THAI EARTHWORMS.

By G. E. Gates, Judson College, Rangoon, Burma.

Contents.

INTRODUCTION.

Very little has been known hitherto of the earthworms of Thailand. In the Tierreich monograph (1900) Michaelsen was able to include Thailand in the distribution of only two species, one from the mainland and one from a small island, both species unimportant zoogeographically. In the same year as the publication of the German work Beddard erected three species on material collected in the peninsular portion near the southern border by the Skeat expedition and recorded a fourth hitherto known only from Sumatra. Three other species, of which two were new, were added by Stephenson in 1917 and 1931 for casual specimens in the Indian and British Museums. Of Stephenson's worms two were from the peninsular portion and one from the mainland, one from each locality probably endemic. Gates (1930) was able to list seven species (six recorded from Thailand for the first time) all of which are more or less widely distributed forms, as a result of study of small collections secured in the most unfavourable season of the year near the Burmese border in the extreme north and south and at Bangkok. This brought the number of species reported from Thailand to the end of 1938 to a total of sixteen.

For comparison it may be noted that 31 species have been collected in the City of Rangoon while the estimated total of species from Burma, including the Andaman and Nicobar Islands as well as a very small transborder portion of Yunnan, is two hundred. (This number includes undescribed and manuscript species). From the portion of the Malay Peninsula south of the Thai border 41 species are known and 24 have been recorded from French Indo-China.

Because of this situation and especially in view of the author's interest in Thailand as one of the areas adjacent to Burma on the worms, of which most of his work has been done, the opportunity afforded by Dr. Schmitt to examine material belonging to the U. S. National Museum and in particular that collected recently by Dr. H. G. Deignan was especially welcome. Study of the new material raises the number of Thai species only to 28, less than the number known from the City of Rangoon. Obviously much remains to be done on the earthworms of Thailand, not to mention aquatic oligo-

chaetes which are completely unknown. Curiously, almost nothing is known of the fauna of the large, densely populated central region, as most of the records are from localities in the far north, north-east and in the peninsula near the extreme southern border.

Earthworms are easy to collect and usually can be secured in sufficient numbers for satisfactory taxonomic treatment without difficulty. Methods of killing and preservation for systematic work are simple and fairly inexpensive.

Interesting and important work can be done in determining the number and range of species in the unstudied central portion of Thailand without the necessity of long, expensive or arduous trips to the peripheral regions.

One difficulty in the way of local work on the earthworms of Thailand may be a lack of pertinent literature. In order to obviate in part such a handicap there have been included in this paper references to literature containing recent diagnoses of many of the species, a few diagnoses especially if definitions of modern standard are not available, a key to the Thai species of *Pheretima*, a key to Megascolecid genera already collected in Thailand or likely to be collected in any part of Thailand, and a key to families of Asiatic earthworms. Further information that may be necessary can probably be obtained from recent volumes of the Records of the Indian Museum (Calcutta), and from Stephenson's two books (1923 and 1930).

The writer is indebted to Dr. C. C. A. Monro of the British Museum for forwarding one unidentified specimen for examination, to Dr. Schmitt of the U. S. Nat. Mus. for the opportunity of studying the material collected by Deignan, and to Dr. Deignan for his special efforts to secure earthworms and for the care taken in preservation of the material secured.

Zoogeographical Notes.

Known Thai earthworms belong to six genera. Four of these genera are represented in the fauna of Thailand by species that are undoubtedly peregrine and which have been introduced directly or indirectly from their original homes in Central America (*Pontoscolex corethrurus*, Glossoscolecinae), Africa (? *Dichogaster affinis*, Megasco-

lecidae), or India (*Lampito mauritii*, possibly also *Perionyx excavatus*, Megascolecidae). A fifth genus, *Drawida*, is known only from two small specimens, one of which is specifically unidentifiable. The sixth and last genus, *Pheretima*, is alone known to be represented in Thailand by species of zoogeographical value.

Pheretima has long been thought to be the dominant genus in the regions of eastern and south-eastern Asia just mentioned, but a prediction is ventured that *Drawida* will be found to be much more important in the southeast than the information, at present available, actually indicates.

A very large proportion of the species now known from Thailand belongs to the genus *Pheretima*; it seems unlikely that exploration of regions, remote from and uninfluenced by human activities, the collection of those small forms that are usually overlooked, and the study of the practically unknown fauna of the central portion of the country will reduce the proportion very significantly.

Some of these species of *Pheretima* are "peregrine," i.e., widely distributed as a result of some unusual and inherent power of migration or as the result of accidental or artificial carriage. In the past a tendency to deny any zoogeographical interest to the peregrine forms has resulted in failure to record accurately and with sufficient detail the distribution of these forms. However a form which has been transported widely may have some interest and significance, if from its present distribution there can be separated off what may be termed a natural range as opposed to that portion of its distribution into which it has been accidentally introduced. Even the accidental portions of a distribution may be of some interest, and especially so in connection with those species whose original homes are unknown or uncertain. (*Vide* discussions of specific distributions in Gates 1937). Accordingly it is more important than has been realized hitherto that information be accumulated regarding the distribution of even those forms which may be regarded as fairly well known both as to structure and distribution. Information regarding elevations is often especially needed.

Species which are more limited in their distribution have been distinguished from the peregrine forms zoogeographically as

"endemics," but the distinction may be quite artificial. Because a species has been successfully introduced, for example into the United States, scarcely seems sufficient reason for denying "endemic" value in the region to which it is native.

Although the term endemic can be applied to a number of the local species it seems unlikely at present that species of *Pheretima* restricted solely to Thailand will be found except perhaps in the uninvestigated central portion of the country. Species from the peninsular portion in the extreme south are related to forms from the Burmese and Malayan portions of the peninsula. Species from the north are probably endemic in areas which include portions of both Burma and Thailand and it is possible that a similar statement may prove to be true of forms from the most eastern portion of the country. The only species known from the east is related to an Indo-Chinese form.

Species of several other genera may be expected in more thorough collections (*vide* table below). *Desmogaster* (Moniligastridae), *Plutellus, Woodwardiella, Ramiella, Lennogaster* (Megascolecidae), *Ocnerodrilus, Gordiodrilus, Eukerria* and *Malabaria* (Ocnerodrilidae) and *Glyphidrilus* (Glossoscolecidae, Microchaetinae) may be anticipated. At present it seems unlikely that any of these genera excepting *Plutellus* and possibly *Glyphidrilus* will be represented by more than one or possibly two species, with endemics most likely in *Desmogaster*, *Plutellus* and *Glyphidrilus*. Endemic species of the last genus are known from Burma, India, the Malay Peninsula and the Archipelago. Even in these areas records are casual and the peculiar glyphidrilid habitat requires careful study.

Accurate assessment of the zoogeographic value of species of *Woodwardiella, Ramiella, Lennogaster*, and the Ocnerodrilid genera that may be found in Thailand is impossible at present. All of these forms are of such a small size as to be most easily transported accidentally. Much further information is required in connection with the origin and distribution of these small species which are almost always overlooked by collectors.

Table.

EARTHWORM GENERA OF SOUTH-EASTERN ASIA.

Burma and the Malay Peninsula.	Thailand.	French Indo-China.
Desmogaster		
Hastirogaster		
*Drawida**	Drawida	*Drawida*
Plutellus		
Pontodrilus		
Woodwardiella		
Tonoscolex		
Nelloscolex		
Lampito*	Lampito	Lampito
*Pheretima**	*Pheretima*	*Pheretima*
*Perionyx**	Perionyx	Perionyx
Octochaetoides*		
Ramiella		
Lennogaster		
Eutyphoeus		
Dichogaster*	Dichogaster	
Gordiodrilus		
Ocnerodrilus*		
Malabaria		
Eukerria*		
Pontoscolex*	Pontoscolex	
*Glyphidrilus**		
Bimastos*		

*With species in the Malay Peninsula. Genera without asterisks have been recorded hitherto only from Burma.

The italics indicates that the genus is represented in the particular region by endemic species at least in part.

SYSTEMATICS.

The classifications of Michaelsen and Stephenson are no longer satisfactory, at least so far as the Moniligastridae and Megascolecidae are concerned. A revision of the Moniligastridae is under way and it is hoped that publication will be possible in the not too distant future. In the meanwhile it is only necessary to note that the African subfamily Syngenodrilinae must be excluded from the Moniligastridae which is again purely Asiatic. The Megascolecidae is a conglomerate of genera that can only be defined, morphological-

ly, as earthworms having prostates.[1] It has usually been divided into five subfamilies: Acanthodrilinae, Megascolecinae, Octochaetinae, Diplocardiinae and Ocnerodrilinae (Stephenson 1930). The Diplocardiinae group has been suppressed recently and its genera transferred to the Acanthodrilinae and Octochaetinae (*vide* Pickford 1937, pp. 83-84 and 1938, p. 95). The Megascolecinae and Octochaetinae are now merely aggregations of genera that *cannot* be defined morphologically and which cannot be delimited from each other, while the Acanthodrilinae are distinguished from the Octochaetinae only by the absence of micronephridia, and from the Megascolecinae only very circuitously, if at all. So far as can be discovered from study of the literature available locally and of the Burmese forms, the Ocnerodrilinae are distinguished from all other Megascolecid forms by five characteristics: absence of dorsal pores (except in *Nematogenia*), restriction of calciferous glands (oesophageal sacs or diverticula) to ix and x, restriction of hearts to segments x and xi, an anterior intestinal origin in xii, and absence of diverticula on the spermathecae (except in *Pygmaeodrilus*). As one step towards a revision of the Megascolecidae it is suggested that the Ocnerodrilinae, the only group distinguishable from the rest of the family by more than one morphological character, be recognized as a distinct family. A revision of the Megascolecidae (minus the Ocnerodrilinae) cannot be attempted for some time yet and not until a very considerable amount of work has been done on the digestive, circulatory, excretory and reproductive systems in most of the genera involved. In the meanwhile the Megascolecidae will be understood to include without subfamily distinctions all of those genera hitherto included in the Acanthodrilinae, Megascolecinae and Octochaetinae.

KEY TO FAMILIES.

1. *a.* Testis sacs suspended in intersegmental septa so as to project anteroposteriorly into two successive segments . . . . Moniligastridae.

[1] This definition necessitates the invention of a new term for the distinctly different Moniligastrid structures, hitherto usually called prostates,

b. Testis sacs lacking or when present not suspended into two segments but restricted to the segments to which the included testes belong 2

2. *a.* Prostates present 3
   b. Prostates lacking 4
3. *a.* Intestine begins in xii, last hearts in xi . . Ocnerodrilidae.
   b. Intestine begins behind xiii, last hearts in xii or xiii . . . . . Megascolecidae.
4. *a.* Gizzard oesophageal . . . . . 5 (Glossoscolecidae).
   b. Gizzard intestinal . . . . . Lumbricidae.
5. *a.* Spermathecae at least partly in front of the testis segments . . . . . Glossoscolecinae.
   b. Spermathecae behind the testis segments . Microchaetinae.

FAMILY MONILIGASTRIDAE.

Hitherto only two specimens of one Moniligastrid genus, *Drawida*, have been collected in Thailand. Another genus, *Desmogaster*, present on the Shan Plateau and in the Tenasserim division, just west of Thailand, and also known from China is probably to be found in Thailand. It is most likely to be secured in regions uninfluenced by activities of man.

GENUS DRAWIDA MICHAELSEN 1900.

Drawida vulgaris?

1930. *Drawida vulgaris*, Gates, Rec. Ind. Mus. XXXII, p. 296. (Type locality Kalewa, Upper Chindwin district, Burma. Types in author's collection.)

Material examined.—From U. S. Nat. Mus.

Chiengmai, 1,000 feet, August 9, 1936, 1 clitellate specimen, H. G. Deignan.

External characteristics.—Length, 35 mm. Diameter, 2½ mm. Unpigmented. Prostomium prolobous. Nephropores begin on iii and when recognizable are on or close to *d*, at anterior margins of the segments, apparently lacking on x.

The setae begin on ii and are closely paired; on xx, *aa* slightly less than *bc*. The ventral setae (and possibly the lateral setae) of ii-vii are larger than on posterior segments.

The epidermis of x-xiv appears to be slightly thickened at the mid-dorsal incision.

Spermathecal pores are small, transverse slits, on 7/8, just median to *c*.

Male pores are tiny, transversely placed, slits *ca*. at mid *bc*, on low transversely placed porophores, (possibly cut off from the posterior margin of x?) concealed from view by apposition of margins of x and xi.

The female pores are on or very close to 11/12, on or just lateral to *b*.

The genital markings are transversely placed areas of greyish translucence, shortly elliptical in outline: paired, presetal on x, ix and viii (the right side only) in a lateral portion of *bc*, postsetal on x in median portion of *bc*; unpaired, median and presetal on ix and xi.

Internal anatomy.—The gizzards are in xiii-xv. The last pair of hearts is in ix. The post-gizzard portion of the oesophagus extends through seven segments with a valve in the seventh segment, the intestine beginning with 22/23. The extra-oesophageal trunk is lateral to the hearts. On the anterior face of 8/9 just median to each heart there is a vertical commissure from the extra-oesophageal.

The testis sacs are elongate, extending from 8/9 to 10/11, slightly constricted by 9/10, apparently sexual. The vas deferens is short, twisted into a few loose loops on the posterior face of 9/10 and passes into the prostate near the ental end without first penetrating into the parietes. (No nephridia in x.) The prostate is small, club-shaped, erect in the coelomic cavity. An outer layer of relatively coarse granulations extending to the parietes readily falls off, revealing a slenderly club-shaped capsule, narrowed ectally.

Segment xi is closed off to form a horseshoe-shaped ovarian chamber which is almost empty. The ovarian sacs are yellowish and distended but restricted to xii.

The spermathecal ampullae appear to be fully developed. The atria are small, rather finger-shaped, erect in vii just in front of 7/8 and somewhat flattened anteroposteriorly. The spermathecal duct

passes into the posterior face of the atrium within 7/8 close to the parietes.

Remarks.—The worm is strongly contracted, especially anteriorly. When first received determination of characteristics of the male genital terminalia was practically impossible without damaging the specimen. More than a year later the specimen was again examined by which time removal of the cuticle had become possible. A reddish clitellar colouration on x-xiv, previously overlooked or unrecognizable is now visible as well as unpaired, median genital markings which had not been noted previously.

The worm does not appear to differ in any characteristics of specific importance from specimens referred to *D. vulgaris*. This species has been found hitherto only in a central region of Burma near the Irrawaddy river in the south and the Chindwin in the north. The unpaired median genital markings are located as in unrecorded Burmese specimens from the southern portion of the *vulgaris* range.

Diagnosis.—Male pores small, transversely placed slits on the posterior margin of x, at or median to mid *bc*. Spermathecal pores on 7/8, on or close to *c*. Genital markings transversely placed areas of epidermal modification of shortly elliptical outline, presetal; paired, in a lateral portion of *bc*, on vii-x, in *bb* on xii-xiv; unpaired in *aa* on viii-xiii; occasionally paired postsetal markings in median portion of *bc* on x. Nephropores on or close to *cd*. Unpigmented. Length 30-50 mm. Diameter 2½-3 mm.

Gizzards in xii-xvi. Vas deferens short (8 mm. long), ectal portion in x thickened, passing directly into the prostate entally. Prostatic capsule rod-shaped but slightly widened entally. Spermathecal atria in vii, ca. 1 mm long, digitiform. Segment xi reduced to a horseshoe-shaped ovarian chamber.

DRAWIDA SP.

E.

Material examined.—From the U. S. Nat. Mus.

Mu'ang Pong (Ban Muang), September 13, 1936, 1 aclitellate specimen. H. G. Deignan.

External characteristics.—Length, 33 mm. Diameter, 1 mm. Unpigmented. Prostomium prolobous.

Setae are closely paired; on xx, $aa < bc$.

Spermathecal pores are on 7/8, on *c*.

The male pores are presumably at the ventral tips of porophores which are in mid *bc*. Each porophore is a whitened, rather conical protuberance, intersegmental furrow 10/11, ending abruptly against the base both laterally and mesially. From the ventral end of the porophore protrudes a short, almost filamentous penis-like body. This latter presumably is retractile into the main portion of the porophore. (Two types of structures have been referred to as penes in the genus *Drawida*. One is formed, wholly or largely, by eversion of a pouch or invagination, as in *D. cheni* Gates 1935, while the other is a permanent structure capable of protrusion from or retraction into a pouch or invagination, as in *D. hehoensis* Stephenson 1924).

Genital markings are lacking.

Internal anatomy.—The gizzards are in xiv-xv. The last pair of hearts is in ix.

Testis sacs are small, rather firm, spheroidal, on the posterior face of 9/10, probably abnormal. The vas deferens is short, twisted into several loose loops on the posterior face of 9/10, and passing into the anterior face of the prostate (near the parietes?), without first penetrating into the body wall. The prostate is club-shaped, small but erect in the coelomic cavity. The external glandular layer is loose and readily falls apart revealing a soft, club-shaped capsule, narrowed ectally.

The ovisacs are sexual and extend into xv. Ovarian chamber?

The spermathecal ampullae are distended. As the spermathecal duct passes into the parietes just behind 7/8 it is slightly enlarged, the widened portion rather conical and slightly protuberant into the coelomic cavity.

Remarks.—The specimen is macerated and broke into several fragments during the examination.

This worm differs from the Chiengmai specimen (of *D. vulgaris*?) in the presence of a penis, a characteristic of sufficient importance to indicate specific distinctness. Possibly near to *D. hehoensis* Stephenson 1924.

Family Megascolecidae.

Although at present only four genera of this family can be listed from Thailand, it is probable that others will be represented in more extensive collections. The key to Megascolecid genera has accordingly been extended to include those genera that are most likely to be encountered.

Key to Megascolecid genera.

1. *a.* Prostates tubular 2
   b. Prostates racemose 8
2. *a.* Purely meganephric 3
   b. Micronephric or mixed mega- and micronephric 4
3. *a.* Nephridia present anterior to xiii . . . . . *Plutellus.* (A)
   b. Nephridia lacking anterior to xiii . . . . . *Pontodrilus.* (B)
4. *a.* No calciferous glands . . . . . *Ramiella.* (C)
   b. Calciferous glands present 5
5. *a.* Calciferous glands behind xiv 6
   b. Calciferous glands in front of xiv . . . 7
6. *a.* One gizzard . . . . . *Octochaetoides.* (D)
   b. Two gizzards . . . . . *Dichogaster.*
7. *a.* One gizzard . . . . . *Eutyphoeus.* (E)
   b. Two gizzards . . . . . *Lennogaster.* (F)

(A) Burmese forms are small worms, some quite small. Interesting species may be found in Thailand.

(B) To be looked for on or near the seashore.

(C) Two species of very small worms are known from Burma, one from the Shan Plateau.

(D) *Octochaetoides fermori* has been found in the Malay Peninsula (possibly an importation), and is widely distributed in Burma though recorded from only two localities on the Shan Plateau, both near the western margin.

(E) May turn up in peninsular Thailand or in a region near the Burmese border of Amherst and Tavoy districts.

(F) Two very small species known from Burma, one of which is present on the Shan Plateau. The other is known only from the Tenasserim division, which is also on the Thai border.

8. *a.* Purely meganephric 9
   b. Micronephric or mixed mega- and micronephric 10
9. *a.* Setae perichaetine . . . . . *Perionyx.*
   b. Setae lumbricine . . . . . *Woodwardiella.*(G)
10. *a.* Gizzard in v . . . . . *Lampito.*
    b. Gizzard behind v. 11
11. *a.* Male pores on xvii, female pores on xiii . . *Tonoscolex.* (H)
    b. Male pores behind xvii, female pores on xiv . . . . . *Pheretima.*

GENUS LAMPITO KINBERG 1867.

1938. *Lampito,* Gates, Rec. Ind. Mus. XL, p. 404. (Revision).

LAMPITO MAURITII KINBERG.

1867. *Lampito mauritii,* Kinberg, Öfv. Ak. Forh. XXIII, p. 103. (Type locality Mauritius. Type in the Stockholm Museum.)

1930. *Megascolex mauritii,* Gates, Rec. Ind. Mus. XXXII, p. 301. (Bawti and Not Theinko.)

1938. *Lampito mauritti,* Gates, Rec. Ind. Mus. XL, p. 413. (Diagnosis.)

Remarks.—This species may prove to be fairly common in the lowlands as in Burma.

GENUS PHERETIMA KINBERG 1867.

Key to Thai species of Pheretima.

1. *a.* No intestinal caeca . . . . . *elongata.*
   b. Intestinal caeca present . . . . . 2.
2. *a.* Quadrithecal . . . . . 3.
   b. Sexthecal or octothecal. . . . . 5.

(G) Small species are known from India, Burma and Ceylon, *W. pumila* or *javanica* or both may turn up in Thailand.

(H) Several species are known from the Shan Plateau including two from Karenni just west of Thailand, and others from Mang Lun State, east of the Salween.

3. *a.* Spermathecal pores segmental, on anterior margins of vii-viii . . . . . *planata.*
   b. Spermathecal pores intersegmental . . 4.
4. *a.* Spermathecal pores on 5/6-6/7. . . . . *morrisi.*
   b. Spermathecal pores on 7/8-8/9. . . . . *hupbonensis.*
5. *a.* Sexthecal. . . . . 6.
   b. Octothecal . . . . . 13.
6. *a.* Male pores on xviii. . . . . 7.
   b. Male pores on xx. . . . . *anomala.*
7. *a.* Male pores superficial. . . . . 8.
   b. Male pores invaginate . . . . . 9.
8. *a.* Testis sacs ventral, seminal vesicles excluded . . . . . *hawayana.*
   b. Testis sacs pass around gut dorsally, seminal vesicles of xi included. . . . . *papulosa.*
9. *a.* Male pore invaginations restricted to parietes . . . . . *peguana.*
   b. Male pores in copulatory chambers protuberant into coelomic cavity . . . 10.
10. *a.* One or more stalked glands to each spermathecal duct . . . . . 11.
    b. No stalked glands to spermathecal ducts . . . . . 12.
11. *a.* First dorsal pore on 10/11 or anteriorly, penial setae lacking . . . . . *houlleti.*
    b. First dorsal pore on 11/12, penial setae present . . . . . *campanulata.*
12. *a.* First dorsal pore on 12/13, last hearts in xii . . . . . *perichaeta.*
    b. First dorsal pore on 11/12, last hearts in xiii . . . . . *virgo.*
13. *a.* Genital markings in a transverse row of 13-16 on or close to 7/8 . . . . . *evansi.*
    b. Genital markings, when present, not so placed . . . . . 14.
14. *a.* Male pores superficial . . . . . 15.
    b. Male pores invaginate . . . . . 20.

15. *a.* Genital markings lacking . . . . . *alexandri.*
    b. Genital markings present . . . . . 16.
16. *a.* Intestinal caeca simple . . . . . 17.
    b. Intestinal caeca compound . . . . . *manicata.*
17. *a.* Genital markings segmental . . . . . *exigua.*
    b. Genital markings intersegmental . . . 18.
18. *a.* Genital markings in three longitudinal rows. . . . . *compta.*
    b. Genital markings not in three longitudinal rows . . . . . 19.
19. *a.* Length less than 100 mm. . . . . *austrina.*
    b. Length greater than 150 mm. . . . . *longicauliculata.*
20. *a.* Septum 8/9 muscular . . . . . 21.
    b. Septum 8/9 lacking or if present represented by a membranous ventral rudiment only 22
21. *a.* Genital markings present, on xvii and xix . . . . . *posthuma.*
    b. Genital markings lacking . . . . . *fluvialis.*
22. *a.* Pseudocopulatory chambers present in xix . . . . . *bipora.*
    b. No pseudocopulatory chambers . . . . . *annandalei.*

While it is hoped that the key above will prove to be helpful in identification of species already recorded from Thailand, it must be used with considerable caution. As a result of important gaps in our knowledge of so many of the species, a really satisfactory key cannot be constructed at the present time.

Pheretima alexandri (Beddard).

1900. *Amyntas alexandri,* Beddard, Proc. Zool. Soc. London, 1900, p. 998. (Type locality Calcutta, India. Type in the British Museum.)
1930. *Pheretima lignicola,* Gates, Rec. Ind. Mus. XXXII, p. 314. (Bangkok, Chiengmai, Chiengrai.)
1937. *Pheretima alexandri,* Gates, Rec. Ind. Mus. XXXIX, p. 192. (Diagnosis.)

Material examined.—FROM THE BRITISH MUSEUM.

Kosichang, Gulf of Thailand, four clitellate specimens. S. S. Flower.

FROM THE U. S. NAT. MUS.

Chiengmai, 1,000 feet, August 14, 1936, 1 clitellate specimen. H. G. Deignan.

"In rich soil of a banana grove," Mu'ang Pong (Ban Muang, a town on the upper Me Yom), September 9, 1936, 1 clitellate specimen. H. G. Deignan.

Remarks.—Probably fairly common throughout most of Thailand. Common throughout most of Burma and also known from Yunnan, Assam, Calcutta, Bombay and the Andaman Islands. The original home of the species presumably is somewhere in Burma or Siam.

PHERETIMA ANNANDALEI STEPHENSON.

1917. *Pheretima annandalei*, Stephenson, Rec. Ind. Mus. XIII, p. 386. (Type locality Singora, Tale Sap. Type in the Indian Museum.)

1934. *Pheretima annandalei*, Gates, Rec. Ind. Mus. XXXVI, p. 256. (after examination of type.)

Diagnosis.—Octothecal, secondary spermathecal pores large, on 5/6-8/9, slightly above the midlateral line. Male pores at ventral ends (?) of tubular penes, two mm. long within large, copulatory chambers with transversely slit-like apertures. Genital markings very small, rounded tubercles in transverse rows of one to three midventrally; presetal and postsetal on viii, xviii and xix. Female pore? Setae: vi/28, vii/30, viii/40, xvii/15, xviii/12, xix/17, 43/v, 59/ix, 55/xii. First dorsal pore? Length 58 mm. Diameter 4 mm.

Intestinal caeca simple. Testis sacs paired and ventral (?). Spermathecal duct longer than the ampulla; diverticulum small, with ovoidal seminal chamber and longer, slender stalk opening into ental end of duct. Genital marking glands stalked and coelomic.

Remarks.—Known only from the holotype. Testis sacs are assumed to be ventral but this is not mentioned by the author. Primary spermathecal pores are invaginate, but nothing is known of the invaginations.

P. annandalei is close to *P. gemella* Gates 1931 and *P. bipora* (Beddard) 1901, from which it is distinguished by the absence of pseudocopulatory chambers.

Probably native to peninsular Thailand and a neighbouring portion of the Malay Peninsula.

Pheretima anomala Michaelsen.

1907. *Pheretima anomala*, Michaelsen, Mitt. Mus. Hamburg, XXIV, p. 167. (Type locality Calcutta, India. Types in the Indian and Hamburg Museums).

1930. *Pheretima anomala*, Gates, Rec. Ind. Mus. XXXII, p. 307. (Chiengrai).

1937. *Pheretima anomala*, Gates, Rec. Ind. Mus. XXXIX, p. 193. (Diagnosis).

Remarks.—Possibly fairly common through most of Thailand. Widely spread throughout Burma and also known from southern Yunnan, Calcutta, the eastern and western Himalayas. The original home of the species presumably is somewhere in Burma or Thailand.

Pheretima austrina Gates.

1932. *Pheretima exigua* var. *austrina*, Gates, Rec. Ind. Mus. XXXIV, p. 514. (Type locality, Leiktho Circle, Toungoo district, Burma.)

1936. *Pheretima austrina*, Gates, Rec. Ind. Mus. XXXVIII, p. 400. (Diagnosis.)

Material examined.—From the U. S. Nat. Mus.

Base of Doi Sutep, *ca.* 1,100 feet, December 1, 1936, 1 clitellate specimen. H. G. Deignan.

Remarks.—The single pair of postclitellar genital markings is on 18/19 on this specimen.

Possibly to be expected throughout western Thailand from the peninsula northwards. The range in Burma is from the peninsular portion (Mergui district) to Myitkyina, but only east of a line passing north from the mouth of the Sittang along the margin of the Shan Plateau to Bhamo and thence to Myitkyina.

PHERETIMA BIPORA (BEDDARD.)

1901. *Amyntas biporus*, Beddard, Proc. Zool. Soc. London, 1900, p. 908. (Type locality unknown. Types in the British Museum.)

1932. *Pheretima bipora*, Stephenson, Ann. Mag. Nat. (10), IX, p. 213. (After examination of types.)

1934. *Pheretima bipora*, Gates, Rec. Ind. Mus. XXXVI, p. 257. (After examination of types.)

Diagnosis.—Octothecal, spermathecal openings[1], on 5/6-8/9. Male pores on penes within copulatory chambers with transversely slit-like apertures. Penis-like processes in paired pseudocopulatory chambers with transversely slit-like apertures on xix. Genital markings: paired transversely elliptical, postsetal on vii; additional markings postsetal on vii just median to spermathecal pores or presetal on viii. Setae present on all clitellar segments. First dorsal pore? Length 115 mm. Diameter?

Intestinal caeca simple (?). Testis sacs U shaped (?); seminal vesicles included (?). Spermathecal duct as long as ampulla; diverticulum longer than combined lengths of duct and ampulla, with long stalk and avoidal seminal chamber. Genital marking glands cushion-like and bilobed.

Remarks.—Close to, if not identical with, the Burmese *P. gemella* Gates 1931 from which it is distinguished for the present, by the paired genital markings on vii and spermathecal characteristics (shortness of duct relative to ampulla, and length of diverticulum relative to combined lengths of duct and ampulla).

Probably endemic in a northern portion of the Malay Peninsula.

PHERETIMA CAMPANULATA (ROSA).

1890. *Perichaeta campanulata*, Rosa, Ann. Mus. Genova, XXX, p. 115. (Type locality Palon, Insein district, Burma. Types in the Genoa Museum.)

1937. *Pheretima campanulata*, Gates, Rec. Ind. Mus. XXXVIII, p. 406. (Diagnosis.)

[1] Spermathecal pores cannot be characterized in this and certain other species. External apertures of the spermathecae may be primary or secondary pores. In these circumstances "openings" is used instead of "pores."

Material examined.—From the U. S. Nat. Mus.

Mu'ang Pong (Ban Muang, a town on the upper Me Yom), September 13, 1936, 1 clitellate, athecal specimen. H. G. Deignan.

Remarks.—The only specimen obtained is of an abnormal form found rather commonly in Burma, *f. rugosa* (*vide* Rec. Ind. Mus. xxxviii, p. 409). The species will probably prove to be as common throughout most of Thailand as it is in Burma. Also known from Yunnan, the Malay Peninsula, Andaman Islands, and the eastern Himalayas in India. The original home of the species probably is somewhere in a region comprising eastern Burma and Thailand.

Pheretima Compta.

1932. *Pheretima compta*, Gates, Rec. Ind. Mus. XXXIV, p. 511. (Type locality, Blachi, Karen Hills of Toungoo district, Burma. Type in author's collection, Judson College.)

Material examined.—From the U. S. Nat. Mus.

Ban Huai Rai, Phre Province, Nov. 4, 1936, 14 clitellate specimens. H. Gaylord Knox.

External characteristics.—Length, 135-235 mm. Diameter, 6-8 mm. The dorsum is characterized by a light reddish pigmentation that fades out gradually passing posteriorly.

The setae begin on ii and on this segment are usually restricted to the ventral side (10) though scattered setae may also be present dorsally. Setae are small and closely spaced, more closely crowded ventrally, smaller and often deeply retracted into the parietes or missing dorsally. Gaps of 2, 3 or 4 intersetal intervals are frequent, setal pits often visible in the gaps. The setal formulae of five specimens are shown below.

vi	vii	viii	xvii	xviii	xix	ii	iii	viii	xii	xx.
41	45	43	—	—	44	5	73	114	—	—
49	53	55	52	41	56	33	84	128	123	122
48	48	51	56	40	58	22	63	133	128	130
53	56	57	53	47	59	18	87	145	130	136
54	54	57	59	46	61	12	70	140	139	133

The first dorsal pore is on 12/13 (14), on one worm a pore-like but apparently non-functional marking on 11/12.

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

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

There is a single female pore (14).

The male pores are minute and superficial, each pore at or near the centre of a disc-shaped porophore which may be almost circular or shortly elliptical (transversely or longitudinally placed), the porophore slightly smaller than the genital markings.

The genital markings are rather small, protuberant, intersegmental, almost circular in outline to shortly elliptical (transversely placed), in three longitudinal rows, all of which are median to the male pore lines. A circular central portion of each marking has a greyish translucent appearance and is surrounded by an opaque band-like margin. The markings are on 19/20-25/26 (13 specimens), 19/20-24/25 (1). One specimen has an additional marking on 18/19 on the left side only. Another specimen lacks the right marking on 19/20 while the median marking on 20/21 is probably double, being about twice the size of a normal marking.

Internal anatomy (three specimens opened).— Septa 5/6-7/8 are slightly muscular: 8/9-9/10 lacking; 10/11-11/12 muscular.

The intestine begins in xv (3). The intestinal caeca are simple, the margins with slight septal constrictions. On the gut just in front of the heart of ix is a large, lobed, glandular collar (3).

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

The testis sacs of x and xi are unpaired and suboesophageal. The nerve cord is adherent to the ventral side of the testis sacs. The seminal vesicles of xi are large, filling the segment and in contact dorsally above the dorsal blood vessel. The vesicles of xii are still larger, in contact dorsally, pushing 12/13 and succeeding septa back into contact with 16/17 or 17/18, or actually passing through one or

more of these septa. The prostates are rather small, confined to xviii (3). The prostatic duct is six to ten mm. long, bent into a hairpin-shaped loop, muscular but rather slender.

The spermathecal duct is not clearly marked off externally from the ampulla but is much shorter than the ampulla, with slightly thicker wall, usually ridged longitudinally (internally). The duct is abruptly narrowed within the parietes. The lumen is fairly large and is abruptly narrowed at the diverticular junction. The diverticulum, which passes into the anterior face of the duct at or close to the parietes, is longer than the combined lengths of duct and ampulla and may be twice as long. The diverticulum may be described as rod-like and of about the same diameter throughout (1 specimen), or a middle region may be slightly narrowed and there may be bulgings, or flattenings of the entalmost portions (2) The diverticulum is not straight but neither is it bent, twisted or coiled in any definite or regular fashion. Ectally the lumen is narrow, and with longitudinal ridges; in a middle portion the lumen is slightly wider and with low annular ridges. The seminal chamber, characterized by a spermatozoal iridescence, is (approximately) the ental third of the diverticulum.

The genital marking glands are sessile on the parietes. In each of segments xvii and xix-xxviii there are paired groups of strong, diagonal muscles.

Remarks.—*P. compta* has been known hitherto from aclitellate specimens and only from two localities in Burma,—the Karen hills of Toungoo district on the western margin of the Shan Plateau, and Karenni on the Thai border. The Burmese specimens have fewer markings, located on 18/19–20/21, 21/22 or 22/23 and smaller setal numbers.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, on 5/6–8/9. Male pores minute and superficial, on small, disc-like porophores, slightly smaller than the genital markings and of circular to shortly elliptical outline. Genital markings small, of shortly elliptical outline, transversely placed, in 3 longitudinal rows median to male pore lines, on 18/19–25/26. Setae: vi/41–54, vii/48–56, viii/43–57, xvii/52–59, xviii/40–47, xix/44–61, 5–33/ii, 63–87/iii, 114–145/viii, 123–139/xii, 122–136/xx. First dorsal pore on 12/13. Length 135–235 mm. Diameter 6–8 mm.

Intestinal caeca simple. Testis sacs unpaired and ventral. Spermathecal duct much shorter than the ampulla; diverticulum longer than combined lengths of duct and ampulla, rod-like, comprising an ectal stalk portion, a middle portion and an elongate seminal chamber. Genital marking glands sessile on the parietes.

Pheretima elongata (E. Perrier.)

1872. *Perichaeta elongata*, E. Perrier, N. Arch. Mus. Paris, VIII, p. 124. (Type locality, "Peru." Types in the Paris Museum.)

1930. *Pheretima elongata*, Gates, Rec. Ind. Mus. XXXII, p. 309. (Bangkok and Chiengmai.)

1937. *Pheretima elongata*, Gates, Rec. Ind. Mus. XXXIX, p. 201. (Diagnosis.)

Material examined.—From the U. S. Nat. Mus.

"Mud," Chiengmai, Nov. 17, 1936, 1 juvenile specimen. H. G. Deignan.

Remarks.—Widely transported within the tropics and doubtless an importation into Thailand. The original home of the species is at present unknown, but is to be looked for in a region which includes the southern portion of the Malay Peninsula, Borneo, Celebes and New Guinea.

Pheretima evansi (Beddard).

1901. *Amyntas evansi*, Beddard, Proc. Zool. Soc. London, 1900, p. 907. (Type locality Biserat, Jalor State. Types in the British Museum).

1932. *Pheretima evansi*, Stephenson, Ann. Mag. Nat. Hist. (10), IX, p. 213. (After examination of types).

Diagnosis.—Octothecal, spermathecal pores minute (?) and superficial (?), on 5/6–8/9. Male pores on laterally directed, protuberant porophores. Genital markings very small, circular, in a transverse row of 13-16 on 7/8 (?). Setae: xviii/17-18, 54/vi, 54/ix, 66/xiii. First dorsal pore on 11/12. Length 95-120 mm. Diameter 4½ mm.

Intestinal caeca simple. Testis sac of x annular (?); of xi cylindrical, seminal vesicles included. Spermathecal duct almost as long and thick as ampulla (?); diverticulum reaching part way onto

ampulla, comprising an ovoidal seminal chamber and a slender, convoluted stalk with loops pressed together and enclosed in a sheath. Genital marking glands ?

Remarks.—Clitella appear to be lacking and spermathecae may not be fully developed. In juvenile specimens of other species spermathecal ducts and ampullae may be of about the same size, as shown in Stephenson's fig. 4. The protuberant porophores may represent everted male pore invaginations or copulatory chambers, but male genital terminalia require more accurate characterization. A stalked glandular mass median to the prostate was noted by Stephenson, for which there should be a corresponding pore or marking on or near the porophore.

P. baruana Stephenson 1932 (from Khota Baru in Kelantan State) appears to be very close to *P. evansi*, from which it can be distinguished only as follows: the slenderer spermathecal duct, length of duct relative to spermathecal diverticulum, (latter does not reach up onto ampulla), incisions of margins of intestinal caeca, the ventral and possibly paired testis sacs of x, absence of preclitellar genital markings, and presence of a postclitellar genital marking on the male porophore. Differences in spermathecae are not of especial importance, at least for the present, in view of the aclitellate condition of the types of *evansi* and the possibility that the spermathecae are not fully developed. One at least, possibly two of the types of *evansi*, lack preclitellar genital markings. The accessory prostates of Stephenson, present in both *evansi* and *baruana*, are probably genital marking glands. A genital marking gland on the male porophores as in *baruana* may have been overlooked by Stephenson on the type of *evansi* or have been unrecognizable because of immaturity or for other reasons, but this is to be expected. Condition of testis sacs in both species requires confirmation or more accurate characterization. In absence of other and more important differences, presence or absence of incisions on the margins of intestinal caeca are not significant. It is therefore possible that *baruana* is the same as *evansi*. *P. malayana* (Beddard) 1901 from Aring in Kelantan State appears to be distinguishable from the *evansi* and *baruana* by the paired postclitellar genital markings and possibly also by the condition of the testis sacs,

P. evansi is known only from the types and type locality. Possibly endemic in Peninsular Thailand and a contiguous region of the Malay Peninsula.

PHERETIMA EXIGUA GATES.

1930. *Pheretima exigua (part)*, Gates, Rec. Ind. Mus. XXXII, p. 310. (Excluding forms from Nayaungbinkwin. Type locality Lashio, Shan Plateau, Burma. Type in author's collection, Judson College.)

1936. *Pheretima exigua*, Gates, Rec. Ind. Mus. XXXVIII, p. 415. (Diagnosis.)

Material examined.—From the U. S. Nat. Mus.

Mu'ang Pon (Ban Muang, a town on the upper Me Yom), September 13, 1936, 4 clitellate specimens. H. G. Deignan.

Remarks.—Three specimens have a pair of presetal genital markings on viii; four specimens have a pair of presetal genital markings on xix.

Possibly fairly widely spread in a northern portion of Thai mainland. In Burma the distribution is from Kalaw, Taunggyi and Kengtung on the Shan Plateau north to Myitkyina.

PHERETIMA FLUVIALIS SP. NOV.

Material examined.—From the U. S. Nat. Mus.

In mud on bank of Mekhong river, Chiengsen Kao, January 16, 1937, 5 juveniles. H. G. Deignan.

Chiengsen Kao, January 15, 1937, 1 juvenile. H. G. Deignan.

Bank of Mekhong, Chiengsen Kao, January 16, 1937, 3 partially clitellate and 4 clitellate specimens. H. G. Deignan.

External characteristics.—Length 365-555 mm. Diameter 6-8 mm. The longest juvenile is 220 mm long and 4 mm in diameter. Pigmentation? Both dorsum and ventrum are dark greyish or brownish grey. The setae are on whitish bands which are very narrow, posterior to the clitellum.

Setae begin on ii on which segment there is a complete or nearly complete circle, the setae small, closely and regularly spaced, circles irregularly interrupted, the gaps containing dark pits which are presumably apertures of follicles from which setae have dropped out. Setal numbers are shown below.

vi	vii	viii	xvii	xviii	xix	ii	iii	viii	xii	xx
19	21	22	20	13	20	99	103	118	106	101*
18	16	15	16	4	14	—	—–	106	—–	—–
—	—	—	15	7	14	—	—–	—–	—–	—–
—	—	—	15	4	10	—	—–	—–	—–	—–
12	16	17	20	8	16	—	—–	—–	—–	—–
14	14	16	17	5	15	—	—–	—–	—–	—–
17	17	18	17	11	16	—	—–	—–	—–	—–

*Juvenile specimen. On other juveniles: xvii/20-21, xviii/12-14, xix/20-21.

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

The clitellum is whitish, annular, extending from 13/14 to 16/17 or onto a presetal portion of xvii; dorsal pores, intersegmental furrows and setæ lacking.

Octothecal, spermathecal pores tiny, transversely placed slits, on 5/6-8/9, each pore at the centre of a transversely placed, greyish translucent area of shortly elliptical outline.

There is a single female pore.

The male pores are tiny transversely placed slits, each pore on or near the centre of a disc-like porophore of circular or shortly elliptical outline. The porophore is marked off by a slight groove, which is deepened laterally so as to form a lid-like flap. A small area including each porophore is slightly protuberant. Presumably the porophore can be slightly depressed and the lateral flap drawn over it.

No genital markings.

Internal anatomy.—Septa 4/5-8/9 are thickly muscular, 5/6-8/9 large, funnel-shaped, apices directed posteriorly; 9/10 lacking; 10/11 and several succeeding septa slightly muscular.

The gizzard in viii. The inner wall of the oesophagus in x-xiii of juveniles is provided with low, vertical ridges which are

lacking only at the mid-dorsal and midventral lines where there are several, lower, longitudinally placed ridges. In clitellate worms definite ridges are unrecognizable though the wall is marked off into numerous small, slightly raised, rather irregular patches. The intestine begins in xv (7). Intestinal caeca are long, slender, simple, with smooth margins or with slight septal constrictions. The typhlosole which begins abruptly in or just in front of the caecal segment, is at first a high, simple, lamelliform ridge but gradually decreases in height and becomes translucent passing posteriorly, unrecognizable behind cl (1), anteriorly into xvi; at least the typhlosole is represented by a low ridge hemicircular in transverse section.

Blood glands are present in ix-iv. Pharyngeal nephridia were seen only in vi. Lymph glands are paired, one small gland on each side of the dorsal blood vessel, just in front of a septum.

The dorsal blood vessel (single) is continued anteriorly to the region of the cerebral ganglia. The supra-oesophageal is as large as the dorsal trunk in xi-xiii, very slender in xiv and disappearing from sight just anterior to 14/15. The subneural bifurcates in xvi, the branches passing laterally and then to the anterior portion of xiv where each branch passes up from the body wall, through 13/14 and then forwards just below the gut into v. From here on the trunks are small and empty. The extra-oesophageals are provided with large, transverse commissures just behind 4/5–7/8. A continuation of the subneural from xv anteriorly, if present, is unrecognizable. In the posterior portion of xiii a vessel, as large or almost as large as the heart of xiii passes dorsally from the extra-oesophageal to unite with a bifurcation of the heart that passes into the supra-oesophageal. The hearts of xi-xiii bifurcate dorsally, one branch passing to the dorsal trunk, the other to the supra-oesophageal. The supra-oesophageal divides, just in front of 10/11, into two large branches which pass ventrally (bound by transparent connective tissue to the anterior face of 10/11) to the extra-oesophageal (no connective to the ventral or dorsal trunks found). The single heart of ix is on the right side (4) or the left side (3). A fairly large vessel passing off from the dorsal trunk opposite the heart of ix can be traced only to the lateral wall of the oesophagus. In viii-v there are large, paired, heart-like commissures, passing off from the dorsal trunk but midlaterally these

commissures are abruptly narrowed and have not been traced ventrally. The heart of ix and those of xi-xiii all open into the ventral trunk. Just anterior to the heart of ix the ventral trunk is abruptly narrowed and hence anteriorly is empty. The last hearts are in xiii (8).

The testis sacs of x and xi are unpaired and ventral, the roof of each sac with longitudinal muscle fibres, the ventral blood vessel on or in the roofs of the sacs (3). Both sacs are somewhat dorsal to the nerve cord. Male funnels are not iridescent and testes appear to be undischarged. Seminal vesicles are small, vertically placed bodies in the anterior portions of xi and xii. Connective tissue, in at least one specimen, in the form of a cylinder, passes from 10/11 to 11/12, just lateral to the seminal vesicle like the wall of a cylindrical testis sac, but here there is no coagulum median to the membrane and the interior of the testis sac of xi is completely shut off from the space enclosed by the cylinder. Prostates are small and thin, confined to xviii: Prostatic ducts are large, about 10 mm. long, muscular, bent into a U-shaped loop.

The spermathecal duct is much shorter than the ampulla; lumen narrow ectally, widened from diverticular junction entally. The diverticulum, which may be as long as or longer than the combined lengths of duct and ampulla, passes into the anterior face of the duct close to or within the parietes; it comprises a muscular stalk shorter than the duct and an elongate seminal chamber (?) of about the same thickness but shortly zigzag looped, surrounded by a layer of tissue, which conceals the looping so that the ental portion of the diverticulum at first appears to be flattened, opaque and thicker than the stalk. There is no spermatozoal iridescence. There are two pairs of spermathecae in vi, one opening anteriorly, the other posteriorly; one pair each in vii and viii, both pairs opening posteriorly.

Remarks.—The clitellate specimens dissected are not sexual. Prostates may not be mature and spermathecae probably are not fully developed.

On juvenile worms each male pore is on a rather spindle-shaped, transversely placed area without sharp demarcation. On partially clitellate specimens the male porophore is demarcated by clear cut, anterior and posterior grooves which are not confluent

mesially or laterally, the surface of the porophore being slightly convex. With further development the grooves become confluent.

The intestine of one of the clitellate specimens is filled with sand from xv to the anal segment.

In all of the dissected specimens it was impossible to trace the ventral trunk anterior to ix, the extra-oesophageals anterior to v, and the heart-like commissures of viii-v ventral to the region of constriction.

P. fluvialis is close to *P. juliani* (E. Perrier) 1875 (Saigon, French Indo-China), from which it is distinguished, for the present, by the complete absence of genital markings and the simple (not convoluted) stalk of the spermathecal diverticulum. Similar replacement of hearts of x by commissural loops has been known hitherto only from *P. posthuma* but in the latter the hearts of xi have also been replaced. Each of the three species is characterized by the presence and muscularity of septum 8/9.

Diagnosis.—Octothecal, spermathecal pores tiny slits, on 5/6-8/9, each pore at centre of a transversely placed area of shortly eliptical outline and greyish translucent appearance. Male pores are, tiny transverse slits on centres of disc-shaped porophores (that can be slightly retracted and covered by lid-like lateral flaps?). Setae: vi/12-19, vii/14-21, viii/15-22, xvii/15-20, xviii/4-13, xix/10-20, 99/ii, 103/iii, 106-118/viii, 106/xii, 101/xx. First dorsal pore on 12/13. Length 365-555 mm. Diameter 6-8 mm.

Septum 8/9 present and muscular. Intestinal caeca simple. Hearts of x replaced by commissural loops, connecting the supra-oesophageal and extra-oesophageal trunks. Testis sacs unpaired and ventral. Spermathecal duct much smaller than ampulla, lumen widened from diverticular junction entally; diverticulum with muscular stalk shorter than duct, seminal chamber (?) zigzag looped and enclosed in a thick sheath.

PHERETIMA HAWAYANA (ROSA).

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

1937. *Pheretima hawayana*, Gates, Rec. Ind. Mus. XXXIX, p. 202. (Diagnosis).

Material examined.—From the U. S. Nat. Mus.

Dor Kiu Koh Ma, 1450 M, north Thailand, December 25, 1932. 1 macerated, aclitellate specimen. Hugh M. Smith.

Remarks.—*P. hawayana* is possibly a fairly recent migrant into Thailand from China, but if not, is to be regarded as an importation. In Burma it is known only from the portion of the Shan Plateau north of 22° latitude. The elevation at which the worm was found in Thailand is in accordance with the suggestion of a temperate zone origin of the species advanced in a previous paper (Gates, 1937, p. 184).

PHERETIMA HOULLETI (E. PERRIER).

1872. *Perichaeta houlleti*, E. Perrier, N. Arch. Mus. Paris, VIII, p. 99. (Type locality, Calcutta, India. Types in the Paris Museum).

1930. *Pheretima houlleti*, Gates, Rec. Ind. Mus. XXXII, p. 311. (Bawti, Not Theinko, Bangkok).

1937. *Pheretima houlleti*, Gates, Rec. Ind. Mus. XXXIX, p. 203. (Diagnosis).

Material examined.—From the U. S. Nat. Mus.

Mu'ang Pong (Ban Muang, a town on the upper Me Yom), September 13, 1936, 3 clitellate specimens. H. G. Deignan.

Chiengmai, 1,000 feet, August 9, 1936, 1 juvenile specimen. H. G. Deignan.

"Glutinous mud of a drying ditch," Chiengmai, December 10, 1936, 4 clitellate specimens. H. G. Deignan.

Abnormality.—One of the Chiengmai specimens lacks the right spermatheca of vii and has the left copulatory chamber in xvii.

Remarks.—Probably common throughout most of Thailand as it is in Burma. Also known from southern Yunnan, the Malay Peninsula, Andaman Islands and Ceylon as well as from a number of localities in India. The original home of the species is probably somewhere in a region comprising eastern Burma and Thailand.

Pheretima hupbonensis, Stephenson.

1931. *Pheretima hupbonensis,* Stephenson, Proc. Zool. Soc. London, 1931, p. 61. (Type locality Hup Bon. Type in the British Museum.)

Diagnosis.—Quadrithecal, spermathecal openings transverse slits, on 7/8-8/9. Male pores towards lateral margins of flat, slightly depressed areas that extend (including protuberant rims) nearly to setal circles of xvii and xix, each pore overhung by a small papilla. Setae: ix/9, xviii/8, 32/v, 45/ix, 54/xii, 68/xix. First dorsal pore on 11/12. Length 225 mm. Diameter 9 mm.

Intestinal caeca simple but with incisions of ventral margins, marking off ventrally directed processes with small tertiary lobes. Testis sacs paired and ventral (?). Spermathecal duct confined to the parietes; diverticulum shorter than the ampulla, comprising a muscular stalk and a slightly thicker seminal chamber about twice the length of stalk.

Remarks.—Stephenson apparently suggests that the small papilla is an everted copulatory pouch. The male genital terminalia certainly should be more accurately characterized, as well as the spermathecal pores. The caecal origin in xvii presumably is a typographical error (should be xxvii?). Testis sacs of a side are said to be continuous which must be regarded as very doubtful. If the tubercle overhanging the male pore is a genital marking, a gland on or within the parietes of xviii should be looked for.

Known only from the type. Possibly a native of Thailand.

Pheretima longicauliculata.

1931. *Pheretima longicauliculata,* Gates, Rec. Ind. Mus. XXXIII, p. 395. (Type locality, Tolo Senca Village, Mong Yang district, Kengtung State, Burma. Type in author's collection, Judson College.)

1936. *Pheretima longicauliculata,* Gates, Rec. Ind. Mus. XXXVIII, p. 423. (Diagnosis.)

Material examined.—From the U. S. Nat. Mus.

Khun Tan Mts, 4,000 feet, November 19, 1928, 1 macerated clitellate specimen. Hugh M. Smith.

Doi Sutep, 2,000 feet, October 10, 1936, 1 clitellate specimen. H. G. Deignan.

Doi Sutep, 5,500 feet, September 26, 1936, 4 clitellate specimens. H. G. Deignan.

External characteristics.—There is a complete circle of setae on ii of the Khun Tan worm. On the same specimen the following numbers were noted: vi/34, vii/37, viii/39, xvii/*ca.*30, xviii/24, xix/*ca.*30.

On the Doi Sutep specimens the genital markings are on 19/20-24/25 (3) or 19/20-25/26 (2) but one of the latter, right side only, has additional markings on 16/17-17/18 and 18/19. On the Khun Tan worm the markings are on 21/22-24/25; the markings 13-15 intersetal intervals wide, separated midventrally by a distance equal to seven or eight intersetal intervals.

On only one of the Doi Sutep specimens are the male porophores normally disc-shaped, and even on this worm the margins of the discs are covered over by a finely lobed overgrowth of the neighbouring epidermis. On other specimens the porophores are rather conical, protuberant with a pointed tip. On one specimen the porophores are retracted in such a way as to form slight, transversely slit-like invaginations, the male pores apparently are on the posterior walls of the invaginations.

Internal anatomy.—Only one pair of hearts (Khun Tan specimen) is present anterior to 10/11 and these are not close to the septum and may belong to ix.

The diverticulum (Khun Tan specimen) passes into the median face of the spermathecal duct at the parietes and is longer than the combined lengths of duct and ampulla, comprising a stalk that is nearly as long as the duct and a longer, slightly thicker cylindrical seminal chamber. The latter is looped, the looping in part approximating to a regularly zigzagged arrangement but with the limbs of the loops very short and close together. The seminal chamber is characterized by a very brilliant greenish-yellow spermatozoal iridescence. A middle region is lacking between chamber and stalk.

The body wall (Khun Tan worm) is soft and nearly transparent as a result of maceration, but, a circular patch in xviii on each

side into the centre of which the prostatic duct passes, is opaque and tougher than the surrounding portion of the integument.

Remarks.—Possibly widely spread throughout a northern portion of Thailand. In Burma this species is known from a region east of a line passing northward from the mouth of the Sittang through Taunggyi and then eastward into southern Yunnan.

PHERETIMA MANICATA.

1931. *Pheretima suctoria* var. *manicata.* Gates, Rec. Ind. Mus. XXXIII, p. 414. (Type locality, Moulmein. Types in author's collection, Judson College).

1936. *Pheretima manicata,* Gates, Rec. Ind. Mus. XXXVIII, p. 432. (Diagnosis).

Material examined.— From the U. S. Nat. Mus.

A.

Doi Sutep, 5,200 feet, October 17, 1936, 1 clitellate specimen. H. G. Deignan.

Doi Sutep, 5,500 feet, September 26, 1936, 3 clitellate specimens. H. G. Deignan.

B.

Doi Angka (Doi Intanon), 4,600 feet, September 6, 1935, 3 clitellate specimens. "Under rotting logs." H. G. Deignan.

A.

External characteristics.— The setae begin on ii on which segment there is a complete circle and are fine, difficult to see, apparently more widely spaced than usual, the circles often with gaps in which no setal pits are visible. The formulae below are only approximations as the cuticle cannot be removed without damaging the epidermis.

vi	vii	viii	xvii	xix	xii
23	22	21	22	26	61
18	21	22	24	26	58
23	21	25	g	g	—
22	23	23	24	27	—

g= gaps in setal circle.

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

The clitellum extends from 13/14 to 16/17 (2) or only onto the middle portion of xvi (3). Setae appear to be lacking ventrally on xvii on those specimens with clitellar glandularity terminating at 16/17 and one of the others, as well as on xviii, setae present ventrally on xvi (2).

The male pore discs are shortly elliptical in outline and longitudinally placed.

The two genital markings, nearly circular in outline, are on xviii fairly close to the male porophores and separated mid-ventrally by a distance equal to about eight intersetal intervals, reaching further towards 18/19 than towards 17/18.

Internal anatomy. (Opened two specimens). The prostates may extend through xvi-xxi. The prostatic duct is about five mm. long, the ectal half thickened.

The lumen in the wider ental portion of the spermathecal duct opens into the narrowed lumen in the slender, ectal portion of the duct through a minute pore at the centre of a tiny, rather disc-shaped, papilla of circular outline, the papilla with a smooth, glistening surface. The spermathecal diverticulum is twisted into a spheroidal mass. The seminal chambers are characterized by a spermatozoal iridescence.

Remarks.—These worms were received in alcohol. After examination they were placed in formalin. A year later cuticle could be removed and when this was done male setae (6) were found on one specimen. On other specimens male setae are lacking and a transverse strip of epidermis on xviii between the genital markings is abnormally thin. The Doi Sutep worms differ from specific topo-types in the more circular shape of the genital markings, the slight elongation of the male porophores and (in part) the absence of male setae. These differences are not of taxonomic importance.

B.

External characteristics.—The largest specimen is 109 mm. long (the posteriormost portion apparently autotomized) and 6½ mm. thick. Other specimens are about five mm. thick and appear to have also lost some posterior portions. The pigmentation, restricted to the dorsum, is reddish brown to brownish.

The setae begin on ii, on which segment there is a complete circle, and are fine, more closely spaced ventrally than dorsally. The setal circles with few interruptions. There are no male setae on xviii on any of the specimens. The formula of one specimen is: vi/22, vii/23, viii/22, 42/ii, 48+/iii, 73/viii, 77/xii, 74/xxi (+ indicates presence of gaps in the setal circle).

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

The clitellum is annular, extending from 13/14 to mid xvi; intersegmental furrows lacking, functional dorsal pores present, setae probably present on xvi but deeply retracted and unrecognizable externally (2). The clitellum is brownish and contracted, not protuberant.

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

There is a single female pore (3).

The male pores are minute and superficial, each pore on a disc-shaped porophore of circular or nearly circular outline.

The two genital markings are median. The anterior marking is on xvii, not quite reaching to 16/17 but dislocating 17/18 posteriorly. The posterior marking belongs perhaps to xix but reaches anteriorly only to the setae of xix (1) or just through the setae of xix (1) or over the posterior three quarters of xix (1) and posteriorly to the setae of xx or on to the anterior margin of xx. On one specimen a transverse area between the male pore discs is marked off by fairly deep anterior and posterior furrows, but the area is not marked off laterally. On the other two specimens the anterior furrow, just about at the level of the anterior margin of the male porophores, is alone present. The epidermis on the region marked off by those furrows appears to be slightly thickened, but the longitudinal musculature is uninterrupted internally by glandular material.

Internal anatomy. (Opened one specimen. The internal anatomy is practically the same as in typical specimens of *P. manicata* from the type locality).

The intestine begins in xvi, the intestinal caeca in xxviii; xxix and xxx are unusually well developed and provided with anteriorly directed finger-shaped, secondary caeca.

The testis sacs are unpaired and suboesophageal, the sac of xi partially hermiated into xii. The seminal vesicles are large, the

the vesicles of a segment in contact above the dorsal blood vessel, the anterior vesicles dislocating 10/11 anteriorly. The prostates extend through xv-xxiii. The prostatic duct is five to seven mm. long, the ectal half thickened.

The spermathecal duct is larger and thicker than in typical forms of *manicata*, but without being bulbous. The disc-shaped porophore within the duct is larger than in any previous specimens of *manicata*, and much more readily found.

The sessile, genital marking glands are large and median.

Parasites. Sessile on the parietes close to the nerve cord are large reddish to yellowish cysts, usually rather shortly ovoidal, the long diameter two mm. or slightly less. In the spermathecal region there are four of these cysts, behind the prostatic region 34 more. In addition there are several similar cysts but of smaller size and more nearly spheroidal in the post-prostatic segments.

Remarks.—The worms can be distinguished from *P. manicata* at present only by the unpaired, median genital markings. All specimens hitherto referred to *P. manicata* have always had symmetrically paired genital markings (and one pair only) on xviii. In *P. anomala* there is some evidence to indicate that parasites may inhibit the development of genital markings or induce development of supernumerary markings. Possibly in *P. manicata* the same or other parasites can influence the development of genital markings so as to produce the condition described above.

PHERETIMA MORRISI (BEDDARD).

1892. *Perichaeta morrisi*, Beddard, Proc. Zool. Soc. London, 1892, p. 166. (Type locality, Penang. Type in British Museum ?).

1937. *Pheretima morrisi*, Gates, Rec. Ind. Mus. XXXIX, p. 205. (Diagnosis.)

Material examined.—From the U. S. Nat. Mus.

Chiengmai, 1,000 ft. August 15, 1936, 2 clitellate specimens. H. G. Deignan.

Remarks.—Each specimen has a pair of genital markings just median to each male pore, and unpaired, median, presetal markings on vi-vii.

Like *hawayana* this species may be a fairly recent migrant into Thailand from China or else an importation.

PHERETIMA PAPULOSA (ROSA).

1896. *Perichaeta papulosa*, Rosa, Ann. Mus. Genova, XXXVI, p. 525. (Type locality, Balighe, Sumatra. Types in Genoa Museum.)

1901. *Amyntas papulosus*, Beddard, Proc. Zool. Soc. London, 1900, p. 892. (Biserat, Jalor State.)

1932. *Pheretima papulosus*, Stephenson, Ann. Mag. Nat. Hist. (10), IX, p. 224. (After examination of Beddard's specimens from Biserat.)

Diagnosis.—Sexthecal, spermathecal pores minute and superficial, on 5/6-7/8. Male pores minute and superficial, on small, disc-like porophores. Genital markings small, circular discs in transverse rows on vii-ix and xvii-xix, the markings on xvii in pre- and post-setal patches of two or three rows. Setae present ventrally on clitellum: vi/13-16, vii/14-17, xvii/14-19, xviii/11-15, xix/16-22, 6-11/xvi, 60/v, 61/ix, 60/xii, 57-67/xx. First dorsal pore on 12/13. Length 52-78 mm. Diameter 3-5 mm.

Intestinal caeca simple. Testis sacs unpaired: of x horse-shoe-shaped; of xi cylindrical, seminal vesicles included. Spermathecal duct as long as or longer than ampulla; diverticulum with short, slender stalk and longer, looped seminal chamber. Genital marking glands stalked and coelomic.

Remarks.—Beddard was unable to find "any trace" of intestinal caeca. Stephenson, however, found caeca, partly covered by coagulum in one specimen. In the other worm, from which Beddard had removed the gut, caeca may have been completely retracted into the intestinal lumen. Stephenson notes that the testis sac of x is "annular in shape, continuous dorsally across the middle line, but, I think, interrupted in the middle line ventrally." Such an interrupted sac is, of course, not completely annular, hence horseshoe-shaped is a more accurate description. According to Stephenson the seminal chamber of the spermathecal diverticulum is ovoidal.

P. papulosa is known only from four widely separated localities, Biserat in the southern portion of Peninsular Thailand, Kengtung,

on the eastern part of the Shan Plateau, Mong Mong Valley in southern part of Yunnan province (China), and Balighe in Sumatra. (Possibly also a fifth locality in Formosa, Michaelsen, Cap. Zool. I, 3, p. 36, 1922). The species may be native to Thailand.

PHERETIMA PEGUANA (ROSA).

1890. *Perichaeta peguana* Rosa, Ann. Mus. Genova, XXX, p. 113. (Type locality Rangoon, Burma. Type in the Genoa Museum).

1898. *Perichaeta peguana* Rosa, Ann. Mag. Nat. Hist. (7), II, p. 289. (Chantaboon).

1930. *Pheretima peguana* Gates, Rec. Ind. Mus. XXXII, p. 318. (Bangkok, Chiengmai, Chiengrai).

1936. *Pheretima peguana* Gates, Rec. Ind. Mus. XXXVIII, p. 444. (Diagnosis).

Material examined.—From the U. S. Nat. Mus.

Chiengmai, 1,000 feet, August 14, 1936, 3 clitellate specimens; August 9, 1936, 1 clitellate specimen; August 15, 1936, 6 clitellate specimens; October 2, 1936, 1 clitellate specimen; October 11, 1936, 1 clitellate specimen. H. G. Deignan.

Doi Sutep, 1,600 feet, October 3, 1936, 1 clitellate specimen. H. G. Deignan.

"In rich soil of a banana grove," Ban Sa-iep, a village in the basin of the Me Yom, September 9, 1936, 8 clitellate specimens. H. G. Deignan.

Mu'ang Pong (Ban Muang), September 13, 1936, 1 clitellate specimen. H. G. Deignan.

Remarks.—Probably fairly common in the lowlands of Thailand, as it is in the lowlands of Central Burma. Unknown from the Shan Plateau except for one record from Mogok which is near the extreme western margin. Has been found twice in Lombok, twice in Java, once at Saigon, and once at Penang. The original home of the species is unknown.

PHERETIMA PERICHAETA (BEDDARD).

1901. *Amyntas perichaeta*, Beddard, Proc. Zool. Soc. London, 1900, p. 896. (Type locality Patalung State? Type in the British Museum).

1932. *Pheretima perichaeta*, Stephenson, Ann. Mag. Nat. Hist. (10), IX, p. 227. (After examination of type).

Diagnosis.—Sexthecal, spermathecal openings on 6/7–8/9. Male pores in large copulatory chambers with transversely slit-like apertures. Setae: xviii/12, 30/v, 36/ix, 39/xii, 40/xix. First dorsal pore on 12/13. Length 160 mm. Diameter 5 mm.

Intestinal caeca simple. Last hearts in xii. Testis sacs paired (?) and ventral (?). Spermathecal duct practically confined to the parietes; diverticulum slenderly tubular, reaching to or nearly to ental end of ampulla, except for a short ectal portion twisted into a ball of closely compacted loops.

Remarks.—Known only from the type. Copulatory chambers and structures therein or thereon such as glands, markings, penes and male pores have not been characterized so that a proper diagnosis is impossible. The species may be close to the Burmese *P. mamillana* Gates 1931 from which it is distinguished at present by the absence of hearts in xiii, the short and slender spermathecal duct and the compact coiling of an ental portion of the spermathecal diverticulum.

PHERETIMA PLANATA GATES.

1926. *Pheretima planata*, Gates, Ann. Mag. Nat. Hist. (9), XVII, p. 411. (Type locality, Rangoon. Type in author's collection, Judson College.)

1937. *Pheretima planata*, Gates, Rec. Ind. Mus. XXXIX, p. 207. (Diagnosis.)

Material examined.—From U. S. Nat. Mus.

"Glutinous mud of a drying ditch," Chiengmai, December 10, 1936, 1 clitellate specimen. H. G. Deignan.

"In cultivated ground cleared from evergreen jungle," Ko Chang, May 11, 1937, 2 aclitellate and 2 clitellate specimens. H. G. Deignan.

Remarks.—Probably fairly widely spread throughout Thailand as it is throughout Burma. Known from the Malay Peninsula, Assam (India) and the Andaman Islands but has been found at only three localities on the Shan Plateau.

PHERETIMA POSTHUMA.

1868. *Perichaeta posthuma*, (part), L. Vaillant, Ann. Sci Nat. (3), X, p. 228. (Type locality, Java. Types in the Paris Museum.)

1930. *Pheretima posthuma*, Gates, Rec. Ind. Mus. XXXII, p. 321. (Bangkok and Chiengmai.)

1937. *Pheretima posthuma*, Gates, Rec. Ind. Mus. XXXIX, p. 207. (Diagnosis.)

Material examined.—From the U. S. Nat. Mus.

Chiengmai, 1,000 feet, August 15, 1936, 7 clitellate specimens, H. G. Deignan.

"In rich soil of a banana grove", Ban Sa-iep, a village in in the basin of the Me Yom, September 9, 1936, 1 clitellate specimen. H. G. Deignan.

Mu'ang Pon (Ban Muang), a town on the upper Me Yom, September 13, 1936, 3 clitellate specimens. H. G. Deignan.

Ban Huai Rai, Phre province, November 4, 1936, 1 juvenile specimen. H. Gaylord Knox per H. G. Deignan.

"Glutinous mud of a drying ditch", Chiengmai, December 10, 1936, 4 clitellate specimens. H. G. Deignan.

Remarks.—Probably fairly common in sand of river banks throughout Thailand, especially in the lowlands. Rather widely spread throughout Burma but unknown from the Shan Plateau where a closley related species has been found. Possibly a native of Siam? also known from a number of localities in northern India, as well as the Andaman Islands.

PHERETIMA VIRGO (BEDDARD).

1901. *Amyntas virgo*, Beddard, Proc. Zool. Soc. London, 1900, p. 895. (Type locality Tale, Singora State? Types in the British Museum.)

1932. *Pheretima virgo,* Stephenson, Ann. Mag. Nat. Hist. (10), IX, p. 236. (After examination of types.)

1934. *Pheretima virgo,* Gates, Rec. Ind. Mus. XXXVI. p. 264. (After examination of types.)

Diagnosis.— Sexthecal, spermathecal openings large, on 6/7-8/9. Male pores in copulatory chambers with transversely slit-like apertures (?). Setae: xviii/12, 36-39/v, 44-48/ix, 41-51/xii. First dorsal pore on 11/12. Clitellum does not reach 13/14 or 16/17. Length 152-157 mm. Diameter 5 mm.

Intestinal caeca simple. Testis sacs unpaired (?) and ventral (?). Glands on anterior and posterior faces of copulatory chambers, prostatic duct into dorsal face. Spermathecae ?

Remarks.—As a result, perhaps, of the presence of parasites, all of the types that were dissected are aberrant. Spermathecae cannot be specifically characterized and nothing is known of such taxonomically important structures as markings, penes, etc., of the copulatory chambers. Until normal specimens have been studied or recognized as belonging to this species a proper diagnosis cannot be given. Quite possibly *P. mendosa* Gates 1932 from the peninsular portion of Burma (Mergui district and also southern part of Tavoy district) is a synonym but the Burmese species likewise is only known from abnormal individuals. Closest relationships of *virgo* and *mendosa* appear to be with the Burmese *P. mamillana* Gates 1931, from which they are distinguished by the location of the genital marking glands on the copulatory chambers (anterior and posterior rather than median and lateral) and also, if *mendosa* is a synonym, by the penes and genital markings within the copulatory chambers.

P. virgo presumably is endemic in a northern portion of the Malay Peninsula.

PHERETIMA SP.

I

Material examined.—From the U. S. Nat. Mus.

Ban Huai Rai, Phre province, November 4, 1936, 2 clitellate specimens, in rather poor condition. H. Gaylord Knox, per H. G. Deignan.

External characteristics.—Length, 240-250 mm. probably incomplete posteriorly. Diameter, 11 mm. Pigmentation restricted to the dorsum, dark blueish grey.

The setae are small and closely spaced, the circles with numerous gaps. There is a single ventral seta on ii of each specimen. The setal numbers are as follows: vi/35+, vii/34+, viii/35+, xviii/31, 1/ii, 48+/iii, 83+/viii, 91+/xii; vi/48+, vii/54, viii/51, xviii/33.

The first dorsal pore is on 12/13 (2).

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

Octothecal, spermathecal pores minute and superficial, on 5/6-8/9.

The male pores are minute and superficial, each pore at or near the centre of a small disc-shaped porophore with longitudinally elliptical outline.

Genital markings are paired, on 19/20, each marking protuberant, 10-11 intersetal intervals wide, with outline approximating to longitudinally elliptical, extending anteroposteriorly to the setae of xix (which are slightly dislocated anteriorly) and through the setal circle of xx nearly to 20/21. The midventral space between the markings is eight to ten intersetal intervals wide.

Internal anatomy (Opened one specimen).—Septa 5/6-7/8 are muscular; 8/9-9/10 lacking; 10/11-11/12 thickly muscular.

The intestine begins in xv. The intestinal caeca are simple, the margins with slight septal constrictions. On the oesophagus just behind the gizzard and in front of the heart of ix is a large, lobed, glandular collar.

The single heart of ix is on the left side. The last pair of hearts is in xiii. All hearts of ix-xiii pass into the ventral blood vessel.

The testis sacs of x and xi are unpaired and ventral, the nerve cord on the ventral faces of the sacs. The seminal vesicles of xi are large, filling the segment and in contract dorsally above the dorsal blood vessel. The vesicles of xii are still larger and push 12/13 and the next two septa posteriorly. The prostates extend through xvii-xix. The prostatic duct is about ten mm. long, with

muscular sheen, bent into a U-shaped loop, the ectal limb slightly thickened.

The spermathecal duct is sharply marked off from the ampulla, slender, slightly shorter than the ampulla, abruptly narrowed within the parietes; the lumen rather large, with annular ridges on the inner wall, and abruptly narrowed in the region of the diverticular junction. The diverticulum which passes into the anterior face of the duct ectally, near the parietes, is slender, rather rod-shaped, longer than the combined lengths of duct and ampulla but looped, the looping, at least in part, approximating to a regular zigzag. An ental portion of variable length is not looped but is nearly straight. A seminal chamber is not especially marked off externally and is not characterized by spermatozoal iridescence but an ental portion equal to one half to two thirds of the length of the diverticulum is filled with an opaque whitish material. In the ectal portion the lumen is somewhat narrower and the wall is ridged longitudinally.

The genital marking glands are sessile on the parietes.

Remarks.—Distinguished from *P. longicauliculata* by the single pair of genital markings and their longitudinally elliptical outline and possibly also by spermathecal characteristics.

II

Material examined.—From the U. S. Nat. Mus.

Kao Sabab, S. E. Thailand, June 29, 1931, 3 macerated, aclitellate specimens. Hugh M. Smith.

External characteristics.—Length, 120-170 mm. Diameter, 6 mm.

First dorsal pore on 11/12 (1), 12/13 (2).

St. xviii/8, 10, 7; viii/12, 10, 11.

Quadrithecal, spermathecal pores minute and superficial, on 7/8-8/9.

Male pores minute and superficial, each pore at the centre of a small transversely placed, shortly elliptical area of parietal translucence in the setal circle.

Internal anatomy.—Heart of ix on the right side (2), left side (1). Hearts of x not found. Last hearts in xiii (3).

Testis sacs of x and xi (apparently) paired and widely separated. Intestine begins in xv. Intestinal caeca compound, the dorsalmost secondary caecum the longest and with (3-4) long, ventrally directed tertiary caeca from ventral margin.

Remarks.—The worms were so soft that they disintegrated during examination.

Genus Perionyx E. Perrier 1872.

Perionyx excavatus E. Perrier.

1872. *Perionyx excavatus*, E. Perrier, N. Arch. Mus. Paris, viii, (3) p. 126. (Type locality Saigon, Cochin China. Types in the Paris Museum).

1891. *Perionyx excavatus*, Rosa, Ann. Nat. Mus. Wien, VI p. 404. (Bangkok, "Insel Koulan.")

1923. *Perionyx excavatus*, Stephenson, Oligochaeta in The Fauna of British India, p. 329. (Diagnosis).

Remarks.—Probably fairly common in a considerable portion of Thailand.

Perionyx sp.

Material examined.—From the U. S. Nat. Mus.

"Under moss and ferns on spray drenched rock at waterfall," Doi Sutep, 3,200 feet, March 24, 1937, 1 clitellate but macerated and unidentifiable specimen. H. G. Deignan.

Remarks.—Possibly *Perionyx excavatus.*

Genus Dichogaster Beddard 1888.

Several small species of *Dichogaster* are widely spread through the tropics. Five, all of which are doubtless importations, have been found in Burma. Some if not all of these are probably to be found in Thailand. The peregrine Dichogasters though small are usually larger than the Ocnerodrilids.

DICHOGASTER AFFINIS (MICHAELSEN).

1890. *Benhamia affinis*, Michaelsen, Mitt. Mus. Hamburg, VII, p. 9. (Type locality Quilimane, Zanzibar. Type in the Hamburg Museum.)

1917. *Dichogaster affinis*, Stephenson, Rec. Ind. Mus. XIII, p. 413. (Tale Sap.)

1923. *Dichogaster affinis*, Stephenson, Oligochaeta in Fauna of British India, p. 471. (Diagnosis).

Remarks.—"The identification is not absolutely certain. as the specimen was not fully mature." (Stephenson 1917, p. 413).

An importation, presumably directly or indirectly from Africa, the home of the genus.

DICHOGASTER SP.

Material examined.—From the U. S. Nat. Mus.

"In crown of coconut tree," Chiengmai, 1,000 feet, October 6, 1936, 2 juveniles. H. G. Deignan.

"On wet leaf on ground in evergreen jungle," Ko Chang, May 11, 1937, 1 juvenile. H. G. Deignan.

"Under old leaf bases of a coconut tree," Chiengmai, 1,000 feet, September 3, 1936, three specimens. H. G. Deignan. (These worms dried out during transit and cannot be identified specifically).

FAMILY OCNERODRILIDAE.

The Ocnerodrilidae have been supposed to be characteristic of the warmer regions of the Americas and Africa. In recent years species of several genera, unknown elsewhere, have been discovered in the Seychelles, India and Burma. Chen (1938) has erected a new genus and species for an Ocnerodrilid from Hainan. Unfortunately all of these Asiatic Ocnerodrilids are of such a size as to be of all earthworms most easily transported accidentally. Records of occurrence of earthworm species of the size of these Ocnerodrilids are rare, for two reasons, neglect by collectors of the very small forms and failure to collect in the proper habitats. In these circumstances it is impossible to determine whether Asiatic Ocnerodrilids are pere-

grine immigrants and accidents or native to the regions from which in part at least they are now alone known. Collecting from swampy and marshy areas has secured in Burma in the last year numbers of specimens of six species, any of which might as well be expected from Thailand.

Family Glossoscolecidae.

Subfamily Glossoscolecinae.

Genus Pontoscolex Schmarda 1861.

Pontoscolex corethrurus (Fr. Müller).

1857. *Lumbricus corethrurus*, (Fr. Müller), Arch. Natg. XXIII, p. 113. (Type locality, Itajahy, Brazil. Types?).

1923. *Pontoscolex corethrurus*, Stephenson, Oligcchaeta, in F. B. I. p. 489. (Diagnosis).

Material examined.—From the U. S. Nat. Mus.

Chiengmai, 1,000 feet, August 15, 1936, 7 clitellate specimens. H. G. Deignan.

"In cultivated ground cleared from evergreen jungle," Ko Chang, May 11, 1937, 1 clitellate specimen. H.G. Deignan.

Remarks.—An importation directly or indirectly from America. Now widely spread throughout the tropics. Probably quite common throughout the lowlands of Thailand.

Subfamily Microchaetinae.

This family is represented in the faunas of India, Burma, the Malay Peninsula and China by one genus, *Glyphidrilus* Horst 1889. Although but five species have been recorded from the areas just mentioned, [1] and from few localities, it is probable that these forms are widely spread and common in the peculiar habitat to which they seem to be especially adapted. In Burma glyphidrilids are to be found only in mud at bottoms of lakes, ponds, tanks, irrigation ditches, etc., and for that reason are but rarely obtained by collectors, but can occasionally be secured without difficulty and in numbers as recession of water in the dry season leaves the bottom mud exposed.

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[1] Further species are known from the Malay Archipelago and East Africa.

FAMILY LUMBRICIDAE.

One species, *Bimastos parvus* (Eisen) 1874, has been introduced into Burma and the Malay Peninsula perhaps by man, but has been collected hitherto only at certain summer resorts in the hills. The species may possibly have been introduced into similar places in Thailand.

Notes on *Pheretima bianensis* from French Indo-China.

PHERETIMA BIANENSIS STEPHENSON.

1931. *Pheretima bianensis*, Stephenson, Proc. Zool. Soc. London, 1931, p. 58. (Type locality Lang Bian Peaks, South Annam, 6,000 feet. Types in the British Museum.)

Material examined.—From the Indian Museum.

Suikat Drau, S. Annam, 3 aclitellate and somewhat macerated specimens. Dr. Malcolm Smith.

External characteristics.—The setae begin on ii on which segment there is a complete circle: vi/20, vii/26, viii/28, xvii/22, xviii/15, xix/21; vi/18, vii/24, viii/23, xvii/20, xviii/14, xix/19; vi/22, vii/24, viii/27, xvii/20, xviii/17, xix/24. The setae of v-vii, and to a less extent those of viii, are enlarged dorsally.

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

Octothecal, spermathecal pores minute and superficial, on 5/6-8/9. Each pore may be on a tiny, circular, smooth porophore.

The male pores are minute, on very tiny conical protrusions into copulatory chambers with wide, transversely slit-like apertures.

The genital markings are tiny, circular discs, presetal, in transverse rows, one row on each side of ix, slightly median to the spermathecal lines. The following numbers were noted: right-3, left-5; right-4, left-5; right-3, left-0.

Internal anatomy.—On the oesophagus, just behind the gizzard, there is a low, glandular collar. The intestinal caeca are simple, with septal constrictions.

The single hearts of ix are on the right side (2). The last pair of hearts is in xiii (2). All hearts of ix to xiii pass into the ventral trunk. The hearts of x are bound by connective tissue to the anterior face of 10/11.

The testis sacs of x and xi are unpaired and suboesophageal; distended by coagulum. The seminal vesicles of xi are attached to the roof of the testis sac so that the sac is opened on removing the vesicle. By removing all of the testicular coagulum from the sac through the opening thus made in a lateral portion of the roof of the sac on one side, it is possible to explore the other half of the testis sac which appears to be completely roofed over under the seminal vesicle. So far then as can be determined the vesicles of xi are excluded. The copulatory chambers are flattened out on the parietes and to each of them are attached a number of coelomic, long-stalked glands. The lumen of each chamber is horizontally slit-like and on the wall are a number of very tiny genital markings bearing the pores of the stalked glands. Ten of these markings were counted in one chamber.

The spermathecae are not fully developed, but a duct is clearly marked off from and about as long as or slightly longer than the rather heart-shaped ampulla. The diverticulum, which passes into the anterior face of the duct at the parietes, is slender with a shortly ovoidal swelling of the ental end.

The genital marking glands are coelomic, long-stalked, of about the same size and shape as the spermathecal diverticula.

Remarks.—Michaelsen (1934) has erected *var. duplofasciata* for specimens having a non-muscular bulb, protuberant into the lumen of the copulatory chamber from the lateral wall. The diverticular stalk is not sharply marked off from the seminal chamber of the spermatheca.

Diagnosis.—Octothecal, spermathecal pores minute and superficial, four pairs, on 5/6–8/9. Male pores minute, each pore on a very tiny, conical protrusion into a copulatory chamber with transversely slit-like aperture. Genital markings tiny, circular discs in a transverse, presetal row of 3–5 on ix, just median to each spermathecal pore line. Setae: vi/18–22, vii/24–26, viii/23–28, xvii/20–22, xviii/14–20, xix/19–24, 32/v, 43/ix, 50/xii, 55/xix. First dorsal pore on 12/13. Length 100 mm. Diameter 5 mm.

Intestinal caeca simple. Testis sacs unpaired and ventral (paired according to Stephenson). Long-stalked glands (5–10) to each copulatory chamber with tiny genital markings on inner wall.

Spermathecal diverticulum with long, looped stalk and shortly ovoidal seminal chamber (?). Genital marking glands long-stalked and coelomic.

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