20	8	54	? 9/10	
12	20	8	..	8/9	
14	18	8	..	? 9/10	
14	21	7	..	? 9/10	
14	20	7	55	7/8	Taungyi.
14	21	11	..	9/10	
14	18	11	..	7/8	
13	18	10	61	8/9	
12	16	10	..	8/9	
15	20	7	..	9/10	Pegu.
15	19	7	54	9/10	
13	19	7	..	9/10	

vii.	viii.	xviii.	xx.	First dorsal pore.	Locality.
15	22	8	..	7/8	Taungyi.
15	20	11	52	7/8	
15	24	10	..	8/9	
13	19	8	51	? 8/9	
16	19	10	..	8/9	
16	20	10	52	? 9/10	
16	20	11	..	? 9/10	
14	20	9	52	? 9/10	
12	20	9	..	8/9	
12	18	8	..	8/9	
11	20	8	56	8/9	
15	22	9	..	8/9	
13	17	8	..	?? 10/11	
15	23	10	52	8/9	Leikthe Circle.
15	20	9	..	8/9	
13	18	10	..	? 9/10	
15	23	9	..	9/10	
15	21	12	..	? 9/10	
15	20	12	..	? 10/11	
16	22	10	57	9/10	
15	21	10	..	? 9/10	
14	21	11	..	?? 10/11	
16	20	12	..	9/10	
14	20	9	..	9/10	
14	21	11	55	9/10	
14	20	10	..	? 9/10	
14	19	10	..	9/10	
15	22	11	..	? 9/10	
15	22	11	..	9/10	
15	22	10	..	9/10	
16	22	7	..	8/9	

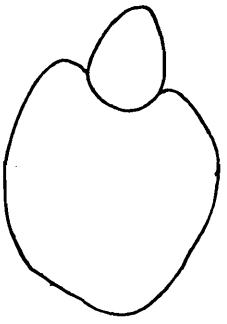
Internal anatomy.—138 specimens opened.

The intestine begins in segment xv (100). The intestinal caeca are simple but may be constricted by the septa through which they pass; they always arise in segment xxvii (54) and extend forward into xxiii—xxv.

The last pair of hearts is in xiii (100) and all the vascular commissures of ix—xiii pass into the ventral blood vessel (100). There is a single commissure belonging to ix in 124 specimens, on the right side in 70 specimens and on the left side in 54 specimens. In 14 specimens there is a pair of commissures belonging to segment ix. In the Young collections there are 38 specimens of this species, of which 19 have a single commissure on the right side, 9 have a single commissure on the left side, while 10 have a pair of commissures; the number of worms with both right and left commissures *plus* the number of worms with a single commissure on the left side exactly equal to the number of worms with a single commissure on the right side.

The seminal vesicles of xi and xii are usually of about the same size. In two specimens from the Leiktho Circle the vesicles of xii are larger than those of xi. On the dorsal face of each vesicle is a mid-dorsal

cleft of varying depth in which is seated the primary ampulla. The ampulla protrudes conspicuously from the dorsal margin of the vesicle



TEXT-FIG. 19.—*Pheretima houlleti.* View of posterior face of seminal vesicle of xii, slightly flattened, showing the primary ampulla, × ca.. 11.

and comes into contact either with the dorsal blood vessel or with the ampulla of the opposite side as a rule. Sometimes (30) the vesicles are so small that the ampulla does not reach to the dorsal blood vessel.

A pair of minute, rudimentary, club-shaped structures can often be made out on the posterior face of 13/14 and of 12/13.

The prostates extend through some or all of segments xvi to xx and are broken up into numerous, flattened, elongate lobes. The prostatic ducts are bent into c-, u- or 8 shapes and are either flat on the coelomic floor or erect and against the median face of the prostates. The copulatory chambers are small but project slightly into the coelom. On the posterior wall of each chamber there is a single stalked glandular mass. On the anterior face of each chamber there are two stalked glandular masses. The stalks of the three glands pass into the wall of the copulatory chamber. Projecting into the lumen of the copulatory chamber is a more or less conical penial body with the tip of the cone bluntly rounded and depressed into a shallow concavity. Within this concavity is a minute pore, presumably the male pore, though I have not succeeded in tracing the prostatic duct through the penial body to this pore. On the base of the penial body, there are two, round, greyish translucent spots. These spots are on opposite sides of the penial body and are sometimes on the ends of slight columnar protuberances in which case there is some resemblance to the penial body of *P. campanulata typica*; but here the central male-pore-bearing portion (?) is much more conspicuous relative to the other two markings than in *P. c. typica.* A protuberant flap of tissue covers over the penial body. A third marking, similar to the two just mentioned is present and is often borne on the end of a slight columnar protuberance from the wall of the chamber. Each of the three markings contains a minute pore.

At least one copulatory chamber of each of the dissected specimens has been opened and examined. No penial setae have been found.

The spermathecal diverticulum ordinarily passes into the median face of the duct but sometimes appears to pass into the anterior or lateral face of the duct. The diverticulum is variously coiled or looped. usaully the loops are not all in the same plane, occasionally all loops in one plane but with a back and forth and up and down arrangement, more rarely loops in a perfectly regular zigzag arrangement. (Note.—Up and down in the previous sentence indicates perpendicular to the back

and forth or zigzagged loops.) The longitudinal musculature was dissected off strand by strand from the coelomic face of the body wall of 37 specimens. Into the anterior or antero-median face of each spermatheca of each of these specimens there passes the stalk of a single gland. Within the duct of the spermatheca and representing an enlargement of the stalk is a single oval translucent area. Another 63 specimens were carefully examined but without removing the longitudinal musculature. In 61 of these worms each spermatheca has but a single stalked gland. Two specimens have each a single spermatheca with more than one stalked gland. In the first specimen there are four shortly stalked glands associated with the left spermatheca of segment viii but all of the stalks pass into the antero-median face of the duct. In the second specimen there are three shortly stalked glands passing into the antero-median face of the left spermatheca of segment ix. As this multiglandular condition has been found in only two of 600 spermathecae it hardly seems necessary to take it into consideration in defining the species. The gland stalk is much longer than in any of the varieties of *P. campanulata.* The glandular body is lifted by the stalk up into the coelom almost always one segment in front of the spermatheca with which it is associated.

The burial of the glands in the longitudinal musculature so frequently observed in *P. campanulata* has never been noted in this species. A number of specimens of the Young collections have bilobed glands, or two glandular masses but with a single stalk. These conditions always associated only with the spermathecae of segment vii.

Remarks.—As *P. campanulata* and possibly other species have been confused with this species for over thirty years, records of the occurrence of *P. houlleti* must be regarded as invalid unless accompanied by data sufficient to enable recognition of the species as it must now be defined.

In his 1931 list of the Oligochaeta of China, Michaelsen includes *P. houlleti,* the inclusion based on the following records :—

1. Nanking, Kiangsu Province. This record is based on an identification of some worms by Stephenson which Chen has since shown to be incorrect (Chen 1931, p. 11). The worms are, according to Chen, *P. vulgaris.*
2. Tientsin, Hopei Province. This record is based on a simple " Fundnotiz " without descriptive matter.
3. Shi-huiyao near Wuchang, Hupeh Province. With regard to this record Michaelsen seems to have been much perplexed. In the list at the beginning of the paper this is not included with the *P. houlleti* records but is given as the occurrence of *P. guillelmi* with the following comment, " Endemic ? Perhaps not a good species " Later on in the same paper (page 13) under heading *P. guillelmi* is this further statement, " I have given the original material of this species a further examination and have come to the conclusion that this form without any further investigation can be combined with *Pheretima houlleti* " If Michaelsen's original description of this species, of which he had several

specimens, is correct, it is quite certainly specifically distinct from *P. houlleti.*

There is therefore no valid record of the occurrence of *P. houlleti* in China.

Pheretima mamillana Gates.

1931. *Pheretima mamillana*, Gates, *Rec. Ind. Mus.* XXXIII, p. 400, fig. 33.
Southern Mergui, September, W. D. Sutton, 111 specimens.
Northern Tavoy, October, W. D. Sutton, 53 specimens.
Ye, October, K. John, 3 specimens.
Kawkareik, October, K. John, 1 specimen.
Victoria Point, October, Saw Nelson, 11 specimens.

External characteristics.—The greatest length is 210 mm. The greatest diameter is 7 mm. The number of segments of 10 mature and complete specimens as follows :—155, 152, 152, 150, 146, 141, 149, 157, 153, 149.

Setae are quite definitely present on the clitellar segments of many of the specimens. In other worms no setae were recognized but the positions of the setal circles are indicated by very fine, whitish, equatorial stripes. The variation in the setal numbers of a few specimens is indicated below.

vii.	viii.	xvii.	xviii.	xix.	xx.	First dorsal pore.	Locality.
20	20	16	10	18	..	12/13	Ye.
20	20	18	10	19	..	12/13	
20	21	16	9	18	..	? 12/13	Kawkareik
23	22	15	11	17	56	12/13	N. Tavoy.
22	23	18	13	19	..	12/13	
23	21	17	8	16		12/13	
24	25	16	12	17	55	12/13	
21	24	18	12	17	49	12/13	
24	25	17	11	18	..	12/13	
24	25	18	12	17	..	12/13	
22	23	16	9	17	..	12/13	
24	26	17	10	19	47	12/13	
23	23	17	11	18	..	12/13	
23	23	16	7	17	..	12/13	S. Mergui.
22	26	15	11	17	..	12/13	
23	22	16	11	17	52	? 13/14	
22	22	18	7	19	..	12/13	
22	23	17	10	14	..	12/13	
24	23	17	11	16	..	12/13	
22	23	16	10	17	53	12/13	
24	25	15	11	15	..	12/13	
25	25	17	12	18	..	12/13	
24	22	18	11	19	..	12/13	

One specimen has a non-functional pore-like marking in 11/12. In all the rest of the specimens the first functional pore or pore-like marking is in 12/13. In a very few individuals the presence of a pore-like marking in 12/13 does not seem to indicate the presence of a functional pore.

The margins of the spermathecal pores may be whitened and finely wrinkled. No everted copulatory chambers were found.

Internal anatomy.—(Opened 75 specimens.)

Septa 6/7—7/8 and 10/11—12/13 are muscular.

The intestine begins in the posterior portion of xv or anteriorly in xvi. In a number of specimens the intestine at first appeared to begin in xv but with a little care septum 15/16 could be peeled off completely from the intestine; in other specimens septum 15/16 is quite definitely attached to the intestine shortly behind its origin. The intestinal caeca arise in xxvii in all of the specimens, they are simple but may be slightly constricted by the septa through which they pass.

There is a pair of hearts belonging to ix in one specimen; the single commissure of ix is on the right side in 43 specimens, on the left side in 31 specimens. The last pair of hearts is in xiii in 74 specimens, in the 75th specimen there is no heart on the right side of xiii.

Paired "lymph" glands are present from xxvi or xxvii posteriorly.

The seminal vesicles of xi are usually of about the same size as the vesicles of xii. In the least mature specimens the vesicle consists of a flattened, leaf-like portion on the posterior face of the vesicular septum with the ventral margin bluntly rounded, the dorsal margin cleft and in this cleft a conspicuously projecting primary ampulla. In the fully mature specimens the median half of the vesicle has become much enlarged so that it has grown dorsally over the ampulla which has become more or less fused with either the lateral or the median portion of the vesicle but still recognizable in most specimens by differences in colour and texture. In young worms the ventral portion of the vesicle can be pulled off from its septum leaving the primary ampulla and a vertical column of tissue on the posterior face of the septum. There are paired, stalked, small but readily recognizable pseudo-vesicles on the posterior faces of 12/13 and 13/14 at the sides of the oesophagus, the free bit of tissue at the dorsal end of the stalk spheroid, ovoid, or elongate.

The prostates are small, confined to xviii in five worms or extending through xvi—xviii or xvii—xviii. The prostatic duct is 2—4 mm. long; the ectal end emerges from the central portion of the roof of the copulatory chamber, passes laterally across the roof of the chamber and then down the lateral face and into the ventral margin of the prostate on the floor of xviii; the duct is never looped and except for the slight curve as it passes down the lateral face of the copulatory chamber could be called straight.

The copulatory chamber has a rounded dome-shape and projects conspicuously into the coelom in xviii. Typically there are attached to each chamber three glandular masses; two of these masses have a smooth, ovoid appearance and are attached to the roof of the chamber slightly lateral to its central point, one anterior to and one posterior to the prostatic duct. The third gland has an acinous appearance, is composed of a number of small spheroid bodies and is attached to the median face of the copulatory chamber just above the parietes. The glandular masses are shortly stalked, almost sessile. Some worms have two acinous masses on the median face of each copulatory chamber, while several other specimens lack one of the small, dorsal, ovoid glands.

Projecting very slightly from the median wall into the copulatory chambers near the narrow neck leading to the exterior are one or two small, rounded papillae, the number depending upon the number of the acinous glandular masses. Or there may be circular, concave, pore-bearing discs on columnar protuberances. The copulatory chamber is nearly filled by a penial structure which hangs down vertically from the roof. This may be described as a conspicuous ring of tissue seated in many worms on a circular, slightly protuberant, basal plate. Within the ring of tissue is a deep concavity. There may project ventrally from the ring of tissue a triangular flap as if a portion of the ring had been everted ; on the outer face of the flap, *i.e.*, the face against the wall of the copulatory chamber, there can be made out in favourable specimens two minute discs, each with a concavity containing a single pore. The male pore has not been definitely located but the prostatic duct has been traced to the bottom of the concavity within the ring previously mentioned. One worm has a tiny papilla on the ventral margin of the ring opposite the flap.

The spermathecal duct is shorter than the ampulla from which it is definitely marked off and into which it is invaginated. As the duct passes into the parietes it becomes thicker with a wide lumen. The diverticulum is always longer than the combined lengths of duct and ampulla. It is straight or nearly so in some of the specimens, slightly bent or twisted in others or looped back and forth in a regular zigzag with all the loops in one plane. The limbs of the loops may be very short or not so short but are never as long as in *P. campanulata*. The ental end of the diverticulum is widened into a more or less elongately ovoid chamber. This portion of the diverticulum is constricted off from the more ectal portion in those specimens in which the diverticulum is straight while in those worms in which the diverticulum is looped, the ovoid chamber is perpendicular to the last loop. The diverticulum passes into the lateral face of the spermathecal duct, *i.e.*, the face away from the nerve cord, in every spermatheca of every specimen. (Two specimens of *P. c. meridiana* which had gotten by a mistake into the jar of *P. mamillana* were detected as soon as they were opened by this difference in point of origin of the spermathecal diverticulum.

Remarks.—The original specimens were all anterior fragments. A considerable number of this year's specimens have also lost a larger or smaller part of the posterior region of the body which ends bluntly in a setigerous segment.

The description of the penial body in the copulatory chamber in the preceding account differs from that included in the original description of the species, the differences between the two accounts due to the more careful examination of this body with higher powers of the binocular. The type and cotype specimens have been re-examined. The penial bodies of those specimens are the same as in the present specimens. The appearance of one of these bodies may be mamma or teat-like with a large terminal pore when viewed with low power but owing to the depth of the concavity the penial body may better be described as ring-like.

A worm from Ye has an additional copulatory chamber in xvii on the left side in line with the chamber of xviii on the left side. This

chamber has the characteristic glands, penial body papillae, as well as a prostate with a characteristic prostatic duct.

Pheremtia mendosa, sp. nov. ?

1900. ? *Amyntas virgo*, Beddard, *Proc. Zool. Soc. London*, p. 895.

Southern Mergui, September, W. D. Sutton, 46 specimens.

External characteristics.—Greatest length 98 mm. Greatest diameter 4½ mm. Number of segments of one specimen, 116; all other worms without tails or with regenerating tails. Colour of dorsum, reddish brown to brownish grey, but the pigmentation posterior to the clitellum is very light; clitellum light greyish.

The setae begin on segment ii. There is no midventral break in the setal circles and a mid-dorsal break is usually lacking. The setal numbers are indicated in the table below :—

vii.	viii.	xvii.	xviii.	xix.	xx.	First dorsal pore.
26	25	15	8	17	..	? 12/13
28	24	14	8	15	56	12/13
27	29	15	8	15	..	12/13
25	26	13	6	14	..	? 12/13
26	26	14	7	15	..	12/13
25	28	15	5	17	..	12/13
27	28	17	9	15	50	12/13
26	25	15	8	15	..	12/13
28	30	15	6	16	..	?? 12/13
26	28	15	8	15	..	12/13

The setae are retracted dorsally. Often setal pits are visible dorsally but no setae, whether setae are retracted or have dropped out cannot be stated.

The first dorsal pore is always in 12/13 but a number of worms have a non-functional pore-like marking in 11/12 or, rarely, anteriorly on xii.

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

The spermathecal apertures are relatively large, transverse slits; three pairs, in furrows 6/7—8/9. The segmental margin immediately in front of and just behind each spermathecal pore is whitened and glistening, these special areas of about the same width transversely as the spermathecal pores and almost oval in shape.

There is a single female pore on xiv.

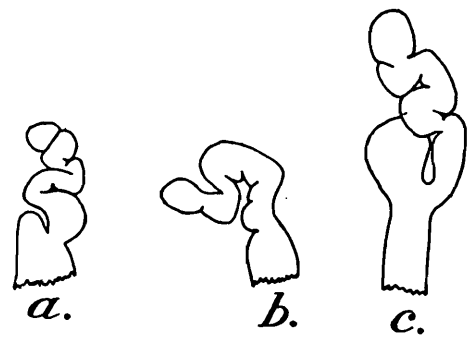
The apertures of the copulatory chambers are transverse slits, about 1–2 intersetal distances wide transversely, in the setal circle of xviii; the anterior and posterior margins of the apertures finely wrinkled. One or both copulatory chambers may be everted as thickly columnar porophores but softening and erosion obviate further description.

There are no genital markings.

Internal anatomy.—(24 specimens opened.)

None of the septa are especially thickened; 5/6–6/7 are strengthened and translucent; other septa may also be slightly strengthened but none are muscular; a slight rudiment of 8/9 can be found; 9/10 is lacking.

The intestine begins with septum 15/16. The intestinal caeca are simple with slight septal constrictions, extending from xxvii into xvii (3 specimens), xviii (4 specimens), xx (1 specimen), xxii (2 specimens).



TEXT-FIG. 20. *a. Pheretima mendosa and b. Pheretima mendosa.* Spermathecae × ca. 11. *c. Pheretima mendosa.* Spermathecae × ca. 19.

There are blood glands in v. There are rather large, paired "lymph" glands from xxvii or xxviii posteriorly. There are large masses of nephridia in v and vi.

The single commissure of ix is on the left side in 13 specimens, on the right side in 11 specimens. The last pair of hearts is in xiii. The commissures of ix—xiii all pass into the ventral blood vessel.

There is a pair of rounded testis sacs on the anterior face of 10/11 and a pair of slightly elongated, ovoid testis sacs in xi. No transverse connections or communications between the sacs of a segment have been found. The seminal vesicles of both xi and xii are small, vertical bodies on the posterior faces of the vesicular septa, each vesicle with a small, but readily recognizable primary ampulla. The prostates are small, rudimentary, in xviii only in 5 specimens ; in xvii only in 3 specimens ; in xvii and xviii in 2 specimens ; in xviii and xix in 1 specimen. The prostatic duct is short and slender, bent into a short u-shaped loop, the loop on the roof of the copulatory chamber with the closed end towards the nerve cord, the ental limb anteriorly ; the ectal limb of the duct is perhaps a trifle thicker in some specimens than the ental limb. The prostatic duct is covered over and bound to the copulatory chamber by transparent connective tissue. The copulatory chambers are, relative to the size of the worms, probably smaller than the chambers of *P. mamillana*. The chambers appear to be larger than they really are when the worm is first opened because of the presence on the roof of the chamber of glands and prostatic duct covered over by the connective tissue. On the posterior face of the copulatory chamber is an acinous mass of glandular tissue ; a similar but smaller mass on the anterior face of the chamber. Projecting into each chamber there is a columnar protuberance bearing a small, round marking with a single pore at the concave centre and a larger, somewhat conical protuberance usually slightly flattened on two sides with a slit-like aperture at the tip or within a slight depression at the tip. Towards the base of the penial body on each flattened side there may be a circular marking with a minute, round pore, the marking similar to that at the end of the columnar porophore.

The spermathecae are always more or less rudimentary, usually represented only by tiny round knobs without trace of demarcation into

duct, ampulla and diverticulum—just projecting through the longitudinal musculature. Occasionally there is a small, slightly looped diverticulum projecting into the coelom, the duct and ampulla represented by a column in the parietes with a pointed tip just reaching through the longitudinal musculature into the coelom. Several spermathecae were found with some slight evidence of an ampullary swelling at the end of the duct. In such cases the diverticulum passes into the lateral face of the duct in which characteristic this species resembles *P. mamillana*. When the diverticulum is best developed it is looped in a regularly zigzag fashion.

Remarks.—Fourteen of the specimens had nematodes in the coelomic cavities of the anterior segments, usually vi—xiii. In 7 of these worms there were also nematode eggs, either scattered singly, or aggregated into loose masses or into flattened, oval discs. Eight of the 14 specimens also had protozoan parasites in the ovaries, the ovaries hypertrophied and extending dorsally at the sides of the oesophagus. In three worms no earthworm ova were found in the ovaries. Associated with the parasites in the ovaries are masses of pseudonavicellae.

The prostates have an acinous appearance quite unlike that of the usual *Pheretima* prostate; each prostate composed of a large number of tiny spherical bodies, the borders of these bodies indicated by fine greyish lines. At the margin of the prostate or at one or two locations in the prostate there are usually one or more masses of opaque, whitish tissue lacking the acinous appearance of the rest of the prostate. These whitish masses may be parasitic but no parasites were actually recognized.

The spermathecae are very evidently rudimentary in the majority of the specimens, and even in those worms in which the spermathecae are best developed the ampullae and ducts must certainly be regarded as vestigial. The seminal vesicles and prostates are all small and in the case of the latter are not characteristically developed. So far as can be determined the specimens are all fully mature; the female and spermathecal pores are patent apertures and the clitellar glandularity is fully developed.

The worms may be regarded either (1) as all abnormal which hardly seems probably, or (2) as having specifically characteristic, small reproductive organs, or (3) as having been profoundly affected by heavy infestation of protozoan and nemic parasites. The third alternative would appear to be more probable were it not for the fact that ten specimens having neither the ovarian gregarines or coelomic nemas have reproductive organs like the heavily parasitized worms.

Assuming that these worms are fully mature and normally developed then *P. mendosa* would appear to be more closely related to *P. mamillana* than to any other Burmese species. If the worms are modified with respect to characteristics of systematic importance as a result of the heavy infestation of parasites, either present or past, it will be rather difficult to determine what are the specific characteristics of normal individuals.

Beddard's *Amyntas virgo* (1900) may possibly be identical with *P. mendosa*. The author's diagnosis of the former species is quoted *in extenso*.

Length 152 mm. Setae of anterior segments rather larger. Clitellum xiv—xvi, without setae. Male pores far apart. No genital papillae. Gizzard septa wanting. Caeca present. Last hearts in xiii. Sperm sacs small in xi, xii. Spermiducal glands confined to xviiith segment with circular terminal sac. Spermathecae very minute in vii, viii and ix, with equal-sized diverticulum.

Two additional bits of information not included in this diagnosis may be gleaned from the account given by Beddard :—The spermathecal apertures are large and the prostatic ducts are short.

In view of the brevity of Beddard's description and the uncertainty with regard to so many points in connection with *P. mendosa* it is hardly possible to do more at the present than to suggest that the worms from the Malay Peninsula and those from Burma appear to have certain characteristics in common which may or may not indicate specific identity.

Pheretima osmastoni Mich. 1907.

Material examined.—3 tubes from the Indian Museum with the following labels "ZEV 2832/7. South Andaman, Wimberleyganj, Port Blair, in dense forest 20′—60′ above sea level; W 1204/1. Wimberleyganj, Andamans 2. xii. 1923. B. Prashad (Two specimens which are not fully mature); W 1220/1. Mt. Harriet, Andamans. Ca. 900′, thick jungle below summit 4. xii. 1923. N. Annandale. (A single specimen also lacking clitellum)."

The spermathecal setae on vii are 11—13; on viii, 12—15; the male setae on xviii are 15—17.

So far as can be judged from the condition of the clitellum none of the specimens are fully mature.

The spermathecal pores are small, transverse slits; three pairs in 6/7—8/9. The epidermis around each pore is wrinkled in such a way as to make the pores appear at first glance larger than they really are.

In the setal circle of xviii on each side there is a fairly large, round or slit-like aperture opening into a slight parietal excavation. The excavation is nearly filled by a thick body with a transversely oval, flat, smooth, ventral surface on which are visible two minute pores and between the pores a single penial seta. The lateral pore is apparently the male pore, the median pore the external aperture of the large bilobed gland. The porophore is protrusible and when so protruded no trace of the parietal excavation is visible.

The genital markings are patches of closely crowded, circular areas or discs, each disc with a smooth, glistening surface and a central pore. The discs may be slightly protuberant beyond the general epidermal level or they may be slightly sunk below the general epidermal level producing an appearance in the unmodified epidermis of a filigree meshwork of delicate strands. The unpaired patches extend across the segments transversely to a distance about equal to 14—16 intersetal intervals. The paired patches are about 9 intersetal distances wide transversely and are separated from each other midventrally by a space about equal to 3—4 intersetal intervals. The patches are postsetal but may push the setae of their segments anteriorly so that the patches extend over more than half the length of the segment. The discs are arranged on the patches in more or less regular transverse rows, the number of the rows varying from 6 to 9.

Internal anatomy.—A delicate sheet of tissue attached centrally to the oesophagus just behind the commissures of ix and peripherally to the anterior face of 10/11 may represent septum 9/10. The hearts of x and a small section of the oesophagus are thus included in a small chamber on the anterior face of 10/11. None of the glands opening to the exterior on x are included within this chamber.

The intestine begins in xv. The intestinal caeca are simple; they may extend dorsally or ventrally at the sides of the oesophagus or anteriorly.

There is a pair of commissures belonging to ix. The last pair of hearts is in xiii. All the hearts of ix—xiii pass into the ventral trunk.

The paired "lymph" glands are large. There are masses of nephridia in v and vi.

The finger-like appendages from the septal faces of the seminal vesicles are folded onto or over the dorsal margins of the vesicles so that the appendages are not conspicuously protuberant.

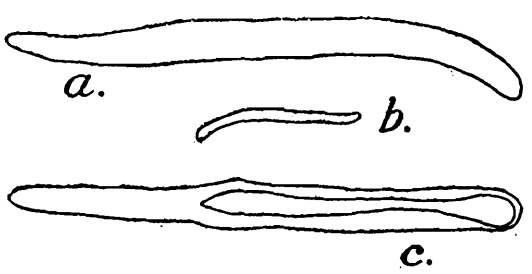
The bilobed gland may extend as far forward as into xv or xvi and as far posteriorly as xxv and is therefore much more extensive than the prostate which may be confined to xviii and xix. That portion of the gland and its duct which is contained within segment xviii is buried within the parietal tissues.

All penial setae examined lacked the outer tips; the measurements as follows:—

Length.	Diameter in thickest portion.
1·14 mm.	·23 mm.
1·25 mm.	·28 mm.
1·13 mm.	·20 mm.

Near the tip of each seta there are a number of more or less unbroken transverse circles of very fine teeth.

At the base of the spermathecal duct is a small mass of tissue most readily recognizable on the anterior face of the duct but which appears



TEXT-FIG. 21. *Pheretima osmastoni.* Three setae from the brown discs × ca. 170.

to extend around the duct in a ring-like fashion similar to the glandular collar of *P. harrietensis.*

Connected with each of the discs of the genital patch by a longish stalk is a roughly spherical, ovoid or lobate gland.

Mt. Harriet, Andaman Islands, July, C. Amirthalingam, 5 aclitellate specimens
Minnie Bay, Andaman Islands, August, C. Amirthalingam, 9 aclitellate specimens.

External characteristics.—Length up to 240 mm. Greatest diameter up to 10 mm. Number of segments up to 153.

The setae begin on segment ii. The setal circles may or may not have a mid-dorsal break of varying width. Behind segment xvii for a varying distance there is usually a slight midventral break, which is however lacking on three specimens. The setae of ii—ix are larger and more conspicuously protuberant both dorsally and ventrally than on succeeding segments. The setal numbers are indicated below :—

vii.	viii.	xviii.	xx.	Locality.
13	14	18	..	Mt. Harriet.
12	13	18	..	
12	12	16	76	
11	12	19	79	
14	17	18	78	
10	11	13	65	Minnie Bay.
12	13	18	74	
12	12	14	76	
13	13	19	79	
12	13	14	67	
13	14	19	71	
12	13	20	84	
12	14	16	69	
12	14	16	..	

The first dorsal pore is in 12/13 except in two specimens in which the first functional dorsal pore is in 13/14 but with a pore-like marking in 12/13.

Positions of the spermathecal pores indicated by minute greyish spots in the intersegmental furrows. There are no female pores visible, no traces of genital markings, no clitellar glandularity ; intersegmental furrows, setae and dorsal pores all present on the clitellar region.

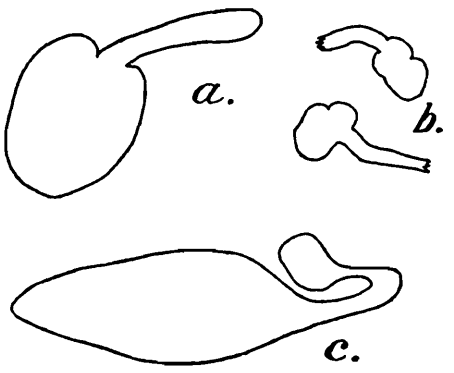
In the setal circle of xviii on each side, on the smallest specimens there is a greyish, transversely oval, very slight depression. Protruding from the centre of this depression is a single seta. In slightly larger specimens there is a protuberance of epidermal tissue around the seta. In the largest specimens the depressed area is slightly larger and deeper and from the centre of the depression there protrudes slightly a small, transversely oval, whitish papilla with two very fine pores, one just median to and one just lateral to the seta. The setae located on these papillae are nearly straight with circles of very fine teeth near the outer tip which is otherwise like that of an ordinary seta.

Internal anatomy.—(All specimens opened.)

Septum 9/10 appears to be present as a sheet of tissue attached peripherally to the anterior face of 10/11.

The intestine begins in xv. The intestinal caeca are simple and constricted by the septa through which they pass; the caeca always extend anteriorly.

The hearts of ix—xiii all pass into the ventral trunk. The last pair of hearts is always in xiii. There is a pair of commissures belonging to ix in each specimen.



TEXT-FIG. 22. *a. Pheretima osmastoni.* View of posterior face of seminal vesicle showing the primary ampulla. *b. Pheretima osmastoni.* Two glands from xii. x ca. 11. *c. Pheretima osmastoni.* Parasite from the brown body × ca. 80.

The seminal vesicles are small flattened bodies on the posterior faces of 10/11 and 11/12. Each vesicle has a single, dorsal, finger-like primary ampulla as shown in the figure. The vasa deferentia are visible and can be traced fairly readily. (Notes on the testis sacs have become illegible.) The prostates are represented by tiny tufts of tissue at the ental ends of the prostatic ducts. The ducts are nearly straight and slightly widened towards the ectal end. In segments xvii and xix there are whitish stalks on the parietes parallel to the nerve cord. At the ental end of each stalk is a small mass of whitish tissue. Ectally these stalks pass into the longitudinal musculature where they bend posteriorly or anteriorly and pass into xviii. In that segment the stalks unite and pass straight down through the parietes. Crowded in between the ectal end of the prostatic duct and the ectal end of the united stalks of the glands of xvii and xix is a sac containing three penial setae.

The longitudinal musculature was removed from a number of specimens but no trace of the glands associated with the genital markings of *P. osmatoni* was found. The spermathecae are rudimentary, visible in the coelom only in the largest specimen, buried in the longitudinal musculature in the other worms.

In segment xiv of every worm there is a pair of more or less flattened, oval, disc-shaped bodies, each attached by a whitish stalk to the posterior face of 13/14 at the side of the oesophagus. Each brown body, as they may be called for their colour is brown, is a sac of delicate whitish connective tissue within which are spherical brownish bodies and whitish masses. The latter are parasites in clumps and were presumably alive when the worms were killed for they are in an excellent state of preservation. The brown spheres are masses of fine brown granules in which are imbedded numbers of setae. The size of these setae varies consi-

derably as will be evident from the figure which shows the largest and the smallest Setae from one brown sphere In segment xiii there is a pair of similar but smaller brown bodies attached to the posterior face of 12/13 at the side of the oesophagus. The marginal outline of the brown bodies of xiii is always more regularly even than is the case with the brown bodies of xiv. In xiii the brown bodies contain setae but no parasites. In the posteriormost region of each of three worms a single brown disc was found. These discs were looked for in other specimens but were not found.

Remarks.—Of the eleven species of the genus *Pheretima* that are found in the Andaman Islands only four have three pairs of spermathecal pores in intersegmental furrows 6/7—8/9 :—*P. campanulata, harrietensis, houlleti,* and *osmastoni.* Of these four species only *P. osmastoni* has paired, bilobed, accessory glands in the prostatic region. The stalked glands described above represent an early stage of the bilobed glands. The specimens collected by Dr. Amirthalingam must then belong either to *P. osmastoni* or to some hitherto undescribed species. Additional evidence for this identification is the similarity between the setal numbers of the immature specimens and those in the Indian Museum collection.

The stalked brown bodies in xiii and xiv suggest a number of interesting questions. These bodies are, apparently, homologous with the structures referred to in connection with other species as pseudo-vesicles. These vesicles have been referred to frequently as egg receptacles but examination of these bodies from a rather considerable number of worms has entirely failed to disclose the presence of a single earthworm ova. In some species these bodies are developed in a manner strikingly similar to that of the true seminal vesicles of xi and xii. Hence the name pseudo-vesicles. Microscopic examination of teased pseudo-vesicles has not lead to a profitable explanation of the function of these bodies. But in these Andaman specimens the brown bodies must be regarded, either as organs for the elimination of setae, or for the elimination of wastes by storage in an insoluble form in the shape of setae. The brown discs found in the posteriormost segments of the body are so similar to the brown bodies in xiii and xiv as to lead to the suggestion that the discs are produced in xiii and xiv and from thence released into the coelomic fluid in which they find their way posteriorly to be gotten rid of, as suggested by Keilin, by autotomy of the posteriormost segments. Brown discs very similar to the brown discs of the Andaman specimens have been frequently found in Burmese worms in which the brown bodies have never been observed in xiii and xiv but which have pseudo-vesicles in those segments. Are these pseudo-vesicles of the adults rudiments of organs which in the young function to eliminate the setae ? Another interesting question is, How do the setae get into the brown bodies ? The brown bodies are present in every one of the specimens in every one of the four locations, which must be taken as an indication of considerable importance to the animal.

Again, if the brown bodies break off from their stalks to become the brown discs, it is curious that in all the specimens examined no evidence of this could be found.

Pheretima peguana (Rosa) 1890.

Tharrawaddy, August, K. John, 7 specimens.
Henzada, August, K. John, 5 specimens.
Pegu, August, K. John, 18 specimens.
Thanatpin, August, K. John, 13 specimens.
Coomzamu, August, K. John, 11 specimens.
Maubin, September, K. John, 12 specimens.
Thanchitaw, September, K. John, 18 specimens.
Yandoon, September, K. John, 12 specimens.
Pyapon, September, K. John, 22 specimens.
Kochi, September, K. John, 16 specimens.
Bassein, September, K. John, 16 specimens.
Ngapugale, August, G. R. Anderson, 4 specimens.
Tantabin, September, K. John, 36 specimens.
Toungoo, September, K. John, 13 specimens.
Pyigyaung, September, K. John, 25 specimens.
Pyinmana, September, K. John, 15 specimens.
Bhamo, September, N. Woodbury, 21 specimens.
Kawkareik, October, K. John, 13 specimens.
Ye, October, K. John, 20 specimens.
Thaton, October, K. John, 23 specimens..
Moulmein, October, K. John, 23 specimens.
Northern Tavoy, October, W. D. Sutton, 7 specimens.
Victoria Point, October, Saw Nelson, 8 specimens.
Myitkyina, October, L. Dudrow, 213 specimens.

External characteristics.—The extent of the variation in position of the first dorsal pore and with regard to the number of male and spermathecal setae was indicated in the previous paper.

The spermathecal pores are minute, transverse or slightly diagonal slits in the intersegmental furrows. A small transversely oval region of the parietes with the spermathecal pore at its centre may be slightly different in appearance from the rest of the body wall nearby.

The male pores are minute, on the wall of a deep parietal excavation, the aperture of the excavation transversely slit-like and about three to four intersetal distances wide from right to left. When fully everted the parietal excavations form thickly columnar porophores about $1\frac{1}{4}$ mm. high. The tissues of the porophore are softish and as a result of friction during transportation the ends of the protruded porophores have been more or less eroded in some of the specimens. In these worms the ectalmost portion of the prostatic duct is visible as a fine thread apparently unaffected by the friction.

The apertures on the genital markings are slightly larger than the male pores. The genital markings are 5—7 intersetal distances wide transversely. The number of genital markings has been definitely noted in 834 specimens. Of this number 826 have the normal two pairs of markings. Eight specimens lack one or more of the genital markings as follows :—one marking lacking on 17/18 on the left side—4 specimens, one marking lacking on 17/18 on the right side—2 specimens, both markings of 17/18 lacking—1 specimen, both markings of 18/19 lacking—1 specimen. There are two previous records of specimens of this species lacking one or more genital markings or with genital markings displaced, apparently as the result of the development of additional prostates and parietal excavations or of the dislocation of these male structures (*vide* Gates 1925, p. 568 and 1926, p. 463).. Although many hundreds of specimens of this species have been collected for class use in the college, no specimens have yet been found with more

than four genital markings. This characteristic constancy in number and position of the genital markings should be compared with conditions in *P. posthuma* which like this species also has two pairs of genital markings with somewhat similar relationships to the male apertures.

Internal anatomy.—40 specimens opened.

Septum 8/9 is present as a ventral rudiment, 8/9 and 9/10 are lacking.

The intestine begins in xv in all of the specimens. The intestinal caeca are simple and may or may not be constricted by the septa through which they pass. In addition there may be several slight dorsal or dorsal and ventral incisions of the margin of the caeca.

The single vascular commissure of ix is on the left side in 15 specimens, on the right side in 14 specimens. There are a pair of vascular commissures belonging to segment ix in 11 specimens; in 7 of these worms both commissures of ix are of the same size and appearance while in two worms the commissure of the left side and in the other two worms the commissure of the right side is much narrower and thinner walled than the other commissure of the same segment. Hearts of x are lacking in all the specimens. The last pair of hearts in all the specimens is in xiii.

There is a pair of widely separated and apparently unconnected testis sacs in each of segments x and xi. Each seminal vesicle has a well developed primary ampulla which is completely sunk into the ventral portion of the vesicle. Each vesicle appears to be enclosed within a transparent membranous sac, the sac much looser and more easily separated off from the ampulla than from the rest of the vesicle. The prostatic ducts are 3—5 mm. long, the duct slender, the ectal portion only very slightly thicker than the ental portion.

The chamber containing the male pore is referred to as a parietal excavation as it does not extend into the coelom. The roof of the excavation is sometimes visible in a gap in the longitudinal muscle layer. There are no papillae on the wall of the excavation.

The spermathecal duct is always much shorter than the ampulla and is pushed into the cavity of the ampulla as a sort of funnel with a thick rim. The diverticulum passes into the anterior or antero-mesial face of the spermathecal duct which is much narrowed within the parietes.

Remarks.—In a north-south direction this species has an extensive distribution within the province of Burma; it has been found as far south as Victoria Point and as far north as Myitkyina. The species appears to be limited however to a central section and to the Tenasserim division.

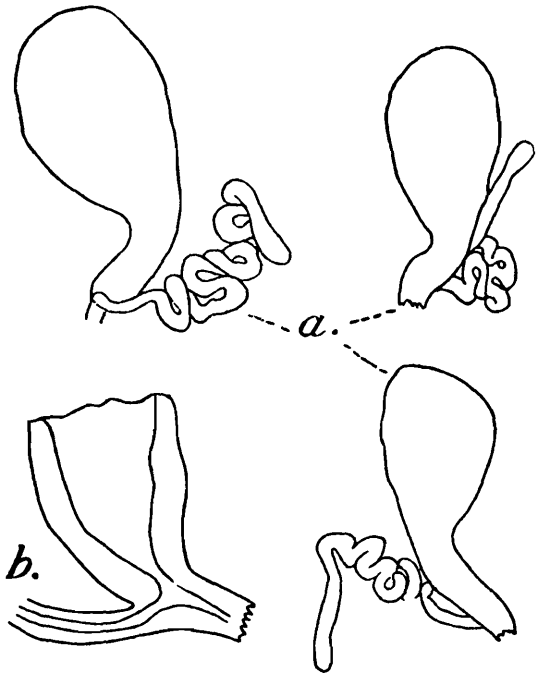
Pheretima terrigena, sp. nov.

Toungoo district, September, G. E. Blackwell, 3 specimens.

Description of the type specimen. External characteristics.—(Statements in parentheses refer to the two cotype specimens.)

Length 89 mm. (Others incomplete posteriorly.) Greatest diameter 4 mm. Number of segments 112. Colour of dorsum anterior to the clitellum, reddish; posterior to the clitellum, brownish red to brownish; clitellum greyish.

The setae begin on ii; are small and closely crowded ventrally, absent or withdrawn deeply into the parietes dorsally. There are no midventral breaks in the setal circles but mid-dorsal breaks are probably present. The setal numbers are:—spermathecal on vii, 20 (17, 17); on viii, 18 (18, 18); male on xviii, 15 (16, 17); (on xvii,—21, 23; on xix,—19, 21).



TEXT-FIG. 23. *a. Pheretima terrigena.* Three spermathecae × ca. 11. *b. Pheretima terrigena.* Supermathecal duct after clearing × ca. 26.

The first dorsal pore is in 12/13.

The clitellum is annular, extending from 13/14 to the setae of xvi; functional dorsal pores and setae present (non-functional pore-like markings and setae present).

The spermathecal pores are minute, three pairs in 6/7—8/9; each pore on a tiny tubercle.

There is a single female pore on xiv just anterior to the setae.

The male pores are minute, each pore on a small, transversely oval, almost round disc in the setal circle of xviii.

The genital markings are small, transversely oval, almost round, whitish, slightly protuberant patches; paired on 17/18, 19/20, 20/21. There is a single marking on 21/22 on the right side in line with the other markings of that side. (On the cotype specimens the markings are four pairs on 17/18, 19/20—21/22. Each marking is about 3—4 intersetal distances wide transversely. The space between the markings midventrally is equal to 6—10 intersetal intervals. The lateral margins of the markings are just median to the median margins of the male-pore markings.

Internal anatomy.—Septa 4/5—7/8 are present (5/6—6/7 slightly thickened); 8/9 is present as a ventral rudiment; 9/10 is lacking.

The intestinal caeca are simple, extending from xxvii forward into xx or xxi, constricted slightly by the septa through which they pass. The intestine begins in xvi.

There are masses of nephridia in v and vi and acinous blood glands in v.

The last pair of hearts is in xiii. (The hearts of x—xiii pass into the ventral blood vessel.)

(There is a single median testis sac belonging to x and a similar sac in xi.) The seminal vesicles of xii are large, pushing 12/13—13/14 posteriorly into contact with 14/15. Imbedded in a slight depression in the middle of the posterior face of the vesicle is a small, more or less cone-like primary ampulla, attached to the oesophageal face of the vesicles by a short stalk. (The vesicles of xii extend posteriorly to the level of 15/16 at least, in the cotype specimens.) The seminal vesicles of xi are enclosed within the testis sac of that segment. The dorsal ends of the testis sac abut against the dorsal blood vessel but are not attached thereto. The prostates extend through segments xvii—xviii or xix.

The prostatic duct is slender, elongate, thrown into a heap of three or four coils or loops.

The spermathecal ampulla is longer than the duct from which it is not sharply delimited. The diverticulum is slender, longer than the combined lengths of duct and ampulla, looped or coiled. The diverticulum passes into the anterior face of the spermathecal duct.

There are transversely oval glandular masses projecting into the coelom dorsal to each genital marking.

Remarks.—The clitella of the cotype specimens are apparently fully developed.

The genital markings of this species are somewhat similar to those of *P. malayana* but the number of spermathecae in the two forms is different and in Beddard's species the genital markings are postsetal rather than intersegmental.

Pheretima umbraticola, sp. nov.

Kawkareik, K. John, October, 4 specimens.

Description of the type specimen. External characteristics.—Length 115 mm. Greatest diameter 6 mm. Number of segments 125. Colour of dorsum anterior to the clitellum, blueish ; posterior to the clitellum, brownish ; clitellum, greyish.

The setae begin on segment ii and are not closely crowded anteriorly either ventrally or dorsally but are fairly regularly spaced. There is no midventral break in the setal circles, but there is a mid-dorsal break of varying width on some segments immediately posterior to the clitellum. Posteriorly the setae are smaller and more closely crowded both dorsally and ventrally. The setal numbers are :—spermathecal on vii, 14 ; on viii, 16 ; male on xvii, 8 ; on xviii 8 ; number of setae on xx, 45.

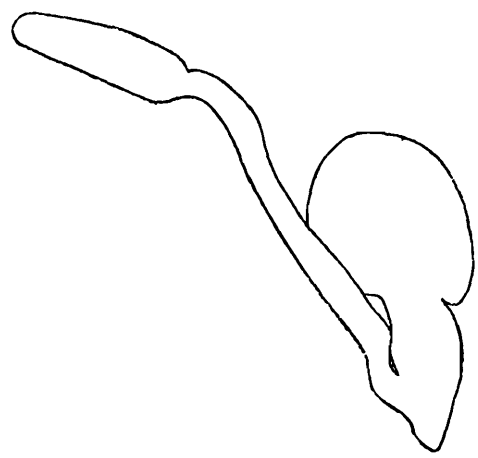
The clitellum is annular, extending from 13/14—16/17 ; dorsal pores, intersegmental furrows and setae lacking.

The first dorsal pore is in 12/13 but there is a pore-like marking in 11/12.

The spermathecal pores are minute, three pairs, in 6/7—8/9 ; each pore located on a tiny round tubercle which is withdrawn slightly into the parietes.

There is a single female pore on xiv.

The apertures of the copulatory chambers are wide slits in the setal circle of xviii with wrinkled margins.



TEXT-FIG. 24. *Pheretima umbraticola.* Spermatheca × ca. 11.

There are no genital markings.

Internal anatomy.—Septa 4/5—7/8 are present, each septum slightly thicker than the preceding septum; 8/9—9/10 are lacking; 10/11—12/13 are strengthened but membranous.

The intestine begins in xv. The intestinal caeca are simple, extending from xxvii into xxiv but long enough to reach into xxiii at least, when straightened out.

There are masses of pharyngeal nephridia in v and vi and masses of blood glands in v.

The last pair of hearts is in xiii.

The testis sac of xi extends dorsally at each side of the oesophagus, the dorsal extensions fused in such a way as to include the posterior portion of the dorsal blood vessel in that segment within the sac. The testis sac of x is similarly provided with dorsal extensions which are fused over the oesophagus in such a way as to include a short portion of the dorsal trunk. The seminal vesicles of xi are constricted into dorsal and ventral portions and are contained within the testis sac of xi. The seminal vesicles of xii reach dorsally only to the dorsal blood vessel; each vesicle has a cone-like primary ampulla. There is a pair of pseudovesicles in xiii, each consists of a septal stalk, a dorsal, elongately oval, smooth body and between these two a small mass of finely granular whitish material. The prostates extend through segments xvi—xx. The prostatic duct is bent into a hairpin loop, the slightly thickened ectal limb passing into the lateral face of the copulatory chamber close to the parietes.

The spermathecal ampulla is longer than the duct from which it is sharply delimited; the duct gradually narrowed in the parietes. The diverticulum is longer than the combined lengths of duct and ampulla and is composed of a thick-walled stalk with a narrow lumen and an ovoid chamber slightly constricted from the stalk.

Remarks.—(All specimens dissected.)

The length varies up to 122 mm. The greatest diameter up to 7 mm. The number of segments up to 135.

The setal numbers are indicated below.

vii.	viii.	xvii.	xviii.	xx.
20	20	14	10	60
18	16	..	8	..
19	19	..	9	..

The first functional dorsal pore is in 12/13 ; one specimen beside the type with a pore-like marking in 11/12.

In the cotype specimens septa 6/7—7/8 and 10/11—11/12 are muscular ; 12/13 strengthened but membranous.

There is a single testis sac belonging to x in one specimen, a pair of testis sacs belonging to x in two specimens ; a single testis sac in xi in two specimens, a pair of testis sacs in one specimen. The prostatic duct is $2\frac{1}{2}$—$4\frac{1}{2}$ mm. in length, the ectal limb quite noticeably thicker than the ental limb though the former is not very thick. On the lining of the copulatory chamber there are smooth glistening patches. No penial body has been found nor has the actual male pore been seen.

Externally *P. umbraticola* looks like *P. houlleti* or *P. campanulata*. The spermathecal diverticulum resembles the diverticulum of *P. heterochaeta* or *P. exigua*.

V.

Spermathecal pores anteriorly on vii—ix.

Pheretima quadrigemina, sp. nov.

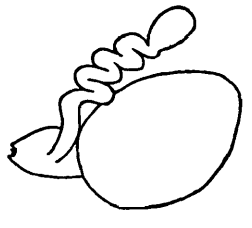
Victoria point, October, Saw Nelson, 2 specimens, one softened.

Description of the type specimen. External characteristics.—(References to cotype specimen in parentheses.)

Length 64 (72) mm. Greatest diameter 4 (3) mm. The worm is incomplete posteriorly (115 segments-cotype specimen). Colour of the dorsum anterior to the clitellum, reddish ; posterior to the clitellum, pinkish ; clitellum, reddish (yellowish).

The setae are deeply retracted on most segments anterior to the clitellum. Posterior to the clitellum there is no midventral break ; a mid-dorsal break of variable width is present. The setal numbers are :—spermathecal on vii, 25 (21) : on viii, 25 (19) ; male on xvii 18 (16) ; on xviii, 6 (6) ; on xix, 16 (16) ; number of setae on xx, ca. 52.

The first dorsal pore is in 12/13 (13/14 but with a very pore-like marking in 12/13).



TEXT-FIG. 25. *Pheretima quadrigemina.* Spermatheca × ca. 11.

The clitellum is annular, extending from 13/14—16/17 ; dorsal pores and intersegmental furrows lacking but a few setae present.

The spermathecal pores are three pairs, on the anterior margins of vii—ix close to the intersegmental furrows, the pores small but not minute, transverse slits. The epidermis immediately around each pore is whitened and slightly tumescent.

There is a single female pore on xiv.

The apertures of the copulatory chambers are transverse slits in the setal circle of xviii with antero posterior lips in contact with each other.

There are no genital markings.

Internal anatomy.—Septa 5/6—7/8 are strengthened but membranous (slightly muscular and translucent); 8/9 is present but delicate (lacking); 9/10 is lacking; 10/11 and several succeeding septa are strengthened but membranous.

The intestine begins in xvi. The intestinal caeca are simple, extending from xxvii into xxv (xx) where they are bent under the gut.

There are masses of nephridia in v and vi. There are paired "lymph" glands from xxvii posteriorly. There are blood glands in v.

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

The testis sacs appear to be paired anteriorly on 10/11 and in xi. Both pairs of seminal vesicles are well developed and cover over the dorsal blood vessel in xi and xii, the posterior vesicles pushing 12/13 back into contact with 13/14. The prostates extend through segments xvi—xx. The prostatic duct is slender, bent into an I shaped loop part of which extends into xvii. In xix and at the posterior face of each copulatory chamber are two ovoid, glandular masses. The stalk of one of these passes into the posterior face of the copulatory chamber, the other stalk into the median face of the chamber. On the anterior face of each chamber is a single ovoid mass. Projecting into each copulatory chamber are three short, but rather thickly columnar bodies, each of which bears at its end a circular, greyish, concave depression within which is a pore. The male pore is minute, on a smaller but otherwise similar body projecting into the chamber from the middle of its roof.

The spermathecae are small; the spermathecal duct is short but is not confined to the body wall, the diverticulum is longer than the combined lengths of the duct and ampulla and is bent into a series of zigzag loops. The diverticulum is slightly widened entally and passes into the anterior face of the spermathecal duct in the parietes.

E.

Four pairs of spermathecae.

I.

Spermathecal pores posteriorly on v—viii.

Pheretima posthuma (L. Vaill.) 1868.

Tharrawaddy, August, K. John, 4 specimens.
Henzada, August, K. John, 6 specimens.
Kyangin, August, K. John, 4 specimens.
Jinghighat, Andaman Islands, August, C. Amirthalingam, 18 specimens.

Pegu, August, K. John, 5 specimens.
Thanatpin, August, K. John, 5 specimens.
Ngapugale, August, G. R. Anderson, 68 specimens.
Keinbyingyi, August, G. R. Anderson, 22 specimens.
Maubin, September, K. John, 10 specimens.
Thanchitaw, September, K. John, 7 specimens.
Yandoon, September, K. John, 22 specimens.
Bassein, September, K. John, 18 specimens.
Toungoo, September, K. John, 10 specimens.
Pyigyaung, September, K. John, 21 specimens.
Pyinmana, September, K. John, 8 specimens.
Bhamo, September, N. Woodbury, 38 specimens.
Moulmein, October, K. John, 24 specimens.

External characteristics.—The spermathecal pores are small, transverse slits on transversely oval, glistening tumescences on the posterior margins of v—viii. Each tumescence is about 3 intersetal distances wide transversely; is sharply marked off from the parietes by a very definite groove; may or may not reach to the posterior intersegmental furrow or may extend slightly across the intersegmental furrow. A number of aclitellate specimens were examined. On these specimens the tumescences had not been formed, the segmental positions of the spermathecal pores were quite evident.

In a previous paper (Gates 1926) it was stated that the "male pore is a minute aperture on the centre of a round, glistening papilla on the wall of the copulatory chamber." The chamber in which the male pore papilla is contained does not protrude through the body wall into the coelom and in accordance with the practice recently adopted is to be referred to as a parietal excavation rather than a copulatory chamber. The excavation can be everted so that the male pore marking is at the end of a more or less columnar porophore.

Like *P. peguana* this species has two pairs of genital markings in the male pore region but unlike *P. peguana* there is much more variation in the number of markings on any particular individual. Of 1,026 specimens of this species brought into the laboratory in the last two years, 897 have had the characteristic two pairs of markings while 129 have had either more or less than that number. In addition to these 129 specimens others have been accumulated for several years with variations in the genital markings. The variations are indicated below.

A. Additional markings present together with the four characteristic markings.

1. A single additional marking as follows :—

	Left.	Right.
xvi	1	2
xx	29	28
xxi	3	4
xxii	3	2
xxiii	2	..
xxiv	..	1
xxvi	1	1
xxvii	1	1

2. More than one additional marking as follows :—

xvi and left xx	1
xx and right xxiii	1
xx, xxi, left xxii	1
xx, left xxi	3
Right xx, right xxi	3
Right xxiii, right xxiv	1
xx	6
Right xx, right xxii	3
Right xxii, right xxiv, right xxv	1
Right xx, left xxiii	1
Right xx, right xxi, right xxii	1
Left xx, left xxi	1
Left xxi, right xxii	1
Left xx, right xxiii	1
Left xxiii, right xxiv	1
Left xxii, left xxiii, right xxiv	1
Left xxiii, left xxiv	1
xx, right xxii, right xxiii, right xxiv	1
Left xvi, left xxii	1
Right side only on xx, xxi, xxii, xxvi	1
Right side on xxii, xxiii, xxiv, xxv, xxvi; left side on xxv, xxvi	1
Left side only on xx, xxi, xxiii, xxiv, xxv, xxvi	1

B. One or more of the usual papillae lacking, additional markings present.

GENITAL MARKINGS.

Absent on		Present on							
xvii.	xix.	xvi.	xx.	xxi.	xxii.	xxiii.	xxiv.	xxviii.	
l.	..	..	r.	..	..	..	..	..	1
l.	..	..	l. r.	..	..	..	..	..	3
l.	..	..	l. r.	l.	..	..	..	..	1
l.	..	..	r.	r.	..	..	..	..	1
l.	..	..	l. r.	r.	r.	..	..	..	1
l.	..	r.	..	..	..	..	..	..	1
l. r.	..	..	l. r.	..	..	..	..	..	6
l. r.	..	..	l. r.	l.	..	..	..	..	1
l. r.	..	..	r.	..	..	..	..	..	3
l. r.	..	..	l. r.	l. r.	..	..	..	..	1
l. r.	..	..	r.	r.	..	..	..	..	1
l. r.	..	..	l. r.	r.	..	..	..	..	1
l. r.	..	..	l. r.	l.	r.	r.	..	..	1
l. r.	..	..	r.	r.	r.	..	..	..	1
l. r.	..	..	l.	l.	l. r.	..	..	..	1
r.	..	..	r.	l. r.	..	..	..	..	2
r.	..	..	l.	l.	l.	..	..	..	1
r.	..	..	l. r.	..	..	..	..	..	1
r.	..	..	l. r.	l.	..	..	..	..	1
r.	..	..	r.	..	..	..	..	..	1
r.	..	..	..	r.	..	..	..	..	1
r.	..	..	..	..	l.	..	..	..	1
r.	..	..	l. r.	r.	..	..	..	..	1
r.	..	..	..	r.	r.	..	..	..	1
r.	..	..	l. r.	r.	r.	..	..	..	1
..	l.	..	..	..	l.	..	l.	..	1
..	l.	..	r.	..	..	..	..	..	1
..	l.	r.	..	..	..	..	..	..	3
..	l.	l.	..	..	..	..	..	..	5
..	l.	l.	r.	r.	r.	..	..	..	1
..	l. r.	l. r.	..	..	..	..	..	..	1
..	l. r.	l.	..	..	..	..	..	..	1
..	r.	l.	..	..	..	..	..	..	2
..	r.	..	l.	r.	r.	..	..	..	1
..	r.	..	r.	r.	..	..	..	l. r.	1
r.	r.	..	l. r.	..	..	..	..	..	1

l. left side.
r. right side.

C. No additional papillae present, one or more of the characteristic papillae lacking.

Markings are lacking as follows :—

On right and left sides of xvii	1 specimen.
On the left side of xvii	1 specimen.
On the right side of xvii	6 specimens.
On right and left side of xix	1 specimen.
On the left side of xix	17 specimens.
On the right side of xix	10 specimens.
On both xvii and xix	1 specimen.

Internal anatomy.—(Opened 30 specimens.)

Septum 8/9 is not only present in each of the specimens but is thickly muscular. No trace of 9/10 has been found.

The intestine begins in xv in each of the specimens. The intestinal caeca arise from the intestine in xxvii, as in other species of this genus and not in xxvi as has been previously maintained, and may be slightly constricted by one or two of the septa through which they pass. (The origin of the caecum was noted on at least one side of every specimen.)

The single commissure of ix is on the left side in 18 specimens, on the right side in 12 specimens. There are no hearts belonging to segments x and xi; the small, thin-walled commissural loops connecting the ventro-laterals and the supra-intestinals in these two segments are quite different from the hearts of xii and xiii of this species and also quite unlike the hearts of x and xi of other Burmese species of the genus. The real hearts connect the supra-intestinals and the ventral blood vessel. The last pair of hearts is in xiii in every specimen.

There is a single, median testis sac with bilobed anterior margin in xi. On the anterior face of 10/11 there is also a single, median sac with two conspicuously protuberant, anterior lobes. In some of the specimens the ventral blood vessel which is contained within the testis sacs suspended from the ceiling of the sac, comes into contact with the floor of the sac in such a way as to divide the contents of the sac into two portions. Otherwise there is no partitioning of the sac. There are no seminal vesicles in x, the structures previously referred to as vesicles are possibly the protuberant anterior lobes of the testis sac.

The seminal vesicles of xii are vertical bodies, quite often almost triangular in cross section. Each vesicle is in two parts, a larger ventral portion and a shorter, more or less cone-like dorsal lobe. The dorsal lobe in its basal portion is of about the same diameter as the ventral portion of the vesicle from which it is sharply constricted; the colour and texture of the dorsal lobe quite distinctly different from that of the ventral portion; the dorsal lobe attached to the posterior face of the vesicular septum by tough connective tissue so that the ventral portion of the vesicle can be pulled off leaving the lobe on the posterior face of 11/12. The vesicles of xi are smaller than the vesicles of xii but are similar in appearance. This is not at first recognizable when the worm is opened

for the vesicles of xi are contained within outgrowths of the testis sac of xi and are covered within this sac, more or less completely, by the testicular material.

There is a pair of small pseudovesicles in xiii, in every specimen. Each vesicle is composed of a stalk just lateral to the oesophagus on the posterior face of 12/13 and at the dorsal end of the stalk a more or less flattened, whitish body. The size of the dorsal ampulla varies considerably but could never be called large. The ampullae have been teased apart and examined microscopically; the tissues of the ampullae are tough and do not easily come apart; no setae, ova, spermatozoa or parasites were found.

The prostatic duct is $2\frac{1}{2}$—$3\frac{1}{2}$ mm. long, bent into a sort of u-shaped loop on the floor of xviii with the closed end of the loop towards the nerve cord and the ental limb anterior to the ectal limb. The posterior limb is slightly thicker than the anterior limb.

The spermathecal diverticulum passes into the median face of the spermathecal duct in many of the specimens, in other specimens the junction of diverticulum and duct is best described as anteromedian. The diverticulum passes into the duct in the coelom; the duct narrowed within the parietes.

Remarks.—The extent of variation in the position of the first dorsal pore and of the numbers of the spermathecal and the male setae was indicated in the previous paper in this series.

Michaelsen includes this species in his 1931 list of Chinese earthworms with the single reference "Prov. Yunnan, Tengyueh (Stephenson 1912)" Stephenson's 1912 record of *P. posthuma* is "A number of specimens, mostly mature. Yenangyaung, Magwe, N. Shan States, Upper Burma" There is therefore in this paper no reference to the occurrence of the species in China. As there do not seem to be any other records of the species from China, *P. posthuma* must be regarded for the present at least as not a part of the Chinese fauna.

It is not clear from Stephenson's record whether he intended to note the occurrence of this species in one, two or three localities. Magwe and Yenangyaung are two distinct but not widely separated towns in the arid, central basin region of Burma, both towns in the district of Magwe. "N. Shan States" may represent a third record or may merely indicate that Stephenson was under the impression that Yenangyaung and Magwe were located in the Shan States. As evidence for the latter may be mentioned the fact that in all other cases Stephenson gives the exact locality from which the specimens were collected.

There is but one other record of *P. posthuma* from the Shan Plateau and that from Taungyi (Gates, 1926). After careful study of old notes and journals I have come to the conclusion that this record is mistaken. Large collections have been made at Taungyi more recently (April, 1930; August, 1931) without finding this species. Other collections made at various times in the year and at widely separated localities in the Shan Plateau have contained no specimens of *P. posthuma*. If this species does occur at all in the Shan Plateau it forms a very uncommon and unimportant portion of the Oligochaete fauna of that area.

II.

Spermathecal pores in 5/6—8/9.

Pheretima alexandri (Bedd.) 1900.

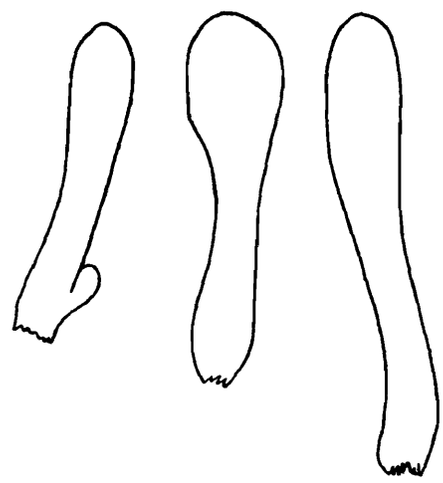
Variety **typica.**

Mt. Harriet, Andaman Islands, July, C. Amirthalingam, 3 specimens.
Minnie Bay, Andaman Islands, August, C. Amirthalingam, 1 specimen.
Kyangin, August, K. John, 6 specimens.
Taungyi, August, H. B. Gates, 15 specimens.
Maubin, September, K. John, 3 specimens.
Yandoon, September, K. John, 1 specimen.
Kochi, September, K. John, 2 specimens.
Bassein, September, K. John, 1 specimen.
Tantabin, September, K. John, 1 specimen.
Toungoo, September, K. John, 1 specimen.
Pyigyaung, September, K. John, 7 specimens.
Blachi, September, G. E. Blackwell, 3 specimens.
Bhamo, September, N. Woodbury, 13 specimens.
Thaton, October, K. John, 10 specimens.
Kawkareik, October, K. John, 2 specimens.
Kengtung, September, R. S. Buker, 325 specimens.
Northern Tavoy, October, W. D. Sutton, 7 specimens.
"Under log in open grassy spot", Kat Pang, Mang Lun State, October, H. Young.

The male setae of xviii were counted on a number of specimens, the numbers as follows :—

10	.	.	.		.	.	.	.	.	23 specimens.
11	.	.	.		.	.		.	.	32 specimens.
12	.	.	.	.	.	.	.			68 specimens.
13	.	.	.	.					.	23 specimens.
14	.	.	.	.	.		.	.	.	42 specimens.
15	.	.	.	.	.	.	.	.		21 specimens.
16	.	.	.	.	.	.		.	.	12 specimens.

All worms with 15 or 16 male setae were opened but all were found to belong to this variety. In addition the setal numbers of the Taungyi



Text-fig. 26. *Pheretima alexandri.* Three spermathecae from highly parasitized individuals.

specimens were determined. These worms are all immature, without trace of clitellar glandularity but with genital markings on xviii developed sufficiently to enable identification. The locations of the spermathecal pores are indicated by minute greyish spots. The setal numbers are as follows :—

vi.	vii.	viii.	xviii.
9	10	11	13
9	12	13	13
9	10	12	14
10	12	13	13
10	11	12	13
9	11	13	14
10	10	12	13
9	12	13	13
9	12	13	14
10	11	13	14
10	11	13	14
9	11	12	13
10	11	12	15
10	12	13	12
10	12	13	13

Each of the two specimens from Kochi has a pair of genital markings that may best be described as :—Slightly protuberant areas of the epidermis not definitely marked off by bounding furrows, each area of a thickly crescentic shape, the narrow opening between the short and thick arms of the crescent directed towards the midventral line. The male pore is located on the lateral-most portion of the unmodified epidermis surrounded by the crescent. There is here no suggestion of the u-shaped ridge or of the depression usually characteristic of the genital markings of this variety.

On the dorsal blood vessel just anterior to 10/11 is whitish connective tissue which covers over the vessel so that it is not visible for a short distance in a dorsal dissection. The connective tissue also extends ventrally in such a way as to conceal the hearts of x. If the worms are dissected from the ventral side it can readily be seen that this appearance is due to tubular continuations of the testis sacs, the two tubes bent dorsally around the oesophagus and fused so that a portion of the dorsal vessel is included within the fused tubes and attached to the tissue which forms the roof of the tube. The hearts of x are contained within these tubular extensions of the testis sacs. Similarly the posterior portion of the dorsal blood vessel in xi and the hearts of xi are not visible in a dorsal dissection. As in x a ventral dissection shows that the testis sacs of xi are continuous with each other dorsally so that the hearts and a small portion of the dorsal trunk may be said to be contained within the testis sacs. (Since writing the above several mature specimens have been found in which the hearts of x and of xi are surrounded by testicular material which extends as far dorsally as the dorsal trunk.)

The ampullae of the spermathecae of the Blachi specimens are dotted with minute flecks of a brownish black pigment.

Variety **gracilior** Gates 1931.

1931. *Pheretima alexandri gracilior*, Gates, *Rec. Ind. Mus.* XXXIII, p. 371 figs. 13-15.

Ye, October, K. John, 6 specimens.

Appendix to **Pheretima alexandri.**

A. Kengtung, September, R. S. Buker, 9 specimens.
B. Kengtung, September, R. S. Buker, 23 specimens.
C. Kawkareik, October, K. John, 3 specimens.

External characteristics.—The length varies from 121 to 172 mm; the greatest diameter from 5 to 7 mm. There is no prostomium.

The ventral setae on ii and iii are nearly straight; the tip of each seta is ornamented with short, transverse rows of fine spines. The setal numbers of some of the specimens from B and C are indicated below.

vi.	vii.	viii.	xvii.	xviii.	xix.	xx.	Locality.
10	12	..	22	17	22	66	Kengtung.
12	14	..	23	20	24	72	
5†	10†	..	17	15	19	67	
12	13	..	22	17	18	58	
9	14	14	23	21	25	65	
12	13	14	21	22	23	60	
11	14	..	23	22	25	68	
11	12	..	25	17	21	76	
6†	11	15	18	17	21	69	
8	12	..	22	19	23	67	
..	..	..	..	14	..	63	Kawkareik.
..	..	..	..	13	..	..	
..	..	..	..	16	..	..	

The first dorsal pore is in 13/14 on one specimen; in 12/13 but with a non-functional pore-like marking in 11/12 on two specimens; in 12/13 on all others.

The clitellar glandularity is fully developed; setae, intersegmental furrows and dorsal pores lacking on the clitellar region. On eight of the Kengtung specimens the clitellar glandularity extends posterior to the intersegmental furrow 16/17; anteriorly the clitellum ends with 13/14 in all specimens.

Twenty of the Kengtung specimens have a pair of female pores on xiv; all others have a single, median female pore on xiv.

The Kawkareik specimens have no spermathecal pores. The Kengtung specimens have spermathecal pores as follows:—two pairs in 5/6—6/7, 1 specimen; two pairs in 6/7—7/8, 1 specimen; three pairs in 5/6—7/8, 15 specimens; 4 pairs in 5/6—8/9, 15 specimens.

None of the specimens have functional male pores. The positions of the male pores are indicated on all the specimens by very minute pore-like markings at the centres of lateral gaps in the setal circles of xviii. Although these pore-like markings do not appear to be functional they have a characteristic appearance and with bright illumination and high magnification will not be mistaken for invaginations of the setal follicles. When a rudiment of a prostatic duct is present the rudiment can be traced through the parietes into the vicinity of the pore-like marking.

There are no genital markings on the specimens from Kawkareik or on the B specimens from Kengtung. Each of the A specimens from Kengtung has a single genital marking; the marking not fully developed in the ordinary sense but characteristic so that the specimens can be identified thereby. The genital marking is on the left side on 2 specimens, on the right side on 7 specimens.

Internal anatomy.—Septa 5/6 and 10/11—11/12 are muscular; 6/7—7/8 are thickly muscular; 8/9 is present as a ventral rudiment in the majority of the specimens; 9/10 is lacking.

There is a post-gizzard collar on the oesophagus. The intestine begins in xv posteriorly, with 15/16 or anteriorly in xvi. The intestinal caeca are simple, slender, long enough to reach into xx-xxii.

The last pair of hearts is in xiii in all specimens. The single commissure of ix is in the left side in 21 specimens; in the right side in 11 specimens. All the commissures of ix-xiii pass into the ventral blood vessel.

There are paired testis sacs anteriorly on 10/11 and in xi without transverse communications between the sacs. The testis sacs of xi are continued dorsally into contact with the dorsal blood vessel. The testis sacs of x are probably also continued dorsally at least to the dorsal blood vessel in all of the specimens but there is no testicular material surrounding the dorsal half of a heart of x in a number of specimens. In one of the Kawkareik specimens the prolongations of the testis sacs of x are fused dorsally in such a way as to include a portion of the dorsal blood vessel within the testis sac. The seminal vesicles of xii fill the segment but do not cover over the dorsal blood vessel which is visible throughout segments xi and xii in all of the specimens. There is a fully developed prostate extending through several segments, with an unusually long but slender duct bent into a mass of loops, in one of the A specimens from Kengtung. There are no traces of prostates in any of the other specimens. In four of the A specimens from Kengtung there is in xviii a single, slender, prostatic duct bent into a short u-shape. The vas deferens can be traced into xviii only when there is a prostate or rudiment of a prostatic duct. In all other cases the vas deferens becomes very fine and thread-like in xiii or xiv and can no longer be distinguished from the tissues of the parietes in which it is imbedded. In some of the specimens the vas deferens of one or both sides is widened in xii and xiii and iridescent, containing apparently, masses of spermatozoa.

The ovaries and oviduct funnels are normal and in the usual positions in xiii. Spermathecae are entirely lacking in the Kawkareik specimens; no vestiges of spermathecae could be found within the longitudinal musculature. Spermathecae are present in varying numbers in the Kengtung specimens. A single specimen has four pairs of spermathecae with normal diverticula—the specimen with a well developed prostate. In this worm the spermathecae are similar to spermathecae of normal specimens of variety *typica*. A second worm has four pairs of spermathecae with diverticula but in this specimen each diverticulum is slender and straight—length about equal to combined lengths of duct and ampulla. A third specimen with four pairs of spermathecae has diverticula on the spermathecae of viii only—shape of diverticula as in preceding specimen. Three other spermathecae were found in which there is a

small, knob-like outgrowth from the side of the duct near the parietes. The diverticula issue from the median faces of the ducts. In other specimens there are spermathecae according to the number of spermathecal pores. The spermathecae are fairly large but without diverticula.

There are large masses of nephridia in v and vi but no blood glands were found.

Remarks.—Nematodes were looked for in each specimen but were found only in the worm with a well developed prostate. Brown discs were found in xvii-xx of one of the Kawkareik specimens; the discs composed mainly of pseudonavicellae spores in addition to which there was brownish granular matter and setae of various sizes.

Practically every specimen is characterized by the presence of large numbers of spheroid or ovoid, translucent cysts one half to three quarters of a millimeter in diameter. The seminal vesicles of xi and xii are almost nothing but masses of these cysts. Similarly the dorsal portion of the pharynx is almost entirely occupied by masses of these cysts in most of the specimens. The dorsal blood vessel and the intestine from xxviii posteriorly bear numbers of these cysts and may in fact be almost completely covered thereby. The cysts decrease rapidly in number per segment in the posterior half of a worm and are almost entirely lacking in the last ten to fifteen segments. Smaller numbers of cysts are found on the coelomic face of the parietes. No cysts have been found on the ventral blood vessel.

The identification of the A specimens from Kengtung rests on the genital markings which are characteristic and quite unlike the markings of other Burmese species of *Pheretima*. The specimens without genital markings are so similar to the specimens with markings that there can be very little doubt about the correctness of the identification.

During the past few years a number of other specimens lacking spermathecal pores and (or) male pores but with fully developed clitella and functional female pores have been collected. Some of these specimens have been identified as *P. alexandri*, others are quite evidently not *P. alexandri* but are more like worms belonging to the *campanulata-houlleti-mamillana* group of species. The non-*alexandri* specimens, lacking so many structures of systematic importance, cannot at present be definitely identified and accordingly extended descriptions of these unidentified specimens have not been included in this paper.

There are several points in connection with these specimens, described or undescribed, to which especial attention is directed. In the first place there is complete absence of metameric anomalies such as incomplete and spiral metamerism. In the second place the digestive, vascular, excretory and nervous systems are normal (from a macroscopic point of view—no microscopic studies of these specimens have been attempted). Again, gonads are present, not only in normal numbers but in normal locations and in these locations only. Finally, the anomalous conditions are confined to what may be called the secondary sexual organs in distinction from the primary sex organs or gonads. In other words, only structures which do not begin to develop until towards the end of the life of an individual, *i.e.*, at the onset of maturity, are abnormal.

The development of each individual must therefore have been quite normal to or nearly to the time at which the secondary sexual organs began their development. The cause of the abnormalities is not therefore " embryological " but something that must be looked for in much later stages of the life history of each individual. Nor can regeneration, either before or after the onset of maturity be invoked to explain the abnormalities. The regenerated anterior ends from hundreds of mature and immature worms have been examined in this laboratory in the course of an unpublished study of regeneration. The anomalies that have been found in these regenerated heads are, with the single exception of the doubling of an ordinarily single female pore, of kinds quite characteristically different from those under consideration. With the elimination of the possibilities of embryological or regenerative causes of the abnormalities, the most obvious of other possible explanations is that of parasitism. Every one of the specimens collected during September and October is characterized by the presence of uncollapsed cysts, collapsed cysts, or vestigial traces of such cysts. A majority of the specimens not only have the cysts but also have large numbers of them. In fact, the total mass of parasites relative to the mass of the host is so large in many specimens that the burden of proof must fall rather upon any who are disinclined to recognize the parasites as responsible for the abnormalities.

In the specimens of *P. alexandri* and other species that are under consideration the parasitism has resulted in the following modifications of conditions that may be referred to as normal for these species :—

1. Doubling of the female pore.
2. Alteration of appearance of characteristic genital markings.
3. Elimination (*a*) of some or (*b*) of all of the genital markings.
4. Reduction in size of prostates,—(*a*) to small but otherwise normal glands or (*b*) to very small rudiments.
5. Elimination of the prostates.
6. Elimination of the prostatic ducts with the prostates.
7. (*a*) Elimination of the male pores or (*b*) reduction of the male pores to non-functional rudiments. (Along with this there is a reduction of the vasa deferentia throughout more or less of their antero-posterior extent to non-functional rudiments.)
8. Alteration of the form of the spermathecal diverticula.
9. Elimination of the spermathecal diverticula (*a*) of some of the spermathecae or (*b*) of all of the spermathecae.
10. Elimination of some of the spermathecae (*a*) symmetrically (*i. e.*, on both sides of a segment) or (*b*) asymmetrically (*i. e.*, on one side of a segment only).
11. Complete elimination of the spermathecae.
12. Reduction in size of the seminal vesicles.
13. Elimination (*a*) of some or (*b*) of all of the seminal vesicles.

If such changes can be brought about by parasitism in *P. alexandri* and worms of the *campanulata-mamillana* group of species there is reason for assuming that the same or similar modifications can be induced by parasitism in other species of the genus. Such an assumption enables not only the explanation of a number of interesting abnormalities, other-

wise very puzzling, but also of the variability in certain structures such as the genital markings of some of the species described elsewhere in this paper. These applications of the theory, so far as Burmese species of the genus *Pheretima* are concerned, are briefly outlined below, the numbers in parentheses referring to the parasitically induced modifications mentioned in the previous paragraph.

P. carinensis, *doliaria*, *papilio*, and *velata*.—Intra-specific variation in the genital markings. (2)

P. carinensis.—Elimination of the genital markings of this species produces forms which have been described as variety *pinguis*. (3*b*).

P. andersoni typica.—Elimination of some of the genital markings of this variety produces the forms with one, two or three genital markings described hereinafter. (3*a*).

P. heterochaeta.—Specimens from Toungoo and other localities with rudimentary prostates, with prostatic ducts but no prostates and with reduced seminal vesicles. (4*a*, 4*b*, 5, 12) *vide* Gates 1930, p. 310 and 1931, p. 389.

P. exigua typica.—Four Kengtung specimens without prostates. *Vide P. e. typica* hereinafter.

P. rimosa.—Elimination of male pores, prostates and prostatic ducts results in forms similar to those described hereinafter as *P. r. effeminata*. (3*b*, 6, 7*a*). Alteration of the appearance of the genital markings together with elimination of the prostates and reduction of the male pores to non-functional rudiments (2, 5 and 7*b* instead of 3*b*, 6 and 7*a*) results in forms like the two individuals with genital markings included in variety *effeminata*.

P. elongata.—(11*a*) Athecal specimens found so commonly in Burma. (11*b*) Individuals with asymmetrical spermathecae found more rarely.

P. glabra, *illota*, and *tenellula*.—(11*a*) Three apparently valid species of which no thecal forms were found.

P. gemella typica.—Rudimentary appearance of the spermathecal diverticula. (8).

P. doliaria.—Alteration of the genital markings together with elimination of the anterior pair of spermathecae results in a form similar to that described as *P. referta*. *Vide* Gates 1931, p. 405.

P. rugosa.—The status of this form is uncertain. It may be derived from either *P. campanulata* or *P. houlleti* as a result of modifications 5, 11, and 12 together with certain other slight changes.

P. defecta.—(5, 11, 12) If 2 is associated with 5, 11 and 12 this species may not be valid.

As illustrations of conditions somewhat similar to those just mentioned and which may also be explained as produced by parasites, two other species are cited.

P. mendosa.—Rudimentary condition of the spremathecae, seminal vesicles, and prostates.

P. gemella typica.—Absence of glands when gland stalks are present on the pseudocopulatory chambers. Absence of similar glands when stalks are present on the postsetal genital markings.

The previous portion of this discussion has been concerned largely with those results of parasitic infestation to which the term negative may be applied. The unusually high percentage of paired female pores on the parasitized specimens of *P. alexandri* indicates that parasitism can react simultaneously on the host in such a way as to bring about changes that may be referred to as positive. As further applications of the theory involving simultaneous positive and negative modifications the following are cited:—

P. andersoni.—Elimination of the genital markings together with a modification of the pigment in the dorsum to a much darker, blue-black pigment results in forms similar to *P. feae.*

P. anomala centralis.—The development of extra mush-room glands, testes and male funnels together with the elimination of the seminal vesicles and spermathecae results in forms similar to those that have been described as *P. a. typica*, the supposed, secondarily bi-sexual male form. On the other hand the elimination of the male pores, prostates, prostatic ducts and mush-room glands results in forms similar to those that have been described as *P. a. insolita*, the supposed, secondarily bisexual female form. If the inhibiting action is less complete than in the forms just mentioned then individuals will be produced similar to those referred to in a previous portion of this paper as intermediate between varieties *centralis* and *insolita.*

Several interesting points require especial emphasis. The parasitized specimens of *P. alexandri* do not have an unhealthy appearance externally. Furthermore these specimens are on the whole as large as normal specimens of the same species from the same locality. The abnormal individuals that were described were collected from two localities more than 300 miles apart. Undescribed specimens were collected at these two localities or at other localities even farther away from either of these two.

It should also be noted that the question of parasitic castration does not arise with but one exception. The parasitized specimens of *P. alexandri* and the individuals of all other forms to which the theory has been applied have normal gonads. In *P. gemella typica* alone is there any suggestion of parasitic castration and in this variety there are parasites in the female gonads. In the castrated specimens all the secondary sex organs are present though certainly not in normal condition.

To anticipate objections that may be raised in the future it is admitted that none of the specimens of the forms to which the theory has been applied have cysts of the type that characterize the abnormal specimens of *P. alexandri*, or at least in such very large numbers. But this does not rule out the possibility of the heavy infestation at some time previous to collection. The theory of parasitically induced abnormality does not demand the presence of the parasites in the matured specimens of the worms but only at such time before or at the onset of maturity as shall

suffice to bring about the changes in the secondary sex organs. After the modifications have been induced the parasites may then disappear leaving little if any trace of their former presence while the hosts, freed from the burden of support of the parasites, may carry on to completion so much of the maturation processes and of the ripening of the gametes as is still possible.

The presence of the cysts in the clitellate specimens is certainly evidence for the presence of the free stage of the parasites concerned at some earlier period in the life history of the hosts and this period may quite well have been the critical period for the development of the secondary sex organs.

Furthermore the specimens of *P. alexandri* with collapsed cysts and vestiges of cysts show quite clearly that most if not all of the actual evidence for the former presence of the parasites may disappear.

Nor is it necessary that the same cysts be found as are present in *P. alexandri*. Other parasites may have the same or similar effects on their hosts.

The objection may also be raised that previous work has shown that " The effects of the parasites on the host are not on the whole very great " (Stephenson 1930, p. 649). But, a very large proportion of the work that has been done on the parasites of earthworms and on the host-parasite relationships has had to do with European forms and especially the Lumbricidae. The statement quoted above, which may be quite correct so far as European forms are concerned, does not necessarily apply to *Pheretima* and the family to which this genus belongs. Only a few species of *Pheretima* have been examined for their parasites (Bhatia, Cognetti di Martiis and Hesse) and many of the species examined are widely spread peregrine forms (Bhatia and Hesse). In Burma we have found that the peregrine forms are not so likely to be heavily parasitized as many of the endemic species. Furthermore, students of earthworm parasites have, concerned themselves in the past mainly with the genital parasites, *i.e.* those species parasitic in the seminal vesicles. Coelomic parasites may be present in much larger numbers and therefore be capable of greater effects on their hosts. In many dissections coelomic parasites have been present in such numbers that the first thing to be noticed in the pinned out and opened earthworm was the considerable number of masses of parasitic nature in the anterior segments. Such masses have been composed of nematodes, nematode eggs, gregarines, pseudonavicellae spores, or cysts. Unfortunately careful records have not been kept of all these occurrences, but a few notes with regard to some of these occurrences have been included in various portions of this paper. However, we are not primarily concerned in this discussion with the parasites of adult earthworms. They may or may not be of importance in this connection. What does concern us here is the presence of parasites and their effects on the host during or just previous to that critical period at which the secondary sex organs begin their development. But information as to this critical period is lacking. The embryologists have confined their studies of development to the embryonic period. We know nothing of the development of the sexual organs of earthworms. The systematists have assumed that immature earthworms could not be identified and have accordingly confined their studies to mature specimens. The

parasitologists have followed, apparently, the example set by the systematists. As a result nothing is known as to what happens to or within a worm from the time it hatches out of the cocoon until it becomes sexually mature. It will probably be a very long time before this deficiency in our knowledge of the life histories of most tropical earthworms is completely rectified for the reason that during a considerable portion of the year the worms simply cannot be found. This unfavourable season, the period of drouth, extends in Burma from November until well into June; it may be longer or shorter elsewhere. But whatever the length of the unfavourable period may be there still remains a considerable portion of the year in which the worms may be studied. That such studies should be made must be quite evident from the foregoing.

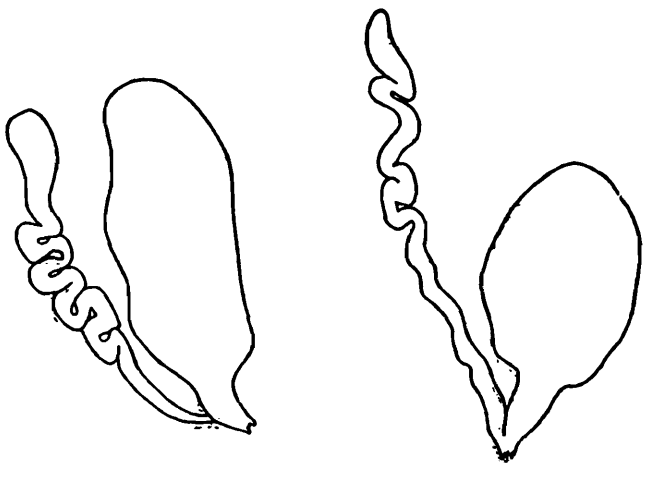
In conclusion, it is recognized of course, that only carefully controlled experiments can actually prove that modifications of the nature suggested can be brought about by parasites. Such experiments cannot be undertaken at the present time in this laboratory. But if some are lead to investigate the various problems dealt with in the previous paragraphs this discussion will have been worthwhile no matter what may be results of the investigations.

Pheretima analecta, sp. nov.

Ko Haw Der, September, G. E. Blackwell, 42 specimens.
Shoko, September, G. E. Blackwell, 153 specimens.
Blachi, September, G. E. Blackwell, 12 specimens.

Description of the type specimen. External characteristics.—Length 102 mm. Greatest diameter 5 mm. Number of segments 101. The dorsum anterior to the clitellum is reddish; posterior to the clitellum reddish brown to brownish; the clitellum is greyish.

The setae begin on segment ii. There are no midventral breaks in the setal circles; anteriorly there may be mid-dorsal breaks of varying width but posteriorly these disappear. The setal numbers are as follows:—Spermathecal on vi, 21; on vii, 23; on viii, 23; male on xvii, 20; on xviii, 17; on segment xx there are about 64 setae.



TEXT-FIG. 27.—*Pheretima analecta.* Two spermathecae × ca. 11.

The first dorsal pore is in 12/13.

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

The spermathecal pores are four pairs in 5/6—8/9, minute, on tiny tubercles.

There is a single female pore on xiv.

The male pores are minute on small, transversely oval, widely separated discs in the setal circle of xviii.

The single genital marking is transversely elongated with bluntly rounded ends. It extends antero-posteriorly nearly to the setae of xix and xx and laterally about to the male pore lines. The marking is not protuberant; it is composed of a greyish rim and central area which are separated from each other by a fine whitish line. The marking is about 19 intersetal distances wide transversely.

Internal anatomy.—Septa 4/5—7/8 are present, 8/9—9/10 are lacking.

The intestine begins in xv. The intestinal caeca are simple with a broad base and extend from xxvii into xxii.

There are masses of nephridia in v and vi and acinous masses of blood glands in v. The last pair of hearts is in xiii.

The seminal vesicles are fairly large and are in contact transversely over the dorsal blood vessel. The prostates are confined to xviii. The prostatic duct is short and slender and bent into a sort of hairpin loop.

The spermatheca has a short duct, a longer ampulla, and a slender diverticulum which is variously looped; the ental end of the diverticulum is slightly enlarged.

A glandular mass dorsal to the genital marking projects into the coelom of segments xix and xx.

Remarks.—The length of the other specimens varies from 50—124 mm., the greatest diameter from 3—5 mm. The segmental numbers of several specimens selected at random are as follows:—96, 96, 97, 82, 91, 97, 98, 101, 92, 102.

The position of the first dorsal pore was noted in 100 specimens:—it is in 12/13 in 81 worms, in 13/14 but with a pore-like marking in 12/13 in 19 worms.

There may be slight, scarcely recognizable mid-ventral breaks in the setal circles for a varying number of segments from xvii posteriorly. The setal numbers of fifteen specimens selected at random are given in the table below.

vi.	vii.	viii.	xvii.	xviii.	xx.
23	24	28	24	14	61
23	24	25	20	16	..
27	27	21†	23	14	..
26	25	25	23	18	76
23	24	25	21	16	69
24	25	26	20	17	..
25	26	27	24	18	81
23	26	28	21	15	..
23	25	28	24	17	..
21	25	26	20	16	..
22	26	28	22	16	..
23	20	28	21	16	74
21	23	23	21	15	..
25	25	27	20	13	..
24	26	29	23	17	..

† Some setae have dropped out.

In many of the specimens the clitellar colouration extends slightly anterior to the position of 13/14 and slightly posterior to the position of 16/17 as indicated by functional or rudimentary dorsal pores, the intersegmental furrows mentioned not actually visible.

The rim of the genital marking is whitish or brownish, the centre usually greyish, rim and centre separated from each other by a whitish region. The ends are bluntly rounded. The marking reaches anteroposteriorly nearly to the setae of xix and xx, in some cases displacing anteriorly and (or) posteriorly the setae of those segments. The transverse width of the marking is equal to 15—20 intersetal distances on xix or xx. Of the 207 specimens, 179 have a single genital marking on 19/20 as in the type specimen, while 28 have an additional marking or markings as follows :—

1. A normal marking on 19/20 and an additional marking on 20/21 extending from the region of the midventral line laterally to the right male pore line. 5 specimens.
2. A normal marking on 19/20 and an additional marking as in 1 but on the left side. 7 specimens.
3. A transversely shortened marking on 19/20 on the left side and a similar marking of about the same size on 20/21 on the right side. 1 specimen.
4. A pair of genital markings on 19/20, the two markings occupying nearly the same space as a single normal marking, except for a short space on the midventral line. 8 specimens of which 7 are from Bhachi.
5. A pair of genital markings on 19/20 as in 4 but the left marking smaller than the right. 1 specimen.
6. A transversely shortened marking on 19/20 on the right side only. 1 specimen.
7. As in 6 but on the left side. 1 specimen.
8. Normal marking on 19/20 lacking, but a marking of usual size on 20/21. 1 specimen.
9. Normal marking on 19/20 present, an additional smaller midventral marking on 18/19. 1 specimen.
10. A transversely shortened marking on 19/20 on the right side and a similar marking on 20/21 on the left side. 2 specimens.

Fifty specimens were opened.

Septum 8/9 is recognizable as a ventral rudiment in many of the specimens.

The intestine begins anteriorly or posteriorly in segment xv in all but one specimen in which worm the intestine begins anteriorly in xvi close to 15/16. The intestinal caeca always have a broad base and lack marginal incisions both dorsally and ventrally.

There is a pair of commissures belonging to segment ix in one worm ; the single commissure of ix is on the left side in 8 worms, on the right side in 10 worms. One worm has no vascular commissure belonging to ix. The last pair of hearts is in xiii in all of the specimens but in one worm the heart on the left side of xiii is much smaller than that of the right side. The hearts of ix-xiii all pass into the ventral trunk in all of the specimens.

The testis sacs are single and median. The seminal vesicles fill segments xi and xii and always cover over the dorsal blood vessel in these segments. The prostates extend through some or all of segments xvii-xxi but are usually restricted to two segments. The prostatic ducts are short, 2—2½ mm. long ; slender but with the ectal portion slightly thicker than the ental portion. The duct is usually bent into a c- or u-shaped loop on the floor of segment xviii with the closed end of the loop towards the nerve cord.

The slender spermathecal duct is always much shorter than the ampulla and is narrowed within the parietes. The diverticulum is always longer than the combined lengths of duct and ampulla and passes into the anterior face of the duct (all spermathecae of all dissected specimens). The diverticulum is looped, usually all of the loops in a regular zig-zag as in *P. campanulata*, or some of the loops, especially those of the ectal portion of the diverticulum, in different planes. Several spermathecae have the diverticulum coiled into an ovoid mass of short loops. In one specimen which is otherwise normal the spermathecae are smaller than usual, the diverticula straight and only slightly longer than the combined lengths of duct and ampulla.

Ten of the dissected specimens are parasitized by one or more species of nematodes. Five of these specimens also have large whitish cysts in the nerve cord in the region between segments ix-xxx. In three of these worms the cysts are so numerous for 10—20 segments that there is no trace of nervous tissue visible, the cysts being contained within a bulged transparent tube of tissue which is continuous anteriorly and posteriorly with the outermost portion of the nerve cord.

The present species is rather like *P. andersoni*, differing from the latter in size, number of segments, length of prostatic ducts, size of prostates and seminal vesicles, and in the absence of the post-gizzard oesophageal collar.

Pheretima andersoni Mich. 1907.

P. andersoni, according to Michaelsen, is characterized by the presence of unpaired, median, genital markings on inter-segmental furrows 19/20—24/25. Specimens referred to this species by Stephenson (1929) and Gates (1930 and 1931) have had genital markings in varying numbers but never exactly the same as on Michaelsen's specimens. None of the specimens obtained during the last collecting season have genital markings approximating in number that given by Michaelsen as characteristic for the species. There is some evidence to indicate that forms referable to this species fall into several distinct varieties. Unfortunately little more than this can be said at the present. No mature specimens of variety *typica* have been available for study and before work on other potential varieties was completed the specimens concerned were thrown away by the laboratory boy. A careful examination has been made of Stephenson's specimens from Myitkyina in northernmost Burma. Stephenson's worms are regarded as belonging to a distinct species, which must bear the specific name *choprai* (*vide P. choprai* hereinafter). Michaelsen's worms and those worms which are most like his specimens with respect to the genital markings will be referred to as variety ***typica***.

The other forms with varying numbers of genital markings are treated separately in the subsequent account. It does not however appear to be feasible at present to regard these forms as varieties, though varietal status may become necessary with acquisition of further information on certain points.

External characteristics.—Length up to 260 mm., all forms, generally speaking, of about the same length. Greatest diameter up to 11 mm.

The first dorsal pore is in 11/12 in one specimen, in 12/13 in 85 specimens.

The clitellum is annular, extending as a rule only to 13/14 and 16/17.

The spermathecal pores are minute, round apertures on tiny papillae or tubercles in intersegmental furrows 5/6—8/9.

There is a single female pore on xiv.

The male pores are minute, each pore at the centre of a small, round or transversely oval disc in the setal circle of xviii, the disc slightly retractile into the parietes.

Genital markings are always present in addition to the male pore discs, the markings always unpaired, median, and intersegmental. In those specimens in which the genital markings have just become visible as faint, very small areas, each area extends laterally beyond the midventral line to an equal amount on each side. No specimens have been found with asymmetrical development of one or more markings as in *P. analecta*. A single worm has been found however with indentations of the anterior and posterior margins of the genital marking in the midventral line.

Internal anatomy.—Septa 5/6—7/8 are muscular; 8/9 is lacking or represented by a ventral rudiment only; 9/10 is either lacking or represented by a thin sheet of connective tissue binding the hearts of x to 10/11 and attached peripherally to the anterior face of that septum; 10/11—11/12 are thickly muscular; 12/13 and several succeeding septa are strengthened but membranous.

The intestine begins in xv always. The intestinal caeca are simple. extending from xxvii forward as far as xviii or xix, slightly constricted by the septa through which they pass.

The last pair of hearts is in xiii. The vascular commissures of ix-xiii all pass into the ventral blood vessel.

There is a single median testis sac with a conspicuously bilobed anterior margin on the frontal face of 10/11 and a similar median chamber in xi. The seminal vesicles and the prostates are large; appearing when the worm is first opened as a continuous row of whitish structures on each side of the oesophagus from 10/11 to the region of segment xx—xxii. The dorsal blood vessel in xi and xii is covered over by the vesicles. The vesicles of xii are much larger than the vesicles of xi and displace 12/13 and several succeeding septa posteriorly in a funnel-like fashion. The anterior vesicles fill all of the space between 10/11 and 11/12 and are attached ventrally to the posterior face of 10/11 and to the roof of the testis sac of xi. A horizontal groove on the lateral face of the vesicles of xii indicates the U-shaped structure of these bodies, the limbs of the U connected by a sheet of connective tissue which is recognizable on the oesophageal face of the vesicle and in which there are a varying number of horizontal whitish cords. At the anterior end of the dorsal limb there

may or may not be recognizable a conical primary ampulla of tougher texture than that of the main portion of the vesicle. The vesicles of xi are lobulated, the marginal incisions produced by muscular cords passing across the segment from 10/11 to 11/12.

Every spermatheca of every dissected specimen has been examined. The diverticulum always passes into the anterior face of the spermathecal duct within the body wall. The duct within the parietes ectal to the diverticular junction is sharply constricted, the ectalmost portion very slender. The diverticulum is always longer than the combined lengths of duct and ampulla, sometimes much longer.

The genital markings are the outer faces of thickenings of the body wall. The coelomic portion of this thickening which protrudes slightly through the longitudinal musculature into the coelom is a layer composed of columnar particles which can be fairly easily brushed or rubbed off from the tougher ventral portion to which it is attached. In many of the specimens tissues of the marking are yellowish in contrast with the whitish appearance of the body wall elsewhere.

Parasites, probably gregarine protozoa and pseudonavicellae cysts, have been found in some of the specimens in the ovaries and in the post-gizzard glandular collar on the oesophagus. Whitish masses of parasitic origin have also been found imbedded in the longitudinal musculature and in the tissues of the nerve cord. Coelomic nematodes have also been found in some of the anterior segments.

Variety **typica**.

Material examined. Indian Museum—One specimen with label, " Pheretima andersoni, Michlsn. ZEV 534/7 Amherst, L. Burma, D. J. Anderson, Type ".

Judson College Collection—22 specimens collected at Chaungson, Bilugyun Island near Moulmein in August, 1930.

The Indian Museum specimen is undissected and according to the nomenclature used in that museum must be a cotype specimen. The worm is not in good condition, the portion behind the clitellum softened and with ruptures in the intestinal wall. None of the Chaungson specimens have any trace of clitellar glandularity.

External characteristics.—The setal numbers are indicated in the table. The first specimen listed in the table is Michaelsen's cotype specimen.

vi.	vii.	viii.	xvii.	xviii.	xix.
26†	36	41	46	33	40
46	43	50	42	32	39
32	33	33	25	19	27
..	..	..	38	33	38
..	..	..	28	26	28
..	..	..	39	32	42
29	32	38	33	27	30
43	43	43	35	32	39
29	32	35	34	24	32
36	37	35	35	25	33
35	36	36	33	34	41

The genital markings of the cotype specimen are six, on 19/20—24/25, each marking about 23—26 intersetal distances wide transversely; laterally the markings do not reach to a point in line with the inner margins of the male-pore markings.

The genital markings of the Chaungson worms are as follows:—

7 on 18/19—24/25	1 specimen.
5 on 19/20—23/24	1 specimen.
6 on 19/20—24/25	15 specimens.
7 on 19/20—25/26	1 specimen.
8 on 19/20—26/27	1 specimen.

Transversely these markings are only 10—15 intersetal distances wide.

Internal anatomy.—The margin of the glandular collar on the oesophagus behind the gizzard may be incised so that there are eight lobes (5 specimens) or six lobes (5 specimens) or ten lobes (3 specimens) or the margin may be scarcely incised at all.

Two specimens have a pair of commissures belonging to ix, but in each worm the commissure of the left side is definitely larger than that of the right side. The single commissure of ix is on the left side in 7 specimens, on the right side in 13 specimens.

In some specimens the spermathecae do not protrude through the longitudinal musculature into the coelom. In these worms each seminal vesicle of xii is represented by a rounded primary ampulla from the base of which there is a thick vertical cord passing down the posterior face of septum 11/12. In slightly older specimens the posterior face of the vertical cord is protuberant in a lobed fashion, the lobes small. In still older specimens the middle portion of the cord is entirely lifted off from the septum and pushed posteriorly so that the cord may now be said to be in the form of a U with the open end of the U facing anteriorly, the anterior ends of the limbs of the U bent upward or downward as they are attached to the septum, the dorsal limb with the primary ampulla. The limbs of the U are connected with each other dorsoventrally by a thin, transparent sheet of connective tissue which passes forward to the posterior face of 11/12. The vesicles of xi are flattened, leaf-like bodies contained within a transparent, connective tissue sac which is attached anteroposteriorly to the septa 10/11 and 11/12 and ventrally to the testis sac of xi. The prostates are small and confined to xviii. The ducts are bent into a U-shape with the limbs in apposition on the floor of xviii, the closed end of the U towards the nerve cord.

In a few specimens rudiments of the spermathecae protrude through the parietes into the coelom. The diverticula of most of the spermathecae of these specimens are straight and longer than combined lengths of duct and ampulla. In two specimens in which the spermathecae are fairly well developed the diverticula are looped somewhat, the looping in the ectalmost portion of the diverticulum, the entalmost portion still straight. The looping is of a regular zigzag sort.

Appendix to **P. andersoni.**

A.

Thaton, October, K. John, 4 specimens.

The setal numbers are indicated below.

vi.	vii.	viii.	xviii.
25	30	30	29
8+	32	30	30
31	32	32	23
29	30	32	22

In one of these specimens the clitellar glandularity extends anterior to 13/14 and posterior to 16/17; there are no functional dorsal pore, belonging to 13/14 and 16/17.

Each specimen has but a single genital marking on 19/20. The marking is about 8—10 intersetal distances wide transversely and does not reach laterally on either side to a point in line with the inner margin of the male-pore discs.

B.

Southern Mergui, September, W. D. Sutton, 1 specimen.
Kawkareik, October, K. John, 9 specimens.

The setal numbers are indicated below.

vi.	vii.	viii.	xviii.	xvii.	xix.
24	27	27	28	..	..
33	32	30	28	..	..
29	31	30	24	..	..
29	28	26	23	..	..
30	31	25	32	..	..
24	26	27	26	..	..
29	28	27	21	34	32
27	29	25	28	36	32
23	24	24	25	33	33

Each specimen has but a single genital marking on 20/21. The marking reaches laterally on each side to a point lateral to the lateral margin of the male-pore discs.

Primary ampullae were recognized on the vesicles of xii in but one specimen.

The prostates are compact or broken up into a number of lobes and extend through some or all of segments xvi—xx. The prostatic duct is 6—9 mm. in length, bent into a hairpin loop with the limbs apposed, the loop on the floor of xviii with the closed end towards the nerve cord and the open end directed laterally.

The spermathecal diverticulum is always straight without looping.

There are no parasites in the post-gizzard glandular collar on the oesophagus.

The genital marking of the Mergui specimen is on 20/21 but dumb-bell-shaped and hence quite different in appearance from the markings of the other specimens. The setal numbers of this specimen are:— spermathecal on vi, 27; male on xvii, 24; on xviii, 16; on xix, 24.

There are ventral breaks in the setal circles of vii and viii in regions where the epidermis is thin and translucent.

C.

Ye, October, K. John, 16 specimens.
Northern Tavoy, October, W. D. Sutton, 1 specimen.
Southern Mergui, September, W. D. Sutton, 35 specimens.

Every one of the specimens included in this section has a peculiar development in the ventral body wall of segments vii and viii while four specimens have a similar development on segment vi. This consists in a thinning of the epidermis which is much more nearly transparent than elsewhere with a loss of setae in the region of modified epidermis. These areas may be regarded as genital markings, each marking extending antero-posteriorly nearly to the intersegmental furrows and laterally to a point just median to the spermathecal pore lines. In two specimens the setal circles of segments vii and viii are continued unbroken across the markings.

The setal numbers are indicated below.

vi.	vii.	viii.	xvii.	xviii.	xix.
b	b	b	..	25	..
b	b	b	26	22	26
34	b	b	..	24	..
35	b	b	..	26	..
26	b	b	..	19	..
b	b	b	..	24	..
32	b	b	31	25	32
26	b	b	..	22	..
27	b	b	36	22	31
25	b	b	..	23	..
25	b	b	..	20	..
26	b	b	..	23	..
b	b	b	..	20	..
29	31	33	..	25	..
33	35	36	36	27	32

b indicates presence of a wide break in the setal circle ventrally.

The first dorsal pore is in 11/12 in 1 specimen, in 16/17 but with a pore-like marking in 12/13 in five specimens, in 12/13 in the remainder of the specimens. The pore belonging to 13/14 is usually not functional and may not even be indicated.

The clitellum is annular; the clitellar glandularity reaching to 13/14 or slightly anterior to 13/14 in all specimens; the clitellar glandularity may or may not reach posteriorly to 16/17.

Each specimen has two genital markings, on 20/21 and 21/22. The markings extend antero-posteriorly to the setae of the segments concerned and laterally about to the male pore lines, or a trifle lateral to the male pore lines.

The margin of the glandular collar on the oesophagus is indented to mark off eight lobes in 9 specimens, seven lobes in one specimen, six lobes in one specimen; while in one specimen the margin is scarcely incised at all.

The single vascular commissure of ix is on the left side in six specimens, on the right side in six specimens.

The prostates are compact structures, confined to xviii but displacing 17/18 and 18/19 anteriorly or posteriorly. The prostatic duct is 10—15 mm. in length; bent into a hairpin loop, the limbs of the loop in contact, the open end of the loop always directed anteriorly and usually with the ental limb of the loop lateral to the ectal limb. Occasionally (both ducts of one worm and a single duct in each of two worms) the ental limb of the loop is nearer to the nerve cord. The duct penetrates through 18/19 and sometimes also through 19/20.

The spermathecal diverticulum is always longer than the combined lengths of duct and ampulla and is almost always nearly straight. In each of two worms there is a single spermatheca with the diverticulum looped into a regular zigzag, all of the loops in one plane. That portion of a spermatheca to which the term duct may be applied is shorter in the spermathecae of ix than in the anterior spermathecae.

One worm has an extra spermatheca in ix on the left side. The spermathecal duct and diverticulum are well developed and like those parts of a normal spermatheca but a diverticulum is lacking. The pore is in 8/9 slightly lateral to the normal pore of the left side.

In every one of the dissected specimens there are fairly large whitish cysts either on the coelomic face of the parietes of the anterior segments or in the nerve cord tissues or in both places. Some of the specimens have in addition whitish cysts in the ovaries.

D.

Maungmagaun, October, 1 specimen.

The setal numbers of this specimen are :—Spermathecal on vi, 22; on vii, 27; male on xvii, 36; on xviii, 22; on xix, 32. There are large midventral breaks in the setal circles of viii and ix. The thin, translucent epidermal areas on this specimen are on viii and ix.

There are three genital markings on 20/21, 21/22 and 22/23; each marking about 30—35 intersetal distances wide transversely and reaching laterally on each side to a point about in line with the inner margin of the male-pore discs.

The glandular oesophageal collar is in eight lobes.

The seminal vesicles of xii each have a definite primary ampulla, the ampullae in contact transversely over the dorsal blood vessel. The base of the ampulla is sunk deeply into the vesicle. The ampulla is much tougher than the main portion of the vesicle.

The prostates are compact and confined to xviii but push 17/18 and 18/19 and several other septa out of position. The prostate is folded onto itself in three or four flaps. The prostatic duct is about 15 mm. in length, bent into a hairpin loop with the limbs of the loop apposed. The loop is parallel to the nerve cord on the floor of the parietes, extending through xvii on one side, through xix on the other side.

The spermathecae have definite ducts which are shorter than the ampullae and which are flattened in an antero-posterior fashion. The diverticula are bent into more or less regular zigzag loopings.

Pheretima compta, sp. nov.

Blachi, September, G. E. Blackwell, 1 specimen.

External characteristics.—Length 86 mm., incomplete posteriorly. Greatest diameter 6 mm. Colour of dorsum, reddish to brownish red ; clitellum, yellowish brown.

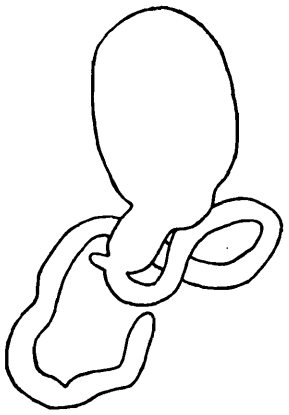
The setae are small and closely crowded and begin on segment ii. Setal pits visible in places where no setae are visible. Spermathecal setae on vi, 39 ; on vii, 41 ; on viii, 45. There are 31 male setae on xviii but there is a midventral break.

The first dorsal pore is in 12/13.

Clitellar segments characterized by different colouration from other segments but intersegmental furrows, dorsal pores and setae are all present.

The spermathecal pores are minute, on tiny conical tubercles in 5/6—8/9.

Male pores were not recognized but are probably located on small, transversely oval areas in the setal circle of xviii. The surface of these areas has been eroded.



TEXT-FIG. 28. *Pheretima compta.* Spermatheca × ca. 11.

The genital markings are in three trios on 18/19, 19/20 and 20/21. The median marking of each trio is in the midventral region, a short distance lateral to it on each side a similar marking. The markings are small, transversely oval and protuberant. All markings are median to the male pore lines.

Internal anatomy.—Septum 5/6 is membranous ; 6/7—7/8 are muscular ; 8/9—9/10 are lacking ; 10/11—11/12 are muscular.

On the oesophagus immediately behind the gizzard is a pair of large, lateral appendices, one on each side of the oesophagus in the shape of a flattened, ear-like flap. The surface of these flaps has a finely granular appearance. The intestine begins in xv. The intestinal caeca are simple, extending from xxvii into xxiii.

There are masses of nephridia in v and vi.

The last pair of hearts is in xiii.

The single testis sac belonging to x is wider than long and has a bilobed anterior margin. The single testis sac of xi is longer than wide. The seminal vesicles of xii are large, extending apparently back to 17/18

but not actually passing through any of the septa 12/13—17/18. The septa just mentioned are strengthened but membranous. The seminal vesicles of xi are large but are less than half the size of the vesicles of xii. The prostates are small, confined to xviii. The prostatic duct is bent into a U-shaped loop and is slender and of about the same thickness throughout.

The spermathecal duct is short. The diverticulum is slender, much longer than the combined lengths of duct and ampulla, not coiled or looped, the ental half a trifle thicker than the ectal half. The diverticulum passes into the anterior face of the duct in the parietes.

There are glandular masses in the parietes dorsal to the genital markings.

Remarks.—The specimen is badly eroded in a number of places; the surfaces of seven of the nine genital papillae, the male pore areas, and the annular ridges on which the setae are located.

In the coelomic cavities there are numerous parasitic masses, each attached by a terminal filament to the body wall, a septum, or to the alimentary tract.

Pheretima exigua Gates.

Variety **typica.**

1929. *Pheretima minuta*, Gates, *Proc. U. S. Nat. Mus.* LXXV, 10, p. 18, fig. 10.
1930. *Pheretima exigua*, Gates, *Rec. Ind. Mus.* XXXII, p. 310.

Kengtung, September, R. S. Buker, 6 specimens.
"In rather dry soil at foot of tree," Kat Pang, October, H. Young, 10 specimens.
"Foot of banyan tree," Tan Yang, Mong Yai State, October, H. Young, 27 specimens.

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

vi.	vii.	viii.	xvii.	xviii.	xx.	Locality.
14	15	16	16	12	40	Cotype.
14	14	15	16	12	..	
14	15	16	15	12	38	
14	15	15	14	10	..	
13	14	15	14	10	..	Kengtung.
11	13	13	13	11	..	
14	15	16	14	11	..	
14	14	14	14	9	..	
14	15	16	18	14	..	
12	11	13	13	10	..	

The first dorsal pore is in 12/13 (43 specimens).

On the posterior margins of segments v—viii there is on each side a very small, transversely oval tumescence of the epidermis with rather sharply outlined margin. On the posteriormost portion of this tubercular pubescence is located the spermathecal pore. In some specimens this pore has the appearance of being located on the posterior margins of segments v—viii rather than in the intersegmental furrows 5/6—8/9 but if the duct is carefully pulled out from the parietes after stripping

off the longitudinal musculature and then the body wall stretched slightly, the apertures can be seen to be in the intersegmental furrows. In two specimens from Tah Yang there is in addition an anterior marginal tubercle of the same size and appearance as the posterior tubercle but just behind each spermathecal pore. These anterior pubescences are similar in appearance and location to those of variety *austrina*.

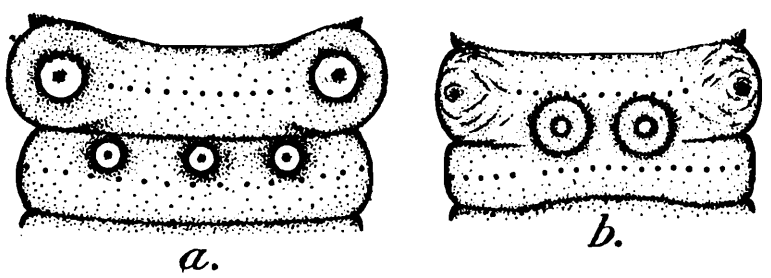
The male pore discs are elongately oval, transversely oval or round.

The genital markings are small; for their size, conspicuously protuberant from the parietes; always presetal. The paired median markings are separated from each other midventrally by a space about equal to 2—4 intersetal distances. The paired lateral markings are separated from each other midventrally by a distance about equal to 8—12 intersetal intervals. The locations of the genital markings are indicated in the table below.

	Kengtung.	Kat Pang.	Tan Yang.
Median pair on vii	..	..	2
Single, median on vii	..	..	5
Median pair on viii	6	10	27
Lateral pair on xvii	2	1	..
Single lateral on xvii	..	1	..
Single lateral on xviii on or close to male pore disc	..	3	1
Single median on xviii	..	..	2
Lateral pair on xix	6	10	27
Single median on xix	1	2	8
Median pair on xix	1	1	4
Lateral pair on xx	..	1	3
Single lateral on xx	1	3	7

Internal anatomy.—(16 specimens opened).

The intestinal widening of the gut is first recognizable at the level of septum 15/16. The intestinal caeca are simple, slightly constricted by the septa through which they pass.



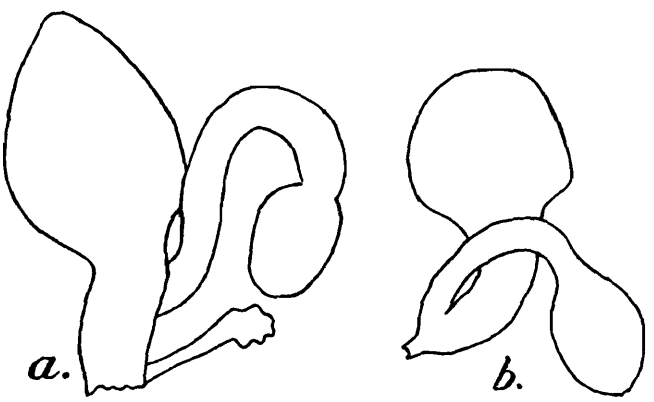
TEXT-FIG. 29. *a. Pheretima exigua typica.* Ventral view of segments xviii and xix. *b. Pheretima exigua austrina.* Ventral view of segments xviii and xix.

The single vascular commissure of ix is on the left side in 8 specimens, on the right side in 8 specimens.

The testis sacs are annular, the sac of xi containing the hearts, vesicles, testes and male funnels of that segment. All vesicles are small; each vesicle consists of a flattened, leaf-like ventral portion with a finely granular surface constricted off from which is a primary ampulla of about the same size as the ventral portion, with surface smooth, and flattened into a sort of triangular-shaped disc. The ventral portion of the vesicle can be pulled off from the vesicular septum leaving the primary ampulla attached to the septum as in *P. rugosa*.

Four of the Kengtung specimens have no prostates. In these specimens the glands of the postclitellar genital markings project more conspicuously into the coelom than in the specimens with prostates.

The spermathecal diverticulum appears to pass into the lateral face of the duct in some specimens, into the anterior face in others, or in others into the duct anterolaterally. Minute, stalked, lobate bodies have been found associated with some of the spermathecae of some of the specimens. The stalk of one of these glands passes into the parietes together with the spermathecal duct and deep in the parietes into the anterior face of the duct. In the majority of the specimens these glands were not found but whether or not they were absent cannot be definitely stated. The glands are very small, difficult to find and in specimens with large amounts of coelomic coagulum are not well preserved. In two of the Kengtung specimens there is whitish, glandular material in



TEXT-FIG. 30. *a. Pheretima exigua typica.* Spermatheca × ca. 50. *b. Pheretima exigua austrina.* Spermatheca × ca. 50.

the parietes around the base of the spermathecal duct, the glandular material associated apparently with the spermathecal tubercle. In other worms the spermathecal tubercle appears to be merely a thickening of the epidermis.

Variety **austrina,** var. nov.

1930. *Pheretima exigua,* Gates, *Rec. Ind. Mus.* XXXII, p. 310.
Leiktho district, September, G. E. Blackwell, 85 specimens.
Kawkareik, October, K. John, 109 specimens.
Myittha, September, W. D. Sutton, 1 specimen.
Northern Tavoy, October, W. D. Sutton, 1 specimen.

External characteristics.—Length 33—68 mm. Greatest diameter 2½—3 mm. Number of segments 73—102.

There is a distinct but slight mid-dorsal and midventral break in the setal circles. The setal numbers are shown in the table below.

vi.	vii.	viii.	xvii.	xviii.	xx.	Number of segments.
10	10	11	10	7	..	86
10	10	14	10	8	24	80
11	10	10	11	8	..	81
11	11	11	8	8	24	87
10	11	12	9	7	30	81
11	11	14	11	8	34	103
11	11	11	9	7	30	101
11	12	14	12	8	32	95
13	15	16	12	8	35	102
10	12	16	12	10	38	88
10	11	12	10	8	34	96
9	10	12	11	7	25	97
10	11	11	9	7	25	97
11	11	12	9	7	32	73
11	12	13	13	9	37	95

The first dorsal pore is in 11/12 in a very few specimens, in 12/13 in all others.

The clitellum is annular, extending from 13/14—16/17; dorsal pores and intersegmental furrows lacking, setae present ventrally at least on xvi and sometimes also present on xiv and xv.

The spermathecal pores are minute; four pairs; on the anterior margins of vi-ix very close to the intersegmental furrows. The spermathecal pores are so near to the intersegmental furrow that at first it hardly seemed worthwile referring to them as segmental rather than intersegmental, but if the spermathecal duct is pulled out from the parietes after removal of the longitudinal musculature the aperture in the epidermis is quite evidently segmental. In some of the worms there is a slight tumescence in the immediate vicinity of the spermathecal pore, the pubescence similar in appearance to that of variety *typica* but here on the anterior instead of the posterior margin of the segment. The pubescence, as a rule, is not as readily recognizable as in *typica*.

The male pores are minute; on small, round markings in the setal circle of xviii. These discs are capable of slight retraction into the parietes. In some of the specimens the male pore areas are not visible, having been eroded, but there is visible a minute penial protuberance: the ectalmost portion of the prostatic duct apparently more resistant to friction than the epidermal tissues of the male pore marking.

The genital markings are similar to those of variety *typica*, each marking with a whitish rim and a round, central, greyish area but slightly wider, not so protuberant from the body and located in different positions as follows:—

1. One pair on 18/19, extending from just behind the setae of xviii to just in front of the setae of xix; median to the male pore markings and almost but not quite in contact in the midventral region. 58 specimens.
2. As in 1 but with the addition of a similar pair of markings across 17/18 in line with the markings of 18/19. 11 specimens.

3. One pair on 18/19, a single marking on 17/18 in line with the right marking on 18/19. 6 specimens.
4. One pair on 18/19, a single marking on 17/18 in line with the left marking on 18/19. 1 specimen.
5. As in 2 but with a single marking anteriorly on xx in line with the markings of the left side. 2 specimens.
6. One marking on 17/18 on the left side, one marking on 18/19 on the left side. 1 specimen.
7. No genital markings. 1 specimen.
8. One pair on 18/19, and a similar pair of markings anteriorly on ix. 2 specimens.
9. One pair on 18/19 ; a similar presetal marking on ix on the left side. 2 specimens.
10. One pair of markings on 18/19, one marking on 17/18 on the right side, a median, presetal marking on ix. 1 specimen.

(After the above had been written the Kawkareik specimens were brought in. On these worms there are three pairs of markings on 17/18, 18/19 and 19/20. On each of two worms there is a single presetal marking on ix, slightly lateral to the midventral line, on the right side in one specimen, on the left side in one specimen.)

Internal anatomy.—The intestine begins in xvi. The intestinal caeca are simple, extending from xxvii into xxv or xxiv, sometimes slightly constricted by the septa through which they pass.

The single testis sac of xi is annular, enclosing the dorsal blood vessel, the hearts, the seminal vesicles, the testes and male funnels. The testis sac of x is similarly annular. The seminal vesicles are smaller here than in *typica*. Each vesicle of xii and occasionally a vesicle of xi has a small primary ampulla, cone-like, or cauliflower-shaped. The prostates extend through xvii—xx. The prostatic duct is straight or slightly bent.

The spermathecae of this variety are like those of *typica* but no stalked masses have been found in the parietes along with the spermathecal ducts.

Remarks.—As all of the specimens collected in a region extending south from Toungoo through Mergui district have been found to be consistently different from the more northern type and cotype specimens with respect to several characteristics it is necessary to place the southern forms in a distinct variety.

Pheretima feae (Rosa) 1888.

Kawkareik, October, K. John, 39 specimens.

External characteristics.—Length varies up to 240 mm. The greatest diameter is 12 mm. The number of segments of ten worms :—132, 140, 146, 130, 153, 138, 131, 148, 145, 150.

The colour of the dorsum of 38 specimens is the characteristic dark, bluish black. The 39th specimen has a light brownish dorsum.

The setae begin on ii ; are small and closely crowded both dorsally and ventrally. There is no midventral break in the setal circles, but a slight mid-dorsal break is sometimes present. The setae on segment

xx were counted on one favourable specimen, the number of setae present, 103. The setal numbers are indicated in the table below.

vi.	vii.	viii.	xvii.	xviii.	xix.
20	23	23	..	18	..
21	24	23	..	20	..
21	20†	21	..	21	..
20	23	25	24	22	29
24	24	26	..	18	..
20	23	23	29	23	34
20	21	20	..	20	..
23	20	23	..	21	..
23	24	24	..	21	..
15†	20	21	..	21	..
18	17	18	30	19	28
19	17	20	29	16	26
20	21	23	..	20	..
19	20	21	30	22	31
21	20	22	30	21	33

† Epidermis eroded, apparent break in setal circle.

The first dorsal pore is in 12/13. The pores belonging in intersegmental furrows 13/14 and 16/17 are not functional on any of the specimens, not even indicated on many specimens.

The clitellum is annular, extending onto xiii and xvii. Intersegmental furrows 13/14 and 16/17 are not visible on any of the worms. When vestiges of the dorsal pores of 13/14 and 16/17 are visible, they are always within the clitellar glandularity. In some of the specimens the clitellar glandularity extends nearly to the setal circles of xiii and xvii, in others to just anterior to or just posterior to the vestiges of the dorsal pores of 13/14 and 16/17. There are no setae, intersegmental furrows or dorsal pores on the clitellum.

The spermathecal pores are minute, in the intersegmental furrows.

There is a single female pore on xiv.

The male pores are minute, each pore on a transversely oval, slightly retractile, small disc in the setal circle of xviii.

Internal anatomy.—(34 specimens opened).

Septa 5/6—7/8 are thickly muscular; 8/9—9/10 are lacking; 10/11—11/12 are thickly muscular; 12/13 and several succeeding septa are strengthened but membranous.

The intestine begins in xv. The intestinal caeca are simple, extending from xxvii forward into xxiv or xxiii. Septa 25/26 and 26/27 are in contact at the sides of the oesophagus so that it is very easy to make a mistake in the determination of segment in which the caeca originate. The post-gizzard glandular collar on the oesophagus is lobulated, the number of lobes usually 6—8.

There are masses of nephridia in v and vi. There are small, acinous masses of blood glands in v.

The single commissure of ix is on the left side in 12 specimens, on the right side in 12 specimens, not noted in other worms. The last pair of hearts is in xiii. All the commissures of ix-xiii pass into the ventral blood vessel.

There are two median testis sacs, each with a conspicuously bilobed anterior margin. In some of the worms there are in the testis sacs, vertical diagonal partitions arising from the floor of the sac, dividing the sac ventrally into three portions, but not continued to the roof of the sac. The seminal vesicles are large and are in contact transversely over the dorsal blood vessel. The vesicles of xii are always at least twice the size of the vesicles of xi and dislocate posteriorly 12/13 and one or more additional septa posteriorly. In many of the specimens the posterior vesicles are so large as to appear to be in contact posteriorly with the prostates. Each vesicle of xii is U-shaped, the limbs of the U thick and connected on their oesophageal faces by a thin, transparent sheet of connective tissue. The dorsal limb bears, in almost every specimen, a conical primary ampulla of much tougher texture than the remainder of the vesicle ; this lobe may be conspicuously protuberant from or sunk into the dorsal limb of the U. The anterior vesicles are attached ventrally to the roof of the testis sac of xi and to the posterior face of 10/11. Removal of the seminal vesicle always opens the testis sac. In several specimens that were opened by a midventral incision a small pore was found in the roof of the testis sac underneath the vesicle, the pore surrounded by a ring of tough, whitish tissue. The left vesicle of xii of one worm appears to have been retarded in its development. It consists of a dorsal lobe of about the same size and appearance as the primary ampulla of normal specimens at the dorsal end of a thick, vertical, whitish column on the posterior face of 11/12. The prostates extend through some or all of segments xvi-xx. The prostatic duct is 15—25 mm. in length, bent into a hairpin loop, the limbs of the loop in contact. The middle third of the length of the duct, *i.e.*, the portion at the closed end of the loop is thickest. The duct extends, on the floor of the coelom, through segments xviii—xxv or xviii—xv, or may be bent under or over the intestine in xviii. The vas deferens is large and readily visible and passes into the prostatic duct a short distance below the margin of the prostate.

The spermathecal duct is always shorter than the ampulla but varies in length relatively and absolutely. The ducts of the anteriormost spermathecae are always longer than the ducts of the posteriormost spermathecae. The diverticulum is always longer than the combined lengths of duct and ampulla, tubular ; more or less straight or variously bent, looped, curled or twisted ; the looping may be regularly zigzag but characterizes usually only one portion of the diverticulum, the ectalmost or entalmost portion or a middle portion. Rarely the whole diverticulum is looped into a regular zigzag. The diverticulum of every spermatheca of every specimen passes into the anterior face of the duct in the parietes, the duct ventral to this junction narrowed.

Remarks.—Gregarine trophozoites and pseudonavicellae spores in large masses were found in the ovaries of some of the specimens.

The spermathecae, seminal vesicles, prostates and testis sacs of *P. feae* and *P. andersoni* are quite similar. The colour of *P. feae* is characteristic ; no specimen of *P. andersoni* has yet been found with a pigmentation like that of *P. feae*. The clitellum of *P. feae* extends beyond the limits of the usual three clitellar segments while in *P. ander-*

soni it usually does not do so. The prostatic ducts of *P. feae* are usually longer than those of *P. andersoni*. The latter is characterized by the presence of genital markings; the former is never so charcterized. Aside from these distinctions there are no important differences between the two forms so far as can be determined at present. The differences mentioned above are slight and would not ordinarily warrant a continuance of the separation of the two forms. But until further information becomes available with regard to several points in connection with the various forms of *P. andersoni*, *P. feae* may be left as at present.

Pheretima gemella Gates.

Variety **typica.**

1931. *Pheretima gemella*, Gates, *Rec. Ind. Mus.* XXXIII, p. 379, fig. 21.
1900. *?Amyntas biporus*, Beddard, *Proc. Zool. Soc. London*, p. 909, fig. 7.

Northern Tavoy district, October, W. D. Sutton, 40 specimens.
Southern Mergui district, September, W. D. Sutton, 1 specimen.
Ye, October, K. John, 3 specimens.

External characteristics.—The length of the present specimens varies up to 143 mm. The greatest diameter up to 7 mm. The number of segments of 10 specimens: 103, 102, 103, 98, 102, 106, 99, 105, 105, 103.

There are slight but definite midventral breaks in the setal circles for a varying number of segments from xvii posteriorly. The setal numbers are indicated below.

vi.	vii.	viii.	xvii.	xviii.	xix.*
26	30	31	16	13	14
26	28	31	16	13	13
26	30	30	15	14	14
27	28	29	17	13	13
27	32	23†	17	13	14
23	28	32	18	12	14
25	28	29	16	13	14
24	27	29	17	12	14
27	28	29	17	15	16
26	29	29	17	13	13

† A large gap in the setal circle, ventrally.
* Number of setae between the apertures in the setal circle.

The first dorsal pore is in 11/12 in 41 specimens, in 12/13 in 1 specimen, in 16/17 in one specimen (but with non-functional pore-like markings in 11/12 and 13/14).

The clitellar glandularity extends from 13/14—16/17; functional dorsal pores sometimes present, otherwise only non-functional pore-like markings.

The spermathecal pores are small, transverse slits in 5/6—8/9.

The paired apertures in the setal circles of xviii and xix are similar in appearance to the openings on the same segments of *P. anomala*, but in *P. gemella* the apertures lead into coelomic chambers rather than parietal excavations. There are two pairs of apertures on 36 specimens; a pair of apertures on xviii and a single aperture on xix on the right side only on 3 specimens; one pair of apertures only, on xviii, on 1 specimen.

A penis protrudes through one of the apertures on xviii on several specimens, sometimes to as much as 2 mm.

The genital markings are preclitellar and located as follows :—(1) presetal markings, varying in number from 3—7, in a more or less straight row just anterior to the setae, one row on vii, one row on viii. These markings are slightly smaller and less readily visible than the postsetal tubercles. (2) Postsetal markings, varying in number up to six per segment on segments vii and viii, located on the posterior margins of the segments almost in contact with the intersegmental furrows, one marking immediately lateral to the spermathecal pore, one just median to the spermathecal pore and one about 5—6 intersetal distances median to the spermathecal pore. The full number of six found only on segment viii and only on three specimens, but at least two markings on each of the three possible locations on viii of every specimen.

Internal anatomy.—Septum 8/9 is represented by a ventral rudiment in each specimen.

The single commissure of ix is on the left side in 6 specimens, on the right side in 10 specimens. The last pair of hearts is in xiii.

There is a pair of testis sacs on the anterior face of 10/11. In some specimens there is quite evidently a transverse communication between these two sacs. In other specimens no transverse communication was found. There is a single, median testis sac in xi. The seminal vesicles cover over the dorsal blood vessel in both xi and xii. The prostates extend through xvii—xix. The prostatic ducts are short and slender. Into the coelom of xviii there projects conspicuously a pair of copulatory chambers, each chamber bent over so that the apex points towards the nerve cord. The prostatic duct which is $1\frac{1}{4}$—$3\frac{1}{2}$ mm. in length passes straight from the margin of the prostate towards the nerve cord till it reaches the apex of the chamber into which it appears to pass directly after a slight bend. There is however visible at the apex a smaller area with a peculiar appearance. If a thin layer of connective tissue is dissected off from this spot there becomes visible a short and slenderer continuation of the prostatic duct bent into the form of a tiny u. The prostatic duct is continuous with a penis which fills the cavity of the copulatory chamber. The penis may reach a length of just over 3 mm ; it is slightly thicker at the base than at the end which bears the tiny, slit-like male pore. Around the base of the penis is a thickish ring of tissue. The penis has a segmented appearance due to the presence of a number of rather regularly placed, slight constrictions. The penis is in reality a double tube as can easily be demonstrated on most specimens by slowly but firmly pulling the prostatic duct out from the wall of the copulatory chamber. As this is done the two tubes are separated from each other, and as the continuation of the prostatic duct is withdrawn the outer tube surrounding it is turned outside in, much as when in withdrawing a finger from a tightly fitting glove the finger of the glove is turned outside in. The outer tube, cleared and examined under the microscope appears to have annular ridges or thickenings of its otherwise thin wall. That this inverted tube is really the outer layer of the penis can be readily shown by pulling the tube so that the outside comes out again.

On each side there projects into the coelom of xix a chamber, bent towards the nerve cord which at first glance appears to be exactly the same as the copulatory chamber of xviii. More careful examination shows, however, that at the apex of this chamber there is an ovoid mass of tissue quite unlike anything present on the chamber of xviii. After dissecting off the connective tissue that covers over this mass it is seen to be composed of a number of whitish columns or threads bent back on themselves. These columns are much like the stalks of glands sometimes present in this region in other species. In none of the dissected specimens is there any glandular tissue at the ental ends of these threads which end abruptly. The threads pass through the wall of the chamber at the apex and can be traced nearly to the end of a papilla. The chambers of xix are hollow like the copulatory chambers and from their roofs there project into the cavities of the chambers columnar papillae, one in each chamber. The length of this column may reach to just over 1 mm. At the end of the column there is a greyish concavity and a marginal, rather triangular flap, that reminds one of the structure at the end of the trunk of an elephant.

The oviduct funnels are present but no normal earthworm ova have been found. In place of the ovary there is on each side a whitish mass composed of cysts and protozoan parasites. The mass reaches dorsally on each side into contact with the dorsal blood vessel.

The spermathecal duct is long, at least twice (usually more) the length of the ampulla. Just below the ampulla the duct widens slightly and bears on its anterior face a sort of conical projection into which the diverticulum passes. Below this junction the duct is slightly narrowed and may also narrow further before reaching the parietes but without constriction or narrowing within the parietes. The diverticulum is small and consists of a short, fine stalk and an ovoid transparent chamber which may be half as large as the ampulla, the length of the stalk and the chamber usually slightly greater than the length of the ampulla. The stalk portion is bent into a sort of zigzag looping, in some cases the looping regular and the limbs of the loops approximated.

The presetal genital markings indicate the presence of coelomic stalked glands, each stalk composite, composed of several whitish threads. At the ental end of the stalk there is a rounded mass of whitish tissue. The postsetal genital markings indicate the presence of somewhat similar bodies, each of which however projects into the coelom but slightly as a sort of column, the column composed of threads, the number of threads in the column larger than in the stalk of the gland to the presetal marking. No glandular tissue was found at the end of the column, the threads ending abruptly.

Remarks.—None of the specimens for which this species was erected were mature.

Segment x is always at least a trifle longer antero-posteriorly than its neighbouring segments, and often is quite conspicuously longer. The setae of x do not appear to be more closely crowded together than on other segments, in some specimens there are wide gaps in the setal circle of this segment.

Only two of this years specimens have setae on the three clitellar segments, one specimen has two ventral setae on xvi.

One spermatheca was found with two ampullae.

There are cysts on the coelomic face of the body wall in the region of segments ix and x in 12 out of 16 specimens. These cysts are opaque and break with a distinct crackling noise when pressed slightly.

Just anterior to the hearts of x may be found a pair of vascular commissures connecting the supra-oesophageals and the ventro-laterals. These commissures are thin walled but when distended with blood as in some specimens might easily be mistaken for a pair of hearts.

There are large, flattened, oval discs in the region of xiv—xix in most of the worms. The discs are composed of nematode eggs. Nemas have been found in most specimens in which they were looked for, usually under the pharynx.

As indicated in the synonymy, there is some question as to the status of *P. gemella*. It may be identical with or a variety of *P. bipora*. This cannot be determined without examinations of Beddard's specimens. The Burmese forms may be distinguished from the worms of the Malay Peninsula by the following characteristics :—

1. The preclitellar genital markings are circular in outline rather than elliptical and more posteriorly located, *i.e.*, nearer to the intersegmental furrow than to the setae.
2. Constant presence of postsetal genital markings on viii rather than vii.
3. Presence on almost all of the specimens of a row of smaller genital markings, presetal in position. (These are small and may have been overlooked by Beddard, but their presence should have been indicated by the stalked glands projecting conspicuously into the coelom which Beddard does not mention).
4. The last pair of hearts is in xiii instead of xii.
5. The prostatic duct is always straight, excepting of course the slight bend and the tiny u-loop concealed under connective tissue. The duct is never " curved on itself in the usual horseshoe shape "
6. The columnar body projecting into the chamber of xix is quite different in appearance and internal organisation from the penis in the copulatory chamber of xviii. Beddard says that, " A penis-like process depends from the dorsal wall of the sac into the interior ; I cannot distinguish this structure from the penis of segment xviii, save for the fact that it has no lumen ".
7. The spermathecal duct is always much longer than the ampulla whereas in *P. bipora* the " duct is quite as long as the pouch." (A footnote to this adds however, " This is not always apparent ". The spermathecal diverticulum is always small, almost minute, but in *P. bipora* it is longer than the spermatheca).
8. There are no seminal vesicles in x. In *P. bipora* " The sperm sacs are large and racemose, meeting in the middle line above, there are three pairs, lying in segments x, xi and xii.

Variety **quadripora**, var. nov.

Southern Mergui, W. D. Sutton, 38 specimens.

External characteristics.—The length varies up to 94 mm., the greatest diameter up to 4 mm. Segment x is longer anteroposteriorly than any other segment in most of the specimens ; in other specimens ix and x are of the same length and longer than all other segments. The number of segments :—95, 93, 94, 90, 96, 96, 94, 95, 93, 94. The pigmentation is lighter than in the preceding variety—the colour of the dorsum anterior to the clitellum, brownish red ; posterior to the clitellum, light greyish brown.

As in *typica* there is a slight midventral break in the setal circles from xvii posteriorly for a short distance. The setal numbers are shown below.

vi.	vii.	viii.	xvii.	xviii.	xix.*	xx.*
23	25	26	14	9	11	12
23	23	24	13	8	9	10
24	27	24	14	10	10	9
24	25	27	13	10	9	10
22	26	24	13	10	9	9
19	21	26	14	8	10	9
24	25	24	12	9	10	12
23	26	25	13	10	10	10
19	23	24	13	10	9	9
25	26	26	14	8	10	9

* Number of setae between apertures of the pseudo-copulatory chambers.

The first dorsal pore is in 11/12 in 37 specimens, in 12/13 but with a non-functional pore-like marking in 11/12 in 1 specimen. The first pore is smaller than the second pore.

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

The apertures of the copulatory and pseudo-copulatory chambers on xviii and xix are as in *typica*. There is an additional pair of apertures on segment xx in 26 specimens ; there is a single aperture on xx on the left side in 4 specimens, on the right side in 5 specimens ; there is an aperture on xxi on the right side but the right aperture of xix is lacking in two worms. Another worm has spiral-metameric abnormalities in the region of the segments just behind the clitellum. The pseudocopulatory chambers of xix and xx may be everted as thickly columnar whitish projections, each with a concave greyish disc on the end. The copulatory chambers may be partially everted. In one worm a copulatory chamber is completely everted, the penis projecting from the ventral end of a whitish porophore similar to those on xix and xx.

The preclitellar genital markings are in more or less regular longitudinal rows ; presetal and postsetal on vii, and viii, presetal on ix. The markings are similar to those located near the spermathecal pores in *typica* and like them are slightly nearer to the intersegmental furrows than to the setae but are less distinct, not so sharply protuberant from the parietes and are situated 5—8 intersetal distances median to the spermathecal pore lines.

Internal anatomy.—The intestine begins in xv. The intestinal caeca are simple, extending from xxvii forward into xxiii—xxii, sometimes constricted by the septa through which they pass, sometimes with additional, marginal, dorsal incisions in xxv—xxvi.

The last pair of hearts is in xiii. The single commissure of ix is on the left side in 3 specimens, on the right side in 7 specimens.

There is a single, median testis sac belonging to x in some worms, in other specimens there are paired testis sacs with transverse communications. There is a single, median testis sac in xi. The seminal vesicles of xi are included within dorsal prolongations of the testis sac. In several cases it has been possible to dissect off a layer of loose testicular material from around the seminal vesicle. In other specimens there seems to be little testicular material except that in the testis sac below the seminal vesicle. The seminal vesicles of xii are flattened, leaf-like bodies. The prostates extend through xvii—xviii or slightly into xix. The prostatic duct is 2—3½ mm. long, quite noticeably thicker than in *typica* and of about the same shape, except that here there is very little trace of the tiny u-shaped loop. The copulatory chambers are like those of *typica* but the penis is shorter, about 1—2 mm. in length and more tapering. The pseudocopulatory chambers in xix and xx are similar to those of xix in *typica* but are smaller and less protuberant into the coelom. From the apex of each chamber there rises a thick bundle of whitish threads or stalks which pass laterally across the top of the chamber into a thicker, whitish, glandular mass. These glandular masses are fairly large and conspicuous structures. On the ceiling of each pseudocopulatory chamber there is a round, greyish genital marking with a central concavity, the marking not at the end of a columnar protuberance.

The ovaries are small, apparently normal structures in the usual positions on the posterior face of 12/13. No parasites were found in these ovaries. The spermathecae are similar to those of *typica* but the duct is a trifle narrower, the diverticulum a trifle smaller and the ampulla is more cylindrical.

The glands associated with the preclitellar genital markings are conspicuous, ovoid or spherical masses of whitish tissue lifted into the coelom by long stalks, each stalk composed of several whitish columns. The glands are in longitudinal rows between the two rows of spermathecae.

Remarks.—There are cysts on the coelomic face of the body wall in segment x in 9 specimens. There are masses of coelomic protozoa.

One specimen has an extra spermatheca in v on the right side, opening to the exterior in 4/5 in line with the spermathecal pores of that side.

Pheretima heterochaeta (Mich.) 1891.

In the preceding paper of this series an account was given of an attempt to determine the extent of variation of some of the specific characteristics of this worm. There is but little to add to that account at present.

The male and the spermathecal pores are minute.

To the dorsal lobe of the seminal vesicle the term primary ampulla has been applied in this paper. The stalked bodies on xiii and xiv of the previous paper are referred to in this paper as pseudovesicles.

The prostatic duct is 2—3 mm., in length, the ectal half thicker than the ental half.

The spermathecal diverticulum passes into the anterior face of the spermathecal duct.

Pheretima longicauliculata Gates.

1931. *Pheretima longicauliculata*, Gates, *Rec. Ind. Mus.* XXXIII, p. 395, figs. 30—32.

" Wet earth near paddy flats," Mong Mong Valley, August, H. Young 8 specimens.
" Manure," Mong Mong Valley, August, H. Young, 8 specimens.
Mong Mong Village, August, H. Young, 33 specimens.
" Grove of trees," Mong Mong Valley, August, H. Young, 8 specimens.
Kengtung town, September, R. S. Buker, 34 specimens.

External characteristics.—The first functional dorsal pore is in 12/13 in every one of these specimens. In addition there is on each of two worms, a somewhat pore-like, dark, depression on the anterior margin of xii close to 11/12.

The clitellum extends anterior to the region of intersegmental furrow 13/14 on all except four of the clitellate specimens, and may reach to just behind the setae of xiii. The dorsal pore of 13/14 is functional only on the four specimens in which the clitellum ends anteriorly with 13/14, it may not even be indicated on some of the specimens. Posteriorly the clitellum terminates with 16/17 except on three specimens on which it passes slightly onto xvii, in which case there is no functional dorsal pore in 16/17, otherwise that pore is functional.

The lateral margins of the genital markings do not quite reach or just reach to the male pore lines. The midventral space between two genital markings is equal to 18—24 intersetal intervals. The markings are 5—7 intersetal distances wide transversely. The genital markings are located as follows :—

Right	17/18—20/21	1 specimen.
	18/19—20/21	24 specimens.
Left	18/19—20/21	3 specimens.
Right	18/19—20/21	2 specimens.
	18/19—right 21/22	4 specimens.
	18/19—21/22	1 specimen.
Right	18/19—left 21/22	3 specimens.
Left	18/19—right 21/22	4 specimens.
Left	18/19—left 22/23	2 specimens.
Right	18/19—left 21/22, left 22/23	1 specimen.
	18/19—left 22/23	2 specimens.
	18/19—right 22/23	1 specimen.
Right	18/19, right 19/20—right 23/24	1 specimen.
	19/20—left 21/22	1 specimen.
	19/20—20/21	14 specimens.
	19/20—right 21/22	1 specimen.
	19/20—left 21/22	1 specimen.
	19/20—right 22/23	1 specimen.
	18/19—left 19/20, left 20/21	1 specimen.
	18/19—left 21/22, left 22/23	1 specimen.
	18/19, left 20/21, right 22/23—23/24	1 specimen.
Right	18/19—right 21/22	1 specimen.
	18/19—right 20/21, left 21/22	1 specimen.
	18/19—right 21/22, right 22/23	1 specimen.
Right	18/19—right 21/22, right 23/24	1 specimen.
Left	18/19—right 21/22, right 22/23	1 specimen.
Right	19/20—left 21/22	1 specimen.

Internal anatomy.—(66 specimens opened).

The intestine begins in xv in all of the specimens. The intestinal caeca arise in xxvii in all of the specimens.

There is a single vascular commissure belonging to ix in 63 specimens, on the left side in 27, on the right side in 36 ; a pair of commissures in 3 specimens. Each of the first six specimens to be opened has genital markings on 19/20—20/21 only and in all of these worms the commissure of ix is on the left side. The location of the commissure of ix was correlated with the genital markings with the following results :—

	1.	2.	3.	4.
Left .	8	3	8	8
Right .	19	2	4	11
Both . . .	1	..	..	2

1. Three pairs of genital markings on 18/19—20/21.
2. As in one save that one of the markings is lacking.
3. Two pairs of genital markings on 19/20—20/21.
4. With genital markings posterior to 20/21.

There are two, single, median testis sacs ; the sac of x large with conspicuously bilobed anterior margin. In the least mature specimens each seminal vesicle of xi and xii is composed of (1) a flattened, leaf-like portion with a bluntly rounded ventral margin and a cleft dorsal margin and (2) a well developed, cone-like primary ampulla in the dorsal cleft. In some specimens the ampulla is contained within a thin, transparent, connective tissue sac. The ventral portion of the vesicle can be pulled off from the septum to which it is attached leaving the primary ampulla and a vertical cord of tissue on the posterior face of the septum. In slightly more mature specimens there is a vertical groove on the posterior face of the leaf-like portion of vesicle, marking it off into two approximately equal halves. In still more mature specimens the median half of the ventral portion of each vesicle of xii has grown much more rapidly than the lateral half and now extends posteriorly along the side of the oesophagus. In these same worms the two halves of the vesicles of xi have grown but the median and lateral halves are still of about equal size. The dorsal margin has however grown dorsally in such a way as to cover over the primary ampulla which is still readily recognizable as a distinct lobe if the vesicle is pushed back from the oesophagus. In slightly older specimens the primary ampullae of the vesicles of xii are also concealed as a result of the growth of the dorsal margins. In the two oldest specimens the primary ampullae were not recognized. In these two worms the dorsal blood vessel is concealed from view by the seminal vesicles as far back as 17/18. The prostates are small and confined to xviii in all of the specimens. The prostatic duct is 6—8 mm. in length, bent into a hairpin loop, the ectal limb of the loop shorter and thicker than the ental limb, the loop so placed on the floor of xviii that the closed end is towards the nerve cord with the ental limb posterior to the ectal limb.

In the youngest specimens the spermathecal diverticulum is a slender, transparent, straight tube alongside the ampulla. In older specimens the diverticulum is still straight but longer. In still older specimens the diverticulum is longer still but the ental portion is looped, the loops

usually in one plane in a regular zigzag arrangement. In still older specimens the loops of the diverticula are not closely bound to each other. In the oldest specimens there are several widened regions in the ental portion of the diverticulum. The diverticulum of each spermatheca passes into the anterior face of the duct which is sharply narrowed in the parietes.

Remarks.—Attention is called to the fact that in this as in other species of the genus the anlage of the genital markings become visible externally long before the worm is fully grown. It is also noteworthy that the development of the clitellar glandularity may be completed before some of the internal reproductive organs have attained full development.

Seven of the 16 Kengtung specimens have numbers of reddish bodies of parasitic origin on the gizzard and the blood vessels in the combined gizzard segments. These parasitic masses are lacking in fifty of the specimens of the Young Collection. But in each of the latter worms there are large numbers of parasites and parasitic bodies loose in the coelomic cavities of vii—xxv. No nematodes were found in this species.

In one of the Young specimens there is a tubular outgrowth from the intestine in segment xx that passes straight through the coelom to the body wall which is penetrated, the blind end of the tube exposed to the exterior through an aperture in the epidermis with a smooth margin.

Pheretima manicata Gates.

1931. *Pheretima suctoria manicata*, Gates, *Rec. Ind. Mus.* XXXIII, p. 414, figs. 41—42.

Variety **typica.**

Moulmein, October, K. John, 3 specimens.
Thaton, October, K. John, 1 specimen.

In addition to the specimens collected this year, the original specimens have been examined.

External characteristics.—There is a complete circle of setae on segment ii. Setae are always present on xvi, at least ventrally, occasionally, laterally and dorsally. The spermathecal setae on vi are 24—30 ; on vii, 24—32 ; on viii, 25—32. The male setae on xvii are 24—29 ; on xviii, 6—9 ; on xix, 25—30. There are 64—68 setae on segment xx of 9 worms, on the tenth worm there are 72 setae.

The first dorsal pore is in 11/12 in 2 specimens ; in 12/13 but with a pore-like marking in 11/12 in 4 specimens ; in 12/13 in 48 specimens ; in 13/14 in 1 specimen.

The clitellar glandularity ends posteriorly with the setae of xvi.

The male pores are slightly nearer to the lateral margins of the male pore discs than to the median margins. The discs are about 2 intersetal distances wide transversely. The space between a male pore disc and a genital marking is about equal to 2—3 intersetal intervals. The genital markings are 6—8 intersetal distances wide transversely ; the antero-posterior length of the marking always quite definitely greater than the width.

Internal anatomy.—(10 specimens opened).

Septum 8/9 is present as a ventral rudiment only; 9/10 is lacking; 10/11 is present but is membranous; 11/12 is membranous but is a trifle stronger than 10/11.

In some of the specimens the intestine begins in xv, in others in xvi. The lateral, dorsoventral protuberance from the intestine in the anterior portion of xxviii may be simple, or with slight lateral lobulations, or there may be distinctly developed finger-shaped pouches thereon.

The single vascular commissure of ix is on the left side in 3 specimens on the right side in 7 specimens.

There is always a single, median testis sac in xi. On the anterior face of 10/11 there may be a single, median sac or a pair of sacs in communication transversely, or a pair of sacs in apposition but without communication, or a pair of sacs without connection or communication. The seminal vesicles of xii are confined to that segment but dislocate posteriorly septa 12/13 and 13/14. The prostatic duct is slender but the ectal portion is slightly thicker than the ental portion.

The spermathecal diverticulum passes into the anterior face of the spermathecal duct.

Remarks.—Five worms were found to have spiral abnormalities, the abnormalities anterior to the clitellum in 2 specimens.

P. manicata is more like certain forms from the region of the Sino-Burmese boundary than the Andaman Island species in which it was previously included. The Burmese forms are therefore all treated as varieties of a species distinct from *P. suctoria.*

Variety **decorosa.** var. nov.

"In wet leaves in ravine," Teung Cong, October, H. Young, 1 specimen.

External characteristics.—Length 40 mm. Greatest diameter 2½ mm. Number of segments 60. The dorsum is bluish red anterior to the clitellum, reddish to very light brownish posterior to the clitellum.

The setae begin on ii, on which segment there is a complete circle of setae. There are no middorsal or midventral breaks in the setal circles. The setal numbers are:—spermathecal on vi, about 28; male on xvii, 20; on xviii, 1; on xix, 19; number of setae on xx, 47. There are 17 setae on xvi.

There are pore-like markings from 7/8 posteriorly.

The clitellar segments are a deeper red than other segments but intersegmental furrows and dorsal pores are present; setae are present ventrally only.

There is a single female pore on xiv.

The male pores are minute, on widely separated, circular discs, each disc about 1 intersetal distance wide.

There is a pair of genital markings on xviii, on the posterior half of the segment as indicated by their position behind the single male seta of the segment, but taking up a considerable portion of the antero-posterior length of the segment. Each marking is transversely elongate, with rounded ends, a raised rim and a concave central portion. The markings are about 8 intersetal distances wide transversely, almost reaching to the midventral line and laterally coming into contact with the male pore discs.

The markings are larger relative to the size of the worm than the markings of variety *supina*.

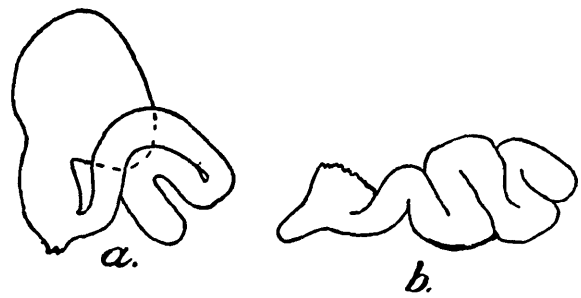
Internal anatomy.—Septa 8/9—9/10 are lacking, 10/11 is very thin.

The intestine begins in xv but is narrower through segments xv—xix than in xx and succeeding segments. The intestinal caeca are compound, each caecum consisting of 6—8 long, finger-like secondary caeca directed anteriorly into xxii or xxiii.

The single commissure of ix is on the left side. The last pair of hearts is in xiii. No hearts belonging to x were found. The hearts of ix, xi—xiii all pass into the ventral vessel.

There are masses of nephridia in v and vi.

There are two pairs of testis sacs but there appear to be transverse communications between the sacs of a segment. The seminal vesicles cover over the dorsal blood vessel in xi and xii. The prostates extend through xvii—xix. The prostatic duct is bent into a hairpin loop, the ectal limb thicker than the ental limb; the length of the duct about $1\frac{1}{2}$ mm.



TEXT-FIG. 31. *a. Pheretima manicata decorosa.* Spermatheca × ca. 26. *b. Pheretima manicata decorosa.* Spermathecal diverticulum × ca. 26.

The spermathecal duct is slender and of about the same length as the ampulla. The diverticula of the first four spermathecae are looped into regular zigzags. The diverticula of the spermathecae of viii and ix are not looped in a regular zigzag fashion. The diverticulum passes into the anterior face of the duct which is constricted within the parietes.

There are glandular masses projecting into the coelom from the parietes over the genital markings on xviii.

Remarks.—A number of nematodes were found in the coelomic cavities.

No spermathecal pores were actually seen, either before or after dissection. There are four pairs of spermathecae in vi—ix with ducts passing into the parietes anteriorly so that the pores should be in or near intersegmental furrows 5/6—8/9. The two anteriormost spermathecae were pulled carefully out of the parietes. The holes thus produced are on the intersegmental furrow 5/6. Presumably the other spermathecal pores are similarly situated in the intersegmental furrows.

Variety **supina**, var. nov.

"Manure" Nam Hpen Noi, August, H. Young, 1 clitellate specimen.

External characteristics.—Length 55 mm., incomplete posteriorly. Greatest diameter 4 mm. Colour of dorsum, reddish brown to bluish grey.

The setae begin on ii on which segment there is a complete circle of setae. There are no definite mid-dorsal or midventral breaks in the setal circles, except for a large ventral break in the setal circle of xix. The setae are small and closely crowded. The setal numbers are :—spermathecal on vi, 28 ; on vii, 29 ; on viii, 28 ; male on xviii, 26, on xix, 0. There are about 68 setae on segment xx.

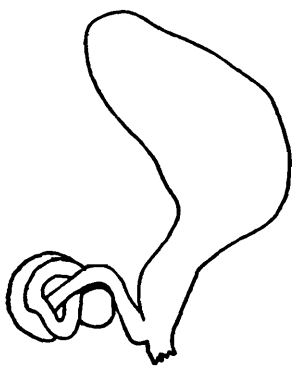
The first dorsal pore is in 12/13.

The clitellum is annular, extending from 13/14 to 16/17 ; intersegmental furrows, dorsal pores lacking. There are 20 setae ventrally on xvi.

The spermathecal pores are minute, four pairs in 5/6—8/9.

There is a single female pore on xiv.

The male pores are minute, on xix, each pore on a small, elongately oval disc which is slightly concave and about 1—1½ intersetal distances wide transversely. The male pore is slightly nearer to the lateral margin of the disc than to the median margin.



TEXT-FIG. 32. *Pheretima manicata supina.* Spermatheca × ca. 11.

The genital markings are a pair of transversely oval areas, apparently on the posterior portion of xix, intersegmental furrow 19/20 lacking ventrally. The genital markings are wider transversely than they are long anteroposteriorly, each marking about 6—7 intersetal intervals wide, separated from the male pore disc by a distance about equal to the diameter of the male pore disc and from the other marking by a space just over 1 mm. in width.

Internal anatomy.—No septa are especially thickened ; 8/9 is a ventral rudiment only ; 9/10 is lacking, 10/11 is either lacking or not normally attached to the parietes.

The intestine begins in xv. The intestinal caeca are compound, each caecum subdivided into about 9 finger-shaped lobes directed dorsally or anteriorly. There is a whitened, vertical, slightly lobed ridge on the intestine in each side in the anterior portion of the segment immediately behind the first caecal segment.

There are small masses of nephridia in v and vi.

There is a pair of commissures belonging to ix. The last pair of hearts is in xiii. The commissures of x are smaller than the hearts of xi—xiii. All the vascular commissures of ix—xiii pass into the ventral trunk.

There is a pair of testis sacs belonging to x which are widely separated from each other and apparently without transverse communication, each sac buried within a seminal vesicle. There is a single median testis sac in xi. The seminal vesicles are large, covering over the dorsal blood

vessel. The anterior vesicles extend forward nearly to the anterior end of the gizzard; the posterior vesicles extend through xii-xiv. The prostatic duct is about 3½ mm. long, slender throughout but with the ectal portion slightly thicker than the ental portion. A glandular mass projects conspicuously into the coelom in segments xix and xx on each side of the body. This gland appears to be similar in structure to the gland of variety *typica*.

The spermathecal diverticulum passes into the anterior face of the duct which is shorter than the ampulla. The diverticulum is curled into a mass of loops that is roughly spherical.

Remarks.—The position of the male pores on segment xix may of course be an individual abnormality.

Pheretima nemoralis, sp. nov.

Northern Tavoy district, October, W. D. Sutton, 2 specimens.

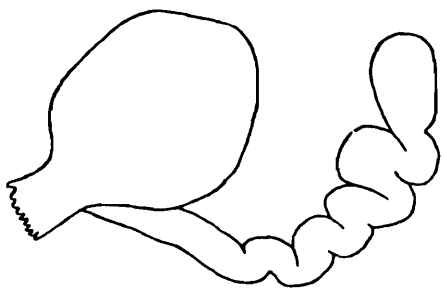
External characteristics.—(Statements in parentheses refer to the cotype specimen.)

Length 197 (134) mm. Greatest diameter 9 mm. Number of segments 131 (incomplete posteriorly). Colour of dorsum reddish brown to greyish brown; of clitellum, greyish.

The setae are small, retracted deeply into the parietes, apparently small and closely crowded. The setae begin on ii. There is a slight midventral break in the setal circles for some distance behind the clitellum but posteriorly this is lacking; there is a wider mid-dorsal break on the same segments which is also lacking posteriorly. The setal numbers are:—Spermathecal on vi, 23 (20); on vii, 25 (22); on viii, 27 (26); male on xvii, 18 (21); on xviii, 14 (14); on xix (20).

The first dorsal pore is in 16/17; there are no porelike markings anterior to this position.

The clitellum is annular, covering segments xiv—xvi and probably extending slightly onto xiii and xvii; 13/14 and 16/17 not visible. There are no setae, dorsal pores on intersegmental furrows.



TEXT-FIG. 33. *Pheretima nemoralis.* Spermatheca × ca. 27.

The spermathecal pores are minute, on tiny tubercles in intersegmental furrows 5/6—8/9.

There is a single female pore on xiv.

The male pores are minute, each pore at the centre of a transversely oval (or round) disc in the setal circle of xviii.

The genital markings are paired on 20/21 and separated from each other midventrally by a space about equal to five intersetal intervals,

counting the midventral break as one interval. Each marking is elongately oval, extending anteroposteriorly into the setal circles of xx and xxi, the former positions of the setae indicate by minute, empty pits in the epidermis. Each marking is slightly protuberant and consists of a darker central portion and a lighter peripheral portion but without a distinct boundary between the two portions. (In the cotype specimen the setal circles of xx and xxi are pushed anteriorly or posteriorly by the genital markings.) The lateral margin of the marking is about in line with the inner margin of the male pore disc.

Internal anatomy.—The septa are all membranous though 5/6—7/8 and 10/11—12/13 are quite evidently stronger than the other septa; 8/9 is lacking; the hearts of x are bound against 10/11 by a sheet of transparent tissue that is continued ventrally over the testis sac of x in such a way that it can be dissected off from that sac without opening it—this sheet may represent a modified septum 9/10.

The intestine begins in xv. The intestinal caeca are simple.

There are masses of nephridia in v and vi and blood glands in v.

The last pair of hearts is in xiii. (All the vascular commissures of ix—xiii pass into the ventral blood vessel.)

(There is a single, median testis sac with a bilobed anterior margin in each of segments x and xi.) The seminal vesicles of xi and xii are in contact transversely over the dorsal blood vessel. (The vesicles of xii push 12/13 and 13/14 back into contact with 14/15 while the vesicles of xi push 10/11 forward at the sides of the gizzard.) The prostates are compact and extend through xvii—xviii (xvi—xix), each prostate in two distinct portions. The prostatic duct is about 10 mm. in length and is bent into a loop the ectal portion of which is quite noticeably thicker than the ental portion.

The spermathecal duct is shorter than the ampulla; the diverticulum longer than the combined lengths of duct and ampulla. The diverticulum is looped, the entalmost loops are more definitely zigzag than the ectal loops; the diverticulum passes into the anterior face of the spermathecal duct.

(There is a layer of columnar material in the longitudinal muscles but there is no projection into the coelom over the genital markings.)

III.

Spermathecal pores anteriorly on vi—ix.

Pheretima choprai Steph.

1929. *Pheretima andersoni choprai*, Stephenson, *Rec. Ind. Mus.* XXXI, p. 233, fig. 5.

Material examined: one tube containing the type specimen and an undissected cotype specimen from the Indian Museum.

External characteristics.—(Statements in parentheses refer to the cotype specimen.)

There was some difficulty in determining the number of the setae in various locations with the low power objective of the binocular that is

ordinarily used. The reason for the difficulty became evident when a higher objective and much brighter artificial illumination were employed. There are in the setal circles very fine, dark specks or dots which may be either the tips of unusually fine setae or something quite different, probably the latter. With the low power some of these specks were mistaken for setae. The tips of the ordinary setae are larger and appear much blacker with artificial light. The setal determinations do not therefore agree with those given by Stephenson. The setal numbers are :—Spermathecal on vi, 14 (20); on vii, 27 (18); on viii, 24 (22); male on xvii 10 (20); on xviii, 10 (8); on xix, 19 (22); there are 73 (68) setae on segment xx.

The clitellum is annular, extending from 16/17 to anterior to 13/14; the dorsal pore belonging to 13/14 functional but quite evidently within the clitellar glandularity.

The spermathecal pores are located anteriorly on vi—ix almost in contact with the intersegmental furrows; the pores small but larger than in *P. andersoni* and slightly elongated in a transverse direction. Immediately anterior to the spermathecal pore the epidermis across the intersegmental furrow and on the posterior margin of the segment in front is raised into a small, whitish, transversely oval, slightly protuberant tubercle.

In the setal circles of xviii are small, rounded discs somewhat like the male-pore discs of *P. andersoni* save that at the centre of each disc is a slight concavity within which is a tiny, short, whitish tubercle which bears the minute, transversely slit-like male pore.

The genital markings are located as described by Stephenson except that the anteriormost median marking of the type specimen is located on 17/18 rather than 18/19. The markings are circular or almost circular rather than bluntly oval or transversely elongated as in *P. andersoni.* Each marking is about 5 intersetal distances wide transversely; the median markings do not reach laterally to a point in line with the inner margins of the male pore discs in the cotype specimen but in the type specimen they reach to or very slightly beyond this point. The paired markings may or may not reach to a point in line with the male pores.

Internal anatomy.—The glandular collar is smaller and less protuberant from the oesophagus than in *P. andersoni.* The commissures of ix—xiii all pass into the ventral blood vessel.

Each seminal vesicle is a flattened, leaf-like body with a primary ampulla which is sunk into the main portion of the vesicle and can be seen only from the anterior or septal face of the vesicle. Septa 10/11 and 12/13 are not displaced by the vesicles. The prostates extend through segments xv or xvi to xviii, xix or xxi. The prostatic duct is about 8 mm. in length bent into a sort of hairpin loop with the limbs of the loop in contact. The duct extends through segments xviii, xix and xx on the floor of the segments; the portions in xviii bent at right angles to the posterior portion of the loops and passing medially towards the nerve cord.

The spermathecal duct is slender and is not definitely marked off from the longer ampulla. The diverticulum of each spermatheca passes into the anterior face of the duct as in *P. andersoni,* and is more or less

looped, the loops may or may not all be in one plane in a regular zigzag arrangement.

Remarks.—It was hoped that the collections made in and near Myitkyina by Mr. Dudrow would contain some specimens of this form as there are some points on which more information is needed. *P. choprai* is not so very different from *P. andersoni* but the differences pointed out above seem to be significant enough to warrant the separation of this form from *P. andersoni* as a distinct species. It should also be noted that the latter species has only been found in a region extending south from Thaton into southern Mergui and that this area is quite some distance from the Myitkyina district where *P. choprai* was collected. In addition, two characteristics emphasized by Stephenson (1929) are still significant, *i.e.*, the smaller size of, and the presence of paired genital markings on 21/22 of *P. choprai.*

Pheretima rimosa Gates.

Variety **typica.**

1931. *Pheretima rimosa*, Gates, *Rec. Ind. Mus.* XXXIII, p. 408, figs. 37—38.

"Village manure heap", To Noi, September, H. Young, 4 clitellate specimens.

"Wet soil, ravine", Bana, June, H. Young, 6 aclitellate specimens.

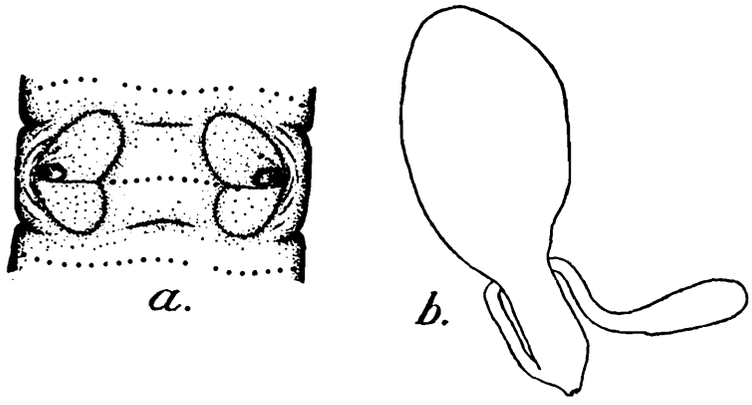
"Wet leaves", Ang Lawng Mt., September, H. Young, 1 aclitellate specimen.

"Wet soil under trees", Peng Sai, Mang Lun State, October, H. Young, 2 aclitellate specimens.

"Hard earth, pine grove", Bana, September, H. Young, 17 aclitellate specimens.

"Wet, shady ravine", Pang Wo, Mang Lun State, October, H. Young, 1 clitellate specimen.

External characteristics.—The greatest length of the Bana specimens is 77 mm., the greatest diameter 3 mm.



TEXT-FIG. 34. *a. Pheretima rimosa typica.* Ventral view of segment xviii. *b. Pheretima rimosa.* Spermatheca × ca. 11. (K. 1).

On segments ii and iii the setae are present only ventrally or ventrally and ventrolaterally. At least on these two segments the setae are nearly straight with outer ends ornamented with short or rarely broken transverse rows of fine teeth. On segments iv—xiii the setal circles may or may not be widely interrupted in the mid-dorsal region or there may be one or more gaps in the setal circles dorsolaterally. The setal circles

of xvii and xix are uninterrupted. The setal numbers and the locations of the first dorsal pore are given in the table below.

ii.	iii.	vi.	vii.	viii.	xvii.	xviii.	xix.	xx.	First dorsal pore.	Locality.
..	..	13	15	15	16	9	17	..	11/12	To Noi.
..	..	14	15	15	17	10	17	..	11/12	
..	..	13	14	13	14	10	16	..	??13/14	
..	..	17	16	18	16	10	19	..	11/12	
3	9	10	11	14	14	10	15	47	11/12	Bana.*
4	8	18	16	18	19	11	19	56	13/14	*
4	8	18	16	18	19	11	19	56	13/14	*
1	8	15	16	17	16	10	17	48	?11/12	*
3	6	13	14	15	15	9	15	..	11/12	*
2	11	14	15	15	15	8	16	..	11/12	*
3	9	17	17	19	17	11	19	..	11/12	*
4	9	11	14	15	16	8	16	..	11/12	Ang Lawng *
2	12	17	16	17	16	7	18	..	11/12	Peng Sai.*
3	14	16	17	17	16	7	19	..	11/12	*
4	16	15	14	16	18	10	20	50	?12/13	Pang Wo.
4	9	11	11	13	..	..	..	47	11/12	Nam Hpen Noi.*
4	7	11	14	14	..	..	..	..	11/12	*
4	8	9	8	8	..	..	..	47	11/12	*
2	3	11	13	13	..	..	..	..	11/12	*
4	6	9	10	9	..	..	..	44	11/12	*
3	6	13	13	11	..	..	..	..	11/12	*
4	10	13	11	11	..	..	..	47	11/12	*
4	8	11	10	12	..	..	..	..	11/12	*
3	8	9	11	11	..	..	..	..	11/12	*
3	7	7	9	11	..	..	..	46	11/12	
3	5	15	14	14	..	..	..	..	11/12	
4	6	13	13	13	..	..	..	47	11/12	
2	7	13	13	11	..	..	..	..	11/12	
3	10	11	12	13	..	..	..	46	12/13	
4	8	10	9	8	..	..	..	..	11/12	
4	8	7	9	7	..	..	..	51	11/12	
4	6	10	12	14	..	..	..	..	11/12	
4	8	11	13	11	..	..	..	45	11/12	
4	8	11	12	12	..	..	..	..	11/12	
4	9	13	12	11	..	..	..	..	11/12	

ii and iii—Number of setae on segments ii and iii.
* Immature.

The Ang Lawng specimen has a slight development of clitellar glandularity on the clitellar segments on which there are setae but no dorsal pores or intersegmental furrows. The clitellar segments of the Peng Sai specimens are dark red but are otherwise unmodified. Intersegmental furrows are lacking in the clitellar region of the Pang Wo specimen but dorsal pores and setae are present.

Spermathecal pores are either present or their positions are indicated by dark spots in the parietes. The pores are always located anteriorly on vi—ix.

The genital markings of the To Noi specimens and of the Pang Wo specimen are like those of the second group of specimens described in the previous paper (Gates, 1931, p. 411). The markings of the first six specimens from Bana are elongate with rounded ends, extending the full length of xviii and slightly onto xvii and xix. The margins of these markings are not very distinctly delimited but there is a slight indentation of the median margin of each marking. The male pores are not visible on these specimens but the prostatic duct can be traced through the parietes into a tiny, conical protuberance on the genital marking towards the lateral margin in line with the setal circle. The genital markings of the Ang Lawng specimen are similar to those just described but are more sharply demarcated. The genital markings of the Peng Sai specimens are similar to those of the Ang Lawng worm. The genital markings of the second batch of Bana worms are elongately oval or circular, glandular protuberances of the epidermis, not sharply demarcated from the unmodified epidermis. The male pores are not visible but the prostatic duct can be traced through the parietes to a tiny, conical swelling located near the lateral margin of the marking.

Internal anatomy.—Septum 8/9 is always present.

The intestine begins in xv in all specimens.

The testis sacs of x and xi are unpaired and median.

There are well developed seminal vesicles covering over the dorsal blood vessel in xi and xii in each specimen. There is a small prostate on the left side, confined to xviii in one of the first lot of Bana specimens. In the second lot of Bana specimens there are small prostates, extending through xvii—xviii or xviii—xix. Otherwise prostates are lacking. The prostatic ducts are formed in all worms and are 2—4 mm. in length; each duct bent into a u-shape with the ectal limb slightly thicker than the ental limb.

Prostates are entirely lacking in the To Noi specimens but the prostatic ducts are well developed, 5—7 mm. in length. The ducts may be confined to xviii or may extend into xvii or xix. In these specimens the seminal vesicles of xi penetrate through 10/11, the portion of the vesicle in x larger than the portion in xi, between the two parts of the vesicle a deep marginal dorsal incision.

There is a single vascular commissure or pair of commissures belonging to ix as follows :—

Locality.	Left side.	Right side.	Both sides.
Bana	2	2	2
Ang Lawng	1	..	..
Peng Sai	..	2	..
Bana	5	12	..
To Noi	1	3	..

Remarks.—A brown disc was found in the region of segments xx—xxv in each of three worms; the disc containing brown granular material, setae, and pseudonavicellae spores.

Variety **effeminata**, var. nov.

"Manure," Nam Hpen Noi, August, H. Young, 26 aclitellate and 16 clitellate specimens.

External characteristics.—The length varies up to 97 mm., the greatest diameter up to 5 mm. All of the mature worms are either incomplete posteriorly or are provided with regenerated tail portions. One specimen in which the formation of new segments appears to have ceased has 93 segments of which 4 are regenerated. The colour of the dorsum, light reddish, sometimes tinged with brownish; clitellum, deep reddish.

The setae begin on ii but are present on that segment and on iii only ventrally or ventrally and ventrolaterally. Posterior to the clitellum there is no definite midventral break in the setal circles; a mid-dorsal break of varying width may be present in the setal circles of some of the postclitellar segments. On segments iv—vi there is usually either a very wide mid-dorsal break or several dorsolateral breaks. On vii—xiii there is usually a fairly wide mid-dorsal break.

The first dorsal pore is in 11/12 or 12/13; in the immature specimens—in 11/12 in 16 worms, in 12/13 in 4 worms, in 12/13 but with a pore-like marking in 11/12 in 6 worms; in the mature specimens—in 11/12 in 15 worms, in 12/13 in 1 worm.

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

The spermathecal pores are four pairs of minute, transverse slits on the anterior margins of vi—ix near the intersegmental furrows.

There is a single female pore on xiv.

There are no male pores.

There are no genital markings and the setal circles of xvii—xx are uninterrupted ventrally except on two specimens. On each of the two exceptional specimens there two pairs of slightly protuberant, poorly demarcated tumescences on xviii, one pair anterior to the setae, the other pair posterior to the setae. In the setal circle of xviii on each side, at the centre of the region between the two protuberances of a side there can be recognized on one specimen, with the higher powers of the binocular, a minute, dark spot almost like the aperture leading into an empty setal follicle. This spot may represent a vestige of a male pore. In each of these two worms there are gaps in the setal circle of xviii, 7 male setae between the gaps.

Internal anatomy.—(Opened 42 specimens.)

Septa 8/9 and 10/11 are present but are thin; 9/10 is lacking; 5/6—7/8 and 11/12—13/14 are strengthened and translucent.

The intestine begins in xv. The intestinal caeca are simple, extending forward from xxvii into xxiii—xxv.

The last pair of hearts is in xiii. There is a single commissure belonging to ix, on the left side in 25 specimens, on the right side in 17 specimens. All commissures of ix—xiii pass into the ventral blood vessel.

There is a single, median testis sac on the anterior face of 10/11 and a similar sac in xi; each contains a pair of male funnels and a pair of testes but no loose testicular material such as is usually found in testis sacs. The seminal vesicles are small vertical bodies in xi and xii which do not reach to the dorsal blood vessel. There are no prostates in any of the

specimens. As a rule the vasa deferentia are readily visible on the coelomic floor though small, and can usually be traced back to xvii or xviii where they pass as fine threads into the parietes. In the worm with vestigial male pores there are prostatic ducts, each duct about 2 mm. in length, bent into the form of a u, with the closed end toward the nerve cord and the anterior, ectal limb slightly thicker than the posterior ental limb. In the other specimen with rudimentary genital markings on xviii the vasa deferentia are slightly thickened as they pass into the parietes in xviii but the muscularity characteristic of a prostatic duct is lacking.

The spermathecae do not differ in any important detail from those of variety *typica*, the duct is straight, not bent. Curiously, even in the shortest and smallest specimens the spermathecae are well developed.

Remarks.—This variety stands in somewhat the same relationship to variety *typica* as does variety *insolita* to the typical form of *P. anomala*. The seminal vesicles in variety *effeminata* are reduced in size when compared with the vesicles of variety *typica* while the supposed female form of *P. anomala* has well-developed seminal vesicles which are lacking in the so-called male form.

Pheretima velata, Gates.

Variety **typica.**

1930. *Pheretima velata*, Gates, *Rec. Ind. Mus.* XXXII, p. 321, fig. 13.

Leiktho Circle, September, G. E. Blackwell, 3 aclitellate specimens.

The greatest diameter is 9—11 mm.

The setal numbers are as follows :—

vi.	vii.	viii.	xvii.*	xviii.	xix.
37	36	34	9	22	26
39	39	37	10	23	30
33	36	34	3	23	24

* Number of setae between the genital markings.

The male pore discs are about 3 intersetal distances wide transversely.

The genital markings extend anteroposteriorly to the levels of 16/17 and 17/18 although these furrows are not indicated ventrally. (In the original description 16/17 and 17/18 should be read for 17/18 and 18/19 in this connection.)

The postgizzard oesophageal collar is in two large lateral flaps.

The intestinal caeca have small ventral lobulations and dorsally are constricted by the septa through which they pass.

There is a pair of testis sacs belonging to x, apparently without transverse communication. There is a single median testis sac in xi. Each seminal vesicle of xi and xii has a dorsal primary ampulla of finger-shape somewhat like that of *P. osmastoni* but shorter. The prostatic duct is 5—7 mm. long, bent into a u-shape in xviii.

The spermathecal diverticulum is at the median side of the ampulla but passes into the anterior face of the duct. The diverticulum is enclosed within a sac which probably also encloses the duct and ampulla.

There is a very fine " fur " around the duct and ampulla which is easily scraped off and which seems to be continuous with the tissue of the sac enclosing the diverticulum.

The dome-shaped structure over the genital marking interrupts the muscular layers and reaches into the coelom to a height of 3—4 mm., and consists of a large mass of vertical columns of softish tissue surrounded by a very tough but thin and translucent membrane.

Variety **alveata,** var. nov.

Thaton, October, K. John, 10 specimens.

External characteristics.—Length up to 236 mm. The greatest diameter is 11 mm. Number of segments of one complete specimen, 134. Colour of the dorsum anterior to the clitellum, greyish blue ; posterior to the clitellum, reddish brown to brownish ; clitellum, greyish.

The setae begin on ii and are small and closely crowded. A mid-ventral break is lacking ; a mid-dorsal break of varying width is present on some of the postclitellar segments but is lacking further posteriorly. The setal numbers are indicated below.

vi.	vii.	viii.	xvii.	xviii.
45	39†	33†	44	36
40†	39†	37†	44	36
30†	31†	41	36	31
41†	41†	30†	47	40
..	..	..	48	37
44	44	47	49	35
..	..	..	43	32‡
39†	37†	35†	47	38
30†	31†	30†	47	33
40	44	39†	44	34

† Indicates that there are gaps of varying size at irregular intervals in the setal circles in which usually there can be seen empty (?) setal pits.

‡ This specimen has no spermathecal pore in 7/8 on the right side.

The male setae of xix are 42—47.

The first dorsal pore is in 12/13 in 9 specimens ; in the tenth worm there are non-functional pore-like markings in 12/13 and 13/14.

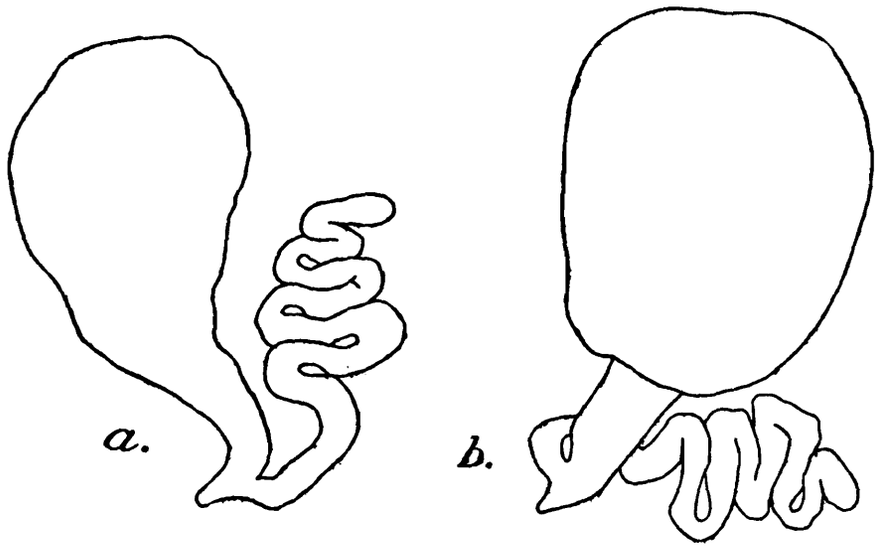
The clitellum is annular, extending (9 specimens) from 13/14 to 16/17 ; dorsal pores, intersegmental furrows and setae lacking. In one specimen the clitellum extends a trifle beyond 13/14 and 16/17.

The spermathecal pores are minute, apparently in 5/6—8/9 on nine worms but anteriorly on vi—ix on one specimen. Each pore is on a transversely oval or elongately oval tumescence of the parietes which includes both the anterior and posterior margins of the segments, so that the intersegmental furrow is lacking across the tumescence. The tumescences are lacking on the worm with segmentally located pores.

There is a single female pore on xiv.

The male pores are minute, each pore at the centre of a small, round or oval disc in the setal circle of xviii, the disc slightly retractile into the parietes and about 3—6 intersetal distances wide transversely.

Each worm has a single genital marking with a whitish margin and a central purplish area, 30—40 intersetal distances wide transversely, with ends bluntly rounded, protuberant or concave as in variety *clavata*.



Text-fig. 35. *Pheretima velata alveata*. Spermathecae × ca. 11.

The marking extends anteroposteriorly from the setae of xix, 19/20, the anterior portion of xx or from the posterior portion of xx to just in front of or just behind the setae of xxii.

Internal anatomy.—Septa 6/7—7/8 and 10/11—11/12 are thickly muscular; 8/9 is a ventral rudiment only; 9/10 is lacking; 12/13 and several succeeding septa are strengthened but membranous.

The intestine begins in xv. The intestinal caeca are long enough to reach into xvii—xix; simple but with a few lobulations ventrally in xxiv—xvi. The post-gizzard oesophageal collar is usually in two large, lateral flaps but in 2 specimens one or both of the flaps are divided up into smaller portions. There are gregarines and pseudonavicellae spores imbedded in the material of the collar.

The last pair of hearts is in xiii. The commissures of ix—xiii all pass into the ventral trunk.

There is a single, median testis sac with bilobed anterior margin in each of segments x and xi. The seminal vesicles cover over the dorsal trunk in xi and xii. The vesicles of xii are at least twice the size of the vesicles of xi, displacing 12/13 and several successive septa posteriorly. The vesicles of xii are similar to those of xii of *P. andersoni* but here the base of the u forms the major portion of the vesicle. Anteriorly on the dorsal limb of the u there is a primary ampulla of quite different colour and texture from the main portion of the vesicle. Each vesicle of xi also has a primary ampulla. The prostates are relatively small, leaf-like and always confined to xviii. The prostatic duct is 4—6 mm. in length and is bent into a c- or u-shaped loop which is erect in xviii, the ectal half of the loop thicker than the ental half. The vasa deferentia do not at first appear to be double but after clearing, two distinct canals are visible at least as far back as into xvii.

The spermathecal duct is shorter than the ampulla from which it is not sharply marked off. The diverticulum is looped back and forth, the loops usually in a regular zigzag, and in the looped condition reaches

to the end of the ampulla, uncoiled much longer than the combined lengths of duct and ampulla. The diverticulum passes into the anterior face of duct which is gradually narrowed in the parietes. The loops of the diverticulum are firmly bound to each other by transparent connective tissue which may indicate the presence of a sac similar to that of the other varieties.

The genital marking consists of a hard thickening of the body wall and an inner layer of columnar material enclosed by a transparent connective tissue layer and protruding through the parietes into the coelom to a height of 1½—2 mm.

Variety **clavata**, var. nov.

Shoko, September, G. E. Blackwell, 5 specimens.

External characteristics.—Length 115—240 mm. Greatest diameter 5—13 mm. Number of segments 122—149. The pigment is in restricted bands or stripes which pass completely around the segment but which do not reach either the anterior or posterior intersegmental furrow of any particular segment. The pigmented bands thus alternate with distinct whitish bands or stripes. The pigmented stripes are blue anterior to the clitellum; dark reddish brown to brownish, posterior to the clitellum. As a rule the pigmentation is about as well developed ventrally as dorsally. Passing anteriorly from segment xiii the pigmented band gradually becomes broader until the whitish strip is finally reduced to a fine line at the intersegmental furrow. The smallest specimens lack the pigment ventrally. Specimens with a diameter of 9 mm. or more have the pigmented bands ventrally.

The setae are small and closely crowded ventrally. A midventral break is lacking. Passing laterally and dorsally on the anterior segments the setae are more and more widely spaced and there is a mid-dorsal break of variable width. On the posterior portion of the worm the lateral and dorsal setae are more closely crowded and more evenly spaced but even here there is usually a slight mid-dorsal break. The setal numbers are indicated below.

vi.	vii.	viii.	xviii.	xix.
42	..	..	26	32*
19	18	19	13	19
19	19	19	13	19
22	20	22	13	20
17	19	22	12	17

* The smallest specimen with a diameter of only 5 mm. and a length of 115 mm.

The first dorsal pore is in 12/13. The dorsal pores are readily visible to the unaided eye as dark dots on the unpigmented stripes.

There is no clitellar glandularity on any of these worms but the largest individual has a slight reddish " smokiness " of the whitish bands from 13/14 to just behind 15/16 that porbably indicates the beginning of the development of the clitellar glandularity.

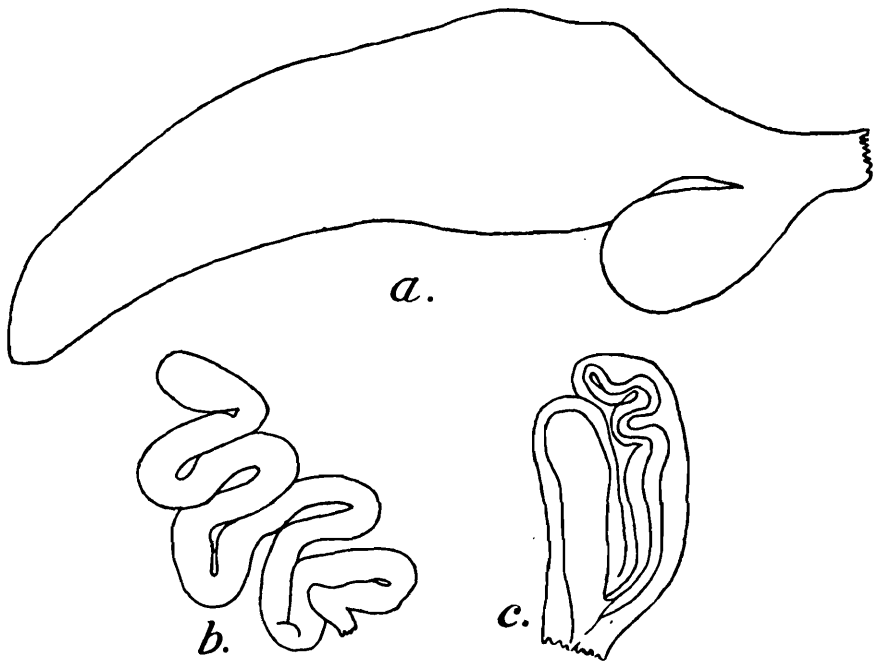
The spermathecal pores are four pairs on vi—ix, on the anterior margins of the segments near to the intersegmental furrows. The pores are minute but are distinctly visible even on the smallest specimen.

There is a single female pore on xiv, on the two largest specimens, about half way between the setae of xiv and 13/14.

The male pores are minute, each pore at the centre of a transversely oval disc in the setal circle of xviii.

There is a single genital marking on xvii. This is a deep, elongately oval, concave depression extending anteroposteriorly onto xvi, dislocating anteriorly the setal circle of xvi and onto xviii nearly to the setae of that segment. The marking has a distinct, wide, whitish rim within which the epidermis is light greyish or blueish grey. At the bottom of the concavity there is an elongate whitish area.

Internal anatomy.—(Much the same as in *typica*).



TEXT-FIG. 36. *a. Pheretima veleta clavata.* Spermatheca × ca. 11. *b. Pheretima velata clavata.* Spermathecal diverticulum after dissecting off the enclosing sac. Somewhat flattened. ×ca. 11.

c. Pheretima velata clavata. Spermatheca from smallest specimen. × ca. 26.

The seminal vesicles of xi and xii are large and cover over the dorsal blood vessel in both segments and are provided with a finger-like primary ampulla. The vesicles of xii push 12/13 back into contact with 13/14.

The prostates extend through xvii—xx or xxi, that part in xvii—xviii markedly smaller than the portion posteriorly. The prostatic duct is 6—8½ mm. long and is bent into a hairpin loop.

The spermathecal ampulla is elongately saccular, the duct short and almost confined to the body wall. The diverticulum at first appears to be saccular but is in reality slenderly tubular, bent back and forth in a zigzag fashion and contained within a thickish opaque sac. This sac can be easily dissected off and when so removed the diverticulum is transparent. The diverticulum is at the median side of the ampulla but passes into the anterior face of the duct.

There is a single, huge, dome-shaped projection into the coelom over the genital marking of xvii, reaching a height in the coelom of 2—3 mm. After stripping off the longitudinal musculature from the body wall this gland (?) can be pulled out of the parietes with the genital

marking including the whitish rim on its ventral face and leaving a hole in the epidermis with a smooth margin, but with the cuticle intact.

Remarks.—Some of the apparent differences between the varieties of this species may be due to the immaturity of the few specimens that have been available for study. The pigmentation of each of the three forms is characteristic so far as can be determined at the present time.

Appendix to the genus **Pheretima.**

A.

Pheretima labosa, sp. nov. (?).

"Manure," Nam Hpen Noi, August, H. Young, 14 aclitellate specimens.
"Wet, shady ravine," Pang Wo, October, H. Young, 8 aclitellate specimens.

External characteristics.—Length up to 70 mm. Greatest diameter up to 4 mm. Unpigmented.

The setae begin on ii on which segment there is a complete circle of setae. The setae are small and closely crowded; the setal circles without mid-dorsal or midventral breaks, except on xxii where the setal circle is interrupted ventrally by the genital marking. The setal numbers of five specimens are indicated below.

vi.	vii.	viii.	xvii.	xviii.	xix.	xx.
24	24	27	23	13	20	89
24	27	27	19	11	19	88
24	23	26	22	13	15	90
26	26	28	23	16	21	79
22	23	22	17	13	20	85

The number of the male setae on xviii in the whole lot varies from 11—19.

The first dorsal pore is in 12/13.

There is a single female pore on xiv.

The male pores are minute, each at the centre of a small, transversely oval area in the setal circle of xviii.

The single genital marking is transversely oval, 9—12 intersetal distances wide transversely, with a concave, greyish central portion and a whitish, non-protuberant rim. The markings extend anteroposteriorly through the whole length of xxii and may extend slightly onto xxiii and (or) xxi and laterally to the male pore lines. One specimen has two markings, one on xxii on the left side, the other on xxiii on the right side. Each of these markings ends abruptly with the midventral line.

Internal anatomy.—(20 specimens opened).

Septum 8/9 is usually present as a ventral rudiment but in one specimen is complete; 9/10 is lacking; 10/11 is thin; 11/12—12/13 slightly thickened but membranous.

The intestine begins in xv. The intestinal caeca are simple.

There is a pair of commissures belonging to ix in 6 specimens; in two of which the comissure of the right side is much smaller than that of the left, while in another two specimens the left commissure is much smaller than the right. The single commissure of ix is on the left side in 8 specimens, on the right side in 6 specimens. The last pair of hearts is in xiii. All the commissures of ix—xiii pass into the ventral trunk.

There are masses of nephridia in v and vi.

The testis sacs are unpaired. The seminal vesicles are always well developed and cover over the dorsal blood vessel in xi and xii, the posterior vesicles displacing 12/13 and 13/14 posteriorly. The prostates are confined to xviii. The prostatic duct is slender and straight or bent into a hairpin loop.

The spermathecae are rudimentary but project into the coelom in all the specimens. The ampulla is represented by a slight swelling of the end of the duct. The diverticulum is a straight, slender tube, longer than the combined lengths of duct and ampulla and passing into the anterior face of the duct.

Remarks.—There is a slight, whitish, and somewhat lobed ridge on the oesophagus just behind the gizzard that looks as if it were the rudiment of a post-gizzard glandular collar.

The genital marking is characteristic so far as the Burmese species of the genus *Pheretima* are concerned.

B.

Pheretima sp.

"Manure," Nam Hpen Noi, August, H. Young, 2 aclitellate specimens.
"Village manure heap," To Noi, September, H. Young, 16 aclitellate specimens.
"Wet, shady ravine," Pang Wo, October, H. Young, 17 aclitellate specimens.
Bana, September, H. Young, 1 aclitellate specimen.

External characteristics.—Length varies up to 120 mm. Greatest diameter 6 mm. Unpigmented, light greyish.

The setae begin on ii on which segment there is a complete setal circle. The setae are small and closely crowded, the setal circles without mid-dorsal or midventral breaks. The male setae on xviii are:—23 (1) specimen, 27 (1), 28 (2), 30 (3), 34 (2), 35 (1), 36 (1).

The first dorsal pore is in 12/13. One specimen has a non-functional pore-like marking in 11/12.

The future positions of the male pores are indicated by widely separated gaps in the setal circles of xviii.

There are no spermathecal pores, female pores, or genital markings visible.

Internal anatomy.—(36 specimens opened).

Septa 5/6—7/8 and 10/11 are thickly muscular; 11/12—12/13 are muscular but not so thick as 10/11; 8/9 is usually present as a ventral rudiment but is complete in one specimen; 9/10 is lacking or modified.

The intestine begins in xv. The intestinal caeca are simple extending from xxvii into xxii—xxiii. There is a small, whitish, glandular collar on the oesophagus just behind the gizzard.

There is a pair of vascular commissures belonging to ix in 4 specimens ; the single commissure of ix is on the left side in 12 specimens, on the right side in 20 specimens. The last pair of hearts is in xiii. All the hearts of ix—xiii pass into the ventral blood vessel.

In xi in each of these specimens there is an antero-posterior sheet of transparent tissue passing like a cylinder from 10/11 to 11/12 in such a way as to enclose the nerve cord, the main longitudinal blood vessels, the oesophagus, hearts, seminal vesicles, testes, male funnels and most of the coelom. The vesicles of xi as well as those of xii are small, flattened, whitish vertical strips of tissue on the posterior face of the vesicular septum. The testes of xi are small, round discs on the septum just below the seminal vesicles. A sheet of tissue in the form of a funnel with the narrow, anterior portion attached around the oesophagus just posterior to the hearts of ix, and with the wider posterior portion attached to the anterior face of 10/11 near its periphery, encloses the organs of segment x. The prostates are minute, flat discs on the floor of xviii, attached to the lateral margin of the vas deferens which is thickened only (but quite noticeably) in the parietes.

No traces of spermathecae were found.

Remarks.—A specimen from Bana differs from the preceding specimens only in such ways as to suggest that it is slightly older than the other specimens. There are slight, transverse, slit-like depressions in the setal circle of xviii, in each of which a male pore is recognizable. A special whitish tumescence of the parietes on each side extends from around the depression to 17/18 and 18/19 both of which are slightly displaced. There are three pairs of spermathecal pores in 5/6—7/8. The spermathecal setae on vi are 33, the male setae on xviii are 20. The seminal vesicles are as in the preceding specimens except that they are slightly wider. Three pairs of spermathecae project slightly into the coelom from the parietes. The spermathecal diverticulum is a straight, narrow tube and is longer than the combined lengths of duct and ampulla.

The testis sacs of these specimens may be called annular but there is here no inner wall to the sac as in species with annular testis sacs, unless the coelomic face of the oesophagus be regarded as the inner wall.

Genus **Perionyx** E. Perrier.

Five species belonging to this genus have been recorded from Burma. *P. m'intoshi* is based on a single, immature specimen. The description is inadequate and the original specimen cannot now be found. In these circumstances the species must, I think, be treated as invalid. Stephenson (1931, pp. 175-176) however disagrees.

P. fulvus, recorded by Stephenson from Inle Lake and by Gates from Rangoon, is probably a synonym of *P. excavatus*.

P. arboricola has four pairs of spermathecal pores in 5/6—8/9. It has been found only once, in the Karen Hills of the Toungoo district.

P. ditheca has spermathecal pores in 6/7—7/8 or in 7/8 only and has no penial setae. This species has been found only once and, like the preceding species, in the Karen Hills of the Toungoo District.

P. excavatus has penial setae and two pairs of spermathecal pores in 7/8—8/9. This species is peregrine and widely spread throughout Burma.

"The Eastern Himalayas, including the Abor Country and Assam" just to the Northwest of Burma is said to be "the chief home of the genus"

Perionyx excavatus E. Perrier 1872.

Taungyi, August, H. B. Gates, 52 specimens.
Pegu, August, K. John, 15 specimens.
Thanatpin, August, K. John, 4 specimens.
Maubin, September, K. John, 5 specimens.
Thanchitaw, September, K. John, 6 specimens.
Yandoon, September, K. John, 34 specimens.
Pyapon, September, K. John, 14 specimens.
Kochi, September, K. John, 9 specimens.
Bassein, September, K. John 9 specimens.
Tantabin, September, K. John, 4 specimens.
Toungoo, September, K. John, 8 specimens.
Pyigyaung, September, K. John, 11 specimens.
Kawkareik, October, K. John, 3 specimens.
Ye, October, K. John, 9 specimens.
Thaton, October, K. John, 4 specimens.

The position of the first dorsal pore was noted on 100 large but aclitellate individuals of this species collected at Rangoon. The pore is in 2/3 on 1 specimen, in 3/4 on 19 specimens, in 4/5 on 80 specimens. A pore in 3/4 is always smaller than the pore in 4/5.

Perionyx sp.?

Leiktho Circle, September, G. E. Blackwell, 11 specimens.
Southern Mergui District, September, W. D. Sutton, 2 specimens.
Northern Tavoy District, October, W. D. Sutton, 2 specimens.

These specimens all lack clitellar glandularity and reproductive apertures but are of about the same size as mature specimens of *P. excavatus*, to which species they probably belong.

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APPENDIX.

Burmese village names may be repeated from one district to another or even within the same district. To avoid confusion in records of distribution a list is appended herewith of towns or villages from which or near which earthworms mentioned in the preceding portion of the paper

were collected, together with some indication as to location, direction, and (when known) altitude.

Amherst District.

Ye, about 190 miles from Moulmein in a southerly direction towards Tavoy.

Kawkareik, a day's journey by boat and motor from Moulmein, at the foot of hills on the route to Siam.

Tavoy District.

Collections were made at Eindawaza, Myigyaunglaung, Shintapi, and Kale-aung in the Forest Reserve in the Heimza Basin area, about 70 miles north of Tavoy. These localities are referred to in the body of the paper as Northern Tavoy district.

References in the body of the paper to Southern Tavoy District are to Kyaukmedaung, Kataungni, Kerraw and Myittha. Myittha is about 33 miles east of Tavoy.

Mergui District.

In the northern portion of this district collections were made at Dubyinchaung in Palaw township and several localities thereabouts. These localities are about 35 miles north of Mergui.

Southern Mergui refers to Sindin, Zowai and Tharrabyin and villages thereabouts, said to be about 30 miles southeast of Mergui town.

Victoria Point. The southernmost point of Burma. Collections were made on a number of the islands as well as on the mainland.

Thaton District.

Thaton. North of Moulmein.

Toungoo District.

Toungoo, 166 miles by rail from Rangoon.

Tantabin, near Toungoo.

Toungoo Karen Hills.

Ko Haw Der and vicinity.

Shoko, Haw Lo Der and vicinity.

Blachi and vicinity.

Leiktho Circle, villages of Ti Pu Chi, Ker Der Ka and Th'Ba Pu.

Shan Plateau.

Taungyi.

Kengtung town.

The Young collection was made at or near the Sino-Burman boundary. Information with regard to the localities was furnished by H. Young; distances and altitudes are approximate.

Bana, 100 miles north of Kengtung, 5000′

Nam Shi Pan, 20 miles southeast from Bana, 5000′.

Nam Hpen Noi, 25 miles northwest of Bana, 5500′

Mong Mong Valley, 150 miles north of Bana and about 100 miles east of the Kunlong Ferry, 4000′.

Ang Lawng Mt., 8000′
To Noi, 30 miles from Bana, 6000′
Mong Ma, 35 miles south of Bana, 4000′
Teung Cong, 25 miles from Bana, 4000′
Kat Pang, Mang Lun State, 100 miles from Lashio, 3000′.
Pang Wo, Mang Lun State, 4500′
Kwang Yeh, Mang Lun State, 5000′.
Nawng Kaw, Mang Lun State, 3500′
Na Hang, Mang Lun State, 3500′
Peng Sai, Mang Lun State, 3500′
Loi Se, Mang Lun State.
Homang Village, Mong Yai State.
Tan Yang, Mong Yai State, 50 miles from Lashio.

Pegu District.
Pegu.
Kyauktan.
Thanatpin.
Paung, about 92 miles from Rangoon by rail.
Shwegyin, in Toungoo district but near Paung.

Pyinmana District.
Pyinmana.
Pyigyaung, in the hills east of Pyinmana.
Ywadaw, in the hills west of Pyinmana.

Bhamo District.
Bhamo.

Myitkyina District.
Myitkyina.

Tharrawaddy District.
Tharrawaddy.
Ngapugale, 7 miles south of Tharrawaddy. Collections were made at jungle areas four miles from the post office.
Keinbyingyi, 8 miles from Sitkwin, the latter 17 miles by rail from Tharrawaddy.

Henzada District.
Henzada.
Kyangin, terminus of railway from Henzada.

Maubin District.
Maubin.
Yandoon.

Pyapon District.
Pyapon.
Thanchitaw.

Bassein District.
Bassein.
Coomzamu.
Kochi.

Sandoway District.
Sandoway.