

FIRST CONTRIBUTION TO THE KNOWLEDGE OF THE INDO-MALAYAN CAMPODEIDAE (THYSANURA-ENTOTROPHA).

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The Thysanura belonging to the family *Campodeidae* are small insects ranging from one to a few millimeters in size, and are found on decayed wood and leaves, under stones, in humus or in earth at different depths. Because of their small size and hiding habit they are somewhat neglected by the general collectors, but considering the number of specimens from the Indo-Malayan Region that I have seen and the number of the species, there can be little doubt that this part of the world is very poor in species of *Campodeidae*. I refer to and describe in this paper two species and a subspecies of the genus *Campodea*, two species and 3 subspecies of the genus *Lepidocampa*, certainly a very small number for the wide area comprised by the Indo-Malayan Region.

Future researches in the low tropical zone will not, I believe, materially increase the number of the *Campodeidae*, but careful collecting in high temperate localities will, perhaps, reveal the existence of interesting types for comparison with forms known from South Europe and the Far East.

Genus *Campodea*.

Subgenus *Indocampa*, nov.

Corpus thoracis macrochaetis ut in *Campodea*, subgen. *Campodea* Pr. 3+3, Mes. 3+3, Mt. 2+2, sed setis marginalibus nonnullis longis macrochaetas simulantibus instructum; abdominis tergita primum ad septimum macrochaetis nullis; setis marginalibus posticis praesertim sublateralibus et lateralibus quam superficiei longioribus. Pedes femore macrochaeta dorsuali destituto, praetarsi unguibus attenuatis arcuatis sed parum ante dimidiam longitudinem plus minusve abrupte arcuatis, angulum obtusum plus minusve manifestum formantibus, et parte basali externa transverse vix sulcata, setis lateralibus unguium longitudinem subattingentibus plus minusve attenuatis.

Species typica: *Camp. (Indocampa) chaseni*, sp. nov.

Observatio. Subgenus hoc inter cetera thoracis setarum marginalium nonnullarum et urotergitorum 1—7 posticarum lateralium longitudine et praesertim praetarsi unguium forma distinctum est.

Campodea (Indocampa) chaseni, sp. nov.

Corpus stramineum setis minoribus brevioribus attenuatis, integris vel subintegris μ 45-55 longis, setis majoribus et macrochaetis plus minusve barbatis.

Caput praeter setas breviores modice numerosas setis paucis consuetis parum longioribus, setis occipitalibus attenuatis brevissime barbatis. Antennae 22-articulatae, articulis setis brevioribus et aliis brevibus apice plus minusve bifurcato ut fig. I, 1-2 demonstrant, articuli tertii macrochaeta laterali externa mm 0,90 longa.

Thorax. Pronotum macrochaetis submedianis anticis 1+1 sat longis, macrochaetis sublateralibus anticis 1+1 submedianis similibus, macrochaetis lateralibus 1+1 quam sublaterales aliquantum longioribus (mm 0,11 longis), omnibus breviter barbatis, setis margi-

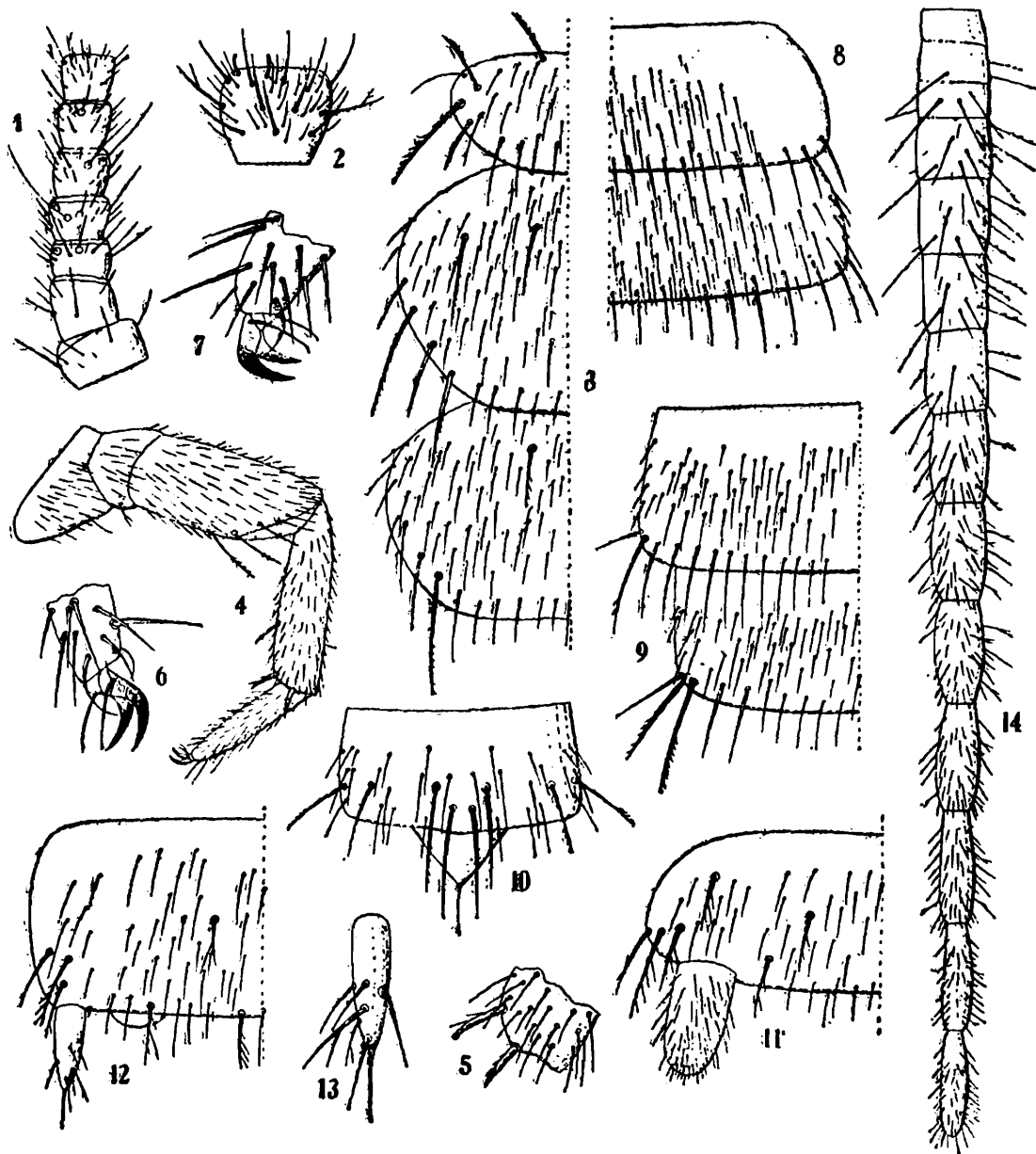


FIG. 1.—*Campodea (Indocampa) chaseni*, sp. nov.

1. antennae dexteræ pars proximalis prona; 2. eiusdem antennae articulus decimus magis ampliatus pronus; 3. thoracis dimidia pars prona; 4. pes paris tertii; 5. eiusdem tibiae apex magis ampliatus; 6. pedis paris tertii tarsi apex et præ-tarsus lateraliter postice parum oblique et 7. omnino lateraliter inspecti; 8. urotergitorum primi et secundi dimidia pars; 9. urotergitorum septimi et octavi dimidia pars; 10. urotergitum decimum cum valvula supranali; 11. urosterni primi dimidia pars; 12. urosterni quinti dimidia pars; 13. eiusdem stilus magis ampliatus; 14. cercus dexter.

nalibus posticis quam superficiei presertim a prima (a macrochaeta) ad tertiam gradatim longioribus robustis et prima barbata ceteris integris vel subintegris; mesonotum macrochaetis submedianis 1+1 longis, sublateralibus subanticis (1+1) quam submedianæ parum longioribus, lateralibus subposticis 1+1 quam sublaterales aliquantum longioribus, margine postico seta etiam macrochaetam lateralem subposticam præcedenti et præsertim setis duabus sequentibus gradatim longioribus

et barbatis; metanotum macrochaetis subanticis nullis cetero mesonoto simili

Sterna setis nonnullis praesternalibus et nonnullis ad acetabuli marginem anticum sat longis ramulosis.

Pedes femore macrochaetis apicalibus infera et antica breviter barbatis, tibia macrochaeta infera postmediana brevior apice brevissime bifurcata, calcaribus spiniformibus robustis ramulis brevissimis auctis, tarso quam tibia aliquantum brevior, setis integris, praetarsi unguibus bene arcuatis, angulum obtusum formantibus, seta basali simplici quam ungues parum brevior, crassiuscula.

Abdomen. Tergita 1—7 macrochaetis nullis setis marginalibus posticis quam superficiei gradatim a submedianis ad sublaterales aliquantum longioribus et seta postica laterali gradatim a tergito secundo ad septimum gradatim longiore, seta laterali postica brevi simplici, setis marginalibus posticis barbula minima plerisque instructis; tergita 8—9 macrochaetis posticis, laterali supera et infera, sat longis (mm 0,11) et breviter barbatis astructa; tergum decimum macrochaetis subposticis 3+3, submedianis sat longis, ceteris brevioribus, omnibus aliquantum barbatis, macrochaetis posticis 4+4, quarum submedianae sat longae, ceterae gradatim breviores, parum robustae, omnibus simplicibus.

Urosternum primum macrochaetis 6+6, appendicibus lateralibus cylindraceis quam sternum parum brevioribus; urosterna 2—7 macrochaetis 6+6, stilis quam sternum dimidio brevioribus seta infera submediana et seta praemediana laterali bifurcatis, seta apicali processu spiniformi minimo uno basali aucta; urosternum octavum macrochaetis posticis 1+1 bene barbatis.

Cerci quam corpus breviores, 12-articulati, articulo primo indistincte diviso, articulis 1—7 setis brevibus et nonnullis longis breviter pennatis, articulis ceteris setis brevissimis numerosis et setis nonnullis brevioribus bifurcatis instructis.

Long. corporis ad mm 2,50, long. antennarum 1,30, pedum paris tertii 0,92, cercorum 1,60.

Habitat. Exempla duo legi ad Johore (British Malaya) in humo infossa.

Observatio. Species haec Clar. F. N. Chasen, Raffles Musei Directori, dicata, ad *C. Butteli* Silv. proxima est, sed cercorum articulorum dimidia parte distali setis tantum brevissimis et brevioribus vestitis et praesertim praetarsi unguibus magis obtuse arcuatis distinctissima est.

***Campodea (Indocampa) greeni*, sp. nov.**

Corpus stramineum setis dorsualibus minoribus attenuatis simplicibus, mesonoti μ 25-30 longis, seta marginali nonnulla et macrochaetis parum barbatis.

Caput supra setis brevissimis sat numerosis simplicibus, setis frontilibus anticis medianis aliquantum longioribus simplicibus, setis occipitalibus brevissime barbatis; antennae 18-articulatae, articulis primo et secundo setis nonnullis brevioribus et brevibus integris vel paullum barbatis, articulo tertio setis paucioribus et brevibus, macrochaetis sat longis (supera externa mm 0,09 longa), sensillo apicali externo subcylindraceo, trichobothriis consuetis, articulis ceteris (decimo exempli

gratia) parum (semper ad apicem) latiore quam longiore setis nonnullis brevioribus et brevibus, quarum proximales praesertim, partim apice bifurcato instructis.

Thorax. Pronotum macrochaetis 3+3, submedianis anticis brevibus, sublateralibus quam submedianae parum brevioribus et ad laterales multo approximatis, lateralibus quam sublaterales magis quam duplo

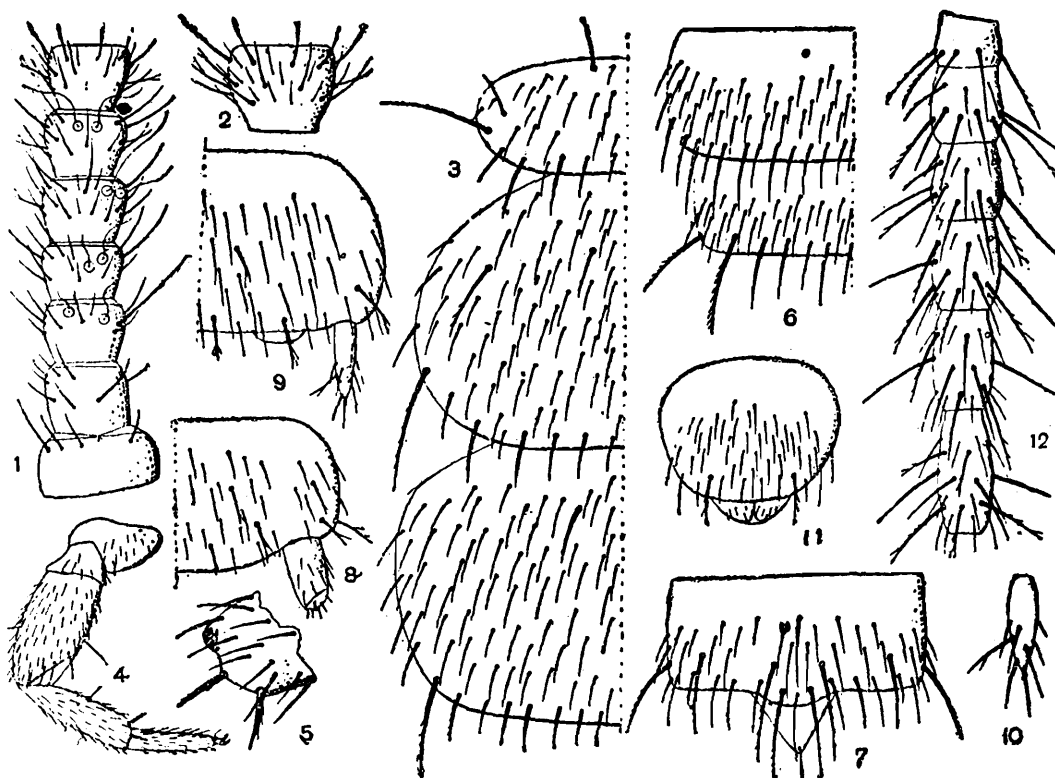


FIG. II.—*Campodea (Indocampa) greeni*, sp. nov.

1. antennae dexteræ pars proximalis prona; 2. eiusdem antennae articulus decimus magis ampliatus pronus; 3. thoracis dimidia pars prona; 4. pes paris tertii, 5. eiusdem tibiae apex magis ampliatus; 6. urotergitorum septimi et octavi dimidia pars; 7. urotergite decimum cum valvula supranali; 8. urosterni primi dimidia pars; 9. urosterni quinti dimidia pars; 10. eiusdem stilus magis ampliatus; 11. urosternum octavum cum papillis genitalibus; 12. cerci laevi pars proximalis.

longioribus, mm 0,10 longis, setis marginalibus posticis prima (a macrochaeta laterali) quam superficiei aliquantum crassiore et barbulis minimis 1—2 aucta, setis secunda et tertia (seta subtiliore haud sumpta) quam superficiei aliquantum longioribus, ceteris gradatim brevioribus; mesonotum macrochaetis 3+3, breviter barbatis gradatim a submedianis ad laterales subposticas (mm 0,10 longas) longioribus, setis marginalibus, macrochaetam praecedenti et sequenti, quam superficiei parum crassioribus, setis marginalibus posticis eisdem pronoti similibus; metanotum macrochaetis subanticis sublateralibus destitutum cetero mesonoto simili.

Pedes femore macrochaetis ventrali subdistali et marginali antica infera brevibus subtilibus barbulis duabus auctis, tibia macrochaeta ventrali brevior apice brevissime bifurcato, calcaribus breviter parum barbatis, tarso setis ventralibus simplicibus, praetarsi unguibus attenuatis obtuse arcuatis basi lateraliter transversa vix sulcata, setis lateralibus simplicibus.

Urosternum primum macrochaetis 6+6 apice bifurcato et laterali postica externa barbulis duabus aucta; urosterna 2—7 macrochaetis 4+4 barbulis longiusculis, stilis seta infera submediana parte distali;

bifurcata, seta apicali processu basali uno minimo ; urosternum octavum macrochaetis posticis 1+1, barbulis tribus auctis.

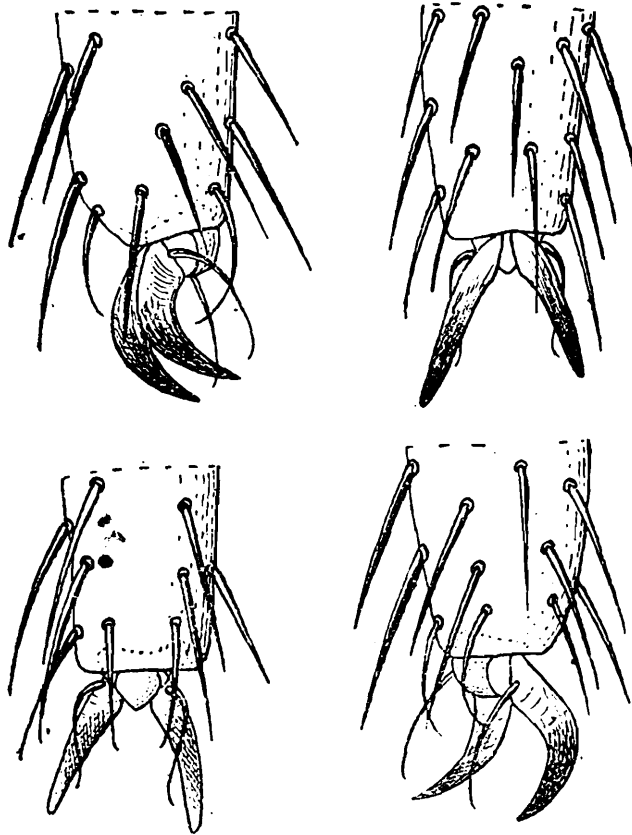


FIG. III.—*Campodea (Indocampa) greeni*, sp. nov. : pedis paris tertii tarsi apex et praetarsus antice, supra, sub, et postice inspecti.

Cerci in exemplis typicis maxima pro parte abruptis, parte sistente (mm 0, 52 longa) 6-articulata, articulis a tertio gradatim paulum longioribus setis brevibus et parum longis (articuli tertii supera externa mm 0, 08 longa) partim bene barbatis, partim integris vel subintegris et setis nonnullis brevissimis apicalibus instructis.

Long. corporis ad mm 1, 80, long. antennarum 0,90, pedum 0,52, cercorum ?

Habitat : Ceylon : Namunakuli, exempla tria typica clar. E. E. Green legit.

Observatio. Species haec, Clar. E. E. Green dicata, ad *Campodea (Ind.) butteli* Silv. perproxima est, sed tergitorum setis marginalibus aliquantum brevioribus et macrochaetis distincte barbatis (haud vel vix in *C. butteli*) et urotergitis octavo et nono macrochaetis duabus posticis sublateralibus et lateralibus barbatis (tantum macrochaeta laterali infera barbata in *C. butteli*) et cercorum macrochaetis partim bene barbatis (in *C. butteli* omnibus integris vel subintegris) distincta est.

***Lepidocampa weberi* Oudemans.**

Oudemans, J. T. Apterygota des Indischen Archipels in : Weber's *Zool. Erg. Niederl. Ost-Indien* I, p. 76, Taf. VII, Fig. 6-12 (1890).

Silvestri, F. On Some Thysanura in the Indian Museum—*Records of the Ind. Mus.* IX, p. 51 (1913), and Campodeidae Insecta Thysanura dell' Estremo Oriente. *Boll. Labor. Zool. Portici* XXV, p. 309, Fig. XX-XXI (1931).

This species first, described by Oudemans from the Islands of Sumatra, Java, Saleyer and Flores and afterwards recorded by me from India, Indochina, China, Japan and redescribed (1931), has a very wide distribution in tropical and subtropical Asia and Malaysia. In the collection of Indian Museum there are specimens from the following localities: Khed, Ratnagiri Dist.; Kierpur, Purneah Dist.; Pophli, Vashishti V. Ratnagiri Dist.; Purulia, Manbhum Dist., Chota Nagpur; Madhupur, Bengal; Tambi, Koyna Valley, Satara Dist. c. 2100 ft. (Gravely).

I have also seen specimens from Borneo: Mt. Dulit, collected by Dr. Mjöberg.

I must note that the specimens of this species examined were generally in not good condition of preservation especially for the antennae and cerci and for the scales, therefore it is always possible that under the same specific name are comprised different varieties or subspecies, but this will be possible only after a study of large series of well preserved specimens; meanwhile I am able to distinguish two subspecies which are described below.

For the characters of the form which I consider as true *Lep. weberi* Oud., I refer the students to my description of 1931 cited above.

***Lepidocampa weberi* subsp. *borneensis*, nov.**

Corpus cremeum; caput supra setis parum numerosis subtilibus brevissimis et brevioribus, setis genalibus et frontalibus lateralibus parum longioribus (mm 0,065 longis), setis frontalibus medianis et submedianis

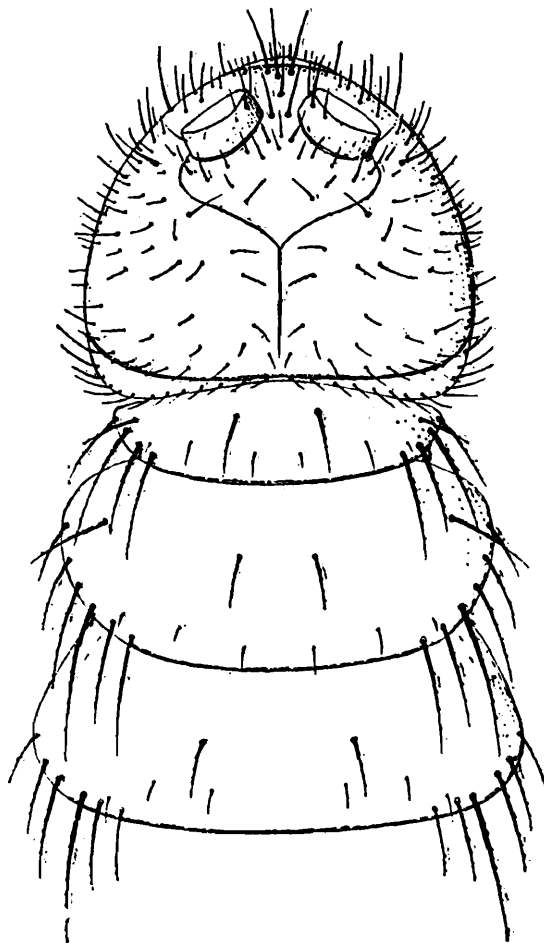


FIG. IV.—*Lepidocampa weberi* var. *borneensis*, nov.: caput et thorax prona.

anticis aliquantum longioribus integris, setis occipitalibus integris; antennae 24-28-articulatae articulis praesertim 3° et 4° macrochaetis longis (articuli tertii macrochaeta supra externa mm 0, 16 longa) integris, articulis a septimo setis brevioribus et setis aliquantum longioribus biserialis, omnibus integris instructis.

Thorax. Pronotum macrochaetis lateralibus 5, quarum antica sublateralis brevior est, macrochaetis submedianis marginem posticum non vel vix superantibus, omnibus ut macrochaetae meso- et metanoti externae vix rãre serrulatis; meso- et metanotum macrochaetis lateralibus bene evolutis, macrochaetis submedianis brevibus, marginem posticum tractu sat longo haud attingentibus et parum robustis.

Sterna praesterno et parte ad acetabuli marginem anticum macrochaetis nonnullis bene barbatis instructa.

Pedes femore macrochaeta dorsuali, macrochaetis ventralibus duabus submediana et subapicali et macrochaetis apicalibus anticis 5 ab infera gradatim minoribus, tibia macrochaeta infera proximali brevior, calcariibus robustis integris, tarso setis omnibus integris, praetarsi unguibus lateralibus valde arcuatis, femoris, tibiae, praeter subapicalem sat longum, et tarsi, praeter submedianum ceteris longius, sensillis chaeticis brevioribus.

Abdomen. Tergita macrochaetis typicis longis, robustis, integris vel vix barbatis.

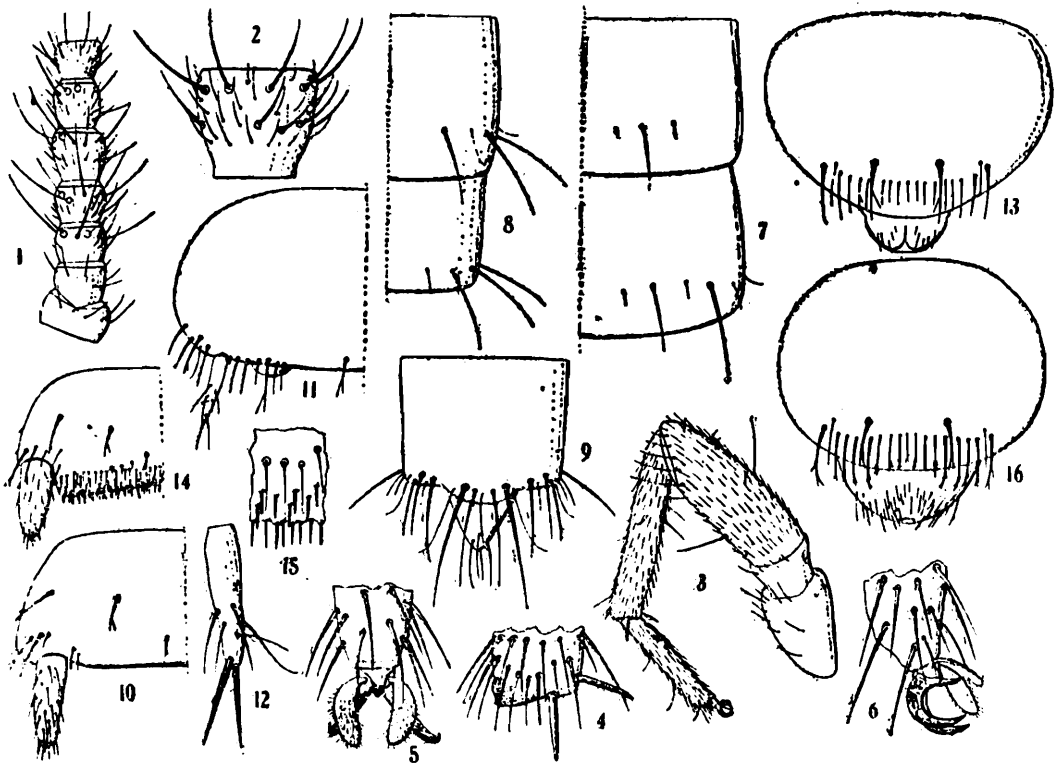


FIG. V.—*Lepidocampa weberi* var. *borneensis*, nov.

1. antennae laevae pars proximalis prona; 2. eiusdem antennae articulus quintus decimus; 3. pes paris tertii; 4. eiusdem tibiae apex magis ampliat; 5.—6. tarsi apex et praetarsus subtus et lateraliter inspecti; 7. urotergitorum tertii et quarti dimidia pars; 8. urotergitorum septimi et octavi dimidia pars; 9. urotergite decimum cum valvula supranali; 10. urosterni primi dimidia pars; 11. urosterni quinti dimidia pars; 12. eiusdem stilus magis ampliat; 13. urosternum octavum cum papillis genitalibus; 14. maris urosterni primi dimidia pars; 15. eiusdem urosterni particula postica submediana magis ampliata; 16. maris urosternum octavum cum papilla genitali.

Urosternum primum macrochaetis brevibus 6+6 bifurcatis, appendicibus lateralibus apicem versus paulum attenuatis; urosterna 2—7 macrochaetis posticis lateralibus 4 et seta subtili, macrochaetis submedianis brevibus bifurcatis 1+1, macrochaetis ad latus internum stili 4, quarum quarta interna aliquantum longiore, bifurcata et setis duabus subtilibus, stilis elongatis seta subapicali apicalem longitudine aequante vel paulum superante et quam eadem paulum crassiore, apicali dente minimo basali aucta; vesiculis bene evolutis.

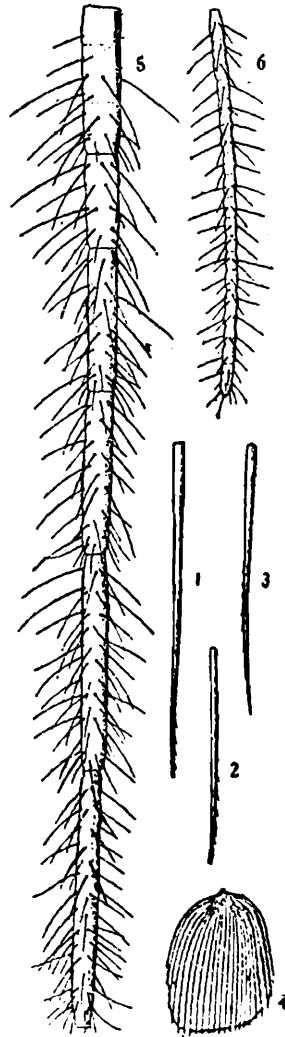


FIG. VI.—*Lepidocampa weberi* var. *borneensis*, nov.

1. mesonoti macrochaeta lateralis subpostica multo ampliata; 2. urotergiti septimi macrochaeta lateralis multo ampliata; 3. urotergiti decimi seta submediana multo ampliata; 4. urotergiti quarti squama subpostica; 5. cerci laevi proni pars proximalis; 6. cerci eiusdem articulus ultimus (eadem amplitudine delineatus).

Urosternum octavum setis posticis 17 ab externa ad medianam gradatim minoribus integris vel subintegris et macrochaetis duabus integris vel subintegris et macrochaetis duabus subposticis submedianis bifurcatis nec non seta sublaterali subpostica subtiliore.

Cerci in exemplis typicis 10-articulati articulo primo divisionibus duabus obsoletis affecto, articulis a secundo gradatim longioribus (articulo sexto mm 0, 50 longo et articulo decimo mm 0, 75) articulis omnibus setis numerosis parum brevibus et sat longis pluriseriatis (articuli sexti seriebus transversalibus c. 14 et articuli decimi c. 19) setis omnibus integris.

♂ Urosternum primum macrochaetis brevibus 6+6, quarum 5 apice bifurcato, parte postica inter appendices setis brevissimis subposticis

attenuatis 1—2 seriatis et setis brevissimis numerosis glandularibus 3—4 seriatis aucta, appendicibus lateralibus parum attenuatis, marginem posticum medianum aliquantum superantibus. Urosternum octavum a feminae differt setis posticis parum longioribus robustioribus et parte distali bene pennata.

Long. corporis ad mm 4,20, long. antennarum 1,85, pedum paris tertii 1,10, cercorum 4.

Habitat. Borneo : Mt. Poi, Sarawak (alt. m. 60) exempla typica cl. Dr. E. Mjöbey legit et exemplum paratypicum majus (corporis long. mm 5 et antennarum articularum numero 30) super Mt. Penrissen (Sarawak, 950 m alt.).

Observatio. Species haec macrochaetis submedianis tergitorum thoracalium brevioribus, cercis longioribus, setis magis numerosis integris, corporis macrochaetis dorsualibus vix spinulosis a *L. weberi* Oud. typica facile distinguenda est.

***Lepidocampa weberi* Subsp. *ceylonica*, nov.**

♀ Corpus album vel stramineum.

Caput setis genalibus submedianis et anticis 7-8 attenuatis c. mm 0,13 longis, quam setae frontales anticae submedianae paullum longioribus, vertice setis brevibus c. 12+12 instructo, setis occipitalibus integris vel subintegris.

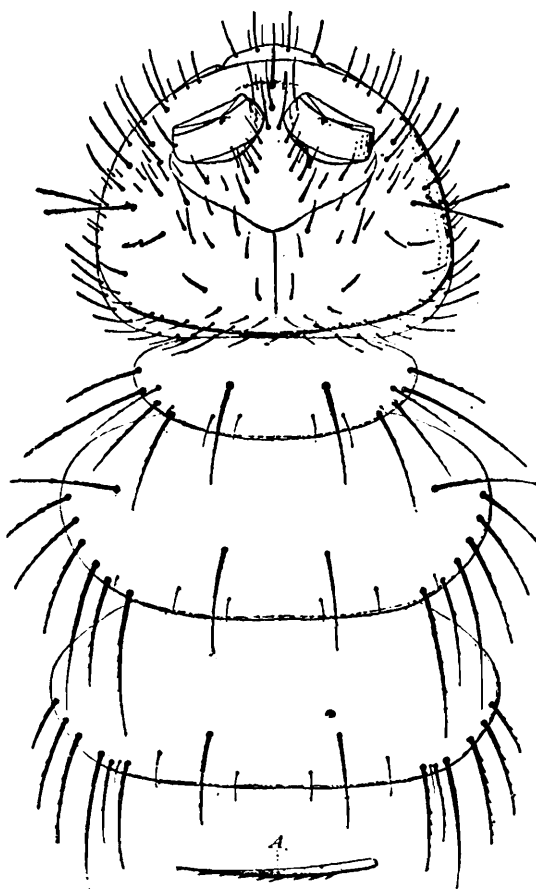


FIG. VII.—*Lepidocampa weberi* var. *ceylonica*, nov. ; caput et thorax prona ; A, metanoti seta lateralis postica magis ampliata.

Antennae 33-articulatae (in exemplo nonnullo antenna altera 28, altera 36-articulata vel 33-36), articulis 3° et 4° macrochaetis longis. articuli tertii macrochaeta supera mm 0,20 longa, articulis a septimo

setis brevibus sat numerosis et setis nonnullis transverse biseriatis aliquantum longioribus integris vel subintegris instructis.

Thorax. Pronotum macrochaetis 6+6, quarum secunda lateralis quam ceterae longior est et submediana sublateralem posticam subaequans, setis minoribus posticis 3+3, quarum submedianae pronoti marginem posticum paullum superant; mesonotum macrochaetis 8+8, quarum duae subanticae sublaterales et duae submedianae subposticae

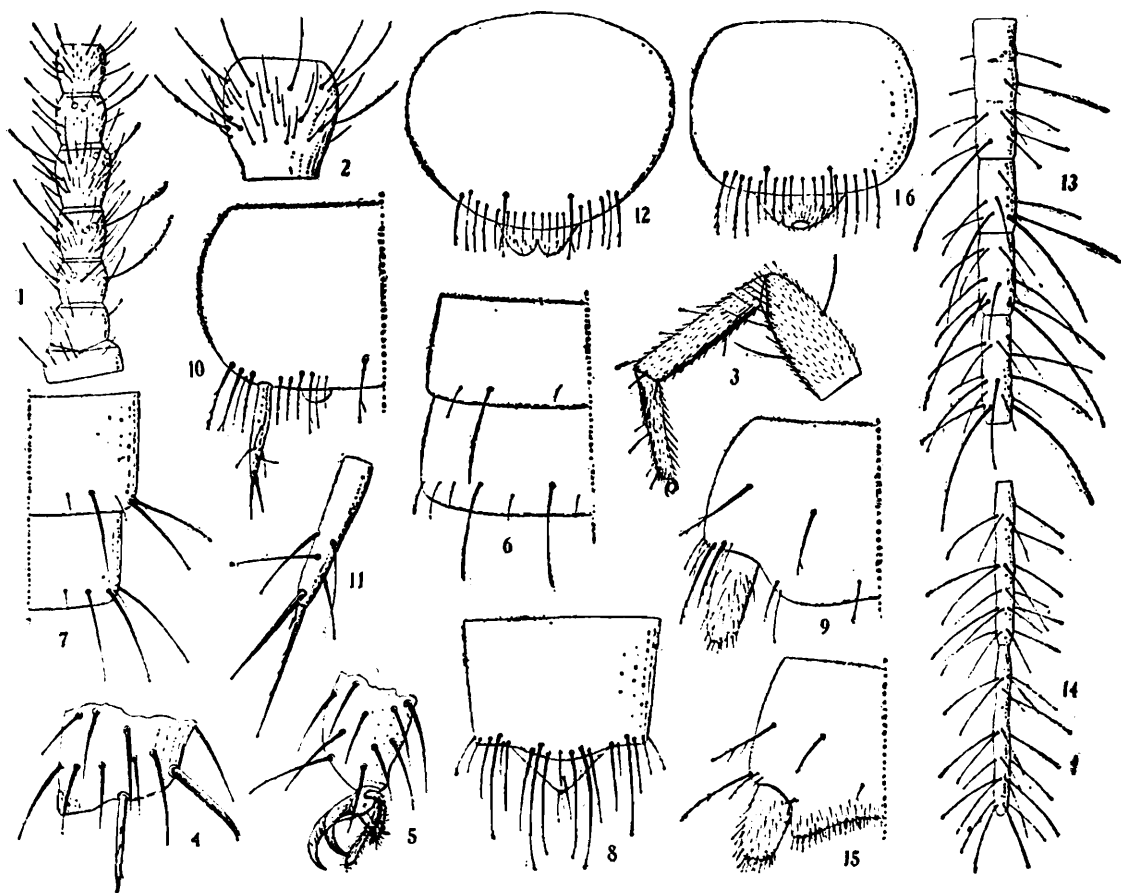


FIG. VIII.—*Lepidocampa weberi* var. *ceylonica*, nov.

1. antennae dexterae pars proximalis; 2. eiusdem antennae articulus quintus decimus; 3. pes paris tertii a femore; 4. eiusdem tibiae apex magis ampliatus; 5. tarsi apex et praetarsus lateraliter inspecti magis ampliati; 6. urotergitorum tertii et quarti dimidia pars; 7. urotergitorum septimi et octavi dimidia pars; 8. urotergite decimum cum valvula supraanali; 9. urosterni primi dimidia pars; 10. urosterni quinti dimidia pars; 11. eiusdem stilus magis ampliatus; 12. urosternum octavum; 13.—14. cerci dexteri pars basalis et pars apicalis; 15. maris urosterni primi dimidia pars.

subaequales, ceterae marginales, quarum quarta et sexta quam ceterae longiores, setis minoribus 3+3 brevioribus; metanotum macrochaetis subanticis sublateralibus nullis; macrochaetis omnibus brevissime unilateraliter (externe) barbatis.

Prosternum antice et ad acetabuli marginem anticum, meso- et metasternum etiam ad acetabuli marginem anticum macrochaetis nonnullis breviter barbatis instructa.

Pedes breviter bene setosi, tertii paris feminae macrochaetis submediana dorsuali et ventrali et apicalibus anticis ab infera gradatim minoribus, tibia macrochaeta brevior infra proximali et setis subtilioribus, brevibus superis 4, calcaribus sat robustis, infero apice vix inciso, supero vix barbulato, tarso quam tibia aliquantum brevior setis omnibus integris, praetarsi unguibus lateralibus bene arcuatis attenuatis.

Abdomen. Tergitum primum macrochaetis nullis tantum setis minimis 1+1, tergita 2—3 macrochaeta laterali et setis minoribus utrimque duabus, tergitum quartum macrochaetis 2+2, tergita 5—9 macrochaetis 3+3 sublateralibus, lateralibus et infero-lateralibus longis (c. mm 0,60), robustis, attenuatis integris vel vix barbatis; tergitum decimum macrochaetis posticis 6+6, quarum secunda submediana quam ceterae longior est.

Urosternum primum macrochaetis transverse submedianis 2+2, quarum sublateralis quam altera bifurcata parum longior et ramulis nonnullis aucta, postice inter appendices macrochaetis 2+2 bifurcatis et seta subtili sublaterali, ad latus externum appendicium macrochaetis tribus et seta subtili, appendicibus cylindraceis duplo longioribus quam ad basim latioribus breviter setosis et setis apicalibus nonnullis brevioribus instructis. Urosterne 2—7 macrochaetis posticis 4+4+1+1+4+4 et setis subtilibus 1+2+2+1, stilis elongatis, seta apicali ramulo basali brevi aucta et cetera vix barbata vel subintegra; vesiculae magnae. Urosternum octavum postice macrochaetis 16 et setis subtilibus 1+1, macrochaetis subposticis 1+1 bifurcatis parum barbatis.

Cerci quam corpus breviores, 9-articulati, gradatim attenuati articulis omnibus setis sat longis nonnullis et setis paucis praeapicalibus longis (basalibus externis mm 0,22 longis) omnibus integris.

♂ Urosternum primum parte mediana pone appendicium basim aliquantum productum margine parum sinuato setis numerosis subposticis brevissimis attenuatis et setis posticis subcylindraceis brevissimis 1—2 seriatis aucto, appendicibus lateralibus brevibus subcylindraceis. Urosternum octavum setis posticis quam feminae robustioribus et magis ramosis.

Long. corporis ad mm 4, *long.* antennarum 2, pedum paris terti 1,30, cercorum 2,10.

Larva alba, *long.* corporis mm 1,56, *long.* antennarum 1, cercorum 0,84.

Corpus squamis, setis et macrochaetis adulto subaequale.

Antennae 18-articulatae.

Cerci 6-articulati setis adulti cercis similes.

Habitat. Ceylon: Namunakuli.

Observatio. Species haec a *L. weberi* subsp. *borneensis* Silv. tergitorum thoracalium macrochaetis submedianis longioribus praesertim distincta est et a forma typica *L. weberi* etiam urosterno octavo setis posticis 16 instructo.

***Lepidocampa gravelyi*, sp. nov.**

♀ Corpus album; caput vertice setis numerosis brevibus subtilibus, setis genalibus anticis 4 ad antennarum basim sat longis robustis, frontalibus medianis vix barbatis, setis occipitalibus majoribus vix barbatis. Antennae 20—23 articulatae, articulis 1° et 2° setis nonnullis brevibus robustis breviter pennatis, 3° et 4° macrochaetis longis (terti macrochaeta laterali externa mm 0,13 longa), trichobotriis sat brevibus, articulis a septimo setis nonnullis brevibus et brevioribus, integris, ut fig. X, 1 et 2 demonstrant.

Thorax. Pronotum macrochaetis lateralibus 5, quarum secunda quam ceterae parum longior, macrochaetis submedianis brevibus, omni-

bus brevissime barbatis ut eadem meso- et metanoti, setis subtilioribus posticis 2+2 brevissimis; mesonotum macrochaetis lateralibus 6, quarum tertia quam ceterae parum longior, macrochaeta subantica sublaterali sat longa, *macrochaetis submedianis nullis*, setis subtilibus

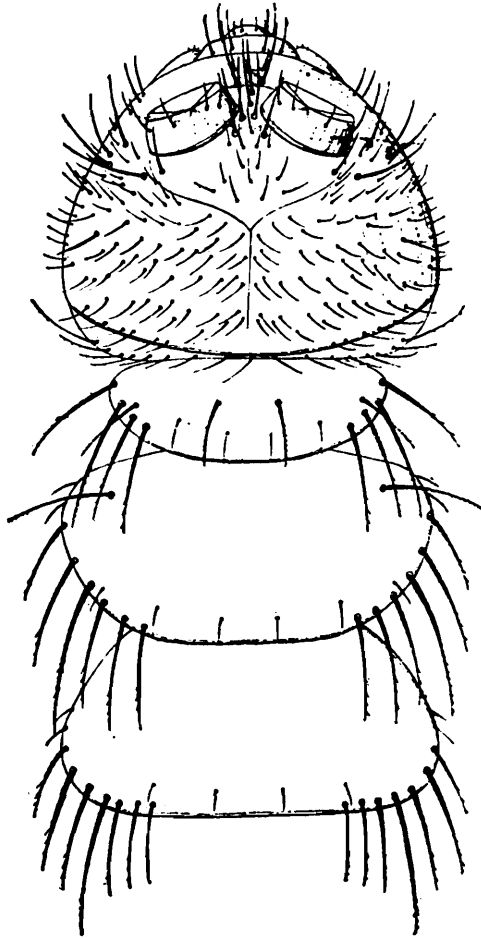


FIG. IX.—*Lepidocampa graveleyi*, sp. nov.: caput et thorax prona.

lateralibus anticis utrimque duabus et setis subtilioribus posticis 2+2 brevioribus; metanotum macrochaetis subanticis sublateralibus et submedianis nullis, macrochaetis lateralibus 7+7, quarum quarta quam ceterae aliquantum longior est.

Sterna parte antica et ad acetabuli marginem anticum praesertim setis nonnullis sat longis ramulosis instructa.

Pedes femore macrochaeta infera submediana, macrochaeta infera subapicali antica et aliis 3 apicalibus anticis gradatim minoribus, tibia macrochaeta ventrali nulla, calcaribus robustis a basi brevissime barbatis, praetarsi unguibus lateralibus bene arcuatis.

Abdomen. Tergitum primum macrochaetis nullis, secundum et tertium macrochaeta sublaterali, tergita 4—7 macrochaetis sublaterali, laterali et laterali infera, tergita 8—9 etiam macrochaeta infera sublaterali, macrochaetis sat longis et vix barbatis; tergitum decimum macrochaetis superis posticis 4+4 et macrochaeta brevissima robustiore etiam barbata ad latus internum macrochaetae sublateralis et setis subtilioribus 2+1+2, quarum sublateralis brevissima.

Urosternum primum macrochaetis transverse submedianis duabus (submediana et sublaterali) et macrochaetis posticis 3+3 et setis subtilibus duabus inter appendices, macrochaeta duabus ad earundem latus externum sat longis et barbatis et setis duabus subtilibus, appendici-

bus cylindraceis breviter setosis; urosterna 2—7 tantum macrochaetis posticis instructa 6+6 inter stilos et tribus ad eorundem latus externum, nec non seta subtili inter quartam et quintam macrochaetam a stilo; stilis elongatis seta infera submediana breviter barbata, seta subapicali robusta quam apicalis parum brevior et ut eadem brevissime barbata, vesiculis consuetis; urosternum octavum setis duabus lateralibus subposticis subtilibus, macrochaetis duabus submedianis subposticis bene barbatis et setis posticis 15, quarum a sublaterali ad medianam gradatim minores, subtiliores et laterales tantum breviter barbatae sunt.

Cerci quam corpus breviores, 16-articulati articulo primo tractu longo divisionibus obsoletis, articulis ceteris brevibus, gradatim aliquantum longioribus, articulis omnibus setis numerosis brevioribus integris instructis.

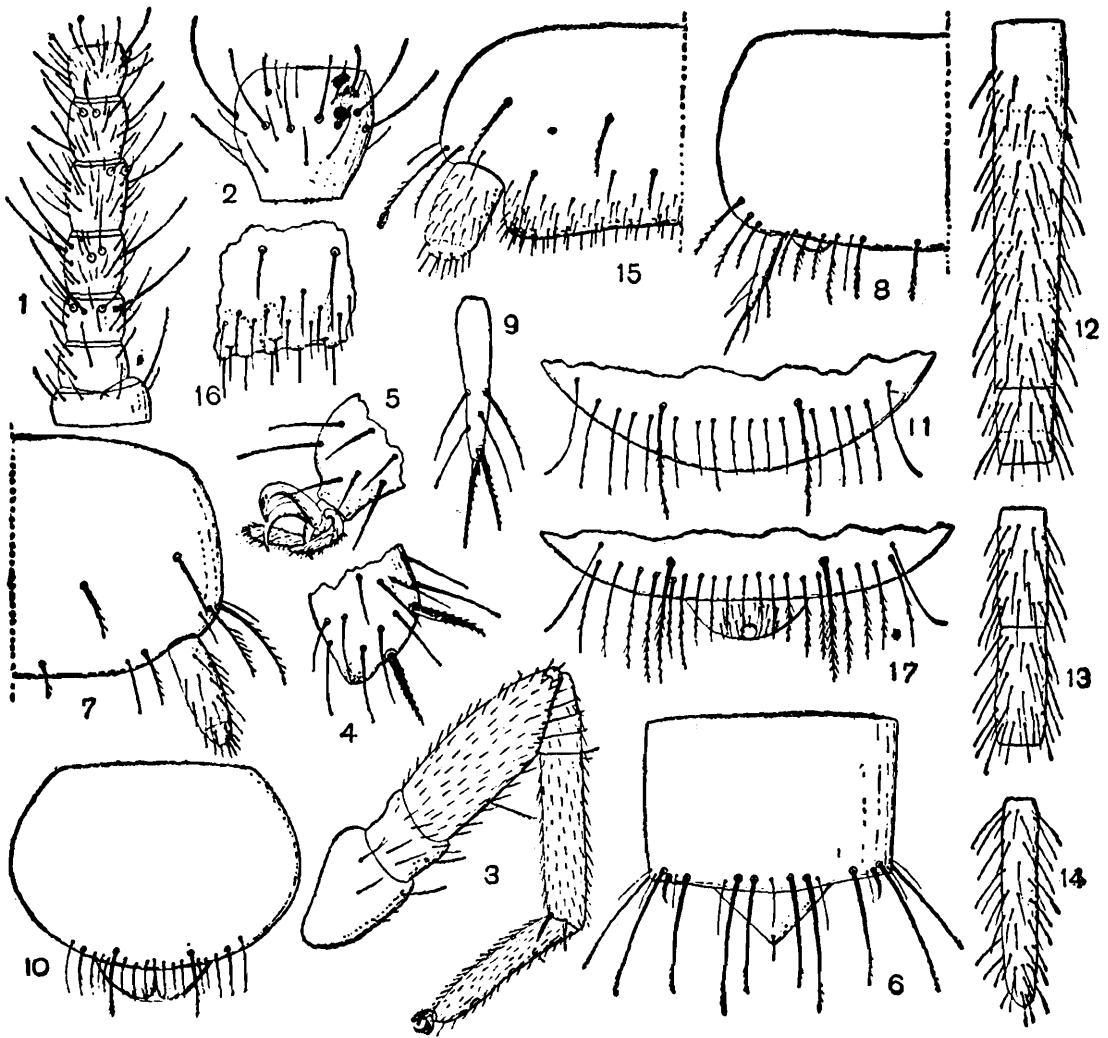


FIG. X.—*Lepidocampa gravelyi*, sp. nov.

1. antennae dexterae pars proximalis prona; 2. eiusdem articulus quintus decimus magis ampliatus; 3. pes paris tertii; 4. eiusdem tibiae apex magis ampliatus; 5. tarsi apex et praetarsus lateraliter inspecti (magis ampliati); 6. urotergum decimum cum valvula supranali; 7. urosterni primi dimidia pars; 8. urosterni quinti dimidia pars; 9. eiusdem stilus magis ampliatus; 10. urosternum octavum cum papillis genitalibus; 11. eiusdem margo posticus magis ampliatus; 12.—14. cerci dexteri pars proximalis, pars submediana et pars apicalis; 15. maris urosterni primi dimidia pars; 16. eiusdem particula postica submediana magis ampliata; 17. maris urosterni octavi pars postica magis ampliata.

Long. corporis ad mm 3,50, long. antennarum 1,50, pedum paris tertii 1,10, cercorum 1,80.

♂ Urosternum primum appendicibus lateralibus brevioribus cylindraceis marginem posticum tractu breviori superantibus, parte postica inter appendices setis subtilibus brevioribus, numerosis, 1—2 inordinatim transverse seriatis subposticis et setis glandularibus posticis sat numerosis 1—2 transverse seriatis aucta.

Urosternum octavum setis posticis 19 plus minusve barbatis, quarum lateralis libellam setae subposticae sublateralis externae haud superans, macrochaetis submedianis subposticis robustioribus.

Habitat. Madras (F. H. Gravely legit).

Observatio. Species haec ad *L. takahashii* Silv. perproxima est sed verticis setis magis numerosis, setis occipitalibus lateralibus aliquantum brevioribus, antennarum articularum numero, pronoti macrochaetis submedianis brevioribus et meso- et metanoti macrochaetis etiam majoribus facile distinguenda est.

***Lepidocampa gravelyi*, var. *submissa*, nov.**

Caput vertice setis sat numerosis, sed aliquantum minus numerosis quam in forma typica.

Antennae 17—18 articulatae (in feminis ovigeris).

Long. corporis ad mm 2,60, long. antennarum 1,30, pedum paris tertii 0,70, cercorum 1,30.

Larva prima. Antennae 14-articulatae, long. corporis mm 1,50.

Habitat. Exempla nonnulla in Barkuda insula (Chilka Lake; Ganjam Dist. Madras) Dr. N. Annandale legit sub saxis.

Observatio. Varietas haec characteribus dictis bene distincta est.

A REVISION OF THE DISTANTIAN AND PAIVAIA TYPES OF NOTONECTIDAE AND CORIXIDAE IN THE INDIAN MUSEUM.

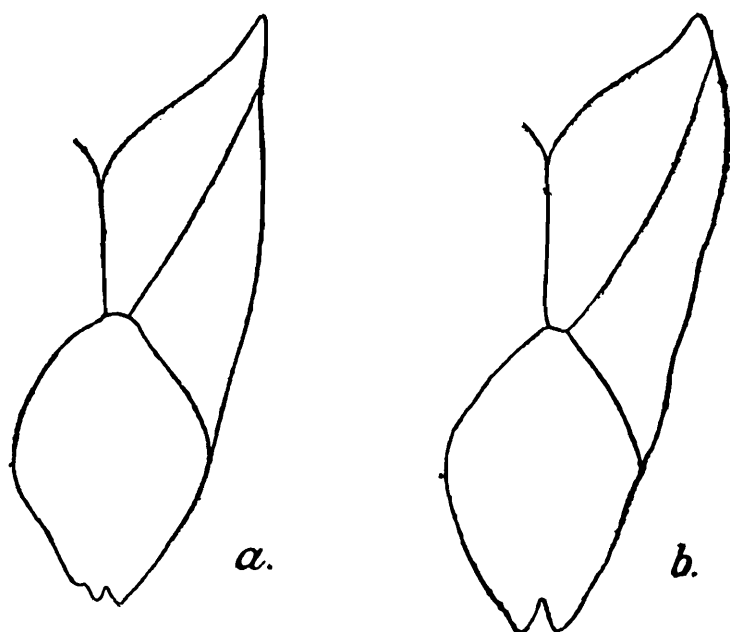
By G. EVELYN HUTCHINSON, M.A., F.L.S., F.E.S., Osborn Zoological Laboratory, Yale University and Yale North India Expedition.

The following notes are based on an examination of the specimens of *Notonectidae* and *Corixidae* described by Distant and by Paiva and preserved in the collection of the Zoological Survey of India (Indian Museum), Calcutta. Limited time and in some cases poor state of preservation of the material did not permit me to make as full descriptions of some forms as would have been desirable, but it is believed that all the species described below can be recognized, at least in more or less topotypical collections. All Paiva's types are preserved in the collection of the Museum, but the specimens of Distant's species are, unless otherwise stated, in all probability paratypes, Distant having retained the types in his own collection which was subsequently incorporated in that of the British Museum (Natural History), London. All the Distantian specimens discussed below are at least topotypical and apparently form part of the original series. The treatment of the Indian species of *Anisops* and *Nychia* is reserved till the material collected by the Yale North India Expedition has been determined, by which time it is hoped that Dr. O. Lundblad's work on the aquatic Hemiptera of the Sunda Islands will be available. My very best thanks are due to Lt. Col. R. B. Seymour Sewell, Director of the Zoological Survey of India and his staff for their kindness in giving me every facility during my stay in Calcutta; I am also indebted to my friend Dr. Hem Singh Pruthi for much assistance in examining the material in his charge.

Family NOTONECTIDAE.

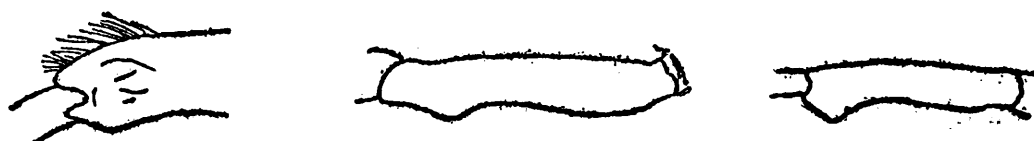
Enithares Spinola.

The larger Oriental species of the genus have been fairly adequately described by Kirkaldy (*Wien. Ent. Zeit.* XXIII, p. 100, 1904); consi-



TEXT-FIG. 1.—Closed elytron of a. *Enithares lineatipes* Horvath; b. *E. templetonii* (Kirby)

derable confusion has, however, resulted from his key having been based on rather unsatisfactory characters. Moreover, the smaller species described by Distant and by Paiva are practically unknown structurally. It seems desirable therefore to publish a provisional key by which species from the mainland of India can be determined. *E. marginata* (Fieber) is unknown to me and has been omitted as insufficiently described. It

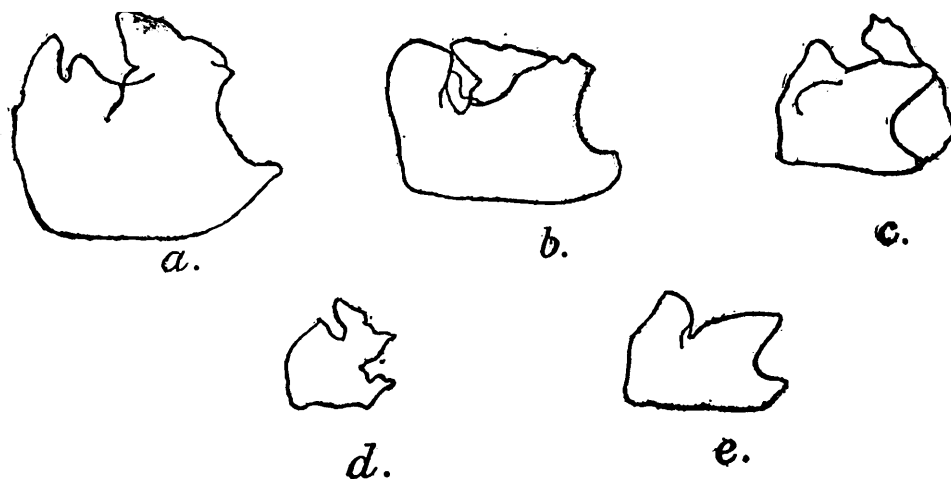


a.

b.

c.

TEXT-FIG. 2.—a. Apex of intermediate tibia of ♂ of *Enithares templetonii* (Kirby)
b. Anterior tibia of ♂ of *E. abbreviata* (Kirby); c. of *E. intha* Paiva.



a.

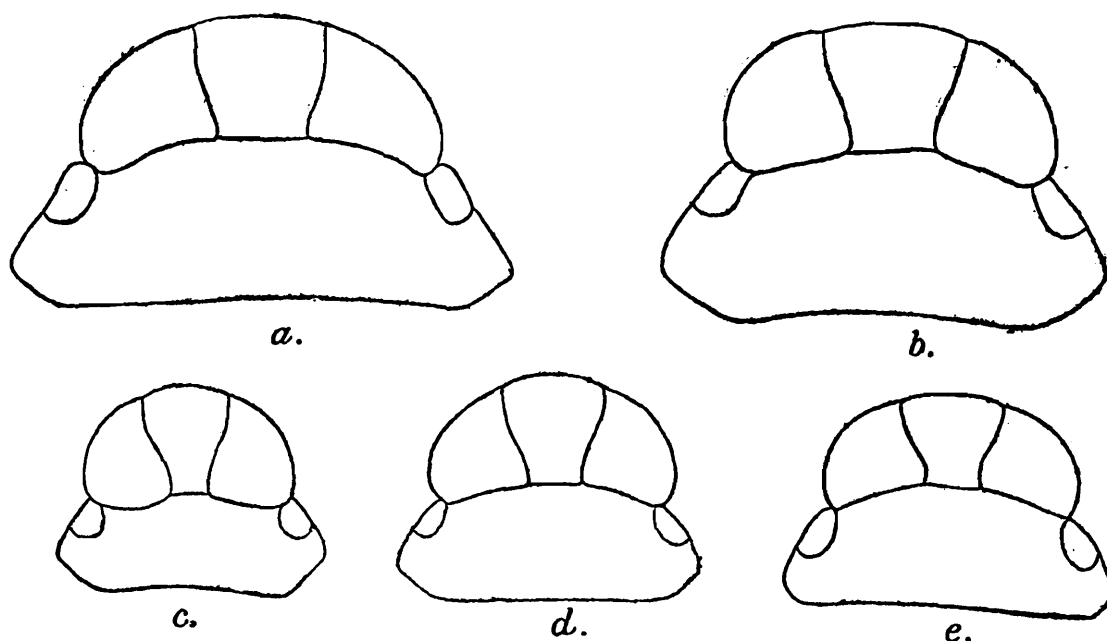
b.

c.

d.

e.

TEXT-FIG. 3.—♂ Genital capsule of a. *E. templetonii* (Kirby); b. *E. lineatipes* Horvath;
c. *E. abbreviata* (Kirby); d. *E. mandalayensis* Distant; e. *E. intha* Paiva.



a.

b.

c.

d.

e.

TEXT-FIG. 4.—Head and Pronotum of a. *Enithares templetonii* (Kirby); b. *E. lineatipes* Horvath; c. *E. mandalayensis* Distant; d. *E. intha* Paiva; e. *E. abbreviata* (Kirby).

would perhaps run down to *E. mandalayensis*, though *E. marginata* is apparently a larger species and the two are probably not identical. *E.*

negersi Distant, from the Nicobar Islands, might on the other hand be identical either with *E. marginata*, *E. lineatipes* or *E. templetonii*. All of these though closely allied, are easily distinguished by the form of the body as defined by the closed elytra (fig. 1); the last species has a tuft of bristles on the apex of the intermediate tibia of the male (fig. 2). The form of the male genital capsule of all the Indian species that I have studied is given in fig. 3, while the structure of the head and pronotum is indicated in fig. 4. In addition to redescriptions of *E. intha* and *E. mandalayensis*, it has seemed desirable to add an amended description of *E. abbreviata*.

- | | | |
|---|---|--|
| 1. Not very stoutly built, under 13.5 mm. long | 2 | |
| Very stoutly built, over 13.5 mm. long | . | <i>triangularis</i> (Guerin). S. India, Ceylon. |
| 2. Under 11.0 mm. long | 4 | |
| Over 11.0 mm. long | 3 | |
| 3. Outline of body with elytra closed, converging posteriorly from before the middle; lateral margins of pronotum straight or slightly concave | | <i>templetonii</i> (Kirby). Central and S. India, Ceylon ¹ . |
| Outline of body with elytra closed, converging only in the posterior third; lateral margins of pronotum convex | | <i>lineatipes</i> Horvath. Punjab, Himalayan Foothills (also Yarkand and Sumatra vide Kirkaldy). |
| 4. Anterior tibia of male with an apical eminence; length over 8.0 mm. | 5 | |
| Anterior tibia of male without apical eminence; length 7.0 mm. | | <i>mandalayensis</i> Distant. Burma. |
| 5. Intermediate distal tarsal joint in male one and a half times the length of the proxima; in female one and one eighth times the length; length 9.8 mm. | | <i>abbreviata</i> (Kirby). Throughout India and Ceylon. |
| Intermediate distal tarsal joint but little longer than the proximal in male; length 8.5 mm. | | <i>intha</i> Paiva. Shan States, Burma. |

***Enithares abbreviata* (Kirby).**

Notonecta indica Fabricius 1803. *Syst. Rhyng.*, p. 103, nec Linnaeus.
Notonecta abbreviata Kirby 1891. *Journ. Linn. Soc. Zool.* XXIV, p. 126.
Enithares abbreviata Kirkaldy 1904. *Wien. Ent. Zeit.* XXIII, p. 109.
Enithares indica Distant 1906. *Faun. Brit. Ind. Rhynchota*, III, p. 42.
E. paivana Distant 1910. *Faun. Brit. Ind. Rhynchota*, V, p. 329, fig. 190.
E. lactea Paiva 1919 in Annandale. *Rec. Ind. Mus.* XVI, p. 155.

Head and pronotum stramineous, the latter tending to be grey anteriorly; scutellum black with two yellow lines adjacent to the central part of its posterior margins. Elytra stramineous grey, the apex of the clavus and the inner margin of the corium widely black; legs concolorous, stramineous; pronotal fossae pale (except in one specimen from Trivandrum and in the paratype of *paivana*).

Build moderately stout, the outer margins of the elytra hardly convergent before the middle of the body.

¹ Paiva (*Rec. Ind. Mus.* XVI, p. 156, 1919) records this species from the W. Himalayas but the specimens from Kumaon, on which this record is based, though placed originally in the series of *templetonii* in the Museum, are normal examples of *lineatipes*.

Head just over $2\frac{1}{2}$ times as wide as the anterior margin of the vertex, which is just over twice as wide as the synthlipsis; inner margins of eyes divergent throughout and very slightly sinuate; anterior margin of vertex projecting little beyond eyes.

Pronotum about $1\frac{1}{3}$ times as wide as head and $1\frac{1}{3}$ times as wide as long.

Lateral margins straight save anteriorly where they converge on the anterior angles; posterior margin very slightly concave (fig. 4e).

Scutellum rather under twice the length of the pronotum.

♂. Anterior tibia with inner margin excavated centrally, the excavation ending distally against a low eminence (fig. 2b). Tibia just over three times as long as the proximal (1 2) joint, which is about $1\frac{1}{2}$ times as long as the distal, claws subequal in length to the latter (42 : 13 : 9 : 9).

Intermediate tibia about $4\frac{1}{2}$ times as long as the proximal (1 2) tarsal joint which is short, broad and somewhat flattened, distal joint about $1\frac{1}{2}$ times as long as proximal and nearly twice as long as the longer outer claw (49 : 11 : 17 : 9).

Genital capsule as in fig. 3c.

♀. Anterior tibia simple, not excavate, proportions of leg as in the male (42 : 14 : 9 : 10).

Intermediate tibia $3\frac{1}{2}$ times as long as the proximal tarsal joint which is about $\frac{7}{8}$ as long as the second, the latter rather less than twice as long as the outer claw (49 : 14 : 16 : 9); length ♂. 9.8 mm.; ♀. 9.8 mm.

The specimen of Distant's *paivana* in the collection is a male from Madhupur (coll. Paiva), either the type or a paratype, in which the paler regions are pallid grey instead of yellowish, the inner margin of the eyes is perhaps a little more sinuate than in the other specimens but the structural peculiarities of the head mentioned in the original description are inappreciable. The form of the body, the structure of the anterior and intermediate legs and the posterior end of the partially extruded genital capsule show the specimen to be undoubtedly referable to *abbreviata*. The type of *lactea* Paiva is structurally a typical female, which is so teneral that it has not yet acquired any pigmentation; the head is slightly displaced so that Paiva's structural characters are illusory. Two specimens, respectively from Verkulay and Korumaadi in Travancore are rather uniformly greyish yellow and are also presumably teneral.

The structure of the anterior and intermediate legs in the male and of the latter in the female is most characteristic. *E. abbreviata* is evidently widely distributed in South and Central India; the material in the Museum is from Ceylon, Travancore, the Western Ghats, Bombay Presidency, Behar (Madhupur) and Lucknow. Specimens referred to *abbreviata* from the Andaman Islands are specifically distinct and may represent a new species; these will be discussed in a later paper.

***Enithares intha* Paiva.**

Enithares intha Paiva 1918. *Rec. Ind. Mus.* XIV, p. 27.

Pale greyish yellow, pronotal fossae black.

Small, build moderate, converging posteriorly from about the middle of the body.

Vertex evenly and rather prominently rounded anteriorly ; head $2\frac{2}{3}$ times as wide as the anterior margin of the vertex which is twice as wide as the synthipsis. Inner margin of eyes divergent in anterior part of head (fig. 4d).

Pronotum $1\frac{1}{3}$ times as long as head and about $1\frac{1}{3}$ times as long as wide ; lateral margins very slightly and evenly curved, posterior margin almost straight.

Scutellum $1\frac{5}{7}$ times as long as the pronotum.

Anterior leg with a conspicuous flat triangular apical eminence on the lower part of the inner surface of the tibia (fig. 2c) ; tibia just under three times as long as the proximal tarsal joint which is $1\frac{3}{4}$ times as long as the distal, claws equal to the latter (51 : 18 : 11 : 11).

Intermediate leg with tibia produced apically to form a short spur overlapping the proximal tarsal joint which is short, wide and flat.

Tibia just over four times as long as the proximal tarsal joint which is very slightly shorter than the distal, claw $\frac{3}{5}$ of the length of the latter (78 : 18 : 19 : 11).

Genital capsule as in fig. 3e.

Length 8.5 mm.

BURMA : Inlé Lake, Shan States (*type* ♂ and *paratype*).

The small size, shape of the head and in the male the structure of the anterior and intermediate tibiae as well as the genital capsule are characteristic.

Enithares mandalayensis Distant.

Enithares mandalayensis Distant 1910. *Faun. Brit. Ind. Rhynchota*, V, p. 331, fig. 192.

Greyish yellow with dark pronotal fossae.

Very small, build moderate, subparallel in middle third of body. Head $2\frac{1}{2}$ times as wide as the anterior margin of the vertex which is $2\frac{2}{3}$ times as wide as the synthipsis ; inner margin of eyes diverging anteriorly in the front part of the head ; anterior margin of vertex produced well in front of the eyes and evenly rounded.

Pronotum subequal in length to the head and about $1\frac{1}{16}$ times as wide as the latter ; lateral margins slightly and evenly rounded (fig. 4c).

Scutellum $1\frac{3}{4}$ times as long as pronotum.

♂. Anterior tibia $2\frac{3}{4}$ times as long as proximal tarsal joint, which is just over twice as long as the distal, the latter subequal to the claws (30 : 11 : 5 : 6).

Intermediate tibia slightly produced apically, just under three times as long as the proximal tarsal joint which is $1\frac{5}{7}$ times the distal, the latter $1\frac{3}{4}$ times the longer claw (35 : 12 : 7 : 4).

Genital capsule very small, as in fig. 3d.

Length 7.0 mm.

Family CORIXIDAE.

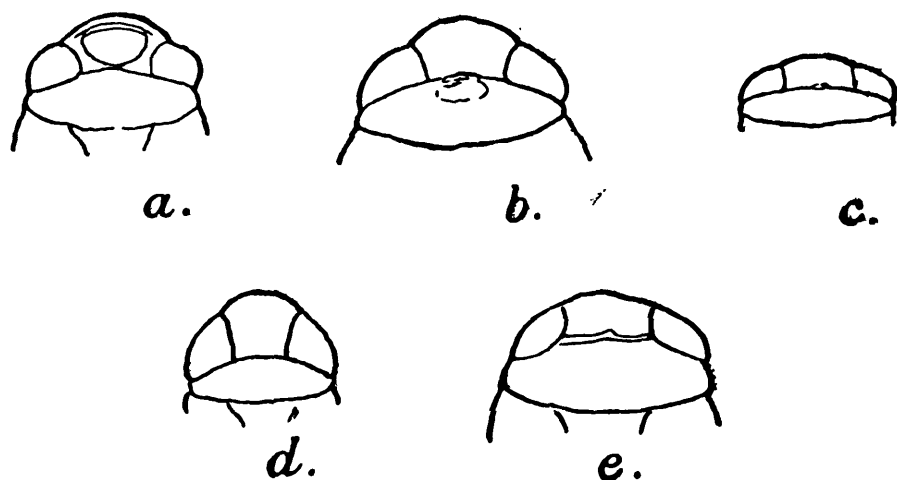
Sub-family MICRONECTINAE.

Micronecta Kirk.

The material determined by Distant is in a state of great confusion, several forms of quite different *facies* having been frequently included

by him under one name. Considerable further study of the types of the Indian species of *Micronecta* in the British Museum is necessary before the status of many of them can be disentangled. In the present paper only two of Distant's species, based on short homogeneous series, are discussed.

In addition to these two, *Micronecta issa* Distant, a species of which I have not seen a male specimen; may be readily identified by the peculiar curved transverse carinae on the vertex. The anterior carina lies just within the anterior margin of the vertex; the posterior, which is not so well marked, lies with its concave edge forward, just in front of the posterior margin. Laterally the carinae run respectively backwards and forwards along the inner margin of the eye to form a continuous ridge, so that an ovoid space is more or less completely enclosed between them (fig. 5a.).



TEXT-FIG. 5.—Head and Pronotum of a. *Micronecta issa* Distant; b. *M. desertana* Distant; c. *M. fulva* Paiva; d. *M. daedala* Distant; e. *M. substriata* Paiva.

Three species of the genus were described by Paiva, all from the Inlé Lake, Shan States, Burma. The unique type of one of these, *M. soror*, is now represented only by a corroded pin; the other two are discussed below.

Micronecta desertana Distant.

Micronecta desertana Distant 1920. *Rec. Ind. Mus.* XVIII, p. 206.

Head yellowish white, with an anterior orange spot on the vertex; pronotum and elytra pale greyish brown, lateral margins of the latter yellowish, clavus with a small indefinite brown spot near the apex, corium with faint traces of darker marking; legs greyish yellow throughout.

Head very slightly narrower than the pronotum, and $2\frac{1}{2}$ times as wide as the least interocular distance.

Pronotum $1\frac{2}{3}$ times as long as the head and almost three times as wide as long, lateral margins distinct, one quarter of the length of the pronotum and just under one-third of that of the posterior margin of the eye; pronotal disc with a slight transverse depression behind a very slight elevation on the anterior margin (fig. 5b).

Scutellum just over half as long as pronotum.

Intermediate leg with tarsus just under $1\frac{1}{2}$ times the length of the tibia and $1\frac{1}{2}$ times that of the claws (12 : 17 : 10). Subcostal fossa of elytra extending to the apex of the metapleuron.

♂. right paramere (only part of genitalia that could be examined) long, rather straight and not dilated in any part of the shaft (fig. 6a).

Length 2.6 mm.

PERSIA : Hurmuk, Persian side of Perso-Afghan-Baluch boundary, 3,000 ft. (desert spring).

The structure of the pronotum, particularly the transverse depression, appears to be rather characteristic. *M. desertana* does not appear to be synonymous with any of the species diagnosed by Horvath in his key to the Palaearctic members of the genus (*Rev. d'Ent.* XVIII, p. 101, 1899).

Micronecta daedala Distant.

Micronecta daedala Distant 1910. *Faun. Brit. Ind. Rhynchota* V, p. 352, fig. 214.

Dull brown, head, margins of pronotum, a stripe along the clavo-corial suture and one along the anterior part of the subcostal margin of the corium paler.

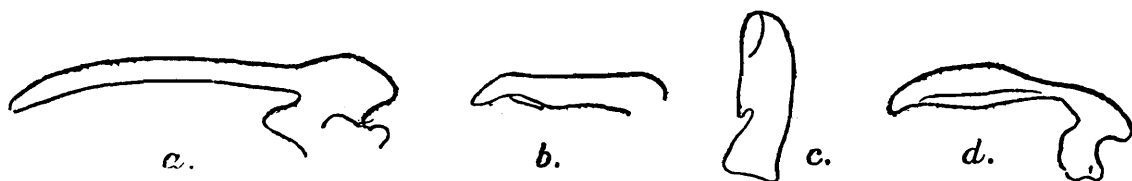
Head $1\frac{1}{4}$ times as long as pronotum and $2\frac{1}{6}$ times as wide as the least interocular distance.

Pronotum finely granulose ; $1\frac{1}{3}$ times as wide as the head and $3\frac{1}{2}$ times as wide as long, lateral margins just over a third as long as pronotum and half the length of the posterior margin of the eye (fig. 5d).

Scutellum $\frac{5}{8}$ the length of pronotum.

Subcostal furrow short.

Right paramere straight, flat and wide (fig. 6b).



TEXT-FIG. 6.—a. *Micronecta desertana* Distant, right paramere ; b. *M. daedala* Distant, right paramere ; c. *M. daedala* Distant, left paramere ; d. *M. fulva* Paiva, right paramere.

Left paramere short, very wide and flat, more or less membranous apically (fig. 6c).

Length 2 mm. (*vide* Distant ; the specimen examined is in too poor a condition for exact measurement.)

N. E. Himalayas : Kurseong, 5,000 ft. (Annandale).

The variegated colour and the very flat wide parameres should enable this species to be easily recognised.

Micronecta fulva Paiva.

Micronecta fulva Paiva 1918. *Rec. Ind. Mus.* XIV, p. 32.

Yellowish brown throughout.

Head slightly longer and subequal in width to the pronotum, rather over $2\frac{1}{2}$ times as wide as least interocular distance. Pronotum three times as wide as long, lateral margins rudimentary, posterior margin evenly rounded (fig. 5c). Scutellum just over half the length of the pronotum. Intermediate leg with tarsus hardly longer than tibia and

rather more than $1\frac{1}{2}$ times as long as claws (14 : 14.5 : 9). Subcostal fossa long and rather narrow, ending indefinitely beyond the apex of the metapleuron.

Right paramere as in fig. 6d.

BURMA : Inlé Lake, Shan States (type ♀ and paratype ♂). This species is somewhat similar to *M. piccanin* Hutch., particularly in the form of the right paramere. I was not able to obtain a satisfactory preparation of the abdomen owing to the softness of the chitin, so its true affinities must be left in doubt. The above notes should enable it to be recognised in collections from Burma.

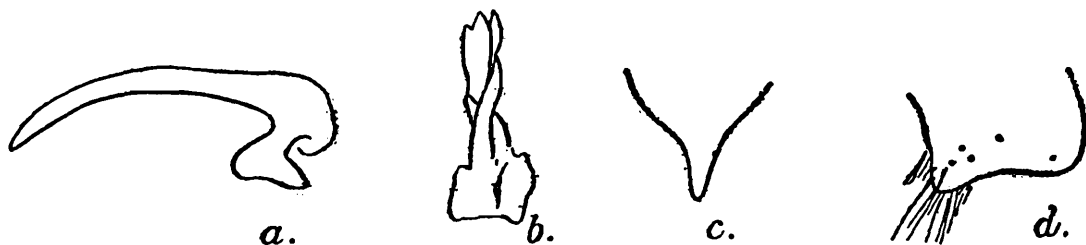
***Micronecta substriata* Paiva.**

Micronecta substriata Paiva 1919. *Rec. Ind. Mus.* XIV, p. 31.

Head dull brownish yellow ; pronotum dull brown, darker posteriorly ; clavus light brown, with a broad irregular darker stripe along the anterior margin ; corium light brown with four indefinite darker longitudinal stripes ; two dark elongate spots on embolium ; outer edge of membrane with a faint dark spot ; intermediate legs dull yellowish brown, apex of tarsus darker.

Head just over half the length of the pronotum, the latter rather more than $2\frac{1}{2}$ times as wide as long and just over $2\frac{1}{2}$ times as long as its lateral margins which are a little more than half as long as the posterior border of the eye (fig. 5e). Scutellum just over half as long as pronotum.

Intermediate leg with tarsus $1\frac{1}{3}$ times as long as tibia, the latter a little longer than the claws (10.5 : 14 : 9). Dull wide part of subcostal fossa extending to rather more than half way from its base to the apex of the metapleuron, narrower apical part of furrow indefinite.



TEXT-FIG. 7.—*Micronecta substriata* Paiva. a. Right paramere ; b. Left paramere (free-hand sketch) ; c. Submedian process of 8th abdominal sternite ; d. Free portion of 8th abdominal tergite.

Submedian process of seventh abdominal sternite as in fig. 7c. Free portion of eighth abdominal tergite as in fig. 7d. Right paramere slender and curved (fig. 7a) ; left paramere irregularly styliform and twisted (fig. 7b).

Length 2.3 mm.

BURMA : Inlé Lake, Shan States (type and four paratypes including dissected ♂).

This species is perhaps synonymous with *M. quadristrigata* Breddin, of which species the Indian Museum possesses female specimens from the Philippines which are probably correctly determined.

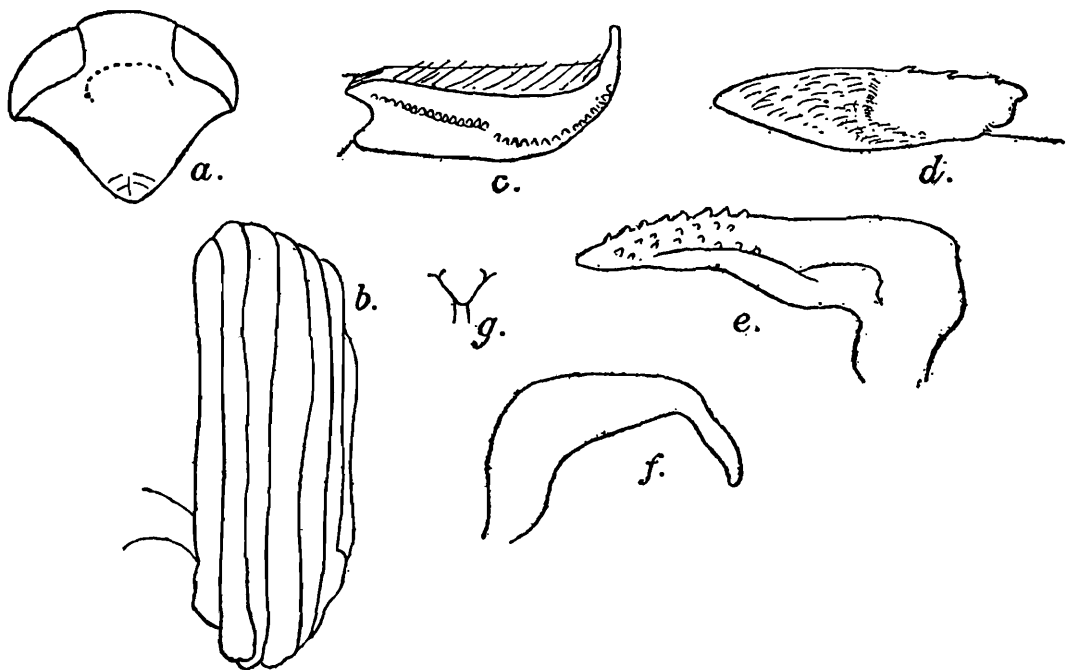
Sub-family CORIXINAE.

Agraptocorixa hyalinipennis* (Fabr.).Agraptocorixa hyalinipennis* Jaczewski 1926. *Ann. Zool. Mus. Polon.* V, p. 18 ;Lundblad 1929. *Arch. f. Hydrobiol.* XX, p. 297.*Corixa unicolor* Paiva 1918. *Rec. Ind. Mus.* XIV, p. 30.*Corixa paivana* Dover 1922. *Rec. Ind. Mus.* XXIV, p. 333.*Agraptocorixa unicolor* Lundblad 1928. *Ark. f. Zool.* XX A. No. 6, p. 2.¹

An examination of the numerous specimens of *paivana* in the collection, including the type, leaves no doubt that they are referable to *hyalinipennis*. The type of *unicolor* is a female but there is no reason to separate it from this well known Asiatic species ; the peculiar form of the head in Paiva's figure is an artist's error, the specimen does not differ from *hyalinipennis* in this or any other respect.

Sigara seistanensis* (Distant).Corixa seistanensis* Distant 1920. *Rec. Ind. Mus.* XVIII, p. 206.

Head yellow, pronotum pale greyish yellow with six very thin black transverse stripes which are much narrower than the intervening spaces, the fourth and sixth somewhat broken, the fifth wider than the others, posterior margin somewhat suffused with black ; elytra predominantly yellow, base of clavus with broad yellow and narrow black transverse bands, rest of elytra with narrow black vermiculations that tend to run together longitudinally in the internal angle of the corium, membrane similarly vermiculated, separated from the corial markings by a yellow



TEXT-FIG. 8.—*Sigara seistanensis* (Distant). *a.* Anterior view of head ; *b.* Strigil ; *c.* Pala ; *d.* Ventral surface of posterior femur ; *e.* Left paramere ; *f.* Right paramere ; *g.* Xyphus.

line ; embolium with a little black at the apex ; legs yellow, apex of intermediate tarsus dark brown.

¹ See also Jaczewski, *Ann. Mus. Zool. Polon.*, p. 19, 1926.

Head not produced anteriorly. Fourth joint of antenna about $\frac{5}{9}$ as long as third. Pronotum rastrate, $1\frac{3}{4}$ as long as head and nearly twice as wide as long; lateral angles slightly obtuse, posterior angle very obtuse; median carina definitely developed on the anterior part of the pronotum, reaching to about the first black stripe.

Xyphus (fig. 8g) forming an equilateral triangle with a slightly rounded apex. Intermediate tibia $1\frac{1}{2}$ times as long as the tarsus, claws about $1\frac{1}{4}$ times as long as the latter (45 : 30 : 37).

Posterior femur with the ventral pubescent area not reaching half way down the middle line (fig. 8d.).

Clavus slightly rastrate, corium almost smooth.

♂. Facial impression slight, not extending between the eyes (fig. 8a). Pala cultrate, with a row of 30 pegs, the proximal 15 arranged in a straight row, the distal in an arc slightly separated from the straight proximal row (fig. 8c).

Strigil long as in fig. 8b. Parameres as in figs. 8e & f.

Length 6.2 mm.

SEISTAN: Water channels near Nasratabad (♂ type). *S. seistanensis* has of course no affinity to *Cymatia rogenhofen* (Fieber) to which it was allied by Distant.

***Sigara seistanensis* f. *randana* (Distant).**

Corixa randana Distant 1920. *Rec. Ind. Mus.* XVIII, p. 206.

The two specimens of *Corixa randana* Distant in the collection are apparently structurally inseparable from the above species, the general form, posterior femur, xyphus, and secondary sexual characters of the male being identical. The only possible structural differences are that the pronotal carina and the rastration appear to be a little more pronounced. These differences, however, may well be illusionary, as the dark colour of *randana* makes it difficult to compare such characters with those of the very pale *seistanensis*. The former form is very deeply coloured.

Head brownish yellow, pronotum brown-black with seven regular yellow stripes subequal in width to the intervening spaces, third, fourth and fifth confluent marginally; elytra as in typical form but black markings much wider so that the yellow colour does not predominate; legs dark yellowish brown, apex of intermediate tarsus hardly darker.

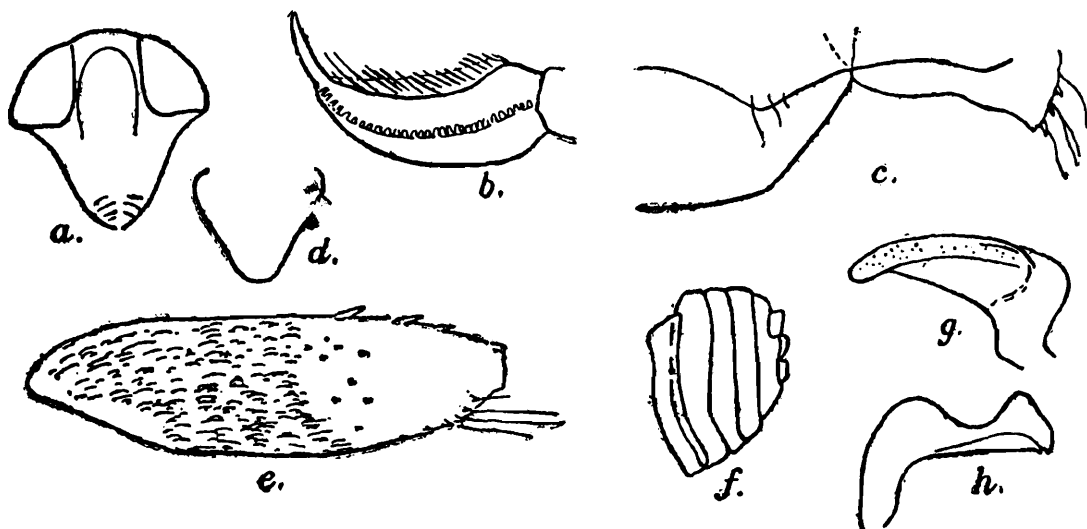
The more intense colouration is clearly real and not due to a discoloration of the chitin as the black bands themselves are distinctly wider than in the typical form. The structural identity of *randana* and *seistanensis* precludes the former from specific rank, but the great difference in colour allows it to be retained as a separate form. Such colour variation is of course well known in the genus. Since both forms are known only from Seistan, it is unlikely that they represent geographically separate subspecies.

***Sigara distorta* (Distant).**

Corixa affinis Distant 1910. *Faun. Brit. Ind. Rhynchota*, V, p. 341, fig. 283. *nec* Leach.

Corixa distorta Distant 1910. *Faun. Brit. Ind. Rhynchota* V, p. 343, fig. 205.

The five specimens of *C. affinis* Distant from Nepal in the collection are all females but are shown by the form of the xyphus, the armature of the posterior femur and the coloration to be conspecific with the unique male type of *distorta*. No new name is therefore required to replace the preoccupied *affinis*.



TEXT-FIG. 9.—*Sigara distorta* (Distant), ♂. *a.* Anterior view of head; *b.* Pala; *c.* Right hand posterior part of 7th abdominal segment; *d.* Xyphus; *e.* Ventral surface of posterior femur; *f.* Strigil; *g.* Left paramere; *h.* Right paramere.

Head dull greyish yellow; pronotum dark, with seven yellow lines a little narrower than the intervening spaces and tending to break and anastomose; elytra black, with yellow fragmented and vermiculated lines which tend to be more regular in the inner angle of the clavus though not thick and straight even in this region, intervening black markings tending to run into indefinite longitudinal series; apico-internal region of left membrane milky; legs dull yellow.

Head rather long centrally, just over $\frac{2}{3}$ the length of the pronotum; fourth joint of antenna $\frac{5}{7}$ the length of third. Pronotum just under twice as wide as long, rastrate, lateral and posterior angles obtuse.

Xyphus subequilateral and well rounded apically (fig. 9*e*). Intermediate leg with tibia and claw subequal, tarsus about $\frac{3}{4}$ the length of the former (32 : 23 : 34). Posterior femur with the non-pubescent area entirely distal to the middle, proximal part of this area with numerous small scattered spines (fig. 9*e*).

♂. Facial impression well marked, extending upward between the eyes as far as the anterior margin of the ventral surface of the head, so forming a rather high arch with a sharply defined edge (fig. 9*a*).

Pala cultrate, with 33 pegs in a regularly curved row (fig. 9*b*).

Strigil, subquadrangular as in fig. 9*f*.

Genitalia as in figs. 9 *g*, *h*.

Material examined: type of *distorta* NEPAL, 1♂, Pharping, paratypes of *affinis* NEPAL, 4♀, Khatmandu, 1♀ Chonebal.

Two females from Seistan in the collection, referred to *affinis* by Distant (*Rec. Ind. Mus. XVIII*, p. 205, 1920) are clearly not conspecific with the above. Without males I do not feel justified at the moment in discussing their identity further. There are no specimens in the collection from Distant's other localities, Bengal and the Simla Hills, and the occurrence of the species outside Nepal is at present unconfirmed.

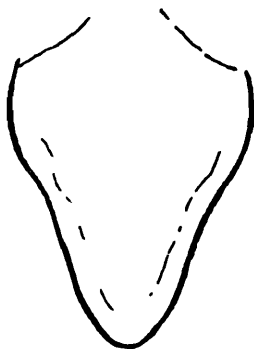
***Sigara promontoria* (Distant).**

Corixa promontoria Distant 1910. *Faun. Brit. Ind. Rhynchota*, V, p. 341, fig. 201.

Corixa ribeiroi Paiva, in Paiva and Dover 1922. *Rec. Ind. Mus. XXIV*, p. 333.

Sigara promontoria is evidently a common and widely distributed species in Northern India. In the near future I hope to examine the material referred by Distant to this species, which lack of time did not permit me to study in Calcutta. At present I merely indicate the salient diagnostic characters based on the type of *C. ribeiroi* Paiva which appears to be an absolute synonym of *promontoria*.

Xyphus elongate (fig. 10); elytra practically smooth; intermediate tibia just under $1\frac{1}{2}$ times as long as tarsus, claw $1\frac{1}{2}$ as long as the latter (38 : 26 : 31); ventral surface of posterior femur with the smooth area entirely in the distal half, a few spines near posterior margin.



TEXT-FIG. 10.—Xyphus of *Sigara promontoria* (Distant).

♂. Head well produced between the eyes, frontal depression rather deep, running up between the eyes to the anterior margin of the prominent head; pala regularly cultrate, with a simple row of 30 pegs; strigil sub-rectangular, $1\frac{3}{5}$ times as wide as long with 7 irregular comb-rows.

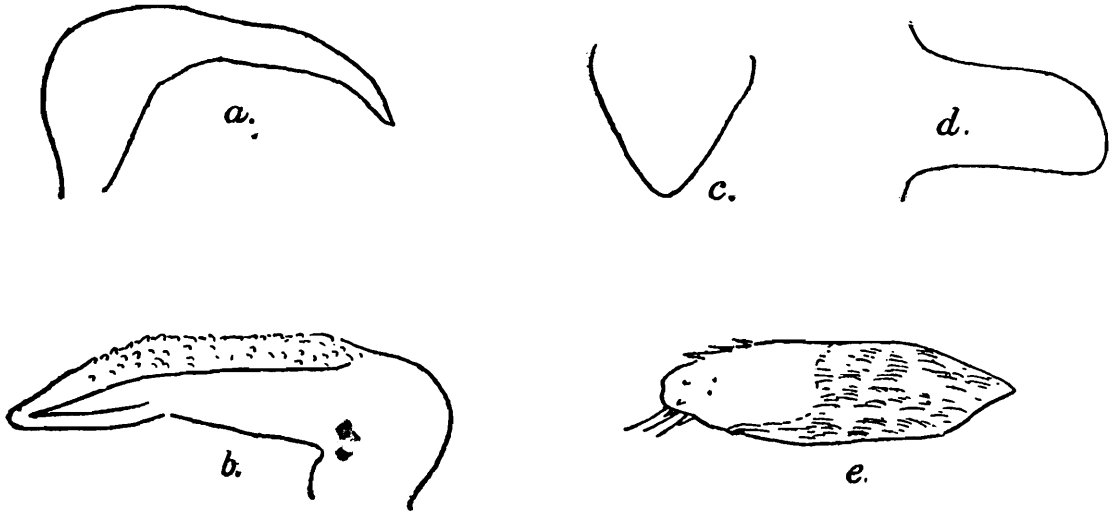
***Sigara septem-lineata* (Paiva).**

Corixa septem-lineata Paiva 1918. *Rec. Ind. Mus. XVIII*, p. 30.

Head yellow; pronotum with seven pale lines which are entire; regular and wider than the intervening spaces; clavus brown with yellow transverse lines which are entire, wide and tending to anastomose in the basal angle but otherwise fragmented; corium with yellow lines broken, brown, intervening spaces confluent and forming a longitudinal line in the inner angle; apical part of left membrane clear; legs pale yellowish. Head fairly short and not produced anteriorly (rather crushed in type).

Pronotum nearly twice as wide as long, posterior margin very widely rounded, the posterior angle being obtuse and rather ill-defined, median carina forming a tubercle extending to the second pale line.

Xyphus equilateral (fig. 11c).



TEXT-FIG. 11.—*Sigara septem-lineata* (Paiva). a. Right paramere; b. Left paramere; c. Xyphus; d. Lateral lobe of prothorax; e. Ventral surface of posterior femur.

Intermediate leg with tibia and claws subequal in length, tarsus about $\frac{2}{3}$ as long as former (28 : 19 : 27).

Posterior femur with the pubescent area of the ventral surface reaching beyond the center of the midline, non-pubescent area with a few minute scattered spines sub-apically (fig. 11e). Facial impression well-marked, extending up between the eyes (exact limits uncertain owing to damage to head).

Genitalia as in figs. 11 a & b.

BURMA : Inlé Lake, Shan States (type ♂).

***Sigara rambhaensis* (Paiva).**

Corixa rambhaensis Paiva, in Paiva and Dover 1922. *Rec. Ind. Mus.* XXIV, p. 331.

Head yellow brown; pronotum dull yellow with six unbroken lines and the anterior and posterior margins dark; elytra predominantly yellow with very vermiculate and anastomosing markings that tend to run together longitudinally, but which do not form definite longitudinal lines, yellow areas thick at base of clavus; membrane dark with yellow vermiculate markings; anterior angles dark, inner part of left membrane colourless and transparent; legs yellow (intermediate legs missing).

Head obtusely rounded anteriorly; antenna with fourth joint just over half the length of the third (45 : 80).

Pronotum about $1\frac{2}{3}$ times as wide as long, posterior angle obtuse, central carina very slightly indicated anteriorly. Lateral lobes of prothorax as in fig. 12c.

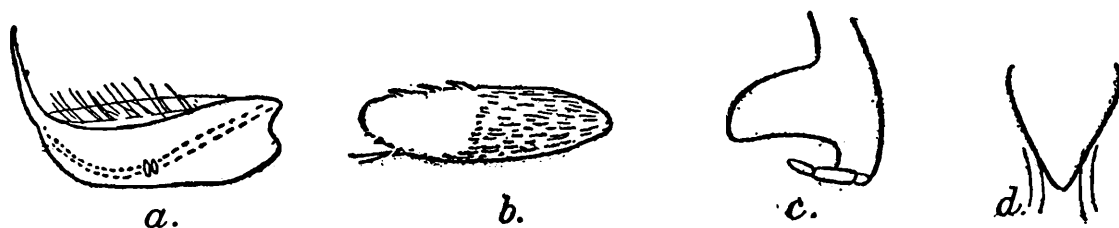
Xyphus sub-acute (fig. 12d).

Posterior femur below with the pubescent area reaching beyond the center of the midline, three anterior and two posterior spines alone developed on the margins of the non-pubescent part (fig. 12b).

Elytra not rastrate.

♂. Facial impression moderately marked, highly arched between the eyes, margin ill-defined.

Pala sub-parallel, with a row of pegs, which is straight proximally and gradually curved in the distal half (fig. 12a).



TEXT-FIG. 12.—*Sigara rambhaensis* Paiva, ♂. a. Pala; b. Ventral surface of posterior femur; c. Lateral lobe of prothorax; d. Xyphus.

Length 6.15 mm. (*vide* Paiva).

MADRAS: Rambha, Ganjam District (type ♂).

The above somewhat inadequate notes are based on the type which is in poor condition, lacking the abdomen entirely. Topotypical material could undoubtedly be recognised.

Sigara annandalei (Paiva).

Corixa annandalei Paiva, in Paiva and Dover, 1922. *Rec. Ind. Mus.* XXIV, p. 332.

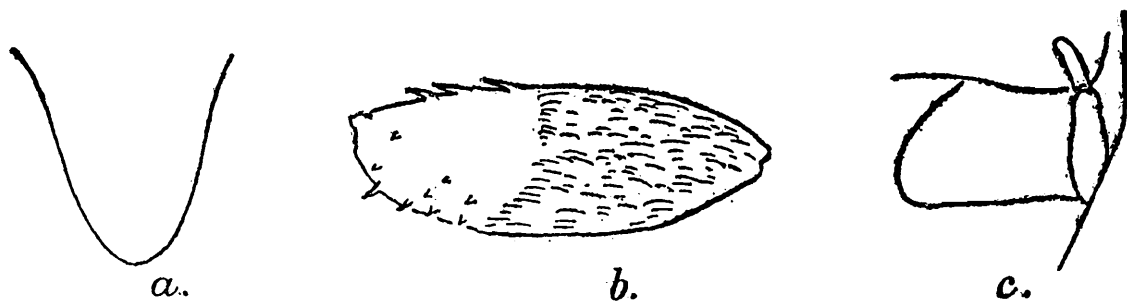
Head dull yellow; pronotum black with six yellow stripes, the first five confluent marginally, subequal to or slightly narrower than the intervening spaces; elytra black brown with clavus and corium evenly vermiculated with yellow markings which are hardly more entire at the base of the clavus than in other parts of the elytra, black areas not forming longitudinal stripes.

Head not elongated anteriorly, evenly rounded, about $\frac{3}{4}$ the length of the pronotum.

Pronotum $1\frac{1}{2}$ times as wide as long, somewhat rastrate, with a slight but definite longitudinal carina throughout; posterior margin gradually rounded to the obtuse rounded posterior angle, lateral angles obtuse.

Lateral lobes of prothorax as in fig. 13c.

Xyphus subelongate (fig. 13a).



TEXT-FIG. 13.—*Sigara annandalei* (Paiva). a. Xyphus; b. Ventral surface of posterior femur; c. Lateral lobe of prothorax.

Elytra shiny, clavus very slightly rastrate, corium smooth.

Intermediate leg with tibia $1\frac{2}{3}$ times as long as tarsus, claw $1\frac{1}{4}$ times the latter (41 : 25 : 30).

Posterior femur below with the pubescent proximal area reaching beyond the center of the middle line, several scattered spines postero-apically (fig. 13b). Length, 7.0 mm.

ORISSA : Satpara (type ♀).

Though the type of *annandalei* is unfortunately a female, the above notes should enable it to be recognised in collections, at least from the north-eastern parts of Peninsular India. The form of the xyphus, the spination of the posterior femur and the shiny elytra are the most conspicuous characters of the species; *annandalei* is also, as Paiva pointed out, slightly larger than its Indian congeners.

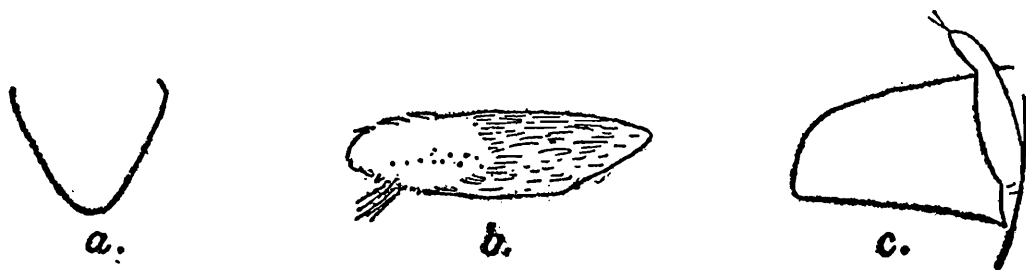
Sigara paivai Lundblad.

Sigara paivai Lundblad 1928. *Entom. Tidskr.* p. 241.
Corixa dubia Paiva, in Paiva and Dover 1922. *Rec. Ind. Mus.* XXIV, p. 332. nec
 Douglas and Scott 1869. *Entom. Mon. Mag.* V, p. 266; nec *Arctocorixa*
dubia Abbott 1916. *Entom. News* XXVII, p. 342.

The name *paivai* was introduced by Lundblad on account of *dubia* being preoccupied; he was however unable to add anything to Paiva's brief description. Since *dubia* Douglas and Scott is a synonym of *S. nigrolineata* Fieber and since *dubia* Abbott is a member of the same genus a new name for the latter is perhaps also required.

The type of *paivai* is a female specimen. During my stay in Calcutta I obtained on 30 October 1932, a second female, clearly to be referred to this species, from a fountain in Dalhousie Square; prolonged search, however, failed to produce any more material of either sex. The following notes should enable the species to be recognized in collections from Peninsular India, the double spine row of the posterior femur is characteristic.

Head yellow; pronotum black, with six yellow transverse stripes slightly narrower than the intervening spaces, the second and third with an irregular cross anastomosis (not in Calcutta specimen). Clavus black, with very irregular and much broken vermiculations except in the proximal angle where they are more or less entire, corium black with very broken yellow vermiculations, the black areas not forming longitudinal lines, inner half of left membrane milky. Legs yellow.



TEXT-FIG. 14.—*Sigara paivai* Lundblad. a. Xyphus; b. Ventral surface of posterior femur; c. Lateral lobe of prothorax.

Head about $\frac{6}{7}$ as long as pronotum; fourth joint of antenna just under half as long as third.

Pronotum rastrate, $1\frac{6}{7}$ times as wide as long.

Lateral lobes of prothorax as in fig. 14c.

Xyphus subequilateral (fig. 14a.).

Intermediate tibia $1\frac{2}{3}$ times as long as tarsus, claws missing in type (slightly shorter than tibia in Calcutta specimen).

Posterior femur below with the pubescent area reaching to more than half the middle length, non-pubescent area with a longitudinal irregularly double spine row (fig. 14*b*).

Length 5.8 mm.

ASSAM : Mazbat, Darrang District (type ♀).

NOTES ON THE BIONOMICS OF *TROCHUS NILOTICUS* LINN.

I.—ON A NEW SPECIES OF *SPIROGLYPHUS* (VERMETIDAE) FROM THE ANDAMANS.

By BAINI PRASHAD, D.Sc., F.R.S.E., F.A.S.B., and H. SRINIVASA RAO, M.A., D.Sc., Zoological Survey of India, Indian Museum, Calcutta.

(Plate X.)

In the course of detailed investigations by one of us (H. S. R.) on the biology of *Trochus niloticus* Linn. in the Andaman waters a large number of shells of a Vermetid was found embedded in calcareous algal growths covering the apical and middle regions of the shells of *Trochus niloticus* Linn. and *Trochus pyramis* Born. On a casual examination, the Vermetid colonies resemble those of a Serpulid worm (Pl. X, fig. 1). They are of a yellowish to a purplish brown colour, and project, in some cases, above the surface of the white calcareous deposits. The shells are often deeply embedded in the periostracal layer of the *Trochus* (Pl. X, fig. 3). We have succeeded in isolating a few of the adult as well as the young shells of this Vermetid, and have studied the external features of the animal and the radula. The species undoubtedly belongs to the sub-genus *Spiroglyphus*, but does not agree with the description of any known species. It is, therefore, described here as *Vermetus (Spiroglyphus) andamanicus*, sp. nov.

As previous authors such as Tryon¹ and Schepman² have remarked, the Vermetidae are "the most disagreeable amongst Gastropods to deal with; the extreme variability in the majority of the species and the often vague descriptions, render it impossible in many cases to make safe identifications" Mörch's descriptions of the species which are quoted in the monographs of Tryon (*op. cit.*) and Clessin³ are too brief to be of any value, and as most of the species are not illustrated it is difficult to identify them with certainty from the descriptions alone.

The exact limits of the generic and subgeneric divisions of the family are still very confused, and as we have not the requisite material for a revision of the group we have followed Thiele's⁴ recent summary in his valuable "Handbuch"

Genus *Vermetus* Daudin.

In view of Adanson's work being pre-Linnaean we have adopted Daudin, who was the first to employ the generic name *Vermetus* in a true binomial sense, as the author of the genus.

¹ Tryon, G. W.—*Man. Conch.*, VIII, p. 164 (1886).

² Schepman, M. M.—"Siboga" *Expedite*, XLIX. The Prosobranchia, Pulmonata and Opisthobranchia Tectibranchia, p. 183 (1909).

³ Clessin, S.—Vermetidae in *Martini-Chemnitz, Conch. Cab.*, (N. F.) VI (6), pp. 1-24, pls. i-xii (1901); pp. 25-80, pl. xiii (1902); pp. 81-104 (1903); pls. xiv, xv (1904); pp. 105-124 (1912).

⁴ Thiele, J.—*Handbuch Syst. Weichtierkunde*, I, p. 186 (1929).

Sub-genus **Spiroglyphus** Daudin.

1800. *Spiroglyphus*, Daudin, *Receuil Moll.*, p. 39.
 1861. *Spiroglyphus*, Mörch, *Proc. Zool. Soc. London*, p. 326.
 1886. *Spiroglyphus*, Tryon, *Man. Conch.*, VIII, p. 166.
 1912. *Spiroglyphus*, Clessin in *Martini-Chemnitz's Conch. Cab.* (N. F.), VI (6), *Vermetidae*, p. 108.
 1929. *Spiroglyphus*, Thiele, *Handbuch Syst. Weichtierkunde*, I, p. 186.

The definitions of the sub-genus *Spiroglyphus* by Mörch, Tryon, and Thiele are very general, and consequently the precise limits of the sub-genus are obscure. The authors mentioned describe the shell of *Spiroglyphus* as being attached to stones or shells in which, according to Tryon, it may excavate a groove which is covered over "with shelly material and thus forming a tubular planorbiform case" Mörch and Tryon describe the operculum as large, thick, convex exteriorly and plane interiorly, while Thiele only describes it as concentric.

So far as the form of the shells before us is concerned, the species can safely be assigned a place in the genus, with the definitions of which it is in accord. Although the operculum of our specimens differs in some respects from that of other species of the genus studied by Mörch and Tryon, we have provisionally assigned our species to the sub-genus *Spiroglyphus*. The differences in the description of the operculum may possibly be due to errors of observation on the part of the earlier authors.

The young shells of the Andaman species agree in some features with those of the sub-genus *Segmentella* Thiele, particularly in that of the earlier whorls being attached to the surface of *Trochus*, but the aperture of the free vertical portion of the shell is not expanded as in *Vermetus* (*Segmentella*) *agulhasensis* Thiele ¹.

Vermetus (Spiroglyphus) andamanicus, sp. nov.

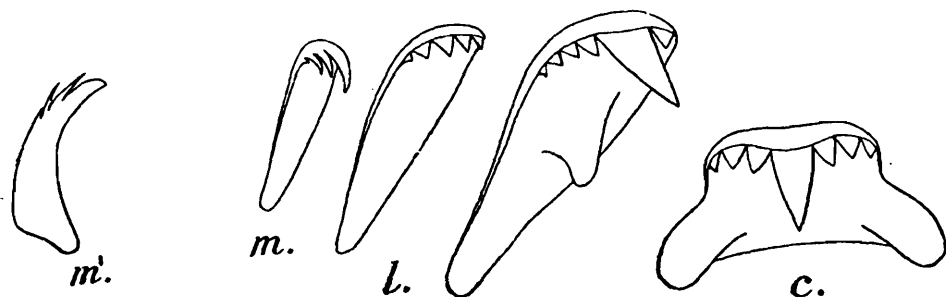
The shell is elongated, irregularly coiled or planorbiform, 5.5 to 6 mm. long from the base of the coiled apical portion to the mouth when elongated or irregularly coiled, 3 mm. in maximum diameter when planorbiform. The mouth of the shell is often more or less distinct from the rest of the shell, somewhat narrowed, thinner, less opaque, irregularly oval to rounded, and 1 mm. in diameter. The shell is not fragile, and is less than 0.5 mm. thick in the thickest part. In the young shell the apical portion is conical, and lies in a transverse plane, and consists of 3-3½ whorls, the first of which is broadly rounded. A portion of the last whorl is raised vertically above the basal axis of the shell, and has a more or less rounded aperture. In the adult shell the conical portion is hardly evident, but when the animal is removed from the shell the apical spiral portion of the soft parts shows the nature of the earlier whorls of the shell. The outer surface of the adult shell has a corrugated appearance due to the irregularly transverse ridges, and bears a number of growth lines which appear to divide the shell into several chambers. There is often a median longitudinal ridge along the whole length of the upper surface of the shell which is, therefore, triangular in cross-section where the ridge is prominent. In the young shell the transverse ridges are minute and more or less regularly spaced

¹ Thiele, J.—*Valdivia Exped.*, VIII, Gastropoden, p. 110 (76), pl. xx (viii), fig. 17 (1925).

so that they give the last whorl a chambered appearance. On the second and third whorls of the young shell, however, there are 4-5 spiral striae parallel to and above the suture, but the transition between the spiral striae and the ridges on the last whorl is very abrupt. The inner surface of the adult as well as the young shell is smooth, and in the adult shining, with the nacreous layer well-formed all over the shell. The colour of the shell is a dull yellowish to purplish brown in the adult, and a deep-amber or brown in the young. The shell is rather opaque in the adult owing to the thickness, but translucent in the young.

The operculum is thin, semi-translucent, rounded, and fits exactly into the mouth of the aperture. It is concave in the centre of the outer surface, slightly raised near the periphery of the concavity and slopes down abruptly to a narrow membranous strip near the edge. On the inner surface the central portion of the operculum is raised into a broad boss which has a narrow canal at its base and the narrow membranous strip of the edge outside the canal. Very fine oblique striae are present in the canal, and the boss is covered with minute granules of various sizes. The muscles of the foot are attached to the boss on the inner surface.

The radular teeth (Text-fig. 1) closely resemble those figured by Troschel for *Vermetus* sp. (*Gebiss der Schnecken*, Pl. xiii, figs. 1 and 3,



TEXT-FIG. 1.—Radular teeth of *Vermetus* (*Spiroglyphus*) *andamanicus* sp., nov.
c. central, l. laterals, m. marginal in situ, m'. the same slightly tilted to the left.

1861) but differ in the marginal having three teeth instead of two, the inner comparatively large and the two outer ones small, with a minute denticle at the base of the outer of the two small teeth.

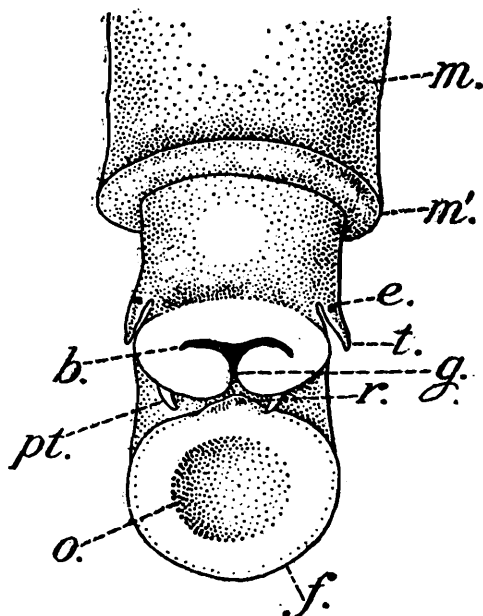
The pedal filaments, foot-tentacles, or anti-buccal appendages of authors are present in our preserved specimens in a much contracted state (Text-fig. 2) in a deep cleft between the head and the foot. A full view of these can be obtained only when the head and the foot are held apart. They lie parallel to the long axis of the body and closely adpressed to the upper surface of the foot. Hedley¹ regards these filaments "as the relic of a degenerated propodium", and suggests that "the process of evolution perhaps continued in the direction of utilising the appendices of the propodium as tentacles". Lacaze-Duthiers² regards them as tactile organs, while Boettger³ suggests that they may act as sense-organs for the perception of water-currents. The margin

¹ Hedley, C.—*Mem. Austral. Mus.*, III, p. 427 (1899).

² Lacaze-Duthiers, H.—*Ann. sci. Nat.*, XIII, pl. 5, figs. 1 & 2, pl. 6 (1860).

³ Boettger, C. R.—*Biol. Zentralbl.*, L, p. 597 (1930).

of the upper surface of the foot where the operculum is attached has a fleshy tubercle which fits into the groove on the underside of the mouth.



TEXT-FIG. 2.—Front view of the head and foot of *Vermetus (Spiroglyphus) andamanicus* sp. nov. (from a preserved specimen).

b. mouth, e. eyes, f. foot, g. groove under the mouth, m. mantle, m'. thickened edge of mantle, o. opercular scar on the foot, pt. pedal filaments or foot-tentacles, r. protuberance on the foot which fits into the groove on the underside of the head, t. tentacle.

The eyes are represented by two dark pigment spots, one on either side of the outer base of the tentacle.

Holotype.—M $\frac{14302}{2}$ on the shell of *Trochus niloticus* in the collection of the Zoological Survey of India, Indian Museum, Calcutta. The young shells are from scrapings of calcareous deposits on *Trochus niloticus*.

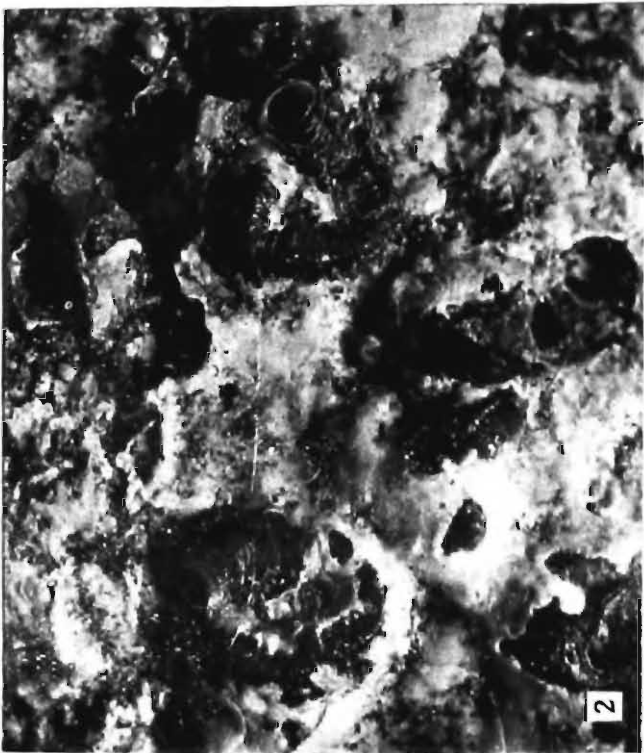
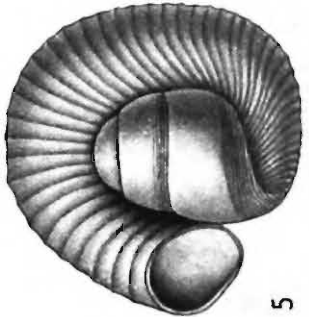
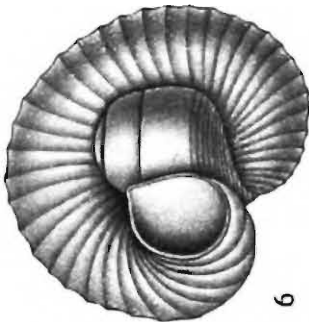
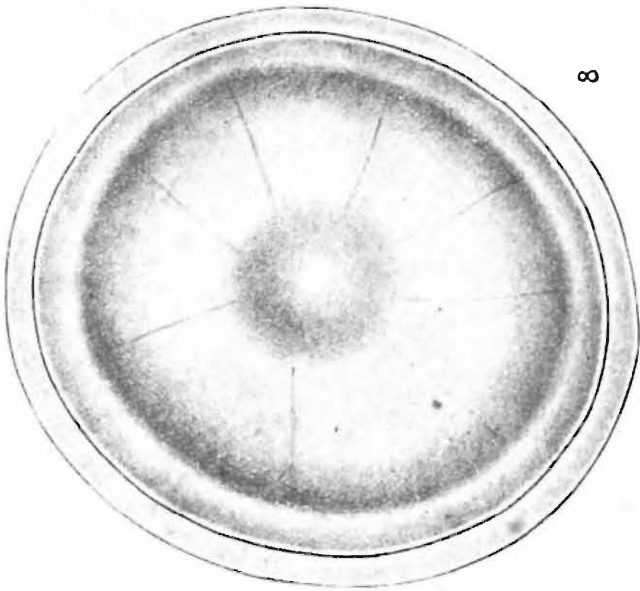
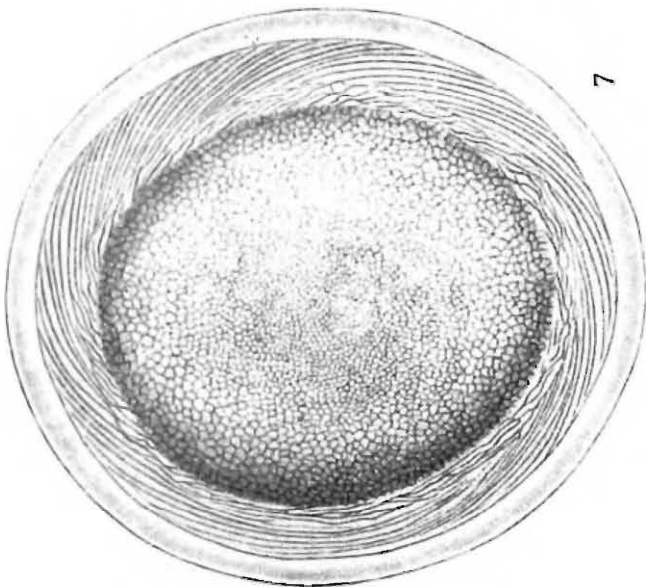
Habitat.—Common in Andaman waters on the shells of *Trochus niloticus* and *Trochus pyramis*. The Vermetid often leaves deep depressions on the periostracal layer (Pl. x, fig. 3), thus detracting from the commercial value of *Trochus*.

Remarks.—*Vermetus (Spiroglyphus) andamanicus* does not agree with any of the species described by Mörch or by later authors, though there is some reason to believe that it may be var. *immersa* Mörch of *Spiroglyphus spiruliformis* De Serres described from Tranquebar as occurring on *Polydonta granularis* Bolten. Unfortunately Mörch does not give any detailed description beyond stating that the shell is deeply immersed with whorls plane, and the lines of growth arcuate, and minutely raised. This description is, however, inadequate to help in identifying the variety referred to above. Chemnitz's figure (*Conch. Cab.*, IX, Pl. cxvi, fig. 999) cited by Mörch and reproduced in Tryon¹, is too poor to be of any use in the identification of this species.

¹ Tryon, G. W.—*Op. cit.*, pl. 51, fig. 49 (1886).

EXPLANATION OF PLATE X.

- FIG. 1.—A group of shells of *Vermetus (Spiroglyphus) andamanicus*, sp. nov., in calcareous deposits on the shell of *Trochus niloticus* Linn. ($\times 2\frac{1}{2}$).
- FIG. 2.—Two of the shells marked with a black cross in fig. 1 are enlarged to show the sculpture. ($\times 7$).
- FIG. 3.—Excavations in the shell of *Trochus niloticus* left by *V. (S.) andamanicus*. ($\times 7$).
- FIG. 4.—Adult shell of *V. (S.) andamanicus*. ($\times 12$).
- FIGS. 5 & 6.—Dorsal and ventral views of the young shell of *Vermetus (Spiroglyphus) andamanicus*. ($\times 50$).
- FIGS. 7 & 8.—Inner and outer view of the operculum of the adult of *V. (S.) andamanicus*. ($\times 64$).



Vermetus (Spirogyphus) andamanicus, sp. nov.

THE EARTHWORMS OF BURMA. IV.

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

INTRODUCTION.

Most of the *Moniligastrin*, *Octochaetin*, *Glossoscolecina*, *Microchaetin* and *Lumbricid* worms with which this paper is concerned were collected during the rainy seasons of 1931 and 1932. The section on the *Megascolecinae* deals only with material collected in 1932 except in so far as *P. anomala* and *P. rugosa* are concerned. In addition to the collections mentioned in the preceding paper of this series, Miss Anderson secured further material from the Pegu Yomas in Tharrawaddy District while Mr. Blackwell collected in the same hills in the western portion of Toungoo District as well as in the independent state of Karenni. Mr. Sutton sent specimens from the Kamaungthwe River region (of Tavoy District) near the Siamese border. Mr. Cope collected in the Chin Hills District, an interesting portion of the province in which no previous collecting had been done. Other collections were made at various places in the Deltas and Dry Zone sections of the Central Basin Region, at Namkham, Kalaw and Taungyi on the Shan Plateau and at Kyaukpyu and Akyab on the western coast of the Arakan Division.

All available types of the Indian *Moniligastrin* and *Octochaetin* species except of *D. doriae* and *E. foveatus* have been examined or re-examined and in many cases the material collected prior to 1931.

Several small collections recently received from the Malay Peninsula contain only specimens of *Pontoscolex corethrurus*. A few notes on these worms have been included in the section on the *Microchaetinae*.

VARIATION.

Very little information has been available in the past to students of the systematics of earthworms regarding the variability of oriental earthworms and in particular in reference to the extent of variation of those characteristics by means of which species are diagnosed and defined. The collections obtained in Burma during the last two years have made available for study rather extensive series of specimens of several species and the opportunity has been taken to accumulate as much information as time has permitted with regard to variation of external characteristics as well as of the internal anatomy. In a preceding paper of this series some of the results of this study of variation, especially in connection with the genus *Pheretima* were presented. Further material is included in the present paper, especially in the sections on the genera *Drawida* and *Eutyphoeus*.

It is now fairly obvious that the lack of this information with regard to variation in characteristics of systematic importance has resulted in considerable confusion, in the erection of unnecessary varieties as well

as species and in the fusion of specifically distinct forms. The confusion has been accentuated by a myopic concentration on a limited number of characteristics some of which at least are widely variable intraspecifically or even individually. The situation has been further complicated so far as the Moniligastrin genera are concerned by the erection or description of new species in entire disregard of the state of maturity of the specimens involved. In these circumstances, it is often very difficult, if not actually impossible, to determine whether or not a particular individual or series of individuals (*Drawida* and *Eutyphoeus*) belongs to an old or to a new species. It is imperative, therefore, that the types of all old species be re-examined and the exact status of forms previously recognized be redetermined. A number of types, and other specimens as well, of species of *Drawida* and *Eutyphoeus* have been made available for study through the kindness of the officials of the Zoological Survey of India (Indian Museum), Calcutta, and have already been examined. Numerous changes in the genera just mentioned will have to be made; these will be considered in detail later in another paper.

IMMATURE SPECIMENS.

Mention has already been made of the fact that in the Moniligastrinae species have been erected in entire disregard of the state of maturity of the specimens involved. This is particularly true with regard to the genus *Drawida* (vide, *Drawida affinis* and *D. barwelli* in Stephenson, 1923). Clitellate specimens of a particular species of *Drawida* may be very difficult to secure and in some cases, at least, fully mature specimens can apparently be obtained only during a short portion of the collecting season. In these circumstances it is obviously of importance to be able to identify immature specimens. Extensive series of ac clitellate specimens, not only of species of *Drawida* but also of all of the Rangoon species and whenever possible of species from other localities, have been examined. A few notes on these juvenile specimens have been included in this paper. At this point it will be sufficient to note that:—(1) Quite small specimens of all of the larger species of Rangoon can be definitely identified. (2) Quite small specimens of many species of *Eutyphoeus* and *Pheretima* can be definitely identified when the adult forms are known. (3) Ac clitellate specimens of *Perionyx* cannot at present be identified specifically. (4) Quite small specimens of certain species of *Drawida* can be identified while much larger specimens, more than 100 mm. in length, of other species cannot be identified. Before the identification of juvenile specimens of *Drawida* is attempted, one must make sure that structures of systematic importance have developed to a stage at which the peculiar specific characteristics are recognizable.

PARASITES OF EARTHWORMS.

A surprisingly large number of worms examined during the last two years have been found to be parasitized, either by nematodes or by gregarinoid protozoa, or by both. The nematodes have been sent to the Division of Nematology in the Bureau of Plant Industry in Washington

and it is expected that some account of these forms will be published shortly. Nematodes have been found mainly in species of *Pheretima*. The protozoa have been found mainly in species of *Pheretima* and of *Eutyphoeus* and are coelomic or so situated that they are visible in dissected specimens. The numbers of the parasites in individual worms are often large, as many as 50-70 have been counted in a single segment of specimens with numbers of segments equally heavily infested. It seems hardly possible that such masses of parasites can be present without having some effect upon the host. Yet some of the most heavily parasitized worms appear to be perfectly normal externally ; they are large, sometimes larger than normal, plump, firm, normally pigmented, with well developed clitella and apparently in healthy condition. The vegetative organs are also, so far as can be determined from macroscopic appearances, perfectly normal, but the "secondary" reproductive organs are rudimentary. In other worms, in which there are large masses of parasites or evidences of previous infestation, reproductive organs are either lacking, rudimentary or abnormally developed. In the preceding paper (Gates 1932, pp. 496-501) the suggestion was made, after consideration of other possibilities, that these abnormalities are parasitically induced. The protozoa, it should be noted, are not in, or on, or (often) even near the reproductive organs which have therefore been affected indirectly or from a distance. If the abnormalities are produced in the manner suggested it is obvious that parasites must be present in the worms during or before the period in which the development of the secondary reproductive structures is begun. In at least one species, the protozoa have now been found in rather small a clitellate earthworms obtained early in the collecting season. Not only trophozoites but also cysts and spores were present. It is quite evident in the case of these particular specimens that many protozoa were present in the worms at a period in the life-history of the host in which the parasites could influence or inhibit the development of reproductive organs. Some further notes on the protozoa have been included in succeeding portions of the paper (*vide* in particular, *P. anomala* and *P. campanulata rugosa*).

MIGRATIONS.

In a previous paper (Gates 1930, p. 263) reference was made to "earthworm migrations". The friend who originally reported the phenomenon with the designation just quoted was asked to submit for publication an account of his observations from which the following is extracted. "In the early morning on certain days in October and November, at the beginning of the cold season, the road is almost covered with worms, one can see worms tumbling down from the banks above on to the road. In the evening not a worm is to be found. I have always assumed that the worms were moving down-hill perhaps in search of water. In this region the mountains are covered with a thick undergrowth of mosses and ferns." Others who have been in the Chin Hills District during the months mentioned have also spoken of earthworm migrations and have given much the same or very similar information. Mr. Cope, who had undertaken to collect earthworms in the Chin Hills District was requested especially to watch for migrating worms, to note the direction of migra-

tion, and to secure a number of the migrating forms. Mr. Cope reports, "All the migrating worms are of the same kind. Both on the slope above the road and the slope below the road the worms were going down, where they followed the road they were going down hill as well." The migrating worms, of which quite a number were secured, are all acitellate specimens of *Perionyx*, possibly of *P. excavatus*.

VARIATION IN SIZE.

Intraspecific variation in size of earthworms is rather extensive, so much so that in the systematic portion of this paper it has hardly seemed worthwhile to indicate more than the maximum length and diameter attained. In the table below are included a few notes on variation in size. The larger of the pair of figures in each case is the length, the smaller the diameter in the region of greatest thickness—usually at the clitellum or just anterior to it. No attempt has been made to show in this table the size of the smallest or of the largest specimen of a species, but only the variation in size at a particular locality is indicated. Thus the dimensions in the two columns indicate merely the size variation in worms collected from a single small locality, as for instance at Maymyo, Sagaing, etc. Measurements are of fully clitellate specimens only and of worms with normal tails without indication of autotomy or regeneration.

<i>Pheretima elongata</i>	.	.	85 × 3½ mm.	300 × 5½ mm.
<i>Pheretima gemella typica</i>	.	.	82 × 4 mm.	165 × 8 mm.
<i>Pheretima hawayana lineata</i>			46 × 2½ mm.	150 × 6 mm.
<i>Pheretima planata</i>	.		64 × 4 mm.	160 × 7 mm.
<i>Perionyx excavatus</i>			46 × 2 mm.	120 × 5 mm.
<i>Octochaetoides birmanicus</i>	.		68 × 4 mm.	156 × 8 mm.
<i>Eutyphoeus bifovis</i>			93 × 4 mm.	290 × 10 mm.
<i>Eutyphoeus excavatus</i>	.		90 × 5 mm.	230 × 6 mm.

ACKNOWLEDGMENTS.

In concluding the present series of papers on the earthworms of Burma, I wish to place on record my sincerest appreciation of the assistance extended to me during the course of the last 10 years by many individuals. The investigation was first suggested and urged by a former principal of the college, Dr. R. L. Howard. His successor, Dr. St. John, the present principal has, for seven years, made possible the continuance of the work initiated under his predecessor and has extended constant support and encouragement. The University of Rangoon has borne, for the past five years, a large share of the expenses of the investigation. H. E. Dudley, G. E. Blackwell, G. R. Anderson, W. D. Sutton, L. A. Dudrow, J. H. Cope, G. S. Seagrave, Harold Young, R. S. Buker, F. R. Bruce, J. L. Lewis, J. H. Telford, N. E. Woodbury, Saw Bruce Taw, U Ba Te, and Saya Ah Sou have laboriously made large collections from areas which are inaccessible to the writer during the best collecting periods of the year. A former student, Maung Kyaw Zan has assisted throughout with the illustrations. Lt.-Col. R. B. Seymour Sewell and Dr. Bains Prashad of the Zoological Survey of India have kindly loaned books from the library of the Zoological survey and

specimens from the Indian Museum and have assisted in other ways too numerous to mention. I wish also to acknowledge my gratitude for advice and encouragement generously extended on many occasions by the head of my department, Dr. F. J. Meggitt, Prof. of Biology in the University of Rangoon, and also by the late Dr. J. Stephenson. A debt of gratitude is also due to two laboratory helpers ; K. John, the laboratory collector, has spent *in toto* several years of his life in the hot sun and chilly rains, in leech- and snake-infested jungles as well as in more pleasant places digging for worms. He and his helper Sarathy have also proved invaluable as they stood by my bench day after day, cutting open and pinning out the worms that were handed to them.

ADDITIONAL NOTES.

The figures of penial setae and reproductive structures are camera lucida sketches. Except in special cases, reference to the original specific descriptions are given only for species erected subsequent to the publication of Stephenson's *Oligochaeta* volume in the Fauna of British India Series. Reference may be made to that monograph for other specific descriptions or previous literature. The list of references at the end of the paper includes only papers or monographs mentioned in the text. In the systematic portion of the paper all species are arranged in alphabetical order under the respective genera. For notes and explanations concerning the setal numbers included in the descriptions of *Pheretima* reference may be made to Gates 1932, p. 387

SYSTEMATICS.

Family MONILIGASTRIDAE.

Genus **Desmogaster** Rosa.

Desmogaster doriae Rosa 1890.

Blachi, August, G. E. Blackwell, 1 anterior fragment of an acitellate specimen.

Leiktho Cirole, September, G. E. Blackwell, 2 acitellate specimens.

Kwachi, September, G. E. Blackwell, 1 acitellate specimen.

Mawchi, September, G. E. Blackwell, 2 acitellate specimens.

Kwachi, October, 1 specimen with slight traces of clitellar glandularity.

The subneural blood vessel of the Blachi specimen bifurcates into two equal branches in xiv, each of which passes out from under the nerve cord and anteriorly as the ventrolateral trunk of its side.

Desmogaster planata Gates.

1931. *Desmogaster planata*, Gates, *Rec. Ind. Mus.* XXXIII, p. 331.

Mawchi, September, G. E. Blackwell, 1 acitellate specimen.

Length 110 mm. Greatest diameter 6 mm. The spermathecal pores are in *c* or *d*, on very slight tumescences on the intersegmental furrows. The female pores are minute, round apertures at the bottom of very

narrow, transversely slit-like depressions anteriorly on xiv, *ca.* in line *b*.

There are paired commissures connecting the dorsal and the ventrolateral blood vessels, on the posterior faces of 10/11 and 11/12.

The testis sacs are developed, apparently, within the septa and project posteriorly more than anteriorly. The vas deferens is probably within the septum which is thin but appears in some places to be more on the anterior face of the septum, in other places more on the posterior face of the septum. The vas passes deep into the parietes median to the prostates, at about *ab*.

The gizzards are six in xix-xxiv.

Genus *Hastirogaster* Gates.

Hastirogaster browni (Mich.).

Examined one acitellate specimen from the Indian Museum, labelled, "*Eupolygaster browni* Mich. ZEV 2935/7. Lashio, N. Shan States, Burma. J. Coggin-Brown, Esq. Type".

There are two small, anteroposteriorly flattened flaps in 8/9 in mid *bc*. The spermathecal pores were not definitely identified but are probably located on the flaps.

The male pores were not definitely identified but may possibly be in 11/12 in *bc* close to *c*.

The female pores were not definitely identified but are probably in transverse slits on the anterior margin of xiv, about in *b*.

The spermathecal ampullae are disc-shaped as in *H. livida*. The ental portion of the spermathecal duct is thick, narrowing gradually as the duct passes ventrally. The duct is twisted into several, slight loops on the posterior face of 8/9 and then passes into septum 8/9 within which it passes directly to the body wall.

There are six gizzards.

The prostates are U-shaped and are flattened. The ectal limb of the prostate is of about the same diameter throughout, the dorsal portion of the ental limb is of about the same diameter as the ectal limb, but the ventral portion of the ental limb is much narrower and softer than the rest of the prostate though much thicker than the vas deferens. The two limbs of the U-shaped loop of the prostate are bound together by connective tissue, much more strongly dorsally than ventrally. The ectalmost portion of the vas deferens is buried in the parietes, emerging therefrom in segment xi posteriorly.

Remarks.—As the single specimen for which *E. browni* was erected is immature, the status of the species must remain doubtful. The number of gizzards can scarcely be used to distinguish *H. browni* from *H. livida* until more is known about the extent of variation with regard to the number of the gizzards and the segmental locations.

Genus *Drawida* Michaelsen.

In Burmese species of the genus the setae begin on segment ii, apparently without exception. The setae also are always closely paired.

To indicate relationships between intersetal intervals, it has been customary to include in specific descriptions and diagnoses some sort of a formula such as " $aa = \frac{1}{2} bc$, $dd > \frac{1}{2}$ the circumference". There is however in certain species considerable intraspecific variation in the relative size of the intersetal intervals aa and bc not only from one worm to another but from one region of the body to another. An apparent lack of similar variation in other species may be due merely to a limitation of observations on this point to a very few specimens or even to a single individual. In these circumstances it is obviously impossible to give setal formulae of the type just quoted or to indicate the relationships of the intersetal intervals except in a rather general way. The practice followed in this paper is to indicate merely the size of aa relative to bc on the segments immediately behind the clitellar region.

Dorsal pores have been recorded from several species of the genus. Several types said to have such dorsal pores have been examined. It is extremely doubtful if definite pores are present. There are, it is true, weakened spots in the parietes in the region of the intersegmental furrows at the mid-dorsal line but no definite pores such as occur in other genera have been noted.

In a number of species paired, segmental masses, either of a rather amorphous, transparent material or of clumps of thread-like bodies have been observed. These structures which have not been investigated either physiologically or histologically will be referred to as enterosegmental organs. The "segmental" is used merely to indicate that the structures are segmentally paired; the "entero" merely to indicate that the bodies are located on the gut.

The shape of the prostate is usually noted in specific descriptions. A prostate may however be erect, nearly straight or only slightly bent on one side of a worm while on the other side the prostate is twisted into a U-shaped loop or into an S-shape. The granular investment of the prostate may be of about the same thickness all around the circumference of the prostate or may be thinner on one or on two sides so as to produce an appearance of lateral or anteroposterior flattening; the investment may extend all the way to the parietes or may be extremely thin or even entirely lacking on an ectal portion. These variations, at least in certain species may be said to be the result of accidents of development and due to the crowding around or compression of the prostate, as it grows, by other organs. The shape of the prostate may therefore be of little, if any, taxonomic value. Removal of the granular investment of the prostate is fairly easy, especially in mature specimens and when so removed there is disclosed a firmer, central body. This central body may be variously bent or twisted but often is, aside from the bending, rather characteristic; it may be short or elongate. If short it may be conical, spindle-shaped or bilobed; if elongate it may be tubular or widened entally.

The prostates and spermathecal atria may be characteristic though not of full size in rather small, aclitellate specimens. The spermathecal ampullae are not developed until later but are usually fully grown and

distended with whitish material which may be iridescent before the appearance of the clitellar glandularity or the distension of the ovarian chamber by the ova. The ovisacs apparently do not develop from firm, whitish, slender, more or less irregular rudiments into softish, yellow, distended sacs until after the ovarian chamber has been filled by ova. The clitellar colouration is the last evidence of sexual maturity to appear.

After the breeding season the clitellar colouration may be retained but usually in a faded, browned or blackened condition. The ovarian chambers and ovisacs of clitellate specimens (of *D. longatria typica*) collected in the early part of the dry season may be distended as in the breeding season but are filled not with ova but with a milky fluid. The milky appearance is due to the presence in an aqueous fluid of large numbers of fine globules, probably of yolk. In clitellate specimens collected much later in the dry season the ovarian chambers are practically empty and the ovisacs are shrunken.

Drawida abscisa Gates.

1931. *Drawida atscisa*, Gates, *Rec. Ind. Mus.* XXXIII, p. 326.

"Dry grassy mound, Mong Mong Valley, ca. 4,000 ft." August, H. Young
12 partially clitellate and clitellate specimens.

Spermathecal genital markings (paired, postsetal or presetal, transverse areas on the margins of vii and viii just anterior to or just posterior to the spermathecal pores) may or may not be present on either of the two segments but are always present on one segment. On each markings there may be one or two greyish spots, each spot the indication of the presence of a gland in the parietes. The gland may be between the circular and longitudinal musculature or may project into the coelom. Other genital markings are merely slight, whitened, thickenings of the epidermis.

Length 40-80 mm. Greatest diameter $2\frac{1}{2}$ -4 mm. Unpigmented.

The gizzards are three to five in segments xiii-xviii as shown below :—

Segments.	Specimens.
xiii-xvi	2
xiv-xvi	2
xiv-xvii	4
xiv-xviii	4
xv-xvii	1
xv-xviii	1

There are two pairs of commissures in segment viii.

The fine, entalmost portion of the vas deferens is looped somewhat as in *D. longatria* and one or two of the loops may project into ix, but the mass of loops of the wider portion of the vas is confined to x and is

as large as or larger than the testis sac. The vas appears to pass into the prostate ventral to the ental end. The prostate is elongate, $3\frac{1}{2}$ -5 mm.

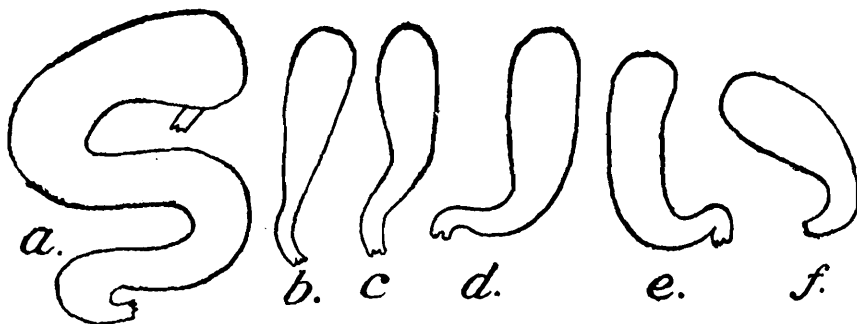


FIG. 1.—*Drawida abscisa* Gates.

a. Prostate central body after removal of granular investment, $\times ca. 20$. b-f. Prostates from five specimens, $\times ca. 11$.

in length, usually bent into an S-shape. The granular layer of the prostate is thickest at the ental end, thinner towards the ectal end and usually entirely lacking for a short distance just before the prostate passes into the parietes. This short region on which the granular layer is lacking is referred to as the stalk. On several of the Mong Mong specimens the granular layer extends clear to the parietes. Removal of the layer of granular material shows the vas deferens passing into the ental end or practically into the ental end of the central body. The central body is elongately tubular increasing gradually in thickness passing entally and without marked enlargement of the ental end.

The spermathecal atria are elongately pear-shaped with a definite stalk or duct portion which is not constricted or marked off from the more saccular ental portion. The luminal face of the atrial wall is ridged, the atrial wall thin relative to the width of the lumen.

Remarks.—With brilliant illumination the genital markings on ix resemble somewhat the genital markings of *D. longatria*, with a central greyish area and a wide, whitish or cream-coloured rim. No parietal glands projecting into the coelom over these markings have been found.

Immature specimens of this species as small as 40×2 mm. can be definitely identified by characteristics of the male porophore and the spermathecal atria.

It has not been possible to determine even from the immature specimens as to whether the male porophore is derived from segment x or xi, or from both, but the juvenile specimens give a slight indication that the porophore develops as a swelling of the anteriormost and posteriormost margins of xi and x, intersegmental furrow 10/11 disappearing across the swollen region, the male pore appearing (on the swelling) to be in line with the intersegmental furrow. The male pore is more readily recognizable in *D. abscisa* than in most of the Burmese species of *Drawida*.

***Drawida ancisa*, sp. nov.**

Sandoway, September, F. R. Bruce, 67 aolitellate and clitellate specimens.

External characteristics.—Length up to 121 mm. Greatest diameter up to 5 mm. Colour, blueish especially dorsally.

The prostomium is prolobous.

The setae begin on segment ii and are closely paired, *ab* equal to *cd*, *aa* less than *bc*.

The clitellum extends when fully developed on to ix and xiv, the clitellar colouration deep red.

The nephridiopores of viii are usually dorsal to *d*.

The spermathecal apertures are transverse slits in $7/8$ just median to *c*.

The female pores are minute, in $11/12$ in *b*.

The male apertures are open, rather conspicuous though minute slits diagonally or longitudinally placed, on special male pore markings.

The male pore markings are slightly protuberant, whitish, transversely elongated but anteroposteriorly narrow areas on the posterior margin of x, extending from *a* or just median to *a* into *bc*. The anterior margin of the male pore marking (but not the lateral or median margins) may be definitely marked off on the larger worms by a slight but evident transverse furrow. The posterior margin of the marking is intersegmental furrow $10/11$. The male pore is on the median half of the marking in line with *b* or only the slightest trifle lateral to *b*. On the lateral half of the marking there may or may not be a tiny, round, greyish marking at the centre of which with bright illumination and high magnification there is visible a minute pore. On some of the specimens on which the clitellar colouration is the deepest there is no anterior furrow bounding the short male area which is merely the posterior portion of a whitened, half-moon-shaped area extending laterally from *a* into *bc* and anteroposteriorly from $10/11$ nearly to the setae of x. The male pore portion of this marking is slightly more protuberant than the anterior portion.

In addition to the male pore markings there are usually two pairs of spermathecal markings—small, transversely oval or half-moon shaped, translucent areas on the posteriormost margin of vii and the anteriormost margin of viii, one marking just in front of and another just behind each spermathecal pore, but the spermathecal pore usually slightly nearer to the median margins of the markings than to the lateral margins.

Thirty-one specimens have further markings on vii or xii. On 17 of these specimens there is a pair of markings on vii, usually one on each side just behind setae *cd*. On 8 specimens the marking on the right side is lacking, on 3 specimens the marking on the left side is lacking. On several specimens the additional markings on vii are slightly dorsal (lateral) to *d* rather than immediately posterior to *cd*. Two specimens have a round marking on the middle annulus of xii in *bc* but slightly nearer to *b* than to *c*.

The markings on vii and xii are the external faces of small parietal glands which may be displayed by removing the longitudinal musculature in a dissected specimen.

Internal anatomy.—Septa $5/6$ - $8/9$ are thickly muscular, $9/10$ is thin and displaced posteriorly as are $10/11$ and $11/12$.

The gizzards are 2-4 in segments xiv-xx as shown below.

Segments.	Specimens.
xiv-xvi	1
xv-xvii	15
xv-xviii	19
xvi-xvii	3
xvi-xviii	1
xvii-xviii	1
xvii-xix	2
xviii-xx	1

In segment xxi, xxii or xxiii the gut is narrowed, abruptly widened in the segment next behind and thence posteriorly lighter in colour.

The last pair of hearts is in ix. There are two pairs of commissures in viii.

The testis sacs are elongate, the portion in x longer than the part in ix, constricted usually by 9/10. One of the sacs may extend underneath the ovarian chamber into xii. The prostates are elongate, erect and club-shaped or bent into a J or U shape. The granular investment,

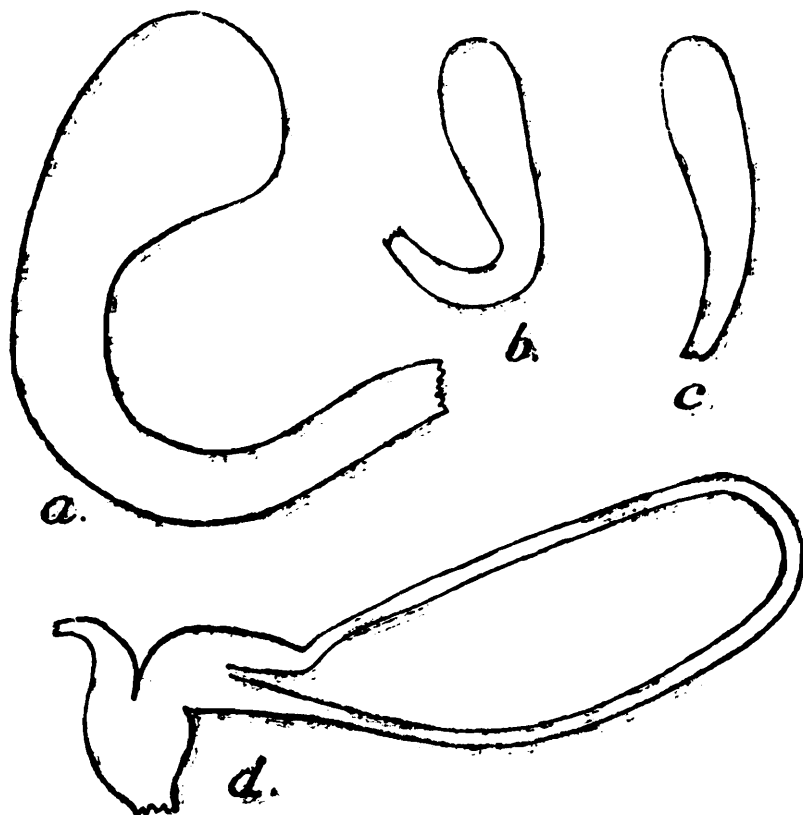


FIG. 2.—*Drawida ancisa*, sp. nov.

a. Prostate central body after removal of granular investment, $\times$ ca. 48. b-c. Prostatae from two specimens. d. Spermathecal atrium, $\times$ ca. 27.

which may be lacking for a short distance near the parietes, is rather thick. Removal of the granular layer displays a central body which is elongate, gradually narrowed towards the parietes. The vas deferens passes into the prostate slightly below the ental end, but was broken off each time during the removal of the granular investment so that the point of entrance into the central body is not known.

The vas deferens is short and appears to be unusually slender in most specimens, with a number of loops in septum 9/10 some of which may project slightly into x.

The ovarian chamber is always opened by dissection, 10/11 and 11/12 passing to the parietes ventrally and laterally independent of each other but probably in contact dorsally. The ovarian chamber is closed off mesially from the oesophagus as in species with an inverted U-shaped chamber but the masses of ova in clitellate specimens are in contact with the parietes at least laterally.

The spermathecal atria are ovoidal and filled with whitish material. The spermathecal duct is coiled in a sort of corkscrew fashion for a short distance just underneath the ampulla and then passes into the septum where it is covered over by a very thin, transparent layer. The portion of the duct in the septum is practically straight. The atria are pear-shaped with a thin wall and empty lumen and narrowed ectally to a more or less stalk-like duct.

Remarks.—The male pores are definitely segmental in location; on small, a clitellate specimens before the genital markings have made their appearance the male pores can be easily identified as patent apertures on x anterior to 10/11.

In one specimen the spermathecal ampullae are in ix on the posterior face of 8/9 but not attached thereto, the spermathecal ducts passing through an aperture in 8/9 just dorsal to the gut and across viii to the posterior face of 8/9 down which they pass to the parietes in a perfectly normal manner.

D. ancisa is closely allied to *D. peguana* but is distinguished from the latter by the segmental and more median location of the male pores and by the distribution of the genital markings. There is no variation in the position of the male pores on any of the Sandoway specimens assigned to *D. ancisa*, nor is there any variation from the intersegmental location of the male pores of large numbers of *D. peguana* collected from widely separated localities in different parts of the province of Burma.

***Drawida bullata*, sp. nov.**

Henzada, August, K. John, 15 a clitellate and 13 clitellate specimens.

Tantabin, September, K. John, 5 a clitellate and 2 clitellate specimens.

Toungoo, September, K. John, 3 a clitellate and 6 clitellate specimens.

Pyigyauung, September, K. John, 4 a clitellate and 4 clitellate specimens.

Kawkareik, October, K. John, 5 a clitellate and 16 clitellate specimens.

External characteristics.—Length 20-45 mm. (Henzada specimens), 40-60 mm. (other localities). Greatest diameter $1\frac{1}{2}$ -2 mm. (Henzada specimens), 3-4 mm. (other localities). Unpigmented, clitellum reddish.

The prostomium is prolobous.

The setae begin on segment ii and are closely paired, *ab* and *cd* are equal, *aa* usually slightly less than *bc*.

The clitellum covers x-xiii and on some specimens extends to ix and xiv.

The spermathecal apertures are tiny, transverse slits or rounded pores in $7/8$ in *c* or just median to *c*, often with swollen anterior and posterior margins.

The female pores are minute, transverse slits in $11/12$ in *b* or just lateral to *b*.

The male pores are short, transverse slits in *bc*, nearer to *b* than to *c*, on porophores which are in *bc*. The median margin of the porophore reaches *b* on the *Henzada* specimens but does not reach *b* on the other specimens. The porophore is a whitened tumescence of the anterior margin of *xi*, conical or anteroposteriorly flattened but pointed and anteroventrally directed. The posterior margin of the porophore may or may not be marked off by a short but quite definite transverse furrow. The transverse furrow may end blindly or may pass at each end into the intersegmental furrow $10/11$; the furrow on *xi* is however never as deep as the groove within which $10/11$ is contained. On the extreme end of the porophore is a tiny round tubercle or what appears to be a tubercle but is in reality only a slightly protuberant, ring-shaped tumescence of the margin of the male pore. On the *Henzada* specimens the male pore is on the median part of the male porophore but on the other specimens the male pore is about at the centre of the porophore.

The genital markings are whitened, flat but protuberant areas in *bc* just lateral to *b*, on *viii*, *x*, *xi*, *xii* and *xiii*. The markings may extend across the whole length of the segment or may be only on the posterior half of the segment. The markings may be continued midventrally into contact with each other posteriorly or may be connected by a whitened strip on the anterior half of the segment (markings on *x* on the *Henzada* specimens).

The nephridiopores of *viii* and *ix* are in *d*.

Internal anatomy.—Septa $5/6$ - $8/9$ are thickly muscular; $9/10$ is thin and displaced posteriorly.

The gizzards are 2-5 in *xiii*-*xviii* as shown below.

Segments.	I	II	III
<i>xiii</i> - <i>xiv</i>	6	..	..
<i>xiii</i> - <i>xv</i>	..	2	..
<i>xiii</i> - <i>xvi</i>	5	9	2
<i>xiii</i> - <i>xvii</i>	..		2
<i>xiv</i> - <i>xv</i>	13	..	..
<i>xiv</i> - <i>xvi</i>	..	7	3
<i>xiv</i> - <i>xvii</i>	..	4	9
<i>xiv</i> - <i>xviii</i>	..	..	3
<i>xv</i> - <i>xvii</i>	..	2	2
<i>xv</i> - <i>xviii</i>	..	2	..
<i>xvi</i> - <i>xvii</i>	..	1	..
<i>xvi</i> - <i>xviii</i>	..	1	

I *Henzada*, II *Toungoo*, *Tantabin* and *Pyigyaung*, III *Kawkareik*.

There are two pairs of vascular commissures in *viii*. The last pair of hearts is in *ix*. There is a band of opaque, whitish or yellowish, material on each side of the dorsal blood vessel from *ix*, *x* or *xii* posteriorly,

The testis sacs are ovoidal, spheroidal or kidney shaped with the concave side facing ventrally, constricted or unconstricted by 9/10,

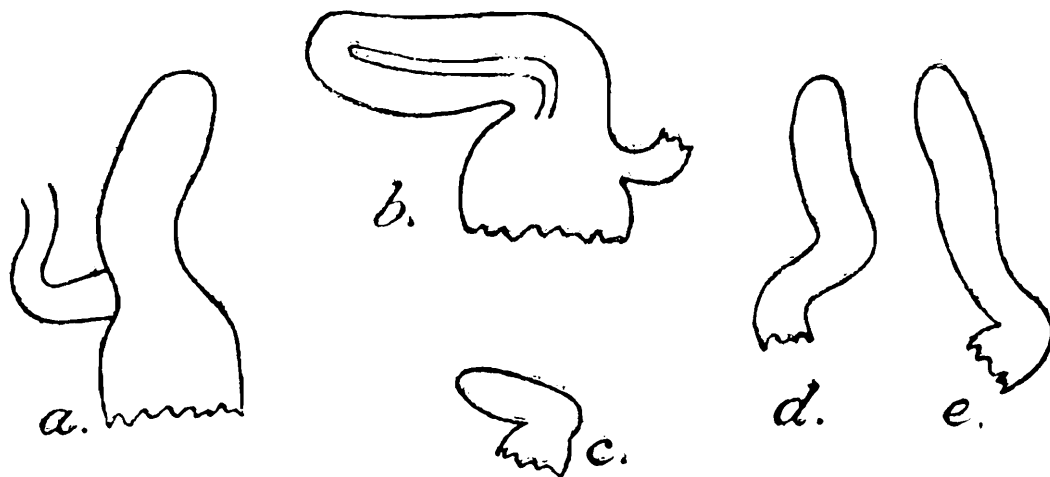


FIG. 3.—*Drawida bullata*, sp. nov.

a-c. Spermathecal atria from three Henzada specimens. d-e. Spermathecal atria of two specimens from Tántabin. All $\times$ ca. 22.

in both ix and x or only in x. The vas deferens is short, almost straight, bent into a few short zigzag loops on the posterior face of 9/10. The prostates are short, erect, club-shaped or bent, the prostate is widest entally narrowing towards the parietes, the portion nearest the parietes in the Henzada specimens very slender and without surface granulations. The central body narrows gradually towards the parietes. The vas deferens passes into the prostate near the ental end.

Segment xi is reduced to a closed ovarian chamber of the inverted U type. The ovisacs extend through xii or xii and xiii, rarely into xiv. The spermathecal atrium is finger-shaped, and widened slightly at the parietes in vii. The widened portion is more noticeable in the Henzada specimens, the atrium in that portion with a bulbous appearance. The atrial lumen is narrow. The atria of the Henzada specimens are shorter than those from other localities.

Remarks.—*D. bullata* is allied to *D. vulgaris* from which it is distinguished by the position of the male pores on the anterior margin of xi.

***Drawida burchardi* Mich.**

1929. *Drawida nepalensis*, Stephenson, *Rec. Ind. Mus.* XXXI, p. 229.

1930. *Drawida nepalensis*, Gates, *Rec. Ind. Mus.* XXXII, p. 290.

1931. *Drawida nepalensis*, Gates, *Rec. Ind. Mus.* XXXIII, p. 348.

Mt. Harriet, Andaman Islands, February, C. Amirthalingam, 12 aclitellate specimens.

Mt. Harriet, July, C. Amirthalingam, 7 aclitellate and 1 clitellate specimens.

Mt. Harriet, September, C. Amirthalingam, 3 aclitellate and 2 clitellate specimens.

Kalewa, August, 10 clitellate specimens.

"Dry, grassy mound, Mong Mong Valley, ca. 4,000 feet," H. Young, August, 5 clitellate specimens.

Sandoway, September, F. E. Bruce, 2 clitellate and 2 aclitellate specimens.

Namkham, September, G. S. Seagrave, 9 partially clitellate or clitellate specimens.

"Banyan Grove," Homang Village, Mong Yai State, October, H. Young, 8 clitellate and 3 aclitellate specimens.

Akyab, September, Bruce Taw, 5 clitellate specimens.

External characteristics.—The nephridiopores of viii are usually displaced dorsal to *d*.

Setal interval *aa* is less than *bc*.

The spermathecal pores are small, transverse slits in $7/8$ just median to *c*.

The female pores are minute, round apertures or transverse slits on the anterior margin of xii or in $11/12$ in line with *b* or very slightly lateral to *b*.

The male pores are on protuberant porophores and are in *bc* a trifle nearer to *b* than to *c*.

The male porophores are in *bc*, usually slightly nearer to *b* than to *c*; the median margin of the porophore does not however reach to *b* on any of the specimens. The porophore is a ventrally directed, more or less cone-like but usually slightly flattened anteroposteriorly, whitish body, apparently between segments *x* and *xi*. It has not been possible to determine definitely whether the porophore is derived from segment *x*, *xi* or from both but the immature specimens appear to indicate that the porophore is derived from both *x* and *xi* with the male pore in line with the intersegmental furrow $10/11$. On the ventral face of the porophore of clitellate specimens there are two distinct markings—towards the median margin, the rather readily visible male pore; towards the lateral margin a small, round, greyish concavity at the centre of which is a very minute pore. Within the porophore and dorsal to the genital marking or greyish concavity there is a small, hard, spheroidal gland. The gland is solid (*i.e.*, with no lumen) and with a greyish translucent appearance that makes the gland rather conspicuous against the whitish tissues surrounding it. The prostatic duct passes through the porophore median to the gland.

The margins of *x* and *xi* immediately anterior and posterior to the male porophores are whitened and in some specimens protuberant as lip-like structures around the base (dorsal portion) of the porophores.

A small, whitened patch of epidermis extends in a diagonal direction from the male porophore towards setae *ab* of *x* or of *xi*.

All except four of the specimens have a pair of postsetal spermathecal markings on segment *vii*, one marking just anterior to each spermathecal pore. Each of these markings indicates the presence of a small, spheroidal, parietal gland which extends through the body wall into the coelom.

Each of the clitellate specimens from the Andaman Islands and eight of the Kalewa worms have a genital marking on segment *ix*. This marking is transversely oval, in *aa*, extending laterally on each side nearly to *a* and located on the middle secondary annulus of the segment, although secondary annuli are not visible on many of the specimens. The marking is merely a greying or whitening of the epidermis; not delimited by a special groove or furrow; no special gland in the parietes dorsal to the marking. Three of the Mong Mong specimens and 5 of the Homang specimens have somewhat similar markings on *ix* but paired, the markings presetal, the centre of the marking about in *a*. Five of the Namkham specimens have a pair of transversely elongated presetal markings on

viii ; each marking extending from about mid *bc* to *c*, *d*, or slightly dorsal to *d*, but not reaching anteriorly to 7/8.

Internal anatomy.—The parietal attachments, at least dorsally, of septa 10/11-17/18, 18/19 or 19/20 are posterior to the intersegmental furrows.

In 14 specimens the gizzards are in successive segments as follows :—xii-xv, 5 specimens ; xiii-xvi, 7 specimens, xv-xvii, 1 specimen ; xvi-xviii, 1 specimen. In all other worms the gizzards are not all in successive segments but are located as shown below.

Segments.	Specimens.
xii, xiii, xiv, xviii	1
xii, xiii, xvi, xvii	1
xiii, xiv, xv, xviii	1
xiii, xiv, xvi, xviii	1
xiii, xiv, xvi, xvii	2
xiii, xiv, xvii	1
xiii, xv, xvi	1
xiii, xv, xvii, xix	1
xiv, xv, xviii	1
xiv, xvi, xviii	1
xiv, xvii, xix	1
xv, xvi, xviii	2
xv, xvii, xviii	1
xv, xvii, xix	2
xvi, xvii, xviii, xx	1
xvi, xviii, xx	1

There are two pairs of vascular commissures in viii.

The testis sac is kidney-shaped with the concavity directed ventrally, about half of the sac in ix and half in x. The vas deferens is twisted into a conspicuous mass of loops in x, the size of which may equal or even exceed the size of the testis sac. No loops of the vas deferens have been seen in ix. Ectally the vas passes into the ental end of the prostate.

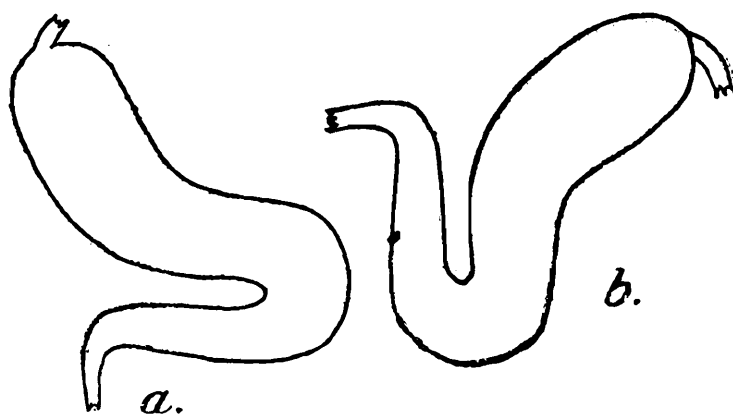


FIG. 4.—*Drawida burchanrdi* Mich.

a-b. Prostate central bodies after removal of granular investment, from two specimens, $\times$ ca. 27.

The prostate is anteroposteriorly flattened and bent into an S, J, U or other shapes or may be bent without being flattened. The layer of

granular material extends clear to the parietes (*i.e.*, there is no coelomic stalk). Removal of the granular layer discloses a central body increasing gradually in diameter passing entally—increasing more gradually than in *D. abscisa* for instance—and without marked special enlargement at the entalmost, end portion. The prostate varies from 3-4 mm. in length.

Segment xi is reduced to an ovarian chamber in the form of a U inverted over the oesophagus from which the ovisacs extend into xiii, xiv or xv. The testis sacs may, one or rarely both, extend underneath the ovarian chamber, through the oesophageal annulus into xii or xii and xiii.

The spermathecal ampulla is large and ovoidal and always contains a transparent mass, either reddish or uncoloured. The spermathecal atrium is elongately pear-shaped and erect in the coelom of segment vii. The ental half or more of the atrium may be annulated and the ental end may be invaginated slightly.

Maximum length of worms 85 mm. Greatest diameter varies up to 5 mm.

Remarks.—The body wall may be weak at the region of the intersegmental furrows in the mid-dorsal line, the weak spots with more or less of an appearance of dorsal pores. Careful examination of a number of specimens on which the weak spots were most evident failed to reveal the presence of any real pore-like apertures through all the layers of the parietes.

A single specimen from the Indian Museum labelled “W 1224/1 *Drawida burchardi*, Mich. Mt. Harriet, Andamans. Dr. Annandale,” has been examined. The worm is a juvenile specimen without trace of clitellar glandularity and does not differ in any significant point from small, aclitellate specimens collected at Mt. Harriet by Dr. Amirthalingam. Re-examination of Burmese specimens in the Indian Museum and the Judson College collection assigned by Stephenson and Gates to *D. nepalensis* shows the latter to be conspecific with *D. burchardi*. Some of the differences between the description given above and that given by Michaelsen (1909, p. 149) are due to the fact that Michaelsen had only juvenile specimens.

***Drawida caerulea* Gates.**

1926. *Drawida caerulea*, Gates, *Rec. Ind. Mus.* XXVIII, p. 143.

Var. *typica* Gates.

Toungoo, September, K. John, 1 specimen.

Pyinmana, September, K. John, 1 specimen.

Kyauk-kyone, September, K. John, 1 aclitellate specimen.

Sagaing, September, K. John, 6 aclitellate specimens.

Tonbo, September, K. John, 4 aclitellate specimens.

Kyaukpadaung, September, K. John, 1 clitellate specimen.

Mandalay, September, K. John, 100 aclitellate and partially clitellate specimens.

External characteristics.—The nephridiopores of segments vii, ix, x, xi and xiii are usually in line with or about in line with *d*. The nephridiopores of viii and xii are displaced dorsal to *d*, quite noticeably. The

nephridiopores of vi and the more anterior segments are also dorsal to *d* but not so noticeably as on viii and xii. Though this arrangement appears to be rather characteristic of the species individual specimens may vary therefrom. Thus one nephridiopore of xii may be in line with rather than dorsal to *d*, and one or both of the nephridiopores of xiii may be displaced dorsal to *d*.

Setal interval *aa* is slightly less than *bc*.

The clitellar colouration is dark reddish.

The apparent spermathecal pores are rather wide transverse slits with tumescent and often lobulated margins in 7/8 in the region of *cd*, opening into a slight parietal excavation. Within the excavation is a rounded, softish tubercle with a smooth, glistening surface. On the ventral face of this tubercle is a round or more or less slit-like aperture, the real spermathecal pore. This development of the ectal end of the spermathecal apparatus is readily recognizable on immature specimens as small as 25 mm., in length with a diameter of $2\frac{1}{2}$ -3 mm.

The male porophores have been described and figured in a previous paper (Gates, 1930, p. 279). The dorsalmost portion of the porophore—the ovoidal basal body—extends anteroposteriorly across some or all of the posterior two thirds of xi, and along the transverse axis, from *b* to lateral to mid *bc*. The epidermis can be scraped off with a little care from the porophore, more readily from the basal portion than from the ventral portion. The tissue of the basal body is softish, but removal of the thin epidermis from the ventral portion of the porophore discloses a firm, nearly spheroidal body. This has a tough, muscular wall and a lumen which is lined with a rather thick layer of soft, whitish tissue. The spheroidal body is regarded as the equivalent of the central body of the prostate in other species, as for instance in *D. fucosa*.

In worms from the southern part of Burma the porophore is always in a condition previously referred to as “everted”. Usually the porophore is conspicuously protuberant and ventrally directed. Rarely the porophores are folded over on the median side towards the midventral line and are in a midventral depression. The “retracted” condition has never been found in the Lower Burma worms.

Specimens from Upper Burma may or may not have the porophore fully everted as in the Lower Burma forms. In the fully retracted condition the ventral portion of the porophore is not visible externally and the ovoidal basal body is not conspicuously protuberant. On the basal body and about in line with 10/11 there is a transversely slit-like depression within which there are visible two narrow, transverse whitish folds or ridges. Removal of the epidermis discloses a spheroidal body as in the worms with everted porophores but here within the softish tissue of the basal body.

In the completely everted condition there is a slight protuberance⁶ from the ventral portion of the porophore, on which the male pore is located. In the fully retracted condition this protuberance is retracted into the central spheroidal body in such a way as to produce the two folds or ridges.

The male pore is a tiny, transverse or longitudinal slit in *bc*, nearer to *b* than to *c*.

The female pore is a minute, transverse slit on the anteriormost margin of xii or in 11/12, in line with or just lateral to *b*.

There are no genital markings.

The length varies from 50-80 mm., the maximum diameter from 3-4 mm. The dorsum is bluish.

Internal anatomy.—There is a lateral strip of soft, yellowish or brownish material on each side of the dorsal blood vessel from segment ix or x posteriorly. Paired enterosegmental organs are present from the first postgizzard segment posteriorly. In a worm 67 mm. long these organs extend as far back as a segment 13 mm. from the tail end.

The subneural blood vessel is almost, if not quite, imperceptible posterior to segment xii but widens in the region of xx-xvii. At about segment xiii the subneural passes out from underneath the nerve cord, to the right or to the left side, and is continued anteriorly on the parietes parallel to the ventral blood vessel as a ventro-lateral trunk. There are, of course, two ventro-lateral vessels but one of these vessels in each worm cannot be traced posteriorly into the subneural trunk and appears to break up into a number of small vessels on the anterior face of 10/11. In x and ix there are paired commissures connecting the dorsal blood vessel with the ventro-lateral trunks. These commissures are on the posterior faces of 9/10 and 8/9 but dorsally pass through the septa and into the dorsal trunk with the hearts of ix and viii. Paired, short, transverse commissures connect the ventral and ventro-lateral vessels in segments viii, vii and v. The hearts of ix-vi connect the dorsal and ventral trunks. There is only one pair of commissures in viii.

The gizzards are 2-4 in segments xiii-xviii as shown below.

Segments.	Specimens.
xiii-xiv	2
xiii-xv	11
xiv-xv	19
xiv-xvi	25
xiv-xvii	2
xv-xvi	23
xv-xvii	11
xv-xviii	3
xvi-xvii	6
xvi-xviii	1
xvii-xviii	2

The testis sacs may extend equally into ix and x or may be entirely in x. In nearly every specimen, one testis sac passes through the perioesophageal annulus under the ovarian chamber into xii or xii and xiii. The testis sac is probably not actually in xii for in favourable specimens the sac can be pulled back again into x leaving a membranous pocket in xii within which the sac had been contained.

The vas deferens is elongate, the loops rather long and loose. The entalmost portion of the vas is within 9/10 but part may protrude into ix. The whole mass of loops is very much smaller than the testis sac.

In the Lower Burma specimens there is no prostate in the coelom. After cutting the diagonal muscle fibres there is visible in the parietes a longitudinally oval area of slightly darker appearance than the surrounding tissues into the centre of which the vas deferens passes. The oval area is the dorsal face of the basal body or portion of the male porophore. Glands such as form the granular layer of the prostate in other species have not been found. In the Upper Burma specimens with retracted male porophores there is a more or less hemispherical, hard projection into the coelom. This projection has a smooth, glistening, pinkish surface without any indication of the presence of the granular layer glands. The vas passes into the anterior face of this body.

In the larger specimens, both clitellate and aclitellate, the spermathecal ampullae are large and ovoidal and filled with whitish material. The spermathecal duct is much thicker throughout relative to the size of the worm than in many other species but is short with only a very few short loops on the posterior face or 7/8. The portion of the atrium that is visible in vii in the dissected specimens has the appearance of a tiny cone at the base of 7/8. The spermathecal duct passes into the ental point of the cone but may be bent ventrally and covered over with tissue so that it at first appears to pass into the median or posterior face of the cone. Within the parietes is a much larger, almost spheroidal portion of the atrium which is covered over by muscular fibres. The parietal portion of the atrium is soft.

Segment xi is reduced to a characteristic, inverted U-shaped ovarian chamber. The ovisacs may extend posteriorly as far as into xviii or xix.

Remarks.—One worm has an extra spermatheca in ix on the right side and an extra spermathecal pore in 8/9 in c. The ampulla and atrium of this spermatheca are smaller than those of the anterior spermathecae.

Just anterior to 5/6 on each side of the pharyngeal bulb are 3 or 4 postero-laterally directed, flattened flaps or appendices.

In the coelom behind the gizzard region of the Mandalay worms there are numbers of rather curious parasites. Each parasite is perfectly spheroidal and about 1 mm. in diameter. The wall of the sphere is thin but tough and perfectly transparent and distended by a clear watery fluid. In this fluid in many of the parasites there are two, whitish, spindle-shaped bodies. The spindles float freely in the fluid and change their position when the parasite is rolled around. No nuclei were found in the spindles which appear to consist merely of masses of closely compacted, fine granules. In a few of the parasites the spindles are replaced by a single, circular disc of granules just underneath the membrane. The number of these parasites per host varies from one to seventeen.

In another worm there are hundreds of ovoidal parasites in the coelom behind the gizzard region. Each parasite is *ca.* .20-.25 mm. in length,

opaque, filled with granules of about the same size and appearance as in the spheroidal parasites.

var. **rasilis**, var. nov.

In a previous paper (Gates 1930, p. 281) it was pointed out that about one fourth of the specimens from Upper Burma referred to *D. caerulea* were distinguished from all other specimens of the species by the length of the vas deferens and the size of the spermathecal atrium. Worms with the large atria were regarded as fully mature, those with smaller atria as only partially mature though both groups were clitellate.

Examination of extensive series of specimens in various stages of development (of the reproductive organs) has failed completely to produce any evidence in support of this view. In these series the spermathecal atria have a definite appearance long before the appearance of the clitellar glandularity. The Upper Burma worms with large spermathecal atria and the very long vasa deferentia must therefore be regarded as taxonomically distinct from the forms with a much shorter vas deferens and a tiny, mainly parietal spermathecal atrium. Unfortunately only one, already partially dissected, not fully mature specimen is at present available for study, so that it is not now possible to attempt a thorough study of the new form. As the differences which have already been pointed out do not appear at present to be very significant the Upper Burma forms are regarded only as a distinct variety.

External characteristics.—The nephridiopores of viii are displaced dorsal to *d*.

The ectal end of the spermathecal apparatus is similar to that of the variety *typica* but the papilla in the parietal excavation is here much longer, longitudinally oval in outline, and the real spermathecal pore is a narrow, longitudinal slit. The tubercle or papilla is much firmer here than in *typica*.

The male porophore has not been found in an everted condition. The appearance of the retracted porophore, externally, is similar to that in the retracted condition of the variety *typica* but here the transversely slit-like depression across the basal body is much deeper and the two ridges are lacking or only one is indicated.

Internal anatomy.—The testis sac may extend equally into ix and x or only into x, in the latter case the testis sac pushes through the perioesophageal annulus under the ovarian chamber into xii. The vas deferens is very long and compacted into a mass of loops that may be as large as the testis sac or even larger. Segment ix is occupied by a portion of the vas, some of the loops of which are in contact anteriorly with 8/9. The prostate or what appears to be the prostate is a large hemispherical to dome-shaped, ovoidal protuberance into the coelom. The surface is smooth without trace of the granular investment of other species of *Drawida*. The vas deferens passes into dorsal face of this body at the centre or slightly anterior to the centre. The coelomic layer (muscular ?) of the prostate is thin and rather easily scraped off disclosing a firm, reddish, spheroidal body like the central body of *typica*. This body can be easily pulled out from parietes and when so removed there is

visible on its ventral face a transverse slit, the margins of which are smooth and shining. This slit probably indicates that the ventral end of the porophore bearing the real male pore has been drawn in or retracted. The spheroidal body and the lumen are both larger than in *typica*.

The spermathecal atrium is large, conical or of an ovoidal or elongately dome-shape, extending antero-posteriorly from 7/8 to 8/9, erect in vii and nearly reaching to the dorsal parietes. The spermathecal duct passes into the median face of the atrium towards the posterior and the ventral margins. The papilla or tubercle in the parietal (spermathecal) excavation is the ventral face of the atrium.

***Drawida constricta* Gates.**

1929. *Drawida constricta*, Gates, *Proc. U. S. Nat. Mus.* LXXV (10), p. 8.

1930. *Drawida constricta*, Gates, (in part) *Rec. Ind. Mus.* XXXII, p. 282.

Mandalay, September, K. John, 26 acitellate and partially clitellate specimens.

Thayetmyo, September, K. John, 28 acitellate specimens.

In addition to the above the following material has been re-examined :—
type-specimen from Mandalay, 22 partially clitellate specimens from Pakokku, 1 clitellate specimen from Kalewa.

The nephridiopores of segment viii are not, usually, displaced dorsal to *d*.

Setal interval *aa* is less than *bc*.

The spermathecal pores are small, transverse slits slightly median or very slightly median to *c*, in 7/8 or on the posterior margin of vii. The margin of the pore may be conspicuously protuberant as a smooth, ring-like lip or the lip may be lobulated.

The male pores are on the ventral faces of porophores and are in *bc* nearer to *b* than to *c* and in line with 10/11.

The male porophores are whitish, ventrally directed, somewhat conical protuberances extending across the posterior portion of *x* and the anterior portion of *xi*. On the Thayetmyo specimens intersegmental furrow 10/11 can be clearly seen ending against the base of the porophore, or on the smallest specimens continued very slightly on to the base of the porophore on each side—the porophore is apparently a development from the contiguous margins of both *x* and *xi*, the male pore at the site of 10/11. The anterior and posterior margins of the porophore are marked off by short, transverse furrows, one just in front of the porophore on *x* and one just behind the porophore on *xi*. On some of the partially clitellate as well as some of the clitellate specimens the anterior furrows have apparently been extended into 10/11 at one or both ends so that the porophore has the appearance of a forward protuberance from the anterior margin of *xi*.

There are paired genital markings on *x* and *xi* except on two acitellate specimens from Thayetmyo and two specimens from Pakokku. Each of the latter has a single transverse marking on *xi*, equivalent to

a fusion of a pair of markings at the midventral line. In addition to those just mentioned genital markings are present as follows :—

1. An unpaired, transverse marking on xii on 38 specimens ; 10 from Mandalay 8 from Pakokku, 20 from Thayetmyo.
2. Paired markings on xii on 8 specimens ; 4 from Pakokku, 2 from Mandalay, 2 from Thayetmyo.
3. An unpaired, transverse marking on ix on 9 specimens ; 1 from Mandalay, 5 from Pakokku, 3 from Thayetmyo.
4. Paired markings on vii and viii, 1 specimen from Mandalay.
5. Paired markings on vii only, 10 specimens from Mandalay.

Each of the paired markings on x and xi is in *bc*, reaching mesially to *b* or sometimes slightly median to *b*, and laterally to mid *bc* about as far as the male porophores or further—sometimes nearly to *c*. These markings are transversely oval, round or variously shaped, white patches or sometimes with a glistening greyish appearance but always without clitellar colouration. The area may be definitely marked off by a circumferential groove and be slightly protuberant, or no groove or furrow may be visible. The marking may be depressed in a concave fashion. Occasionally the depression, but not the marking is continued mesially so that there is a single transverse depression extending across the midventral line. Anteroposteriorly the markings extend across the two posterior secondary annuli of a segment. The markings on x do not extend median to *a*. On three Pakokku specimens the markings of xi extend median to *a*, just median to *a* on each side on one, slightly further towards the midventral line on each side on another, almost reaching the midventral line on a third. The paired markings on xii are like those of x and xi. A single transverse marking of xii extends to mid *bc* on each side and anteroposteriorly across the posterior two secondary annuli of the segment, including on its anterior margin the setae *ab* of each side. The single transverse marking of ix is similarly located. The markings on vii and viii are not as smooth as the posterior markings and appear to be slightly more protuberant. Each marking extends across the posterior two secondary annuli of the segment and from *b* to *c* or rarely slightly median to *b*.

Internal anatomy.—Septa 5/6-8/9 are thickly muscular. The gizzards are 2-3, in segments xiv-xviii as shown below.

Segments.	I	II	III	IV
xiv-xv	2			.
xiv-xvi	5		1	
xv-xvi	15	1	10	3
xv-xvii		..	8	2
xvi-xvii	..	..	6	20
xvi-xviii	..	..	1	..
xvii-xviii	..	..	..	2

I Pakokku, II Kalewa, III Mandalay, IV Thayetmyo.

One specimen has two gizzards, in segments xv and xvii. Eight specimens with three gizzards in the list above have the anteriormost or posteriormost gizzard much smaller than the other two, but still moniliform.

There is brownish material along the sides of the dorsal blood vessel from ix or x posteriorly. There is only one pair of commissures in segment viii but on the posterior face of 8/9 there is a pair of commissures passing from the dorsal to the ventrolateral trunks and corresponding to the median pair of commissures in viii of other species. There is a pair of commissures on the posterior face of 9/10 connecting the dorsal and the ventrolateral trunks.

The vas deferens is rather slender and short, twisted into a small mass of loose loops, part of the loops anterior to 9/10 and part posterior to 9/10. The prostates are short but project definitely into the coelom; mound-shaped, somewhat conical, almost always, if not always, slightly wider than long, very rarely flattened and plate- or disc-like. The granular investment may be removed easily disclosing a firm central body bent over towards the nerve cord as a rule. Into the ental end of this body the vas deferens passes. The vas passes into the prostate of some specimens at the centre of the dorsal face but in other specimens passes into the granular layer mesially or at an antero-median point. The central body is more or less club-shaped, narrowing gradually as it passes into the parietes.

The spermathecal duct is very slightly thickened in the parietes, the thickened portion of the duct in the shape of a minute cone, the point of which may reach up from the parietes in the tissues of septum 7/8. The spermathecal ampullae of the *Thayetmyo* specimens are filled with a whitish material.

Remarks.—The acitellate specimens from *Thayetmyo* reach a length of 95 mm., and a maximum diameter of $4\frac{1}{2}$ mm.

The species, as it is now defined, has no coelomic, spermathecal atria and differs from *D. rara* in the characteristics of the prostates, the number of gizzards, the appearance of the male porophores and possibly also in size and certain characteristics of the genital markings.

The *Thayetmyo* specimens in spite of their size are not fully sexual, the identification—in the absence of clitellate specimens from that region—is not regarded as positive.

***Drawida flexa* Gates.**

1929. *Drawida flexa*, Gates, *Proc. U. S. Nat. Mus.* LXXV (10), p. 10.

Kamaunghwe River, August, W. D. Sutton, 2 acitellate specimens.

Kawkareik, October, K. John, 19 acitellate and 26 clitellate specimens.

Ye, October, K. John, 1 acitellate and 8 clitellate specimens.

External characteristics.—The nephridiopores of viii are displaced dorsally, usually, quite noticeably, rarely not quite so markedly. The nephridiopores of ix may be in line with *c*, *d*, in *cd* or slightly dorsal to *d*.

Setal interval *aa* is less than *bc*.

The clitellar colouration is lacking on a midventral region of variable extent.

The spermathecal pores are minute, transverse slits in $7/8$ in line with or very slightly median to c , the margin of vii just anterior to each pore tumescent with deep longitudinal creases.

The female pores are minute, transverse slits on the anterior margin of xii or in $11/12$, in b or very slightly lateral to b .

The male pore in bc nearer to b than to c is a minute, transverse slit on a special porophore disc.

The male porophores of acitellate specimens are whitened, circular, flattish, very slightly protuberant areas in bc with the median margin in line b , extending anteroposteriorly across the posteriormost one sixth of x and the anteriormost one sixth of xi . The male pore which is readily visible at the bottom of a small depression at the centre of the disc is in line with $10/11$ though $10/11$ is not continued across the disc. On the clitellate specimens the male porophore may be circular or elongated slightly in a transverse direction and may extend posteriorly on to the middle secondary annulus of xi . A very slight crease runs across the porophore in line with $10/11$. The disc may be nearly flat, slightly depressed at the centre or the epidermis around the male pore may be slightly protuberant with an anterior and a posterior lip which must be separated before the male pore is visible as in the type-specimen. No gland has been found within the male pore disc as in the male porophores of *D. longatria* and *D. tumida*.

The genital markings are circular, transversely oval or elongately oval with wide whitish rims and a central, round, greyish spot as in *D. longatria* or the boundaries of the markings may be very faintly demarcated, or the rim may be scarcely if at all recognizable while the central grey spot can be recognized only with difficulty. The markings indicate thickenings of the body wall, but the thickened portions though somewhat like the parietal glands of *D. longatria* do not protrude into the coelom. The longitudinal musculature must be removed in dissected specimens before the glands become visible. After removal of the longitudinal musculature the glands can be pulled out of the body wall leaving an aperture through the parietes with a smooth margin and the cuticle intact. The locations of the genital markings are as previously indicated except that in a few of the recent specimens a marking may extend across more than one secondary annulus.

The length varies up to 112 mm., the diameter up to $3\frac{1}{2}$ mm., unpigmented.

Internal anatomy.—The longitudinal muscles are easily stripped off from the body wall in segments x and xi , the diagonal muscles are much more delicate in this region than in *D. tumida* and *D. longatria*.

The gizzards are in segments xvi - $xxiv$ as shown below.

Segments.	Specimens.
xvi - xx	1
$xvii$ - xix :	2
$xvii$ - xx	4
$xvii$ - xxi	5
$xviii$ - xxi	10

Segments	Specimens.
xviii-xxii	2
xix-xxi	2
xix-xxii	6
xx-xxii	1
xx-xxiii	4
xx-xxiv	1
xxi-xxiii	1
xxi-xxiv	1

There are two pairs of vascular commissures in viii but the median commissures are usually much smaller than the more lateral commissures (*i.e.*, those between the dorsal and ventral trunks).

The testis sacs are medium-sized to large, deeply constricted as a rule by 9/10, the part in x usually 2-3 times the size of the part on ix, extending from 8/9 to the ovarian chamber which may be pushed back dorsally by the testis sacs. The vas deferens is short, a few short loops in a vertical mass within septum 9/10, with several of the loops projecting into ix, and a few loose loops in x underneath the testis sac. The vas passes into the ental end of the prostate or very slightly below the

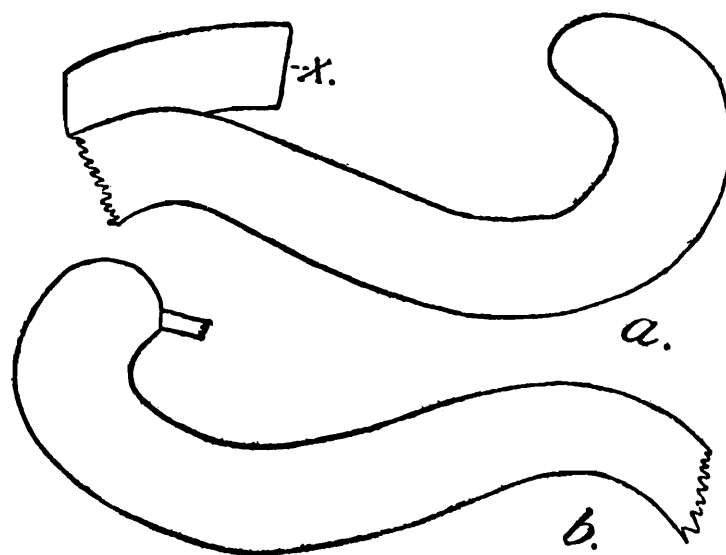


FIG. 5.—*Drawida flexa* Gates.

Prostate central bodies after removal of granular investment, of two specimens, *a-b.* $\times ca$ 35. x=granular investment.

ental end. The prostate has a finely granular surface and is bent into a crescentic, J, U, or S-shape. The granular layer varies in thickness on different parts of the prostate, the variation in thickness of this layer sometimes affecting quite considerably the appearance of the prostate but removal of the granular layer discloses a central body that is of about the same diameter throughout, only very slightly, if at all, widened entally.

The spermathecal ampullae (clitellate specimens) are relatively very large, filling all of segment viii except the ventralmost portion. The ampullae are filled with an iridescent whitish material. The spermathecal atria are short and small; slightly wider at the ental end than at the ectal end; with a thin, transparent wall; erect or bent at right

angles or crushed into a small mass at the base of 7/8. The atria are usually empty but in several clitellate specimens there is a pasty whitish material in the atrial lumen.

Remarks.—In a previous paper (Gates, 1931, p. 338) the statement was made that the male pores in this species are not located on porophores. In that paper the term porophore was restricted to apply to especially protuberant structures as on *D. l. typica*, *deminuta*, etc. In the present paper the term porophore has been used to refer to any special area on which the male pore may be located whether protuberant or not. If the porophore gland of *D. tumida* were lost, the male porophore of that species would probably be much like that of *D. flexa*. The parietal glands of *D. flexa* are like the parietal glands of *D. longatria* in a juvenile stage.

***Drawida fucosa*, sp. nov.**

1930. *Drawida constricta*, Gates³ (in part), *Rec. Ind. Mus.* XXXII, p. 282, fig. 4.

Prome, September, K. John, 5 acitellate, 7 partially clitellate and 2 fully clitellate specimens.

The following material has been re-examined:—8 clitellate specimens from Kalewa, August.

External characteristics.—The Kalewa specimens reach a length of 170 mm., the Prome specimens, 130 mm. The greatest diameter of the Kalewa specimens is 6 mm., of the Prome specimens, 7 mm. Unpigmented.

The nephridiopores are on the anterior margins of the segments and about in line *d*.

The prostomium is prolobous.

The setae begin on ii, *ab* and *cd* are closely paired, the setal intervals vary somewhat, but behind the clitellum *aa* is usually slightly less than *bc*.

The clitellum when most fully developed extends on to the posterior portion of ix and the anterior portion of xiv. The clitellar colouration is dark red.

The spermathecal apertures are small, transverse slits slightly median to *c* on the posterior margin of vii. The parietes around each pore is slightly swollen and protuberant, the protuberance forming a smooth ring around the pore or wrinkled.

The female pores are minute, transverse slits in 11/12 or on the anteriormost margin of xii, about in *b*.

The male porophores are ventrally directed, anteroposteriorly flattened flaps in *bc*, the median margin just lateral to *b*. Dorsally the porophore is flattened out slightly, the basal portion of the porophore extending across the whole of the anteriormost secondary annulus of xi. On the Kalewa specimens the basal portion is more flattened out so that the porophore is slightly less protuberant but is extended anteriorly over 10/11 from which it can however be easily pushed back. The porophore is softish, whitened and sharply marked off by a circumferential furrow at the base.

The genital markings are as described below.

Kalewa specimens :—

1. One pair of transversely elongated, postsetal markings on the posteriormost secondary annulus of x. Each of these markings is white, smooth and glistening; slightly protuberant; extending laterally as far as the male porophores extend and mesially to *a* or to slightly median to *a*. The lateral end is usually bluntly rounded, the median end more pointed. These markings are present on 8 specimens.

2. A pair of similar but smaller postsetal areas on xi, 5 specimens.

3. A transversely elongated area on xi, reaching laterally into *bc* as far as do the male porophores, and anteroposteriorly covering the last two secondary annuli of xi. Each of the last two secondary annuli is wider than the anteriormost secondary annulus. Setae *ab* are on the anterior margin of this marking which is usually slightly protuberant 2 specimens.

4. A transversely elongated area on xii, of the same size, appearance and location as that of xi. 2 specimens.

5. A transversely elongated area on ix, of the same size, appearance and location as that of xi. 1 specimen.

Prome specimens :—

1. A pair of markings on the last two secondary annuli, somewhat similar to those of the Kalewa specimens, but here elongated in a longitudinal direction and extending from *b* nearly to *c*. Except on one specimen these markings are depressed in a regularly concave fashion. 14 specimens.

2. Paired postsetal genital markings on xi, each slightly depressed, usually elongated in a transverse direction, reaching laterally nearly as far as do the male porophores, mesially to *a* or slightly median to *a* and anteriorly to include *ab* or on fully clitellate specimens to 10/11 just median to the male porophore.

The genital markings are areas of slight thickening of the epidermis only.

Internal anatomy.—Septa 5/6-8/9 are thickly muscular, 9/10 is thin and displaced posteriorly.

The gizzards are in xv-xvii in the Kalewa specimens; in xv-xvii (5), xv-xvi (2), xvi-xvii (4) and xvii-xviii (1) in the Prome specimens.

The last pair of hearts is in ix. There are 2 pairs of vascular commissures in viii. In the Prome specimens there are small masses of a translucent material on the dorsal surface of the intestine one of each side of the dorsal blood vessel for about 8 segments following the last gizzard segment. In Kalewa and Prome specimens there is a strip of opaque, yellowish material along each side of the dorsal blood vessel, from about segment xii posteriorly.

The testis sacs are kidney-shaped and are in both ix and x, the portion in ix slightly smaller than the portion in x in the Kalewa specimens, of the same size in the Prome specimens. The testis sac is slightly constricted dorsally by 9/10 in the Kalewa specimens, usually unconstricted in the Prome specimens. The concave face of the sac is directed ventrally. The vas deferens is rather short, twisted, in the Kalewa specimens, into a very few rather closely compacted coils on the posterior face of 9/10 just under the testis sac. The vas deferens in the Prome specimens is twisted into a number of rather loose coils on the posterior face of 9/10 forming a mass about one fourth the size of the testis sac. Ental to the mass of coils or loops the vas is slenderer and either in 9/10 entirely or with a very few short loops projecting into ix. The prostate is rather short, sessile, more or less conical, often anteroposteriorly flattened, usually bent towards the nerve cord, narrowed only in the parietes. The vas deferens passes into the morphological ental end of

the prostate which faces mesially. The granular layer may be easily scraped off to display the pinkish, central body which is of about the same diameter throughout.

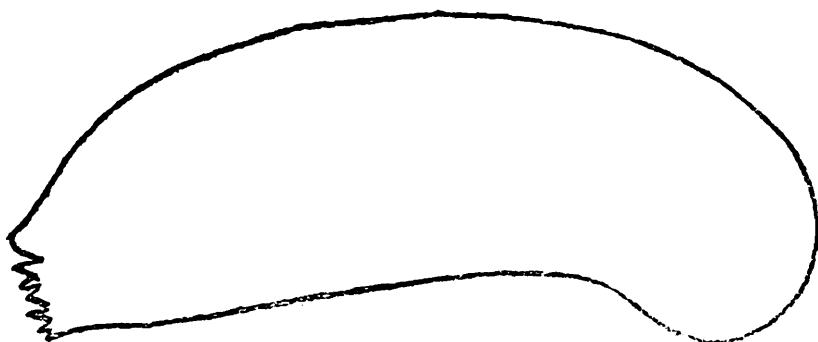


FIG. 6.—*Drawida fucosa*, sp. nov.

Prostate central body after removal of granular investment, $\times ca. 40$.

The ovarian chamber is U-shaped and inverted over the oesophagus.

The spermathecal ampullae are filled with whitish material even in the aclitellate specimens. The spermathecal duct is twisted into a number of loose loops just ventral to the ampulla and then passes ventrally straight to the parietes in septum 7/8 just underneath a rather delicate coelomic layer. The duct is slender and appears to be slightly narrower ectally than entally. The spermathecal atria of the aclitellate Prome specimens are erect in vii, 6-10 mm. in length, looped back and forth in a rather regular zigzag fashion, or compressed into a rounded mass at the base of 7/8 and covered over by transparent connective tissue. The wall of the atrium is thin and transparent. The atria in the aclitellate and clitellate specimens from Prome are empty. The ental portion of the atria of the Kalewa specimens is widened, the lumen filled and the atrium distended by a mass of sticky whitish material, the zigzagging of the atrium more or less completely lost. The spermathecal duct passes into the atrium in the parietes.

Remarks.—Certain worms from Kalewa and Mandalay formerly (Gates, 1930, p. 282) referred to *D. constricta* have well developed atria in segment vii. *D. constricta* as now defined has no spermathecal atria in vii. It has therefore been necessary to erect a new species for the worms with atria.

The atria, except when distended by the presence of sticky whitish material, are very similar in appearance to the atria of *D. longatria* (those forms with short atria). No sticky whitish material has ever been found in the atria of *D. longatria*. *D. fucosa* is distinguished from *D. longatria* by the characteristics of its genital markings and by the absence of parietal glands in or near the male porophores.

***Drawida gracilis* Gates.**

1925. *Drawida gracilis*, Gates, *Ann. Mag. Nat. Hist.* (9) XVI, p. 660.

Pegu, August, K. John, 12 aclitellate specimens.

Tharrawaddy, August, K. John, 47 aclitellate specimens.

Pegu Yomas, August, G. R. Anderson, 1 aclitellate specimen.

Sandoway, September, F. R. Bruce, 3 aclitellate specimens.

Thanatpin, September, K. John, 2 aclitellate specimens.

Letpadan, September, K. John, 4 aclitellate specimens.

Prome, September, K. John, 4 aclitellate specimens.

Tiddim, September, J. H. Cope, 1 aclitellate specimen.

External characteristics.—The nephridiopores of viii are not generally displaced dorsal to *d*.

Setal interval *aa* is less than *bc*.

The spermathecal pores are rounded apertures or transverse slits on 7/8 or on the posteriormost margin of vii near to 7/8, in line with or very slightly median to *c*. On the largest specimens the margin of the pore is slightly swollen, the tumescence a simple ring or lobulated.

The female pores are minute, transverse slits in 11/12 in line with or very slightly lateral to *b*.

The male pore is a very short, transverse slit, in *bc* but nearer to *b* than to *c* as a rule. The posterior margin of the pore is swollen as a sort of tiny rounded lobe or teat-like projection which often conceals the male pore.

The male porophore is a whitened, slightly protuberant epidermal area with a flat ventral surface or elevated into a cone-like protuberance, extending across the posterior half of the last secondary annulus of *x* and the anterior half of the first secondary annulus of *xi*, the median margin of the porophore about in line *b* or very slightly lateral to *b*, the median margin not reaching to *c*. Intersegmental furrow 10/11 is not continued across the male porophores. No glands have been found in the male porophores as in the porophores of *D. longatria* or *D. burchardi*.

The genital markings are whitened, faintly or scarcely demarcated thickenings of the epidermis, protuberant externally only and slightly; no glands visible in a dissected specimen after removal of the longitudinal musculature. Usually there are two pairs of the genital markings, one marking, just in front of each male porophore—on the middle annulus and the anterior half of the posterior annulus of *x*, and one marking just posterior to each male porophore on the middle annulus of *xi*. There may be additional markings as previously indicated.

Internal anatomy.—The gizzards are 1-4, in segments xv-xxi as shown below :—

Segments.	Specimens.									
xv-xvi	.	.	.	.	.	.	.	.	.	1
xvi	.	.	.	.	.	.	.	.	.	1
xvi-xvii	.	.	.	.	.	.	.	.	.	1
xvi-xix	.	.	.	.	.	.	.	.	.	1
xvii-xviii	.	.	.	.	.	.	.	.	.	5
xvii-xix	.	.	.	.	.	.	.	.	.	4
xviii-xix	.	.	.	.	.	.	.	.	.	2
xix-xxi	.	.	.	.	.	.	.	.	.	1

In one of the cotype specimens there are three gizzards in segments xvi, xviii and xix.

There are two pairs of commissures in viii, the median commissures often very much smaller than the lateral commissures. There is a streak of opaque, whitish or yellowish material on each side of the dorsal blood vessel from ix or x posteriorly.

The testis sacs are usually kidney-shaped, the concave side directed ventrally, in ix and x, the portions in the two segments of about equal size. Rarely the testis sac does not protrude into ix but pushes underneath the floor of the ovarian chamber into xii. The vas deferens is elongate with a mass of loops in ix and another mass of loops in x, the size of these two masses together, small relative to the size of the testis sac. The vas passes into the dorsal face of the prostate at the centre or towards the median margin anteriorly.

The prostate is a flattened disc, circular in outline, or shortly cone-like and slightly protuberant into the coelom. The layer of surface granulations is very thin in the smaller specimens, thicker in the larger specimens. Removal of the granular layer discloses an erect, cone-like central body into the pointed ental end of which the vas passes. The parietal base of the central body is wide.

The spermathecal atrium has a smooth surface and is erect in vii on the anterior face of 7/8. The atrial wall is thick, the width of the atrial lumen less than the thickness of the atrial wall. In cleared atria the wall appears to consist of two layers, an outer thin and transparent layer and an inner much thicker layer which clears more slowly and less satisfactorily.

Remarks.—The specimen from Tiddim is only 59 mm. in length and 3 mm. in diameter but appears to be nearly sexual, as the spermathecal ampullae are ovoidal and distended with whitish material, septa 10/11 and 11/12 are widely separated from each other mesially by a mass of ova. The ovisacs which extend only into xiv or xv are firm and whitish. In this specimen the posterior ends of both testis sacs are pointed and project into xii. The spermathecal duct is slightly more than 5 mm. in length, the atrium slightly more than $1\frac{1}{2}$ mm. in length.

The body wall of segments x-xiii of the type and one of the cotype specimens is slightly pinkish, a characteristic which was overlooked or not recorded originally. These two specimens may be fully clitellate or the light colouration may indicate only an early stage of clitellar development. Aside from the two specimens just mentioned no clitellate worms of this species have yet been found.

Segment xi is always opened in dissection but is always closed off from the oesophagus mesially as in those species which have an inverted, U-shaped, ovarian chamber.

***Drawida hehoensis* Steph.**

1931. *Drawida hehoensis*, Gates, *Rec. Ind. Mus.* XXXIII, p. 340.

Maymyo, August, K. John, 2 acitellate specimens.

Kalaw, September, Saya Ah Sou, 1 acitellate specimen.

In addition to the above, material collected previously from Maymyo, Taungyi and Yaungwhe has been re-examined.

External characteristics.—The nephridiopores of viii and ix are not as rule displaced dorsal to *d*.

Setal distance *aa* is less than *bc*.

The genital markings are one or two pairs and are whitened areas on the margins of *x* and *xi* immediately anterior to or posterior to the penis. The markings on *x* are small and protuberant in a rounded fashion, the markings on *xi* are also protuberant but more as triangular flaps projecting anteriorly over 10/11 from the margin of *xi*. These flaps at first glance look very much like male porophores but lack pores. The anterior pair of markings are always lacking on the Taungyi and Yaungwhe specimens but are clearly visible on the specimens from Kalaw and Maymyo. On several of the Maymyo specimens the markings on *xi* are scarcely indicated.

Setae *a* and *b* of segments *x* and *xi* may be located at the centres of tiny whitened areas on which the clitellar colouration is lacking.

The markings represent merely thickenings of the epidermis; no parietal glands have been found.

The penis is rarely tubular in a strict sense but is slightly flattened anteroposteriorly and with a broader basal (dorsal) portion. The penis is usually retracted into an invagination of the parietes at the intersegmental furrow, and in the retracted condition is entirely concealed from view by the flap from the anterior margin of *xi* or by the juxtaposition of the margins of the two markings of a side. On several of the Maymyo specimens the invagination containing the penis has been partially or completely everted. When partially everted, the ventral end of the penis protrudes to the exterior from between the margins of the markings. When fully everted, the penis is seated on a porophore-like protuberance that is more or less conical and of which the markings of *x* and *xi* now appear to be integral portions. The penis and male pore are in mid *bc* perhaps a slight trifle nearer to *b* than to *c*.

Internal anatomy.—The gizzards are in *xiii-xviii* or *xix*, the first gizzard in *xiii*, *xiv* or *xv*.

There is a band of opaque, yellowish material along each side of the dorsal blood vessel from *ix* or *x* posteriorly. There are masses of brownish or reddish translucent material on the dorsal surface of the intestine for several segments behind the last gizzard segment, one mass on each side of the dorsal blood vessel in each segment.

The testis sacs may be kidney-shaped with the concave side facing ventrally or of various other shapes. The testis sac may or may not be noticeably constricted by 9/10. The testis sac may be mainly in *x* or with portions of about equal size in *ix* and *x*. At the anterior and posterior ends of the testis sacs there may be narrowed prolongations referred to as "beaks or tails" variously bent. The tails at the posterior ends of the testis sacs may protrude underneath the ovarian chamber into *xii*.

The vas deferens is twisted into a rather compact but very small mass of loops on the posterior face of 9/10 but one or two or several of the loops may project slightly into *ix*. The vas passes into the prostate ventral to the ental end, usually quite noticeably so. The prostate is rather

long and erect in the coelom, sometimes bent. The layer of surface granulations is easily scraped off, especially in acitellate

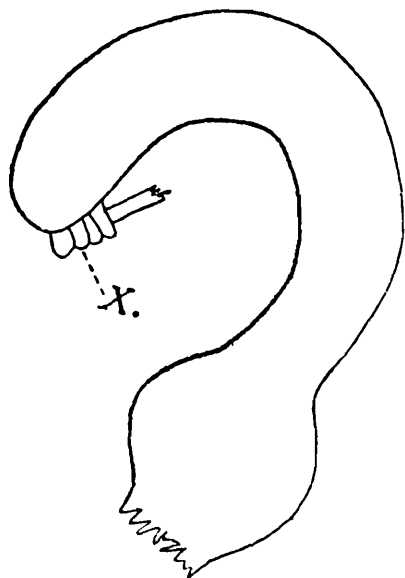


FIG. 7.—*Drawida hehoensis* Steph. 1924.

Prostate central body after removal of granular investment, $\times$ ca. 20. x =granular investment.

specimens revealing a firm columnar central body. The central body appears to be widened quite noticeably as it passes into the body wall, the widening more or less spheroidal in appearance. In some specimens this widened region projects conspicuously into the coelom. This spheroidal body is probably not a part of the prostate at all but merely a parietal invagination into the coelom through the wall of which the central body of the prostate is continued into the penis. The layer of granular material does not always extend clear to the parietes or to the spheroidal body and rather infrequently may be limited to a "crown" or tuft of fairly large granulations at the ental end of the central body of the prostate. The granulations on the prostates of the Kalaw specimens are unusually large and can be pulled or

scraped off from the prostate individually as they are very loosely attached to each other and to the central body of the prostate.

The spermathecal duct is 6-7 mm. in length and twisted into a few loose loops on the posterior face of 7/8 just underneath the spermathecal ampulla. The duct is slightly widened ectally, the widened region slenderly conical in shape, in septum 7/8, bound to the posterior face of 7/8 or projecting, erect, into viii at the base of 7/8.

Remarks.—There are probably always two pairs of vascular commissures belonging to segment viii but in some of the specimens the median commissures appear to be unusually small and when empty are difficult to find. In one specimen the median commissures of viii (the commissures to the ventrolateral trunks) are actually in septa 8/9.

***Drawida lacertosa* Gates.**

1930. *Drawida lacertosa*, Gates, *Rec. Ind. Mus.* XXXII, p. 284.

var. *typica* Gates.

Sandoway, September, F. R. Bruce, 2 acitellate specimens and 1 specimen with slight clitellar colouration on segments x and xi.

The greatest length is 144 mm., the greatest diameter $6\frac{1}{2}$ mm. Unpigmented.

The nephridiopores of viii and ix are about in *d*.

The spermathecal apertures are transverse slits about in *c* or very slightly median to *c*, probably on 7/8 but with the appearance of being on the posteriormost margin of vii, the anterior and posterior margins of the pore tumescent, the tumescence lobulated. The posterior tumescence appears to be actually on 7/8.

The male pores are readily recognized at the ends of the whitened male porophores.

The male porophore consists of a firm or hard, more or less conical or teat-like ventral portion and a softer dorsal or basal portion which has an appearance of a basal plate or of a thickish ring about the dorsal part of the conical portion of the porophore. The basal portion of the porophore extends across the posterior half of the last secondary annulus of x and the whole of the anteriormost secondary annulus of xi, in *bc* from *b* to mid *bc* and is marked off from the conical or teat-like ventral portion by a fairly deep, circular furrow.

The genital markings are not sharply delimited by grooves or furrows and are located as follows:—

1. A transversely elongated, presetal area extending laterally on each side to just beyond *b* on viii and on ix.
2. A protuberant area on xii in *aa* extending across the anterior two secondary annuli (type-specimen) or across the whole length of the segment.
3. Paired very slightly protuberant or not protuberant areas in *bc* just lateral to *b* on x and xi, one area just anterior to and one area just behind each male porophore.

Internal anatomy.—The gizzards in the Sandoway specimens are five in xvi-xx, the gizzard in xvi smaller than the other gizzards.

The last pair of hearts in the Sandoway specimens is in ix. There are two pairs of vascular commissures in viii. There is a band of opaque and yellowish or transparent and brownish or reddish material on each side of the dorsal blood vessel from segment ix or x posteriorly. There are paired enterosegmental organs in a few segments (8 or more) just

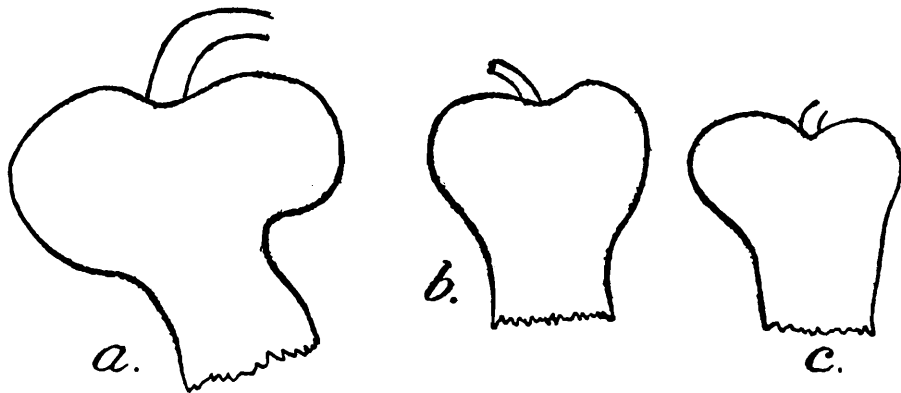


FIG. 8.—*Drawida lacertosa typica* Gates.

- a.* Prostate central body after removal of granular investment, $\times$ ca. 40. Variety *sepulta* *b-c.* Prostate central bodies after removal of granular investment $\times$ ca. 20.

following the last gizzard segment, each organ of long, whitish or transparent threads.

The testis sacs of the Sandoway specimens are fairly large, in both ix and x, constricted or unconstricted by 9/10, the portion in ix smaller than the portion in x or of about the same size. The entalmost portion of the vas deferens is very slender and appears to project into ix but is covered over with transparent connective tissue which also surrounds the hearts of ix. In segment x the vas is wider and twisted into a compact mass of loops which may be slightly smaller or about as large as the testis sac. The vas passes into the centre of the dorsal face of the prostate. The prostate is an elongate body with bluntly rounded ends, sessile on the parietes and conspicuously protuberant into the coelom,

Removal of the granular investment displays a tough, hollow, fairly large, elongated central body with a depression at the centre of the dorsal face into which the vas deferens passes. The central body is continued through the parietes and the tissues of the male porophore as a short but tough and thickly columnar stalk.

The ovarian chamber is of the usual inverted U-shape and in the specimen with slight traces of clitellar glandularity is distended by ova. The ovisacs extend through xii and xiii.

The central body of the prostate is nearly filled with a soft, whitish material which can be easily scraped off leaving a clear, uncoloured or reddish, transparent layer of considerable toughness.

Remarks.—*D. lacertosa* was erected for a single specimen with a dark red, clitellar colouration on segments x-xiii but with small testis sacs, ovarian chamber and ovisacs. The specimen was collected late in October, probably at the close of the breeding season, the testis sacs probably reduced in size, *i.e.*, smaller than normal for a sexual specimen, the ovarian chamber and ovisacs almost certainly shrunken, like the post-reproductive period ovarian chambers and ovisacs of *D. longatria*.

var. *sepulta* Gates.

1931. *Drawida sepulta*, Gates, *Rec. Ind. Mus.* XXXIII, p. 352, fig. 4.

Toungoo District-west, September, G. E. Blackwell, 2 acitellate specimens.

Blachi, September, G. E. Blackwell, 1 acitellate specimen.

Kawkareik, October, K. John, 13 acitellate and 43 clitellate specimens.

Thaton, October, K. John, 9 acitellate and 16 clitellate specimens.

The nephridiopores of viii and ix are not displaced dorsal to *d*.

The male porophores are like the porophores of the variety *typica* but the conical ventral portion is usually smaller than in *typica*.

The genital markings are transversely elongated, anteroposteriorly short areas of parietal thickening, only slightly different in appearance from the ventral parietes and not marked off by definite grooves or furrows. The markings extend laterally on each side to *a*, rarely to about mid *bc* or to *c* or *d*, and are located on the posteriormost annulus of ix, the posteriormost annulus of viii and the presetal portion of ix.

The gizzards are 3-5 in segments xiv-xix as shown below.

Segments.	Specimens.
xiv-xvi	1
xiv-xvii	5
xiv-xviii	2
xv-xvii	2
xv-xviii	13
xvi-xviii	4
xvi-xix	4

There is a band of opaque, yellowish or brownish material on each side of the dorsal blood vessel from segment ix or x posteriorly. There are paired enterosegmental organs in a few segments just posterior to the last gizzard segment, each organ of transparent reddish material and similar in appearance to the dorsal blood vessel.

The prostates are sessile, circular patches into the centre of which the vas deferens passes, only slightly protuberant into the coelom. Removal of the granular investment displays a small but firm central body with a bilobed dorsal face, the anterior lobe slightly larger than the posterior lobe, the vas passing into the central body in the transversely depressed region between the two lobes.

Remarks.—The central body of the prostate of *D. sepulta* is really only a smaller copy of the central body of *D. lacertosa*, the prostates of the two forms differing from each other only in the size of the central body and the thickness of the granular investment. Such differences cannot be accepted as evidence of specific distinction. The second reason for regarding *D. sepulta* as specifically distinct from *D. lacertosa* was the posterior location of the gizzards in the latter; in xiii-xix in *sepulta*, in xvii-xx in *lacertosa*.

The variation in segmental location of the gizzards is however much greater than was formerly supposed (*vide D. longatria* as well as other species) so that the slight differences in segmental location of the gizzards can also not be regarded now as evidence for specific distinctness of *D. sepulta* and *D. lacertosa*.

As the size of the prostate and the central body seems to be subject to only slight variation in the two forms, *D. sepulta* is retained, for the present, as a distinct variety.

Drawida longatria Gates.

1925. *Drawida longatria*, Gates, *Ann. Mag. Nat. Hist.* (9) XVI, p. 50.

I.

One large, flask-shaped, parietal gland in each male porophore region.

var. typica Gates.

1930. *Drawida longatria typica*, Gates, *Rec. Ind. Mus.* XXXII, p. 286, fig. 5.

Pegu, August, K. John, 1 a clitellate specimen.

Tantabin, September, K. John, 48 specimens, 40 a clitellate.

Maubin, September, K. John, 10 clitellate specimens.

Sadoway, September, F. R. Bruce, 53 a clitellate and 8 clitellate specimens.

Pyapon, September, K. John, 47 a clitellate and 7 clitellate specimens.

Thanchitaw, September, K. John, 1 a clitellate specimen.

Coomzamu, September, K. John, 4 a clitellate and 3 clitellate specimens.

Yandoon, September, K. John, 3 a clitellate and 1 clitellate specimens.

Letpadan, September, K. John, 73 a clitellate and partially clitellate specimens.

Prome, September, K. John, 27 a clitellate and partially clitellate specimens.

Akyab, September, Bruce Taw, 4 a clitellate specimens.

Henzada, October, K. John, 6 a clitellate specimens.

Myaungmya, October, William Law, 196 a clitellate and partially clitellate specimens.

Mandalay, September, K. John, 3 clitellate and 10 a clitellate specimens.

Tonbo, September, K. John, 16 a clitellate and 27 clitellate specimens.

Examined 1 specimen from the Indian Museum labelled "W 1796/1, Kamaing, Myitkyina, Upper Burma, R. Chopra".

External characteristics.—The nephridiopores of viii are usually displaced slightly dorsal to *d* ; nephridiopores on other segments usually in line *d* or about in line *d*.

Setal interval *aa* is usually less than *bc*, but occasionally is nearly equal to *bc*.

The clitellar colouration is yellowish, dark yellow or dark red, usually the latter. The colouration when fully developed extends over segments x-xiii and on to ix and xiv.

The spermathecal pores are small, transverse slits in $\frac{7}{8}$ in line with *c* or very slightly median to *c*.

The female apertures are minute, rounded pores or transverse slits, on the anteriormost margin of xii or in $\frac{11}{12}$, in line *b* or very slightly lateral to *b*.

The male porophore is located on a slightly protuberant and whitened ridge, the median margin of the base (dorsal portion) of which is about at line *b* or reaching very slightly median to *b* or very slightly lateral to *b* ; the lateral margin median to *c*. The ridge extends across the posteriormost secondary annulus of x and the anteriormost margin of xi or the anterior secondary annulus of xi. The male porophore is an elongately ovoid body attached to the parietes along the whole length of the ridge on x, but with the dorsal surface of the posteriormost portion free, the porophore projecting posteriorly over xi. The anterior end of the porophore is bluntly rounded, the posterior end more or less pointed. At the posterior end is the small male pore which is about at the level of the setae of xi or slightly anterior to or slightly posterior to the setal level of xi. The male pore faces posteriorly as a rule but the male porophore may be turned very slightly into a diagonal position so that the male pore is directed posterolaterally or more rarely posteromesially. The porophore is marked off from the more dorsal portion of the ridge by a completely circumferential furrow that is oval in outline. Dorsal to this furrow there are usually two or three additional horizontal furrows on the porophore ridge.

Buried in the tissues of the parietes in each ridge and concealed from view in a dissected specimen by the diagonal muscle fibres is a single, large, flask-shaped gland with a firm or tough, reddish wall and a softer, whitish internal content. This gland, as also in other varieties may be displayed by removing or simply cutting the diagonal muscles and then carefully separating the longitudinal muscle fibres in a dissected specimen or by removal of the epidermis from the porophore and ridge externally. The gland is more or less horizontal in position with the neck of the gland directed posteriorly. In the parietes the prostatic duct is narrowed, thin, flattened and strap-like and passes posteriorly in the porophore on the dorsal surface of the neck of the parietal gland. No definite pore of the parietal gland has been found but if there is such a pore distinct from the male pore, it must be just ventral to the male pore, at the posterior end of the porophore. The gland of the porophore differs from the genital marking glands mainly in that it has a longer neck and is more horizontal in position. The characteristic shape and appearance of the male porophore in this variety may be said to be an external expression of the size and location of the

tough parietal gland which is just under the epidermis of the male porophore and its ridge.

On worms of this variety there are areas of greyish appearance on each side, one just anterior and another just posterior to the spermathecal pore, the intersegmental furrow $7/8$ forming one margin of each area, the centre of the area usually slightly median to *c*. The area of vii may be slightly median to the area of viii or *vice versâ*, or the areas of vii and viii may be directly opposite each other. Each of these areas may be the external face of a single parietal gland, or on each area of viii there may be two, three or four small, round areas, each of which is the external face of a smaller gland. These glands like the glands of the other genital markings project through the parietes into the coelom.

Other genital markings are round areas, usually presetal; an unpaired marking in *aa*, and paired laterals extending from about line *b* to mid *bc*. These markings are to be found on segments ix-xii and very rarely on xiii.

The length of clitellate specimens varies considerably but fully mature worms may reach a length of about 190 mm. and a diameter of 6 mm. Unpigmented.

Internal anatomy.—The gizzards are 2-5 and are located in segments xv to xxi as shown in the table below. One specimen has a gizzard in each of segments xv, xvii, xviii, xix and xx.

	I	II	III	IV	V	VI	VII
xv-xvii	..	..	..		..	3	..
xv-xviii	1	..	..	1	1	2	4
xv-xix				..		1	2
xvi-xviii	4	4	5		..	9	4
xvi-xix	1	4	4	..	..	12	1
xvi-xx	..	..		..	1	..	
xvii-xix	4	21	19	..	2	..	4
xvii-xx	..	3	2	..	..	2	1
xvii-xxi	..	..	1	..	..	..	..
xviii-xix	..		1	..	..	..	..
xviii-xx		3	6	..	..	..	..
xviii-xxi	..		1	..	..	..	..
xix-xx	..	..	..	..	..	1	

I=Maubin. II=Sandoway. III=Pyapon. IV=Thanchitaw. V=Akyab. VI=Rangoon. VII=Various localities.

The testis sacs, though not ordinarily constricted by $9/10$, extend into both ix and x, the portion in ix smaller than that in x, sometimes very much smaller. The testis sac may be dorsal to the main mass of the coils of the vas deferens, or posterior to the main mass of the coils. In the latter case the testis sac may protrude underneath the ovarian chamber into segment xii (very rarely into xiii-xiv). When the testis sac is behind the main mass of coils of the vas or protrudes into xii, the anterior end of the sac is located within the posterior part of a tubular, posterior pocket of septum $9/10$.

The ental end of the vas deferens is fine, arranged in a vertical but narrow series of more or less regularly zigzagged loops within the tissues of septum $9/10$, or a few of the loops may project anteriorly into ix. The vas passes from the tissues of $9/10$ into x where it is widened and twisted

into a closely compacted mass of loops that is as large or larger than the testis sac. Emerging from this mass of coils the ectal end of the vas passes into the ental end of the prostate. The latter is an elongate body, 5-6 mm. in length with a finely granular surface and may be twisted in such a way as to be spirally coiled. Careful removal of the granular layer from the surface of the prostate does not reveal any markedly noticeable widening of the ental end of the prostate.

The spermathecal atrium is long ; it may reach a length of 140-180 mm. The atrial wall is rather thin and transparent. The atria are always either transparent or almost so. No opaque, whitish material has been noted in the atria of any of the specimens.

There are two pairs of vascular commissures in segment viii.

Remarks.—A typographical error in the original description of the species placed the spermathecal atrium in viii instead of vii. The atrium is always in vii. In the same account the nephridiopores were said to be in the intersegmental furrows and in line with *b*. This is incorrect. The nephridiopores, are, generally speaking, in line with *d* and on the anterior margins of the segments close to the intersegmental furrow.

Rangoon specimens of this variety even as small as $52 \times 2\frac{1}{2}$ -3 mm. can be identified. In specimens of this size the genital markings are not visible and the male porophores are represented only by very slightly protuberant whitish patches, one on each side, on the posterior margin of *x* just lateral to *b*. Intersegmental furrow 10/11 is dislocated posteriorly very slightly by each patch, or the patch may have the appearance of extending on to 10/11. The male pore at this stage is a definite slit on the posteriormost margin of *x* or on the swollen portion of 10/11. In slightly larger specimens (60-70 mm.) the male porophore is more protuberant, more ovoidal and extends posteriorly over segment xi. The male pore is at the posterior tip of the porophore but there is no trace as yet of the ridge.

The spermathecal atrium, in the smallest specimens that have been identified, is a fine thread, projecting into the coelom of segment vii and bent into a few, rather short, zigzag loops. The prostate is elongate, erect and columnar or slightly twisted. The testis sac is very small but is equalled in size by the mass of coils of the vas deferens in *x*.

There are no parietal glands visible in the coelom of the smallest specimens on which genital markings can be recognized—the longitudinal musculature dorsal to the glands is uninterrupted. Removal of the longitudinal musculature in some of these specimens shows the primordia of the glands as very slight elevations underneath the circular muscle layer. The parietal glands are to be regarded as ectodermal structures.

The Myitkyina specimen in the Indian Museum is acelitellate. The male porophores are characteristic but the porophore ridge is only slightly developed.

The Mandalay-Tonbo Specimens.

External characteristics.—The length varies up to 65 mm., the greatest diameter up to $3\frac{1}{2}$ mm.

The male porophore ridge extends across the posteriormost annulus of x and the anteriormost annulus of xi. The portion of the ridge which belongs to the anteriormost margin of xi forms a sort of lip on which the posterior end of the male porophore rests on some of the specimens, while on other worms the lip covers over the posterior end of the porophore. The porophore itself is flattened rather than ovoidal but the outline of the porophore is oval, bluntly rounded at the anterior end and pointed at the posterior end. The anterior part of the porophore slopes dorsally so that the posterior end of the porophore is much more protuberant from the general body level than the anterior end. (In normal specimens of *typica* the ovoidal male porophore is not flattened and is horizontal, the anterior end of the porophore pushed out from the body about as much as the posterior end.) The porophores are slightly diagonal so that the male pores are directed towards *ab* of xii, *i.e.*, the anterior end is very slightly more lateral than the posterior end. The flask-shaped parietal gland in the porophore is, relative to the size of the worm, about as large as in specimens of *typica*, the difference in appearance of the porophores, due mainly to the deeper position of the gland in the parietes.

Each worm has a pair of postsetal spermathecal markings on vii and a pair of slightly larger, presetal, spermathecal markings on viii. In addition to these markings 17 specimens have one or two other genital markings, all of which are presetal in position. Nine specimens have an unpaired, median marking on xi; 1 specimen has a single, lateral marking on the left side of xii; four specimens have a single, lateral marking on the right side of xii; one specimen has a pair of lateral markings on xii; one specimen has a single, median marking on xi and a lateral marking on the right side of xii; one specimen has two unpaired median markings, on segments x and xi.

Internal anatomy.—The gizzards are located in segments xiv-xix as shown below.

Segments.	Specimens.
xiv-xv	2
xv-xvi	3
xv-xvii	10
xvi-xvii	10
xvi-xviii	17
xvii-xviii	11
xvii-xix	6
xviii-xix	2

A testis sac may project into xii.

A spermathecal atrium from an apparently characteristic specimen is 35 mm. long.

Remarks.—Aside from the external appearance of the male porophores the Mandalay-Tonbo worms are distinguished from the variety *typica* by (1) small size, (2) short atria (relatively, not absolutely), (3) fewer gizzards (average number of gizzards per worm *ca.* 2.5 contrasted with *ca.* 3.3 in the variety *typica*).

var. **planata** Gates.

1931. *Drawida longatria planata*, Gates, *Rec. Ind. Mus.* XXXIII, p. 344, fig. 2.

The nephridiopores of viii are displaced dorsal to *d*. The nephridiopores of ix may or may not be similarly displaced.

The protuberant male porophore ridge is triangular in shape with the point of the triangle directed towards the midventral line. Secondary annulations are lacking or not very clearly developed but the porophore ridge appears to extend across the posteriormost annulus of x and the anteriormost annulus of xi or what would correspond to those two annuli. The base of the triangular ridge (the lateral margin) is not sharply marked off but the other two sides are clearly outlined. The male pore is located at the point of the triangle and is more median in position than on other varieties, being slightly median to *a*, in line with *a*, or very slightly lateral to *a*. The male pore does not, as a rule, face directly towards the midventral line but towards setae *ab* of segment xi of the opposite side. There is no ovoid porophore as in the preceding variety, the ventral face of the protuberant area wrinkled or furrowed. Within each thickened area is a single, large, flask-shaped gland with the bulbous portion laterally and deep in the parietes, the neck of the gland directed mesially and more superficially.

var. **ordinata** Gates.

1930. *Drawida longatria ordinata*, Gates, *Rec. Ind. Mus.* XXXII, p. 283, fig. 7.

Toungoo, September, K. John, 14 clitellate specimens.

The nephridiopores of viii are slightly dorsal to *d* and a trifle more posterior to the anterior intersegmental furrow than on other segments.

The male porophore ridge extends across the anteriormost annulus of xi and the posteriormost secondary annulus of x, in *bc* slightly nearer to *b* than to *c* but the median margin of the ridge not as near to *b* as in *typica*. The ridge is not as long ventrally as dorsally (as in *typica*) but has more of a cone-like appearance than in *typica*. The male porophore is a very small, smooth-surfaced, more or less ovoidal body at the ventral end of the ridge, with the posterior pointed end directed across xi so that the male pore is at the level of the setae of xi or even slightly posterior to that xi. The porophore is perhaps a quarter of the size of the porophore of *typica* and is delimited from the ridge by a completely circumferential furrow which is usually circular in shape. The ridge dorsal to the porophore is wrinkled or furrowed. The male pore is directed posteriorly or posterolaterally. Within the ridge is a large, flask-shaped gland with the bulbous portion deep in the parietes, the neck of the gland passing ventrally and posteriorly. When the gland is dissected out from the parietes the concavity in which the gland was contained appears to be wholly within the last half of the posteriormost annulus of x.

On the middle secondary annulus of x just anterior to the male porophore on each side but distinct from the porophore ridge is a genital marking. On some specimens this marking is pushed slightly back into the posteriormost annulus, the position of the postsetal secondary furrow usually indicated by a crease across the marking.

There are no unpaired median markings. The characteristic markings of this variety are the presetal, paired median markings on segments

ix, x, xi and xii. In addition to these markings there may be paired lateral markings on vii and viii and spermathecal markings in the vicinity of the spermathecal pores.

The length varies up to 200 mm., the greatest diameter up to 9 mm.

II.

One small, flask-shaped, parietal gland in the thickened male porophore region.

var. *deminuta* Gates.

A.

1930. *Drawida longistria deminuta*, Gates, *Rec. Ind. Mus.* XXXII, p. 287, fig. 6.

Pyigyauung, September, K. John, 14 a clitellate and 5 clitellate specimens.

Ywadow, September, K. John, 11 a clitellate specimens.

Kochi, September, K. John, 18 a clitellate specimens.

Bassein, October, K. John, 18 a clitellate specimens.

Kokya, October, K. John, 41 a clitellate and partially clitellate specimens.

Tavoy District, September, W. D. Sutton, 807 a clitellate, 137 partially clitellate and 33 fully clitellate specimens.

Tavoy District, September, W. D. Sutton, 24 a clitellate and 18 clitellate specimens.

Thazi, September, K. John, 12 a clitellate specimens.

Thazi, September, K. John, 32 partially clitellate and clitellate specimens.

External characteristics.—The nephridiopores of viii of the Kochi specimens are displaced dorsally. The nephridiopores of viii of the Pyigyauung and Pyinmana specimens are in line with *d*. The nephridiopores of viii are in *d* on all of the Tavoy-Thazi specimens on which the location was noted.

The clitellar colouration is a very dark red. The clitellum is annular but the clitellar colouration is interrupted ventrally by the genital markings.

The white, male porophore ridge extends across the posteriormost secondary annulus of x and the anteriormost secondary annulus of xi in all of the specimens while on worms from the first five localities the ridge has the appearance of being extended anteriorly on to the middle annulus of x. The ridge is located in *bc* nearer to *b* than to *c*, the male pore much nearer to *b* than to *c* (but about in mid *bc*, equidistant from both *b* and *c* on worms from the last two localities). The male porophore is much like the porophore of *typica* except in size, being much smaller and shorter; it is marked off from the ridge on which it is located by a completely circumferential furrow that is circular in shape. On the Tavoy-Thazi specimens the porophore is variable in shape and the furrow marking off the smooth porophore portion from the furrowed and wrinkled portion of the ridge is also variable in shape. Within the ridge is a small, horizontally placed, flask-shaped gland. The thin, flat prostatic duct passes along the dorsal surface of the neck of this gland to the male pore. The gland, though small, can be pulled out of the parietes after the removal of the epidermis, leaving a concavity in

the posterior half of the last secondary annulus of x. In the anterior half of the last secondary annulus of x there is another parietal gland but with a shorter neck, the gland vertical in position, the ventral face of the gland forms the genital marking on the anterior portion of the ridge but on the posteriormost secondary annulus. The Pyigyaung-Kokya specimens have, as a rule, another genital marking immediately anterior to the one just mentioned and on the middle secondary annulus of x. This marking and gland are of about the same size and appearance as the marking and gland just behind. The middle gland does not, as a rule, project conspicuously, if at all, into the coelom; the anterior gland (on the middle annulus) when present usually does so project into the coelom.

The ovoid porophore on several of the Pyigyaung-Kokya specimens is retracted within the ridge leaving a transverse slit on the ventral face of the ridge at about the level of 10/11, the posterior lip of the slit covering over the porophore.

The porophore is directed posteriorly (or very rarely posteromedially) on the Pyigyaung-Kokya specimens, posterolaterally on the Tavoy-Thazi worms so that the male pore is directed towards *cd* of segment xi or xii of the same side.

On acitellate specimens of the Tavoy-Thazi collections the genital marking just anterior to the male porophore is always on the anterior portion of the posteriormost annulus of x. On clitellate specimens the marking may extend slightly on to the middle secondary annulus of x. On the Pyigyaung-Kokya specimens the marking is prevented from extending anteriorly by the marking on the middle annulus. On Tavoy-Thazi worms the marking just anterior to the male porophore is larger than on the Pyigyaung-Kokya worms.

The Tavoy specimens lack genital markings aside from those already mentioned and the spermathecal markings. The Thazi specimens (all except one) have unpaired, presetal median, markings on some or all of segments xi-xiii.

The Pyigyaung specimens are 140-170 mm. in length: the greatest diameter 5-6 mm. The Ywadow specimens, though acitellate and not sexual, are 110-150 mm. in length. Worms from Tavoy (1) may reach a length of 175 mm. and a diameter of $4\frac{1}{2}$ mm. or (2) a length of 180 mm. and a diameter of $6\frac{1}{2}$ -8 mm.

Internal anatomy.—The gizzards are 1-5, in segments xiv-xx as shown below.

	I	II	III	IV	V	VI	VII	VIII	Total.
xiv-xv		..	..	..	..	..		1	1
xiv-xvi	. ..	..	..	..	..	..	1	2	3
xv-xvi	..	..		..	..	..	1	4	5
xv-xvii	1		2	6	..	..	3	3	15
xv-xix	..		..	..	2	1	..	.	3
xvi-xvii	. 1			1	..	..	2	9	13
xvi-xviii.	1		2	14	..	..	2	7	26
xvi-xix	1	4	1	4	40	1	..	..	51
xvi-xx	. ..	..	..	..	9	1		..	10
xvii	. . .	..	.	..	..	..	1	..	1

	I	II	III	IV	V	VI	VII	VIII	Total
xvii-xviii	1	..		5	..	..	2	9	17
xvii-xix .	. . .	3	1	12	..	..	..	..	16
xvii-xx	. . .	2	..	..	34	3	..	..	39
xvii-xxi	..	..	..	..	2	1	..	..	3
xviii	. . .	..	..	..	..	..	..	1	1
xviii-xix	. . .	1	..	2	..	..	..	..	3
xviii-xx	..	1	..	1	6	..	..	..	8
xviii-xxi	..	..	..	..	7	8	..	..	15
xviii-xxii	..	..	..	..	..	1	..	..	1
xix-xx	..	..	..	1	..		..	..	1

I=Pyigyauung. II=Ywadow. III=Kochi. IV=Bassein and Kokya. V=Tavoy District. VI=Tavoy District. VII=Thazi. VIII=Thazi.

A specimen from Bassein has no testis sacs, the position of the sacs indicated only by opaque whitenings of septum 9/10, one white spot just dorsal to the ental end of each vas deferens.

The spermathecal atria of Tavoy worms are 75-80 mm. in length.

B.

Kaungmudaw, September, K. John, 55 partially clitellate specimens.

Mandalay, September, K. John, 5 partially clitellate specimens.

External characteristics.—Each of these specimens has an elongately oval genital marking with bluntly rounded ends on x on each side, just behind setae *ab*, the median margin of the marking slightly median to *a*, the lateral margin slightly lateral to *b*. The male porophore is a tiny, pointed projection of the posterior margin of x over xi directed towards *cd* of xii. The porophore is not sharply marked off from the slight ridge of which it is the posterior extremity, the whole of the ridge and the porophore finely wrinkled. The male pore is in mid *bc* about equidistant from both *b* and *c*. Within the porophore and ridge is a single, small, flask-shaped gland in a more or less horizontal position, usually with the bulbous portion of the gland somewhat dorsal to the neck portion. Removal of the gland leaves a concavity in the posterior half of the last secondary annulus of x. Dorsal to each of the oval markings is an elongately ovoidal gland which projects into the coelom.

In addition to the paired presetal and postsetal spermathecal markings on viii and vii and the oval postsetal markings on x there may be one or more round markings, unpaired and median or paired and lateral, presetal on ix, xi-xiii or postsetal on viii-ix.

The worms are small, the maximum length 70 mm., the maximum diameter $3\frac{1}{2}$ mm.

Internal anatomy.—The gizzards are 2-4, in segments xiv-xviii as shown below.

Segments.	Specimens.
xiv-xvii	1
xv-xvi	7
xv-xvii	7
xvi-xvii	36
xvi-xviii	5

One or both of the testis sacs may project into xii.

The spermathecal atria are about 20 mm. long.

Remarks.—These worms differ from specimens assigned to the variety *deminuta* in the presence of two postsetal, longitudinally oval genital markings in the region of *ab* on x and the absence of genital markings on the ridge anterior to the male porophore.

C.

Meiktila, September, K. John, 24 clitellate specimens.

The male porophores of these specimens are directed posteriorly and are similar in appearance to those of the Kaungmudaw specimens (B) but are slightly nearer to *b* than on the Kaungmudaw worms. Postsetal genital markings in *ab* on x are lacking on each of these specimens but 15 worms have an oval marking on each side on x, just anterior to the male porophore. Aside from these markings and the spermathecal markings the only other genital markings are unpaired median markings in *aa* on viii-xii.

III.

Male porophore a tiny conical or teat-like protrusion of the epidermis within which there is only the ectalmost portion of the prostatic duct.

var. **tortuosa** Gates.

1931. *Drawida longatria tortuosa*, Gates, *Rec. Ind. Mus.* XXXIII, p. 345.

Blachi, September, G. E. Blackwell, 8 aclitellate and 8 clitellate specimens.

Leiktho Circle, September, G. E. Blackwell, 4 aclitellate and 5 clitellate specimens.

Sagaing, September, K. John, 56 clitellate specimens.

External characteristics.—The nephridiopores of viii may or may not be displaced dorsal to *d*.

The secondary annuli are not marked out or are only imperfectly indicated on these specimens. On the posteriormost portion of x on each side there is a characteristic *longatria* genital marking, just lateral or slightly lateral to *b*. The male porophore is a tiny, teat-like or conical protrusion of the epidermis, ventrally directed with the male pore at the tip; the porophore located mesially or posteromesially on the margin or rim of the genital marking and hence much nearer to *b* than to *c*. The porophore contains only the ectalmost portion of the prostatic duct (no parietal gland or gland neck). Anterior and very slightly lateral to the male porophore genital marking but still on the postsetal portion of x there may be a second genital marking, of about the same size as the posterior marking.

The genital markings are the external faces of the spheroidal parietal glands, the anterior gland (when present) projecting, as a rule more conspicuously into the coelom than the posterior gland which may not be visible at all in the coelom.

Genital markings are almost entirely lacking on the Blachi-Leiktho specimens except for those on x and the spermathecal markings. The ventral surfaces of segments viii or ix to xii or xiii of the Sagaing specimens are almost covered with genital markings as in the variety *verrucosa*. Each of the Sagaing worms has a pair of postsetal spermathecal markings on vii but the presetal spermathecal markings of viii are lacking except on two specimens.

The length of the Blachi-Leiktho specimens varies from 90-140 mm. The greatest diameter is 4 mm. The Sagaing specimens reach a length of only 60 mm. and a maximum diameter of 3 mm.

Internal anatomy.—The gizzards are two to five, in segments xvi-xx as follows :—

							I	II
xiii-xv	.		.				..	1
xiv-xv	.			.			..	4
xiv-xvi	.						..	14
xv-xvi		.	.	.			..	21
xv-xvii		.		.	.	.	..	15
xvi-xvii			.	.	.	.	..	1
xvi-xix	.		.	.	.	.	1	..
xvi-xx	.	.	.	.	.	.	1	..
xvii-xix			.	.	.	.	2	..
xvii-xx				.	.	.	4	..
xviii-xx							1	..

I=Blachi-Leiktho. II=Sagaing.

One or both of the testis sacs may extend into xii.

The spermathecal atria of the Sagaing specimens are about 10 mm. in length, the atria of the other specimens longer than 10 mm.

Remarks.—There are spheroidal, cream-coloured cysts in the testis sacs of all of the Sagaing worms.

var. *verrucosa* Gates.

1931. *Drawida longatria verrucosa*, Gates, *Rec. Ind. Mus.* XXXIII, p. 347 fig. 3.

A.

Tharrawaddy, August, K. John, 11, aolitellate specimens.

Ngapugale, August, G. R. Anderson, 28 aolitellate specimens.

Keinbyingyi, August, G. R. Anderson, 6 specimens with slight traces of olitellar glandularity.

Myagyaung, September, K. John, 4 aolitellate specimens.

Letpadan, September, K. John, 1 aolitellate specimen.

Tharrawaddy, September, K. John, 30 aolitellate and partially olitellate specimens.

External characteristics.—The nephridiopores of viii are in line *d*.

In *bc* on each side there is a longitudinally extended, whitish disc with bluntly rounded ends, slightly protuberant from the parietes,

and extending when most fully developed across the last two secondary annuli of x and the first two secondary annuli of xi. The disc may be shortened at either end. The lateral margin of the disc is just median to *c*, the median margin slightly lateral to *b*. On each disc are two or three genital markings, the external faces of spheroidal, parietal glands. Ordinarily there is one marking on the posterior portion of the disc belonging to segment xi, another marking on the anterior portion of the disc, and usually a smaller marking near the median margin of the disc and between the other two markings. Just lateral to the small marking, which may have rather vague outlines and be rather difficult to recognize, is a tiny, teat-like male porophore within which there is only the ectalmost portion of the prostatic duct. Intersegmental furrow 10/11 is not continued across the disc. Ordinarily the porophore is situated about in line with 10/11 or slightly anterior thereto, but in a few specimens it is slightly posterior to the region of 10/11 and has the appearance of being a forward protuberance of the anterior margin of xi. The male pore is directed anteriorly or anterolaterally towards *cd* of x and is nearer to *c* than to *b*. The portion of the disc between and around the genital markings may be finely wrinkled or furrowed.

The genital markings are numerous and closely crowded, on ix-xii, rarely xiii. The postsetal spermathecal markings of vii are present but the presetal spermathecal markings of viii are lacking.

The length of clitellate specimens may be as much as 160 mm., the greatest diameter varies from 6-9 mm.

Internal anatomy.—The gizzards are three to four, in segments xv-xxi as shown below :—

Segments.	Specimens.
xv-xviii	1
xvi-xix	4
xvii-xix	4
xvii-xx	4
xviii-xix	1
xviii-xx	11
xviii-xxi	1
xix-xxi	1

The oesophagus in one, two or three segments anterior to the first gizzard segment may be strengthened and whitened but the thickened whitish region is not moniliform.

B.

Tonbo, September, K. John, 21 acitellate and 8 partially clitellate specimens.

Kyauk-kyone, September, K. John, 26 acitellate and 7 partially clitellate specimens.

External characteristics.—The nephridiopores of viii are dorsal to *d*.

The clitellar glandularity is probably not fully developed, the clitellar colouration a light pinkish, on segments x-xiii.

The spermathecal pores are minute transverse slits or rounded apertures in 7/8 in line with *c* or just median to *c*.

The male pores are minute, apparently a trifle nearer to *c* than to *b* and anteriorly or anterolaterally directed.

The female pores are minute, transverse slits in 11/12 in line with or very slightly lateral to *b*.

A longitudinally elongated, whitish region with bluntly rounded ends extends across the posteriormost annulus of *x* and the anteriormost annulus of *xi*; in *bc* but nearer to *c* than to *b*. The anterior portion of this area is smooth, not protuberant, sometimes slightly depressed. The posterior portion of the area, including that portion belonging to *xi* and to the posteriormost portion of *x* is protuberant ventrally as a firm, more or less conical porophore. Within the porophore is a very small, flask-shaped gland the short neck of which passes ventrally in a vertical fashion. The prostate duct is flattened and strap-shaped and is usually lateral, rarely median to the porophore gland. The male pore is on the anterior face of the porophore. On the posterior face of the porophore there may be a circular area delimited by a slight furrow (12 specimens). No pore or central, round greyish spot as on the *longatria* markings was noted on this area but there is within the parietes dorsal to the marking a small, spheroidal gland. If the gland and its marking are lacking the male ridge may extend posteriorly only over the first half of the anteriormost secondary annulus of *xi*. On every one of the Tonbo specimens (and on those specimens only) there is a slightly protuberant, whitish circular area on the middle secondary annulus of *x*, just in front of the male area. On a very few specimens this appears to be a portion of the ridge, but on others the marking is separated from the ridge by the postsetal secondary furrow. No pore or round, greyish spot was noted on this marking on any of the specimens but within the parietes just dorsal to the marking is a very small, spheroidal gland. This gland as well as that in the posterior portion of the ridge is larger than the male porophore gland, and is, like the two latter glands, entirely concealed within the parietes and not visible in the coelom in dissected specimens.

Each of the Tonbo specimens has a pair of spermathecal markings on *vii*, one just in front of each spermathecal pore. These markings may be rather easy to see or may be very difficult to recognize. They are the external faces of *longatria* glands which project through the parietes into the coelom. On three of the Kyauk-kyone specimens the spermathecal markings extend across 7/8 on to the margins of both *vii* and *viii*.

On the Tonbo specimens, in addition to the markings of the male ridge and the spermathecal region, there may be presetal, unpaired median markings on *ix* and *x*. Each of these markings is a small, circular, whitish, slightly protuberant area on the anteriormost annulus of a segment. Eleven specimens have markings on both segments *ix* and *x*, 7 specimens have a single marking on *ix*. The markings are the ventral faces of the glands which do not project into the coelom and are not visible in dissected specimens until after removal of the longitudinal musculature. In one worm, one gland of segment *x* protrudes through the parietes into the coelom. On the Kyauk-kyone specimens the additional markings are located as follows:—an unpaired median marking on the anteriormost secondary annulus of *x*—4 specimens; an

unpaired median marking on the last two secondary annuli of ix and an unpaired median marking on the last two secondary annuli of x—1 specimen ; an unpaired median marking on the anteriormost secondary annulus of each of segments x-xii—4 specimens ; a pair of lateral markings on the middle annulus of ix, each marking just median to c—2 specimens ; paired lateral markings just median to c, on the middle annulus of ix as well as of viii—7 specimens.

Internal anatomy.—The gizzards are located in segments xiii-xviii as shown below :—

Segments.	Specimens.
xiii-xv	2
xiv-xv	3
xiv-xvi	17
xiv-xvii	1
xv-xvi	3
xv-xvii	18
xvi-xvii	6
xvi-xviii	5
xvii-xviii	1

There are two pairs of vascular commissures in viii.

The testis sacs extend into both ix and x ; one or both sacs may protrude into xii or through xii into xiii. The vas deferens is short and is coiled into a closely compacted but small mass of loops or into a few loose loops on the posterior face of 9/10 and then passes into the ental end of the prostate. The latter is spirally coiled or bent into a U or S-shape. Removal of the finely granular surface layers displays an elongated central body much like that of *typica*, though the ental end may be very slightly widened.

The ovarian chamber is of an U-shape, inverted over the œsophagus. The ovisacs extend into xii-xv. The spermathecal atrium is a thin-walled, transparent, tubular structure in vii, about 2-4 mm. long, into the posterior face of which the spermathecal duct passes just dorsal to the parietes. The atrium is crushed down to form a rounded mass at the base of 7/8 but is readily straightened out.

Remarks.—The short, spermathecal atria are more like the atria of *D. tumida* than the atria of *D. longatria*. *D. tumida* has, however, been found hitherto only in the Tenasserim Division. The Tonbo and Kyauk-kyone specimens are regarded for the present as rather aberrant forms of *D. longatria*. The male areas, especially when two spheroidal glands are present therein, are much like the male areas of the variety *verrucosa*, but no gland has been found in the male porophore of the latter variety.

IV

The male porophore a small, anteroposteriorly flattened flap in intersegmental groove 10/11.

var. **nana**, var. nov.

Rangoon, July, 2 acitellate specimens.

Rangoon, August, 1 acitellate specimen.

Rangoon, January, 1 acitellate specimen.

External characteristics.—Length to 66 mm. Greatest diameter to 3 mm. Colour, slightly blueish or greyish, both dorsally and ventrally. There are no secondary annulations. The clitellar region of one specimen is whitened.

The spermathecal pores are minute, transverse slits in 7/8 just median to *c* or in line with *c*.

The female pores are in line with *b*, anteriorly on segment xii.

The male porophore is a very small, more or less conical but usually slightly anteroposteriorly flattened structure in or rather on 10/11 and apparently belonging neither to *x* or to *xi*; in *bc*, apparently a slight trifle nearer to *c* than to *b*. The porophore may be concealed in the groove between the margins of *x* and *xi* or the end of the porophore may protrude slightly from between the margins of the segments mentioned. The anterior margin of *xi* immediately posterior to the porophore is slightly tumescent and forms a sort of special lip just behind the porophore.

The genital markings are small, paired, transversely oval or almost circular, greyish areas, each with a central pore which is in line *a* or slightly lateral or median to *a*. Each area is situated just in front of *ab* but does not reach to the anterior margin of the segment. The markings are paired on vii-xii on the first three specimens. On the fourth specimen the markings are located as follows; right side of *vi*, left side of *ix*, right and left sides of vii-viii, x-xii. A further pair of markings is located on segment *x*, one just in front of the male porophore on each side (save on the January specimen which lacks the marking on the left side). The genital markings are similar in appearance to those of *D. peguana* but are slightly more protuberant.

Internal anatomy.—The gizzards are in xiii-xv (2), xiii-xiv (1), or xiv-xv (1).

There are two pairs of vascular commissures in viii.

The testis sacs are ovoid to spheroidal and apparently wholly in *x* except in the January specimen in which a slight knob from the sac of one side projects slightly into *ix*. The vas deferens is long and compacted into a mass of loops about equal in size to the testis sac. The width of the vas is slightly greater, relative to the size of the animal, than in other varieties. The vas passes into the ental end of the prostate. The latter is long and spirally coiled or looped in a regularly zigzag fashion and has a finely granular surface.

Segment *xi* was opened by dissection in each specimen. Septa 10/11 and 11/12 are attached to the parietes close together ventrally and laterally but are probably fused dorsally. The ovisacs are wide and blunt and turned laterally in *xii*. The spermathecal atria are elongate, 12-15 mm. in length, coiled into a rounded mass of loose loops which are easily straightened out.

Dorsal to each genital marking there projects into the coelom a spheroidal, whitish, soft-walled gland. These glands as in other varieties can be pulled out of the body wall leaving a gap in the parietes with a smooth margin and the cuticle intact. In the smallest specimen, which is about 40 mm. long, the glands do not project into the coelom.

Remarks.—The genital markings recall those figured by Stephenson in his F. B. I. volume for *D. japonica*. The locations of the genital markings are somewhat similar to those of the variety *ordinata*.

APPENDIX TO *D. longatria*.

Tavoy, September, W. D. Sutton, 20 acitellate specimens.

The male porophores are in such rudimentary condition that the variety cannot be determined. The reproductive organs though quite rudimentary are sufficiently developed to enable accurate specific identification. The worms are fairly large, around 150 mm. in length and with a maximum diameter of about 5 mm.

The gizzards are 4-6, in segments xv-xxi as shown below.

Segments.	Specimens.
xv-xviii	2
xv-xix	2
xv-xx	1
xvi-xix	9
xvi-xx	1
xvi-xxi	1
xvii-xx	3
xvii-xxi	1

Drawida molesta, sp. nov.

Victoria Point, October, Saw Nelson, 28 acitellate specimens.

External characteristics.—Greatest length 146 mm. Greatest diameter 5 mm. None of the specimens are deeply pigmented, a few have a dark blueish or greyish tinge dorsally, others show no trace of this colouration. Two specimens have slight indications of a reddish clitellar colouration on segments x-xiii,

The prostomium is prolobous.

The setae begin on ii and are closely paired, *ab* equal to *cd*, *aa* less than *bc*, usually just a trifle more than one half *bc*.

There are no dorsal pores but a few dark spots are visible in the mid-dorsal line at some of the intersegmental furrows.

The nephridiopores of viii are usually displaced dorsal to *d*, quite noticeably, or rarely only slightly. The nephridiopores of vii and ix are either in line with *d* or very slightly dorsal to *d*.

The spermathecal pores are transverse slits, on the posteriormost margin of vii, just median to *c*, each pore with a tumescent anterior and a posterior lip, lips usually lobulated. The posterior lip actually on 7/8. The lips may be so protuberant as to present the appearance of a columnar or conical porophore.

The male aperture is a transversely slit-like or crescent-shaped pore at the ventral end of a short, tubular or slightly flattened penis. The penis is usually located in the groove between segments x and xi and is probably on intersegmental furrow 10/11 but in some specimens the appearance is such that the penis seems to belong to the posteriormost margin of x. The penis is on a whitish, genital marking in mid *bc*, reaching neither to *b* nor to *c*, longitudinally oval in shape, but with

bluntly rounded ends, extending across the anteriormost secondary annulus of xi or slightly more and the posteriormost secondary annulus of x. The groove between x and xi is continued across the genital marking so that the two halves of the genital marking produced by the groove must be separated, at least in some specimens, in order to see the penis. In other specimens the ventral end of the penis protrudes slightly from the groove as if between two whitened lips (retracted or partially retracted conditions). On two specimens the groove across the genital marking is lacking and intersegmental furrow 10/11 ends abruptly against the median and lateral margins of the marking which is much more protuberant than on other specimens; the whole of the penis clearly visible.

There is a single, transversely elongated, whitened genital marking extending from 9/10 to just behind the setae of x and laterally as far as the lateral margin of the male porophore, on nearly all of the specimens. The marking is only faintly indicated on one, lacking on five other specimens, but these 6 worms are among the smallest of the collection.

Internal anatomy.—Septa 5/6-8/9 are thickly muscular, 9/10 is thin and displaced posteriorly as are 10/11 and 11/12.

The gizzards are three to five, in segments xiii-xxi as shown below.

Segments.	Specimens.
xiii, xv, xvii, xix	1
xiii, xvi, xvii	1
xiv, xv, xvi, xix	1
xiv, xv, xvi, xviii, xx	1
xiv, xvi, xviii	1
xiv, xv, xvii, xviii, xix	1
xiv, xv, xvii, xix	1
xiv, xv, xvii, xix, xx	1
xiv, xv, xvii, xx	1
xiv, xv, xviii, xix, xxi	1
xiv, xv, xviii, xx	1
xiv, xvii, xviii	1
xv, xvi, xviii, xix	1
xv, xvi, xviii, xx	2
xv, xvii, xix	1
xv, xvii, xix, xx	1
xvi, xviii, xx	1

One specimen has a gizzard each in segments xv, xvi, and xxi and two gizzards in xix. Another specimen has a gizzard each in xviii and xix and two gizzards in xv.

The gut immediately behind the last gizzard for two or three segments is wider than the gizzard, gradually decreasing in diameter until segment xxviii, xxix or xxx is reached, where the gut is a very narrow, straight tube. Behind this segment the gut is much larger again and the coelomic face of the gut is lighter in colour.

The last pair of hearts is in ix. There are two pairs of commissures in viii. There is a second dorsal blood vessel, which might be called a supra-intestinal blood vessel, first visible in the last gizzard segment from whence it passes anteriorly into ix or the anteriormost portion of x where it bifurcates and passes ventrally at each side of the oesophagus.

The supra-intestinal vessel is never as large as the dorsal vessel and may be quite definitely smaller; the bifurcated, ventrally directed branches at the anterior end in ix, when distended with blood look something like a second pair of hearts for which they might easily be mistaken.

The testis sac is usually more or less ovoid but may be laterally flattened, unconstricted, at first glance only in x. There is however a funnel-like outpocketing of septum 9/10 into x, the anterior end of the testis sac within this pocket. A testis sac may pass underneath the floor of the ovarian chamber into xii. The vas deferens is long, twisted into a mass of coils which is usually as large as the testis sac. The ectal end of the vas passes into the ental end of the prostate.

The prostate is elongate, about 8-9 mm. in length, variously twisted, looped, bent or coiled. The granular investment is so firmly adherent that I did not succeed in displaying completely the central body, but so far as can be determined from attempts to dissect off the layer and from cleared prostates, the central body is of about the same diameter throughout, very slightly narrower entally. The granular investment may be lacking for a short distance just before the prostate enters the parietes. As the prostate enters the parietes it appears to be slightly enlarged, this apparent enlargement is a slight parietal invagination within which is the dorsalmost portion of the penis.

Both septa 10/11 and 11/12 are attached to the parietes independently, ventrally and laterally but probably are fused dorsally. Segment xi is shut off from the oesophagus mesially as in species with an inverted U-shaped ovarian chamber. The ovisacs are finger-like projections into xiii or xiv, often with dark, blackish masses in the posterior portion of the sac.

The spermathecal ampullae are small, but are probably not fully developed. The spermathecal duct is threadlike, looped slightly in a sort of rounded zigzag fashion, reaching a length of 8 mm., on the posterior face of 7/8. The atria are large, empty sacs, reaching a length of 8 mm., of which an ectal portion of about 2-3 mm. is narrower and somewhat stalk-like. The atrial wall is thick, ridged internally in a transverse fashion.

Remarks.—The female pores are probably in 11/12 in line with *b*.

The prostates of *D. molesta* are like those of *D. longatria*, the atria like those of *D. burchardi*. The penis is somewhat like the penis of *D. hehoensis* except that in a retracted condition it is concealed between lips formed from the margins of x and xi rather than withdrawn into a parietal invagination. The segmental locations of the gizzards are like those which characterize *D. burchardi*.

It is unfortunate that no clitellate or sexual specimens were obtained. However there is every reason to believe that structures such as the spermathecal atria, the penis and the prostates have reached definitive stages in development and that further development, if any, of these structures will be only along lines of slight increase in size. The granular investment of clitellate specimens will probably be slightly thicker and the ovisacs larger.

D. molesta is distinguished from *D. longatria* by characteristics of the genital markings and of the spermathecal atria, from *D. hehoensis*

by the presence in vii of large spermathecal atria and from *D. burchardi* by the tubular penis in place of a porophore with a parietal gland.

The presence of an apparently indigenous species of *Drawida* as far south as Victoria Point is a matter of some zoogeographical interest.

***Drawida peguana* GATES.**

1925. *Drawida peguana*, Gates, *Ann. Mag. Nat. Hist.* (9) XV, p. 316.

Pegu, August, K. John, 14 specimens.

Kyangin, August, K. John, 4 specimens.

Meiktila, August, W. C. Dudley, 13 acitellate specimens.

Pegu Yomas, August, G. R. Anderson, 1 clitellate and 3 acitellate specimens.

Leiktho Cirole, September, G. E. Blackwell, 5 acitellate specimen.

Thanchitaw, September, K. John, 7 specimens.

Toungoo, September, K. John, 18 specimens.

Southern Mergui District, September, W. D. Sutton, 9 specimens.

Ywadow, September, K. John, 17 acitellate and 1 clitellate specimens.

Kyaukpadaung, September, K. John, 11 acitellate specimens.

Mahlaing, September, K. John, 6 acitellate specimens.

Thayetmyo, September, K. John, 5 acitellate specimens.

Myagyaung, September, K. John, 11 acitellate specimens.

Prome, September, K. John, 3 acitellate specimens.

Kokya, October, K. John, 14 acitellate specimens.

Thaton, October, K. John, 16 acitellate and 1 clitellate specimens.

Kawkareik, October, K. John, 31 acitellate specimens.

External characteristics.—The nephridiopores of viii, on most of these specimens, are displaced dorsal to *d*; on the remainder of the specimens the nephridiopores of viii are in line *d*.

Setal interval *aa* is less than *bc*.

The clitellar segments of mature or nearly mature worms are often much lighter in colour than the other segments, with a creamy-white or light greyish-white appearance. In other specimens the clitellar segments are pinkish or light reddish.

The spermathecal apertures are tiny, rounded pores or transversely or longitudinally placed slits, in 7/8 in *c* or just median to *c*.

The female pores are short, transverse slits in *b* or very slightly lateral to *b*, in 11/12 or on the anteriormost margin of xii.

The male pores are tiny, longitudinal or diagonal slits on 10/11 slightly lateral to *b*. The male pores are not located on special porophores or protuberances nor is the epidermis around a pore swollen to form a lip. The margins of groove 10/11 have to be separated from each other, as a rule, before the pores can be seen.

The genital markings are small, round areas of greyish translucence which are located usually on regions of special whiteness that are not noticeably protuberant or demarcated by furrows. One of these regions is located just in front of and another just behind each spermathecal and male pore, median to *d* on vii and viii and just lateral to *b* on x and xi. Each whitened region may have one, two, three, or four markings. Isolated markings of about the same size and appearance as those on the whitened regions may be present occasionally. Such isolated markings are variously located on segments vii-xi outside of the whitened regions.

Within the parietes dorsal to each marking is a spheroidal or ovoidal gland. These glands do not project through the longitudinal musculature into the coelom and are not visible in a dissected specimen until after the removal of the longitudinal musculature.

Worms of this species may reach a length of 130 mm., and a maximum diameter of 6 mm. Colour : blueish, purplish, or reddish purple.

Internal anatomy.—The gizzards are 2-5, in segments xii-xix as indicated below :

	I	II	III	IV	V	VI
xii-xiv	..	..	..	..	..	1
xiii-xv	..	..	..	2	..	1
xiii-xvi	..	..	..	1	..	..
xiv-xv	..	..	..	..	..	2
xiv-xvi	3	6	..	4	8	2
xiv-xvii	8	1	2	..	3	..
xiv-xviii	..	..	2	..	..	..
xv-xvi	..	1	..	..	..	..
xv-xvii	. . 6	8	3	..	3	..
xv-xviii		..	14	..	..	..
xvi-xviii		..	3	..	..	..
xvi-xix	. ..	..	3	..	..	..
xvii-xix	..	..	1	..	..	..

I=Ywadow. II=Thaton. III=Karkareik. IV=Kokya. V=Kyaukpadaung. VI=Mahlaing.

There are 2 pairs of vascular commissures in viii. There is a soft whitish or yellowish material along each side of the dorsal blood vessel from x posteriorly.

The vas deferens is rather short and is coiled into a few loose loops on the posterior face of 9/10. The prostates are club-shaped and erect. The ental end is rounded ; below this swollen portion the prostate narrows gradually towards the parietes. Just before reaching the

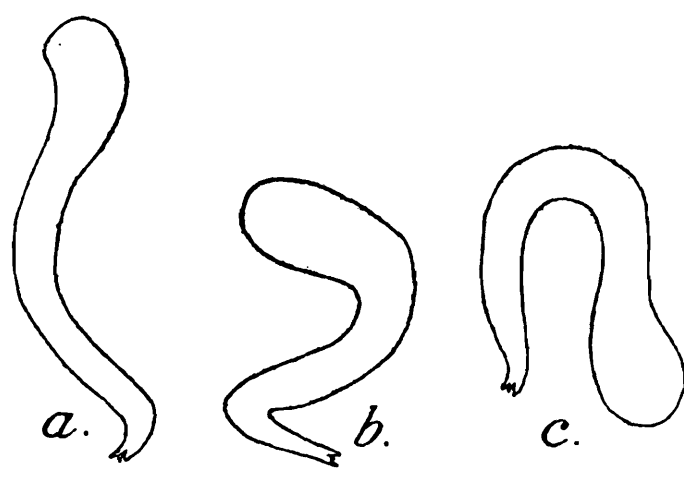


FIG. 9.—*Drawida peguana* Gates.

a-c, Prostate central bodies after removal of granular investment, $\times$ ca. 20.

parietes there is a stalk portion of variable length on which the layer of surface granulations appears to be lacking. The vas deferens passes into the prostate just below the swollen ental portion or at the ectal margin of the swollen portion.

Segment xi is rather narrow but is always opened in a dorsal dissection. The segment is closed off mesially from the oesophagus as in those species which have an ovarian chamber in the form of an inverted U, but septa 10/11 and 11/12 pass to the parietes both laterally and dorsally independent of each other. In a worm dissected from the ventral side the ova are on the dorsal parietes.

The spermathecal atria are thin-walled, pear-shaped sacs, erect in vii. The atrium may reach dorsally into contact with the dorsal blood vessel or may extend dorsal to that vessel into the opposite side of the segment. The ectalmost portion of the atrium is a tubular stalk.

Remarks.—One or both testis sacs may project into segment xii.

The spermathecal ampullae of all dissected specimens clitellate or aclitellate are filled with a sticky, whitish material. The atria are usually empty but may contain a small amount of whitish, sticky material, usually as an irregular layer lining the lumen. In one atrium there was found an elongate mass of tissue, about 12 mm., in length, twisted into a mass of loose coils. In one specimen the atrium of one side is lacking though the spermathecal duct and ampulla of that side are normally developed. The atria of rather young specimens frequently have a blackish pigment scattered in fine flecks on the entalmost portion.

Within the ovisacs, at the posterior end, there are often spheroidal, brownish or blackish masses.

***Drawida rangoonensis* Gates.**

1925. *Drawida rangoonensis*, Gates, *Ann. Mag. Nat. Hist.* (9) XV, p. 320.

1931. *Drawida rangoonensis*, Gates, *Rec. Ind. Mus.* XXXIII, p. 349.

Pegu, August, K. John, 1 aclitellate specimen.

Bassein, September, K. John, 3 aclitellate specimens.

Yandoon, September, K. John, 2 aclitellate specimens.

Maubin, September, K. John, 26 aclitellate and 9 clitellate specimens.

The nephridiopores of both viii and ix are displaced dorsal to *d* as a rule.

The spermathecal pores are tiny, transverse slits in 7/8 just median or slightly median to *c*.

On the 1931-32 specimens setal interval *aa* is about equal to *bc* or very slightly smaller than *bc*.

The gizzards are in segments xii-xvi as shown below :

Segments	I	II	III
xii-xv	1	..	3
xiii-xv	2	..	8
xiii-xvi	14	..	1
xiv-xvi	17	2	11

I=Maubin. II=Yandoon. III=Rangoon.

There are bands of opaque, yellowish or brownish material on the sides of the dorsal blood vessel from ix or x posteriorly. There are probably paired enterosegmental bodies in a few segments immediately posterior to the gizzard but these bodies are softened, translucent and rather formless. There are two pairs of commissures in segment viii.

The entalmost portion of the vas deferens is very slender and within the tissues of 9/10 though one or two or several loops may project into

ix. The portion of the vas in x is wider, twisted into a mass of loops closely compacted together and equal or nearly equal in size to the testis

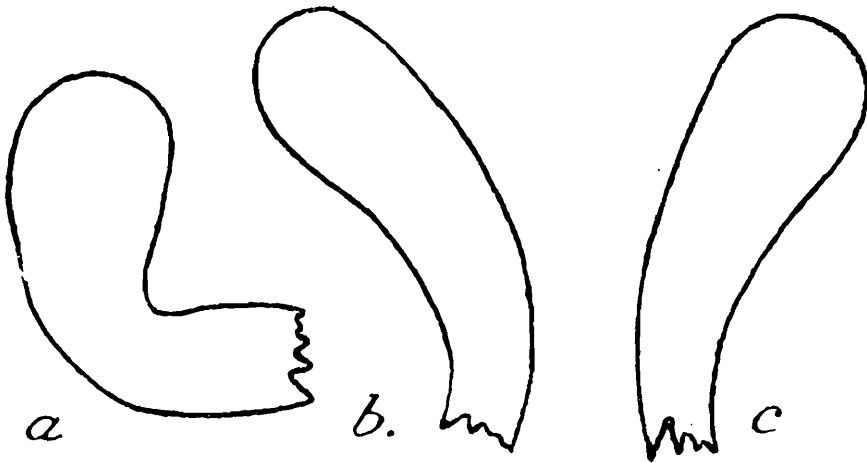


FIG. 10.—*Drawida rangoonensis* Gates.

a-c. Prostate central bodies after removal of granular investment, of three specimens, $\times$ ca. 40.

sac. The vas passes into the ental end of the prostate. The prostate is erect, straight, or slightly bent, usually towards the nerve cord. The granular investment is fairly thick, removal of this layer discloses a tubular central body decreasing very gradually in diameter passing ectally.

The spermathecal ampullae are filled with whitish material in the a clitellate specimens. The atria are empty. The atrial wall is strong but thin relative to the width of the lumen and may be ridged internally. The atria are flattened but may be referred to as elongately saccular but with a short and gradually narrowed stalk portion.

The atrium of the left side of one specimen is in viii instead of vii.

***Drawida rara* Gates.**

1925. *Drawida rara*, Gates, *Ann. Mag. Nat. Hist.* (9) XV, p. 321.

Kyauktan, August, K. John, 2 a clitellate specimens.

Pegu, August, K. John, 7 a clitellate and 12 clitellate specimens.

Falam, August, J. H. Cope, 7 partially clitellate specimens.

Thanchitaw, September, K. John, 11 a clitellate specimens.

Kochi, September, K. John, 10 a clitellate and 1 clitellate specimens.

Thanatpin, September, K. John, 18 a clitellate and 25 clitellate specimens.

Pyigyau, September, K. John, 4 clitellate and 2 a clitellate specimens.

Coomzamu, September, K. John, 3 clitellate specimens.

Bassein, September, K. John, 11 a clitellate specimens.

Thonze, September, K. John, 32 a clitellate and partially clitellate specimens.

Letpadan, September, K. John, 20 partially clitellate and clitellate specimens.

Tharrawaddy, September, K. John, 2 a clitellate specimens.

Myagyaung, September, K. John, 2 a clitellate specimens.

Bassein, October, K. John, 53 partially clitellate and clitellate specimens.

Kokya, October, K. John, 8 partially clitellate specimens.

Henzada, October, K. John, 58 a clitellate and partially clitellate specimens.

Kamaungthwe River, October, W. D. Sutton, 3 a clitellate specimens.

Falam, March, J. H. Cope, 1 a clitellate and 2 clitellate specimens.

The spermathecal pores are short, transverse slits on the posterior margin of vii in *c* or just median to *c*. The margin of the pore may be swollen, the tumescence smooth or lobulated.

The male porophores are more or less flattened but slightly protuberant areas, circular in outline, extending across the anteriormost secondary annulus of xi or a part thereof and the posterior half of the posteriormost secondary annulus of x, and from *b* or slightly lateral to *b* to mid *bc*. At the centre of each porophore there is a very slight projection or teat-like protuberance at the ventral end of which is the male pore.

In many specimens the male porophores appear to be anterior projections from the margin of xi, intersegmental furrow 10/11 displaced anteriorly by the projection. A fairly large series of specimens of this species was collected at Rangoon in the early part of the rainy season. In the smallest specimens that can be identified the male pores are quite clearly on 10/11, with little, if any, traces of the porophores. On slightly larger specimens the male pore is located on a tiny tumescent region which extends across 10/11 on to both x and xi. On slightly larger specimens the tumescent region has become circular and more characteristic in appearance, the approximate location of 10/11 across the male porophore indicated by a very fine furrow on which the male pore is present. On these specimens there is visible at the anterior margin of each male porophore a crescentic groove with the concavity facing posteriorly. There may be slight indications of a similar groove at the posterior margin of the porophore. On still larger and on clitellate specimens the anterior groove has extended laterally and mesially into intersegmental furrow 10/11 and is so deep and like the intersegmental furrow that it appears to be an anteriorly displaced portion of that furrow. There are however on most specimens still visible very slight traces of what may be 10/11 on the male porophore.

The gizzards are 3-5 in segments xii-xviii as shown below :

Segments	I	II	III	IV	V	VI	VII	VIII
xii-xv	..	..	..	..	..	..	..	1
xii-xvi	..	..	..	..	..	..	..	1
xiii-xv	..	..	..	..	2	..	..	5
xiii-xvi	3	3	3	..	..	..	4	..
xiii-xvii	..	..	1	1	..	..	..	..
xiv-xvi	..	2	8	..	3	3	9	8
xiv-xvii	2	3	19	..	..	1	9	1
xv-xvii	1	1	5	..	1	4	14	16
xv-xviii	..	1	3	2	..	..	6	1
xvi-xviii	..	1	3	..	..	..	2	..

I=Thanchitaw. II=Kochi. III=Thanatpin. IV=Falam. V=Pyigyauung.
VI=Kokya. VII=Various localities. VIII=Rangoon.

There are two pairs of vascular commissures in segment viii. There are bands of opaque, yellowish or brownish material on the dorsal blood vessel, one on each side, beginning in ix or x or posteriorly. Reddish, transparent masses paired in a few segments behind the last gizzard segment may be enterosegmental organs or blood vessels, the colour is almost exactly the same as that of the dorsal blood vessel which is not however transparent.

The prostate is a flattened, circular disc, sessile on the parietes. Sometimes the dorsal face of the disc is slightly rounded, but in either case the vas passes into the centre of the dorsal face. Removal of the granular investment displays a tiny central body which is almost entirely buried in the parietes—within the tissues of the male porophore. In specimens with especially conspicuous porophores the vas deferens appears to pass into the parietes and not into a central body. The granules of the granular layer are rather large but not firmly adherent, either to each other or to the central body and are readily removed without breaking the vas deferens.

The spermathecal duct appears to be slightly widened in the parietes but it is not clear whether or not this apparent widening of the spermathecal duct is really an atrium or not. In some specimens the widened portion extends up from the parietes into 7/8, but only slightly.

***Drawida spissata* Gates.**

1930. *Drawida spissata*, Gates, *Rec. Ind. Mus.* XXXII, p. 291.

Collectors have been unable to secure specimens of this species since the original examples were secured. The type-specimens have been re-examined.

The nephridiopores of viii and ix are not displaced dorsal to *d*.

There are two pairs of commissures in viii, the median commissures small and held against the anterior face of 8/9 by transparent connective tissue. There is a band of opaque, yellowish or whitish material on each side of the dorsal blood vessel from segment ix, xi or xii posteriorly. There may be paired enterosegmental organs in a few segments posterior to the last gizzard segment; the masses are reddish and transparent. There is a supra-oesophageal blood vessel in segments x-xiv or xv at least.

The gizzards are in xvii-xx (2) or xvii-xxi (1) as in previously opened specimens.

The vas deferens as it emerges from the testis sac is very fine and thread-like and twisted into a number of loops in a small mass immediately underneath the testis sac. Emerging from this mass of loops the vas is widened about 2-4 times and twisted into another mass of loops which covers over and conceals from view the loops of the slenderer portion. The vas may pass into the very centre of the ental end of the prostate or into the ental face but near the margin or at the side just below the ental end. The granular investment of the prostate is uniformly thin over the whole length but is lacking for a short space just before the prostate passes into the parietes. The prostate within the parietes is not narrowed and sometimes appears to be widened though anteroposteriorly flattened. The central body of the prostate is lined with soft whitish tissue which is longitudinally ridged. The soft tissue can be scraped off leaving only a thin and transparent but tough layer.

The ental portion of the spermathecal duct is glistening, the wider ectal portion is tough but with an opaque dull appearance. The mass of loops of the ectal portion of the spermathecal duct somewhat resembles the mass of loops of the spermathecal atrium in vii of *D. longatria*.

Drawida tumida GATES.

1929. *Drawida tumida*, Gates, *Proc. U. S. Nat. Mus.* LXXV (10), p. 12, fig. 4.

VAR. *typica* GATES.

1930. *Drawida tumida typica*, Gates, *Rec. Ind. Mus.* XXXII, p. 294.

Ye, October, K. John, 6 specimens.

Northern Tavoy District, October, W. D. Sutton, 2 specimens.

External characteristics.—The nephridiopores of viii are usually displaced dorsal to *d*.

The clitellar colouration, a dark red, extends across x-xiii and on to the posterior portion of ix and the anterior portion of xiv.

Setal interval *aa* is smaller than *bc*.

The spermathecal pores are minute apertures in 7/8 in *c* or just median to *c*.

The female pores are minute, transverse slits in 11/12, in *b*, or just lateral to *b*.

The male porophore is white, circular in outline and borne on a slight elevation above the general body level or on the posterior end of a longitudinal, whitened ridge. It is located in *bc* but nearer to *b* than to *c* and extends across the anteriormost portion of xi and the posteriormost portion of x, intersegmental furrow 10/11 not continued across the porophore but ending abruptly against the base (dorsal portion) on each side. The ventral surface of the porophore may be nearly flat or may slope very slightly to an eccentric point, the pointed portion a minute, teat-like epidermal protuberance within which is the ectalmost portion of the prostatic duct. The male pore is a minute slit on the ventral surface of the porophore either at the end of the epidermal protuberance or not elevated above the rest of the porophore. On the ventral face of the porophore slightly anterior and either median or lateral to the male pore is a small, round, grey spot such as is usually at the centre of a *longatria* genital marking. With adequate illumination it is sometimes possible to make out a rim around the grey spot also as on a *longatria* marking, the rim interrupted by the male pore protuberance. Within the porophore is a single, small, flask-shaped gland of the same type as is present within the porophores of *D. longatria*. The bulbous portion of the gland is not visible in a dissected specimen until after the diagonal muscles have been cut and also, as a rule, until after the longitudinal muscle strands have been separated. The neck of the gland is short and passes ventrally to the greyish spot on the porophore. The prostatic duct is not as flattened and strap-like as in the *longatria* porophores and may be median, posterior or lateral to the neck of the porophore gland.

The longitudinal genital marking on the median side of the male porophore ridge is the ventral face of an elongately ovoidal parietal gland of the *longatria* type which is buried in the tissues of the ridge and is not visible in a dissected specimen until after the diagonal muscles have been cut and removed. The marking and gland are always present on both sides in this variety. On small, aclitellate specimens the marking is confined to the posterior half of the anteriormost annulus of x

but in larger acitellate as well as the clitellate specimens the marking extends on to the middle annulus of x. The lateral margin of the marking is a trifle nearer to c than the median margin is to b. The lateral face of the ridge which bears the longitudinal marking is whitish and with short horizontal furrows.

There is ordinarily but a single pair of spermathecal markings and these are usually on the posterior margin of vii, the markings just anterior to and slightly lateral or slightly median to the spermathecal pores. Rarely the markings are on the anterior margin of viii. More rarely there are two pairs of spermathecal markings on vii and viii as on *D. l. typica*. Each marking is an external indication of the presence of a spheroidal or ovoidal gland which penetrates through the parietes into the coelom.

Further genital markings are rare in this variety, but when present are the external faces of *longatria* glands which penetrate through the muscular layers of the body wall into the coelom.

Maximum length 110 mm., maximum diameter $4\frac{1}{2}$ mm. Unpigmented.

Internal anatomy.—The gizzards are 3-5, in segments xvi-xxii as indicated below.

Segments.	Specimens.
xvi-xix	3
xvi-xx	3
xvii-xx	15
xvii-xxi	4
xviii-xxi	13
xix-xxi	1
xix-xxii	3

There are two pairs of vascular commissures in viii. There is a slight layer of opaque, whitish or yellowish material on each side of the dorsal blood vessel from segment ix or x posteriorly. There are paired masses of translucent material in several segments posterior to the last gizzard segment, the masses on the dorsal surface of the intestine, one at each side of the dorsal blood vessel in each segment.

The testis sacs may extend into xii but are usually in both ix and x, sharply constricted by 9/10, the portion in ix smaller than that in x. The ental portion of the vas deferens in septum 9/10 is fine and is looped in a compact fashion in septum 9/10 with some of the loops protuding into ix as in *D. l. typica*. The wider portion of the vas is compacted into a close mass of loops on the posterior face of 9-10, the mass of loops much smaller than that of the testis sac. The vas passes into the median face of the prostate below the ental end. The prostate is short, erect, antero-posteriorly flattened, the ental end widened and inclined or bent mesially towards the nerve cord.

The spermathecal atria are almost spheroidal in acitellate and clitellate specimens both. The duct passes into the posterior face of the atrium just dorsal to the parietes. The atria are not erect but are crushed down on to the floor of vii against the base of 7/8. The atrial wall is thin and transparent, the atrial cavity filled with a whitish, rather pasty mass, similar in appearance to the whitish material in the spermathecal ampulla. The atria are 2-3 mm. in length, tubular, but usually very slightly wider entally than ectally.

Drawida vulgaris Gates.

1930. *Drawida vulgaris*, Gates, *Rec. Ind. Mus.* XXXII, p. 296.

The nephridiopores of viii are displaced slightly dorsal to *d*.
All specimens are either fully clitellate or partially clitellate.

The male porophores are in *bc* slightly nearer to *b* than to *c*, the median margin of the porophore not quite reaching to *b*. The porophore is formed, apparently, by the development of a short transverse furrow towards the posterior margin of *x* on each side. On the partially clitellate and some of the clitellate specimens this furrow terminates blindly at each end. On some of the clitellate specimens the furrow is deepened and extended laterally and mesially to pass into the intersegmental furrow 10/11, cutting off from the posterior margin of *x* a "slice" which fits into a definite indentation on the posterior margin of *x*. At the centre of the slice is the male pore which can be definitely identified only with high magnification and brilliant illumination or by pulling the anterior margin of the porophore forward in such a way that the male aperture is stretched widely open. The ventral face of the porophore may be elevated slightly producing a cone-like or flap-like appearance.

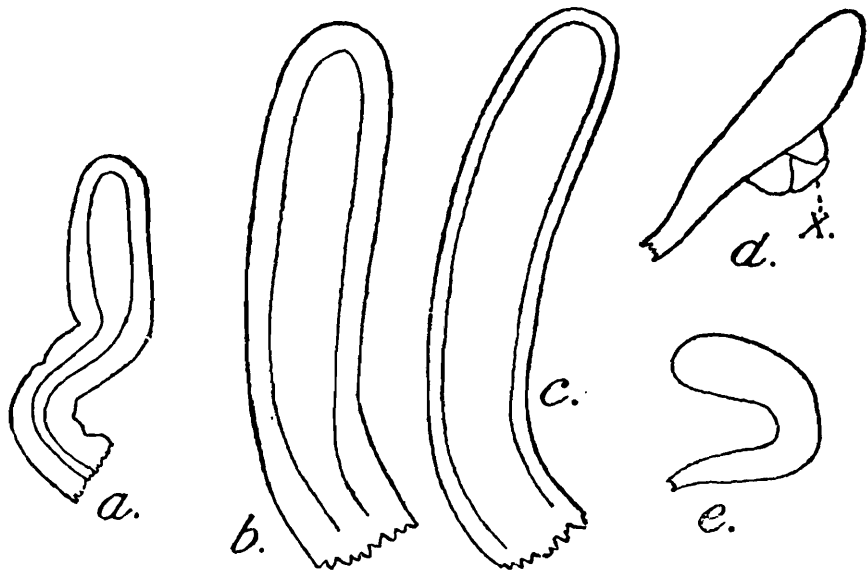


FIG. 12.—*Drawida vulgaris* Gates.

a. Spermathecal atrium $\times$ *ca.* 27. *b-c.* Spermathecal atria from two other specimens, $\times$ *ca.* 47. *d-e.* Prostate central bodies after removal of granular investment. *x*=granular investment $\times$ 55.

There are two pairs of vascular commissures in viii.
The gizzards are 2-4 in xii-xvi as shown below.

Segments.										Specimens.	
xii-xiv	.	.	.	.	.	.	.	.	.	4	
xii-xv	.	.	.	.	.	.	.	.	.	4	
xiii-xv	.	.	.	.	.	.	.	.	.	11	
xiii-xvi	.	.	.	.	.	.	.	.	.	1	
xiv-xv	.	.	.	.	.	.	.	.	.	2	

The prostate is short, erect or bent, club-shaped. The central body decreases gradually in diameter passing ectally. The granular investment is much thinner on a short portion near the parietes or lacking. The vas deferens which is short and slender passes into the prostate near the ental end.

The spermathecal ampullae are large relative to the size of the worm. The atria are finger-shaped tubes, erect in vii, the ental portion smooth, the ectal portion may be bent and annulated. The ectal part of the atrium appears to be, at first, of about the same diameter as the ental part but is probably slightly narrower but covered over with connective tissue.

Drawida sp.

Tharrawaddy, August, K. John, 1 acitellate specimen.

Thayetmyo, September, K. John, 1 acitellate specimen.

Length 26, 25 mm. Greatest diameter 1 mm., *ca.* 2 mm. Unpigmented. No trace of clitellar colouration.

Setal interval *aa* is slightly less than *bc*, *ab* and *cd* closely paired.

The spermathecal pores are small transverse slits in $7/8$ slightly median to *c*.

The female pores are in $11/12$ slightly lateral to *b*.

In the groove between segments *x* and *xi*, in *bc* but slightly nearer to *b* than to *c*, on each side there is a short, tubular but slightly flattened anteroposteriorly placed penis. At the ventral end of the penis is the minutely transverse, slit-like male pore. The posteriormost margin of *x* just in front of the penis, as well as the anteriormost margin of *xi* just behind the penis, is swollen and forms a sort of lip at the base of the penis. The median margins of the lips do not reach to *b*.

There are no genital markings.

Internal anatomy.—The last pair of hearts is in *ix*. There are two pairs of commissures in *viii*.

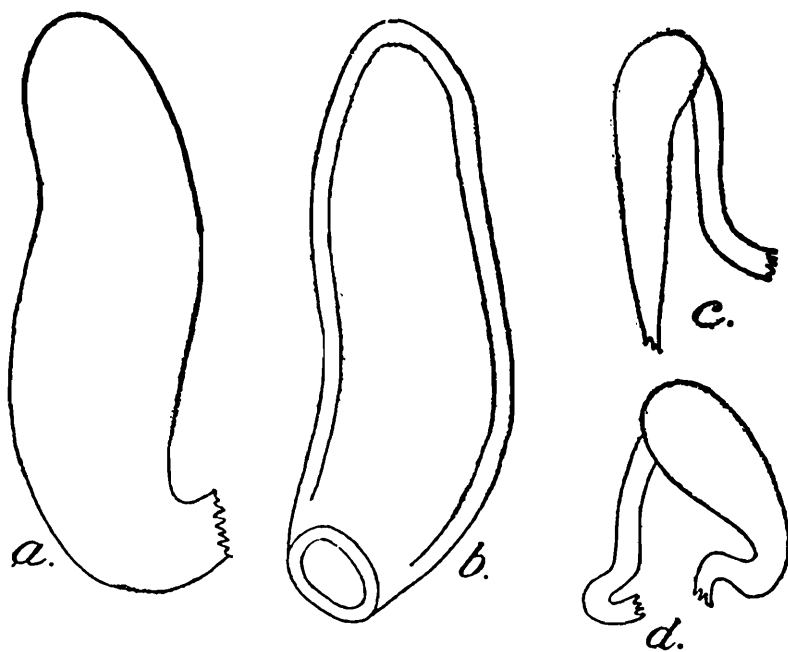


FIG. 13.—*Drawida* sp.

a-b. Spermathecal atria $\times ca.$ 75. *c-d.* Prostates $\times ca.$ 47.

There are four gizzards in *xiii-xvi* or three in *xiv-xvi*.

The testis sacs extend slightly into *ix*, constricted by $9/10$. The vas deferens is long, rather wide and coiled into a mass of loops in *x* underneath the testis sac which is of about the same size as the testis sac. The vas passes into the prostate near the ental end. The prostate is erect, club-shaped or pear-shaped with a finely granular surface.

The ovarian chamber is of the inverted U type. The ovisacs are small, in xii. The spermathecal ampullae are large, the duct fairly thick relative to the size of the worm. The spermathecal atrium is finger-shaped, erect, thin-walled, the atrial lumen filled with whitish material.

There are paired, whitish masses, probably enterosegmental organs on the dorsal surface of the intestine at the sides of the dorsal blood vessel, in several segments just behind the last gizzard segment.

Remarks.—The penis is rather like the penis of *D. molesta*. All of the reproductive organs except the ovisacs appear to be fully developed. The ovarian chamber is not distended by ova as in completely sexual worms.

The worms cannot be placed in any of the Burmese species of *Drawida*.

Family MEGASCOLECIDAE.

Subfamily MEGASCOLECINAE.

Genus **Plutellus** E. Perr.

Plutellus inflexus Steph.

1931. *Plutellus inflexus*, Stephenson, *Rec. Ind. Mus.* XXXIII, p. 179, figs. 2-4.

var. **typicus** Stephenson.

Stephenson did not see the spermathecal pores but stated that "from internal dissection they are four pairs, opening in furrows 5/6—8/9 in line with the ventral setae." Three specimens of this species forwarded by Dr. Stephenson have been examined. With the 25 mm. objective and bright illumination the spermathecal pores can be recognized on each of these specimens. The pores are in the intersegmental furrows in setal line *b*.

The clitellum according to Stephenson "extends over segments xiii-xix." In the three specimens just mentioned the clitellum extends to 18/19 on one, to just behind 18/19 on another, and about half way across xix on the third.

var. **compositus**, var. nov.

Tonbo, September, K. John, 59 a clitellate and 72 clitellate specimens.

External characteristics.—Length of clitellate specimens 50-87 mm. Greatest diameter, 2 mm. The clitellate worms are about 2 mm. in diameter throughout. Unpigmented, yellowish clitellum. The anterior end is hooked as in the variety *typicus*.

The prostomium is prolobous, marked off from segment i by a transverse furrow. Just behind the prostomium on i, in the mid-dorsal line is a minute triangular area with the base of the triangle a portion of the furrow separating the prostomium from segment i. The first segment is quite noticeably wider than the succeeding segments and usually has a single, more or less complete secondary furrow.

The setae begin on segment ii. Interval ab is always smaller than cd but the relative widths of the other intervals vary, the following relationships were noted :—

$$\begin{aligned} ab < cd < bc < aa \\ ab < cd < bc = aa \\ ab < cd < bc > aa \\ ab < cd > bc < aa \end{aligned}$$

On the preclitellar segments, setae a and b are about as large and conspicuously protuberant as are c and d but posterior to the clitellum setae c and d appear to be slightly larger and more conspicuously protuberant.

The position of the first dorsal pore was noted on 25 specimens on each of which the pore is in 7/8.

The clitellum is saddle-shaped, reaching anteroposteriorly across segments xiii-xviii at least. In a few specimens the clitellar glandularity extends slightly on to segments xii and xix. The clitellar glandularity on xix is slight, when present, and on none of the specimens does it extend as far posteriorly as on the specimen of the variety *typicus* referred to above. Ventrally the clitellar glandularity extends to setal line b . Setae a and b are present on the clitellar segments except on segment xviii. Setae c and d are not usually visible on the clitellar segments although on some specimens the positions of these setae may be indicated by very minute pits, the apertures of apparently empty setal follicles. Dorsal pores are lacking between the clitellar segments but the pore in 12/13 and that in 18/19 is almost always, possibly always, functional. Intersegmental furrows are not usually recognizable ventrally on the clitellar region and are not indicated dorsally and laterally.

The spermathecal pores (except in one specimen) are four pairs in intersegmental furrows 5/6-8/9. The pores are minute and cannot be seen except with the highest power of the binocular, with lower powers of the binocular the positions of the spermathecal pores can often be determined, the site of the pore is indicated by what appears to be a minute blackish dot. The locations of the spermathecal pores are variable but are always in aa , median to a . The pores are almost always symmetrically placed, *ie.*, the pore on one side is at about the same distance from the midventral line as the corresponding pore on the opposite side. In five specimens the pores are not symmetrical, one pore of each pair nearer to the midventral line than the other pore. As a rule the ventral distance between a pair of pores varies from one intersegmental furrow to the next. On a number of specimens the greatest ventral distance is in 5/6, the ventral distance shortening in each succeeding furrow until the last pair of pores in 8/9 is fairly closely approximated to the midventral line. On one specimen with a similar pore-arrangement there is a single spermathecal pore in 8/9, in the midventral line. The regular decrease or shortening of the ventral distance from 5/6 posteriorly is not characteristic, the ventral distance varying from one furrow to the next in many specimens in so many ways as to be scarcely worth recording.

There is a pair of female pores on xiv on a transversely elongated, protuberant area on the anterior half of the segment, the area reaching to b on each side or slightly lateral to b . Each pore is just anterior to seta a .

The male pores were not definitely identified. There is, however, on xviii, on each side and about in line with *a*, a minute, pit-like depression. If the prostatic duct is carefully pulled out of the parietes after removal of the longitudinal musculature a bit of the epidermis on which this pit is located is also removed.

The male area is not clearly outlined but is almost circular, transversely oval, or elongately oval, extending across xviii and on to the posterior margin of xvii and the anterior margin of xix. On a few specimens there can be made out two very slight and rather vague protuberances, one on each side about in line *a* and on this protuberance is the pit previously mentioned.

The genital markings are transversely oval, median and slightly protuberant areas in the region of the intersegmental furrows, reaching laterally to *a* on each side. Each marking involves the anterior portion and the posterior portion of two successive segments, the intersegmental furrow lacking across the marking. At the centre of each marking is a slight, transverse depression. Five specimens have a single marking on 12/13 while 67 specimens have two markings on 11/12 and 12/13.

Internal anatomy.—(Opened 20 specimens.)

Septa are present, at least from 5/6 posteriorly; 5/6-8/9 or 9/10 are thickly muscular; 9/10 or 10/11 to 11/12 or 12/13 are slightly muscular or muscular but never as thickly muscular as 5/6-8/9.

There is a gizzard, slightly longer than wide, just anterior to 5/6. The intestine begins in xiv.

The last pair of hearts is in xii in each specimen.

The testes and male funnels are free in x and xi. There is a small, acinous, vertical seminal vesicle at each side of the oesophagus on the posterior faces of 10/11 and 11/12. The prostate is S-shaped or more or less approximates to an S-shape, is straplike, flattened out against the parietes, in xviii and xix or practically confined to xix. The prostatic duct is short and slender, almost straight, widened slightly and glistening towards the ectal end. On the posterior or mesioposterior aspect of the duct is the bundle of penial setae.

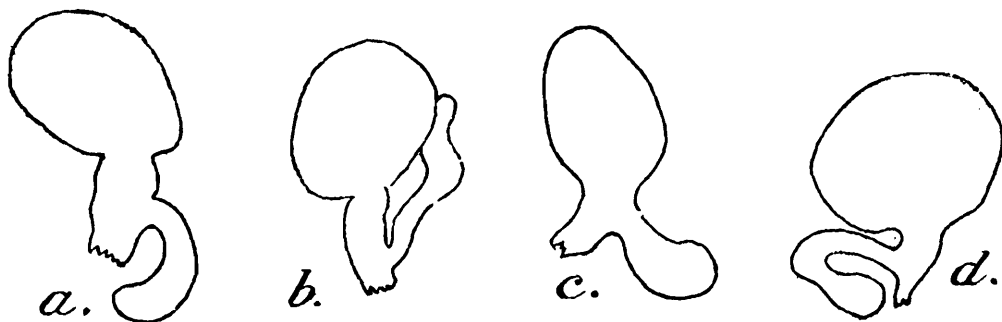


FIG. 14.—*Plutellus inflexus compositus*, var. nov.
a-d. Spermathecae $\times$ ca. 14.

The penial setae are .4 to .5 mm. in length. The middle portion of the shaft is practically straight, the base of the seta bent towards one side as the handle of a walking stick. The tip is usually a straight continuation of the shaft, but may be very slightly bent towards the same side as the basal bend. The tip tapers gradually to a fine point, and is ornamented by a few spines or teeth. In some specimens these spines seem to be paired and located at the sides of the seta, usually three or

four pairs. In other specimens one or two additional spines can be made out between the lateral spines, forming rings. The bases of the spines of a ring do not however appear to be continuous. There are either three or four of such rings and there may be in addition faint indications of a supplementary ring.

The spermathecae are four pairs, in vi-ix, each spermatheca passing into the parietes close to the ventral nerve cord. In a very few specimens the spermathecal ducts of the posterior pair of spermathecae appear to come into contact within the parietes, but there are distinctly separate spermathecal pores. One specimen, having a single spermathecal pore in 8/9 in the midventral line, has the last pair of spermathecae partially fused. Each spermatheca of this pair has an ampulla, a diverticulum and a duct, but before the duct passes into the parietes it unites with the duct of the other spermatheca, a fused duct of about twice the usual width passing into the parietes in the midventral line underneath the nerve cord.

The vas deferens in several specimens was traced from the posterior faces of septa 10/11 or 11/12 until it passes into the parietes. The posterior end of the vas was not found.

Remarks.—The spermathecal diverticulum is similar to that figured for *P. pandus* save that in these specimens the oval chamber at the end of the diverticulum is empty. The ovaries are paired masses of egg strings in xiii. There are paired receptacula ovarum as in *P. pandus* but the number of the egg-like bodies in the receptacle appears to be smaller in the specimens from Tonbo.

Aside from the location of the spermathecal pores the differences between the Tonbo specimens and the Kalewa specimens (variety *typicus*) are slight. But the constant location of the spermathecal apertures in *aa* rather than in *b* appears to be significant and when taken together with other less important points to justify a distinct varietal status for the Tonbo specimens.

Plutellus pandus, sp. nov.

Rangoon : June, 7 acitellate and 2 clitellate specimens ; July, 13 acitellate and 20 clitellate specimens ; August, 51 acitellate specimens ; September, 7 acitellate specimens.

External characteristics.—Length of clitellate specimens, 57-87 mm. Greatest diameter 2 mm. Number of segments of 5 specimens selected at random :—185, 186, 177, 202, 205. Unpigmented ; clitellum yellowish. The acitellate specimens are practically straight, the partially clitellate specimens may be straight or hooked, all fully clitellate specimens hooked. The hooked appearance is due to the bending of the anterior end of the worm in the clitellar region towards the ventral side.

The prostomium is prolobous but on many specimens there is dorsally on the anteriormost margin of i just behind the transverse furrow separating the prostomium from i a minute, triangular area outlined by slight but definite furrows.

The setae begin on segment ii and are eight per segment throughout the length of the body. Interval *ab* is always less than interval *cd*,

usually about one half or less but the other intervals vary relative to each other throughout the length of one individual or from one worm to another. The following were noted :—

$$ab < cd < bc < aa$$

$$ab < cd > bc = aa$$

$$ab < cd > bc < aa$$

$$ab < cd < bc = aa$$

Setae *c* and *d* are always slightly larger and more protuberant throughout the whole length of the worm than *a* or *b*.

The position of the first dorsal pore was noted in 50 specimens in each of which it is in 7/8. In two specimens there is a non-functional, black marking in 6/7.

The clitellum, when fully developed, extends at least from 12/13 to 18/19, but in many specimens the clitellar glandularity extends very slightly beyond these limits on to xii and xix. There are no dorsal pores on the clitellum but pores in 12/13 and 18/19 are always functional. The clitellum is saddle-shaped, reaching ventrally into *bc*, to mid *bc*, or to just lateral to *b*. Setae *a* and *b* are present on each of the clitellar segments except on segment xviii. Setae *c* and *d* may be both present on the clitellar segments or seta *d* may be lacking on each of the segments or both *c* and *d* may be lacking on each of the segments.

The spermathecal apertures are six pairs in intersegmental furrows 5/6-10/11 (11/12 on one specimen). The pores are minute, so small as to be scarcely recognizable as definite pores even with high powers of the binocular. Each of the first four pairs of pores is surrounded by a very fine, rim-like lip, which is lacking about each of the last two pairs of pores. The latter appear, with the high powers of the binocular, to be merely minute black dots in or in the region of the intersegmental furrows. The spermathecal apertures are in line with seta *a* or very slightly median to *a*.

There is a pair of female pores on xiv, each pore just in front of seta *a*, the aperture a trifle larger or more readily recognizable than either the spermathecal or male pores.

The male pores have not been definitely identified. There is on xviii on each side in the transverse setal line and in line *a* longitudinally, a minute pit or pore. When the prostatic duct is carefully pulled out from the parietes after removal of the longitudinal musculature a circular patch of epidermis is removed on which the pit is located.

The male area is not clearly outlined but is a single, transversely oval area, reaching laterally to *b* or nearly to *b*, extending across the whole length of xviii and reaching slightly on to xvii and xix. On this area there are two very slight and very small tumescences, each of which bears one of the pits or pores associated with the ectal end of the prostatic duct.

The genital markings are unpaired and median in position. Each marking is a transversely elongated, anteroposteriorly narrowed swelling or tumescence of the parietes just along the intersegmental furrows, reaching laterally to *b* or nearly to *b* or slightly lateral to *b*. The number

and location of these markings were determined on all specimens on which the markings can be recognized and are as follows:—

Markings.	Specimens.	
	I	II
9/10, 10/11, 11/12	..	2
9/10, 10/11	1	..
10/11, 11/12	8	8
10/11, 11/12, 12/13	..	4
11/12, 12/13	8	1
11/12	5	7
12/13	4	..

I=acitellate. II=clitellate.

On several acitellate specimens as well as on four of the clitellate specimens one of the markings is asymmetrical and just lateral to the midventral line, on one side or the other. The intersegmental furrow is lacking ventrally in the region of the genital marking but the spermathecal pores on a marking are in line with the intersegmental furrow.

Internal anatomy.—(Opened 14 clitellate and several acitellate specimens).

All septa are present from 5/6 posteriorly, 5/6-9/10 thickly muscular, 10/11-12/13 also thickened and slightly muscular as a rule; 12/13 usually thinner than the preceding septa.

The gizzard is located just anterior to 5/6, is not very strong, slightly longer than wide. The intestine begins in xiv, with 14/15 or anteriorly in xv.

The last pair of hearts is in xiii in all but one specimen in which the last pair is in xii (the specimen is however abnormal in other respects).

The testes and male funnels are free in segments x and xi. There are two pairs of seminal vesicles, in xi and xii. Each vesicle is a small, acinous, vertically elongated body on the posterior face of 10/11 or 11/12 at the side of the oesophagus. The prostates are flattened and strap-like, in xix and xviii or xix only, bent into an S-shape or an approximation of an S-shape. The prostatic duct is straight, short, slender, but with a thickened and glistening ectal portion. The vasa deferentia were not found.

The ovaries are small and hard to find in most specimens. As a matter of fact I did not succeed in getting out the ovaries from a number of specimens although a small, button-like body in the usual location in xiii on each side was noted. In three specimens the ovaries were readily visible and were removed. Each ovary consists of a number of elongated egg strings, each string containing several fairly large, ovoid ova at the posterior end and anteriorly a string of smaller, almost cuboidal ova in which the nuclei are much larger relative to the size of an ovum than posteriorly. In each worm there is a pair of receptacula ovarum in xiv, each ovisac attached to the posterior face of 13/14 just lateral and close to the gut. In a number of specimens these ovisacs were not at first visible but were eventually found in a slight funnel-shaped invagination of septum 13/14 anteriorly in such a way that the ovisacs are pressed against the oesophagus and covered over by the septum. The ovisacs were removed from a number of the specimens. Each contains a central,

dark mass of tissue around the periphery of which are arranged a number of cells which may be of various sizes. Each cell has a single ovoidal (nuclear?) body or several such bodies. Definite measurements were not made but each of these ovoidal bodies is of about the same size and appearance as a terminal ovum of an egg string.

The spermathecae are six pairs, located in segments vi-xi (one specimen with 7 pairs in vi-xii). In the first four spermathecal segments each spermathecal duct is, as a rule, slightly shorter than the ampulla which is ovoidal. The diverticulum consists of a short and narrow stalk portion, swelling out ventally into a more or less ovoidal-shaped sac in which there is a solid ovoidal body nearly but not quite filling the lumen. The solid body is iridescent and presumably contains spermatozoa. Each spermathecae of the next two spermathecal segments are provided with a diverticulum with stalk a trifle thicker than anteriorly, while the duct is usually longer than the ampulla which is spheroidal rather than ovoidal. In several specimens a diverticulum is lacking on one of the spermathecae of xi. The diverticulae of spermathecae of segments x and xi have the iridescent mass as anteriorly. Curiously, this iridescent mass is present in the terminal chambers of the diverticula of specimens which have no trace whatever of clitellar glandularity. The spermathecae of xii are small and lack diverticula.

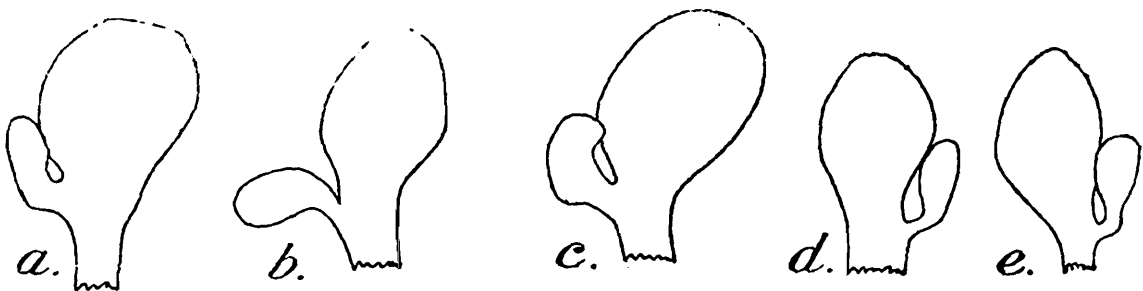


FIG. 15.—*Plutellus pandus*, sp. nov.

Spermathecae from left side of one specimen. a. from segment vi, b. from segment vii, c. from segment ix, d. from segment xi, e. from segment xii.

The penial setae are .033-.047 mm. in length and about .007-.009 mm. thick at the region of greatest width. The shaft is straight throughout, or with a slight bend at one end or with a bend at each end, in the latter case both bends are towards the same side of the shaft. The tip narrows gradually to a fine point and is ornamented with a few sparsely scattered teeth or spines that are very difficult to see.

Remarks.—Although large numbers of earthworms have been collected in Rangoon, nearly every year for ten years, no mature specimens of this species were obtained until this year. All of the 1932 specimens were collected from one spot about five minutes walk from the University estate. When this little area dried up in September the worms disappeared and none have been found since. As clitellate specimens were found only in June and July, it would appear that the breeding season of this species, at least in Rangoon, is unusually early, i.e., at the very beginning of the rainy season. The majority of the aclitellate specimens obtained in August and September are fully as large as the clitellate individuals but have no traces of clitellar glandularity.

The species may be distinguished from all other Indian and Eumese species of *Plutellus* by the six pairs of spermathecae.

Plutellus sp.

Chaukan near Pegu, August, K. John, 1 acitellate specimen.

Length 250 mm. Diameter about 2 mm. There is a pair of pores on xviii, each pore about in line *a*. The anterior setae on segments ii-vii are enlarged and blackened so that the appearance of the ventrum anteriorly is much like that of *Drawida gracilis*.

The last pair of hearts is in xiii. The intestine begins in xvii.

Enlarged anterior setae such as are present in this specimen have not been observed in any species of *Plutellus* hitherto recorded from Burma. The worm is either abnormal with respect to this characteristic or else belongs to some species not yet found in a clitellate condition. The length is also much greater than any previously noted in Burmese species of *Plutellus*.

Genus **Tonoscolex**, gen. nov.

Unpigmented worms with spermathecal pores in 6/7-7/8, in *a* or median to *a*; paired female pores on xiii; male pores on xvii in seminal grooves which extend either across xvi and xvii or xvii and xviii. Gizzard large in vi; intestine begins in xiv; paired, stalked calciferous glands on the oesophagus in ix-xii. Last pair of hearts in xii. Testes paired in ix and x; seminal vesicles paired in x and xi; prostates strap-shaped with soft, whitish ducts. Ovaries and oviducal funnels in xii.

The genus is erected for Burmese worms formerly referred to *Notoscolex*. Three Indian species of *Notoscolex* and one species of *Megascolex* are probably to be included in the new genus. Further discussion of the relationship of *Tonoscolex* to *Megascolex* and *Notoscolex* as well as a consideration of the classification of the Megascolecinae is postponed for lack of space to a later occasion.

Tonoscolex birmanicus (Gates).

1927. *Notoscolex birmanicus*, Gates, *Ann. Mag. Nat. Hist.* (9) xix, p. 609.

Maymyo, August, K. John, 10 acitellate specimens.

Tonoscolex depressus (Gates).

1929. *Notoscolex depressus*, Gates, *Proc. U. S. Mus.* LXXV (10), p. 14.

Pyinmana, September, K. John, 12 clitellate specimens.

Taungyi, September, Saya Ba Te, 18 clitellate specimens.

The Pyinmana specimens.—Length of each specimen greater than 200 mm., the tail portion of each worm lacking. Greatest diameter 6-7 mm.

The first dorsal pore is in 9/10 (1 specimen), in 10/11 (4), in 10/11 but with a non-functional, pore-like making in 9/10 (7).

The clitellum is fully developed and is reddish. Intersegmental furrows and dorsal pores lacking.

The male region is an area of slight protuberance without the mid-ventral depression that characterizes the type specimens. The seminal grooves when fully developed have the f-shape characteristic of the

species. On some of the specimens the grooves are unusually short, ending anteriorly just behind the male pore or continued anterior to the male pore only slightly. The posterior ends of the male pores are in line with *c* or slightly median to *c*. The male pores, when not in seminal grooves, are readily recognizable as small, transverse slits.

Testes were not found in ix and x but the male funnels are well developed as are the oviducal funnels. The seminal vesicles are small. The vasa deferentia have an unusually wide lumen and an abnormally thin wall. The spermathecae are small.

In ix and x there are masses of nematodes. In each seminal vesicle of xi (and occasionally also in vesicles of x) are several "brown discs". The disc is composed of a brownish granular material, setae and pseudonavicellae cysts. Cysts filled with pseudonavicellae spores are present in the seminal vesicles, massed in the coelom of ix and x, and are also scattered throughout the coelom posterior to the prostatic region.

The Taungyi specimens.—The greatest length is 150 mm. The greatest diameter is 5-5½ mm.

The clitellar region is markedly protuberant and dark reddish. Intersegmental furrows are lacking but dorsal pores or rudiments of the pores are visible.

The first dorsal pore is in 9/10 in 17 specimens, in 10/11 in one specimen.

The male region is, as in the preceding specimens, an area of slight protuberance without a midventral depression. The seminal grooves are perfectly formed and contain the male pores which are recognized only with difficulty. The male region of each specimen is divided into two portions by a groove at the midventral line.

The prostatic duct emerges from the median margin of the gland and about one-third of the length of the gland from the anterior end. In several specimens each prostate is separated into two distinct portions, the prostatic duct bifurcating to send a branch to each portion. The posterior portion of such a divided gland is usually folded on itself.

The spermathecae and seminal vesicles are small.

There are no calciferous glands in segment x of one specimen.

There are masses of spermatozoa (morula stage) in segments ix and x. Scattered through these masses are numerous cysts containing pseudonavicellae spores. In several specimens there are additional cysts sparsely scattered throughout the coelom of the region behind the prostates. In one specimen the parietes is nearly covered by cysts throughout the whole length of the worm behind the prostatic region. No nemas were found.

var. **scutatus**, var. nov.

Loikaw, September, G. E. Blackwell, 7 acitellate or partially clitellate specimens.

Koopa, September, G. E. Blackwell, 19 clitellate specimens. (Three acitellate specimens without seminal grooves or genital markings may also belong to this variety).

External characteristics.—Length up to 160 mm. Greatest diameter 5½-6½ mm.

The setae begin on segment ii and are eight per segment, although on ii-viii, ix or x, setae *a* and *b* are usually not visible and possibly lacking. The ratios of the setal intervals vary but usually $ab < cd < bc < aa$, dd slightly greater than one half of the circumference.

The first dorsal pore is in 9/10 but on a number of specimens there is a more or less pore-like marking in 8/9 in the mid-dorsal line.

The spermathecal apertures are minute, in 6/7-7/8, in line with or slightly median to *a*.

The male pores are minute, transverse slits towards the anterior ends of the seminal grooves.

The clitellum is conspicuously protuberant, reddish, annular, extending from 12/13 to 16/17 or only across the anterior two-thirds of xvi. Dorsal pores and intersegmental furrows are lacking; setae may or may not be present.

Segments xvii and xviii are longer ventrally than preceding and succeeding segments and in this region the epidermis and muscular layers are thickened, the thickened region in the shape of a U with the limbs of the U directed posteriorly and parallel to the midventral line. Midventrally between the limbs of the U the body wall is thin, the epidermis often transparent so that the muscle fibres underneath can be recognized from the exterior. The midventral area between the limbs of the U may be depressed as a whole or there may be two longitudinal, slit-like grooves or depressions of the area, one on each side just median to the arm of the U. The thin epidermis is flecked with minute bits of yellowish or brownish pigment. The seminal grooves are located on the arms of the U. Posteriorly each groove is slightly median to *c* or in the lateral portion of *bc* and is practically parallel to the midventral line. The anterior portion of the groove is also almost straight and is bent at an angle to the posterior portion of the groove so that the anterior end of the groove almost reaches the midventral line. There is no specially protuberant U-shaped ridge at the anterior terminus of each seminal groove as in the previous specimens of the species but the epidermis at each side of the groove is slightly protuberant, softly tumescent anteriorly, more firmly tumescent posteriorly. On xvii, immediately in front of the anterior ends of the seminal grooves there is a deep, transversely, slit-like groove or depression, reaching laterally on each side about to *b*.

Internal anatomy.—(Opened 13 specimens).

Septa 6/7-10/11 or 11/12 are thickly muscular, 12/13 (and sometimes 11/12 also) are slightly muscular and translucent.

The last pair of hearts is in xii in every specimen.

Male funnels are present in ix and x but no testes were definitely identified. The seminal vesicles are small, vertical bodies at the sides of the oesophagus on the posterior faces of septa 9/10 and 10/11. The prostates extend through xvi-xx, xxi, or xxii. The vas deferens has not been traced throughout in any specimen but can be seen in xvii rising from the parietes and passing into the prostate just anterior to the point of emergence of the prostatic duct. The latter is about 3-4 mm. long.

The anterior spermathecae are usually slightly smaller than the posterior spermathecae. The spermathecal ampulla is spheroidal,

subspheroidal to heart-shaped and is longer than the coelomic portion of the duct which is short and stout and narrowed abruptly within the parietes. The diverticulum is rounded, usually more or less spheroidal

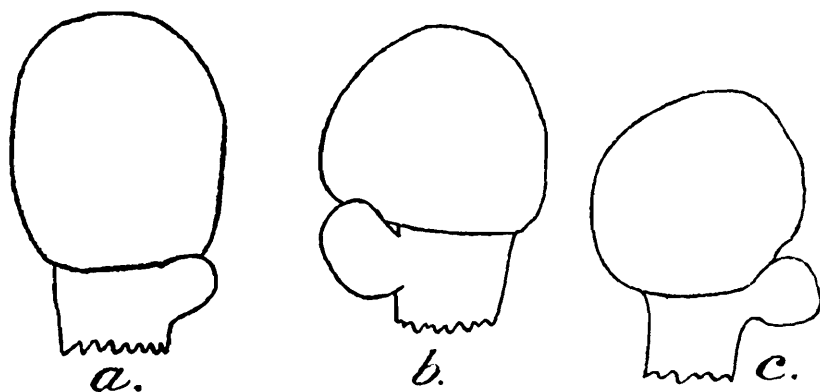


FIG. 16.—*Tonoscolex depressus scutarius*, var nov.
a. Spermathecae from 3 specimens, $\times$ ca. 14.

and apparently sessile on the duct at the junction of the latter with the ampulla. It is possible to dissect off from the duct connective tissue which conceals from view a stalk-like portion of the diverticulum that passes into the duct nearer to the parietes. The spermathecal ampulla is distended by masses of finely granular, light brownish material.

The U-shaped thickening of the parietes projects conspicuously into the coelom but is concealed from view in a dissected specimen by numerous muscular cords which pass in a diagonal fashion from the dorsal face of the thickening to the parietes laterally.

Remarks.—No parasites were found.

The reproductive organs of the aclitellate specimens are minute rudiments or entirely unrecognizable.

***Tonoscolex ferinus*, sp. nov.**

Koopra, September, G. E. Blackwell, 5 aclitellate specimens.

External characteristics.—Length, to 125 mm. Greatest diameter, 5 mm. Unpigmented. On segment v there is a single, postsetal, secondary furrow. On segment vi and the succeeding segments there is a presetal secondary furrow and in addition a postsetal secondary furrow. Tertiary furrows are not well developed and rarely are completely circumferential. There may be a tertiary furrow on the posterior-most secondary annulus of viii-xi and a similar tertiary furrow on the anterior-most secondary annulus of ix-xi. On segments vi and vii there are numbers of short furrows passing anteroposteriorly on the midventral region.

The setae begin on segment ii. The setal circles have a wide mid-dorsal and midventral break anteriorly but posteriorly the mid-dorsal break decreases until it almost disappears, but the midventral break remains of about the same width throughout. The numbers of the setae on three specimens are indicated below.

ii	vii	xii	xx
29	29	39	40
23	26	36	37
26	21	31	41

The number of setae on the posterior segments varies from 34-41.

The first dorsal pore is in 9/10 ; two specimens have a non-functional, pore-like marking in 8/9 in the mid-dorsal line.

One specimen has very slight indications of the initial development of clitellar glandularity on segments xiii-xv and the anteriormost portion of xvi.

The spermathecal apertures are minute, two pairs, in 6/7-7/8, slightly median to *a*. On one specimen there is an unpaired median spermathecal pore about in the midventral line in 6/7 as well as in 7/8.

The female pores are paired on xiii, in *aa* and are either in the transverse setal line or slightly anterior to the transverse setal line.

The male pores are minute, transverse slits in the seminal grooves—towards the anterior ends of the grooves.

Segments xvii and xviii are much longer ventrally than the preceding and succeeding segments. On these two segments of the most mature specimen there is a thickening of the body wall in a sort of U shape. The limbs of the U are not parallel to the midventral line but posteriorly are slightly more lateral than anteriorly. On each arm of the U is a seminal groove ; the posterior end of the groove is about opposite seta *e*, *f*, or *g*, from whence the groove passes anteriorly and then mesially but not quite reaching the midventral line. On xvii, immediately in front of the anterior ends of the seminal grooves there is a deep, transversely slit-like groove or depression, reaching laterally on each side about to *b*. The midventral region between the arms of the U is unusually thin, the epidermis so thin that the circular muscle fibres are visible from the exterior through the epidermis.

The midventral thinness of the parietes on the male area is developed only in one specimen, but with this exception the male areas are alike in all the specimens.

Internal anatomy.—(All specimens opened).

Septa 6/7-10/11 are muscular or thickly muscular, 11/12 and 12/13 are slightly muscular and translucent.

The gizzard in vi is well developed. The intestine begins in xiv. There are four pairs of stalked calciferous glands in ix-xii.

The last pair of hearts is in xii.

The testes and male funnels are paired in ix and x. The seminal vesicles are vertical bodies at the sides of the oesophagus on the posterior faces of septa 9/10 and 10/11. The prostates are flattened, strap-shaped bodies extending through segments xvii-xix, xx, xxi, or xxii. Each prostate has a smooth median margin, the lateral margin incised by the septa through which the prostate passes. The prostate is thinner laterally than at the median margin. The prostatic duct is about 1-1½ mm. in length, soft, whitish, practically straight. The vas deferens has not been traced throughout but can be seen in xvii rising from the parietes and passing into the prostate just anterior to the point of emergence of the prostatic duct. The prostatic duct emerges from the median margin of the prostate near the anterior end or from the anterior margin (1 specimen).

The parietal thickening of the male region projects slightly into the coelom. Muscular cords pass from the dorsal face of the thickened region to the parietes laterally.

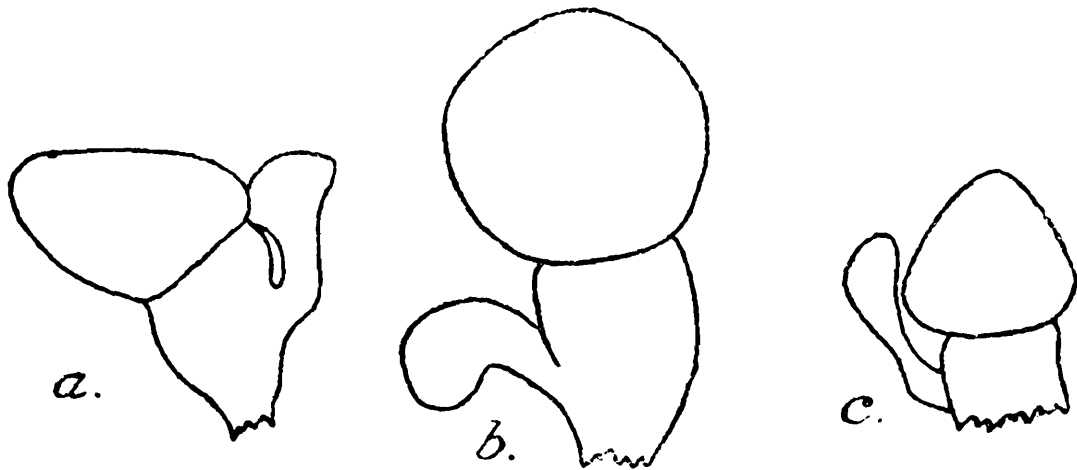


FIG. 17.—*Tonoscolex ferinus*, sp. nov.
a-c. Spermathecae $\times$ ca. 22.

The spermathecal ampulla is spheroidal to heart-shaped, longer than the coelomic portion of the duct which is stoutish. The duct is narrowed within the parietes. The diverticulum is small but consists of a narrow, stalk-like portion and a widened terminal chamber. The diverticulum issues from the duct just as the latter passes into the parietes. The anterior spermathecae appear to be slightly smaller than the posterior spermathecae.

In the specimen with unpaired, median spermathecal pores the ducts of a pair of spermathecae unite in the parietes opening to the exterior by a single pore.

The ovaries and oviducal funnels are at the usual locations in xii.

Remarks.—In spite of the fact that the clitellar glandularity is not developed the reproductive apertures and the reproductive organs appear to be fully developed.

T. ferinus differs from other Burmese species of *Tonoscolex* only in the possession of perichaetine setae. Were it not for these setae the determination of the specific status of the worms would be rather difficult. The seminal grooves are almost exactly like the grooves of *T. d. scutatus* and are not very different from the grooves of *T. triquetrus*.

T. ferinus stands in somewhat the same relationship to the Burmese species of *Tonoscolex* as does *M. horai* to the Assamese species of *Tonoscolex*. Stephenson states (1923, p. 248) with reference to *M. horai* that "This species is closely related to an Assamese group of species of *Notoscolex* and has doubtless arisen from some species of this group, independently of the great majority of species of *Megascolex*." In spite of the apparent origin of *M. horai* from the Assamese species of *Notoscolex* and the greater similarity of *M. horai* to those species than to any species of *Megascolex* and merely because of the presence of perichaetine setae, *horai* was placed in the genus *Megascolex*. Only a single, immature specimen of *M. horai* has been collected hitherto. Until further material and especially clitellate specimens become available for study, the status of *M. horai* must be regarded as doubtful. The species may have to be included in *Tonoscolex*.

Tonoscolex lunatus (Gates).

1929. *Notoscolex lunatus*, Gates, *Proc. U. S. Nat. Mus.* LXXV (10), p. 16.

“Wet soil, grove of trees, Peng Sai, Mang Lun State, October”, H. Young, 9 clitellate specimens.

Namkham, September, G. S. Seagrave, 5 clitellate specimens.

The Peng Sai specimens.—Length 85-121 mm. Greatest diameter 3 mm. Unpigmented, clitellum bright yellowish after more than a year of formol preservation.

The setae begin on ii and are present throughout, though one or more setae may be lacking on any particular segment.

The clitellar region is conspicuously protuberant; intersegmental furrows lacking but functional dorsal pores or rudiments of pores present.

The first dorsal pore is in 9/10.

The spermathecal and male pores were not identified.

The male genital field is characteristic as in the type specimens.

The seminal vesicles and the spermathecae are small, the spermathecal diverticula unusually short. The vasa deferentia are very delicate, abnormally narrow and thread-like especially towards the posterior end. Each ovary contains only a few ova.

In each of eight dissected specimens there are masses of cysts in ix-xi. The cysts are white or transparent, if white filled with pseudonavicellae spores. There are also further cysts or masses of spores sparsely scattered throughout the coelom behind the prostatic region. There are nemas in the coelom of segments ix and x of three specimens.

The small size of the worms, the small size of the seminal vesicles and of the spermathecae and the abnormal condition of the vasa deferentia may, perhaps, be regarded as results of parasitism.

The Namkham specimens.—Length 140-170 mm. Greatest diameter $4\frac{1}{2}$ mm.

The first dorsal pore is in 9/10.

The clitellar region is markedly protuberant.

The longitudinal setal rows are regular on three of the specimens, quite irregular behind the clitellum on two specimens.

The male field is an area of slight protuberance, without the mid-ventral depression present on the type and the Peng Sai specimens. The seminal grooves are characteristic. The posterior ends of the grooves are about in line with *b* or slightly lateral to *b*. The U-shaped ridge at the anterior end of each seminal groove is unusually protuberant, the ridge soft, wrinkled and apparently retractile.

The seminal vesicles and the spermathecae are small and the vasa deferentia are unusually fine. The spermathecal diverticula are unusually short; they may be knob-shaped, about twice as long as wide, or 3-4 times as long as wide but never as long as in the type specimens.

There are nematodes in the masses of spermatozoa (morula stage) in segments ix and x. There are numerous cysts on the parietes behind the prostatic region and also on the intestine.

? ***Tonoscolex triquetrus*** (Gates).

1932. *Notoscolex triquetrus*, Gates, *Rec. Ind. Mus.* XXXIV, p. 370, fig. 2.

Koopa, September, G. E. Blackwell, 7 acitellate specimens.

The length varies from 340-450 mm., but three of the specimens are incomplete posteriorly. The greatest diameter is 10 mm. Unpigmented.

The longitudinal setal rows are more or less irregular. Any seta of a particular segment may be lacking or displaced mesially or laterally from its normal position. Nine setae were found on one segment of one specimen.

The first dorsal pore is in 9/10.

Each specimen has a single, readily recognizable female pore in the midventral line on xiii.

The male genital field is an area of slight protuberance without midventral depression. The seminal grooves vary slightly in their conformation. On one specimen the grooves are perfectly straight as in *triquetrus*. On other specimens there is some slight bending so that there is more or less resemblance to the grooves of *depressus* or on two specimens to the grooves of the variety *scutatus*.

The ovaries and testes are represented by slight ridges on the posterior faces of the reproductive septa. The seminal vesicles and the spermathecae are small. The spermathecal diverticula are tubular or finger-shaped, longer than the spermathecal ducts but shorter than the ampullae.

There are masses of nemas in segments ix and x, smallish cysts with pseudonavicellae spores in the seminal vesicles and larger cysts with similar spores on the parietes from ix posteriorly. The parietal cysts are flattened discs with an oval outline and a length of 1 mm. or slightly more.

The Koopa specimens are not only the best preserved specimens of the genus *Tonoscolex* that have been collected for a couple of years, but also have the most normal appearance, so far as external conditions are concerned. The worms are plump and the body wall is firm. The presence of so many parasites in worms that appeared to be in such good condition was therefore quite unexpected.

A single female pore has not hitherto been noted in the genus *Tonoscolex*.

Genus ***Megascolex*** Templeton.

Megascolex mauritii (Kinberg).

Meiktila, August, H. E. Dudley, 3 acitellate and 1,001 clitellate specimens.

Mahlaing, September, K. John, 16 specimens.

Magyidaung, September, K. John, 8 specimens.

Mondine, September, K. John, 33 specimens.

Kyaukpadaung, September, K. John, 17 specimens.

Tonbo, September, K. John, 21 specimens.

Thazi, September, K. John, 43 specimens.

Mandalay, September, K. John, 51 specimens.

Sagaing, September, K. John, 6 specimens.

Meiktila, September, K. John, 53 specimens.
 Kyauk-kyone, September, K. John, 7 specimens.
 Prome, September, K. John, 5 specimens.
 Thayetmyo, September, K. John, 26 specimens.
 Akyab, September, Bruce Taw, 77 specimens.
 Bassein, October, K. John, 1 specimen.
 Kyaukpyu, January, Saya Ah Sou, 38 specimens.

An acitellate specimen from Meiktila had lost the first seven segments and a considerable portion of the eighth segment. It had regenerated the lost portion of segment viii and six segments and a prostomium.

Genus *Pheretima* Kinberg.

Pheretima alexandri (Bedd.).

Maymyo, August, K. John, 29 specimens.
 Loikaw, September, G. E. Blackwell, 70 specimens.
 Koopra, September, G. E. Blackwell, 1 specimen.
 Mala, September, G. E. Blackwell, 69 specimens.
 Thandaung, September, G. E. Blackwell, 14 specimens.
 Mt. Popa, September, K. John, 5 specimens.
 Sagaing, September, K. John, 5 specimens.
 Thayetmyo, September, K. John, 1 specimen.
 Prome, September, K. John, 1 specimen.
 Taungyi, September, Saya Ba Te, 173 clitellate specimens.
 Kalaw, September, Saya Ah Sou, 295 clitellate specimens.
 Kalaw, September, Saya Ah Sou, 32 clitellate specimens.
 Kamaungthwe River, August, W. D. Sutton, 140 clitellate specimens.
 Kamaungthwe River, October, W. D. Sutton, 49 clitellate specimens.

In a previous paper two varieties of *P. alexandri* were distinguished. During routine examinations of collections these varieties have been identified by counting the male setae on xviii. If the number of setae is less than xiv the worm has been considered to belong to the variety *typica* but every fifth worm has been opened to confirm the identification. If the number of male setae is xiv or more the specimen has been opened and the identification made in accordance with certain internal characteristics as previously described (Gates 1931, p. 367). This procedure had made possible the placing of any particular worm in one or the other of the two varieties until the Taungyi-Kalaw-Kamaungthwe collections were taken up. The points of especial interest in connection with the specimens in these collections are summarized briefly below.

The Taungyi specimens differ from the variety *typica* as follows:—The genital markings are only faintly indicated or feebly developed. The testis sacs of x are fused dorsally in such a way as to include the hearts of x and a small portion of the dorsal blood vessel in an inverted U-shaped chamber, the hearts of x surrounded by testicular material. The muscular widening of the spermathecal duct is less evident though recognizable.

The Kalaw specimens (first batch) differ from the variety *typica* as follows:—The male pore areas on xviii are deeply retracted into the parietes, in such a way that the male pore areas appear to be much

nearer than usual to the midventral line. The seminal vesicles of xii are unusually small. The spermathecae are smaller than usual and the diverticula are bright yellowish, of about the same shade as the clitellar colouration.

The Kalaw specimens (second batch) differ from the variety *typica* as follows :—The male setae on xviii are 13-22 : 13 (4 specimens), 14 (3), 15 (4), 16 (3), 17 (1), 18 (4), 19 (2), 20 (8), 21 (2), 22 (1). The spermathecal setae on segment vi are 14-18. The genital markings are of the *gracilior* type. The spermathecae are smaller than usual and the diverticulum is always shorter than the combined lengths of the duct and ampulla.

The Kamaungthwe specimens (first batch) differ from the variety *typica* as follows :—The male setae on xviii are 16-22 : 16 (1 specimen), 17 (17), 18 (41), 19 (9), 20 (9), 21 (4), 22 (1). The spermathecal setae on vi are 11-14. The genital markings are of the *gracilior* type. The testis sacs of x are rounded bodies projecting anteriorly from 10/11 on the ventral parietes. The hearts of x do not pass into the testis sacs until they have passed down about to the level of the ventral face of the oesophagus, the dorsal face of a testis sac distinctly invaginated at the point where the heart passes into the sac. Each seminal vesicle of xii as well as of xi is in two parts,—a dorsal, cream-coloured, smooth portion which fits over the dorsal end of the ventral part as the socket of a ball and socket joint. The ventral part of the vesicle is greyish with finely granular surface. The spermathecal duct is unusually narrow, just ectal to the ampulla.

The Kamaungthwe specimens (second batch) differ from the variety *typica* as follows :—The male setae on xviii are 16-22. The spermathecal setae on vi are 9-14. The genital markings are of the *gracilior* type. The internal characteristics are as in the August specimens from the same localities. The October worms are however unusually large, reaching a length of as much as 290 mm., and a diameter of 9 mm.

All of the Taungyi worms are infested with parasites in an encysted or trophozoite stage as follows :—Cysts in the nerve cord from segments xi-xxx or xxxv, 85 specimens. Cysts in or on the dorsal blood vessel of segments xix-xxx or xxxv, 25 specimens. Small cysts on the intestine which is almost entirely covered thereby from segment xix to the anal region, 1 specimen. A few small cysts scattered throughout the coelom from segment xix to the tail region, 62 specimens. The genital markings of the last 62 specimens are more like the genital markings of *typica* than on any of the other specimens, but curiously these 62 worms are all much smaller and slenderer than the others from the same locality.

Three cysts were found on the dorsal blood vessel in the region of segment xvii of one specimen of the first batch of Kalaw specimens. No parasites were found in the other worms of that batch.

In 17 specimens of the second batch of Kaiaw specimens there are masses of small, spheroidal or ovoidal cysts on the dorsal blood vessel and on the dorsal face of the gut in the region of segments xvi-xxvii, xxviii or xxix, the dorsal blood vessel scarcely if at all recognizable and the dorsal face of the gut completely covered by the cysts. In some of these specimens there are in addition cysts in the walls of the

hearts of xii-xiii, the hearts hypertrophied, formless structures filling the coelom between the gut and the parietes. Smaller numbers of cysts in the same region were noted in 2 specimens. No macroscopic parasites were found in the remaining 13 specimens of the batch.

No parasites were found in the first batch (August) of worms from the Kamaungthwe River region. In the second batch (October) from the same area every specimen is parasitized. The parasites are in a cyst stage and are located on : -septa 6/7 and 11/12-13/14, on the parietes of segments vii-xx, on the spermathecal diverticula, on or within the seminal vesicles. The spermathecal diverticulum or seminal vesicle may be nothing but a mass of cysts. Collapsed cyst-like bodies, either empty or filled with a finely granular, brownish material are fairly common within the longitudinal muscular layer in the region behind segment xx. Attention is called to the fact that in spite of the heavy parasitic infestation these worms are unusually large, i.e., long and thick. Externally, as in so many other cases, the worms have a perfectly healthy appearance.

The failure to find parasites in the August Kamaungthe specimens is probably due to the fact that at that time of the year the parasites are present only in some microscopic stage of the life cycle and hence are not readily visible in the dissected specimens.

One of the Loikaw worms has no male pore or male pore area on one side of xviii, the marking of the other side poorly developed. The spermathecae are rudimentary and without diverticula ; prostates and prostatic ducts lacking. The parietes of the region from xix to the tail is covered with cysts.

The Mamyo-Loikaw-Thayetmyo-Prome worms can all be referred to the variety *typica*. The Taungyi-Kamaungthwe worms cannot be definitely referred to either *typica* or *gracilior* as previously defined. It now seems likely that some if not all of the characteristics that were thought to be typical of *gracilior* are in reality the result of protozoan parasitism.

***Pheretima analecta* Gates.**

1932. *Pheretima analecta*, Gates, *Rec. Ind. Mus.* XXXIV, p. 501, fig. 27.

variety *promota*, var. nov ?

Pegu Yomas, August, G. R. Anderson, 2 clitellate specimens.

One of the worms (No. 1) was improperly preserved. The wall of the gut is rotted but the body wall and the reproductive organs are in a fairly good state of preservation.

External characteristics.—Length, ca. 94 mm. Greatest diameter, 4 mm. Number of segments (No. 2), 108. Colour: dorsally, reddish to brownish; clitellum, greyish. The buccal cavity is everted and conspicuously protuberant at the anterior end.

The setae begin on ii, are small and closely crowded. There is no definite midventral break, a slight middorsal break of variable width may be present. The setal numbers are indicated below.

	1.	2.
vi	27	26
vii	28	28
viii	31	29
xvii	29	26
xviii	18+	20
xx	..	96

The first dorsal pore is in 12/13.

The clitellum covers or nearly covers segments xiv-xvi. Setae, dorsal pores and intersegmental furrows lacking.

The spermathecal pores are four pairs, minute, on tiny tubercles on intersegmental furrows 5/6-8/9.

The single female pore is on xiv, at the centre of a transversely oval, whitish area.

The male pores are minute, each pore at the centre of a small, round or longitudinally oval disc which is marked off from the parietes by a definite but slight furrow; the discs probably slightly retractile into the parietes.

Each worm has a single, transversely elongated, concave or protuberant but level genital marking with rounded ends, extending antero-posteriorly to the setae of xviii and xix and (No. 2) including on its margins the setae of xviii and xix. Laterally the marking reaches nearly but not quite to a point in line with the median margin of the male pore disc. The marking of No. 1 is 26 intersetal distances wide transversely, the marking of No. 2, 21 intersetal distances wide.

Internal anatomy.—Septum 6/7 is muscular but not especially thick, 8/9 present only ventrally; 9/10 lacking.

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

The last pair of hearts is in xiii. There is a single heart belonging to ix, on the right side. The commissures belonging to x are bound against the anterior face of 10/11 by connective tissue.

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

There is a single, median, transversely elongated testis sac on the anterior face of 10/11 and a similar but slightly shorter sac in xi. The seminal vesicles are paired in xi and xii, the vesicles of a segment in contact dorsally over the dorsal blood vessel and filling the segment but not markedly displacing the septa. The prostates are small, confined to xviii (No. 1) or extending through xviii-xix. The prostatic duct is short and slender, about 2 mm., in length in the softened specimen, more than 4 mm., in length in the other worm; bent into 2 u-shaped loops (No. 1) or coiled.

The spermathecal duct is slender, shorter than the ampulla. The diverticulum is longer than the combined lengths of duct and ampulla, narrowly tubular but slightly widened entally, bent into a regular zigzag,

coiled or irregularly looped. The diverticulum passes into the anterior face of the spermathecal duct in the body wall.

Remarks.—The more important differences between these two worms and the original specimens are the anterior location of the genital marking and the slightly greater setal numbers, especially on segment xx.

Of 207 specimens of this species previously examined all but one have a genital marking on 19/20. Several specimens have an additional genital marking, but this extra marking is located on 18/19 in only one worm and is smaller than the normal marking on 19/20. The presence of a single marking of normal size on 18/19 and the absence of the marking on 19/20 together with the slightly greater setal numbers may perhaps justify the erection of a distinct variety. It is however unfortunate that further specimens from the Yomas were not available to furnish data as to the variation in the location of the genital markings in the worms from that particular region.

***Pheretima anomala* Mich.**

With the assistance of J. P. Owen, B. A.

This portion of the paper is based on a study of the specimens of *P. anomala* secured during 1928-32 from a rather considerable number of localities widely scattered throughout the province of Burma. A complete report of our studies on these worms will be rather lengthy. We therefore present only a selection of the data secured, in the form of a fairly extensive description of the variety *typica*, restricting the descriptions of the other varieties mainly to a consideration of those conditions or structures which may be regarded as characteristic of the varieties.

During the last few years such large numbers of worms have been received in this laboratory that it has been necessary to crowd the specimens into a limited number of jars. We cannot therefore report on seasonal and local variations in connection with a number of interesting points, an omission which is regretted.

Individuals of this species are unusually difficult to preserve in perfect condition and even when perfectly preserved seem to be easily damaged by handling or during transportation or as a result of crowding in jars. In a mixed collection of species, the specimens of *P. anomala* are almost always in the poorest condition. As a result our report is not as complete in several points or as definite in connection with several important structures as we had planned.

var. *typica* Stephenson.

1929. *Pheretima anomala typica*, Stephenson; *Rec. Ind. Mus.* XXXI, p. 236

Pegu Yomas, August, G. R. Anderson, 1 a clitellate specimen.
Kamaungthwe River, August, W. D. Sutton, 377 specimens.
Falang, August, J. H. Cope, 7 specimens.
Loikaw, September, G. E. Blackwell, 14 specimens.

Koopra, September, G. E. Blackwell, 5 specimens.
 Mala, September, G. E. Blackwell, 6 specimens.
 Thandaung, September, G. E. Blackwell, 2 specimens.
 Letpadan, September, K. John, 1 specimen.
 Akyab, September, Bruce Taw, 1 specimen.
 Kalaw, September, Saya Ah Sou, 9 specimens.
 Tiddim, September, J. H. Cope, 1 specimen.
 Taungyi, September, Saya Ba Te, 32 specimens.
 Myitkyina, September, L. R. Dudrow, 1 clitellate specimen.
 Henzada, October, K. John, 1 specimen.
 Bassein, October, K. John, 1 specimen.
 Kamaungthwe River, October, W. D. Sutton, 69 specimens.

External characteristics.—The length of clitellate specimens varies from 89 to 200 mm., the greatest diameter from 3-7 mm. The dorsum is usually reddish (much darker anterior to the clitellum than posteriorly) but may be light brownish, greyish, or practically unpigmented. The clitellum is yellowish, light or dark brownish or greyish.

The number of segments varies from 119-130 (*vide* Gates 1932, p. 378) as follows :—

Segments.	Specimens.
119	1
120	5
121	1
122	3
123	7
124	1
125	11
126	8
127	21
128	20
129	9
130	13

The setae begin on ii on which segment there is an uninterrupted setal circle. The setae are small and closely crowded, slightly more so ventrally than dorsally, the setal circles unbroken in the midventral and middorsal lines. The number of setae on segment xiii varies from 86-96 as shown below :—

Setae.	Specimens.
86	2
87	4
89	4
90	2
91	1
92	1
96	1

Setae are not visible on segments xiv and xv of clitellate specimens but there is always a ventral row on segment xvi with the tips of the

setae projecting quite definitely from the epidermis. The number of setae in this row varies from 6 to 24 as indicated below.

Setae.	Specimens.
6	1
15	1
16	1
17	1
18	1
19	3
20	6
21	9
22	7
23	3
24	3

The number of ventral setae between the genital markings on segment xvii varies from 17-23 as follows :—

Setae.	Specimens.
17	5
18	9
19	11
20	15
21	15
22	6
23	1

The number of ventral setae between the male pore markings on xx varies from 16-21 as follows :—

Setae.	Specimens.
16	9
17	8
18	20
19	14
20	7
21	3

The first dorsal pore is in 12/13 in 98 specimens, in 13/14 with a non-functional, pore-like marking in 12/13 in 2 specimens. There are no dorsal pores on the clitellum.

The clitellum is annular, extending from 13/14 to 16/17, intersegmental furrows lacking.

Spermathecal pores are lacking except on three specimens each of which has a single spermathecal pore.

There is a single female pore on xiv (100).

The genital markings are paired slits, opening into slight, parietal excavations. On xx the slits are very slightly wider than on other segments but the lateral margins of these slits are practically in line with the lateral margins of the slits of the other segments. Some or all of the parietal excavations into which the slits open may be partially on

wholly everted as porophores. When fully everted the porophores of xx are thicker and longer than those of the other segments. The circular, pore-bearing disc on a porophore of xx is slightly larger than on the porophores of other segments and bears the minute male pore. The slits or porophores are always symmetrical, *i.e.*, each marking of a pair is equidistant from the midventral line, and are located as follows :—

Segments.	Specimens.
xvii-xxi . . .	75
xvii-xxii . . .	279
xvii-right xxii . . .	69
xvii-left xxii . . .	67
xvii-xxiii . . .	99
xvii-left xxiii . . .	77
xvii-right xxiii . . .	54
xvii-xxiv . . .	21
xvii-right xxiv . . .	7
xvii-left xxiv . . .	1
xviii-xxi . . .	10
xviii-xxii . . .	32
xviii-left xxii . . .	10
xviii-right xxii . . .	4
xviii-xxiii . . .	22
xviii-xxiv . . .	2

In addition there are 71 worms on which a slit or porophore is lacking on one side of two, three, or four segments.

Internal anatomy.—Ordinarily no septa are thickly muscular ; some or all of septa 5/6-7/8 and 10/11-14/15 may be slightly muscular and translucent. Septum 8/9 is always present ; it may be complete, a ventral rudiment only, or may have lost much of its septal appearance—passing mesially to the oesophagus as fine shreds or fibres. Septum 9/10 does not, at first, appear to be present, but what is probably a ventral rudiment of this septum can be found on the parietes ventrally in well-preserved specimens. In one specimen 8/9 is complete and thickly muscular. In a very few specimens 11/12-12/13 or 13/14 are thickly muscular and opaque.

The intestine begins in xv in almost all of the specimens in which this character was noted. The intestinal caeca are simple, extending forward from xxvii into xxii or xxiii or long enough to do so if straightened out. The caeca are simple but may be incised on the dorsal and ventral margins by the septa through which they pass. On the oesophagus immediately behind the gizzard is a collar or ridge of whitish (glandular ?) material which is small but quite definite and practically always without incisions. Although there is some variation in height the ridge is always small and is easily overlooked.

The last pair of hearts is in xiii in 296 specimens. In four specimens there is a single heart in xiii.

What appears at first to be septum 10/11 is in reality a double sheet of tissue, at least ventrally and mesially. The anterior lamella repre-

sents 9/10, the posterior lamella 10/11. Between these two lamellae—at the sides of the oesophagus are the hearts of x; ventral to the oesophagus, the testes and male funnels of x. On the anterior face of the anterior lamella and just behind the heart or hearts of ix is a pair of funnels belonging to ix.

The testes and funnels of x may be contained within a single space, shut off from the rest of the coelom of x, or may be contained within two small spaces shut off from the rest of the coelom of x, or the testis, funnel and heart of one side may be in one space shut off from a similar space on the other side of the oesophagus.

Usually a portion of the coelom of segment xi containing the testes and male funnels is partitioned off from the rest of the coelom. The method of partitioning varies as well as the size of the closed-off portion. In some specimens 10/11 itself comes into contact with 11/12 in such a way as to shut off a mesial or a ventral testicular chamber. In other specimens there is a definite sheet of tissue passing from 10/11 to 11/12 to close off a chamber. The chamber may be small and ventral or may extend dorsally for some distance at the sides of the oesophagus. In several specimens a cylindrical sheet of tissue extending from 10/11 to 11/12 encloses a considerable portion of the coelom of xi at about the centre of which is the oesophagus. The testicular chamber may be single or may be partitioned off in various ways into two small chambers, each of which is more or less equivalent to a testis sac. The testicular chambers, as a rule, are almost empty for the testes and male funnels do not occupy all of the space in the chambers. The whitish material present in the testis sacs of other species of *Pheretima* is almost always lacking.

On the posterior faces of the septa, opposite each male funnel or its approximate position, there may be a small, disc-shaped body, circular in outline. These discs are similar in appearance to the testes in the testis sacs of young specimens of normal species of the genus. Michaelsen (1908) refers to these bodies as testes and this term will be used hereinafter. Although the discs appear to be testes the production of spermatozoa by the discs is very dubious. In several hundred specimens that were especially examined with this in mind no spermatozoa were found either in x and xi or in the coelom of segments v-ix.

Testes and male funnels are present in segments v-xii. Both funnels and testes are always present in x and xi. A pair of funnels, each of about the same size and appearance as the funnels of x and xi, is present in xii in one specimen. The funnels of ix are almost always present but the testicular discs of ix may be lacking. There is a pair of funnels and also a pair of testes in each of segments v to ix in 14 specimens. In all other specimens in which these structures were especially noted there is more or less variation from this arrangement. Thus, one or more of the funnels may be lacking, one or more of the testes may be lacking, or in place of a single testis there may be two or even three testes. In the latter case the supernumerary discs are almost always smaller than the paired discs. The distribution of testes and male funnels in a random sample of 22 specimens is shown below. In this table super-

numerary testes are not indicated, though 12 of these bodies were noted in nine specimens.

Segment.	O.		1 pr.		L.		R.	
	T.	f.	T.	f.	T.	f.	T.	f.
v.	4	10	16	6	2	6	..	..
vi.	2	6	17	10	2	3	1	3
vii.	1	2	20	18	..	1	1	1
viii.	..	..	22	19		1		2

Figures under column headings indicate number of specimens.

O. indicates absence of both testes and funnels.

1 pr. indicates presence in segment of paired testes and paired funnels.

L. indicates presence on left side only of a testis or funnel.

R. indicates presence on right side only of a testis or funnel.

T.—testis.

f.—male funnel.

One specimen has no male funnels anterior to x, but testes are present in v-ix. Three specimens have no funnels or testes in v-ix.

The stalks of all of the male funnels of a side can be traced to an elongate vas deferens which runs posteriorly from v to xx in but very few specimens. In many of the specimens the stalks of the funnels of v-viii cannot be traced further than into the parietes, the stalks apparently ending blindly in the parietes. Inability to trace the stalks posteriorly may be due in some cases to poor preservation but it is very doubtful if the failure to trace the stalks of the funnels posteriorly in the majority of the specimens can be explained in this way. From segment xiii to xx the vasa deferentia are readily recognizable and easily traced; they pass into the prostates just anterior to the point of emergence of the prostatic duct. The stalks of the male funnels of ix were traced to the vas deferens in 14 specimens. Possibly these funnels are always or nearly always connected to the vas. The stalks of the funnels of x and xi of a side unite usually in xii but may not do so until into xiv or xv.

Seminal vesicles are usually lacking. In a number of worms a pair of collapsed, bladder-like structures was noted on the posterior face of 11/12. Each of these sacs has a thin, transparent wall and is filled with a clear, watery fluid. Paired flattened or rounded but solid masses of tissue on the posterior faces of 10/11 and 11/12 that may be interpreted as minute rudiments of seminal vesicles have also been noted in several specimens. Definite seminal vesicles of varying size, but never as large as in the variety *centralis*, have been noted as follows:—

Vesicles.	Specimens.
1 pair, in xi	10
1 pair, in xii	55
1 pair, in x	2
2 pairs, in xi-xii	29
1, in xi	2
1, in xii	10
2, 1 in xi, 1 in xii	3

The prostates are large, extending through some or all of segments xvi-xxiii. The prostatic duct is 4-7 mm. in length, glistening throughout but thickening gradually towards the parietes; bent into various shapes, U, C, or 8, or otherwise twisted, looped or coiled. Removal

of the longitudinal musculature discloses a ring of whitish tissue around the ectal end of the prostatic duct, similar but smaller rings around the ectal ends of the stalks of the mushroom glands. The mushroom gland stalk is thick, straight and glistening.

A pair of oviducal funnels which appear to be fully developed and perfectly normal is always present in xiii. The ovaries are rounded discs with fairly smooth margins, on the posterior face of 12/13. The disc varies from $\frac{3}{4}$ —1 mm. or very slightly more in diameter. Each ovum has a more or less eccentric nucleus, oval in outline, containing a single eccentric endosome.

Four worms have a single funnel in segment xii. This funnel is smaller than the male funnels and of about the same size and appearance as the oviducal funnels of the succeeding segment. There is no ovary or testis on the posterior face of 11/12 opposite the funnel.

Remarks.—Three thecal specimens of this variety have been found. The characteristics of these worms may be briefly summarized as follows :—

1. (Myitkyina) Genital markings on xvii-xx on the left side, on xviii-xxiii on the right side. Single spermathecal pore in 7/8 on the left side. Paired prostates with prostatic ducts in xviii, mushroom glands as indicated by genital markings. Paired testes and male funnels in v-xi, pair of small seminal vesicles in xi, single, normal, *centralis* spermatheca in viii.

2. (Moulmein) Genital markings on xvii-xxi, spermathecal pore in 6/7 on the left side. Prostates in xx, mushroom glands in xvii-xix and xxi, no seminal vesicles, testes and male funnels in v-xi. Rudiment of a spermatheca buried in musculature.

3. (Kya In) Genital markings on xvii-right xxiii. Single spermathecal pore in 8/9 on the right side. Prostates and prostatic ducts in xx, mushroom glands in xvii-xix and xxi-right xxiii, no seminal vesicles, testes and male funnels in v-xi. Single, normal, *centralis* spermatheca in ix.

var. *centralis* Stephenson.

1929. *Pheretima anomala* forma *centralis*, Stephenson, *Rec. Ind. Mus.* XXXI, p. 234.

Loikaw, September, G. E. Blackwell, 1 specimen.

Koopro, September, G. E. Blackwell, 21 specimens.

Myagyaung, September, K. John, 6 specimens.

Taungyi, September, Saya Ba Te, 7 specimens.

Myitkyina, September, L. R. Dudrow, 1 specimen.

Bassein, October, K. John, 6 specimens.

External characteristics.—The number of segments varies from 119 to 130 as indicated below :—

Segments.	Specimens.
119	2
120 . . .	2
121 . . .	2
122 . . .	2
123 . . .	4
124 . . .	7
125 . . .	5
126 . . .	13
127 . . .	6
128 . . .	4
129 . . .	1
130 . . .	1

The number of setae on segment xiii varies from 81-90.

The first functional dorsal pore is in 11/12 in 3 worms, in 12/13 in the remainder. There is a definitely pore-like, but non-functional marking in 11/12 on a number of the specimens.

The number of spermathecal setae on segments vi and vii varies from 17 to 22.

There are three pairs of transverse slits in 5/6-7/8 which at first appear to be spermathecal apertures. Each of these apertures opens into a parietal invagination within which is a round disc that bears at its centre the real, minute spermathecal pore.

The male pores are on segment xx. On all but one of these specimens there are four pairs of genital markings on segments xvii-xx. On the exceptional specimen there is in addition a single marking on xxi on the left side. The markings are slits or porophores as in *typica*.

Internal anatomy.—Septa 5/6-7/8 are present, slightly muscular and translucent; 8/9 is present as a ventral rudiment only; 9/10 cannot be definitely identified but a remnant of it may be present as the hearts of x are bound to the anterior face of 10/11 by very delicate connective tissue; 10/11 is very thin and transparent but is always present; 11/12-12/13 or 13/14 or 14/15 are usually slightly strengthened, transparent to translucent.

There is a slight (glandular?) collar on the oesophagus immediately behind the gizzard which may or may not be incised. The intestine begins in xv. The intestinal caeca extend from xxvii forward into xxi-xxiv or are long enough to do so when straightened out.

The testis sacs of x and xi are unpaired and dumb-bell shaped or paired. The neck between the two portions of a dumb-bell-shaped sac is sometimes so small as to be very difficult to recognize. The testis sacs are always distended with whitish material. The seminal vesicles are fairly large and paired in xi and xii. The vesicles of a segment fill the space between the oesophagus and the body wall and push 10/11 anteriorly and 12/13 posteriorly into contact with 13/14 but dorsally the vesicles reach only to the dorsal blood vessel. The margin of each vesicle has several incisions. The prostates extend through some or all of segments xix-xxiii. The prostatic duct is 4-6 mm., in length, glistening, gradually widening towards the parietes, usually bent into an elongately u-shaped loop. The prostates are on the whole smaller than in *typica* and are often confined to xix and xx though 18/19 and 20/21 are displaced anteriorly and posteriorly.

The spermathecal duct is long and slender, and may be nearly as long as the elongately saccular ampulla from which it is not clearly marked off. The diverticulum is longer than the combined lengths of duct and ampulla and is slenderly tubular except the entalmost portion which is slightly widened and filled with iridescent whitish material. The diverticulum passes into the anterior face of the duct which is widened in the parietes.

The ovaries are discoidal, but are elongately oval in outline and, as a result of the posterior displacement of 12/13 by the vesicles of xii lie with the posterior face of the disc on the floor of xiii just in front of the oviducal funnels. The ova are as in the variety *typica*.

Each specimen has a pair of mushroom glands in each of segments xvii-xix.

var. *insolita* Gates.

1929. *Pheretima anomala* forma *insolita*, Stephenson, *Rec. Ind. Mus.* XXXI, p. 236.

Kamaungthwe River, August, W. D. Sutton, 11 specimens.

Loikaw, September, G. E. Blackwell, 6 specimens.

S'nite, September, G. E. Blackwell, 148 specimens.

Koopra, September, G. E. Blackwell, 67 specimens.

Mala, September, G. E. Blackwell, 1 specimen.

Letpadan, September, K. John, 2 specimens.

Thayetmyo, September, K. John, 1 specimen.

Akyab, September, Bruce Taw, 2 specimens.

Kalaw, September, Saya Ah Sou, 5 specimens.

Taungyi, September, Saya Ba Te, 293 specimens.

Henzada, October, K. John, 11 specimens.

Kamaungthwe River, October, W. D. Sutton, 2 specimens.

The number of segments varies from 119 to 128 as indicated below :—

Segments.	Specimens.
119 . . .	1
120 . . .	6
121 . . .	3
122 . . .	8
123 . . .	8
124 . . .	9
125 . . .	5
126 . . .	6
127 . . .	3
128 . . .	2

The number of setae on segment xiii varies from 87 to 94. The number of spermathecal setae on segments vi and vii varies from 17 to 25.

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

There are three pairs of spermathecal apertures as in *centralis* on every specimen referred to this variety.

There are no male pores, at least such as can be detected by external examination.

Internal anatomy.—As in the variety *centralis* except as noted below.

There are no mushroom glands or prostates or prostatic ducts.

Seminal vesicles and testis sacs always present and as in *centralis*.

The ovaries are discoidal and with smooth margin as in the preceding varieties, circular in outline as in *typica* or oval as in *centralis*. The ova are as in the preceding varieties.

The posterior terminus of the vas deferens is as in the forms referred to as transitional and described below.

*Intermediate or transitional forms.***A.**

Kamaungthwe River, August, W. D. Sutton, 31 specimens.

Loikaw, September, G. E. Blackwell, 10 specimens.

Koopra, September, G. E. Blackwell, 9 specimens.

Mala, September, G. E. Blackwell, 9 specimens.

Thandaung, September, G. E. Blackwell, 2 specimens.

Kalaw, September, Saya Ah Sou, 2 specimens.

Namkham, September, G. S. Seagrave, 4 specimens.

Taungyi, September, Saya Ba Te, 3 specimens.

Kamaungthwe River, October, W. D. Sutton, 8 specimens.

These worms are like *insolita* except that there are one or more *centralis* mushroom glands, one or more prostates or ducts without prostates.

The vas deferens in many of these specimens is unusually conspicuous, especially so in some or all of segments xvi-xxx. In this region the vas is widened slightly and coiled in a loosely spiral fashion, the coils projecting conspicuously from the parietes. The vas may end abruptly and blindly or may be attenuated into a very fine thread which cannot be traced to a definite ending. If a prostatic duct is present the vas passes into the ental end of the duct or into its prostate when present. In several specimens in which there are no prostates the vas appears to pass, within the parietes, into the duct of a mushroom gland, but before the gland stalk is reached the vas becomes thread-like and so slender that it has been impossible to trace the thread into the tissues of the duct. The vas may become thread-like or terminate anywhere in segments xvi-xx or may be continued posteriorly as far as xxx, very rarely more posterior still, before becoming thread-like.

A worm may have mushroom glands only, mushroom glands and prostatic ducts with or without prostates or prostatic ducts with or without prostate glands but no mushroom glands. The incidence of these structures in the worms collected during the last few years is shown below.

	Number of specimens.
1. Mushroom glands present, no prostates or ducts.	
1 in xx, left side	17
1 in xx, right side	20
1 in xvii, left side	2
1 in xvii, right side	2
1 in xviii, left side	1
1 in xviii, right side	1
1 in xix, left side	
1 in xix, right side	2
1 in xxi, right side	1
2 in xx	13
2 in xviii	1
2, right xvii, left xx	1
2, left xvii, right xx	1
2, right xx, left xxi	1
3, right and left xx, right xxi	1
3, left xviii, right and left xx	1

	Number of specimens.
1. Mushroom glands present, no prostates or ducts— <i>contd.</i>	
3, right and left xvii, right xix	1
4, right xvii, xviii, x, ix and xx	1
5, left xvii, xx, xxi and right xviii, xix	1
5, right xvii, xviii, xix, right and left xx	1
8, paired in xvii, xviii, xix and xx	1
8, paired in xvii, xviii, xx and left xix, right xxi	1
2. Prostatic ducts with or without prostate, no mushroom glands.	
1 pair ducts and prostates, xx	5
1 duct and prostate, left xx	2
1 duct and prostate, right xx	1
1 duct and prostate, left xxi	3
1 duct and prostate, right xix	3
1 duct and prostate, left xix	1
1 pair ducts and prostates, xxi	1
1 pair ducts and prostates, xix	1
1 duct, left xxi	1
3. Mushroom glands and prostatic ducts, with or without prostates.	
1 gland right xx, prostatic duct right xxi	1
1 gland left xx, duct and prostate right xx	1
1 gland right xx, duct and prostate left xx	1
1 gland right xx, paired prostates and ducts in xxi	2
2 glands in xx, prostate and duct left xxi	1
2 glands in xx, prostate and duct right xx	1

In the last specimen mentioned above, the prostatic duct passes into the soft tissues of the head of the mushroom gland rather than into the parietes.

One specimen with a genital marking on the left side of xx has on the parietes just dorsal to the marking an irregular clump of whitish tissue into which the vas passes but there is no prostatic duct or the prostate.

B.

The worms mentioned in A may be regarded as intermediate between *insolita* and *centralis*. Three specimens have been found that may possibly be regarded as intermediate between *typica* and *centralis*. The characteristics of these worms are briefly summarized below.

1. Four pairs of mushroom glands in xvii-xx. Paired seminal vesicles in xi and xii, testis sacs in x and xi, paired testes and male funnels in v-viii.
2. Four pairs of mushroom glands in xvii-xx. Paired seminal vesicles in xii, paired testes and male funnels in v-xi, normal spermatheca in vii on right side. No testis sacs.
3. Four pairs of mushroom glands in xvii-xx, one gland in xxi on the right side. Single seminal vesicle in xii on the right side. Paired testes and male funnels in v-xi. Single testis sac in xi on the right side. Septum 8/9 thickly muscular.

The determination of the systematic status of the various forms just described is a peculiarly interesting and puzzling problem. Stephenson (1929) regards the variety *centralis* as a normal hermaphrodite form from which secondarily bisexual male (*typica*) and female (*insolita*) forms have diverged. Some objections to considering the varieties *typica* and *insolita* as secondarily bisexual forms have already been mentioned (Gates 1932, p. 388). To furnish a basis for further consideration of this problem large series of the varieties *typica* (1), *centralis* (2), *insolita* (3)

and of the intermediate forms (4) were examined. In the course of this examination special attention was devoted to variation both of vegetative and reproductive structures. Some of the results of this examination are indicated in the table below. Variation in the testes and male funnels of v-viii of *typica* and of the prostates and their ducts and of the mushroom glands is so great that it has not been practicable to include these in the table. Indications of the extent of this variation are given in the descriptions of these two groups of forms.

The examination of the four series has supported the objections previously raised against Stephenson's interpretation. Thus for instance, spermatozoa were found in only two of the supposed male forms but were found in every one of the supposed female forms while normal ovaries and ova were found in every one of the supposed male forms. The Pickford-Stephenson thesis of the evolution of secondary bisexuality must obviously be discarded in this connection at least.

Referring again to the results of the examination of the four series as indicated in the table, the following points should be noted. There is no variation so far as the presence or absence of the oesophageal collar is concerned while the variation with regard to the hearts of ix, xi-xiii and the beginning of the intestine is small, certainly no greater than is likely to be found in any other Burmese *Pheretima*. Furthermore there is no variation with regard to the normal gonads (*i.e.*, in x, xi and xiii) and the normal (*i.e.*, in x and xi) spermiducal and oviducal funnels. There is, on the contrary extensive intraspecific or intravarietal variation with regard to structures that may be called secondary reproductive organs—structures which, in contrast to those just mentioned, are not present in very immature worms but which develop late, at the onset of maturity. These organs are the prostates and their ducts, the spermathecae, the seminal vesicles and the mushroom glands. But it is just these structures that will be affected by pre-maturity parasitism if parasites can produce abnormalities as has been suggested elsewhere in this as also in the preceding paper. Is there then any evidence to indicate that the development of secondary reproductive structures in *P. anomala* may be influenced by parasitic infestation?

	I	II	III	IV
Intestine begins in xiv .	2	..	..	..
Intestine begins in xv .	244	130	250	65
Intestine begins in xvi .	4	..	.	
Oesophageal collar present	250	130	250	65
Last pair of hearts in xiii	247	129	249	65
Right heart of xiii lacking .	1		..	
Left heart of xiii lacking	2	1	1	..
Paired hearts belonging to ix	?	5	10	1
Single heart of ix on left side	?	64	117	33
Single heart of ix on right side	?	61	123	31
Paired testes and male funnels in x and xi	250	130	250	65
Testis sacs of centralis type .	..	130	250	65
Spermatozoa in (testis sacs of) x and xi .	2	130	250	65
No spermatozoa .	248	..	..	..
No seminal vesicles	187		..	..
Seminal vesicles paired in x . . .	1	..	..	..

	I	II	III	IV
Seminal vesicles paired in xi	5	..	..	..
Seminal vesicles paired in xii	25	..	..	..
Seminal vesicles paired in xi and xii	19	129	250	65
Single seminal vesicle in xi	2	*1	..	..
Single seminal vesicle in xii	10	..	..	..
Seminal vesicles paired in xiii	1	..	..	..
Paired ovaries and oviducal funnels in xiii	250	130	250	65
Three pairs of normal spermathecae	..	130	249	65
Extra spermatheca in ix on the right side	..	..	1	..
Anteriormost pair of spermathecae lacking	..	..	1	..

I=Variety *typica*. II=Variety *centralis*. III=Variety *insolita*. IV=Intermediate forms.

* This specimen has, however, a pair of seminal vesicles in xii.

? Information not available owing to the notes having been lost.

In the series of *centralis* one specimen has a vesicle on the right side, but only about half the normal size of a seminal vesicle. Another specimen has a vesicle in xii on the right side of about half the normal size.

In the *insolita* series there is one specimen with a half-sized vesicle in xi on the left side.

In the series of intermediate specimens there is one worm with the vesicles of the left side both half-sized.

Every specimen of the *typica* series has a pair of male funnels belonging to segment ix.

There are paired hearts in xi and xii of every specimen of each series.

Every specimen of series 1 and 2 has a pair of normal prostates and ducts ; prostates and ducts lacking in series 3, present or absent in series 4.

In a series of 250 clitellate specimens of the variety *typica*, 77 worms are heavily parasitized. In these worms the parasites are present in a trophozoite stage, each parasite a small spheroidal or ovoidal body filled with a mass of densely packed minute granules. Each parasite examined contains a single nucleus which is clear and transparent except for a single, opaque and eccentric endosome. The parasites are restricted in almost all of these specimens to the region of segments vii-xiii where they are found on the gizzard, in or on the blood vessels of vii, viii, on the ventral surface of the oesophagus from ix-xiii in the region subtended by the longitudinal oesophageal sheet of tissue (*vide* Gates, 1926, p. 546) and in or on the hearts of xi-xiii. The parasites always appear to be located in a blood vessel or in the wall of a blood vessel, but often the masses of these parasites are so large that the vessel is distorted almost beyond recognition. The gizzard is frequently so covered by these parasites that the surface is not visible at a single point. In some of the most heavily parasitized specimens there is a deposit of black or dark brownish pigment on the septa and (or) on the parietes in the immediate vicinity of the parasitic masses.

Similar masses of parasites have been seen in other series of this variety but no records were kept as to the exact number of parasitized individuals.

In a series of 130 clitellate specimens of the variety *centralis* no parasites were found.

In a series of 250 clitellate specimens of the variety *insolita* there are 38 parasitized individuals. The number of parasites in any one host is not large. The parasites are always in an encysted stage, the cysts scattered throughout the coelom in segments xi-xv and in the region

behind the gizzard segments. The cysts are packed full of spores, rather pseudonavicella-like in appearance but smaller than spores of that type which have been observed in other species. No blood-vessel parasites, such as are present in the variety *typica*, were to be found. The majority of specimens in this series are fully clitellate and were obtained late in the collecting season.

In the series of 65 clitellate specimens of the transitional or intermediate forms, 16 worms have cysts filled with pseudonavicella-like spores in the coelom of the region behind segment xviii. Furthermore each specimen of the series has one or more peculiar parasites in each ovary. The eggs in these ovaries however appear to be normal and are like those in the ovaries of other varieties in which no parasites were noted.

Two of the specimens regarded as intermediate between the varieties *typica* and *centralis* have small masses of *typica* parasites in the blood-vessels on the gizzard.

In a series of 434 clitellate specimens of *insolita* there are 40 worms parasitized¹ as in the first series of this variety. In a third series of clitellate specimens of the same variety (total number not recorded) there are 44 specimens which are parasitized¹ as in the first series. The parasites in all three series in a cyst stage.

The records cited above refer only to macroscopic parasites—trophozoites and cysts—that are readily recognized by the unaided eye or by means of a magnifying glass or the lowest power of a binocular microscope. No search was made in the seminal vesicles, testis sacs, coelom or other structures for microscopic parasites or stages.

Thus out of a total of practically 1,100 specimens of the intermediate forms and of the varieties *typica* and *insolita* (but not including *centralis*) 171 worms or roughly 15 per cent. are characterized by the presence of protozoan parasites in late stages of the life cycle. Earlier stages probably of microscopic size may be present in many other specimens in which case the percentage of parasitized specimens will possibly be much higher than 15 per cent. To be contrasted with this situation is the entire absence of macroscopic parasites in the 130 normally developed worms referred to the variety *centralis*.

There is then a certain amount of evidence to indicate not only that the forms referred to as *centralis* are merely normal individuals of the species while the varieties *typica* and *insolita* comprise merely abnormal individuals but also to indicate that the presence of one type of parasite is associated with one variety, while another type of parasite is associated with the other variety.

Objection may be raised that parasites, in order to bring about the results suggested, must be present at rather early stages and that the presence of parasites, even in trophozoite and encysted stages does not constitute evidence for the presence of parasites in the earthworms at the critical stage, *i.e.*, just at or just before the initiation of the development of the secondary reproductive organs.

¹ In many of these specimens there are considerable masses of cysts in the region of segments xi-xiv or xv.

Unfortunately we have not been able to secure an extensive collection of immature specimens but some 65 specimens of the variety *typica* and 36 specimens of the variety *insolita* were collected at or near Rangoon at the beginning of the rainy season. These worms are quite small, about 40-60 mm., in length and $2\frac{1}{2}$ to $3\frac{1}{2}$ mm. in diameter. The rudiments of the spermathecal pores of *insolita* and of the genital markings of *typica* can just barely be recognized with good magnification and favourable illumination.

In the 65 specimens of the variety *typica* no parasites were found. In 17 of the 36 specimens of *insolita* considerable masses of coelomic parasites in trophozoite and cyst stages were found. These parasites must have been present in the young worms before the initiation of the development of the secondary reproductive organs.

The names *typica* and *insolita* are retained to designate in each case a characteristic forma or facies which can be readily recognized or identified.

***Pheretima birmanica* (Rosa).**

Maymyo, August, K. John, 1 clitellate specimen.

Namkham, September, G. S. Seagrave, 4 clitellate specimens.

Myitkyina, September, L. R. Dudrow, 6 clitellate specimens.

The Maymyo specimen is abnormal. The spermathecal pores are paired in 5/6 and 6/7, a single pore in 7/8 on the right side only. There is a median, female pore on xiii and one on xiv. On the left side the male pore is on xvii. On the right side the male pore is on xviii. The clitellum extends over segments xiii-xv on the left side, over segments xiv-xvi on the right side.

The intestinal caeca extend from xxvii into xxiv on the right side, from xxvi into xxiii on the left side. The intestine begins in xv on the right side, in xiv on the left side. The last heart is in xiii, on the right side.

There is a single seminal vesicle in xii, on the right side; a pair of vesicles in xi, a single vesicle in x on the right side. Septum 9/10 is present on the left side only. There is a single testis sac on the anterior face of 9/10, a pair of testis sacs on the anterior face of 10/11; a single testis sac on the anterior face of 11/12, on the right side.

The right oviducal funnel and ovary are in xiii. The left oviducal funnel and ovary are in xii.

***Pheretima bournei* (Rosa).**

Kwachi, September, G. E. Blackwell, 1 clitellate specimen.

The setal numbers of this specimen are as follows:—spermathecal on vi—7, on vii—19; male on xvii—25, on xviii—15, on xix—23; on segment xx—55.

The genital markings are rather small, circular areas. The pre-clitellar genital markings are three pairs, one marking just posterior and very slightly median to each spermathecal pore. Each of these markings is delimited by a slight but definite furrow. The postclitellar markings are two pairs; two markings just anterior to the setal circle

of xviii and two just posterior to the setal circle of xviii, the two markings of a side just median to the male pore. There projects into the coelom over each of the preclitellar genital markings and probably also over each of the postclitellar markings an irregular mass of softish (glandular ?) tissue.

***Pheretima campanulata* (Rosa).**

var. *typica* (Rosa).

Pogu Yomas, August, G. R. Anderson, 8 acitellate and 4 clitellate specimens.

Kamaungthwe River, August, W. D. Sutton, 103 specimens.

Minnie Bay, Andaman Islands, September, C. Amirthalingam, 1 clitellate specimen.

Mt. Harriet, Andaman Islands, September, C. Amirthalingam, 1 clitellate specimen.

Toungoo District-western, September, G. E. Blackwell, 35 specimens.

Leiktho Circle, September, G. E. Blackwell, 122 specimens.

Thandaung, September, G. E. Blackwell, 84 specimens.

Akyab, September, Bruce Taw, 2 clitellate specimens.

Kalaw, September, Saya Ah Sou, 3 clitellate specimens.

Namkham, September, G. S. Seagrave, 2 clitellate specimens.

Kamaungthwe River, October, W. D. Sutton, 86 clitellate specimens.

Bassein, October, K. John, 7 clitellate specimens.

Padali, October, Bruce Taw, 2 clitellate specimens.

Hitherto the copulatory chambers have not been found in an everted condition. Two of the western Toungoo specimens have the copulatory chambers everted as porophores. Each porophore is a thick, short, whitish, protuberant column from the ventral face of which there project slightly the small, greyish papillae, and from near the median margin and much more conspicuously the trifid penial body.

Seven specimens from Koopra probably belong to this variety but are all abnormal; prostates and prostatic ducts lacking and spermathecae rudimentary or abnormal. Five specimens from the western portion of the Toungoo District and 3 specimens from Mala probably also belong to this variety but have abnormalities similar to those of the Koopra specimens.

var. *meridiana* Gates.

1932. *Pheretima campanulata meridiana*, Gates, *Rec. Ind. Mus.* XXXIV, p. 457.

Kamaungthwe River, August, W. D. Sutton, 205 clitellate specimens.

Toungoo District-western, September, G. E. Blackwell, 40 clitellate specimens.

Taungyi, September, Saya Ba Te, 2 clitellate specimens.

Kamaungthwe River, October, W. D. Sutton, 72 clitellate specimens.

var. *penetralis* Gates.

1931. *Pheretima campanulata penetralis*, Gates, *Rec. Ind. Mus.* XXXIII, p. 435, figs. 46-47.

Kamaungthwe River, August, W. D. Sutton, 29 clitellate specimens.

Kalaw, September, Saya Ah Sou, 7 clitellate specimens.

Namkham, September, G. S. Seagrave, 1 clitellate specimen.

Toungoo District-western, September, G. E. Blackwell, 24 clitellate specimens.

Loikaw, September, G. E. Blackwell, 1 clitellate specimen.

Leiktho Circle, September, G. E. Blackwell, 14 clitellate specimens.

Thandaung, September, G. E. Blackwell, 8 clitellate specimens.

Taungyi, September, Saya Ba Te, 3 clitellate specimens.

Bassein, October, K. John, 2 clitellate specimens.

Kamaungthwe River, October, W. D. Sutton, 102 clitellate specimens.

Worms referred to the variety *penetralis* in this paper not only lack parietal glands and markings but also the accessory glands on the spermathecal duct, aside from the two which are characteristic of the species.

var. *rugosa* Gates.

1926. *Pheretima houletti rugosa*, Gates, *Ann. Mag. Nat. Hist.* (9) XVII, p. 459. figs. 9-10.

1932. *Pheretima rugosa*, Gates, *Rec. Ind. Mus.* XXXIV, p. 398.

Pegu Yomas, August, G. R. Anderson, 2 clitellate specimens (athecal).

Falam, August, J. H. Cope, 4 clitellate specimens (athecal).

Toungoo District-western, September, G. E. Blackwell, 75 clitellate specimens (62 athecal, 13 thecal).

Leiktho Circle, September, G. E. Blackwell, 3 clitellate specimens (athecal).

Thandaung, September, G. E. Blackwell, 1 clitellate specimen (athecal).

Kalaw, September, Saya Ah Sou, 6 clitellate specimens (athecal).

Namkham, September, G. S. Seagrave, 4 clitellate specimens (athecal).

Taungyi, September, Saya Ba Te, 158 clitellate specimens (87 athecal, 71 thecal).

A.¹

Atheal Specimens.

External characteristics.—The length varies from 92-200 mm., the greatest diameter from 4-7 mm. The number of segments varies from 92-140 but the segmental numbers most commonly found are between 115 and 125.

The pigmentation of the dorsum varies from light brownish to dark brownish or brownish red, light reddish (rarely) to dark reddish, or light greyish brown to dark bluish grey.

The setae begin on ii on which segment there is usually a nearly complete circle. There may be a definite midventral break in the setal circles of the preclitellar segments and also of a varying number of post-clitellar segments beginning with segment xvii, xviii or xix, or this break may be lacking on one or the other or both of these regions. On the posterior portion of the body the setal circles are usually closed mid-ventrally. A mid-dorsal break of varying width may or may not be

¹ This section of the paper is based upon a study of an extensive series of collections secured during the past six years from a number of Burmese localities.

present. The ventral setae may be quite noticeably larger than the dorsal setae or only slightly larger. The ventral setae of the anterior-most segments may be regularly or irregularly spaced. Posterior to the clitellum, seta *a* may or may not be conspicuously enlarged and especially protuberant from the parietes, the setae, passing laterally gradually decreasing in size. The midventral setae, especially anterior to the clitellum and on a varying number of segments just behind the clitellum may be modified; straight and ornamented or sigmoid and ornamented. The number of the setae on segment xx is quite variable as is shown in the table below.

	Number of setae on segment xx.				Number of specimens.
	44	.	.	.	1
	46	.	.	.	1
	47	.	.	.	1
	50	.	.	.	1
	51	.	.	.	2
	55	.	.	.	1
	56	.	.	.	1
	58	.	.	.	1
	59	.	.	.	1
	60	.	.	.	2
	61	.	.	.	1
	62	.	.	.	1
	65	.	.	.	1

There are no empty setal pits on segment xx of any of these worms to indicate that setae have recently dropped out. The number of male setae on xviii is relatively less variable, the extent of variation being about that normally found.

Locality.	4	5	6	7	8	9	10	11	Number of male setae.
Taungyi .		1	7	34	27	16	2	..	
Bhamo, etc.	1	..	15	24	72	39	31	12	
Toungzoo	..	12	27	11	9	3	..	..	
	1	13	49	69	108	58	33	12	Totals.

The first dorsal pore or definitely pore-like marking is in 11/12 on all but one of the specimens. In five specimens there is a very small, blackish dot in the mid-dorsal line in 10/11, but this can hardly be called pore-like. The first functional dorsal pore is in 11/12 in all except 24 specimens, in 23 of which there is a pore-like marking—but doubtfully functional—in 11/12; the first functional pore in 12/13. In the 24th specimen the first definitely functional pore is in 13/14 with a doubtfully functional, pore-like marking in 12/13.

The clitellum is annular, extending from 13/14 to 16/17 in all specimens; dark reddish, dark brownish, light yellowish or light brownish. Dorsal pores and intersegmental furrows are lacking, but setae are pro-

sent. The clitellar setae are of various sizes, the outer tip may or may not be bifid as previously illustrated (Gates, 1926, p. 461). The clitellar setae are usually characterized by more or less regular, completely circumferential furrows which produce a curiously abnormal appearance. The clitellar setae are not protuberant from the epidermis as a rule and may be exceedingly difficult to see, except with high magnification and brilliant illumination. The aperture of the setal follicle is usually at the bottom of a minute concavity. The concavities are in three rows on the clitellar segments and are readily visible and can almost always, in these worms, be taken as indications of the presence of clitellar setae, although this is not necessarily so in other species.

There is a single female pore on xiv.

There are no indications of spermathecal pores on any of these specimens.

The apertures of the copulatory chambers are small and usually somewhat rounded as in *P. houlleti* and *P. campanulata*.

There are no genital markings.

Internal anatomy.—A rudiment of 8/9 is recognizable in each specimen, attached to the parietes only ventrally and to the ventral surface of the oesophagus just behind the gizzard. No trace of 9/10 was found. Septa 5/6-7/8 are thickened; they may all be slightly muscular and translucent, or may all be thickly muscular and opaque or the last two may be quite noticeably thicker than the first. Septa 10/11-12/13 are slightly muscular, usually translucent; rarely 10/11-11/12 are opaque.

The intestine begins in xv. The intestinal caeca are simple, extending from xxvii into the region of xxi-xxiii. The margins are usually indented by the septa through which the caeca pass, in addition to which there may be one or two other very slight indentations of the dorsal or ventral margin.

The last pair of hearts is in xiii in each specimen. The commissures of ix-xiii all pass into the ventral blood vessel. The single commissure of ix is on the right or on the left side in approximately equal numbers of worms. There is a pair of commissures belonging to ix in one specimen.

There are masses of nephridia and of blood glands in v and vi. There are lymph glands from xxviii or xxix posteriorly.

The testis sacs of x and xi may be unpaired and median or paired. When unpaired the anterior margin of a sac is bilobed. The seminal vesicles are always small though slightly variable in size. The vesicle is in two parts:—a flattened, leaf-like ventral portion with smooth ventral and lateral margins, the dorsal margin incised or depressed; in the incision or depression an avoidal, primary ampulla. The ampulla may be larger than the ventral portion, of about the same size, or quite definitely smaller. The seminal vesicle may be flat against the posterior face of a septum or the median portion of the vesicle may be on the side of the oesophagus, reaching in rare cases to the posterior septum of the segment.

There are paired, stalked, minute, club-shaped pseudovesicles in xiii and xiv.

The prostates vary considerably in size. When well developed, they extend through segments xvi-xx but may be limited to xvii-xix;

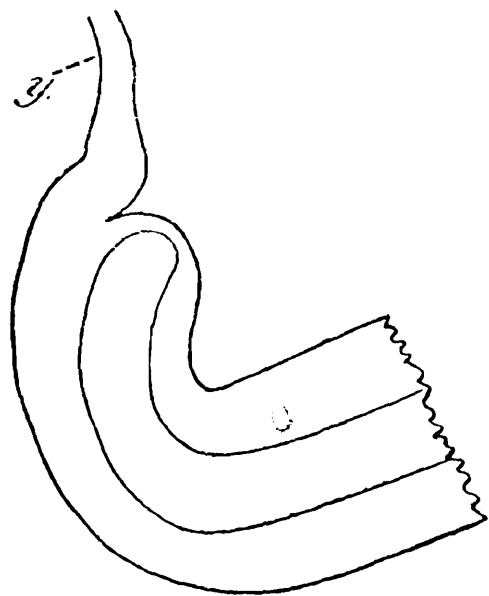


FIG. 18.—*Pheretima campanulata rugosa* Gates.

Ental end of prostatic duct from specimen without prostates $\times$ ca. 66. y=posterior end of vas deferens.

Rarely prostates are lacking. In worms without prostates the prostatic ducts may be present and characteristically developed. The ental end of a prostatic duct from a worm without prostates is shown in the figure. The prostatic ducts may also be lacking. In worms without prostatic ducts there are ordinarily copulatory chambers with the usual stalked glands which may project conspicuously into the coelom or may not be visible until after removal of the longitudinal musculature from the parietes of a dissected specimen. In a very few specimens there are no copulatory chambers; the setal circle of xviii is interrupted at the site of the copulatory chamber aperture.

In the copulatory chamber there are several small papillae and a more conspicuously protuberant columnar body, the terminus of this body may be pointed. On the ventral end of the column there are usually 4, occasionally 5-6 papillae similar to those on the wall of the chamber. The arrangement of these papillae is variable but almost always one is much more conspicuously protuberant from the column, either ventrally or laterally, than the others. In general this columnar papillaphore resembles the penial body of *P. campanulata typica* or *penetrans*, but is usually smaller, often much smaller. The appearance of the papillaphore is so variable that all that can be said about it is that it is never exactly like the penial body of *P. c. typica* or *meridiana*, but more like that of the former than that of the latter.

The ovaries and oviducal funnels are present in xiii and appear to be normal. Removal of the longitudinal musculature from the coelomic face of the parietes of dissected specimens entirely fails to reveal any rudiments or traces of the spermathecae.

rarely confined to xviii and more or less rudimentary. The prostatic ducts are 5-7 mm. in length, bent usually into a C or U-shape, the middle portion of the duct muscularly thickened. The duct passes into the lateral face of the copulatory chamber. The copulatory chambers project more or less conspicuously into the coelom. On the posterior face of each copulatory chamber there are several stalked glands, usually three to five, while on the anterior face there are further glands, ordinarily 2-3 more than on the posterior face. There are no penial setae in the copulatory chambers of any of these specimens.

Rarely prostates are lacking. In worms without prostates the prostatic ducts may be present and characteristically

B.

Thecal Specimens.

Each of these worms is characterized by one or more spermathecal pores and a similar number of more or less rudimentary spermathecae but is otherwise like the athecal worms.

The male setae of xviii of these specimens are 6-11 as shown below.

Locality.	4	5	6	7	8	9	10	11	Number of male setae.
Taungyi . .	..	..	13	27	21	5	2	3	
Toungoo . .	..	..	2	6	5	2	..	..	
TOTAL .	0	0	15	33	26	7	2	3	

The variation in number of male setae on xviii of thecal and athecal specimens is indicated below.

Number of male setae.	Number of specimens.
4 .	1
5 . . .	13
6 . . .	64
7 . . .	102
8 . . .	134
9 . . .	65
10 . . .	35
11 . . .	15

The number of spermathecal setae on vii or on viii was determined on as many specimens as possible :—vii—13, 18, 15, 20, 16, 16, 16, 15 ; viii—19, 20, 19, 15. These numbers are probably not useful for systematic purposes as the spermathecal pores are often asymmetrical with relation to the midventral line, *i.e.*, one of a pair of pores is more lateral than the other pore.

The spermathecal pores are transverse slits in the intersegmental furrows 6/7-8/9 as in *P. houlleti* and *P. campanulata*. On 102 specimens there are 166 spermathecal pores as shown in the table below.

Locality.	6/7.		7/8.		8/9.		Specimens.
	l.	r.	l.	r.	l.	r.	
Bhamo and Kengtung	1	1	5	5	7	7	18
Toungoo . . .	3	0	7	4	1	4	13
Taungyi	25	9	45	39	1	2	71
TOTAL.	29	10	57	48	9	13	102

Genital markings are present on a few of the Taungyi and Toungoo specimens. These markings are very small, round areas of greyish translucence in the epidermis ; each marking the external indication of the presence of a stalked gland, the duct of which passes into the parietes as indicated by the marking rather than into the spermathecal duct. These markings are always in the immediate vicinity of a spermathecal pore, one or two markings near a pore, just in front of, just

behind, or just median to the pore, on the anteriormost or posteriormost margin of the segment concerned. In size and appearance these markings appear to be identical with those of *P. campanulata typica*.

Five specimens have no prostate on one side ; in two of these worms a prostatic duct is also lacking. Otherwise prostates and prostatic ducts are present.

The spermathecae are always more or less rudimentary. The characteristics of the spermathecae of these specimens are briefly indicated below.

- a. A small, whitish, hollow cone of tissue over the spermathecal aperture, the cone covered over by the longitudinal musculature.
- b. Similar to *a* but the cone slightly larger, either just visible between the strands of longitudinal muscles or projecting slightly into the coelom.
- c. Cone of tissue projecting slightly into the coelom with stalked glands passing into the cone in the parietes. There may be one of these glands passing into the anterior face or into the posterior face, or two glands, one to the anterior face and one to the posterior face.
- d. Cone projecting into the coelom, no stalked glands but 1, 2, 3 or 8 rounded knobs on the coelomic portion of the cone.
- e. As in *c* but with one or two rounded knobs on a coelomic, filamentar prolongation of the tip of the cone.
- f. Cone projecting into the coelom, the tip of the cone continued dorsally as an elongated, solid filament.
- g. Cone projecting into the coelom and attached thereto a small, but definitely zigzagged diverticulum.
- h. A whitish column projecting quite conspicuously into the coelom, the ental end of the column pointed or bluntly rounded. The column is of about the same size as a spermathecal duct and is probably roughly equivalent to a duct.
- i. Duct with or without a rudimentary ampulla at its ental terminus, with or without a definitely zigzagged diverticulum.
- j. Duct with a short finger-like diverticulum.
- k. Duct with a medium-sized or large ampulla, no diverticulum, one or two stalked glands to the duct.
- l. Duct short and tough, an elongate thin-walled, transparent ampulla, with or without one or two stalked glands to the duct.
- m. Duct short, ampulla small, one stalked gland to the posterior face of the duct in the parietes.
- n. Duct, ampulla, two stalked glands—one to the anterior face, the other to the posterior face of the duct. With or without a very short, straight, tubular diverticulum.

Parietal glands with stalks passing through the musculature to the genital markings are present in a few of the Taungyi and Toungoo specimens, associated with *b*, *g*, *l*, *m* and *n*.

In five specimens having a zigzagged spermathecal diverticulum there is within the diverticulum an iridescent whitish material, the iridescence is probably due to the presence of spermatozoa.

Remarks.—The percentage of thecal individuals of the variety *rugosa* varies considerably from one locality to another. A collection of several hundred individuals of *rugosa* from Rangoon contains only two worms with spermathecal pores ; of the Toungoo batch less than one-fifth are thecal ; while in the Taungyi collection the number of thecal specimens is nearly as large as the number of athecal specimens. On the whole, however, thecal specimens have been found much less frequently than athecal worms.

C.

Four worms from Toungoo with no copulatory chambers and lacking spermathecae and spermathecal pores are something of a systematic

puzzle. Leaving out of consideration the structures at the ectal end of the male deferent apparatus these worms cannot be distinguished from athecal specimens of *rugosa*. The male setae on xviii are 6-9.

In the setal circle of xviii on each side where the aperture of the copulatory chamber should be located there is a break or gap where setae are lacking. The region of the gap may be smooth and glistening, roughened, or very slightly invaginated.

The vas deferens becomes very thin and filamentous in xvi or xvii and cannot be traced further posteriorly.

D.

The name *rugosa* was first used (Gates 1926, p. 459) as a varietal designation for certain athecal worms found in Rangoon. These worms were characterized by the presence in the clitellar segments of setae with peculiar bifid tips. Setae with somewhat similar tips were also found in the clitellar segments of two other (thecal) forms at the same locality. As clitellar setae of this type were known, at that time, to characterise only *P. houlleti* all three forms—athecal and thecal—were placed provisionally as varieties of *P. houlleti*. Later (Gates, 1927) one of these varieties, *P. h. tortuosa*, was shown to be identical with Rosa's *P. campanulata*. With the separation of *P. campanulata* from *P. houlleti* some of the reasons for the inclusion of *rugosa* in *P. houlleti* disappeared. However, it was not quite clear as to just what *rugosa* actually was and so it was allowed to remain as a variety of *P. houlleti*. As additional specimens of *rugosa* were collected and studied it became increasingly evident that *rugosa* was at least as near, if not actually nearer, to *campanulata* than to *houlleti*, but inasmuch as the significance of this relationship was not clear, the worms were referred to simply as *P. rugosa*, as in the preceding paper (Gates 1932, p. 398).

The reduction or absence of prostates and the lack of spermathecae in the early specimens together with the curious furrowing of the clitellar setae seemed to indicate that the worms with these conditions were to be regarded simply as abnormal specimens of either *P. houlleti* or *P. campanulata* (Gates 1926, p. 157). *P. rugosa* was, however, found to be, in numerous localities, nearly as common as either *P. houlleti* or *P. campanulata*, or occasionally in greater numbers than one or the other. (For a similar instance note numbers of *P. campanulata* and *rugosa* from Taungyi in this year's collection). It hardly seemed at that time that a form about as common as or even more common than the possible normal form could be regarded as abnormal. Furthermore, the curious mixture of *houlleti* and *campanulata* characteristics in *rugosa* required explanation. It may of course be possible that *rugosa* is a hybrid, *P. houlleti* $\times$ *P. campanulata*; the two species are almost always found together in Burma. There is, however, no evidence available to show that earthworm species hybridize naturally and certainly no evidence for this particular suggestion has been found during the last eight years.

At this point it may be emphasized again that *P. houlleti* and *P. campanulata* are very similar in many ways, so much so that they have

been confused even quite recently. If the characteristics which these two species have in common be left out of consideration the similarities between the athecal forms of *rugosa* and *P. houlleti* may be stated as follows :—

1. Absence of penial setae in the copulatory chambers.
2. Size and shape of the seminal vesicles.
3. Number of male setae on xviii : (4-11 in *rugosa*, 5-12 in *houlleti*, 11-16 in *campanulata typica*, 9-13 in *campanulata penetralis*).

On the other hand the athecal forms of *rugosa* resemble *P. campanulata* in the following characters :—

1. Position of the first dorsal pore in 11/12 or posteriorly.
2. Number of stalked glands on the anterior face of the copulatory chamber.

The following characters may be regarded as peculiar to *P. rugosa* :—

1. Furrowing of the clitellar setae.
2. Characteristically variable papillaphore in copulatory chamber.
3. The presence ordinarily of more than two stalked glands on the posterior face of the copulatory chamber.

No definite evidence has been found to disprove the specific identity of the thecal and athecal forms referred to *rugosa* while the similarity of the copulatory chambers and the associated structures in the two groups of forms may be regarded as definite evidence for such identity. If the thecal and athecal forms are taxonomically identical then to the second list above there may be added the following :—

3. Presence of stalked glands in the spermathecal region with ducts passing through the parietes to genital markings.
4. Biglandular apparatus on the spermatheca, the duct of one gland passing to the anterior face, the duct of the other gland passing to the posterior face of the spermathecal duct or its rudiment.
5. The looping of the diverticulum in a regularly zigzag fashion.

In this connection it may be pointed out that in normal specimens of *P. campanulata* on the spermathecal duct there is always a posterior stalked gland which is always lacking in *P. houlleti*, and that genital markings may be present in *P. campanulata* but are never found in *P. houlleti*.

Furthermore, there are in this year's collections several specimens which can be definitely identified as *P. campanulata typica*. In each of these worms some (but not all) of the spermathecae are rudimentary and similar to the spermathecae of the thecal individuals of *rugosa*. Rudimentary spermathecae of the types characteristic of *rugosa* (a-n) have not been found in *P. houlleti*.

Finally the size of the seminal vesicles cannot be regarded as very important in this connection. The vesicles of immature specimens of *P. campanulata* are often much like those of clitellate specimens of *P. houlleti* and of *rugosa*, both in size and general appearance. The vesicles of *P. rugosa* can be regarded as retained in the clitellate specimens in their juvenile condition. The absence of penial setae is also probably not of importance in this instance, penial setae are always lacking in one variety of *P. campanulata*, i.e., var. *meridiana*. The transverse

furrowing of the clitellar setae can be regarded as produced by irregularities in secretion associated with the abnormal conditions of the spermathecae and the male deferent apparatus.

The worms hitherto designated as *P. houlleti rugosa* or *P. rugosa* are accordingly regarded now as abnormal specimens of *P. campanulata* var. *typica* and possibly also var. *penetrans*. The designation *rugosa* is, however, retained for the rather characteristic forma or facies which is of such frequent occurrence.

E.

The striking similarity, almost identity of the "abnormalities" of worms from so many widely separated localities indicates, that the agency responsible for the production of the abnormalities is common to all the worms. There is some evidence in the worms themselves as to one agency that may be the cause of the development of the abnormalities.

In every one of the Taungyi specimens of *rugosa* segments v and vi are crammed full of masses of small cysts. Six of the Toungoo specimens have masses of exactly similar cysts in segments v and vi. Fifty-four of the Toungoo specimens have cysts scattered throughout the body in the coelom from segment xvii, xviii or xix to the tail. In the remainder of the Toungoo specimens no cysts were found in the coelom.

The cysts from segments v and vi are variously shaped; spheroidal, ovoidal, disc-like and circular or oval in outline, flask-shaped or elongately spindle-shaped. The flask-shaped cysts may be short with the neck of about the same length as the bulbous portion, or the cysts may be much larger with the neck portion five to six times the length of the bulbous portion. The walls of the cysts are thin and transparent, the lumen within the cyst filled with short, spindle-shaped spores.

At one or both poles the cysts taper off gradually to a sort of filament, the tapering portion is opaque, apparently solid and without spores. The ends of most of the filaments are jagged and appear to have been broken. The ovoidal, spheroidal and discoidal cysts have terminal filaments at one or both poles. The elongately spindle-shaped cysts have a terminal filament at each pole. The flask-shaped cysts have terminal filament only at the end of the neck. One perfect cyst of the flask-shaped type was found. The bulbous portion is about twice the width of the neck, the latter about six times the length of the bulbous portion, both neck and bulb are filled with spores. The neck narrows gradually to a fine filament, the end of the filament slightly swollen and with a cluster of closely crowded sucker-like structures. The spores of this cyst are shortly spindle-shaped. At each pole of a spore is a clear space within which there is an ovoidal body like a nuclear endosome. The central portion of the spore is occupied by a much larger, dark, spheroidal body.

The cysts from the coelom behind xvii are spheroidal, ovoidal or discoidal. The transparent wall of the cyst is here thicker than in the case of the spindle-shaped or flask-shaped cysts of v and vi. The cavity of a cyst is occupied by a dark mass of fine granules. No nuclear structures or spores were found though a number of cysts were ruptured and their contents examined.

In a batch of 116 specimens of *P. rugosa* collected in Rangoon during the month of October, 1932, there are 37 specimens with masses of cysts in v and vi. These cysts are like the cysts in v and vi of the Toungoo-Taungyi specimens. In 40 further specimens there are masses of these cysts in v and vi and in addition cysts throughout the coelom of the rest of the body behind vi excepting only segments xi-xiii or xiv. The cysts from the postclitellar region are similar in appearance to the postclitellar cysts of the Toungoo specimens, but in the Rangoon worms many of the cysts examined are filled with pseudonavicella-like spores. One cyst is filled with soft round bodies, presumably zygotes at a stage antecedent to that of the formation of a spore wall. Some of the spindle-shaped cysts have a transverse partition so that the spores are contained within two distinct chambers.

In the remaining 39 Rangoon specimens there are no conspicuous masses of cysts as in the other worms but isolated cysts are scattered here and there in the posterior portion of the body of nearly every one of these specimens.

Numbers of normal specimens of *P. campanulata typica* and of *pene-tralis*, collected from the same localities and at the same time as the infested specimens of *rugosa*, were carefully examined in an attempt to find the *rugosa* cysts but without success.

***Pheretima carinensis* (Rosa).**

var. *mota* Gates.

1932. *Pheretima carinensis mota*, Gates, *Rec. Ind. Mus.* XXXIV, p. 449.

Mawchi, September, G. E. Blackwell, 1 specimen.

Leiktho, September, G. E. Blackwell, 20 specimens.

Thandaung, September, G. E. Blackwell, 41 specimens.

The genital markings of the Leiktho and Thandaung worms are unusually small, with a stunted appearance, and even when fully developed almost restricted to the anterior half of segment xviii, just passing beyond the setal circle of that segment. On four specimens the presetal locations of the markings are indicated by very small rudiments. The genital markings of the Mawchi specimen are normal in appearance and fully developed.

No parasites were found in the Mawchi specimen. Every one of the Leiktho and Thandaung worms is heavily infested with parasites as in the specimens of the variety *pinguis* (*vide infra*). The nerve cord cysts are, however, fewer in these worms, more widely separated from each other and peripherally located, *i.e.*, only at the margin of the nerve cord. In 13 of the worms the larger, transparent nematodes were not found.

var. *pinguis* Gates.

1932. *Pheretima carinensis pinguis*, Gates, *Rec. Ind. Mus.* XXXIV, p. 451.

Toungoo District-western, September, G. E. Blackwell, 3 specimens.

Leiktho, September, G. E. Blackwell, 19 specimens.

Thandaung, September, G. E. Blackwell, 20 specimens.

Every one of these worms is heavily infested with parasites which are present in four definite regions. (1) Coelom of segments vii-xiv. In this region in each of the worms there are small nemas with a bluntly rounded bulbous swelling of the posterior end on which is a spine. All the nemas examined are ovigerous. (2) On or near the pharyngeal bulb. In this region of each specimen there are nemas of about the same diameter but slightly longer than those in (1). These nemas lack the bulbous swelling of the posterior end and have peculiar, barrel-shaped ova. All nemas examined are ovigerous. (3) Posterior to segment xviii coelom or muscular layers. Larger nemas (6-7 mm., in length) with a transparent, glassy appearance. These nemas were not found in five worms. In one worm a single nema was found anterior to segment xviii, buried in the musculature in the region of segment ix. (4) Nerve cord—cream coloured cysts. These cysts are present in numbers in each worm. In some individuals the cysts are crowded so closely together for a space of several segments that no trace of nerve cord tissue can be recognized therein.

Worms referred to this variety may be nothing more than individuals in which the development of the genital markings has been inhibited by the presence of the parasites.

var. **Vara**, var. nov.?

Leiktho Circle, September, G. E. Blackwell, 10 achitellate and 5 clitellate specimens.

Thandaung, September, G. E. Blackwell, 1 clitellate specimen.

Although the clitellar glandularity is indicated on the specimens noted as clitellate, it is not as well developed as in some other varieties. These "clitellate" specimens may not be fully mature. Each of the worms appears to have lost some portion of the tail region, at some time previous to the collection.

The setal numbers of several specimens are indicated below.

vii.	viii.	xviii.
15	16	20
16	18	22
15	17	20
16	17	18
15	18	20

The male pore discs are definitely posterior to the transverse setal line of xviii. Each disc is transversely oval to almost round. The male pore is a minute but open aperture at the centre of the disc in a greyish concavity. The latter is surrounded by a very slightly raised, whitish rim, external to which is a definite but slight circumferential furrow.

The genital markings of each specimen are two pairs. The anterior pair is located on 17/18, the centre of each marking about in line with or very slightly median to the centre of the male pore disc. Each marking is a transversely oval, greyish, concave area, slightly larger than a male pore disc. The second pair of markings is in the setal circle of

xviii. Each marking is transversely oval to round and like a male pore disc in appearance but slightly smaller or definitely smaller and without a central pore. The marking is lateral to the male pore disc.

Setae are lacking on each side on xviii from a point just lateral to the setal circle marking to a point just median to the median margin of the male pore marking.

Twelve specimens were opened. Projecting into the coelom over each of the anterior pair of genital markings is a flattened glandular mass. A smaller mass of similar tissue may project into the coelom just over each of the lateral markings of xviii, or the tissue dorsal to these markings may be buried in the parietes. The prostatic duct passes into the parietes in contact with the median margin of the tissue dorsal to the lateral markings. Deep in the parietes there is similar tissue around the ectal end of the prostatic duct.

The location of the male pore on the posterior genital markings was confirmed by removing the longitudinal musculature from the dissected specimens and tracing the prostatic duct through the parietes.

The postsetal location of the male pores is a characteristic of Rosa's specimens (*vide* variety *typica* in Gates, 1932, p. 447). Possibly all worms with such postsetal male pores should be referred to one variety. The present specimens, however, have genital markings in slightly different locations. The anterior markings of the present specimens correspond to the markings of *typica* but are displaced anteriorly. The male pore discs correspond roughly to the male pore areas of Rosa's specimens while the lateral genital markings correspond to the lateral halves of male pore areas of the variety *sectilis*. As previously indicated there is some reason for believing that the absence of genital markings, as in the variety *pinguis*, may be due to the action of parasites. Possibly the diversity in location and size of genital markings may also to some extent be brought about as the result of heavy infestation by parasites.

In six worms nemas were found in the coelom of segments vii-xxix. These nemas have a swollen and bulbous end with a single spine thereon.

APPENDIX TO *P. carinensis*.

Mawchi, September, G. E. Blackwell, 2 clitellate specimens.

Thandaung, September, G. E. Blackwell, 1 clitellate specimen.

Koopa, September, G. E. Blackwell, 1 clitellate specimen.

The male pore areas of these worms are in the setal circle of xviii, each area transversely elongated with pointed ends.

The genital markings of the Mawchi specimens are a pair of areas on 16/17 reaching towards or nearly to the setae of xvi and (or) xvii. Each marking is slightly longer in a longitudinal direction than transversely.

The specimen from Thandaung has in addition to the markings on 16/17 a pair of transversely oval areas on 19/20 like the genital markings on 17/18 in the variety *vara*.

The Koopa worm has a single pair of markings on 17/18 reaching antero-posteriorly nearly to the setae of xvii and xviii.

A large number of nemas were found in the coelom of segments viii-xx of the Koopra specimen. No nemas were found in the Mawchi-Thandaung specimens.

***Pheretima compta* Gates.**

1932. *Pheretima compta*, Gates, *Rec. Ind. Mus.* XXXIV, p. 511, fig. 28.

Mawchi, September, G. E. Blackwell, 17 acitellate specimens.

External characteristics.—The greatest length is 110 mm. The setal numbers of five specimens are indicated below.

vi.	vii.	viii.	xviii.
35	39	41	29
36	38	41	28
37	40	42	31
31	32	34	25
31	31	34	21

The first dorsal pore is in 12/13 on each of the specimens.

None of the specimens have any trace of clitellar glandularity.

The male pores are minute, each pore at the centre of a transverse, small, whitish area in the setal circle of xviii.

The genital markings are not as fully developed as in the type specimen but are definitely recognizable in 9 specimens where they are located on 18/19-21/22 (5) or 18/19-22/23 (4). One of the lateral markings of the last trio may be lacking and one or two of the first trio may also be lacking. The genital markings appear at first glance to be lacking on 8 of the specimens, but careful examination under proper illumination and magnification enables recognition of what appear to be the primordia, very faint, of the markings.

Internal anatomy.—(Opened 13 specimens).

Each specimen has a pair of the rather characteristic glandular flaps on the oesophagus just behind the gizzard.

The seminal vesicles in xii are smaller than in the type-specimen. The spermathecae are all rudimentary.

Remarks.—The single type-specimen was not fully clitellate and was rather heavily parasitized by protozoa. In three of this year's specimens the coelomic face of the parietes throughout almost the entire length of the body is covered by masses of brownish and whitish cysts. A few cysts, larger, firmer, and more nearly spheroidal than the others are deeply imbedded in the parietes. Nematodes were found in the coelomic cavities of the anterior portion of the body in another four worms.

***Pheretima doliaria* Gates.**

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

var. *armillata* Gates.

1932. *Pheretima doliaria armillata*, Gates, *Rec. Ind. Mus.* XXXIV, p. 415, fig. 7.

Loikaw, September, G. E. Blackwell, 1 specimen.

There is a complete circle of setae on segment ii. The spermathecal setae on viii are 22; the male setae on xviii are 17

The spermathecal pores are located anteriorly on viii and ix, towards the lateral margins of the half-moon-shaped whitenings on viii and ix. There are similar whitenings posteriorly on vii and viii, but none are as clearly indicated or as sharply delineated as in the original specimen.

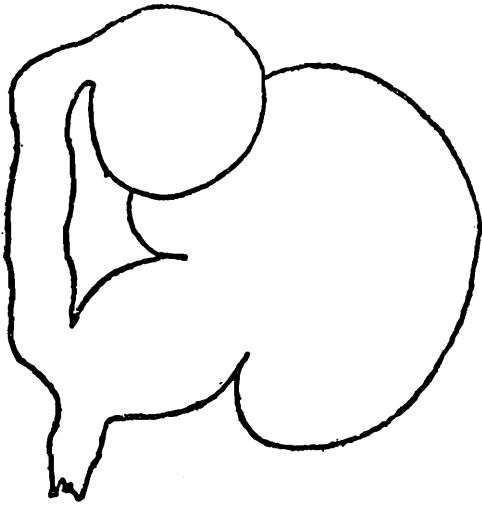


FIG. 19.—*Pheretima doliaria armillata*
Gates.

Spermatheca $\times$ ca. 14.

The male pore areas and the genital markings are slightly eroded and in addition do not appear to be fully or characteristically developed. The male pores were not recognised.

The seminal vesicles of xi are included within the testis sac of xi. The ectalmost portion of the prostatic duct is only slightly thinner than the middle portion.

***Pheretima elongata* (E. Perr.).**

Maymyo, August, K. John, 4 specimens.

Mt. Popa, September, K. John, 38 specimens.

Tonbo, September, K. John, 46 specimens.

Mandalay, September, K. John, 10 specimens.

Sagaing, September, K. John, 79 specimens.

Akyab, September, Bruce Taw, 6 specimens.

Minnie Bay, Andaman Islands, September, C. Amirthalingam, 1 specimen.

Henzada, October, K. John, 2 specimens.

***Pheretima exigua* Gates.**

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.

var. *typica* Gates.

1932. *Pheretima exigua typica*, Gates, *Rec. Ind. Mus.* XXXIV, p. 512, fig. 29a.

Kalaw, September, Saya Ah Sou, 7 clitellate specimens.

Taungyi, September, Saya Ba Te, 4 clitellate specimens.

Loikaw, September, G. E. Blackwell, 2 clitellate specimens.

Mala, September, G. E. Blackwell, 4 clitellate specimens.

Prostates are either entirely lacking or represented only by minute rudiments. Prostatic ducts are present.

var. *austrina* Gates.

1932. *Pheretima exigua austrina*, Gates, *Rec. Ind. Mus.* XXXIV, p. 514, fig. 29b.

Kamaungthwe River, October, W. D. Sutton, 4 clitellate specimens.

The testis sacs and seminal vesicles of each of these specimens are distended by masses of small, spheroidal, transparent cysts.

Pheretima fucosa, sp. nov.

Kamaungthwe River, August, W. D. Sutton, 1 acitellate specimen.

Kamaungthwe River, October, W. D. Sutton, 5 clitellate specimens.

Description of the type-specimen.

External characteristics.—Statements in parentheses refer to the paratypes.

Length 120 mm. (98-120 mm.). Greatest diameter, 6 mm. (5-6 mm.). Number of segments, 114 (115, 114, 115). Colour of dorsum, reddish, darker anterior to the clitellum, on the posterior half of the body much lighter and almost brownish.

The buccal cavity is everted, the intersegmental furrow between segments i and ii only faintly indicated.

The setae are small and fairly closely spaced and begin on ii, on which segment there is a complete setal circle. There is no midventral break in the setal circles, a mid-dorsal break may or may not be present. The setal numbers are indicated below.

vi.	vii.	viii.	xvii.	xviii.	xix.	xx.
..	45	41	39	31	39	105
..	40	46	39	33	39	*110
..	40	46	..	27	37	..
..	42	41	32	27	36	92
..	39	38	35	29	35	..
..	39	39	29†	29	35	†..
32	46	..	38	29	40	‡*87
36	40	..	33	27	37	‡*78

* Immature specimen.

† Type-specimen.

‡ Kalaw specimens, *vide* appendix to *P. fucosa*.

The first dorsal pore is in 12/13 with a non-functional, pore-like marking in 11/12. (The first dorsal pore is in 13/14 with non-functional pore-like markings in 11/12 and 12/13—one specimen, in 12/13 with a non-functional, pore-like marking in 11/12—4 specimens).

The clitellum is annular, extending from 13/14-16/17; intersegmental furrows and dorsal pores lacking; no setae were recognized.

The spermathecal apertures are three pairs of minute pores in 6/7-8/9. Each pore is located on a tiny, transversely oval tumescence which is not sharply demarcated.

There is a single female pore on xiv in the midventral line.

The male pores are minute, each pore at the centre of a round (or transversely oval) disc, the disc surrounded by a slight but definite furrow. (The male pore discs 3-4 intersetal distances wide transversely.).

The genital markings are two pairs on 17/18 and 18/19, each marking transversely oval, only very slightly protuberant, reaching antero-posteriorly nearly to the setae of xvii and xviii or xviii and xix. The lateral margin of a marking is very slightly lateral to the median margin of the male pore disc. (The genital markings are 9-11 intersetal distances wide transversely, the markings of a pair separated from each other midventrally by a space equal to or slightly greater than the width of a single marking),

Internal anatomy.—(Opened 5 specimens).

Septa 5/6-7/8 and 10/11-12/13 are slightly muscular ; 8/9 is represented by a ventral rudiment only ; 9/10 is lacking.

There is a small, glandular collar on the oesophagus just behind the gizzard. The intestine begins in xv. The intestinal caeca are simple, extending anteriorly into xvii or long enough to do so.

There is a single vascular commissure belonging to ix. The last pair of hearts is in xiii. (The commissure of ix is on the right side—4 specimens. The last pair of hearts is in xiii. The hearts of ix, x-xiii all pass into the ventral blood vessel).

There are nephridial masses in v and vi and blood glands in v.

(The testis sac of x is single, with a bilobed anterior margin ; the testis sac of xi also single and with a bilobed anterior margin). The seminal vesicles of xi are fairly large and in contact dorsally. The vesicles of xii are larger than those of xi, in contact dorsally, displacing 12/13-13/14 posteriorly into contact with 14/15. Each vesicle of xii has a primary ampulla. (No primary ampullae on the vesicles of xi). The prostates extend through segments xvii-xx (or xix). The prostatic duct is $4\frac{1}{2}$ - $6\frac{1}{2}$ mm. in length, bent into a hairpin shape, the ectal limb slightly thicker than the ental limb.

The spermathecal ampulla is flattened, of about the same length as or slightly longer than the duct from which it is clearly demarcated. The diverticulum is tubular, coiled into a flattened mass of loops, and passes into the anterior face of the stoutish spermathecal duct close to the body wall. (Ectal to the junction of the duct and diverticulum the duct is narrowed just as it passes into the parietes).

Over each of the four genital markings is a glandular mass which projects conspicuously into the coelom.

Remarks.—Intersegmental furrow 1/2 is very faint on each of the cotype specimens. The buccal cavity of each worm is everted. The immature specimen, though without trace of clitellar glandularity has characteristic genital markings only slightly smaller than those of the clitellate forms. The genital markings are here, however, only slight thickenings of the epidermis. The thickened epidermis is very easily rubbed off leaving a slightly concave depression in the circular muscle layer.

The genital markings are somewhat similar in number and location as well as appearance to those of *P. peguana*.

Each worm is parasitized. In the type-specimen there are numbers of small ovoid cysts in the coelom behind segment xviii. Four of the cotype specimens have cysts in the lateral margins of the nerve cord of the posterior half of the body. In the immature specimen these cysts are smaller and more sparsely distributed. One of the cotype specimens contains a rather amazing collection of parasites. In addition to the nerve cord cysts there are the following : (1) a large nema about 30 mm. in length, alongside the gut in segments vii-xiv ; (2) a much smaller nema in that portion of the dorsal blood vessel just over the gizzard ; (3) numbers of small, ovoid cysts in the coelomic spaces posterior to segment xviii ; (4) two varieties of protozoa attached by stalks to the

parietes in the region of segments iv-vi. (5) Six spheroidal, reddish cysts, each about $1\frac{1}{2}$ mm. in diameter on the ventral parietes of iii-v.

P. fucosa is somewhat like *P. terrigena* from which it may be distinguished by the following characteristics: (1) position of the genital markings; (2) setal numbers; (3) extent of the clitellum; and (4) presence of a glandular collar on the oesophagus just behind the gizzard. The seminal vesicles of xi not enclosed within the testis sac of xi.

APPENDIX TO *P. fucosa*.

Kalaw, September, Saya Ah Sou, 2 clitellate specimens.

These specimens differ from the Kamaungthwe worms as indicated below.

The setal circles of ii and iii are incomplete, setae lacking dorsally.

The spermathecal pores are three pairs in 5/6-7/8 with very slight indications of rudimentary pores in 8/9.

The male pores are minute, each pore at the centre of a round disc which is withdrawn into the parietes, the margin of the depression minutely lobulated.

The genital markings are 7-9 intersetal distances wide transversely and located as follows: specimen 1—on 17/18 and 18/19 on the right side, on 16/17 and 17/18 on the left side; 2, on 20/21 and 21/22 on the right side, on 16/17 on the left side.

The seminal vesicles and prostates are rudimentary. The testis sacs are filled with cysts. The prostatic ducts are bent into hairpin-shaped loops, each duct about 7-8 mm. in length, the ectal limb of the duct quite noticeably thicker than the ental limb.

The spermathecal duct is scarcely recognizable and is not marked off from the ampulla. The diverticulum is slenderly tubular, looped into a zigzag with the loops closely adpressed or separated or the diverticulum may be more or less spirally twisted.

Remarks.—In each specimen there are large numbers of cysts attached loosely to the coelomic face of the parietes. These cysts are so numerous that in some regions the parietes is almost entirely covered thereby. In one segment over 60 of these cysts were counted.

No nemas were found.

The genital markings on the right side of one specimen are as in *P. fucosa*, to which species these worms appear to belong more than to any other Burmese form. If the rudimentary spermathecae of vii-ix were all fully developed and the spermathecae of vi were lacking there would be little doubt as to the identification. None of the specimens of *P. fucosa* have spermathecae in vi. It should be noted however that each specimen of *P. fucosa* is heavily parasitized and a characteristic pair of spermathecae in segment vi may have been inhibited from developing.

Pheretima gemella Gates.

var. typica Gates.

1932. *Pheretima gemella typica*, Gates, *Rec. Ind. Mus.* XXXIV, p. 519.

Kamaungthwe River, August, W. D. Sutton, 8 acitellate and 35 clitellate specimens.

Kamaungthwe River, October, W. D. Sutton, 72 clitellate specimens.

All except two of the specimens have the presetal, preclitellar genital markings. All of the specimens have the postsetal, preclitellar markings.

var. quadripora Gates.

1932. *Pheretima gemella quadripora*, Gates, *Rec. Ind. Mus.* XXXIV, p. 523.

Kamaungthwe River, August, W. D. Sutton, 6 clitellate specimens.

Kamaungthwe River, October, W. D. Sutton, 15 clitellate specimens.

Pheretima hawayana* (Rosa).*?var. typica** (Rosa).

Namkham, September, G. S. Seagrave, 3 clitellate specimens.

Each worm has two genital markings in the male pore region, just median to and almost touching the male pore disc, one anterior to and one posterior to the setal line. These three markings, the male pore disc and the two genital papillae, are on an area surrounded by two or more concentric furrows. In addition there is a pair of similar markings anteriorly on xviii and another pair anteriorly on xix, the markings of a side in line longitudinally with the two markings close to the male pore disc.

var. lineata Gates.

1926. *Pheretima hawayana lineata*, Gates, *Rec. Ind. Mus.* XXVIII, p. 154.

Mt. Popa, September, K. John, 11 clitellate specimens.

Maymyo, August, K. John, 34 clitellate specimens.

Kalaw, September, Saya Ah Sou, 32 clitellate specimens.

Taungyi, September, Saya Ba Te, 205 clitellate specimens.

Myitkyina, September, L. R. Dudrow, 13 clitellate specimens.

Very slight pressure on the anterior end of some of these worms forced out through the anteriormost dorsal pores, in addition to the usual coagulum, spheroidal or ovoidal cysts containing gregarine (pseudonavicellae) spores, nematode eggs, and spheroidal, multicellular bodies of a greenish colour.

***Pheretima heterochaeta* (Mich.).**

Kalaw, September, Saya Ah Sou, 1 specimen.

***Pheretima houletti* (E. Perr.).**

Falam, August, J. H. Cope, 193 specimens.

Maymyo, August, K. John, 23 specimens.

Kamaungthwe River, August, W. D. Sutton, 87 specimens.

Mt. Harriet, Andaman Islands, September, C. Amirthalangam, 5 clitellate specimens.

Kyaukpadaung, September, K. John, 2 clitellate specimens.

Mt. Popa, September, K. John, 12 clitellate specimens.
 Toungoo District-western, September, G. E. Blackwell, 1 clitellate specimen.
 Loikaw, September, G. E. Blackwell, 57 clitellate specimens.
 S'nite, September, G. E. Blackwell, 69, clitellate specimens.
 Koopra, September, G. E. Blackwell, 9 clitellate specimens.
 Mala, September, G. E. Blackwell, 69 clitellate specimens.
 Letpadan, September, K. John, 5 clitellate specimens.
 Thonze, September, K. John, 10 clitellate specimens.
 Prome, September, K. John, 17 clitellate specimens.
 Letpadan, September, K. John, 3 specimens.
 Tharrawaddy, September, K. John, 1 specimen.
 Akyab, September, Bruce Taw, 87, clitellate specimens.
 Kalaw, September, Saya Ah Sou, 295 specimens.
 Namkham, September, G. S. Seagrave, 1 specimen.
 Tiddim, September, J. H. Cope, 27 specimens.
 Taungyi, September, Saya Ba Te, 133 clitellate specimens.
 Myitkyina, September, L. R. Dudrow, 8 clitellate specimens.
 Bassein, October, K. John, 15 clitellate specimens.
 Henzada, October, K. John, 12 clitellate specimens.
 Myaungmya, October, William Law, 8 clitellate specimens.
 Kamaungthwe River, October, W. D. Sutton, 34 clitellate specimens.
 Kyaukpyu, January, Saya Ah Sou, 5 clitellate specimens.

The first functional dorsal pore of every one of the specimens is either in 10/11 or anterior to 10/11.

Three Taungyi specimens have the copulatory chambers completely everted, the penial body is at the ventral face of a whitish, rounded mass. The prostatic ducts pass directly into the parietes as in worms without copulatory chambers.

***Pheretima jacita* Gates.**

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

Kamaungthwe River, August, W. D. Sutton, 38 specimens.

Kamaungthwe River, October, W. D. Sutton, 28 specimens.

Pheretima jacita was erected for five immature worms collected at Ye, several years ago. Several attempts to obtain mature specimens at Ye and elsewhere failed. The Kamaungthwe worms which have been assigned to this species have been compared side by side with the type-specimens. Some of the immature specimens in the present collection are exactly like the types, while others are slightly more developed. The following notes are based on the clitellate specimens. Most of the worms are badly preserved.

External characteristics.—Maximum length, 170 mm. The greatest diameter varies from 5-7 mm.

The setal circle of segment ii is uninterrupted. There is no definite midventral break in the setal circles but a slight mid-dorsal break of variable width may be present. The setal numbers of a few of the best preserved August specimens are given below.

vi.	vii.	xvii.	xviii.	xix.
30	34	26	19	26
35	35	27	17	25
30	29	26	17	27
29	33	26	14	25
27	27	21	16	22

The male setae of xviii of eight of the October worms are : 13—3 specimens, 14—2 specimens, 15—3 specimens.

The first dorsal pore is in 12/13 in 16 specimens, on five of which there is a definitely pore-like but apparently non-functional marking in 11/12 ; in 13/14 in three specimens, on one of which there is a non-functional pore-like marking in 12/13.

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

The spermathecal pores are minute, round apertures on the anterior margins of vi, vii and viii close to the intersegmental furrows. When the spermathecal duct is pulled out from the parietes of a dissected worm, a hole is left that appears to be mainly across the intersegmental furrow, but in pulling out the duct, the tissue around the pore is removed. A rod of spermatozoa projecting from the spermathecal pore can be recognized on some specimens and is quite clearly (when viewed with high magnification at which the pore itself is alone visible) on the anterior margin of the segments.

In the setal circle of xviii on each side there is a smooth, glistening, longitudinally oval area about 5-7 intersetal distances wide transversely which does not quite reach to 17/18 or 18/19. This area is usually on a slight protuberance and is delimited by a slight but definite circumferential furrow, external to which there may be several concentric furrows. At the centre of each marking is a small, rounded tubercle on the centre of which is the minute male pore. The male pore tubercle is slightly retractile into the parietes.

Internal anatomy.—Septa 5/6-7/8 are slightly thickened and translucent ; 8/9 is represented by a ventral rudiment only ; 9/10 is lacking ; 10/11 is present but is displaced anteriorly by the seminal vesicles of xi.

The intestinal caeca are compound, each caecum with 5-9 anteriorly directed, elongate, finger-like secondary caeca, one or more of which may have small tertiary caeca thereon. The dorsalmost caecum is usually the longest, the length of the secondary caeca decreasing ventrally.

The last pair of hearts is in xiii. All hearts of x-xiii pass into the ventral blood vessel. There are masses of blood glands in v and vi.

There are paired testis sacs on the anterior face of 10/11 and 11/12, the sacs of a segment are without transverse communication. The seminal vesicles of xi are large, pushing 10/11 anteriorly into contact with the gizzard. The vesicles of xii push 12/13 and 13/14 back into contact with 14/15. The prostates are large, extending through xvii or xviii to xxi-xxii but pushing 17/18-15/16 anteriorly to 14/15 so that the prostates appear, at first, to be in contact with the posterior seminal vesicles. The prostatic duct is about 4-6 mm., in length, stout, bent into a sort of crescent or U-shape, usually with the concavity of the crescent or U facing laterally.

The spermathecal duct is shorter than the ampulla, constricted abruptly in the outermost region of the parietes so that the bluntly

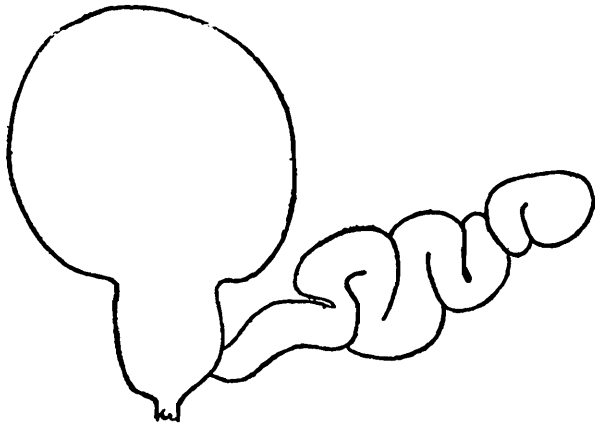


FIG. 20.—*Pheretima jacita* Gates.
Spermatheca $\times$ ca. 14.

rounded ectal end of the duct can be felt underneath the epidermis. The diverticulum passes into the anterior face of the duct, is longer than the combined lengths of duct and ampulla, and is looped; some of the loops at least, but usually not all are in a regular zigzag arrangement. The ectalmost portion of the diverticulum is slightly narrower than the ental portion. The ampulla usually contains a

rounded, berry-like mass, the peripheral portion of which is transparent and gelatinous, the central portion more compact, opaque and slightly iridescent. This mass is continued as a sort of stalk through the spermathecal duct to project, in some specimens, to the exterior through the spermathecal pore as a fine thread.

Remarks.—Re-examination of the type-specimens shows that on these specimens also the spermathecal pores are segmental rather than intersegmental.

In the parietes around the ectal end of the prostatic duct is a collar of whitish, probably glandular material.

In the coelom of segments xi-xiii of many of the October specimens there are nemas. No cysts were found in August or October specimens.

? var. **defecta** Gates.

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

Kamaungthwe River, October, W. D. Sutton, 8 clitellate specimens.

The male setae of segment xviii are 13-15; 13—3 specimens, 14—2 specimens, 15—3 specimens.

The first dorsal pore is in 11/12 or 12/13.

The male genital markings are more or less eroded but are similar to the markings of the type-specimen of *P. defecta* as well as to the markings of *P. jacita*.

Spermathecal pores lacking—7 specimens; three pores on one specimen, anteriorly located, on viii—right and left sides, and vii—right side only.

The seminal vesicles are quite small in seven specimens, minute in one specimen. In the latter worm there are no testis sacs. Well developed prostatic ducts are present in each worm as in the type-specimen. Prostates are lacking as in the type specimen in 7 worms. In one worm the prostates are rudimentary and confined to segment xviii.

Seven specimens are athecal. One specimen has three spermathecae, those on the left side without diverticula and with rudimentary ducts and ampullae. The spermatheca of the right side has a diverticulum

looped in a regular zigzag and passing into the anterior face of the duct in the parietes.

Remarks.—*P. defecta* was erected for an anterior fragment of a single, athecal worm without prostates. The absence of spermathecae and prostates may be the result of a heavy parasitic infestation of some sort, as in *P. rugosa* and *P. alexandri*. If this be correct then *P. defecta* will be merely an athecal form of some thecal species. The appearance of the genital markings indicates that *P. jacita* may be the thecal form. The male pore markings may not however be specifically characteristic, i.e., markings of the same type or of a very similar sort may be present on other species. Such species have not yet been found in the Tenasserim region from which *P. jacita* and *P. defecta* were collected, but the area has not yet been worked over so thoroughly as to warrant the conclusion that such species are absent from the area. The single spermatheca of the single thecal individual of *P. defecta* may possibly also be regarded as evidence for the derivation of *P. defecta* from *P. jacita* by the loss of spermathecae and prostates. The spermathecal characteristics are certainly similar in the two, so far as can be judged from the material available. But in the thecal specimen of *P. defecta* the whole length of the diverticulum is looped in a regular zigzag fashion, a condition which has not been found in any specimen of *P. jacita*. Therefore, though the evidence available appears to indicate, on the whole, that the worms referred to *P. defecta* are athecal individuals of *P. jacita*, this relationship can scarcely be regarded as proven.

In the coelom of segments viii-xiv of five of the specimens there are numbers of nemas. In the coelom of the region behind segment xviii there are in each specimen large numbers of small, whitish cysts. Such cysts were not found in any specimen of *P. jacita*.

***Pheretima longicauliculata* Gates.**

1931. *Pheretima longicauliculata*, Gates, *Rec. Ind. Mus.* XXXIII, p. 395, figs. 30-31.

Loikaw, September, G. E. Blackwell, 16 clitellate specimens.

Kwachi, September, G. E. Blackwell, 6 aclitellate specimens.

Mawchi, September, G. E. Blackwell, 16 aclitellate specimens.

Taungyi, September, Saya Ba Te, 60 clitellate specimens.

External characteristics.—Nearly one-third of the Taungyi specimens have a dark reddish pigmentation of the dorsum in place of the usual greyish blue.

The clitellate specimens have unusually small but otherwise characteristic genital markings. The aclitellate worms though of about the same size as the clitellate forms have only very faint indications of the clitellar glandularity while the genital markings are indicated only by tiny rudiments. The genital markings are located on 19/20-29/30 as shown below.

	I	II
19/20-24/25 .	1	9
19/20-25/26 .	5	8
19/20-26/27 .	7	3
19/20-27/28 .	1	2
19/20-29/30 .	1	..
20/21-27/28 . . .	1	..

I=clitellate specimens.

II=aclitellate specimens.

Internal anatomy.—The clitellate specimens are characterized by very rudimentary spermathecae, the diverticula being short and straight. The seminal vesicles of xii are small relative to their normal size and the prostates are tiny rudiments in xviii. The prostatic ducts are, on the contrary, well developed. In the aclitellate specimens the spermathecae are larger and with some portion of the diverticulum looped in a regularly zigzag fashion. The prostates and prostatic ducts are of about the same size as those of the clitellate specimens.

Remarks.—A few coelomic nemas were found in each of five clitellate specimens. A considerable number of gregarinoid parasites are present in the coelom throughout the whole length of the body of one of the clitellate specimens. Each parasite attached to the parietes by two fine filaments. In every worm except the one just mentioned there are large (huge is the word in the original notes) numbers of cysts. The cysts are whitish or brownish, flattened, oval discs attached lightly to the body wall which may be so completely covered in a pinned out specimen as to be almost invisible. In a segment at about the middle of the body of a clitellate specimen 40 cysts were counted. In a few specimens these cysts are also present on the septa, the ventral blood vessel, and in the nerve cord. In some of the specimens there are in addition larger, spheroidal, tough-walled cysts buried almost completely in the parietes. These cysts are more sparsely distributed throughout the body. In several cases there are two longitudinal rows of these cysts in the ventral parietes, the two rows parallel to each other and to the nerve cord and about equidistant from the nerve cord.

***Pheretima maculosa*, sp. nov.**

Kamaungthwe River, August, W. D. Sutton, 2 specimens—1 clitellate.

Kamaungthwe River, October, W. D. Sutton, 13 clitellate specimens.

Description of the type specimen.

External characteristics.—(Statements in parentheses refer to the cotype specimens).

Length 49 (46-82) mm. Diameter 4 (3-4) mm. Number of segments, 109 (119). Colour of dorsum, light reddish; clitellum greyish.

The setae begin on ii, on which segment there is a complete circle. The setae are slightly larger and slightly more widely spaced ventrally and ventro-laterally than dorsally. There are no definite midventral or mid-dorsal breaks in the setal circles. The setal numbers are indicated below.

vii.	xiv.	xv.	xvi.	xvii.	xviii.	xix.	xx.
29	9	3	8	11	8	12	..
27	6	7	6	12	8	12	54
30	5	8	9	12	8	12	57
29	6	10	7	12	10	13	..
30	5	8	10	12	7	14	..
31	7	9	11	12	9	13	..
26	6	8	10	12	9	12	53
29	4	8	7	10	8	12	..
27	6	8	8	12	7	13	*55

* Type-specimen.

The first dorsal pore is in 11/12 but there is a definitely pore-like marking anteriorly on xi(10/11—2 specimens, 11/12—3 specimens, 11/12

but a definitely pore-like but non-functional marking in 10/11—8 specimens).

The clitellum is annular and extends from 13/14-16/17. Setae are present ventrally on each segment (always).

The spermathecal pores are minute, in 6/7 a single pair.

The male pores have not been definitely identified but are probably on round discs in the setal circle of xviii which extend nearly to 17/18 and 18/19. (The male pores are minute, scarcely recognizable even with high powers of the binocular and brilliant illumination. The approximate location of the pore can however be determined by carefully pulling the prostatic duct out from the parietes after removal of the longitudinal musculature. This procedure leaves an aperture at the centre or very slightly lateral to the centre of the male pore disc. In some specimens a definite but slight furrow marks off the disc while in others no furrow is visible. On the male pore disc and median to the male pore there are usually three markings of about the same size as those on 17/18 but here much more difficult to recognize).

The genital markings are minute, round, greyish spots on 17/18. There are six of these markings on each side, two of those on the right side and one of those on the left side are slightly anterior to the others and probably on the posterior margin of xvii; 17/18 not clearly visible in this region. The markings are in transverse rows extending from a point just in front of the centre of the male pore disc to a point just median to the median margin of the disc. The preclitellar markings are similar in appearance to the postclitellar markings but are post-setal and segmental in position, slightly nearer to the setae than to the intersegmental furrow, just median to the spermathecal pore lines on segment viii. There is a single marking on the right side and a transverse row of two markings on the left side.

(The genital markings are minute, round discs in the region of 17/18 and 18/19 and on segment viii, in transverse rows when there is more than one marking in a special area. The postclitellar markings extend from a point about in line with the male pore towards the midventral line, and are in two rows, one of which appears to be actually on the posteriormost portion of xvii or xviii, the other actually on the intersegmental furrow 17/18 or 18/19 or perhaps in a few cases on the anteriormost margin of xviii or xix. Markings in the region of 18/19 are present only on two specimens. The numbers and locations of the genital markings of those specimens on which the setae were counted is indicated below).

17/18.		xviii.	
Left.	Right.	Left.	Right.
3-4	1-5	1	0
7-7	5-6	1	0
6-7	6-7	3	2
0-0	1-4	0	0
4-6	4-6	1	1
3-6	3-6	1	0
4-5	1-6	1	0
4-5	1-6	1	0
2-5	1-5	0	0
1-5	2-4	2	1

The first figure of a pair indicates the number of markings on the posterior margin of xvii, the second figure those on 17/18 or perhaps on xviii.

Internal anatomy.—(Eight specimens opened).

Septa 5/6-7/8 are present; 8/9 represented by a ventral rudiment only; 9/10 lacking. No septa especially thickened.

The intestinal caeca are simple (long enough to reach into xxii-xxiii). The intestine begins in xv.

There are masses of nephridia in v and vi.

There is a pair of hearts which appear to belong to segment ix but no hearts belonging to segments x or xi were found. There are paired hearts in xii and xiii. (A pair of commissures connecting the dorsal and ventral blood vessels is present in each specimen just behind the gizzard. Each of these commissures is slenderly tubular like the single commissure belonging to segment ix of other species and not "baggy" like the true hearts of segments xii-xiii. Because of the location near the gizzard rather than on the anterior face of 10/11 these commissures are considered to belong to ix. No hearts belonging to x or xi have been found in any of the specimens. Each specimen has paired hearts in xii and xiii passing into the ventral blood vessel).

There is a pair of vertical testis sacs on the anterior face of 10/11 but these sacs do not reach to the dorsal blood vessel. There are paired vertical testis sacs in xi which do reach to the dorsal blood vessel and are not bound by connective tissue to the oesophagus as in *P. alexandri*. The seminal vesicles of xi are contained within the posterior testis sacs. (No ventral transverse communication between the testis sacs of a segment has been found). The seminal vesicles of xi are surrounded by testicular material. The seminal vesicles of xii are vertical bodies, each with a tiny, dorsal primary ampulla. The prostates are small and confined to xviii. The prostatic duct is short, about 1 mm. in length and rather stout. (The prostatic duct is either straight and muscular throughout, or bent into a U-shape—the greater portion of the duct muscular, or bent into a hairpin shape—the ectal limb of the duct muscular and very much stouter than the ental limb which is almost thread-like).

The spermathecae are abnormal. (The spermathecae are quite evidently abnormal in two specimens, apparently normal in two speci-

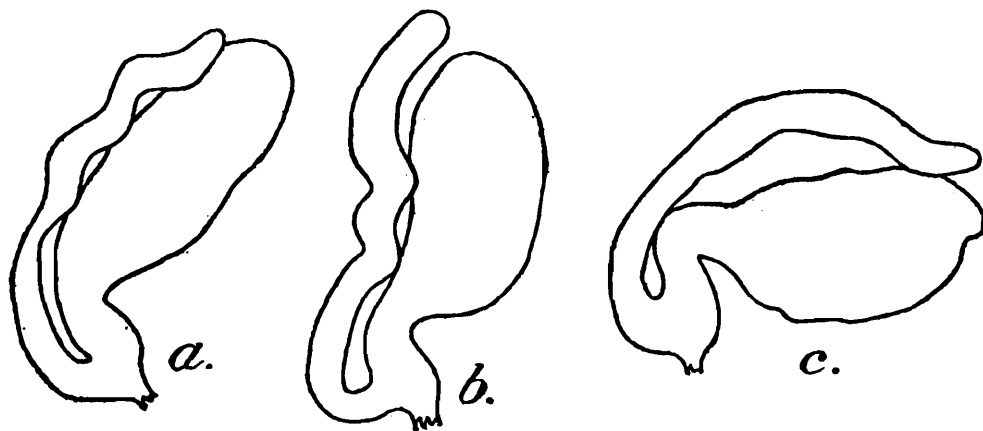


FIG. 21.—*Pheretima maculosa*, sp. nov.
a-c. Spermatheca $\times$ ca. 14.

mens, rudimentary in three specimens. One of the supposedly normal spermathecae is figured. The spermathecal diverticulum passes into the anterior face of the duct).

There are very small, coelomic, stalked glands dorsal to both the pre- and postclitellar genital markings.

Remarks.—There are numerous, whitish, parasitic bodies in the nerve cord of the anterior half of the type specimen. There are also parasites in the coelom.

P. maculosa is distinguished from all other Burmese species of *Pheretima* by the location of the single pair of spermathecal pores in 6/7.

***Pheretima mamillana* Gates.**

1931. *Pheretima mamillana*, Gates, *Rec. Ind. Mus.* XXXIII, p. 400, fig. 33.

Kamaungthwe River, August, W. D. Sutton, 28 clitellate specimens.

Kamaungthwe River, October, W. D. Sutton, 223 clitellate specimens.

***Pheretima manicata* Gates.**

1932. *Pheretima manicata*, Gates, *Rec. Ind. Mus.* XXXIV, p. 527.

var. *decorosa* Gates.

1932. *Pheretima manicata decorosa*, Gates, *Rec. Ind. Mus.* XXXIV, p. 528.

Thandaung, September, G. E. Blackwell, 1 clitellate specimen.

Mala, September, G. E. Blackwell, 1 clitellate specimen.

Koopra, September, G. E. Blackwell, 1 clitellate specimen.

Loikaw, September, G. E. Blackwell, 2 clitellate specimens.

Mawchi, September, G. E. Blackwell, 4 clitellate specimens.

External characteristics.—Length to 120 mm. Each specimen lacks some portion of the tail region. Greatest diameter, 6 mm.

The setal numbers of three specimens are indicated below. The number of male setae on xviii on six specimens from Loikaw and Mawchi is 10-20 ; 10—2 specimens, 11—2 specimens, 19—1 specimen, 20—1 specimen. Setae may be lacking on xviii immediately anterior to the genital markings and present only midventrally, or the setae may be continued straight across xviii ventrally between the median margins of the male pore markings, or setae may be entirely lacking ventrally between the male pore areas.

vi.	vii.	viii.	xiv.	xv.	xvi.	xvii.	xviii.	xix.	xx.
23	20	20	3	3	18	27	0	27	69
23	29	29	0	0	12	28	10	27	63
*17	18	..	3	3	9	18	2	20	53

* Abnormal specimen from Koopra.

The first functional dorsal pore of each specimen is in 12/13.

The clitellum extends from 13/14 nearly to, or slightly posterior to the setae of xvi but does not reach 16/17. Setae are present ventrally on xvi of each specimen, but may or may not be present ventrally on xiv and xv.

The spermathecal pores are minute, in intersegmental furrows 5/6-8/9.

The male pore markings may be small, circular discs with the male pores exactly at their centres or elongately oval areas, or thickly crescent-shaped areas with the concave margin towards the midventral line.

In the last two cases the markings may reach to 17/18 and 18/19 or may reach neither furrow or may extend across both 17/18 and 18/19 or across 18/19 only, reaching anteriorly about to 17/18. The male pore may be near the lateral margin of the marking or further mesially. In the former case the prostatic duct passes into the parietes in contact with the lateral margin of the glandular mass in the coelom while in the latter case the prostatic duct passes into the glandular mass.

Each specimen has a pair of transversely oval, postsetal genital markings on segment xviii. These markings nearly meet at the midventral line and extend laterally about to the male pore areas but do not quite reach 18/19.

Internal anatomy.—The intestine begins in xv and is not narrowed in xvi-xix. Each specimen has a pair of characteristically compound intestinal caeca. In addition there is on the intestine in xxviii on each side a vertical ridge with slight pocket-like or shortly finger-like projections; usually 4-6, but there may be as many as 10-15. There is a similar but less well developed ridge on the intestine on each side in xxix in some specimens.

The hearts of x are present in each specimen.

There are two unpaired, median testis sacs. The prostatic ducts are short—2 to 3 mm. in length bent usually into a u-shaped loop, slender, the ectal limb slightly thicker than the ental limb.

The spermathecal duct is shorter than the ampulla and is narrowed in the parietes. The ectal portion of the diverticulum is narrowly tubular, straight and passes into median face of the spermathecal duct; a middle portion is looped, the loops arranged in a more or less spheroidal mass projecting slightly from which there is an ovoidal or spheroidal widening of the ental end.

Into the coelom of xviii on each side there projects a mass of loose, glandular tissue.

Remarks.—The Koopra specimen is slightly abnormal lacking the posterior pair of spermathecae. The setal numbers of this worm are slightly smaller than those of the other specimens on which the setae were counted.

Nemas were found in the coelom of two specimens.

The account of this variety in the preceding paper was based on a single, not fully mature specimen collected by H. Young at Teung Cong.

***Pheretima mendosa* Gates.**

1932. *Pheretima mendosa*, Gates, *Rec. Ind. Mus.* XXXIV, p. 473, fig. 20.

Kamaungthwe River, August, W. D. Sutton, 3 clitellate specimens.

***Pheretima ornata* Gates.**

1929. *Pheretima ornata*, Gates, *Proc. U. S. Nat. Mus.* LXXV (10), p. 20, fig. 11.

Namkham, September, G. S. Seagrave, 1 clitellate specimen.

The Namkham worm lacks the small genital markings on xviii and the associated glands, but is otherwise normal and like the previous specimens,

***Pheretima papilio* Gates.**

1930. *Pheretima papilio*, Gates, *Rec. Ind. Mus.* XXXII, p. 317, fig. 34.

var. *typica* Gates.

Kamaungthwe River, August, W. D. Sutton, 1 specimen.

var. *hiulca* Gates.

1932. *Pheretima papilio hiulca*, Gates, *Rec. Ind. Mus.* XXXIV, p. 402, fig. 4.

Toungoo District—western, September, G. E. Blackwell, 7 specimens.

The first dorsal pore is in 11/12 in 2 specimens; in 12/13 in five specimens, in four of which there is a non-functional pore-like marking in 11/12.

The spermathecal setae on vi are 37, 33, 35, 36, 34. The male setae on xviii of the same specimens are 12, 13, 11, 14, 12.

The spermathecal pores are situated on hard, rounded protuberances from the anterior margin of vi. From the median margin of each protuberance a narrower, transversely elongated, hard whitened area reaches towards the midventral line. The spermathecal porophore is about 7-9 intersetal distances wide transversely. Intersegmental furrow 5/6 is dislocated anteriorly by the spermathecal porophore and the body wall just in front of the porophore is deeply retracted to form a slit-like cavity.

The genital markings on xviii are elongately oval, about 5-6 intersetal distances wide transversely, extending antero-posteriorly about to 17/18 and 18/19. In line with the setae of xviii on each genital marking there is a deep, transversely slit-like depression. The male pore is a small slit within this depression, surrounded by a slightly tumescent lip.

Into the coelom of segment v there projects conspicuously a transversely elongated body. The posterior wall of this body is much thicker than the anterior or dorsal wall. The spermathecal duct passes into the posterior face of this coelomic protuberance.

In xviii on each side there is a smooth surfaced, hard, more or less conical body, rising in the coelom to a height of $1\frac{1}{2}$ mm. This structure appears to be equivalent roughly speaking to a copulatory chamber.

var. *fracta*, var. nov.

Toungoo District—western, September, G. E. Blackwell, 3 clitellate specimens.

External characteristics.—Length to 80 mm. Greatest diameter 4 mm.

Setae are present on segment ii both dorsally and ventrally. There is a gap in the setal circle of vi on each side, behind the spermathecal pore. The spermathecal setae on v are 25, 26, 23; the male setae on xviii are 9, 3, 4. Setal pits are visible ventrally on the clitellar segments but no setae were recognized.

The first dorsal pore is in 13/14, 11/12 and 12/13.

There is a deep, transverse pit in intersegmental furrow 5/6 on each side. On the posterior face or wall of this pit there is a slightly protu-

berant, flat-surfaced, round area at the centre of which is the small but not minute, transversely slit-like spermathecal pore.

The male pore markings are a pair of elongately oval, very slightly protuberant and very indistinctly outlined areas, each about 9-10 inter-setal distances wide transversely, extending antero-posteriorly from the posterior part of xviii on to the posterior portion of xvii. On the anterior portion of each marking is a greyish area with rounded anterior margin and a posterior margin that at first glance appears to be perfectly straight and in the setal circle of xviii. This area is depressed, the depth of the depression increasing very gradually passing posteriorly. In line with the setae of xviii, at the posterior margin of the greyish area is a deep but short slit-like depression. The male pore has not been seen but is probably located in the deepest lateral portion of this depression.

The intestinal caeca extend anteriorly into xxiv-xxiii; the shape triangular, several short but definite pockets on the dorsal margin.

A finger-like primary ampulla projects dorsally from each seminal vesicle of xii. There is a hard, round, hemispherical projection into xviii on each side, into the anterior face of which the short but stoutish prostatic duct passes.

The spermathecal duct is slightly widened in the parietes and in this widened portion is contained the slit-like invagination in the region of 5/6. The diverticulum passes into the anterior face of the duct, is looped in a regularly zigzag fashion, the loops short, the ental end slightly widened, the widening ovoidal in shape.

***Pheretima peguana* (Rosa).**

Mahlaing, September, K. John, 4 specimens.

Mt. Popa, September, K. John, 14 specimens.

Sagaing, September, K. John, 17 specimens.

Letpadan, September, K. John, 11 specimens.

Prome, September, K. John, 12 specimens.

Thayetmyo, September, K. John, 30 specimens.

Thonze, September, K. John, 7 specimens.

Tharrawaddy, September, K. John, 9 specimens.

Myitkyina, September, L. R. Dudrow, 143 specimens.

Bassein, October, K. John, 16 specimens.

Henzada, October, K. John, 12 specimens.

Padali, October, Bruce Taw, 27 specimens.

Myaungmya, October, William Law, 1 specimen.

Akyab, September, Bruce Taw, 101 specimens.

Kyaukpyu, January, Saya Ah Sou, 237 clitellate specimens.

Aclitellate specimens of this species as small as 65 mm., in length and $2\frac{1}{2}$ mm., in diameter can be identified by means of the rudiments of the genital markings. In the smallest specimens that have been studied the anlage of the genital markings are faintly indicated, tiny, transversely oval tumescences. The intersegmental furrows are usually not visible in the region of these markings but at this early stage the anterior markings appear to be on the posteriormost portion of xvii, the posterior markings on the anteriormost portion of xix.

In slightly larger specimens the genital markings have pointed ends while the central pore is so large relative to the size of the marking that

the papilla appears to be merely a ring of tissue around the pore. In still larger specimens the ends of the markings are rounded and the hard flat area is recognizable. This firm area increases in size more rapidly than the pore.

The male pore is first visible as a minute, dark or blackish dot in the setal circle, the dot distinguishable with difficulty from the tip of a retracted seta. Later this rudiment of the male pore is located at the centre of an almost circular area of slight tumescence. Still later the epidermis immediately in front of and immediately behind the tumescence is greyish. In larger specimens the greyish areas now crescentic in shape are depressed slightly. With the continuation of this depression and the confluence of the depressions at the lateral and median margins of the male porophore, the porophore becomes sunk in a parietal excavation. The anterior depression appears to grow more rapidly than the posterior depression with the result that the male pore disc is on the posterior face of the excavation. The margins of the depressions at first smooth later become minutely lobulated. The excavation can be everted so that the male pore disc is on the ventral end of a columnar porophore.

***Pheretima planata* Gates.**

1926. *Pheretima planata*, Gates, *Ann. Mag. Nat. Hist.* (9) XVII, p. 411.

Letpadan, September, K. John, 5 clitellate specimens.

Myagyaung, September, K. John, 4 clitellate specimens.

Thonze, September, K. John, 2 clitellate specimens.

Tharrawaddy, September, K. John, 7 clitellate specimens.

Namkham, September, G. S. Seagrave, 1 clitellate specimen.

Akyab, September, Bruce Taw, 7 clitellate specimens.

Garai-berana, Andaman Islands, November, C. Amirthalingam, 41 specimens.

Corbyn's Cove-south, Andaman Islands, November, C. Amirthalingam, 52 acitellate and 25 clitellate specimens. (2).

Navy Bay, Andaman Islands, November, C. Amirthalingam, 53 clitellate specimens. (3).

Kyaukpyu, January, Saya Ah Sou, 53 clitellate specimens.

Padali, October, Bruce Taw, 275 specimens.

Myaungmya, October, William Law, 7 clitellate specimens.

Bassein, October, K. John, 3 clitellate specimens.

The heart or hearts of ix are as follows in the Andaman Islands specimens :—

	(1)	(2)	(3)
Left side only .	15	12+17	20
Right side only .	26	13+25	33
Paired .	..	10	

The Garai-berana specimens have a " sickly " appearance externally. In this collection the seminal vesicles of xii are rudimentary in 4 specimens, entirely lacking in 6 specimens. The seminal vesicles of xi are lacking in two specimens; rudimentary, hard, rounded, fibrous bodies in the other specimens.

The testis sacs of x are lacking in two specimens. Oviducal funnels are lacking in 2 specimens. In one worm there are gland ducts to the

copulatory chambers but no glands at the ental ends of the ducts. (*Vide*, *P. gemella typica* for a similar condition.) The prostates are rudimentary, confined to xviii in 7 specimens; entirely lacking in 1 specimen.

There are numerous cysts on the parietes and the gut and septa of segments viii-xiii.

***Pheretima porrecta* Gates ?**

1932. *Pheretima porrecta*, Gates, *Rec. Ind. Mus.* XXXIV, p. 444, fig. 16.

Loikaw, September, G. E. Blackwell, 6 specimens.

External characteristics —The colouration is a very unnatural, washed out brownish. The clitellar region of each worm is concave. An almost exactly similar appearance can be produced in fully mature specimens of certain species by scraping off the hypertrophied clitellar epidermis. The muscle fibres of the body wall in the clitellar region are visible externally but are covered over by a very delicate transparent tissue except at a few localized spots where there opaque patches. The male genital areas are eroded and also the ridges in which the setae are located so that setal counts have been difficult or impossible.

Length to 120 mm. Greatest diameter, 6 mm.

The first dorsal pore is in 12/13.

The spermathecal setae on vi are about 25; on vii, about 26: the male setae on xviii are 11-14.

The spermathecal apertures are minute, transverse slits on the anterior margins of vi, vii and viii, close to the intersegmental furrows.

The male apertures have not been identified on any specimen but the position was ascertained by carefully pulling the prostatic duct out from the parietes. This procedure leaves a small, round hole in the body wall about at the centre of the genital marking and almost entirely removes what appears to be a round tubercle that may be slightly retractile into the parietes. The male pore tubercle is at the centre of a longitudinally oval area which is about 5 intersetal distances wide transversely and which reaches anteroposteriorly to or nearly to 17/18 and 18/19.

Internal anatomy.—Septa 5/6-7/8 are thickly muscular; 10/11-11/12 thickened and translucent; 12/13 strengthened but transparent.

There is a well developed collar with a finely granular surface on the oesophagus just behind the gizzard. The intestinal caeca extend anteriorly into xx-xix and are simple but with slight indentations of the dorsal and ventral margins, especially posteriorly.

The testis sacs are unpaired. The seminal vesicles are fairly large, the vesicles of a segment in contact dorsally over the dorsal blood vessel, each vesicle with a hard, ovoid primary ampulla. The prostates extend through xvii-xix. The prostatic duct is stoutish, 2-4 mm. in length, straight or nearly straight or bent into a J-shaped or U-shaped loop.

There is no glandular material in the coelom over the male pore markings though the epidermis of the markings seems to be thickened.

The spermathecal duct is slender, shorter than the ampulla or of about the same length but not sharply marked off therefrom. The diverticulum is slenderly tubular, longer than the combined lengths of

duct and ampulla, bound ectally to the duct, almost straight or slightly sinuous or more markedly sinuous but not looped. The diverticulum passes into the anterior face of the spermathecal duct.

Remarks.—No parasites were found in any of the specimens.

The male pore areas lack the glistening peripheral rim present on the type specimen of *P. porrecta* and are rather like the male pore areas of *P. jacita*. Otherwise the present specimens are more like *P. porrecta* than *P. jacita*. The single specimen for which *P. porrecta* was erected though very much larger was not fully clitellate. The Loikaw specimens are regarded, somewhat dubiously, as abnormal specimens of *P. porrecta*.

***Pheretima posthuma* (L. Vaill.).**

Kyaukpadaung, September, K. John, 14 clitellate specimens.

Mandalay, September, K. John, 10 clitellate specimens.

Sagaing, September, K. John, 36 clitellate specimens.

Thonze, September, K. John, 7 clitellate specimens.

Thayetmyo, September, K. John, 26 clitellate specimens.

Prome, September, K. John, 24 clitellate specimens.

Letpadan, September, K. John, 20 clitellate specimens.

Akyab, September, Bruce Taw, 203 specimens.

Henzada, October, K. John, 16 clitellate specimens.

Bassein, October, K. John, 16 clitellate specimens.

Minnie Bay, Andaman Islands, February, C. Amirthalingam 17, clitellate specimens.

Mahlaing, September, K. John, 14 clitellate specimens.

Specimens of this species as small as 50 mm. in length and 3 mm. in diameter can be identified. In worms of that size the male pore disc is visible as a very slightly tumescent, circular area without limiting furrows; the minute male pore at the centre of the area. In slightly larger specimens a slight crescentic furrow is visible at the anterior margin and another similar furrow at the posterior margin of the disc. Later these grooves become more conspicuous, deeper and finally confluent laterally. The male pore disc is then depressed and with it a short portion of the setal ridge with one or two setae just median to the disc. In the adult worms the parietal excavation is deepest laterally while on the median wall of the excavation there may be one or two setae. The minute rudiments of the genital markings, white, transversely oval, slight tumescences in the setal circles are recognizable at the stage when the male pore discs are first visible, the centres of the genital markings slightly median to the centres of the male pore discs.

***Pheretima rufula*, sp. nov.**

Toungoo District—western, September, G. E. Blackwell, 98 clitellate specimens.

External characteristics.—Length to 150 mm. Greatest diameter 11 mm. Number of segments of several specimens selected at random :—07, 114, 109, 105, 116, 111, 112.

The dorsum is reddish, darker anterior to the clitellum, lighter behind the clitellum, posteriorly much lighter; or the colouration anterior to the clitellum may be a dark, greyish blue, posteriorly reddish, pinkish or light brownish.

The setae are small and closely spaced, lacking dorsally on ii; a definite mid-dorsal break of varying width in the setal circles, usually no midventral break. The setal numbers of several specimens are indicated below.

ii.	vi.	vii.	viii.	xvii.	xviii.	xx.
1	37	40	43	40	29	119
9	35	35	37	41	27	..
3	35	32	33	39	27	108
11	35	35	39	38	31	..
5	39	38	39	35	29	..
7	37	39	42	..	27	..
10	37	37	41	36	28	..
7	35	42	45	39	30	..
5	34	33	36	41	30	..
10	33	37	38	40	30	..

The position of the first dorsal pore was noted on fifty specimens; 12/13—48 specimens, 12/13 but with a non-functional, pore-like marking in 11/12—1 specimen, 13/14—1 specimen.

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

The spermathecal apertures are minute, four pairs, in 5/6-8/9.

There is a single female pore.

The male apertures are minute each pore at or near the centre of a male pore disc. This area is definitely demarcated by a slight circumferential furrow, lateral to which there may be two or three additional, short furrows. The disc is transversely or longitudinally oval, or nearly round, and is usually slightly depressed in a concave fashion. In a few specimens the disc is slightly diagonal in position.

The single pair of genital markings is just median to the male-pore discs on 18/19. Each marking is 9-12 intersetal distances wide, reaching anteroposteriorly nearly to the setae of xviii and xix, separated from the marking of the other side by a midventral space about equal to 8-10 intersetal distances. The markings are usually elongated in an antero-posterior direction and have bluntly rounded ends, but may be nearly circular or with a bulge of the lateral or median margin. The markings are usually slightly depressed in a concave fashion but may be level with the surface of the body or protuberant in a flattened or rounded fashion. The margins of the markings are not clearly demarcated but there may be a slight indication of a rim which is lighter in colour than the main portion of the marking.

Internal anatomy.—(Opened 39 specimens).

Septa 4/5-7/8 are present, 5/6-7/8, thickly muscular; 8/9 lacking; 9/10 apparently lacking; 10/11-11/12 are thickened, translucent to opaque; 12/13 is strengthened, usually transparent but translucent in some specimens.

The intestine begins in xv (39). The intestinal caeca are simple, extending forward into the region of xxii-xxiii. There is in each specimen, on the oesophagus, just behind the gizzard, a rudiment of a glandular collar. In many specimens this is simply a ring of tiny greyish bodies, in size and appearance like the granulations of a fully developed collar of other species. In some specimens the granular bodies are

slightly more numerous and aggregated into a more definitely ridge-like protuberance. In a very few specimens the ridge is even more protuberant—though not conspicuously so—and the margin is incised to produce a lobulated appearance.

There are blood glands in v and nephridial masses in v and vi.

The last pair of hearts is in xiii (39). There is a pair of commissures belonging to segment ix in three specimens, in one of which both commissures are of the same size, in another the commissure of the right side is the larger, while in the third the commissure of the left side is the larger. In one specimen there are no commissures belonging to ix. In the remaining specimens there is a single commissure belonging to ix, on the right side (23) or on the left side (12). The hearts of x are empty in many specimens and in this condition are hard to find and difficult to trace. In other specimens the commissures are filled with blood and can be more readily traced. In such specimens these vessels appear to be bound by transparent connective tissue against the anterior face of 10/11 and to pass from the supra-oesophageal vessel to the ventral trunk. No connection of the hearts of x with the dorsal blood vessel has been found. The hearts of ix, x-xiii all pass into the ventral blood vessel.

There is a single, median testis sac on the anterior face of 10/11 and a single median testis sac in xi. The seminal vesicles of xi and xii fill their segments, covering over the dorsal blood vessel, the vesicles of xii sometimes pushing 12/13 back into contact with 13/14. No primary ampullae were found in any of the specimens. The prostates extend through xvii-xix. The prostatic ducts are muscular but rather slender, short, about 2-4 mm. in length.

A flattened glandular mass protrudes slightly into the coelom of xviii-xx from the genital marking. The prostatic duct passes into the parietes in contact with this mass.

The spermathecal duct is usually shorter than the ampulla but may be of the same length. It is not sharply demarcated from the ampulla and narrows gradually in the coelom and parietes. The diverticulum is slenderly tubular ectally, widened entally, looped in a regular zigzag fashion or irregularly looped, the loops as a rule in a flattened rather than a spheroidal mass. The entalmost portion of the diverticulum projects from the mass of loops with an ovoidal or spheroidal appearance.

Remarks.—A single pair of genital markings across 18/19 characterizes 95 specimens, only three specimens of the lot varying from that form. On one of these three worms the genital marking of the right side is lacking. A second specimen has two characteristic genital markings, the right on 17/18 the left on 18/19. The third worm has a pair of markings on 17/18 and in addition a single marking on 18/19 on the right side.

Two specimens have each a double spermatheca; on the left side of viii in one and on the left side of vii in the other. In each case there are two normal spermathecae with ducts, ampullae and diverticula, the two ducts passing into the parietes side by side and in the parietes united to open to the exterior by a common spermathecal pore.

There are numbers of small, ovoidal to spheroidal cysts attached lightly to the septa or parietes in 13 worms. In four other worms there

are gregarinoid parasites in the coelom. Several coelomic nemas were found in one worm.

***Pheretima terrigena* Gates.**

1932. *Pheretima terrigena*, Gates, *Rec. Ind. Mus.* XXXIV, p. 482, fig. 23.

Loikaw, September, G. E. Blackwell, 1 fragment.

The first seven segments and a portion of segment viii are lacking. The intersegmental furrows, dorsal pores and setae are lacking in the clitellar region but the clitellar glandularity is only faintly indicated.

The first functional dorsal pore is in 16/17 but there are pore-like markings in 12/13 and 13/14.

The setal numbers are as follows :—spermathecal on viii, about 18 ; male on xvii—28, on xviii—20, on xix—29.

The male pores are minute, each pore at the centre of an eroded area in the setal circle of xviii.

The paired genital markings are on 17/18 and 18/19, the markings of a pair separated from each other midventrally by a space about equal to 5 intersetal distances. Each marking is a transversely oval area, 7-9 intersetal distances wide transversely, reaching laterally nearly to the line of the median margins of the male pore areas.

The simple intestinal caeca extend anteriorly into xix ; each caecum has four slight pockets on the ventral margin posteriorly.

The primary ampullae of the seminal vesicles of xii project posteriorly from the posterior margins of the vesicles. The prostates are confined to xviii-xix. The prostatic ducts are about 9 mm. in length.

Remarks.—Nemas are present in the coelom of segments ix-xiv.

Aside from the characteristics of the spermathecae which cannot be determined, the Loikaw worm differs from the specimens of *P. terrigena* described in the preceding paper mainly in the number and locations of the post-male-pore genital markings.

***Pheretima velata* Gates.**

1930. *Pheretima velata*, Gates, *Rec. Ind. Mus.* XXXII, p. 321, fig. 13.

var. *clavata* Gates.

1932. *Pheretima velata clavata*, Gates, *Rec. Ind. Mus.* XXXIV, p. 541, fig. 36.

Mala, September, G. E. Blackwell, 52 clitellate specimens.

Kwachi, September, G. E. Blackwell, 8 aclitellate specimens.

Mawchi, September, G. E. Blackwell, 10 aclitellate specimens and one specimen with slight traces of clitellar glandularity.

Kwachi, October, G. E. Blackwell, 3 clitellate but very badly preserved specimens.

The Mala specimens though clitellate are small ; the greatest length is 164 mm., the greatest diameter 7 mm. The aclitellate specimens from the other two localities are much larger, reaching a length of as much as 250 mm., and a diameter of 12 mm.

The pigmentation of the Mala specimens is also not characteristic. Anterior to the clitellum the dorsum is bluish but of a faded or washed

out appearance. There is very little indication of the intersegmental white or yellow bands. Posterior to the clitellum there is no pigmentation or only a faint greyish or brownish colouration. On specimens from other localities the pigmented bands are dark, the colouration brilliant while the intersegmental whitish or yellowish bands are clearly outlined. In the smaller specimens the pigmented bands are not present on the ventrum; in 12 specimens the pigmented bands are completely continuous around the ventrum.

In the largest specimen, a worm from Mawchi, the intersegmental furrows are not visible between the clitellar segments, but setae and dorsal pores are present on or between segments xiv-xvi. The intersegmental bands in the region of 14/15 and 15/16 are pigmented but not as darkly as the segmental bands.

The male setae of xviii on the Kwachi-Mawchi specimens vary from 10-15 as follows:—10—6 worms, 11—4 worms, 12—2 worms, 13—6 worms, 14—1 worm, 15—2 worms.

All of the Mala specimens and 8 of the Kwachi-Mawchi worms were opened.

The spermathecal diverticulum is always contained within an opaque sac.

Nemas were found in the coelom of segments xi-xiv in 48 of the Mala specimens. In 4 of the Mala specimens no nemas were found. No nemas were found in any of the Kwachi-Mawchi worms. No protozoan parasites nor nerve cord cysts were found.

***Pheretima* sp.**

Kamaungthwe River, August, W. D. Sutton, 1 acitellate specimen.

External characteristics.—Length 72 mm. Diameter 3 mm. Colour reddish.

The setae begin on ii on which segment there is a complete circle. There are no mid-dorsal or midventral breaks in the setal circles. The setal numbers are:—spermathecal on vi—22, on vii—22; male on xvii—16, on xviii—10, on xix—14.

The first dorsal pore is in 11/12.

The spermathecal pores are small, transverse slits in 5/6-7/8.

On segment xviii on each side there is a large, round opening into an excavation which is narrowed dorsally in a transverse direction so that the chamber may be said to be of an inverted v-shape. On the anterior face or wall of the excavation is a transversely oval, glistening area, a similar area on the posterior face. The male pore has not been definitely identified but is probably located in the dorsal portion of the chamber median to the glistening areas.

Internal anatomy.—Septum 10/11 is either fragmentary or very delicate and ruptured in dissection, if present, it is displaced anteriorly by the seminal vesicles of xi.

The intestine begins in xv. The intestinal caeca are simple but with small pockets on both the dorsal and ventral margins.

The hearts of x-xiii all pass into the ventral blood vessel.

There are paired testis sacs belonging to x and xi. The seminal vesicles are large and in contact transversely over the dorsal blood

vessel, the posterior vesicles displacing 12/13 and 13/14 posteriorly. The prostates extend through xvii-xix. The prostatic duct is bent into a U-shape or looped, the ectal half of the duct much thickened.

The spermathecal duct is not sharply marked off from the ampulla. The diverticulum passes into the anterior face of the duct.

Dorsal to the male excavation on xviii there is a whitish glandular mass which projects slightly into the coelom.

Remarks.—Somewhat like *P. bellatula* but the genital markings are different.

Pheretima sp.

Kamaungthwe River, October, W. D. Sutton, 1 clitellate specimen.

External characteristics.—Length 110 mm. Greatest diameter *ca.* 5 mm. Colour of dorsum, light reddish to brownish.

The setae begin on ii. The setal numbers are:—spermathecal on vi—23, on vii—21, on viii—20; male on xvii—20, on xviii—15, on xix—21. There are 2 setae ventrally on segment xvi.

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

The clitellum is annular and extends from 13/14 nearly to 16/17. There are no intersegmental furrows or functional dorsal pores.

The spermathecal apertures are minute, four pairs, located anteriorly on vi-ix, the intersegmental furrows immediately in front of the spermathecal pores.

The male pores are minute, each pore at the centre of a transversely oval, almost circular disc in the setal circle of xviii, each disc surrounded by a definite but slight furrow.

The genital markings are two pairs, on 19/20 and 20/21. Each marking is transversely oval, about 5 intersetal distances wide transversely and reaching anteroposteriorly nearly to the setal circles of the segments concerned. The distance between the markings of a pair midventrally is about equal to the transverse width of a single marking.

Internal anatomy.—No septa are strongly thickened, 6/7, 10/11 and 11/12 are slightly muscular.

The intestine begins in xv. The intestinal caeca are simple. There is a glandular collar on the oesophagus just behind the gizzard.

The single commissure belonging to ix is on the right side. The last pair of hearts is in xiii. The hearts of ix-xiii pass into the ventral blood vessel.

There is a single large testis sac belonging to x on the anterior face of 10/11 and a bilobed median testis sac in xi. The seminal vesicles are moderately large, in contact dorsally over the dorsal blood vessel. The vesicles of xii push 12/13 back into contact with 13/14. The prostates are each composed of two main lobes and extend through xvii-xix. The prostatic duct is about $3\frac{1}{2}$ mm. in length, bent into the shape of a U, the ectal half thicker than the ental half.

The spermathecal diverticulum is longer than the combined lengths of the duct and ampulla and passes into the anterior face of the duct close to the body wall. The diverticulum is narrowly tubular, coiled into a series of zigzag loops, the arms of the loops short. The duct is

about equal in length to the ampulla and is narrowed just below the junction of the diverticulum as it enters the parietes.

Remarks.—There are whitish glandular masses in the coelom over the genital markings.

The specimen is softened, the gut just behind the prostatic segments is decomposed.

This worm is nearest perhaps to *P. nemoralis*, but differs from the latter in size, segmental location of the spermathecal pores, number and direction of the long axis of the genital markings, and the possession of a glandular collar on the oesophagus.

Genus *Perionyx* E. Perrier.

The rather extensive collections made throughout the Chin Hills district by Mr. Cope comprise about 8,500 worms of which nearly 8,300 belong to the genus *Perionyx*. The genus is represented in these collections by at least four, possibly 5 or 6 species. Unfortunately the vast majority of the specimens are immature, and it is not possible at the present time to identify immature specimens of *Perionyx*.

Perionyx excavatus E. Perr.

- 1916. *Perionyx fulvus*, Stephenson, *Rec. Ind. Mus.* XII, p. 322, pl. xxi, fig. 16.
- 1918. *Perionyx fulvus*, Stephenson, *Rec. Ind. Mus.* XIV, p. 16, fig. 4-5.
- 1926. *Perionyx fulvus*, Gates, *Ann. Mag. Nat. Hist.* (9) XVII, p. 472.
- 1926. *Perionyx fulvus*, Gates, *J. Burma Research Soc.* XV, p. 213.
- 1926. *Perionyx fulvus*, Gates, *J. Bombay Nat. Hist. Soc.* XXXI.
- 1932. *Perionyx excavatus*, Gates, *Rec. Ind. Mus.* XXIV, p. 360.

“From ground near manure piles and near a water course ” Falam,

March, J. H. Cope, 9 clitellate and 43 partially clitellate specimens.

Falam, August, J. H. Cope, 35 clitellate specimens.

Mt. Popa, September, K. John, 2 clitellate specimens.

Kalaw, September, Saya Ah Sou, 71 clitellate specimens.

Taungyi, September, Saya Ba Te, 203 clitellate specimens.

Letpadan, September, K. John, 3 clitellate specimens.

Prome, September, K. John, 2 clitellate specimens.

Thonze, September, K. John, 1 clitellate specimen.

Henzada, October, K. John, 8 clitellate specimens.

Bassein, October, K. John, 2 clitellate specimens.

Myaungmya, October, William Law, 30 clitellate specimens.

Kyaukpau, January, Saya Ah Sou, 2 clitellate specimens.

In addition to the above the following have been examined :—One tube from the Indian Museum labelled “*P. fulvus* Steph. Inlé, S. Shan States, Sta. 28, W.108/1.” Specimens of *P. fulvus* in the Judson College collection.

External characteristics.—The length of the clitellate specimens varies from 30-180 mm., and the diameter from 3-7 mm. The dorsum is light pinkish to dark reddish, sometimes with a bluish appearance—especially anterior to the clitellum, rarely almost unpigmented, or light yellowish brown posteriorly to a dark reddish brown anteriorly.

The setae begin on ii on which segment there are both dorsal and ventral setae. The setae are usually located on a band or stripe that is much lighter in colour than the rest of the segment, but the width of the band and the degree of distinctness from the rest of the segment vary considerably. A middorsal break of varying width is usually present but may be lacking on any particular segment. There is usually no definite midventral break. The number of spermathecal setae on

viii (*i.e.*, setae between lines parallel to the midventral line and passing across the centres of the spermathecal pores) varies from 4-6. The number of setae on certain segments of several specimens is indicated below.

v.	ix.	xii.	xx.
46	56	52	50*
48	53	52	52*
41	47	47	52*
45	50	47	50*
42	46	48	46*
47	50	50	49†

*. Rangoon. † Falam.

The first dorsal pore is in 2/3-5/6.

The clitellum is annular, extending over segments xiii-xvii. On several specimens the clitellum covers only segments xiv-xvii but these specimens may not be fully mature. Circles of setae are present on all segments and the intersegmental furrows are usually faintly indicated. There are no functional dorsal pores but the pore in 17/18 is functional. There is usually no functional pore in 12/13 and often the pores in 10/11 and 11/12 do not appear to be functional.

The spermathecal pores are closely paired in 7/8-8/9. The pores may be transverse slits with the anterior and posterior margins in contact or the pores may be circular and open. In the latter case the aperture is filled with a transparent, yellowish or brownish plug which may project externally. Occasionally a definite circular rim around the aperture is marked off from the parietes by a slight but definite groove.

The single female pore is presetal on xiii, in the midventral line, usually about half way between the setae and 12/13.

The male apertures have not been definitely identified.

The male area is a small, transversely placed midventral area in the setal circle of xviii which does not reach anteriorly to 17/18 or posteriorly to 18/19. The anterior portion of the area may be depressed transversely. When the anterior margin is depressed the posterior margin is usually depressed in a similar fashion. Lateral margins of the area are rarely indicated. The major portion of the area is occupied by two papillae or tubercles which do not quite meet in the midventral line. On each of these tubercles there is a transversely slit-like depression, the margin of which may be slightly tumescent and (or) lobulated. On each male tubercle there are 2-6 black dots visible, the tips of the penial setae. These black dots and the slit-like depressions can be recognized on acitellate specimens before any other characteristics of the male area have appeared.

The nephridiopores are located on the anterior margins of the segments near to the intersegmental furrows. The first nephridiopores are on segment ii.

Internal anatomy.—No septa appear to be especially thick relative to other septa, but in the acitellate specimens especially all septa seem to be unusually thick.

The oesophagus in segment xiii of recently killed specimens is distended with calcareous particles.

The last pair of hearts is in xii (25 specimens).

The spermathecae are large, erect and with the ental ends in contact transversely over the dorsal blood vessel. The duct is short and stout, usually less than one half the length of the ampulla. In many of the specimens there are no spermathecal diverticula. In others there may be a very small, rounded, knob-like diverticulum on the duct near the ampulla, or there may be a row of such knobs running almost completely around the duct. The spermathecal duct and the ampulla are filled with a transparent mass in which are imbedded whitish, iridescent masses of spermatozoa. Similar masses of iridescent whitish matter may be present in spermathecae of specimens with little or no trace of clitellar glandularity.

The bundle of penial setae is on the median face of the prostatic duct. The penial setae are .62-.9 mm. in length. The thickness varies from .015-.025 mm. The shape of the tip varies; it may be bluntly rounded, flat and spatula-like, bluntly pointed, finely pointed or truncate. The number of the rings of spines is also variable. In several Rangoon specimens the variation is as follows:—9 rings—1 seta, 10 rings—5 setae, 11 rings—1 seta, 12 rings—2 setae, 13 rings—1 seta, 14 rings—1 seta, 15 rings—1 seta. In the Kalaw specimens the number of rings varies from 6-10; in the Taungyi specimens from 5-9; in the Chin Hills specimens from 8-16.

Remarks.—After careful examination of the specimens of *P. fulvus* and comparison with specimens of *P. excavatus* I can find no justification for the retention of *fulvus* even as a variety.

***Perionyx viridis*, sp. nov.**

Falam, Chin Hills, August, J. H. Cope, 20 clitellate specimens.

Tiddim, September, J. H. Cope, 1 a clitellate specimen.

Haka, October, J. H. Cope, 37 a clitellate specimens.

External characteristics.—Length 40-78 mm. Greatest diameter 3 mm. Colour of dorsum anterior to the clitellum, brownish; posterior to the clitellum light brownish. The specimens, when first received at the laboratory several weeks after collection had a very definite greenish colouration of the dorsum which has now disappeared except for very slight traces. Number of segments of 3 specimens:—120, 125, 103.

The setae begin on ii, are small, not conspicuously protuberant from the parietes. There is usually no midventral break in the setal circles; there may or may not be a slight mid-dorsal break of varying width. There are 6-8 spermathecal setae on vii. The number of setae on xx varies from 42-47.

The first dorsal pore is in $3/4$ in 3 specimens; in $4/5$ in many, if not all, of the other specimens. There is, however, a more or less definitely pore-like marking in $3/4$ on all of these worms.

The clitellum is annular, extending—when most fully developed—from $12/13$ to $17/18$ but the clitellar glandularity may be entirely lacking on xvii or present only dorsally. Colour reddish, yellowish or brownish. Intersegmental furrows are slightly indicated, dorsal pores are lacking but setae usually can be recognized.

The spermathecal apertures are closely paired in 7/8, but the margins of the pores do not quite meet. The pores may be transversely slit-like or rounded. In the latter case the aperture is filled by a plug of transparent material.

The single female pore is on xiv in the midventral line anterior to the setae.

The male pores have not been identified and must be minute.

The appearance of the male region on xviii varies considerably but many of the apparent variations appear to represent merely different stages of development of the area. On some worms there are two male tubercles or papillae, oval in outline and slightly diagonal in position so that the posterior ends of the tubercle are slightly nearer to the midventral line than the anterior ends. On each tubercle is a slit-like but shallow depression. On a few specimens the two male tubercles are fused so that there is a single, thickly crescent-shaped male area, the concavity of which is directed anteriorly.

Internal anatomy.—(Opened 12 specimens).

There is a rudimentary gizzard, apparently in v. Septa 5/6-6/7 are very delicate and pushed posteriorly to the level of 7/8 by a mass of tissue which covers the gut dorsally and laterally. The intestine begins in xv or xvi and may or may not be narrowed in the region of segments xvii-xix.

The oesophagus is swollen in xiii, the lumen of the gut in that segment is filled with calcareous granules.

The last pair of hearts is in xii in each specimen.

The testes and male funnels are free in x and xi. The seminal vesicles of xi fill the segment and are in contact dorsally over the dorsal blood vessel. The vesicles of xii are also in contact dorsally and extend through some or all of segments xiii-xvii. The prostates are confined to segment xviii. The prostatic duct which is surrounded by the prostate and connective tissue is bent into 2 J-shaped loops in such a way that the short arm of the two loops is identical. The ectal portion of the duct is stoutish and glistening.

The spermathecal duct is stoutish, just over 1 mm. in length and only slightly narrower than the ampulla which is shorter than the duct. On the anterior face of the duct near the ampulla is the diverticulum. This is usually spheroidal and without a stalk but may be represented only by a low, transverse ridge, or by two or three tiny rounded protuberances. Rarely there is no trace whatever of a diverticular protuberance.

The penial setae are small and slender, hard to find and difficult to remove after they have been found. Many of the setae were broken in attempting to pull them out of the parietes. The length varies from .65-.76 mm., the greatest thickness from .011-.013 mm. The shaft is straight except for a slight bend near the tip. The ornamentation consists of 12-14 annular rows of elongate spines or teeth.

Remarks.—One of the specimens has three pairs of spermathecal pores in 6/7-8/9, and a male area on xvi which is the penultimate segment of the clitellum. There are also abnormalities of certain of the reproductive organs but the penial setae and the spermathecae are normal. The abnormalities probably arose in the course of regenerating a lost anterior

end. Supernumerary spermathecae are produced by *P. excavatus* in regenerating a lost anterior end.

The acitellate specimens from Haka and Tiddim have a greenish colouration similar to that of the Falam specimens. What appear to be very minute rudiments of the spermathecal pores in 7/8 can be seen with brilliant illumination. The penial setae are similar to those of the types but are slightly larger, .6-.82 mm. in length and about .015 mm. in diameter. There are 16-20 annular rows of spines on the penial setae. The specific status of the worms cannot be definitely determined.

Only one species of *Perionyx* with spermathecal pores in 7/8 has been recorded hitherto from India and Burma viz., *P. ditheca* Steph. 1931, from Thandaung, Burma. From this, *P. viridis* is distinguished by the presence of the penial setae.

Perionyx sp.

- A. John Lawrence Island, Andaman Islands, October, C. Amirthalingam, 11 acitellate specimens.
- B. Akyab, September, Bruce Taw, 2 acitellate specimens.
- C. Mt. Popa, September, K. John, 13 acitellate specimens.
- D. Maymyo, August, K. John, 28 acitellate specimens.
- E. Taungyi, September, Saya Ba Te, 217 acitellate specimens.
- F. Myitkyina, September, L. R. Dudrow, 6 acitellate specimens.
- G. Kyaukpyu, January, Saya Ah Sou, 36 acitellate specimens.
- H. "From ground near manure piles and near water courses", Falam, March, J. H. Cope, 6,906 acitellate specimens.
- I. Falam, August, J. H. Cope, 89 acitellate specimens.
- J. Tiddim, September, J. H. Cope, 1 anterior fragment, clitellate.
- K. Tiddim, September, J. H. Cope, 125 acitellate specimens.
- L. Tiddim, September, J. H. Cope, 3 acitellate specimens.
- M. Haka, October, J. H. Cope, 523 acitellate specimens.
- N. Chin Hills District—south, January, J. H. Cope, 361 acitellate specimens.
- O. Chin Hills District—south, January, J. H. Cope, 17 acitellate specimens.
- P. Tiddim, September, J. H. Cope, 3 clitellate anterior fragments.
- Q. Kamaungthwe River, August, W. D. Sutton, 7 acitellate specimens.

A.-G. Probably *P. excavatus*; the worms are very similar in appearance to immature specimens of *P. excavatus* from Rangoon. The penial setae are like those of *P. excavatus*. The worms were collected at localities at or near which only *P. excavatus* has hitherto been found.

H. Possibly *P. excavatus*. The penial of several specimens were examined and found to be like those of *P. excavatus*.

I. Possibly *P. excavatus*.

J. Spermathecal pores paired in 7/8-8/9. Male area a transversely oval depression anterior to the transverse setal line. The body wall is finely wrinkled on the anterior margins of viii and ix between the spermathecal pore lines. The colouration is reddish as on the majority of specimens of *P. excavatus* but the penial setae are like those of *P. viridis*. The spermathecae are somewhat like those of *P. viridis* but the duct is slightly slenderer, the ampulla smaller, the diverticulum or diverticula lateral.

K. Probably not *P. excavatus*, though the spermathecal pores or rudiments of the pores are in 7/8-8/9. The length varies from 120-

175 mm. The greatest diameter varies from 6-7 mm. The penial setae are somewhat like those of *P. excavatus*.

L. Each of these worms was regenerating a tail when killed. Diameter 5 mm. Colour, dark reddish. First dorsal pore in 4/5. Spermathecal apertures small but patent pores in 7/8-8/9, the pores more widely separated than in *P. excavatus*. Spermathecal setae on viii, 12-16; number of setae on xx, 65-73. The setae are more closely spaced ventrally than dorsally. The spermathecal ampulla is 2-3 times the length of the duct and only a trifle wider than the duct. Diverticulum as a ridge on median face of duct near ampulla. Aside from the spermathecae no reproductive organs were found. Probably not *P. excavatus*.

M. Possibly *P. excavatus*.

N. Possibly *P. excavatus*.

O. Not *P. excavatus*. The pigmentation is annular on each specimen. Each segment is girdled by a broad pigmented band which is about equal in length to two-thirds of the length of the segment, the setal circle at the centre of the band. The band is dark blue dorsally, pinkish, reddish or purplish ventrally. In the region of each intersegmental furrow is an unpigmented whitish or yellowish band the margins of which are sharply demarcated especially on the dorsum. The spermathecal pores in 7/8-8/9 are widely separated; spermathecal setae on viii, ca. 21. There are rudiments of paired and fairly widely separated male areas on xviii.

P. Probably not *P. excavatus*. The worms are very brittle and break easily but the setae are unusually easy to count, the numbers are indicated below.

v	ix	xii	xx
55	58	59	59
54	61	64	70
50	53	58	58

The clitellum extends from 12/13 or 13/14 to 17/18. The spermathecal apertures are open, rounded pores in 7/8-8/9, the circumferential lips of the pores in contact at the midventral line. The single male area is a depressed region on xviii, the anterior margin concave, the concavity facing posteriorly, the posterior margin shorter than the anterior margin. In the wider anterior portion of the depression on each side there is an oval, diagonally placed male tubercle. On each tubercle there is a diagonal slit-like depression within which can be seen the tips of several penial setae.

The internal anatomy is similar to that of *P. excavatus*. The spermathecal ampulla is elongately ovoid and of about the same length as the duct which is 1-1½ mm. long and only slightly narrower than the ampulla. The diverticulum, a low ridge of 2-4 small, seminal chambers, is on the median face of the duct near the ampulla.

The penial setae are almost straight; a very slight bend at the extreme tip; 1.1-1.3 mm. long and .02-.025 mm. thick at region of greatest thickness; ornamented with 13-23 annular rows of spines.

Q. Length 130-160 mm. Maximum diameter 5-5½ mm. Each of these worms is characterized by a dark purplish pigmentation of the dorsum. No traces of reproductive organs were found.

Sub-family *OCTOCHAETINAE*.Genus *Octochaetus* Beddard.

Earthworms from New Zealand as well as from India have been assigned to this genus but "Michaelsen has pointed out that the Indian species of *Octochaetus* differ from those of New Zealand in possessing better developed calciferous glands. For this reason, and on grounds of geography, he divides the genus into two sub-genera, *Octochaetus* for the New Zealand and *Octochaetoides* for the Indian species" (Stephenson, 1930, p. 844).

There are, according to Stephenson, four or five species of *Octochaetus* in New Zealand. These are, presumably, *O. antarcticus*, *O. huttoni*, *O. michaelseni*, *O. multiporus*, and *O. thomasi*. In each of these species the dorsal blood vessel is said to be double. Furthermore, in these worms all septa behind the gizzard are present while six or seven of the septa immediately behind the gizzard are muscularly thickened. Thus 6/7-12/13 are thickened in *O. michaelseni* and *O. thomasi*; there are seven thickened septa in *O. multiporus*; six stout and two not quite so stout in *O. huttoni*, while in *O. antarcticus* 7/8-12/13 are thickened. The spermathecal pores are located apparently in 7/8-8/9. The spermathecae are characterized by the presence of several, minute diverticula:—"a number of small, saccules, irregularly arranged and embedded in the wall of the duct" in *O. michaelseni*; "embedded in the body wall" in *O. multiporus*; "Numerous, minute diverticula crowded round duct" in *O. thomasi*; "minute clump of diverticula" in *O. huttoni*; "three or four small diverticula clustered around the duct" in *O. antarcticus*. There is no indication in the descriptions of the New Zealand species of the presence of copulatory setae in segments viii and ix. (This apparent absence may, however, be due to the failure to search for such setae).

In the Indian section of the genus *Octochaetus* there are 20 species; *aitkeni*, *barkudensis*, *barnesi*, *beatrice*, *birmanicus*, *castellanus*, *excavatus*, *fermori*, *ganeshae*, *hodgarti*, *maindroni*, *montanus*, *paliensis*, *pattoni*, *philoti*, *pittnyi*, *prashadi*, *roseus*, *surensis* and *thurstoni*.

In all these species, except in *O. aitkeni*, *barnesi*, *excavatus*, *montanus*, *pattoni* and *prashadi*, the spermathecal pores are segmental, located on viii and ix rather than intersegmental and in 7/8-8/9.

Copulatory setae have been described from all Indian species with the exception of *O. aitkeni*, *beatrice*, *fermori*, *hodgarti*, *maindroni*, *pittnyi* and *thurstoni*. With regard to *O. fermori*, Gates (1930, p. 327) states that "Setae *a* and *b* on viii and ix are slightly modified," but no figure or indication as to the type of modification is given. In *O. fermori* these setae are small and the isolation and removal of the setae is a matter of some difficulty. Quite possibly there are copulatory setae in the other species just listed, which have been overlooked or were not found because of their small size.

In *O. castellanus* all septa are present behind the gizzard but only two are thickened. In *O. montanus* no septa are lacking but 5/6-6/7

are very thin. A similar condition prevails, apparently, in *O. philloti*. In *O. ganeshae*, *barnesi*, and *paliensis* septa 5/6-6/7 are lacking; in *O. birmanicus* and *fermori* 5/6-7/8 are lacking; in *O. excavatus* 5/6-9/10 are lacking. In *O. hodgarti*, *roseus* and *prashadi* only 6/7 is lacking. In *O. barkudensis*, and *beatrice* 6/7-7/8 are lacking; in *O. thurstoni* 6/7-7/8 and possibly 8/9 are lacking; while in *O. pattoni* 6/7-8/9 are very thin and in part vestigial. No information is available as to the condition of the septa in *O. aitkeni*, *maindroni*, *pittnyi* and *surensis*. Presumably the last three species just named are not very different so far as the post-gizzard septa are concerned from other Indian species or attention would have been directed to this characteristic.

There are said to be no spermathecal diverticula in *O. beatrice*, while *O. barkudensis* is said to have no spermathecal diverticula or one or two diverticula, either stalked or sessile. In *O. maindroni* the diverticulum is said to be a row of about seven chambers at the end of the spermathecal duct, almost encircling the duct. In all other Indian species there is a single, well-marked, and usually fairly large spermathecal diverticulum.

There is no record of the occurrence of a double, dorsal blood vessel in any of the Indian species.

The first descriptions of species of the genus date back twenty-five to thirty-five years or more. Some of the species have not been studied since the publication of the original descriptions. *O. aitkeni* in particular is known only from a brief description published in the preceding century since which time the species has not been seen. In these circumstances there are many points in connection with worms of this genus about which additional information is needed.

It is, however, fairly evident from the accounts given by the various writers, and in spite of the incompleteness of these accounts, that the Indian species differ from the New Zealand species not only with regard to the calciferous glands (which appear to be not only better developed, but morphologically different) but also with regard to the single character of the dorsal blood vessel; the possession of copulatory setae on viii and ix; the well developed, single spermathecal diverticulum rather than a number of minute saccules embedded in the spermathecal duct; the loss of a varying number of post-gizzard septa or the development of muscularity in a small number of post-gizzard septa and (in the majority of species) by the segmental rather than the intersegmental locations of the spermathecal pores. These differences together with geographical considerations are quite sufficient to justify a separation of the two groups of species generically.

Genus **Octochaetoides** Michaelsen.

Definition.—Setae lumbricine. One oesophageal gizzard. Calciferous glands as sacs sharply delimited from the oesophagus, one pair in xv or xv and xvi, or two pairs in xv and xvi. Purely micronephridial. Sexual apparatus purely microsclecine.

This definition is practically the same as that of Stephenson (1930) for the sub-genus *Octochaetoides*. With the acquisition of further information with regard to some of the incompletely described species, it may be possible to include in the generic definition statements with regard to some of the peculiarities of the Indian species aside from the calciferous glands.

Distribution.—With a single exception, *Octochaetoides* appears to be confined to India (including Burma). *O. birmanicus* is fairly widely spread throughout Lower Burma. *O. fermori* is widely distributed throughout both India and Burma and has been reported from the Malay Peninsula by Stephenson.

***Octochaetoides birmanicus* (Gates).**

1925. *Octochaetus birmanicus*, Gates, *Ann. Mag. Nat. Hist.* (9) XV, p. 55.

Kyauktan, K. John, August, 12 specimens.

Thanatpin, August, K. John, 18 specimens.

Pegu, August, K. John, 14 specimens.

Coomzamu, September, K. John, 14 specimens.

Thanchitaw, September, K. John, 12 specimens.

Kochi, September, K. John, 12 specimens.

Bassein, September, K. John, 12 specimens.

Tantabin, September, K. John, 9 specimens.

Toungoo, September, K. John, 16 specimens.

Thonze, September, K. John, 11 specimens.

Letpadan, October, K. John, 10 specimens.

Bassein, October, K. John, 15 specimens.

Moulmein, October, K. John, 10 specimens.

External characteristics.—The first dorsal pores is in 11/12 on 1 specimen, in 12/13 but with a pore-like marking in 11/12 on 1 specimen, in 12/13 on 232 specimens, in 18/19 on 1 specimen.

The spermathecal pores, on viii and ix, are in the transverse setal lines, though *a* or *b* or both may be displaced anterior to or posterior to that line.

Each specimen (100) has two female pores on a transversely oval or bilobed, whitish area in *aa*.

The male pores can be identified, without dissection only very rarely. At each end of each seminal groove there is a transversely slit-like aperture through which the penial setae protrude.

Internal anatomy.—(Opened 50 specimens).

Anterior to the gizzard there is one thickly muscular septum, attached to the parietes in the region of intersegmental furrow 4/5. The next septum is 8/9, septa 5/6-7/8 lacking or perhaps represented by slight rudiments.

On the oesophagus just behind the gizzard there is a more or less completely circumferential, whitish collar, a low but knife-like ridge somewhat similar in appearance to the post-gizzard oesophageal collar of certain species of *Pheretima* but not granular. The intestine begins in xvii in each specimen, 16/17 is bulged anteriorly into a funnel-shape.

The last pair of hearts is in xiii (50). Anterior to 8/9 three vessels pass out laterally and then ventrally from the dorsal trunk on each side. The pair just anterior to 8/9 representing the hearts of viii can always be traced to the ventral trunk. The next pair (anteriorly) representing the hearts of vii have not been traced to the ventral trunk. The third pair of vessels pass laterally to the dorsal surface of the gizzard and can be traced for longer or shorter distances passing ventrally on the posterior margin of the gizzard. If this pair of vessels represents the hearts of vi the gizzard must be considered as in vi. The commissures of vi, may be very slender and difficult to trace or about as large

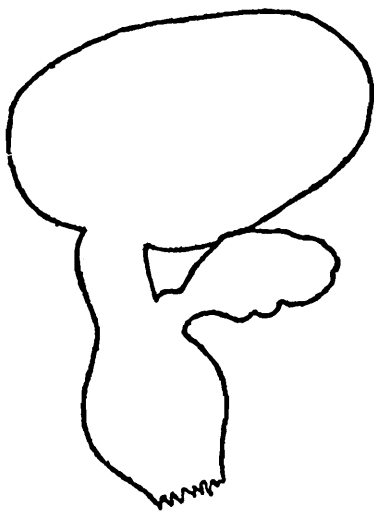


FIG. 22.—*Octochaetoides birmanicus* (Gates).
Spermatheca $\times$ ca. 14.

as the commissures of vii and viii. Anterior to the gizzard is a pair of commissures belonging to v, which can be traced in some specimens to the ventral trunk but in others only to the ventro-lateral trunks. The ventral vessel anterior to 8/9 is very much slenderer than from 8/9 posteriorly. Mesial to each heart of viii is a commissure as large or larger than the heart, connecting the supra-intestinal vessel and the ventro-lateral trunk. This commissure might easily be mistaken for a heart but no connection to the dorsal blood vessel has been traced and the vessel has been disregarded in making segmental enumerations.

Segments x and xi are not opened by dorsal dissection. Each specimen has a pair of seminal vesicles in ix and a pair in xii.

Each specimen has a pair of small receptacula ovarum in xiv on the posterior face of 13/14 containing numbers of ova with a more vacuolated appearance than the ovarian ova of xiii.

The spermathecae of ix are always anterior to 8/9.

Remarks.—A number of specimens with abnormalities of the male genital field have been collected; one is especially interesting. On this worm there are paired female pores on xiv and xv and paired ovaries in xiii and xiv. On each of the segments xxi-xxviii the posterior portion of the male genital field is serially repeated. On each of these segments, on each side in the region of *ab* is a longitudinal seminal groove, extending from the middle region of the segment anteriorly on to the posterior portion of the preceding segment. In the midventral region of each intersegmental furrow from 20/21-27/28 there is a fairly deep, transverse depression, reaching on each side to just beyond *b*. On the posterior face of each depression in *aa* is a pair of transversely oval papillae.

Aclitellate specimens of *O. birmanicus* as small as 50×2 mm. can be definitely identified. On worms of that size there is as yet no trace or only very faint indications of the presence of the seminal grooves but seta *a* on each side of segments xvii and xix is very close to seta *b* and quite lateral to setal line *a*. Furthermore, setae *a* and *b* of xviii are lacking as a rule, although four specimens of more than a hundred

examined have a single ventral seta on each side of xviii, in setal line *a*. On slightly larger specimens the future positions of the seminal grooves are indicated by longitudinal whitish lines. These lines, nearly straight, slightly bent towards the midventral line at the ends or slightly irregular, are about in line with *b*, or very slightly median to *b*. On many specimens, at this stage, setae *a* and *b* of xvii and xix are either withdrawn deeply into the parietes or are lost, only the setal pits visible. On slightly older specimens the male pore can be recognized in the seminal groove in line transversely with the setae of xviii. At each end of each seminal groove and between the two setal pits is a minute pore, of almost exactly the same size and appearance as a setal pit. This aperture is presumably the prostatic pore. Some specimens at this stage, and almost all slightly larger worms show a slight tumescence of a midventral area extending across segments xvii-xix on which intersegmental furrows 17/18 and 18/19 are no longer visible. On much larger specimens the transverse depression on the posterior portion of xvii and the similar depression on the anterior portion of xix has become visible, along with an increase of tumescence of an outer margin of the genital area and of a middle portion of the area on xviii. Later still a whitish, firm, slight tumescence develops at each side of the seminal groove.

The spermathecal pores can be identified in very young specimens, in *ab*. Setae *a* and *b* of each side of viii and ix are either lacking or completely withdrawn into the parietes so that only setal pits are visible. On nearly mature specimens the copulatory setae are always conspicuously protuberant. On mature specimens the copulatory setae may or may not be visible externally, the setal pits are of about the same size as the spermathecal pores. The pubescence posterior to a spermathecal pore may be evident in fairly young specimens, often not sharply demarcated, and may be only faintly indicated on mature specimens.

One specimens has seta *a* of each side of segment vii modified, similar in size and ornamentation as well as shape to the copulatory setae of viii and ix.

***Octochaetoides fermori* (Mich.).**

1929. *Octochaetus lunatus*, Gates, *Proc. U. S. Nat. Mus.* LXXV, 10, p. 24.
1930. *Octochaetus lunatus*, Gates, *Rec. Ind. Mus.* XXXII, p. 325.
1931. *Octochaetus lunatus*, Gates, *Rec. Ind. Mus.* XXXIII, p. 417.
1932. *Octochaetus fermori*, Gates, *Rec. Ind. Mus.* XXXIV, p. 361.

Henzada, August, K. John, 65 clitellate specimens.

Maymyo, August, K. John, 3 clitellate specimens.

Coomzamu, September, K. John, 4 clitellate specimens.

Pyinmana, September, K. John, 1 clitellate specimens.

Magyidaung, September, K. John, 2 clitellate specimens.

Kyappea, September, K. John, 83 clitellate specimens.

Mondine, September, K. John, 4 clitellate specimens.

Mt. Popa, September, K. John, 1 clitellate specimen.

Tonbo, September, K. John, 3 clitellate specimens.

Sagaing, September, K. John, 105 clitellate specimens.

Kyaukkylene, September, K. John, 38 clitellate specimens.

Kaungmudaw, September, K. John, 55 clitellate specimens.

Akyab, September, Bruce Taw, 5 clitellate specimens.

Namkham, September, G. S. Seagrave, 1 clitellate specimen.

Thonze, September, K. John, 11 clitellate specimens.

Bassein, October, K. John, 8 clitellate specimens.

Padali, October, Bruce Taw, 5 clitellate specimens.

The first dorsal pore is in 11/12 on 10 specimens; in 12/13 but with a definitely pore-like marking in 11/12 on 2 specimens, in 12/13 on 135 specimens. On 50 of the latter specimens there is a small, slightly pore-like or blackish marking on the anterior margin of xii near 11/12.

The septa are as in *O. birmanicus*. Segment x is opened by dissection but not segment xi.

The intestine begins in xvii. There is a collar on the oesophagus just behind the gizzard as in *O. birmanicus* but often the collar is hard to find.

The commissures from the dorsal blood vessel are as in *O. birmanicus*.

Protozoan parasites have been noted in the coelom of the region behind the prostates in several specimens.

Genus **Eutyphoeus** Michaelsen.

The prostomia do not appear to be of any importance so far as the systematics of Burmese species of *Eutyphoeus* are concerned. No mention is therefore made of these structures in the specific descriptions.

The intersetal intervals vary in width intraspecifically not only from one worm to another but also from one region of the body to another. It is not possible therefore to represent the relationships between the intersetal intervals by compact numerical formulae. The practice adopted in the following account is to indicate in a general way by the use of (< and >) signs the relationships between the intervals on segment xx.

In every Burmese species there are two septa anterior to the gizzard, 4/5-5/6; usually both are muscular, 5/6 often thicker than 4/5. Septa 6/7-7/8 are always lacking. Septa 8/9, 9/10, and 10/11 are displaced posteriorly and are usually thickly muscular.

A single, large gizzard is always present in the region of segments vi-viii. No further mention of this organ is necessary except in the case of *E. strigosus* where the gizzard is either deformed or curiously modified. Similarly calciferous glands of a type characteristic to the genus are always present in the gut wall in the region of segment xii. Lateral intestinal caeca are lacking in all dissected specimens in the absence of any statement to the contrary. Supra-intestinal glands have been noted in every species except in *E. macer* where they have not been positively identified. The intestine begins in segment xv in all specimens in which this characteristic was noted. The last pair of hearts is in xiii in all specimens in which this characteristic was noted with but one exception. Hearts of ix-xii are also always present. This lack of variation, as shown in the table below, is to be compared with the variation in method of ending anteriorly of the dorsal blood vessel

and in the presence or absence of vascular commissures belonging to vii, vi and v, as indicated in connection with each species hereinafter—

Species.				Number of Specimens.	Last pair of hearts in xiii.	Intestine begins in xv.
<i>annulatus</i>	.	.	.	50	50	50
<i>bifovis</i>	.	.	.	25	25	25
<i>bullatus</i>	.	.	.	28	28	28
<i>constrictus</i>	.	.	.	69	69	69
<i>excavatus</i>	.	.	.	25	25	25
<i>falcifer</i>	.	.	.	7	7	7
<i>foveatus</i>	.	.	.	40	40	40
<i>hastatus</i>	.	.	.	25	25	25
<i>longiseta</i>	.	.	.	40	40	40
<i>macer</i>	.	.	.	2	1*	..
<i>manipurensis</i>	.	.	.	27	27	27
<i>marmoreas</i>	.	.	.	12	12	12
<i>peguanus</i>	.	.	.	100	100	100
<i>planatus</i>	.	.	.	25	25	25
<i>rarus</i>	.	.	.	82	82	82
<i>sejunctus</i>	.	.	.	8	8	8
<i>strigosus</i>	.	.	.	21	21	21

* One specimen lacks a heart in xiii on one side.

The figures in the first column indicate, not the number of specimens dissected, but the number of specimens in which the position of the last pair of hearts and the origin of the intestine were actually noted.

The seminal vesicles of xii are always present, well developed, flattened against the oesophagus in the region of segments xi-xii and call for little further comment in the specific descriptions beyond some indications of size, and occasionally posterior extent. The ovaries and oviduct funnels are also always present, in segment xiii, and require no further comment as a rule. Male funnels are lacking in segment x in absence of definite statement to the contrary.

A rather extensive series of observations was made on variation in size and shape of the spermathecal diverticula and the number and arrangement (grouping) of the seminal chambers. The variation is so great, not only from one individual to another but also from one spermatheca to another and from one side of a spermatheca to the other that little if any use can be made of these characteristics for systematic purposes. To be compared with this variation is the almost entire absence of intraspecific variation in the number of spermathecal diverticula and the location of the diverticula on the duct (*vide* specific descriptions hereinafter).

The penial setae of large numbers of specimens are either softened or broken and therefore offer little of value for purposes of systematics.

The vestibular invaginations and the penes or penial bodies do not appear to be as widely variable as other characteristics that have been used for systematic purposes and probably are more useful in this connection than other structures the characteristics of which have been used as criteria of specific distinction.

Eutyphoeus annulatus Gates.

1931. *Eutyphoeus annulatus*, Gates, *Rec. Ind. Mus.* XXXIII, p. 418. figs. 43-44.

var. typicus Gates.

Kaungmudaw, September, K. John, 23 acitellate and 43 clitellate specimens.

Sagaing, September, K. John, 3 acitellate and 22 clitellate specimens.

External characteristics.—Length of clitellate specimens to 70 mm., diameter to 4 mm.

Seta *d* is not displaced dorsally on the posteriormost segments.

The first dorsal pore is in 10/11 on 1 specimen; in 11/12 on 20 specimens but with a non-functional pore-like marking in 10/11 on 10 specimens.

The clitellum may reach to 17/18.

The spermathecal pores are small, transverse slits in *c* or just median to *c*.

There are two female pores (90).

On the smallest immature specimens there is a minute pit on xvii on each side, in *b* or very slightly median to *b*. On slightly larger specimens this pit is at the centre of a circular, whitened area. On larger specimens at the centre of the whitened area which now dislocates 17/18 anteriorly and 18/19 posteriorly is a circular depression in which is the minute rudiment of a penis. On still larger specimens and on the clitellate worms the whitened area is invaginated so that the penis is no longer visible. The vestibula are not as definitely characterized as in *E. foveatus* and some other species but are somewhat slit-like, often with a slight diagonal appearance as if the posterior end were slightly nearer to the midventral line than the anterior end. The margin of the whitened area of clitellate specimens is protuberant as a sort of U-shaped ridge which is especially thick at the median end of the arm. The vestibular wall is smooth and glistening.

The genital markings are as previously indicated. Of the clitellate Kaungmudaw specimens, 28 have pre-, intra-, and post-clitellar markings; 13 have pre- and intra-clitellar markings only, while 1 has pre- and post-clitellar markings only. The Sagaing specimens have markings in all three localities.

Internal anatomy.—(Opened 25 specimens).

The median intestinal caeca are in xxviii-xxxv as shown below—

Segments.	Specimens.
xxviii-xxxi	3
xxviii-xxxii	3
xxviii-xxxiii	8
xxviii-xxxiv	1
xxix-xxxii	5
xxix-xxxiii	2
xxix-xxxiv	2
xxix-xxxv	1

Each specimen has paired hearts belonging to vi, vii and viii. The dorsal blood vessel in each worm is continued into the pharyngeal

region. In v there are large (*i.e.*, readily visible, but not as large as hearts of vi) commissures in 17 specimens; much smaller commissures visible only after search in 5 specimens; no commissures found in v in 3 specimens.

No male funnels were found in x in 24 specimens. One worm has paired male funnels in x. The vas deferens of each side is single. The testis sac is median, ventral to the oesophagus. The hearts of xi do not at first appear to be bound to the oesophagus but very delicate connective tissue, which can be demonstrated by pulling the hearts away from the oesophagus, does hold these commissures to the gut. The prostatic ducts are 5-6 mm. in length, the ental half almost transparent, slightly thinner than the opaque ectal half. The bulbus ejaculatorius is well developed, longer than wide, conspicuously protuberant into the coelom at the side of the prostatic duct in each specimen, sometimes covered over with tissue which is usually very delicate and transparent. There is a definite, more or less conical protrusion into the coelom on each side in xvii, the roof of the vestibulum into which the prostatic duct and the bulbus ejaculatorius passes.

The penial setae from at least one side of each of the dissected specimens were examined. The tips of practically all, reserve as well as functional are more or less softened. The two functional setae are dark yellowish brown, the reserve setae very light yellowish or greenish. There may be one, two or three constrictions of the seta at various distances from the tip, or there may be two constrictions close together or these constrictions may be entirely lacking.

The spermathecal ducts are short and stout, barrel-shaped or slightly flattened, shorter than the ampulla, narrowed just before passing into the parietes, the duct easily pulled out of the parietes. Every spermatheca has one lateral and one median diverticulum. On the left side of one worm there are two spermathecae the ducts of which pass into the parietes side by side. Each spermatheca of the pair has two diverticula and an independent external pore.

Remarks.—In the coelom of each of the specimens there are coelomic parasites scattered in masses throughout the whole length of the body but in especially large numbers in segments ii-iv, vi-viii and xi-xii. The parasites are small, ovoid bodies, each containing pseudonavicellae cysts.

Slight pressure on an unopened worm forces out of the anterior dorsal pores coelomic coagulum containing pseudonavicellae cysts and nematode ova.

In segment xxvii on the left side of one specimen there is a finger-like outgrowth midlaterally from the intestine which passes through the coelom and the parietes, the blunt end of the outgrowth visible externally through a round aperture in the epidermis.

One worm has no ova, the eggs being replaced by masses of parasites.

var. *compositus*, var. nov.

Tonbo, September, K. John, 1 acitellate and 5 clitellate specimens.

Kyauk-kyone, September, K. John, 47 acitellate and 89 clitellate specimens.

External characteristics.—Length to 85 mm. Greatest diameter to 4 mm. The colour of the dorsum is brownish anterior to the clitellum and of about the same depth as in the variety *typicus*, but posterior to the clitellum the pigmentation is very slight (except in the region of the mid-dorsal line) or lacking.

The first dorsal pore is in 11/12 on 25 specimens but there is a definitely pore-like, though apparently non-functional marking, in 10/11 on 17 specimens.

The clitellar thickening of the epidermis is lacking in the region of the midventral line.

The spermathecal pores are in *c* or just median to *c*.

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

The vestibular pores are rounded, in *b* or very slightly lateral to *b*. Immediately anterior to and just posterior to each pore is a transversely oval, greyish area, extending from *a* or very slightly median to *a* into *bc* very slightly lateral to *b*. The vestibula are short but well-like, the penes with short lips or smooth margins.

The genital markings are postsetal, transversely oval areas, slightly protuberant or slightly depressed and with a protuberant marginal rim, paired on *x* and *xi*, each marking in *bc*, but usually extending very slightly median to *b*, and not quite reaching to *c*.

Internal anatomy.—(Opened 25 specimens).

There is recognizable on each side of the gut in ten specimens in segment *xxiv* a slight midlateral bulge. In one specimen there is a pair of slight but definite, ventrally directed caeca in *xxiv*. In two specimens there is a pair of slight but dorsally directed caeca in the same segment. In the remaining specimens no intestinal caeca are recognizable either in *xxiv* or elsewhere. The ventral caeca are in *xxviii-xxxiv* as shown below—

Segments.	Specimens.
<i>xxviii-xxxi</i>	2
<i>xxix-xxxi</i>	5
<i>xxix-xxxii</i>	12
<i>xxix-xxxiii</i>	2
<i>xxix-xxxiv</i>	4

The dorsal blood vessel is continued into *iii* in every specimen, with hearts belonging to segments *vi*, *vii*, and *viii*. In three specimens there is a pair of very slender commissures passing ventrally in *v* from the dorsal blood vessel, in one specimen no commissures could be found, in the remaining specimens commissures of *v* are readily recognizable but not as large as the hearts of *vi*.

The median testis sac (segment *xi*) is a horseshoe-shaped chamber the limbs of which may reach dorsally as far as in contact with the dorsal blood vessel but the limbs are not bound to the oesophagus and may or may not contain the hearts of *xi* which enter the sac at the median sides of the dorsal extensions rather than at the dorsal ends. The bulbus ejaculatorius is smaller and less readily visible than in the variety *typicus*. The prostates are in *xvii-xviii* or *xix*. The prostatic duct is 2-3 mm. in length and of about the same thickness and appearance throughout.

The spermathecal duct is barrel-shaped, stoutish, easily pulled out from the parietes, but the duct in each specimen is quite definitely shorter and thinner than in the variety *typicus*. Each spermatheca has a lateral and a median diverticulum which may be ovoidal, bilobed or trilobed.

There are glandular masses projecting into the coelom from the parietes over the genital markings as in *typicus*.

Remarks.—The primordia of the genital markings are clearly visible even on the smallest, acitellate specimens. One worm lacks the genital marking on the left side of x. This very small amount of variation in number and the entire absence of variation in location of the genital markings is rather unusual. The status of the Kyauk-kyone and Tonbo specimens, is not quite clear, but the worms appear to be closer to *E. annulatus* than to any other species.

Eutyphoeus bifovis Gates.

1929. *Eutyphoeus bifovis*, Gates, *Proc. U. S. Nat. Mus.* LXXV (10), p. 25.

Meiktila, August, H. E. Dudley, 1 acitellate and 69 clitellate specimens
Thazi, September, K. John, 6 clitellate specimens.

Kyaung-gone, September, K. John, 2 clitellate specimens.

Tonbo, September, K. John, 8 clitellate specimens.

Kaungmudaw, September, K. John, 11 acitellate and 10 clitellate specimens.

Sagaing, September, K. John, 3 acitellate and 8 clitellate specimens.

Meiktila, K. John, September, 32 acitellate and 8 clitellate specimens.

External characteristics.—The unpigmented ventral and lateral portions of the body are of a distinctly greenish hue when first killed but this green disappears, externally at least after several days of formalin preservation. The nephridial masses in iii and the coelomic face of the body wall still have a distinctly greenish appearance even after several weeks of preservation.

The setal intervals vary, *ab* is slightly smaller than, slightly larger than or equal to *cd*, the latter is only slightly smaller than *bc* which is smaller than *aa*.

The first dorsal pore is in 11/12 on 20 specimens; in 17/18 but with pore-like markings in 11/12 and 12/13 on 5 specimens.

The brown, clitellar pigmentation ends ventrally just behind the setae of xvi, a whitened region behind the setae of xvi, including the lateral lips of the vestibular apertures is wrinkled extensively, especially on the midventral portion between the two vestibular apertures.

The spermathecal pores are in *d* or in *cd* slightly median to *d*.

The female pore is on the left side only on 24 specimens, on the 25th specimen there are two female pores.

There are really no penes, the transverse slits through which the penial setae protrude to the exterior are at the centres of more or less transversely oval, smooth, glistening areas on the roof of the vestibula; the margins of the pores may be very slightly protuberant. Usually 3-4 glistening tumescences from the vestibular wall project slightly into the vestibulum, two anteriorly and two posteriorly. The apertures of the paired vestibula are elongately slit-like. The body wall is thickened around the vestibular aperture, the thickening in a sort of U laterally,

anteriorly and posteriorly but not noticeable in the median wall though the vestibular roof is thickened especially laterally.

Fifty-three specimens have median genital markings on 15/16 and 18/19, in *bb*; 15 specimens have a marking on 18/19 only; 1 specimen has markings on 15/16, 18/19 and 19/20; 1 specimen has markings on 18/19 and 19/20; 1 specimen has markings on 14/15, 15/16 and 18/19.

Internal anatomy.—(Opened 25 specimens).

The ventral intestinal caeca are in xxxiv-xl as shown below—

Segments.	Specimens.
xxxiv-xxxviii .	1
xxxiv-xxxix .	5
xxxiv-xl	3
xxxv-xxxix	3
xxxv-xl	3

The diverticula are fairly large, the basal portion, attached to the intestine is much wider than the pointed anterior end filled with mud.

Paired hearts belonging to vii and viii are present (25). An additional 15 specimens were opened to look at the hearts of vii and viii. Of the 40 dissected specimens, 11 have one of the hearts of vii reduced in size, *i.e.*, more slenderly tubular and less baggy than the real hearts, 2 specimens have both hearts of vii very much smaller than the hearts of viii. The dorsal blood vessel ends exactly with the hearts of vii (25). From the hearts of xi and xiii branches pass to a supra-intestinal vessel.

The testis sac is annular, the testicular material dorsal to the dorsal blood vessel. The prostates extend through xviii-xx or xxii, usually a small part of the prostate in xvii. The prostatic duct is 14-21 mm. in length, the width increasing gradually towards the ectal end. There is a small bulbus ejaculatorius buried in the body wall.

A number of functional as well as reserve penial setae were examined but the tips of practically all are softened and flattened. Those not softened are spoon-shaped. The ornamentation is of a large number of closely spaced, transverse or circumferential rows of fine spines.

Each spermatheca has one lateral and one median diverticulum, the diverticulum in most specimens finger-like or tubular, bent or straight, rarely bilobed or trilobed (3 spermathecae). The spermathecal duct is stout, muscular, the coelomic portion short, narrowed in the outer layers of the parietes.

The muscular layers are not interrupted dorsal to the genital markings though the body wall is elevated slightly into coelom over the genital markings.

Eutyphoeus bullatus, sp. nov.

Tiddim, September, J. H. Cope, 1 aclitellate and 35 clitellate specimens.

External characteristics.—Greatest length 210 mm. Greatest diameter 7 mm. Colour of dorsum anterior to the clitellum, light greyish blue; just posterior to the clitellum the bluish colouration is continued for a short distance, fading posteriorly to a greyish or light brownish.

The setae begin on segment ii and are slender. On segment xx the setal formula is $ab < cd < bc < aa$. Seta d is not displaced dorsally on the posteriormost segments.

The first dorsal pore is in 10/11 on 16 specimens; in 11/12 on 3 specimens; in 11/12 but with a pore-like marking in 10/11 on 12 specimens; in 12/13 but with pore-like markings in 10/11 and 11/12 on 4 specimens; in 12/13 but with a pore-like marking in 11/12 on 1 specimen.

The clitellum is annular and extends from just in front of the setae of xiii to 16/17 or slightly posterior to 16/17, rarely reaching about to the setae of xvii dorsally; intersegmental furrows and dorsal pores lacking, setae present, dark bluish grey to brownish or reddish brown.

The spermathecal apertures are transverse slits in 7/8, with their centres in b or in ab . When there are no genital markings in the immediate vicinity of the spermathecal pores, the parietes immediately around each pore may be much wrinkled.

There is a pair of female pores on each specimen.

The vestibular pores are paired on xvii, each pore is usually a wide open, rounded aperture, though the anterior and posterior margins may be more or less approximated so that the vestibular pore is more or less transversely slit-like. The pores are about in ab , reaching about to a or rarely very slightly median to a and into bc slightly lateral to b . In the vestibulum there is visible a single, rounded, greyish, slightly translucent, much wrinkled body which protrudes through the pore to the exterior only rarely. There is no tubular penis, nor are penial setae visible until after the vestibulum is cut open. The deep vestibular cavity is largely filled by the rounded body, but when the vestibulum is cut open the appearance of this body is found to be rather variable; it may be more or less spheroidal, but is usually folded or cleft into a thickly U-shaped body, or with a deep cleft or fold along it somewhere. The appearance varies from one side to another and from one specimen to another. In the roof of the vestibulum immediately anterior to this body is a slight depression through which, in some specimens, protrude penial setae. On the anterior margin or the antero-ventral margin of the vestibular body there is a transversely slit-like, minute, depression which may contain the male pore.

The genital markings are small, usually transversely oval to round, each with a rim and central concavity. The location of the markings are shown below :—

Location of markings.	Specimens.
One, just anterior to each spermathecal pore	17
One, just posterior to each spermathecal pore	12
One, presetal, median, in aa on viii	21
One, probably on 16/17, median	20
Two, postsetal on xvi, each just behind ab	31
Two, presetal on xviii, each just in front of ab	17
Two, presetal on xix, each just in front of ab	10
Two, on 17/18, each in region of ab	10
Two, on 18/19, each in region of ab	5

Occasionally one of a pair of markings is lacking, this has not been indicated in the table to save space. Intersegmental furrow 16/17 is

not visible midventrally, but the median genital marking in that region appears to extend across the margins of both xvi and xvii. Intersegmental furrows 17/18 and 18/19 are not clearly indicated in some of the specimens, but when these furrows are clearly indicated both intersegmental and segmental locations of the markings have been observed. The median marking in the region of 16/17 may be elongated in an antero-posterior direction.

Internal anatomy.—(Opened 28 specimens).

The lateral intestinal caeca are in xxvii in 27 specimens, in xxvi in one specimen. Each caecum is fairly well developed and clearly marked off from the intestine as a pocket much like the simple caecum of *Pheretima*. The caeca may project anteriorly or be bent dorsally but usually pass ventrally and underneath the gut. The caeca are attached to the gut wall so that their cavities open into the gut about at the region of 27/28 (26/27). The ventral caeca are in xxxii-lv as shown below—

Segments.	Specimens.
xxxii-xlvi	1
xxxii-xlviii	1
xxxii-lii	1
xxxii-liii	3
xxxii-liv	4
xxxii-lv	1

The dorsal blood vessel ends in the region of segment vi in 24 specimens, either with the hearts of vi, or with a very slight, thread-like continuation on to the posterior face of 5/6. In four specimens the dorsal blood vessel is continued, much diminished in diameter, into segment iii; in one specimen with a pair of very fine, thread-like commissures in v, in three specimens with no traces of commissures in v. Both hearts of vi are present in each specimen as well as both hearts of vii and of viii.

There are well developed, whitish, seminal vesicles in ix, flattened against the anterior face of 8/9 in three specimens. In ten specimens there are paired vestiges of seminal vesicles in ix, attached to the anterior face of 8/9 as in the preceding specimens. These vestiges vary considerably in size. In two specimens they are rather small, almost minute, in the others quite definitely larger, about one eighth to one quarter the size of the vesicles in the first three specimens. The minute and smaller vesicles have a wrinkled and translucent brownish appearance. No traces of seminal vesicles were found in ix in 15 specimens. In every specimen there is a pair of well developed male funnels in segment x. These funnels are not as large as those of xi. No testes were found in x, but in one specimen segment x is filled with a whitish material that appears to be similar to the contents of the testis sac of xi. The testis sac of xi is cylindrical, the testicular contents passing above the dorsal blood vessel. The seminal vesicles of xii extend through 12/13 or push 12/13 back into contact with 13/14. The vasa deferentia have not been definitely traced from beginning to end in any one specimen. They are either buried in the parietes or covered over with tissue so that it has been a matter of some difficulty to trace them. Though in contact the

vasa deferentia of a side appear to retain their identity, without fusion, until into xvi. In segment xvi the vasa deferentia pass up, under a mass of muscular fibres, on to the dorsal surface of the gland over the genital marking in *ab* on xvi and then turn laterally to pass around the lateral side of the vestibular bulb. Further than this the vas has not been definitely traced. No bulbus ejaculatorius has been found. Over each vestibular pore there projects into the coelom rather conspicuously in xvii, a thickwalled body, the vestibular bulb, which is longitudinally elongated and oval in outline but with the ends blunty rounded. The penial setae and the prostatic duct pass into the vestibular bulb on the lateral face, near the parietes.

The prostates extend through segments xvii-xix or xx. The prostatic duct is 12-14 mm. in length and is looped. The penial setae are 1.9-2.7 mm. long, the region of greatest diameter 35-40 micra thick. The shaft is nearly straight, the basal portion usually slightly thicker than the rest of the shaft; sometimes with a very slight curvature on one side of the shaft. The tip is usually bent slightly over towards the concave side or almost doubled back on itself, the latter apparently due to softening. The few immature setae, that were found, lack the bending of the tip. The ornamentation consists of fairly regularly placed, transverse rows of 2-4 or a few more teeth.

The spermathecal ampulla is usually elongated in an anteroposterior direction. The duct is thickly barrel-shaped, with a thick wall, somewhat narrowed as it passes into the parietes, *ca.* 2 mm. in length. Each spermatheca has two diverticula, on the lateral and median faces of the duct, but the diverticula may be dislocated, or the duct twisted so that the diverticula appear to be anterior or posterior rather than median and lateral. The shape of the diverticulum varies considerably; the number of seminal chambers varies from one to four.

Each genital marking is the ventral face of a flask-shaped gland protruding into the coelom.

Remarks.—A column of hard, whitish material protrudes to the exterior through each of the spermathecal pores in a number of specimens. In the spermathecal ampulla there is a granular material of a greenish tinge mixed with soil particles.

The vestibula are not developed on the aclitellate specimens but there is on xvii on each side, about in *b*, a slight depression at the bottom of which a peni-setal pore and penial setae can be seen. Immediately behind the depression is a minute pore, possibly the male pore.

The three specimens with well developed seminal vesicles in ix are characterized by the absence of genital markings, smaller and flatter vestibular bulb, smaller, protuberant body within the vestibulum, and continuation of the dorsal blood vessel into segment iii (commissures belonging to v in one specimen only and there very slender). However, two specimens with no seminal vesicles in ix have no genital markings, while one specimen with genital markings has the dorsal blood vessel continued into v. Furthermore some of the forms with characteristic genital markings have small seminal vesicles in ix and since all specimens have male funnels in x, the three specimens with well developed seminal vesicles are not here separated off as a distinct form.

Numbers of very small nematodes are present in the coelom of segments vi-viii, xi-xii, and xx posteriorly, especially in the latter location. There are fairly large protozoan parasites in the coelom, along with the nemas in many of the specimens.

Eutyphoeus cochlearis Gates.

1931. *Eutyphoeus cochlearis*, Gates, *Rec. Ind. Mus.* XXXIII, p. 422, fig. 45.

The vestibulum is not quite as deep as in *E. excavatus*, especially in the midventral region. The anterior margin has an indentation at the midventral line which has not been noted in the specimens of *E. excavatus*. The penial setae project into the vestibulum through minute, transverse slits in the roof. In some specimens there is a very slight, whitish rim around the peni-setal pore but no real penis.

The ventral intestinal caeca are in xxv-xxxviii (1) or xxxvi-xlii (1).

The dorsal blood vessel ends just in front of the hearts of vii as a triangular-shaped tag.

The testicular material in the testis sac passes above the dorsal blood vessel.

Many of the penial setae, both reserve and functional have a spoon-shaped tip. On a very few setae the tip is merely slightly swollen. On other setae there is at each side of the shaft at the tip a thin, sheet-like, lateral wing or flap, directed laterally or very slightly towards the convex rather than the concave side of the bend.

Eutyphoeus constrictus Gates.

1929. *Eutyphoeus constrictus*, Gates, *Proc. U. S. Nat. Mus.* LXXV (10), p. 28.

Meiktila, August, H. E. Dudley, 188 acitellate and 76 clitellate specimens.

Chappea, September, K. John, 5 clitellate specimens.

Kyaukpadaung, September, K. John, 17 acitellate and 2 clitellate specimens.

Meiktila, September, K. John, 3 acitellate and 8 clitellate specimens.

Toungoo, September, K. John, 5 clitellate specimens.

Toungoo, September, K. John, 8 clitellate but small specimens.

Ywadow, September, K. John, 19 clitellate specimens.

Pyinmaná, September, K. John, 27 clitellate specimens.

External characteristics.—Length to 216 mm. Greatest diameter to 7 mm. Unpigmented; clitellum reddish or yellowish.

The first dorsal pore is in 11/12 on 56 specimens; in 11/12 but with a pore-like marking in 10/11 on 21 specimens; in 12/13 but with pore-like markings in 10/11 and 11/12 on 1 specimen.

The spermathecal pores are wide, transverse slits, in *ab*, with centres in *b*, or (first batch from Toungoo) with centres in *c*.

Each specimen has a pair of female pores.

The male genital areas are elongately oval, transversely oval, or nearly round, on xvii; the surface level, depressed in a concave fashion or protuberant slightly in a convex fashion; extending usually from *a* to *c* or *d*, sometimes with *d* on the lateral margin, sometimes reaching nearly to the midventral line or very rarely fused with the marking of the other side to form a single, dumb-bell-shaped area as on the type-

specimen. The areas are not sharply delimited by definite grooves or furrows but are always recognizable, except on the very smallest aclitellate specimens. On the aclitellate specimens the markings of xvii push 17/18 posteriorly and 16/17 anteriorly. On the median portion of each area, about in *ab* is a short but transversely slit-shaped vestibular pore. The portion of the marking on which the pore is located is usually slightly elevated as a shortly conical but somewhat blunt elevation. The anterior and posterior margins of the vestibular pore are usually slightly swollen, the tumescence often eroded. On the posterior wall of the vestibulum and near the vestibular aperture is a minute pore, probably the male pore. The margin of the pore is usually swollen to form a ring-like lip, which may be fairly conspicuous though small. The vestibulum is small and anteroposteriorly narrowed. On the roof of the vestibulum is a transversely oval papilla on which are two setal pits.

Aside from the male pore areas, genital markings are lacking except on the first batch of specimens from Toungoo and the Ywadow-Pyinmana worms. On the Toungoo specimens the markings are sucker-like, concave depressions from *b* or just median to *b* to *c* or just lateral to *c*; paired on xiii on four specimens, on xiii on the right side and on xiv on the left side on one specimen. On each of the Ywadow-Pyinmana specimens there is a pair of markings on xvi in *ac*. These markings are protuberant and rather triangular in shape but with rounded corners. The short side of the marking is parallel to the midventral line, the longest side is diagonal, the base of the triangle just anterior to the male area.

Internal anatomy.—(Opened 69 specimens).

No lateral intestinal caeca were found in 34 specimens; in 31 specimens there is a pair of small, flap-like caeca in xxviii on the anterior face of 28/29; in two specimens there is a pair of flap-like caeca in xxix but on the posterior face of 28/29; there is a single, flap-like caecum on one side of the intestine in xxviii in 2 specimens. The ventral caeca are in xxxii-lxxii as shown below.

Segments.	Specimens.
xxxii-lviii	1
xxxii-lix	1
xxxii-lx	1
xxxii-lxv	1
xxxiii-lx	1
xxxiii-lxii	1
xxxiii-lxiii	1
xxxiv-lv	2
xxxiv-lvi	1
xxxiv-lviii	1
xxxiv-lx	5
xxxiv-lxii	3
xxxiv-lxv	2
xxxiv-lxvii	2
xxxiv-lxxii	1
xxxv-xlvii	1
xxxv-lx	2
xxxv-lxli	1

The dorsal blood vessel is continued into the pharyngeal region in every specimen (69). Every worm has a pair of hearts belonging to vi as well as to vii and viii. There are paired commissures from the dorsal blood vessel in v in 62 specimens; in 7 worms no commissures were found in v. The dorsal blood vessel is usually much smaller anterior to the hearts of vi than posteriorly.

Each specimen has a pair of male funnels in x. The vasa deferentia of a side may pass back into xvii without coming into contact—sometimes rather widely separated—or may come into contact at any point between xii and xvii. Deferent ducts in contact may unite at any point anterior to the bulbus ejaculatorius. The stalks of the funnels of x are usually much slenderer than the stalks of the funnels of xi. There is a rudimentary seminal vesicle in ix on the left side of one specimen. The testis sac is annular, the testicular material surrounding the hearts and the dorsal blood vessel. The prostates extend through xvii-xviii, xix, xx or xxi. The prostatic ducts are slender, 4-9 mm. in length, usually bent into one or two, short u-shaped loops. The bulbus ejaculatorius is small but coelomic. The penial setae are like those of *E. peguanus*.

Each spermatheca (138) has a median and a lateral diverticulum. The diverticula are spheroidal, ovoidal, finger-shaped—straight or bent, bilobed, trilobed, or otherwise. The duct is wide but softish, apparently not narrowed in the parietes.

Remarks.—The eight small specimens from Toungoo are perfectly normal in appearance externally and have fully developed and markedly protuberant clitella but the prostates, spermathecae and seminal vesicles are rudimentary. The coelomic spaces from xix posteriorly, of each worm, are jammed full of protozoan parasites.

E. constrictus is very close to *E. peguanus*—with which it may eventually have to be merged—but it can be distinguished from it by the continuation of the dorsal blood vessel into the pharyngeal region and the presence (normally) of a pair of commissures belonging to segment v. *E. peguanus*, as a rule, has postclitellar genital markings which are lacking in *E. constrictus*. *E. constrictus* must be regarded as more primitive than *E. peguanus*, yet *E. constrictus* has been collected only from a limited area of the central basin region of the province while *E. peguanus* is rather widely distributed throughout the province.

Eutyphoeus excavatus Gates.

1929. *Eutyphoeus excavatus*, Gates, *Proc. U. S. Nat. Mus.* LXXV (10), p. 30.

Meiktila, August, H. E. Dudley, 252 aclitellate and 25 clitellate specimens.

Chappea, September, K. John, 3 clitellate specimens.

Thazi, September, K. John, 3 aclitellate and 19 clitellate specimens.

Sagaing, September, K. John, 20 clitellate specimens.

Meiktila, September, K. John, 41 clitellate specimens.

External characteristics.—Setal intervals on xx vary, *ab* is equal to or slightly less than *bc* which is usually slightly less than but may equal *aa*.

The first dorsal pore is in 11/12 on 23 specimens; in 12/13 on one specimen; in 17/18 on one specimen.

The spermathecal pores are in *b*.

There is a single female pore on the left side only, on each clitellate specimen.

Of the aclitellate specimens the thirteen smallest have no trace of a vestibular excavation. There are visible on xvii only transversely oval, greyish areas, without definite delimiting furrows, on which are located the peni-setal apertures. Penial setae are visible in the apertures even at this stage. The vestibulum is more or less clearly indicated on 214 specimens on none of which are the *anlage* of the genital markings visible. On 25 specimens the *anlage* of the genital markings are visible. On each of the clitellate specimens there are two, transversely oval genital markings with bluntly rounded ends, in *aa* to *bb*, extending across 14/15 and 15/16. The anterior margin of each marking may or may not include seta *a* of xiv or of xv. The vestibular aperture on all specimens is transversely slit-shaped. The peni-setal, slit-like apertures on the vestibular roof are usually without trace of marginal swelling or protuberance. The Sagaing specimens do have, however, a short, whitish, tumescence of the margin of the aperture that might be regarded perhaps as a very rudimentary penis.

Internal anatomy.—(Opened 25 specimens).

The ventral intestinal caeca are in xxxiv-xli as shown below.

Segments.	Specimens.
xxxiv-xl	1
xxxv-xxxviii	1
xxxv-xxxix	6
xxxv-xl	2
xxxv-xli	2
xxxvi-xl	2
xxxvii-xli	1

Both pairs of hearts of vii and viii are present in each specimen. The dorsal blood vessel ends with the hearts of vii in 18 specimens. In 5 specimens the dorsal blood vessel is continued to or towards the gizzard but ends abruptly as a bluntly rounded stub. In two specimens the stump in front of the hearts of vii is triangular.

The testis sac is annular with considerable testicular material dorsal to the dorsal blood vessel. The seminal vesicles push 12/13 and 13/14 back into contact with 14/15. The prostates extend through xvii-xix or xx, or only into xviii. The prostatic duct is 12-16 mm. in length, the ectalmost portion of the duct is slightly thicker than the entalmost portion. There is a slight bulbus ejaculatorius, imbedded in the connective tissue.

The tips of the penial setae with but few exceptions are softened. The ornamentation consists of scattered individual teeth or short, transverse rows of teeth.

The spermathecal duct is thick, short, almost confined to the parietes, but the length of the coelomic portion varies. The diverticulum is on the lateral side of the duct only (25) and varies in size, shape and number of chambers; it may be fan-like with a narrower, stalk-like portion, or a vertical, transverse, or diagonal ridge or row of seminal chambers.

Eutyphocus falcifer, sp. nov.

Leiktho Circle, September, G. E. Blackwell, 17 clitellate specimens.

Description of the type specimen.

External characteristics.—Length, 52 mm. Greatest diameter (in the clitellar region) 3 mm. Number of segments, *ca.* 152. Unpigmented, clitellum reddish.

The setae begin on ii; on segment xx the setal formula is $ab < cd < bc < aa$, on the posteriormost segments seta *d* of each side is dorsal in position and the interval *dd* is small.

The first dorsal pore is in 11/12 but there are non-functional pore-like markings in 8/9-10/11.

The clitellum is annular and extends from mid xiii dorsally and from just behind the setae of xiii ventrally to 17/18 dorsally and to the region of 16/17 ventrally. The dorsal pore in 13/14 is functional, but otherwise dorsal pores are lacking as well as the intersegmental furrows.

The spermathecal pores are longitudinal or slightly diagonal slits in *b* with a minute lobe or lip on the median and the lateral margin of the pore.

The female pores are each just in front of *a* on xiv.

The male porophores on each side of xvii are in *b*, have the appearance of a very short, conical penis. From the pore at the ventral end of the penis there project two penial setae. The body wall is whitened and wrinkled midventrally between the two porophores.

Internal anatomy.—The dorsal blood vessel is continued through 5/6 but was not traced anteriorly. There are paired hearts belonging to vi.

The single, median testis sac extends dorsally on each side of the oesophagus in such a way as to enclose the hearts of xi and the dorsal blood vessel. There are paired, rudimentary male funnels in x. The seminal vesicles push 12/13 back into contact with 13/14. The prostates are short and confined to xvii or with a slight projection into xviii. There is a coelomic bulbus ejaculatorius.

The spermatheca has a short but relatively stout duct and a single lateral diverticulum.

Remarks.—The length varies from 38-57 mm.

Seta *d* is dorsal on the posteriormost segments of every specimen, but the length of the interval *dd* varies considerably. The interval may be quite small, *d* very close to the mid-dorsal line; large (two specimens only) *d* slightly dorsal to the midlateral line; or intermediate between the two widths just mentioned.

The first functional dorsal pore is in 11/12 in each specimen, but a number of the worms have a more or less pore-like marking in 10/11, and in two specimens bending of the body was sufficient to force fluid out through the parietes at that point. The aperture in 10/11 however has a squarish appearance as it passes through the muscular layers so that it is probable that a weak spot in the body wall was ruptured by the pressure placed on the worm.

The spermathecal pores are in *b* on each specimen. The pores certainly appear to be on the posteriormost portion of the segment; just

median and just lateral to the pore, the body wall slightly protuberant as a sort of lip. When the spermathecal duct is pulled out from the parietes the aperture also appears to be on the posteriormost part of vii and just anterior to intersegmental furrow 7/8.

The female pore is always double.

There are no genital markings but on each specimen the body wall is thin in the midventral line across the clitellum and without clitellar glandularity.

The male areas may have, as in *E. pusillulus*, the appearance of diagonally placed oval papillae. On each papilla two setal pits can be recognized which may be at the bottom of a slight depression, or there may be a very slight, conical protuberance within which are the penial setae. A quite definite furrow is developed around the base of the conical protrusion on some specimens.

Six worms besides the type-specimen were dissected. There are two ventral intestinal caeca in each specimen in segments xxviii-xxix.

The dorsal blood vessel is continued into the pharyngeal region in each specimen with a pair of hearts in vi; usually a very fine pair of commissures can be traced in v, in one case into the ventral blood vessel.

In each of the specimens there are rudimentary male funnels in x and a double vas deferens on each side, the double condition is maintained clearly to the bulbus ejaculatorius or the two vasa of a side may unite at various points anteriorly. The testis sac extends dorsally in each specimen to include the dorsal blood vessel. The prostate is 2-3 mm. in length and usually confined to xvii where it is looped several times; the prostatic duct 1-1.5 mm. long and also slightly looped. The coelomic bulbus ejaculatorius is always visible.

The penial setae are 0.82-1.3 mm. in length and when flattened out by the pressure of the cover glass appear to be nearly straight except for the tip which is slightly sickle-shaped. The ornamentation is of transverse rows of fine teeth or spines, the rows fairly closely crowded. Only four penial setae were found in each specimen, reserve setae either lacking or lost in dissection. The tips of most of the setae are worn, cracked or otherwise damaged, the tip, if normal, narrowing gradually without a terminal spine.

Each spermatheca has a single, small diverticulum projecting from the lateral face of the duct near the ampulla. The diverticulum is short, almost spherical, longer but straight or bent downwards, upwards, anteriorly or posteriorly.



FIG. 23.—*Eutyphoeus falcifer*, sp. nov.

Penial seta $\times$ ca. 75.

***Eutyphoeus foveatus* (Rosa).**

Tharrawaddy, August, K. John, 5 specimens.

Henzada, August, K. John, 5 specimens.

Pegu, August, K. John, 13 specimens.

Kyauktan, August, K. John, 10 specimens.

Ngapugale, August, G. R. Anderson, 10 specimens.

Toungoo, September, K. John, 10 specimens.
 Maubin, September, K. John, 13 specimens.
 Yandoon, September, K. John, 12 specimens.
 Tharrawaddy, September, K. John, 11 specimens.
 Thonze, September, K. John, 7 specimens.
 Prome, September, K. John, 31 specimens.
 Moulmein, October, K. John, 10 specimens.

External characteristics.—The setal formula on xx is $ab < cd < bc < aa$. On the posteriormost segments dd is about equal to one-half of the circumference.

The first dorsal pore is in 11/12 on 35 specimens; in 11/12 but with a pore-like marking in 10/11 on 4 specimens; in 12/13 but with a pore-like marking in 11/12 on 2 specimens; in 18/19 but with pore-like markings in 11/12 and 12/13 on 2 specimens.

The spermathecal pores are in ab or b .

There is a single female pore on the left side on 37 specimens. On three specimens there is a pore-like marking but apparently non-functional, on the right side; on one of these specimens the pore-like marking is on a transversely oval, whitish area which is not as large as the female pore area of the other side.

The penes are narrowly tubular, only very slightly thicker dorsally than ventrally, the ventral margin smooth without trace of lobulation. The roof of the vestibulum is very thin but there is a thick ring of tissue in the body wall around the vestibular pore.

The genital markings of all specimens of *E. foveatus* collected during the last few years have been re-examined. On one specimen from Pegu there are two distinct genital markings. The larger of the markings extends from just anterior to the setae of xvi to just posterior to the setae of xv. The anterior marking is smaller and extends from just anterior to the setae of xv to just beyond a point half way between the setae of xv and the setae of xiv. This double condition of the genital marking is similar to that described originally for *E. spinulosus* from Bassein. One specimen from Rangoon and one specimen from Maubin have, each, two distinct markings as on the Pegu specimen. Each of the two specimens from Tharrawaddy has a small genital marking extending only from the setae of xv to the setae of xvi and on which setae a and b of xv are not included. One specimen from Prome has a small genital marking extending only from the setae of xiv to the setae of xv. One specimen from Prome has in addition to the normal genital marking a small, transversely oval marking on 18/19 in aa . Seta a of xv may be lateral to the genital marking, in the margin of the marking or median to the margin of the marking. Rarely seta b of xv is included in the margin of the marking. The edge of the genital marking is usually raised as a slight ridge; this may be definitely marked off by a slight furrow on its outer margin and (or) by another furrow on the inner margin.

Internal anatomy.—(Opened 40 specimens).

Careful search was made for lateral intestinal caeca. In several specimens there is a slight lateral protuberance or bulge from the intestinal wall in xxviii on each side. In several other specimens the protuberance is more clearly demarcated and rather flap- or ear-like, but

no very definite caeca were found. The ventral caeca are in xxxiv-lix as shown below.

Segments.	Specimens.
xxxiv-l	1
xxxiv-lii	2
xxxiv-liii	2
xxxiv-liv	3
xxxiv-lv	2
xxxiv-lvi	4
xxxiv-lviii	1
xxxiv-lix	1
xxxv-lv	1
xxxv-lvi	1
xxxv-lvii	2
xxxv-lix	1
xxxvi-lvi	1

The dorsal blood vessel in every specimen except 4 ends with the hearts of vii. In one specimen the dorsal blood vessel ends abruptly just anterior to the hearts of vii as a rounded stub. In two specimens the short continuation of the vessel in front of the hearts of vii is a triangular flap. In another specimen the dorsal blood vessel anterior to the hearts of vii is very slender and passes on to the gizzard and here turns to the right side and passes ventrally on the posterior margin of the gizzard where it gradually fades out.

The testis sac is median and ventral to the oesophagus, but the hearts of x are bound down to the oesophagus. The prostatic duct is 7-14 mm. long, the ectal half usually quite noticeably thicker than the ental half and bent into a crescent or bow-shape. The bulbus ejaculatorius is large, larger than in any other Burmese species of the genus.

The penial setae are usually 2-4 mm. in length, rarely slightly longer. The functional setae are yellowish or brownish, rather light in colour; the reserve setae much darker, usually reddish. The ornamentation of the outer ends of the penial setae varies considerably. It may consist of a few scattered spines or teeth, or the teeth may be aggregated into short, transverse rows or the rows may be more or less continuous in circles around the shaft. The rows of teeth may be few or many.

Every spermatheca has one median and one lateral diverticulum. The duct is well developed, thickly muscular and barrel-shaped, sharply narrowed in the parietes.

There is a slight bulge into the coelom over the genital marking but the longitudinal musculature is not interrupted.

Remarks.—In the smallest specimens of *E. foveatus* that can be identified there is visible on xvii only a single setal pit about in line with *a* on each side but no setae are visible in this pit. On slightly larger specimens there is a slight whitening of the epidermis around each setal pit and midventrally between these two whitenings an area of greyish appearance. In slightly larger specimens there are nearly always two, well-developed penial setae protruding to the exterior through the pit, which is about in line with *a* or very slightly lateral

to *a*. On some of these specimens there is visible a minute pore on the parietes immediately behind the setal pit, but in still older specimens this pore is not visible. On larger specimens a slight midventral depression is evident on xvii and the margin around each peni-setal pit is slightly tumescent. As the midventral depression becomes deeper and extends laterally the whitish tumescence about the setal pit becomes more distinct and shortly conical. As the depression becomes still deeper the protuberant cones are carried out of sight laterally into the vestibule under the overhanging margin.

The slightest pressure on the posteriormost tail segments of some worms was sufficient to force out through the dorsal pores numbers of small, whitish, spherical or nearly spherical objects. Each of these spheres is packed full of pseudonavicellae spores, the spores of some four or five distinctly different sizes, each spore containing a bit of protoplasm and a single nucleus. One spherical body is full of triangular cysts. Along with the spheres nematode eggs were passed to the exterior. Keilin thinks that masses of spores may be got rid of by autotomy of the posteriormost segments. But such mutilation may not be necessary. The posteriormost dorsal pores of many worms are unusually large and there seems to be no reason why the parasitic masses cannot be passed to the exterior through such pores, especially when the masses have accumulated so as to considerably distend the posteriormost segments.

Branched specimens of *A. singularis* in couples, trios, or quartettes or as isolated individuals have been found in the smallest specimens of *E. foveatus* that can be identified, in specimens collected in the earliest part of the collecting season, the month of June. *A. singularis* can almost always be found in clitellate specimens, especially in the region of segment iii or on the masses of nephridia in iii. In the testis sac there are often numbers of elongate, unbranched protozoa smaller than the coelomic *A. singularis*.

Eutyphoeus hamatus Gates.

1930. *Eutyphoeus hamatus*, Gates, *Rec. Ind. Mus.* XXXII, p. 329, fig. 19.

There are paired male areas on xvii. Each area is transversely oval, slightly protuberant, extending median to *a* and well into *bc*. A considerable portion of the area has a wrinkled, dark-greyish, translucent appearance. A part of the wrinkled region is slightly more protuberant than the rest as a circumferential lip or rim around the transversely slit-like peni-setal aperture.

The genital markings on xx are transversely oval, slightly depressed and concave, reaching nearly the whole length of the segment and extending from median to *a* into *bc*.

The dorsal blood vessel extends into iii. There are large commisures in v and the hearts of vi-viii are present.

The ventral intestinal caeca are in segment xxxi-(*ca*) xlviii.

The spermathecal duct is short, definitely coelomic, stoutish.

The vasa deferentia do not unite, apparently, until in xvii, just at the ental end of the bulbus ejaculatorius which is fairly large.

There is a parietal thickening in the region of the male pore area, visible in the coelom as a low, flat disc.

***Eutyphoeus hastatus* Gates.**

1929. *Eutyphoeus hastatus*, Gates, *Proc. U. S. Nat. Mus.* LXXV (10), p. 32.

Thayetmyo, September, K. John, 24 acitellate and 140 clitellate and partially clitellate specimens.

Prome, September, K. John, 1 clitellate specimen.

External characteristics.—Length to 140 mm. Greatest diameter to 5 mm.

The first functional dorsal pore is in 11/12 on 23 specimens, in 12/13 on 2 specimens but there are pore-like markings in 10/11 and 11/12.

The spermathecal pores are small, transverse slits in *c* or very slightly lateral to or very slightly median to *c*.

Each worm has a pair of female pores.

The vestibular apertures are tiny, transverse slits towards the lateral and posterior ends of the anterior genital markings. The more protuberant portion of the marking bearing the vestibular aperture may be marked off from the remainder of the genital marking by a slight groove or this groove may be completely lacking. The vestibulum is slight and no trace of a penis has been found. Two peni-setal pits are visible on the roof of the vestibulum but a male pore has not been found.

The genital markings are clearly indicated even on the acitellate specimens. One hundred and thirty eight specimens have in addition to the paired markings bearing the vestibular apertures a single, transversely oval genital marking on xviii. The anterior and posterior margins of this marking are often indented at the midventral line but on none of these specimens is the marking completely divided into two portions. Three specimens have an additional genital marking on xix.

Internal anatomy.—(Opened 25 specimens).

The ventral intestinal caeca are in xxx-lxi as shown below.

Segments.	Specimens.
xxx-li	1
xxxiii-xlix	1
xxxiii-liii	3
xxxiii-l	1
xxxiii-lv	7
xxxiii-lvi	1
xxxiii-lviii	1
xxxiii-lxi	1

Each worm has a pair of hearts belonging to vi. The dorsal blood vessel is continued through 5/6 and 4/5. In v there is a pair of readily recognizable commissures, in each worm. The commissures may be slender and tubular or baggy and of about the same size as the hearts of vi.

The seminal vesicles of ix are usually smaller than the vesicles of xii, ordinarily confined to ix but sometimes pushing through 8/9 in which

case the vesicles may be nearly as large as those of xii. The testis sac (xi) is annular, the testicular material surrounding the hearts of xi and covering over the dorsal blood vessel. The bulbus ejaculatorius is small. The prostatic duct is muscular throughout, widening slightly but gradually passing ectally, 3-3½ mm. long.

Each spermatheca has a median and a lateral diverticulum. The diverticula usually have a number of seminal chambers, but there may be only one, two or three. The duct is thick and muscular and is narrowed gradually as it passes into the parietes.

The penial setae from at least one side of each of the dissected specimens have been examined. All are characterized by the widening of the tip, the thickened region often of a diamond shape, otherwise rounded. The shaft is straight except for the bend near the tip. The ornamentation is sparse, or the rows of teeth may be closely crowded.

Remarks.—There are protozoan parasites in the spermathecae of a number of specimens; gregarine-like trophozoites in the granular mass within the ampulla, cysts attached to the ampullary wall or imbedded in the wall of the ampulla. Several worms have similar parasites in segment iii. Three worms have large numbers of small, ovoid, whitish cysts scattered throughout the coelom of the postclitellar segments. The anterior seminal vesicles, are, in many worms, filled with parasites.

***Eutyphoeus longiseta* Gates.**

1930. *Eutyphoeus longiseta*, Gates, *Rec. Ind. Mus.* XXXII, p. 332, fig. 21.

Akyab, September, Bruce Taw, 5 clitellate specimens.

Sandoway, September, F. R. Bruce, 198 aclitellate and 29 clitellate specimens.

External characteristics.—The clitellum has a distinct, dark reddish tinge, even after one year of formalin preservation.

The first dorsal pore is in 11/12 on 24 specimens; in 11/12 but with a pore-like marking in 10/11 on one specimen; in 12/13 but with a pore-like marking in 11/12 on 4 specimens.

The spermathecal pores are always in *bc*.

The single female pore is on the left side of every specimen.

The male pore markings are almost circular to elongately oval, depressed, level or protuberant. The penis is thickly and shortly columnar. It consists of a smooth, firm, basal whitish ring and a distal portion that is much wrinkled, more tender, and in various stages of eversion or withdrawal into the basal portion. On one specimen the basal rings are sunk into the male porophore and not protuberant. The lumen of the penis is large and on its posterior wall is a minute pore into which there appears to pass a delicate strand of special tissue from near the ventral end. The pore may possibly be a male pore. On aclitellate specimens the male porophores are first indicated as transversely oval areas of especial whiteness, with a transverse slit at the centre. On the posterior margin of the slit is a minute pore, probably the male pore: With growth this pore comes to lie within the penis, on the posterior wall. At the dorsal end of the penial lumen there is a transversely oval papilla on which there are two setal pits. Just anterior to and just posterior to each male porophore there is a more or less well defined "crescent".

The genital markings are preclitellar, intraclitellar and postclitellar. One specimen has intraclitellar markings only, 23 specimens have intra- and post-clitellar markings, 5 specimens have intra-, pre-, and post-clitellar markings. The preclitellar markings are much more sucker-like in appearance than the other markings. The segmental locations of the markings are shown below.

Markings.	Specimens.
Paired, postsetal laterals, on vii	2
Single, presetal median, on viii	4
Single, postsetal median, on viii	1
Single, presetal median, on ix	3
Single, postsetal median, on ix	1
Paired, postsetal laterals, on xiv	3
Paired, postsetal laterals, on xv	28
Single, median, on 18/19	1
Single, median, on 19/20	20
Single, median on 20/21	27
Single, median, on 21/22	7

Internal anatomy.—(Opened 40 specimens).

The lateral intestinal caeca are fairly large, finger-shaped, ventrally directed, in xxviii in each specimen. The ventral caeca are in xxxii-lx:—xxxii-lv (2 specimens), xxxiii-lvi (1), xxxiii-lvii (3), xxxiii-lx (3), xxxiv-lix (1).

The dorsal blood vessel ends with the hearts of vii in every specimen.

The testis sac is median and ventral to the oesophagus. The prostates extend through xvii-xx, xxi or xxii. The prostatic duct is 20-26 mm. in length, the ectal portion slightly thicker than the ental half. The bulbus ejaculatorius is small, buried in the parietes or covered over by nephridia, muscle bands, etc., and not visible until after this tissue has been dissected off. In 39 specimens there are no male funnels in x but in the very last specimen opened there is a pair of large and very definitely funnel-like structures on the anterior face of 10/11. No continuation of these structures to the vas deferens could be found.

The spermathecal duct is narrowed in the parietes and also just below the ampulla. On the narrowed ental neck of each spermatheca is a median and a lateral diverticulum; the diverticula are long. The ampulla is always anteroposteriorly elongated.

Remarks.—The variety *postremus* was erected for specimens without male porophores, the penes being contained in vestibular excavations. If, however, the supposed vestibulum is cut open and spread out the appearance is exactly that of a male porophore of the variety *typica*. The porophore on the specimens of *postremus* is apparently folded across transversely and then drawn up into the body wall, but a vestibulum such as characterizes *E. foveatus* is not present. Aside from the folding and retraction of the male porophores, *postremus* is distinguished from *typicus* only by the presence of paired markings on xvi instead of xv. This can scarcely be regarded in *E. longiseta* as sufficient justification for the retention of the variety.

E. longiseta is rather like *E. rarus*, and large specimens of the latter from Sandoway are very similar in appearance and many other ways to specimens of *longiseta* from the same locality. The two species may be distinguished by the characteristics of the penes.

Eutyphoeus macer, sp. nov.

Thaton, October, K. John, 2 clitellate specimens.

Description of the type-specimen.

External characteristics.—(Statements in parentheses refer to the cotype specimen).

Length 61 (82) mm. Greatest diameter 3 (4) mm., in the clitellar region. Number of segments, *ca.* 161. Unpigmented, clitellum reddish (purplish).

The setae begin on ii. On xx, $ab < cd < bc < aa$. On the posterior-most segments seta *d* is mid-lateral in position or a trifle dorsal to that but projects to the exterior horizontally.

The first dorsal pore is in 11/12.

The clitellum extends from the middle portion of xiii to 17/18 (or nearly to 17/18).

The spermathecal apertures are in 7/8 in *c* (or just median to *c*).

There are two female pores, each located on xiv just anterior to *a*.

The penes are flattened out or slightly eroded, in *b* (on the cotype specimen the penes are distinctly protuberant, tubular structures *ca.* in *b*). On the posterior and ventral margin of each penis there is a distinct, slight notch so that the posterior margin or lip of the penis has a bilobed appearance.

The genital markings are paired, transversely oval, postsetal, whitish areas, without demarcating furrow or groove, on xvi, about in *ab* but extending very slightly lateral to *b*.

Internal anatomy.—The type specimen was broken in the course of dissection so that it was not possible to determine accurately the position of the paired, lateral, intestinal caeca, but they appear to be in segment xxiv, but attached to the intestine in the posterior part of the segment or at 24/25. (The caeca are definitely in xxiv but attached to the gut at the level of septum 24/25). (The ventral caeca are in xxix-xxxiii, filled with dirt and readily recognizable).

The dorsal blood vessel is continued through 5/6 to the pharyngeal region. There is a pair of blood filled vessels passing ventrally from the dorsal blood vessel in v. There is a pair of hearts belonging to vi. The last heart is in xiii on the right side, no heart on the left side of xiii was found. (Paired hearts in xiii).

The median testis sac passes dorsally at the sides of the oesophagus so as to contain the hearts of xi and the dorsal blood vessel (and so that the testicular material is above the dorsal blood vessel). The seminal vesicles push 12/13 into contact with 13/14 (or pass through 12/13 into xiii). The prostates are short and looped (*ca.* 1.5-2 mm. long), the prostatic duct narrow and shorter than the prostate but also looped (*ca.* 1-1.5 mm. in length).

The bulbus ejaculatorius if present is covered over with tissue and not visible in the coelom.

The spermathecal duct is short, stoutish, strong, and easily pulled out of the parietes, but only projecting slightly into the coelom. There are two diverticula, apparently from the posterior face of the duct and directed posteriorly. The ampulla is flattened and pressed anteriorly so that when viewed from the dorsal side an appearance is produced as shown in the figure.

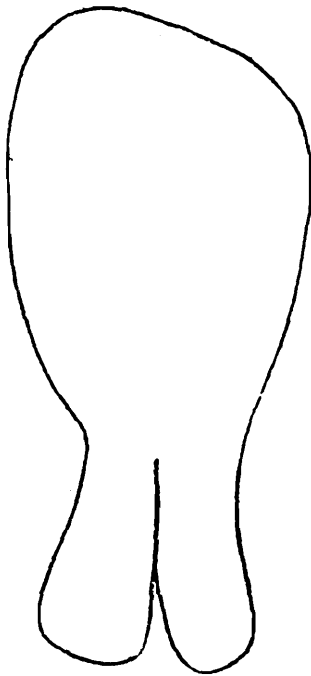


FIG. 24.—*Eutyphoeus macer*, sp. nov.
Spermatheca, as seen from dorsal side, $\times$ ca. 45.

(The penial setae are 2.4-3 mm. in length; .014-.016 mm. wide, nearly straight when flattened out by the cover glass except for a bend towards one side of the tip. The tips of the four setae examined—no reserve setae found—are all softened and rather curious. One has a distinct terminal spine but a small portion of the seta immediately behind this spine is hollow. In the second seta the terminal spine is not visible and the hollow portion is ruptured into several fragments but at the centre of these fragments is a solid rod, a continuation of the centre of the setal shaft. The two remaining setae have softened tips

in which little can be made out except that the tip appears to be hollow and contains a rod which is visible for a short distance as the central portion of the seta behind the cavity. The shaft, near the tip, is ornamented with transverse rows of fine teeth).

***Eutyphoeus manipurensis* Steph.**

Falam, Chin Hills, August, J. H. Cope, 27 clitellate and aclitellate specimens in very poor condition, especially behind segment xix.

Tiddim, Chin Hills, September, J. H. Cope, 7 clitellate specimens, well preserved.

External characteristics.—The Falam specimens are on the whole larger than the Tiddim specimens, the greatest length of the former 145 mm., the greatest diameter 4 mm.; the greatest length of the latter 83 mm., the greatest diameter 3 mm.

The worms are unpigmented. The clitella of the first batch are reddish, brownish, or dark greyish, of the second batch, yellowish to yellow-brown.

The setal formula on xx is $ab < cd < bc < aa$.

The first dorsal pore is definitely in 10/11 on 5 specimens; in 11/12 but with a definitely pore-like but apparently non-functional marking in 10/11 on 5 specimens.

The clitellum extends from just in front of or just behind the setae of xiii to the anterior margin of xvi, rarely further posteriorly on xvi.

The spermathecal pores are large, transverse slits in 7/8, extending from *b* to *c* or from slightly median to *b* nearly to *c*.

There are two female pores on each specimen.

The male pore area on each side may be described as longitudinally oval with bluntly rounded ends, extending about the whole length of

xvii and reaching from about *a* or slightly median to *a* into *bc* near to *c*. The peripheral portion of this area is slightly depressed, the depression, as a rule, least emphasized posteriorly. External to the depressed portion the parietes is raised into a sort of ridge forming a rim about the area. The main portion of the area within the depression is raised into two bodies which have a wrinkled, turgid, greyish, translucent appearance. The posterior of the two bodies is much larger than the anterior and rounded while the anterior is anteroposteriorly flattened. Between these two bodies is a narrow transverse slit, at the bottom of which there is a transversely oval, smooth, glistening area, usually slightly convex which bears two setal pits, through which on some of the specimens the penial setae protrude. On several specimens a distinct pore can be recognized on the anteroventral margin of the posterior protuberance, possibly the male pore.

The genital markings are very small, transversely oval to almost round areas, with slightly raised rim and a depressed central concavity. Each specimen has several of these markings located as shown below.

Markings.	Specimens.
Unpaired, presetal, median, on vii	6
Unpaired, postsetal, median, on vii	14
Unpaired, presetal, median, on viii	18
Unpaired, postsetal, median, on viii	13
Paired, lateral, spermathecal markings, one just anterior to and one just posterior to each spermathecal pore	9
Paired, lateral, spermathecal markings, two anterior to and two posterior to each spermathecal pore	6
Paired, lateral, spermathecal markings, three anterior to and two posterior to each spermathecal pore	1
Paired, postsetal, medians in aa, on—	
xvi	16
xvii	14
xviii	5
xix	2

The spermathecal markings are slightly smaller than the other preclitellar genital markings.

Internal anatomy.—(Opened 27 specimens).

In each specimen of the first batch segment xi was opened by the dissection, 10/11 and 11/12 passing apparently to the parietes independently of each other in the ventral portion of the body. But dorsally only one septum could be found so that in the dorsal half of the body, 11/12 appears to be united to or attached to 10/11. The worms of the second batch that were opened have a U-shaped testicular chamber or sac inverted over the gut, the chamber not opened by dissection, the dorsal blood vessel surrounded by testicular material.

There is in each of 12 worms a pair of finger-shaped, ventrally directed, lateral intestinal caeca in xxvi, on the anterior face of 26/27. In the other specimens the position of the caeca cannot be determined due to the rotting of the gut wall. The ventral caeca are in xxxi-xxxv (4 specimens), in xxxi-xxxiv (1 specimen), and in xxxiii-xxxv (1 specimen).

In each worm the dorsal blood vessel extends into iii with paired commissures in v, one pair of commissures just anterior to the gizzard and two pairs of commissures at the anterior face of 8/9.

The seminal vesicles of ix are usually smaller than those of xii, but may be of about the same size, in which case they either pass through 8/9 or push 8/9 anteriorly. The vesicles of xii pass through 12/13 by which they are constricted and push 13/14 into contact with 14/15. The prostates extend through segments xvii-xix or xx. The small bulbus ejaculatorius is covered over with tissue or buried in the parietes. The penial setae are as described by Stephenson ($1\frac{1}{2}$ -2 mm. long) save that the tips of the setae are here ornamented with short transverse rows of a few isolated teeth very sparsely distributed.

On 53 of the spermathecae there is but a single diverticulum and that lateral. One spermatheca, from the right side of one specimen has in addition, a rather rudimentary diverticulum, about one quarter the size of the normal diverticulum on the median side. The diverticulum may be sessile or stalked. There is a definite but short, rather stout and thick-walled duct which is not narrowed within the parietes. The ampullae of some of the worms contain a granular brownish or greyish or yellowish material of about the same colour as the material in the lumen of the oesophagus and in which there are gritty soil particles.

There are rounded glandular (?) bodies projecting into the coelom over each of the genital markings.

Remarks.—Stephenson erected *E. manipurensis* for three worms from Loktak Lake in Manipur which is not very far from the Burmese Chin Hills. The male pore areas of the Burmese specimens are exactly the same as on the type-specimens except that on the types the region bearing the two protuberances has been invaginated so that the protuberances appear to lie at the bottom of a shallow, well-like depression. This difference may be merely the result of greater contraction at time of killing. The spermathecal pores of the type specimens are in *ab* rather than *bc* but similar variations occur in Burmese species of the genus. The type-specimens are probably unpigmented, the greyish appearance probably due to the method of killing or preservation. A midventral region extending across the posterior portion of xvi and the anterior portion of xvii may be depressed in the Burmese as in the type-specimens. The spermathecal duct of the clitellate Burmese specimens is more readily recognized as such than in the type-specimens, but in the aclitellate specimens the condition is as in the type-specimens. The type-specimens are probably, as indicated by the condition of segment xi, not fully mature. There is, however, one difference between the Burmese specimens and the types that may be important. In the worms from the Chin Hills the lateral intestinal caeca are in xxvi while in the types the caeca are in xxvii. It should be noted that on one side of one of the type-specimens the diverticulum is in xxvii.

***Eutyphoeus marmoreus*, sp. nov.**

Tiddim, Chin Hills, September, J. H. Cope, 15 clitellate specimens of which five lack portions of the anterior end.

External characteristics.—Greatest length 230 mm. Greatest diameter 6 mm. Unpigmented, whitish or light greyish; clitellum light yellowish-brown.

The setae begin on segment ii and are fine. On segment xx and posteriorly the setal formula is $ab < cd < bc < aa$. Seta *d* is not displaced dorsally on the posteriormost segments.

The first dorsal pore is in 11/12 on 6 specimens; in 11/12 but with a small, blackish, dot-like marking in 10/11 on 4 specimens; in 16/17 with pore-like markings in 11/12 and 12/13 on 1 specimen.

The clitellum is annular and extends from anterior to the setae of xiii to 16/17, intersegmental furrows and dorsal pores lacking.

The spermathecal pores are transverse slits in 7/8 with their centres in *b*.

Each worm has a pair of female pores.

The vestibular pores are paired on xvii, each aperture usually wide open and elongately quadrangular, extending nearly the whole length of xvii which is elongated ventrally. The lateral and median margins are more or less closely approximated on several of the specimens to produce an elongately slit-like appearance of the vestibular aperture. The apertures are about in the region of *ab* the margins very slightly median to and lateral to *a* and *b*. There is no definitely demarcated lip around the aperture, but the lateral margin of the pore may be slightly thickened and protuberant. The vestibula are not quadrangular but triangular in cross section. This is due to the fact that the deepest part of the vestibulum is towards the median wall, while the lateral wall slopes at a very decided angle towards this deep portion. The lateral wall or face is smooth, glistening; the deepest portion of the vestibular wall and the anterior, posterior and median walls are wrinkled and greyish. In three specimens very little more than this can be made out in the vestibula save that at the posterior end and towards the median face or wall the vestibulum is especially deepened in a funnel-like fashion. Cutting down through this depression (as viewed from the ventral side) there becomes visible deep at the bottom a narrow slit at the bottom of which are two, minute papillae each bearing a penial seta. From the posterior margin of the pit containing the penial seta is protuberant a small, ovoidal tag which bears a pore, possibly the male pore. In other specimens there is visible in the vestibulum at the postero-median corner, a more or less conical body, with a hard centre, but a soft, greyish translucent and wrinkled surface. On the ventral face of this body is a slit at the bottom of which can be seen the peni-setal papillae. The ovoidal tag at the posterior margin of the slit is variously protuberant, sometimes recognizable with difficulty, sometimes eroded. The conical body protrudes in several specimens slightly through the vestibular aperture.

There are no genital markings.

Internal anatomy.—(Opened 12 specimens).

There is in each specimen a pair of well developed lateral intestinal caeca much like those of *E. bullatus* but located here in segment xxviii in each specimen. The ventral caeca are in segments xxxiii-lix:—xxxiii-xlvii (1), xxxiii-liii (1), xxxiii-lvi (1), xxxiii-lvii (1), xxxiv-lix (1).

The dorsal blood vessel passes into segment iii in each specimen. There are fairly large commissures in v in 11 specimens, on one side only in one specimen. The hearts of vi-viii are all present.

There is a pair of well developed male funnels in x but these funnels are not quite as large as those in xi. The seminal vesicles of ix are about one half or less the size of the vesicles of xii, flattened against the anterior face of 9/10, in one specimen projecting anteriorly and through 8/9. The vesicles of xii extend into xiv. Segment xi is modified into a cylindrical testis sac within which the testicular material surrounds the dorsal blood vessel. The vasa deferentia of a side are continued posteriorly in contact but not united. In segment xvii they pass laterally and around the lateral face of the vestibular bulb and then on to the posterior face. Just as the vasa deferentia bend behind the vestibular bulb to pass mesially they are united and at once enlarged to form an elongate bulbus ejaculatorius on the posterior face of the vestibular bulb, passing into the wall of the bulb about in the middle of the posterior face. The prostates extend through segments xvii-xix, xx, or xxi. The prostatic duct is 12-14 mm. in length and looped.

Projecting into the coelom over the vestibular pore is a thick-walled, smooth-surfaced body, the vestibular bulb. In those specimens in which there is no conical protuberance into the vestibulum the vestibular bulb in the coelom is high and conical in shape. In the specimens in which there is a conical body in the vestibulum, the vestibular bulb is shorter, less conical in form, elongately ovoid with bluntly rounded ends.

No penial setae were to be seen in the coelom of any of the specimens but were found in slitting open the conical protuberances into the vestibula. No reserve setae were found. The penial setae are 1.2-1.7 mm. in length. The thickness of the widest portion of the shaft varies from 25-35 micra. The main portion of the shaft is usually fairly straight, towards the tip the shaft is bent slightly towards one side. The tips of all setae examined are either softened or broken off. The ornamentation is of short, transverse rows of teeth, the rows being fairly closely spaced.

The spermathecal ampullae are usually elongated in an anteroposterior direction. The duct is stout and barrel-shaped, and constricted as it passes into the parietes. The coelomic portion is thick-walled and slightly more than 2 mm. long. Each spermatheca is provided with one median and one lateral diverticulum. The number of the seminal chambers varies from 1-4.

Remarks.—In *E. orientalis* there appear to be vestibular apertures of an elongately quadrangular shape as in *E. marmoreus*.

***Eutyphoeus montanus*, sp. nov.**

Pegu Yomas, August, G. R. Anderson, 10 clitellate specimens.

External characteristics.—Length to 65 mm. Greatest diameter to 6 mm. Unpigmented behind the clitellum, anterior to the clitellum there is a slight greyish or greyish blue appearance, especially dorsally; clitellum, brownish.

The first dorsal pore is in 10/11 on 2 specimens; in 11/12 on 4 specimens; in 11/12 but with a non-functional, pore-like marking in 10/11 on 4 specimens.

The setae begin on ii. Setal formula, $ab < cd < bc < aa$. The setae are darker, slightly larger, more protuberant, and hence more readily visible on these specimens than on individuals of *E. peguanus* with which *E. montanus* was collected.

The clitellum is annular and extends from just in front of or just behind the setae of xiii to just in front of or just behind the setae of xvii; setae present, dorsal pores and intersegmental furrows lacking.

The spermathecal apertures are transverse slits in 7/8 with centres in mid bc , or near to c or in c .

The female pores are paired on each specimen.

The male areas and the genital markings are all more or less eroded. The male areas are rounded, on xvii, about in ab with a transversely slit-shaped vestibular pore at their centres. Just lateral and just median to each of the circular areas there is a crescent-shaped marking with the arms of the crescent close to and about the male area. Most specimens show no indications of a penial body but on two worms there are slight traces of eroded penial bodies like those of *E. peguanus*.

The genital markings are nearly circular areas, with roughened surfaces, but in several specimens with indications of having been smooth and glistening. These areas are paired, extending from a or just median to a to mid bc or slightly more lateral than mid bc , and across the intersegmental furrows nearly to the setae of the segments concerned; on 19/20 (1 specimen), 20/21 (5), 18/19 (1), right 20/21 only (2), left 20/21 (1).

Internal anatomy.—Septum 11/12 is thinner than 10/11 and in most specimens, if carefully dissected, is recognizable as a definite septum attached to the parietes ventrally and ventrolaterally and to the oesophagus mesially; it cannot be traced to the parietes dorsally or dorso-laterally and in the dorsal part of the body appears to fuse with 10/11.

There are small, paired, lateral intestinal caeca in xxviii on the anterior face of 27/28 in each specimen, the caeca laterally flattened and ear-like in 5 specimens, with a ventrally directed, pointed portion in 5 specimens. The ventral caeca are in xxxiii-lx:—xxxiii-lvii (1), xxxiii-lviii (5), xxxv-lx (1).

The dorsal blood vessel ends with the hearts of vi in one specimen, with the hearts of vii in 2 specimens, is continued into iii with slender commissures passing ventrally in v in 7 specimens.

The male funnels in x are large and may be as large as the funnels of xi, a trifle smaller or quite distinctly smaller, but are never rudimentary. The seminal vesicles of ix usually extend through 8/9 and may be as large as the vesicles of xii. The seminal vesicles of xii may be confined to xii and xiii or may extend posteriorly into xvi, xvii or even xviii. The testis sac may be described as annular, for a ring of whitish testicular material encircles the gut; the ventral wall of the sac appears to be the ventral parietes, laterally connective tissue passing longitudinally from 10/11 to 11/12 shuts off the testicular material from the parietes, dorsally the sac is closed off, apparently, by the fusion of 10/11 and 11/12. Included within the sac are the hearts of xii and the dorsal blood vessel.

The prostates extend through xvii-xix. The prostatic duct is 5-7 mm. in length. The vasa deferentia of a side are in contact but do not unite until into xvii. If the vasa are cut across just anterior to the

bulbus ejaculatorius the two separate. The bulbus is small but coelomic, slightly longer than thick. The penial setae are contained within a column of opaque whitish tissue which passes ventrally into the dorsal end of a more or less conical mound of whitish tissue just between and slightly median to the parietal ends of the prostatic duct and the bulbus ejaculatorius.

The penial setae are almost perfectly straight, 1.5—2.3 mm. long, the shaft slightly enlarged near the tip and in that region ornamented with numbers of very short, transverse rows of fine spines or teeth. The tip of nearly every seta examined is broken straight off and lost; several unbroken setae have softened tips. Two setae with perfect tips are figured.

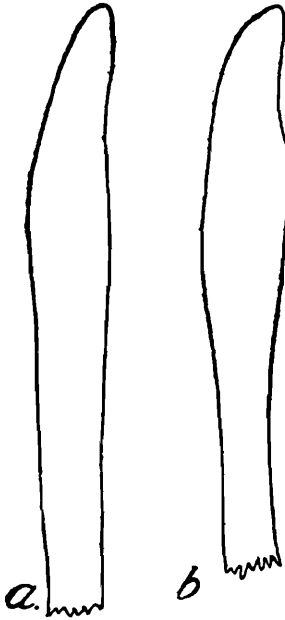


FIG. 25.—*Eutyphoeus montanus*, sp. nov.

a-b. Tips of two penial setae $\times$ ca. 110.

The spermathecal duct is short and stout, but only very slightly coelomic, and apparently not constricted within the parietes. Each spermatheca has two diverticula, one median and one lateral. In three specimens the spermatheca of the left side appears to have no lateral diverticulum but on close examination a minute rudiment of the diverticulum can be seen protruding from the duct. In one worm the rudiment is double. The diverticulum is thick, sessile, slightly elongated with bluntly rounded end or nearly spheroidal, or with a narrow, non-iridescent, short, stalk-like portion.

Over each genital marking there is visible in the coelom a slight bulge of the body wall, but no glandular material projects into the coelom through the longitudinal muscles.

Remarks.—Two specimens differ from the worms described above as follows:—Genital markings across 21/22, male funnels in x but no testes in x and no seminal vesicles in ix. The seminal vesicles of these worms extend into xvii. The dorsal blood vessel is continued into iii with ventrally directed commissures in v. At the vestibular pores are eroded vestiges of tumescences, one at the anterior margin of the pore, the other at the posterior margin, the tumescence at the posterior margin similar to the penial body of *E. peguanus*. The worms may perhaps be abnormal specimens in which the testes of x and the seminal vesicles of ix have failed to develop.

The genital markings, except for their intersegmental location, do not appear to be different from those of *E. peguanus*.

***Eutyphoeus peguanus* Gates.**

1925. *Eutyphoeus peguanus*, Gates, *Ann. Mag. Nat. Hist.* (9) XV, p. 323.

Kamaungthwe River, August, W. D. Sutton, 2 acitellate and 10 clitellate specimens.

Pegu Yomas, August, G. R. Anderson, 128 acitellate and 186 clitellate specimens.

Blachi, September, G. E. Blackwell, 2 clitellate specimens.

Ywadow, September, K. John, 21 clitellate specimens.

Pyigyauing, September, K. John, 10 clitellate specimens.

Toungoo, September, K. John, 41 clitellate specimens.

Thonze, September, K. John, 15 a clitellate and 11 clitellate specimens.

Myaungmya, October, William Law, 1 clitellate specimen.

Ye, October, K. John, 13 clitellate specimens.

Thaton, October, K. John, 11 clitellate specimens.

Kamaungthwe River, October, W. D. Sutton, 7 clitellate specimens.

External characteristics.—The spermathecal pores are wide, transverse slits with their centres in *b*, mid *bc*, lateral to mid *bc* or very rarely in *c*.

Each specimen has a pair of female pores.

The vestibular aperture may be at the ventral end of a short, mound-like protuberance. The protuberance may be a part of a genital marking or the marking may be lacking. If there is no protuberance the vestibular pore is on a genital marking. The markings are paired, elongately oval, transversely oval, or almost round, definitely marked off by a slight furrow or not so marked, usually extending the whole length of xvii and from *a* or slightly median to *a* to *c*, *d* or lateral to *d*. The vestibular pore may be at the centre of the median half of the marking or at the centre of the posterior half. When the paired markings are lacking there may be a midventral marking on xvii between the two mound-like elevations.

In addition to the markings on xvii there may be a pair of markings on any of the clitellar segments or any of segments xviii-xxii. A small number of specimens have an extra pair of markings or an extra asymmetrical marking, but the markings are always segmental, usually extending the whole length of the segment, from *a*, median to *a* or lateral to *a* to mid *bc*, *c*, or *d*, or rarely slightly lateral to *d*. Fifty-two specimens have only the markings on xvii; 248 specimens have a pair of markings on xix; 6 specimens have paired markings on xix and on xx; 58 specimens have a pair of markings on xx; 44 specimens have paired markings on xvi and xx; many of the other specimens have an asymmetrical marking in addition to a pair of markings on xvi, xv, or xviii-xxi. Only one of the specimens collected in the last two years has markings on xxii.

Internal anatomy.—(Opened 175 specimens; the numbers in parentheses denote the number of specimens in which a particular characteristic was noted).

One specimen has a pair of intestinal caeca in xxix on the anterior face of 28/29; one specimen has no lateral intestinal caeca; two specimens have a dorsally directed, pointed caecum in xxviii on each side; one specimen has a pair of bilobed caeca in xxviii; 61 specimens have a pair of small, pointed, ventrally directed caeca in xxviii; the remainder have a pair of small, flattened, flap-like or ear-like caeca on the anterior face of 28/29, laterally directed or anteriorly directed but not pointed. The ventral caeca are in segments xxxii-lxx as shown below.

Segments.	Specimens.
xxxii-lx	1
xxxiii-lx	1
xxxiv-lvii	1
xxxiv-lix	1
xxxiv-lx	4
xxxiv-lxiv	1
xxxiv-lxviii	1

Segments.	Specimens.
xxxv-lx	1
xxv-lxi	1
xxxv-lxii	1
xxxv-lxiii	3
xxxv-lxiv	3
xxxv-lxvi	2
xxxv-lxviii	1
xxxvi-lx	1
xxxvi-lxiii	2
xxxvi-lxvi	1
xxxvi-lxviii	1
xxxvii-lxviii	1
xxxvii-lxx	1

The dorsal blood vessel ends with the hearts of vii in 2 specimens; is continued into the pharyngeal region in 4 specimens in two of which there are paired commissures from the dorsal blood vessel in v; ends with the hearts of vi in 127 specimens; is continued anterior to the hearts of vi but not anterior to 5/6 in the remainder.

There is a pair of male funnels in x in each specimen (100). The vasa deferentia of a side may come into contact at some point from xii posteriorly or not until xvii; or may be widely separated in xvii; they may be united after coming into contact or may continue side by side but not unite until in xvii. The bulbus ejaculatorius is coelomic, very well developed in some of the Pegu Yoma specimens and spindle-shaped. The testis sac is cylindrical, the testicular material surrounding the hearts of xi and the dorsal blood vessel. The prostatic ducts are $5\frac{1}{2}$ -10 mm. in length.

Each spermatheca has a median and a lateral diverticulum (175). One spermatheca has in addition a small diverticulum on the median face of the duct. The spermathecal duct is wide, softish, only slightly coelomic and apparently not narrowed in the parietes. The duct cannot be pulled out from the parietes as in some other species at least not before the longitudinal musculature is removed. The granular material within the spermathecal ampulla often contains soil particles.

Remarks.—Specimens of *E. peguanus* as small as 80×3 mm. can be definitely identified when collected in Rangoon where all other species of *Eutyphoeus* are pigmented. On the smallest specimens both setae *a* and *b* are present on xvii on each side, *b* about in line *b* but *a* lateral to line *a* and very close to *b*. These setae are not as protuberant on xvii as on other segments, the tips just barely visible. On slightly larger specimens there is a transverse slit about in *b* or very slightly lateral to or median to *b* and just behind this slit there is another pore, also transversely slit-like. The anterior slit is the rudiment of the vestibular invagination, the posterior slit is probably the male pore. On slightly larger specimens the epidermis immediately around the posterior slit is protuberant as a tiny marginal ring on the posterior margin of the vestibular pore. On slightly larger specimens the ring is visible only on the posterior wall of the vestibulum. In fully mature and perfectly preserved specimens

this ring is developed into a funnel-like structure with a narrow stalk; the stalk passing down into the vestibulum, a crescent-shaped slit at the ventral end of the funnel. The funnel is probably in the nature of a penis. It is small, soft, and very delicate and may protrude to the exterior through the vestibular pore. When so protruded it is very readily damaged. Very slight friction against anything firm seems to be sufficient to erode the penis so that it is almost unrecognizable.

Specimens of *E. peguanus* have been grouped hitherto into seven varieties according to the location of the genital markings or the presence or absence of a mound-like vestibular protuberance. So many variations in characteristics of the male areas on xvii and in the locations of the genital markings have been found in the last two years that the previous scheme of varietal classification has completely broken down. Merely to list the various combinations of characteristics observed would require several pages.

***Eutyphoeus planatus* Gates.**

1929. *Eutyphoeus planatus*, Gates, *Proc. U. S. Nat. Mus.* LXXV (10), p. 35.

Thayetmyo, September, K. John, 36 clitellate specimens.

External characteristics.—Length to 224 mm. Greatest diameter to 8 mm. The worms, when first brought to the laboratory, had a distinct greenish tinge ventrally and ventrolaterally where the brown pigment is lacking.

. On each of these worms there is ventrally and ventrolaterally a midsegmental, transverse row of minute, dark spots, in line with the setae, readily recognizable on the anterior segments, sometimes visible but less readily posterior to the clitellum.

The first dorsal pore is in 11/12 (25).

The spermathecal apertures are transverse slits in 7/8, the centre of the slit in *b*, or slightly lateral to *b*, or (very rarely) slightly median to *b*.

There is a single female pore in each worm.

The vestibular aperture is large, the anterior half of the aperture wider (transversely) than the posterior half as previously figured. The parietes around the aperture is hard and forms a firm, circumferential lip which is not definitely marked off. On the roof of the vestibulum there is visible on each side just lateral to the midventral line an elongate, tumescent and ridged area or there may be two areas. The penes are short, relatively thick, whitish, truncated cones in the deepened portions of the vestibulum and not visible usually from the exterior until after the lateral portion of the lip of the vestibular aperture has been pushed or cut away.

Thirty-two specimens have a single, transversely oval, genital marking in the region of 13/14 as on the type specimen. One specimen has a marking on 12/13 instead of on 13/14, another has a transversely shortened marking on the right side only in the region of 12/13, a third has no genital marking, a fourth has two distinct markings, one in the region of 13/14, the other in the region of 14/15.

Internal anatomy.—(Opened 25 specimens).

The ventral intestinal caeca are in segments xxxiii-xxxix as shown below.

Segments.								Specimens.
xxxiii-xxxix	.	.	.	.	.	.	.	1
xxxiv-xxxvii	.	.	.	.	.	.	.	2
xxxiv-xxxviii	.	.	.	.	.	.	.	7
xxxiv-xxxix	.	.	.	.	.	.	.	7

The dorsal blood vessel ends with the hearts of vii in 14 specimens. In 10 specimens the dorsal blood vessel is continued a short distance beyond the hearts of vii, ending as a sharply conical tag. In one specimen there is a thread-like continuation from the cone anteriorly on to the gizzard.

The testis sac is median, the hearts of xi bound down to the oesophagus. The prostatic duct which may reach a length of 10 mm. appears to be muscular throughout and is only slightly thicker ectally than entally. The bulbus ejaculatorius is small, soft, buried in the parietes.

The functional penial setae of one side of each worm were examined ; all have the characteristic, flattened and widened tip.

The spermathecal ampulla is large and dumb-bell-shaped as a rule. The duct is short but stout and muscular and can be easily pulled out from the parietes. Each spermatheca has one median and one lateral diverticulum. In one worm the lateral diverticulum of the right side is in two independent portions. The diverticula are short and stumpy and ovoid, bilobed, trilobed or rarely with four or five seminal chambers.

Into the coelom of segment xvii there projects a conspicuous elevation of the parietes, wider transversely than long. Under the nerve cord the dorsal wall of this projection is thinned and depressed so that, after removal of the nerve cord there appear to be two longitudinally ovoid bodies. Into the centre of each half of the elevation pass the prostatic duct and the bundle of penial setae.

The parietes is only slightly protuberant into the coelom over the anterior genital marking, the longitudinal muscular layer uninterrupted.

The ovaries are flattened, opaque, oval discs, either in septum 12/13 or covered over by tissue. A peripheral layer of tough tissue must be dissected off from the disc before the ova can be seen.

Remarks.—There are protozoan parasites in the region of segment iii in each specimen, in pairs, trios, quartettes, or sometimes singly. Each parasite is elongate and has at one end a mass of sucker-like or finger-like projections. In a few worms isolated individuals are present in the coelom posterior to segment iii. In five worms there are considerable numbers of ovoid, opaque cysts free in the coelom behind segment xvii. There are protozoan parasites and nematodes in the testis sac of each of the worms.

The protozoa in segment iii are somewhat like *A. singularis*, but are not branched.

Eutyphoeus pusillulus Gates.

E. pusillulus was erected for a single specimen. The following notes may be added to the original account.

The appearance of the posterior end indicates that a portion of the tail had been lost prior to the time of collection.

There is a very small, transverse area of especial smoothness on the anteriormost margin of viii on each side just posterior to each spermathecal pore.

The male pore areas in *ab* are very small, very slightly depressed, whitish and oval, each area slightly diagonal to the midventral line. Each area bears a minute pit through which on one side penial setae protrude. Just median to the peni-setal pore of the other side there appears to be a minute aperture which may be the male pore.

No vascular commissures were found in *v* though the dorsal blood vessel extends into the pharyngeal region.

Only one ventral intestinal caecum was found, in segment xxix.

The single spermathecal diverticulum is lateral.

Remarks.—The status of *E. pusillulus* is not clear. The single individual may represent an abnormal specimen of a holandric species, but no holandric species have been found in or near the region from which this worm was collected. The species is perhaps nearest to *E. falcifer*.

From the latter it differs in a number of characters, most important of which seems to be the condition of the anterior male genitalia. In *E. pusillulus* there are seminal vesicles in ix and male funnels and (presumably) testes in x but no male funnels or testes in xi or seminal vesicles in xii. *E. falcifer*, on the other hand has male funnels in x and xi and seminal vesicles in xii but no vesicles in ix. Now *E. manipurensis*, which is a metandric species but with male funnels in x as in *E. falcifer*, may occasionally have small seminal vesicles in ix. If similar variations occur in *E. falcifer* it may be possible to regard *E. pusillulus* as a specimen of *E. falcifer* in which the posterior male funnels and seminal vesicles have failed to develop, perhaps as a result of some parasitic infestation. Other differences between *E. falcifer* and *E. pusillulus* appear to be of minor or possibly of no importance. Seta *d* is dorsal in the posteriormost segments of *E. falcifer*, not dorsal apparently in *E. pusillulus*, but the posterior end of the type of the latter is probably lacking. The ventral intestinal caeca of *E. falcifer* are in xxviii and xxix, in *E. pusillulus* one only, in xxix. The absence of a caecum in xxviii may be merely an individual variation as the number of caeca varies in other species also.

Eutyphoeus quinquepertitus Gates.

1930. *Eutyphoeus quinquepertitus*, Gates, *Rec. Ind. Mus.* XXXII, p. 343.

The vestibula are narrow, transversely slit-like. The vestibulum of one side of the cotype specimen was slit open. Into this vestibulum from the highest point which is laterally, there projects from the roof a tubular body with a slit at the ventral end and two marginal lips. The penis was removed and teased apart but no penial setae were found. There is a slight protuberance into the coelom over the vestibular region, it is a sort of flattened vestibular bulb almost oval in outline. The posterolateral portion of this bulb just dorsal to the penis is slightly

more protuberant than the remainder. The prostatic duct passes into the lateral face of the bulb, while the elongate bulbus ejaculatorius enters its posterior face.

The dorsal blood vessel ends with or just in front of the hearts of vii.

The ventral intestinal caeca of the cotype specimen are in segments xxxiv-liv.

The testis sac is ventral to the gut but transparent connective tissue binds the hearts of xi to the oesophagus.

***Eutyphoeus rarus* Gates.**

1925. *Eutyphoeus rarus*, Gates, *Ann. Mag. Nat. Hist.* (9) XVI, p. 59.

Kyangin, August, K. John, 37 specimens.

Sandoway, September, F. R. Bruce, 16 specimens.

Myagyaung, September, K. John, 2 specimens.

Prome, September, K. John, 33 specimens.

Kochi, September, K. John, 4 specimens.

Bassein, September, K. John, 85 specimens.

Bassein, October, K. John, 9 specimens.

External characteristics.—The first dorsal pore is in 10/11 on 2 specimens ; in 11/12 on 117 specimens ; in 11/12 but with a pore-like marking in 10/11 on 19 specimens ; in 12/13 on 1 specimen ; undetermined on other specimens.

The spermathecal pores are in *bc* (186).

There is a single female pore on the left side only (186).

The male markings of xvii may be described as well-like vestibula, one on each side of xvii, with a more or less definitely indicated rim or lip about the vestibular pore, usually the latter delimited by a slight circumferential groove. At the bottom of the vestibulum (when viewed inverted) is a small, transversely oval papilla with two setal pits. Around this papilla is a slight, annular or short tubular body, the penis. From the ventral end of the penis there projects an anterior lip and a posterior lip. The anterior lip may be smooth or minutely lobed but is never very conspicuously lobed while the posterior lip has two, elongate, more or less pointed lobes that often protrude to the exterior through the vestibular pore. No specimen has been found with a vestibulum everted and penis fully exposed to the exterior ; to determine the characteristics of the penis the vestibulum was opened.

Four specimens from Sandoway have no genital markings aside from the "crescents at the margins of the vestibular apertures. There are intracuticular markings, paired or unpaired, presetal or postsetal "medians" on 180 specimens, of which 60 specimens from Bassein and Kochi have no other markings. There are preclitellar lateral and median markings on 20 specimens. The postclitellar, paired lateral markings are on 18/19 (18 specimens), 19/20 (18), 20/21 (2), 21/22 (4). On segment xviii in *aa* on 35 specimens there is a pair of postsetal markings.

Internal anatomy.—(Opened 86 specimens).

The paired intestinal caeca are in xxviii, ventrally directed (84 specimens) or dorsally directed and small (1), or mere flattened, ear-like

flaps (1). The caeca are attached to the gut at or near 28/29. The ventral caeca are in xxxii-lvi as shown below.

Segments.	Specimens.
xxxii-xlix	1
xxxii-l	1
xxxii-li	1
xxxiii-xlvi	3
xxxiii-xlix	3
xxxiii-l	4
xxxiii-li	2
xxxiii-lii	2
xxxiii-lvi	1

The dorsal blood vessel ends with the hearts of vii (86).

The testis sac is ventral to the oesophagus (86). No male funnels were found in x in 84 specimens. One specimen has a large pair of male funnels in x; one specimen has a single large male funnel on the left side. The stalks of these funnels cannot be traced to the vas deferens. The prostates extend through xvii-xx or xxi. The prostatic duct is 8.13 mm. long (Sandoway specimens 15-21). The bulbus ejaculatorius is small but coelomic. The penial setae may reach a length of just over 4 mm. (5-6 mm. in Sandoway specimens). The terminal spine of one seta is bifid.

Each spermatheca has a lateral and a median diverticulum (86). The spermathecal duct is thick, but shorter and slenderer than in *E. longiseta*, constricted in the outer layers of the parietes from which it can be easily pulled out.

Remarks.—Aclitellate specimens as small as $85 \times 3-3\frac{1}{2}$ mm. can be identified by rudiments of the post-clitellar genital markings. On such small specimens the vestibula are not formed and on xvii there is visible on each side only a small transverse slit in *b*. Through the slit, even at this stage, there project penial setae.

One worm, when killed, was regenerating, segment i and the prostomium. No instances of anterior regeneration have been found in the genus *Eutyphoeus* hitherto.

In a preceding paper, worms belonging to *E. rarus* were classified into 4 varieties according to the presence or absence of certain genital markings. So much variation in the number and location of the genital markings has been found in recent specimens that the previous scheme of classification has broken down. The four varieties are therefore no longer retained. It should be noted however that worms with the preclitellar genital markings have been found only in a region from Prome, Kyangin, and Bassein westwards to Sandoway.

E. rarus is differentiated from *E. longiseta* by the definite vestibula on xvii, characters of the penes and of the postclitellar genital markings.

***Eutyphoeus sejunctus* Gates.**

1930. *Eutyphoeus sejunctus*, Gates, *Rec. Ind. Mus.* XXXII, p. 349, fig. 25.

Leiktho Circle, September, G. E. Blackwell, 8 specimens.

External characteristics.—On the tail portion of each worm seta *d* is dorsal as in the original specimens.

The first dorsal pore is in 11/12 on 7 specimens; in 11/12 but with a pore-like marking in 10/11 on 1 specimen.

The spermathecal pores are in *b* (8).

There is a pair of female pores on each specimen, each pore just in front of *a*.

There are slight traces of crescent-like markings around the vestibular apertures on each specimen.

Internal anatomy.—The lateral intestinal caeca are finger-shaped, ventrally directed, in xxvi but attached to the intestine near or close to 26/27 so that the lumen of the caecum appears to be an extension of the intestinal lumen of segment xxvii. The ventral caeca are in xxxii-xliii:—xxxii-xl (2), xxxii-xlii (1), xxxii-xliii (1).

The dorsal blood vessel is continued to the pharyngeal region but anterior to 5/6 is slender. There is a pair of commissural vessels to the dorsal blood vessel just anterior to 5/6 but these have not been traced to the ventral blood vessel. There are paired hearts belonging to vi, vii and viii in each specimen.

The testis sac is median but with a lateral or dorsal extension of the sac at each side of the oesophagus. The hearts of xi do not pass into the dorsal extensions of the testis sac but are median to the extensions. The prostates extend through xvii-xix or xx. The prostatic duct is 4-5 mm. in length. The bulbus ejaculatorius is small but coelomic though covered over with transparent connective tissue. The penial setae are bow-, crescent or U-shaped and are located on the lateral face of the "column." The tips of all functional penial setae are cracked, broken or softened. The tips of the reserve setae narrow gradually to a point without a terminal spine. The ornamentation is of closely crowded rows of fine teeth or spines.

The spermathecal duct is short but stout, whitish but strong, easily pulled out from the parietes within the outer layers of which it is constricted. The spermathecal diverticula are short, rounded bulbs or elongated and straight or bent. Each spermatheca has one lateral and one median diverticulum.

A rounded, glandular (?) mass projects into the coelom over each genital marking.

***Eutyphoeus spinulosus* Gates.**

1926. *Eutyphoeus spinulosus*, Gates, *Rec. Ind. Mus.* XXVIII, p. 164, figs. 5-6.

Bassein, September, K. John, 14 specimens.

Coomzamu, September, K. John, 1 specimen.

Bassein, October, K. John, 31 specimens.

Kokya, October, K. John, 4 specimens.

One specimen from Coomzamu has two genital markings as on the Pegu specimen of *E. foveatus* (*vide* account hereinbefore of genital markings in *E. foveatus*). Other specimens either have no genital markings or a single marking as in *foveatus*.

Thirty-five specimens were dissected. The ventral intestinal caeca are in xxxiv-lxv:—xxxiv-lxv (1), xxv-lx (2), xxxvi-lx (1), xxxvi-lxi (1).

The dorsal blood vessel ends with the hearts of vii.

The prostatic duct is 14-20 mm. long, the ental half weak and flabby, the ectal half firmer and gradually thickened passing ectally. The bulbus

ejaculatorius of every specimen is shorter, narrower and softer than in *E. foveatus*.

None of the penial setae, functional or reserve, of the 35 specimens have the spiral bending characteristic of *E. foveatus*. The tip of a penial seta may have "wings" as previously described or may be merely widened. The widening is so pronounced that it can be recognized with the 55 mm. objective of the binocular. The rows of spines or teeth may be continuous or frequently interrupted; the ornamentation may be reduced to a few short and scattered rows or to a few isolated teeth.

Of the 70 spermathecae each one has only one diverticulum, on the lateral face of the spermathecal duct. The duct is slightly longer and stouter than in *E. foveatus*.

A specimen from Bassein has on xvi on the left side of the segment, a half portion of an extra vestibulum containing a penis and continuous with the vestibulum of xvii. The vestibular pore is twice as long antero-posteriorly on the left side as on the right side. There is an extra prostate and bundle of penial setae in xvi on the left side and a bulbus ejaculatorius. There is no bulbus ejaculatorius in xvii on the left side.

E. spinulosus seems to mature much later than *E. foveatus*. The laboratory collector went to Bassein in September 1931 especially to get mature specimens of this form but did not find a single one. He returned to Bassein again in October 1932 and succeeded in finding only a few, fully clitellate specimens.

E. spinulosus is retained for the present as a distinct species. No variation has been found in the number of spermathecal diverticula either in *E. foveatus* or *E. spinulosus*. The penial setae of the two forms are characteristic and without intergradations or variation. The genital markings of the two forms are not however specifically characteristic as was previously thought. Aclitellate specimens of *spinulosus* without genital markings or vestibulum can be definitely identified.

Eutyphoeus strigosus, sp. nov.

Shoko, September, G. E. Blackwell, 17 clitellate and 3 aclitellate specimens.

Blachi, September, G. E. Blackwell, 4 clitellate specimens.

Ko Haw Der, September, G. E. Blackwell, 2 specimens.

Description of the type-specimen.

External characteristics.—Length 139 mm. Greatest diameter (in clitellar region) 5 mm. Number of segments, *ca.* 189. Unpigmented; clitellum, reddish.

The setae begin on ii and are paired, on xx $ab < cd < bc < aa$, *dd* is greater than one half of the circumference. On the posteriormost segments seta *d* is about mid-lateral in position or perhaps a very slight trifle dorsal to the mid-lateral line.

The first dorsal pore is in 11/12.

The protuberant clitellum is annular and extends dorsally across the posterior third of xiii and about to 17/18 and ventrally from 13/14 to 16/17; ventral setae present, positions of the dorsal pores indicated; intersegmental furrows lacking.

The spermathecal pores are in 7/8 about in *c*.

There is a pair of female pores, each pore being just anterior to *a*.

There are small male vestibula on xvii. The vestibular aperture is rounded and about in *b*, the vestibular pore practically filled by the slightly protuberant penis. The region around the vestibular pores and between the two vestibular pores midventrally is whitish and wrinkled.

The single genital marking is in *aa*, reaching laterally on each side so as to include *a* within its border and extending slightly on to the anterior half of xii and just across 12/13 on to the anteriormost margin of xiii. The posterior half of xii is much longer than the anterior half.

Internal anatomy.—The gizzard is curiously deformed. It is elongate and extends through vi and vii nearly to 8/9. The anterior end is bluntly rounded, the oesophagus opening into the gizzard on the dorsal surface. The posterior end of the gizzard is squarish, from each dorsal corner of the gizzard there passes posteriorly a strong cord of tissue, the oesophagus passing out from the gizzard on the middle of the ventral surface. The lateral intestinal caeca are finger-shaped, ventrally directed, in xxvii.

There is a pair of hearts belonging to vi anterior to which the dorsal blood vessel is continued to the pharyngeal bulb. There are readily visible commissures in v passing ventrally from the dorsal trunk.

The testis sac is median but with a dorsal outpocketing at each side of the oesophagus into which the heart of xi does not pass. The seminal vesicles push 12/13 and 13/14 back into contact with 14/15. The prostates extend through xvii-xx. The vas deferens is readily visible throughout most of its course. The small bulbus ejaculatorius is covered over with transparent connective tissue but is readily visible. The peni-setal bundle projects through xvii-xix.

There is glandular material projecting very slightly into the coelom over the single genital marking.

Remarks.—The spermathecal pores are in *c* or just median to *c*.

The first dorsal pore is in 11/12 on 1 specimen; in 11/12 but with a pore-like marking in 10/11 on 25 specimens.

The clitellum which is reddish extends from xiii, just behind the setae, to 17/18 or from 13/14 to mid xvii or to 17/18.

Seta *d* is about mid-lateral on the posteriormost segments, never dorsal as in *sejunctus*.

There are two female pores on each specimen.

Posteriorly the clitellum is interrupted midventrally by a whitish area which extends to *b* or slightly lateral to *b*. About in line with *b* is the rounded vestibular pore. The vestibulum is small, practically filled by the penis, which is cone-like to columnar, but usually with the base slightly thicker than the tip. At the bottom of the penis (internally) is a transversely oval papilla bearing two setal pits.

Each specimen, except three, has a single median, preclitellar, post-setal genital marking. The marking is transversely elongated with bluntly rounded ends, on the posterior half of segment xii which is 2-4 times the length of the anterior half of the segment. The genital marking may impinge slightly on to the anterior half of the segment (in which case seta *a* of each side is included in the margin of the marking) and may also extend slightly on to xiii. The marking is usually confined to

aa but may extend laterally into *ab* on each side. One specimen from Blachi and two from Ko Haw Der have no genital markings.

The gizzard is deformed as in the type in each of the 21 dissected specimens. The lateral intestinal caeca are finger-shaped, ventrally directed, in xxvii (20). The caeca are attached to the intestine just in front of 27/28 so that the lumen of the intestine of xxviii communicates with the caecal cavity, the septum 27/28 attached to the posterior face of the caecum. In one worm one caecum is in xxviii instead of xxvii but is attached to 27/28. The ventral caeca are in xxxiii-xlvi :—xxxiii-xlv (2), xxxiv-xliv (1), xxxiv-xlv (4), xxxiv-xlvi (4).

The dorsal blood vessel passes anteriorly through 5/6 to the pharyngeal bulb in every specimen. There are paired but narrow commissures in v in each specimen, the commissures traced to the ventral trunk in one specimen.

The prostates are in xvii-xxi. The prostatic ducts are 4-6 mm. in length. There is a small but coelomic bulbus ejaculatorius which is well developed relative to the size of the worm. The penial setae are like those of *E. sejunctus* except that the crescent or bow-shape is more widely open.

Each spermatheca has two diverticula, one median and one lateral. The diverticula are bent, almost at a right angle, the ectal portion of the diverticulum perpendicular to the duct and parallel to the ventral parietes, the ental portion of the diverticulum directed anteriorly or posteriorly. The duct is stout and whitish, easily removed from the parietes in the outer layers of which it is constricted.

Remarks.—*E. strigosus* is distinguished from *E. sejunctus* by the lateral position of seta *d* on the posteriormost tail segments, by the single median genital marking and its location, and by the location of the lateral intestinal caeca in xxvi.

Eutyphoeus sp.

Tiddim, Chin Hills, September, J. H. Cope, 1 clitellate specimen.

External characteristics.—Length 128 mm. Maximum diameter 4 mm. Unpigmented.

The setae begin on segment ii. On xx the setal formula is $ab < cd < bc < aa$. On the posteriormost segments interval *cd* is widened so that *d* is dorsal to the mid-lateral line.

The first dorsal pore appears to be in 10/11.

The clitellum is annular and extends from anterior to the setae of xiii to slightly posterior to 16/17; intersegmental furrows and dorsal pores lacking, setae present.

The spermathecal pores are transverse slits in 7/8 in *ab*.

There are two female pores.

There are paired male areas on xvii, each area dark greyish, oval but placed slightly diagonally so that the anterior end is slightly nearer the midventral line than the posterior end, slightly depressed. There is a slight suggestion of a ridge around the posterolateral portion of the marking. On the anteromedian portion of the marking there is a slight elevation on which is seated a tubular, softish body. At the ventral

end of this body there is a slit through which the penial setae protrude. The posterior margin of the slit is especially protuberant as a sort of tag-like body which is somewhat eroded. There are no other genital markings.

Internal anatomy.—The ventral intestinal caeca are fairly large and in segments xxxiii-lx.

The dorsal blood vessel is continued into segment iii. There is a pair of fairly large commissures in v and also commissures belonging to vi-viii.

The seminal vesicles of ix are small and flattened against the anterior face of 9/10. There is a pair of male funnels in x but no testes or testicular material was observed. The testis sac (segment xi) is annular. The seminal vesicles of xii push 12/13 back into contact with 13/14. The prostates extend through segments xvii-xx. The prostatic duct is about 5 mm. long. There is a slight coelomic bulbus ejaculatorius.

Two functional penial setae and one reserve seta were removed from one side. The functional setae are 1.6-1.8 mm. in length, about 45-50 micra thick in the widest region; the main portion of the shaft is nearly straight, the tip bent over to one side as shown in the figure and ornamented with numerous, short, transverse rows of teeth. The tip of the reserve seta is swollen and softened.

The body wall in the region of the genital marking is thickened and slightly protuberant into the coelom as a flattened disc.

Remarks.—As only one specimen is available for study a specific determination in this case is a matter of some difficulty. The worm does not appear to belong to any of the Burmese or Indian species known at present but may be an abnormal individual of some species that normally has genital markings or of a species that normally has no seminal vesicles in ix.

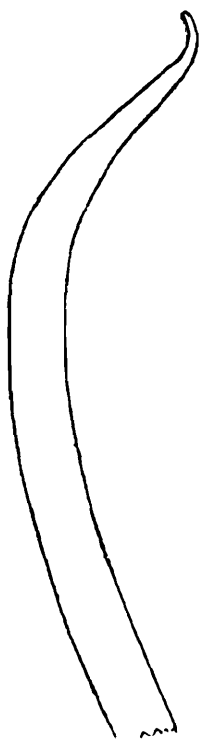


FIG. 26.—*Eutyphoeus* sp.
Tip of penial seta $\times$ ca.
110.

Family LUMBRICIDAE.

Sub-family GLOSSOSCOLECINAE.

Genus *Pontoscolex* Schmarda.

Pontoscolex corethrurus (Fr. Müll.).

- Tharrawaddy, August, K. John, 5 clitellate specimens.
- Mt. Harriet, Andaman Islands, August, C. Amirthalingam, 5 clitellate specimens.
- Chaukan, August, K. John, 1 clitellate specimen.
- Thanatpin, August, K. John, 1 clitellate specimen.
- Kamaungthwe River, August, W. D. Sutton, 196 specimens.
- Coomzamu, September, K. John, 4 clitellate specimens.
- Thanchitaw, September, K. John, 5 clitellate specimens.
- Pyapon, September, K. John, 13 clitellate specimens.
- Bassein, September, K. John, 18 clitellate specimens.

- Tantabin, September, K. John, 1 clitellate specimen.
 Toungoo, September, K. John, 4 clitellate specimens.
 Leiktho Circle, September, G. E. Blackwell, 86 specimens.
 Mt. Harriet, Andaman Islands, September, C. Amirthalingam, 5 clitellate specimens.
 Letpadan, September, K. John, 1 clitellate specimen.
 Akyab, September, Bruce Taw, 50 specimens.
 Kalaw, September, Saya Ah Sou, 2 clitellate specimens.
 Taungyi, September, Saya Ba Te, 2 clitellate specimens.
 Northern Mergui District, September, W. D. Sutton, 130 specimens.
 Myittha, September, W. D. Sutton, 136 specimens.
 Minnie Bay, Andaman Islands, September, C. Amirthalingam, 37 clitellate specimens.
 Myaungmya, October, William Law, 96 specimens.
 Kawkaeik, October, K. John, 16 specimens.
 Ye, October, K. John, 31 specimens.
 Thaton, October, K. John, 31 specimens.
 Northern Tavoy District, October, W. D. Sutton, 165 specimens.
 Victoria Point, October, Saw Nelson, 2,292 specimens.
 Bassein, October, K. John, 3 clitellate specimens.
 Kamaungthwe River, October, W. D. Sutton, 93 specimens.
 Kyaukpyu, January, Saya Ah Sou, 20 acitellate and 146 clitellate specimens.
 Mt. Harriet, Andaman Islands, February, C. Amirthalingam, 5 clitellate specimens.
 Toungoo, Myingyan District, September, K. John, 3 acitellate and 2 clitellate specimens.
 Kyaukpadaung, September, K. John, 6 clitellate specimens.
 Mt. Popa, September, K. John, 2 clitellate specimens.
 Thazi, September, K. John, 3 clitellate specimens.
 Maymyo, August, K. John, 2 acitellate specimens.
 Sungei Buloh, Selangor, Malay Peninsula, December, A. S. Corbet, several specimens.
 "Primary jungle soil," Sungei Buloh, Selangor, April, A. S. Corbet, several specimens.
 "Agricultural clay soil, cultivated about five years," Tanah Rata, Cameron's Highlands, Malay Peninsula, April, K. B. Williamson, 72 specimens.

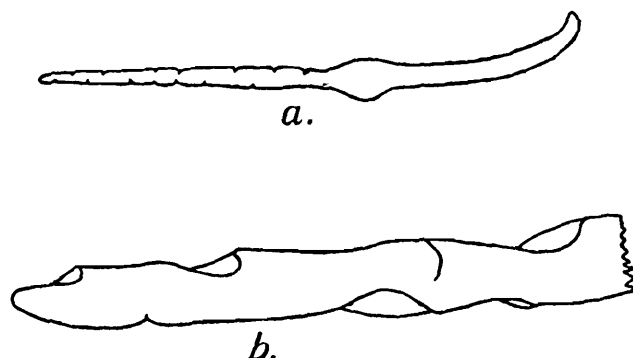
According to Mr. Williamson, cocoons were numerous in the soil in which the worms were found. As only one species of earthworm was associated with the cocoons the latter were, presumably, deposited by the former. Winter formation of cocoons by this species has previously been recorded (Gates, 1930, p. 352).

Four of the Tanah Rata specimens have a peculiarity not hitherto noticed in this species. In each of these worms there is on the left side of segment xviii in the region of *ab* a pair of whitened, tumescent areas, each area having a very evident, deep, slit-like aperture. Setae *a* and *b* of the left side of xviii are not visible. The whitish areas have an appearance like that of genital markings. Protruding conspicuously into the coelom of xviii above these areas is a pair of hypertrophied setal follicles, each follicle containing a single giant seta. The measurements of four of these setae are as indicated below :—

1. Length 1.09 mm., diameter through nodule near the base or ental end, 60 micra.
2. Length 1.05 mm., diameter through base which lacks the nodule, 60 micra.
3. Length 1.28 mm., diameter through base which lacks the nodule, 90 micra.
4. Length 1.16 mm., diameter through nodule near base, 115 micra.
 The tip, ectal end, is lacking, probably broken off in course of dissection,

Seta 1 is J-shaped, with a slight curve at the base. The other three setae are practically straight. At least one half of the length of the shaft is sculptured, the sculpturings on all sides of the shaft, the appearance of the sculpturings as if pieces had been gouged out in such a way as to form pockets, the wall of the pocket extremely thin near the mouth.

FIG. 27.—*Pontoscolex corethrurus* (Fr. Müll.).
a. Giant seta from segment xviii $\times$ ca. 50.
b. Tip of a giant seta $\times$ ca. 205.



Five Burmese specimens have one or two pairs of similar giant setae on xviii, two specimens with a pair on the right side, two with a pair on the left side, one with two pairs.

The giant setae are merely hypertrophied clitellar setae, for setae *a* and *b* of segments xvii-xix at least are similar to the giant setae in shape and sculpturing but are smaller.

The spermathecae lack diverticula. The spermathecal ampullae are flattened oval discs. The length of the spermathecal duct varies considerably as shown below by measurements of the coelomic portion of the ducts of the left side of two specimens.

Segment.			Length of spermathecal duct.	
vii	.	.	ca. 1 mm.	ca. 1½ mm.
viii	.	.	ca. 1½ mm.	ca. 4 mm.
ix	.	.	ca. 5 mm.	ca. 5 mm.

Subfamily MICROCHAETINAE.

Genus *Glyphidrilus* Horst.

Glyphidrilus papillatus (Rosa).

"In clay and mud under water in paddy fields" Bana, June, H. Young, 6 specimens.

"Dry, grassy mound" Mong Mong Valley, August, H. Young, 8 specimens.

Tharrawaddy, August, K. John, 20 specimens.

Bassein, September, K. John, 2 specimens.

The wings of the Bassein worms extend across segments xviii-xxiv, of the Tharrawaddy worms across xviii-xxv, of the Mong Mong worms across xxi-xxviii, of the Bana worms across some of segments xxi-xxx as follows:—xxiii-xxx (1), xxii-xxix (1), xxi-xxix (2), xxi-anterior portion of xxix (1), posterior portion of xxi-anterior portion of xxix (1).

The Young specimens have paired, lateral genital markings only, on segments xiii-xxvi and xxix-xxx as follows:—xiii-2 specimens, xiv-6, xv-12, xvi-12, xvii-12, xviii-13, xix-13, xx-13, xxi-13, xxii-12, xxiii-7, xxiv-5, xxv-1, xxvi-1, xxix-7, xxx-3.

Glyphidrilus sp.

" In clay and mud under water of paddy fields " Bana, June, H. Young, 12 specimens.

Thanchitaw, September, K. John, 4 specimens.

Letpadan, September, K. John, 5 specimens.

" Mud in paddy fields " Na Hang, Mang Lun State, October, H. Young, 14 specimens.

Henzada, October, K. John, 1 specimen.

All these worms lack wings, genital markings and clitellar colouration. As no other species of the genus has hitherto been found in Burma these worms probably are *G. papillatus*.

Subfamily *LUMBRICINAE*.

Genus **Bimastus** Moore.

Bimastus parvus (Eisen).

Taungyi, August, H. B. Gates, 1 specimen.

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APPENDIX.

A list of localities from which worms were secured in 1931 was included in the preceding paper (Gates 1932, p. 548). The list below includes only those localities at which worms were collected in 1932. Attention may be directed to the fact that Pyinmana, Pyigyauung and Ywadow, three localities mentioned in the preceding paper, are in Yamethin District and not, as was stated, in Pyinmana District.

Tavoy District.

Kamaungthwe River. Collections were made from Kyaukmedaung north to and along the Kamaungthwe chaung and its tributaries the Kameik chaung and the Gaungse chaung; in the vicinity of Kameik, along the Ban chaung and in the vicinity of Pyin Tha Daing and Kataungni. The area in which the collections were made is northeast of Tavoy towards the Siamese border. The most western point reached by the collector was in jungles west of Kameik and about 25 miles from Siam.

The Shan Plateau.

Kwachí, on the western border of Karenni.

Mawohi, on the Kemapyu River. Collections were made at Mawohi, along the river to Kemapyu, at Kemapyu, and then northwards at Bawlake, Kyebogyi, Po Saw and Kay Ba.

Loikaw, in Kantarawaddi State, the headquarters of Karenni. Collections were made at and in the vicinity of Loikaw, Ngedaung and Naungpale.

Mala, West of Loikaw. Collections were made at or near the villages of Mala, Shimi Sawde, Waw Baw Blau.

Koopra, west of Mala. Collections made at Koopra and Lerbako.

S'nite, in Mong Pai State, F. S. S.

Leiktho. Collections made along the road from S'nite to Yado and Leiktho village.

Kalaw, 63 miles from Thazi.

Taungyi.

Maymyo.

Namkham, on the Chinese border about 132 miles from Lashio.

Mandalay District.

Mandalay.

Tonbo.

Kyauk-kyone.

Sagaing District.

Sagaing.

Kaungmudaw.

Meiktila District.

Mahlaing, 22 miles northwest of Meiktila.

Mondaing, 9 miles southeast of Meiktila.

Meiktila.

Thazi.

Myingyan District.

Mt. Popa.

Kyaukpadaung.

Chappea.

Toungoo.

Kyaung-gone.

Toungoo District—west.

Collections made at villages of Su Law and Pray Law in the hills of the Pegu Yomas due west of Toungoo.

Tharrawaddy District.

Myagyaung.

Tharrawaddy.

Letpadan.

Thonze.

Pegu Yomahs. This designation is used to refer to a number of villages in the hills east of the Rangoon-Prome railway line which were reached from Letpadan *via* Nyaungbinzu (1,000'): Raytho (1,500'), Palete, Hseywa, Kyawkwet, Pankepin, Myanmalike, Thei Mai South (3,600'), Thei Mai North.

Myaungmya District.

Myaungmya.

Akyab District.

Akyab. Collections were made in the region between Akyab and Myinbya "near the Arakan Yomas."

Padali, "15 miles along the creeks north of Akyab."

Kyaukpyu District.

Kyaukpyu.

Chin Hills District.

Falam, about 4,000'.

Tiddim. Collections were made at and near Tiddim, in the region south of Tiddim on both sides of the Manipur River, as well as to the north and northwest.

Haka. Collections were made at or near Haka and at or near Kanpetlet and along the road from Haka to Kanpetlet.

Chin Hills District—South. Collections were made at various places south of Kanpetlet to the borders of Minbu and Akyab Districts.

Bassein District.

Bassein.

Kokya.

SILUROID FISHES OF INDIA, BURMA AND CEYLON.

1. LOACH-LIKE FISHES OF THE GENUS *Amblyceps* BLYTH.

By SUNDER LAL HORA, D. Sc., F.A.S.B., F.R.S.E., Assistant Superintendent, Zoological Survey of India, Calcutta.

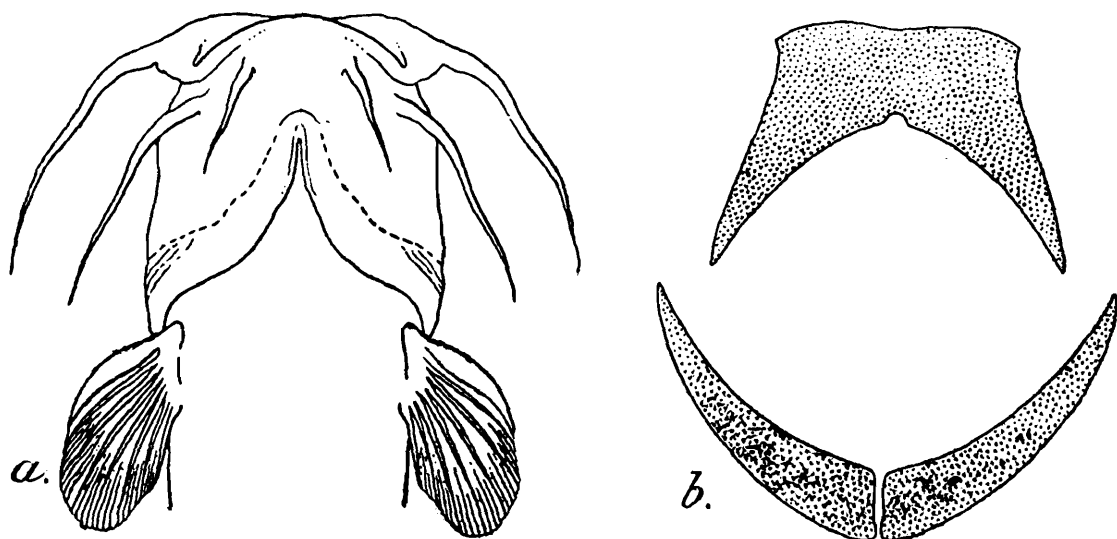
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DEFINITION.

The genus *Amblyceps* comprises small "Cobitis-like Siluroid" fishes in which the body is long, slender and compressed except in the region in front of the ventrals where the lower surface is flattened. The head is broad and depressed with the anterior end somewhat rounded or truncate. The head is greatly swollen in the region of the opercular chambers. The eyes are small, superior and subcutaneous. The nostrils are situated close together; the anterior nostril is rounded and its edges are raised to form a short tube; the posterior nostril is oval and is surrounded by a cutaneous flap which is produced into a prominent nasal barbel anteriorly. The two nostrils appear to be separated superficially by the nasal barbel. The mouth is wide and transverse. The jaws are subequal, either the upper or the lower being slightly longer than the other. The lips are continuous and surround the gape of the mouth; both the lips are slightly fimbriated and are thrown into a fold at each corner of the mouth (fig. 1a). The maxillary barbels are slightly shorter than the head and are provided with broad bases. There are 2 mandibular and 2 mental barbels. In the upper jaw there is a broad band of small, villiform teeth (fig. 1b) produced at the sides. In the lower jaw there is a similar, but narrow band which is interrupted in the middle. There are no teeth on the palate. The gill-openings are very wide extending forwards for a considerable distance on the ventral surface; in young specimens the notch extends as far forwards as the chin (fig. 1a). The gill-membranes are very extensive and are united to each other across the isthmus; they are supported by a well-developed hyoid arch and 12 long and strong branchiostegal rays (fig. 2b, b. o.). Above and anterior to the base of the pectoral fin and immediately behind the gill-opening is a prominent fold of skin on which the gill-membrane rests when the opening is closed. The ventral surface in the thoracic region is devoid of any adhesive apparatus. The anterior

dorsal fin is situated very far forwards, almost above the pectoral fin; it is enveloped in a thick skin and is provided with one soft spine and 5-6 rays. The adipose dorsal is low, and its length is variable. The



TEXT-FIG. 1.—*Amblyceps mangois* (Ham. Buch.).

a. Ventral surface of head and anterior part of body $\times 3$; b. Tooth-bands $\times 4\frac{1}{2}$.

paired fins are small, horizontally placed and enveloped in skin. The pectoral fin contains about 8 rays; the outermost ray is soft and broad, and is produced along its anterior border into a number of soft, long cartilaginous processes which run along the length of the ray. This ray is thus composed of several longitudinal strands. The ventral fin possesses one spine and five rays; it is separated from the anal fin by a considerable distance. The anal fin is also enveloped in skin and contains 9 to 12 rays of which 2 to 3 may be soft spines. The caudal fin is either sub-rounded, truncate, slightly emarginate or deeply furcate (fig. 5). The anal opening is situated in a pit between the ventral fins. The lateral line is entirely absent. The air-bladder is greatly reduced and is divided into two lateral chambers (fig. 2a) which are partially enclosed in bone.

Type-species.—*Amblyceps mangois* (Ham. Buch.)

HISTORY.

The genus *Amblyceps* was erected by Blyth¹ to accommodate the species —*A. caecutiens*² Blyth—from Maulmein in 1858. He pointed out its close affinity to *Olyra* McClelland,³ but distinguished it by “the head much broader and flatter, with minute eyes, placed near the hind aperture of the nostril; two pairs of cirri above and below, the inner

¹ Blyth, *Proc. As. Soc. Bengal*, XXVII, p. 281 (1858).

² In the old register (Catalogue of Fish) containing a list of specimens transferred from the Asiatic Society of Bengal to the Indian Museum, there is an entry under number 587 which shows that two specimens of *Amblyceps caecutiens* Blyth were [received in the collection. The locality given is “Andamans,” and the name of the donor is not mentioned. Though this entry was transferred to the New Registers under numbers F. 9814-15

¹, unfortunately the specimens cannot be traced now in the collection. The species is not found in the Andamans, and there is no doubt that the mistake is due to the wrong labelling of the specimens. On the other hand, it seems probable that these were the type-specimens which were obtained at Maulmein.

³ McClelland, *Calcutta Journ. Nat. Hist.*, II, p. 588 (1842).

above situate between the fore and hind apertures of the nostrils; pectoral and dorsal spines short and concealed, but comparatively robust; the second or adipose dorsal short and low; and the ventrals and anal also short; tail large and moderately furcate; a band of card-like teeth above and below, but no palatal band discernible in the specimens; body subcylindrical, compressed, becoming more so to the tail." Two years later Blyth¹ assigned *Pimelodus mangois* Ham. Buch.² to *Amblyceps* and remarked that "the form is rather less elongated, the tail more sharply formed, the eyes (to judge from the drawing) more distinct and the adipose dorsal better defined and less distinct from the first dorsal than in *A. caecutiens*." At the same time he described another species—*A. tenuispinis*—from Ghazipur which he distinguished "by the slenderness of its short dorsal and pectoral spines, and also by the fineness of its eight cirri." He also amplified the definition of the genus by pointing out that "the lateral line wanting in all the species." Günther³, when writing his *Catalogue*, had no specimen of the genus, and, therefore, his characterization was based on Blyth's definition. Later in 1892, Günther⁴ described a species of *Amblyceps* from the Min River, Province Sze-Chwan, China, with a subtruncate caudal fin; but this has been referred by Regan⁵ to *Liobagrus*. After an examination of abundant material Day⁶ was led to conclude that there was only one species of the genus *Amblyceps* in India and Burma. He was, however, aware of the great variations exhibited by this fish. All the same he characterized the genus as having a "forked caudal." Chaudhuri⁷ in describing *A. murray-stuarti* emended the definition of the genus to include species with a truncate caudal fin and an adhesive thoracic surface. The adhesive folds of skin referred to by Chaudhuri in *A. murray-stuarti* are an artifact. The folds represent shrunk muscles and loose skin in the thoracic region. In *Amblyceps* there is no adhesive apparatus. Prashad and Mukerji⁸ further emended the definition of the genus *Amblyceps* to accommodate *A. horae*, which on examination has been found to be a species of *Olyra* McClelland. Wu⁹ has recently described *A. marginatoides* from Sze-Chwan which, like its close ally *A. marginatus* Günther, may be a species of *Liobagrus*. Smith¹⁰ has extended the range of *A. mangois* to Siam where it has been taken in widely separated places and will no doubt be found in suitable waters all over the country. I have collected a large number of specimens of *Amblyceps* in Sevoke River at the base of the Darjeeling Himalayas. These specimens exhibit considerable variation in the form of the caudal fin, the extent of the adipose dorsal, the form of the body, etc., etc. In spite of these differences, I am of opinion, and in this I agree with

¹ Blyth, *Journ. & Proc. As. Soc., Bengal*, XXIX, p. 153 (1860).

² Hamilton-Buchanan's drawing of *Pimelodus mangois* was reproduced by me in *Mem. Ind. Mus.*, pl. xxii, fig. 4 (1929).

³ Günther, *Cat. Fish. Brit. Mus.*, V, p. 190 (1864).

⁴ Günther, in Pratt's *Snouts of Tibet*, p. 245 (1892).

⁵ Regan, *Ann. Mag. Nat. Hist.*, (7) XIII, p. 193 (1904).

⁶ Day, *Proc. Zool. Soc. London*, p. 524 (1869); *Fish India*, p. 490 (1878).

⁷ Chaudhuri, *Rec. Ind. Mus.*, XVI, p. 273 (1919).

⁸ Prashad & Mukerji, *Rec. Ind., Mus.*, XXXI, pp. 172, 173 (1929).

⁹ Wu, *Bull. Mus. Paris* (2) II, p. 256 (1930).

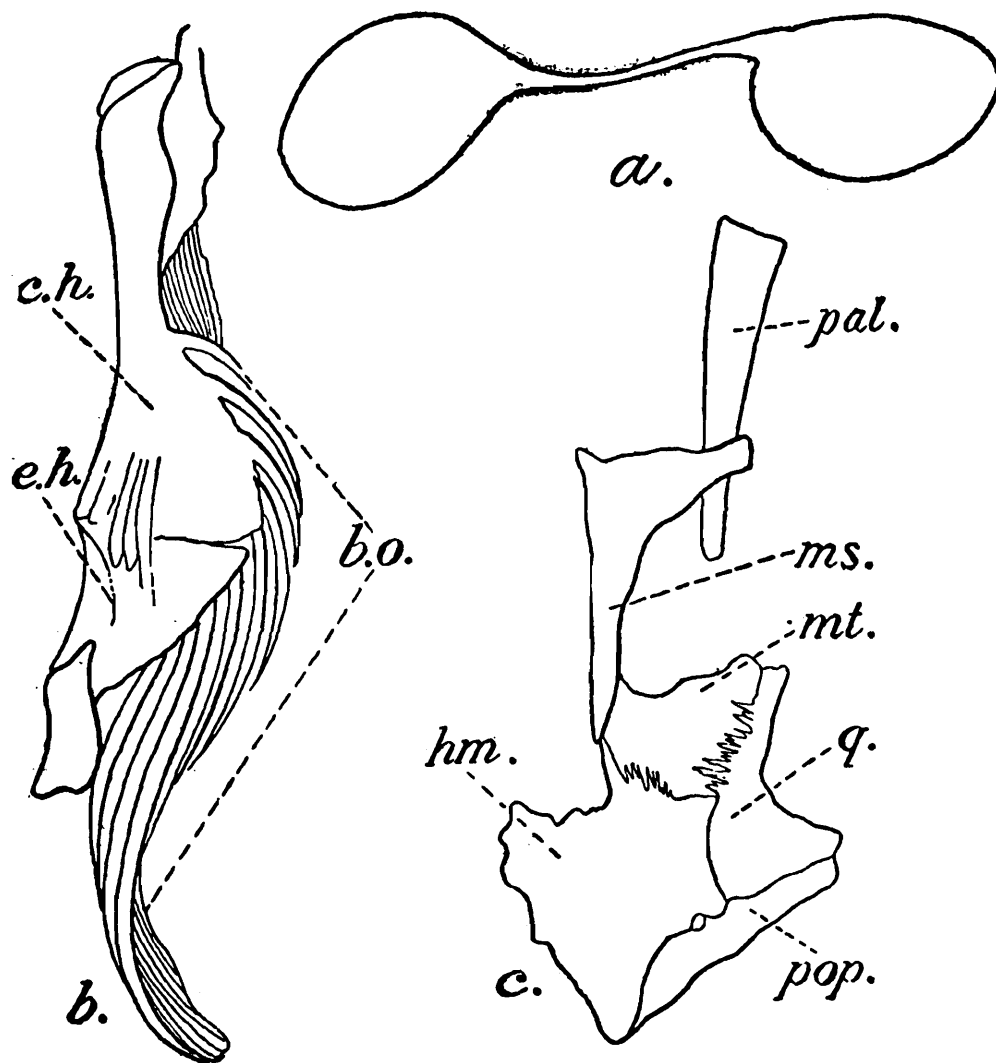
¹⁰ Smith, *Journ. Siam Soc., Nat. Hist. Suppl.*, VIII, p. 180 (1931).

Day, that there is only one species of the genus and that the divergent forms probably represent the habitat varieties of the species *A. mangois* (Ham. Buch.).

Griffith¹ remarked that a loach-like *Silurus* is not uncommon about Julraiz in Afghanistan. I² have indicated that in this record reference is made to *Glyptosternum reticulatum*; but Day³ doubtfully considered this loach-like *Silurus* to be an *Amblyceps*. So far as I am aware *Amblyceps* has never been definitely recorded from any place west of the Kangra Valley.

RELATIONSHIPS.

According to Regan⁴ *Amblyceps* belongs to the family Amblycepidae which, in its external characters as well as in its osteology, bears a general resemblance to the Bagridae. It possesses certain features of specialisation (fig. 2c). "The pterygoid is absent, the metapterygoid is reduced,



TEXT-FIG. 2.—*Amblyceps mangois* (Ham. Buch.).

a. Greatly reduced air-bladder $\times 15$; b. Bony support of the extensive gills-membrane $\times 7$; c. Hyopalatine arch $\times 7$.

b. o.=branchiostegals; c. h.=ceratohyal; e. h.=epihyal; hm=hyomandibular; ms=mesopterygoid; mt = metapterygoid; pal=palatine; pop= praeoperculum; q=quadrate.

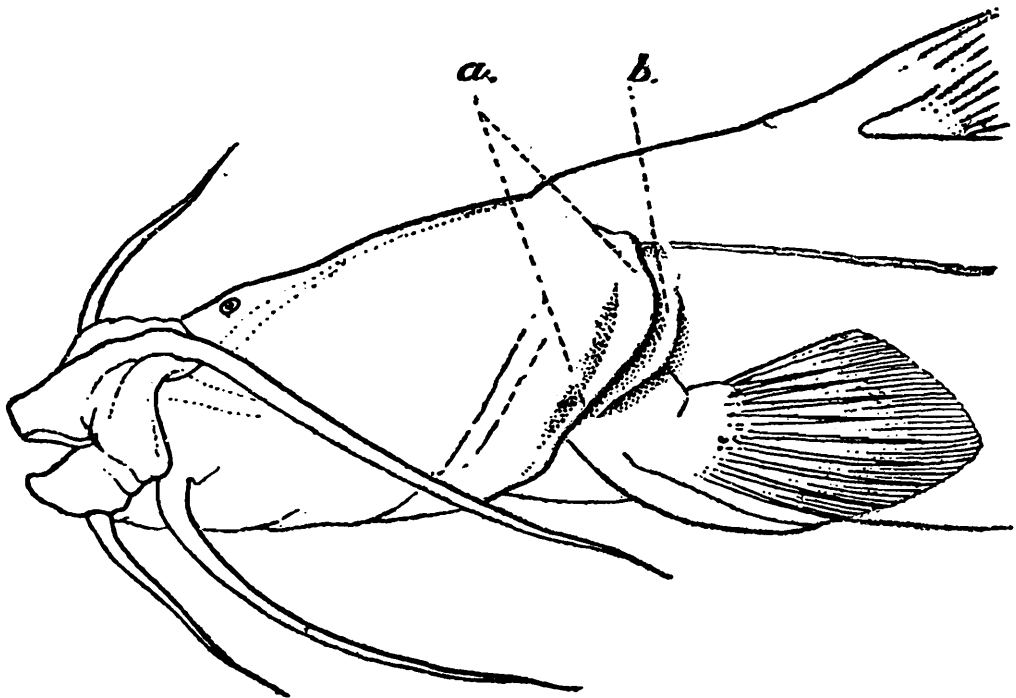
¹ Griffith, *Calcutta Journ. Nat. Hist.*, II, p. 564 (1842).

² Hora, *Ann. Mag. Nat. Hist.* (10)X, p. 177 (1932), v 1

³ Day, *Ichthyology, Sci. Res. 2nd Yarkand Miss.*, p. 19, foot-note (1878).

⁴ Regan, *Ann. Mag. Nat. Hist.* (8) VIII, p. 562 (1911).

and the elongate mesopterygoid extends from the palatine to the hyomandibular. There is no post-temporal and the proximal end of the upper limb of the supra-cleithrum is wedged in between pterotic and epiotic. The parapophyses of the fourth vertebra form on each side a semicylinder incomplete below, or an inverted cup, partly enclosing the reduced air-bladder, which is divided into two lateral sacs." Besides *Amblyceps* this family includes *Liobagrus*, *Akysis* (*Sosia*) and *Acrochordonichthys*. All these fishes are of small size and inhabit the fresh waters of Asia. Chaudhuri (*op. cit.*) included a heterogenous assemblage of genera, including *Amblyceps*, in the family Sisoridae without giving any reason except perhaps that his Sisoridae "consists of small cat-fishes found in swift mountain streams in Northern India, Burma, Tibet and China." Different forms living under similar conditions become modified in a similar way, but this superficial likeness, though confusing at times, does not indicate genetic affinities of the various units. Jordan¹ included *Amblyceps* in his family Amblycipitidae with three other genera, *Acrochordonichthys*, *Akysis* and *Sosia*. *Liobagrus*, which is very closely related to *Amblyceps*, has been placed by Jordan in Bagridae. According to Regan² "*Amblyceps* is distinguished from *Liobagrus* by the nostrils, which are close together instead of well separated, and by the forked caudal." Having observed very extensive variations in the form



TEXT-FIG. 3.—Lateral view of head and anterior part of body of *Amblyceps mangois* (Ham. Buch.).

a=opercular flap ; *b*=flap of skin behind gill-opening and in front of base of pectoral.

of the caudal fin of *Amblyceps mangois*, I requested Mr. J. R. Norman to send me a specimen of *Liobagrus* for study. He sent a specimen of *L. nigricauda* Regan and taking this species as a typical member of the genus I find that as compared with *Amblyceps*, fishes of the genus *Liobagrus* are more stoutly built and possess much broader and rounded head.

¹ Jordan, *Classification of Fishes*, p. 148 (1923).

² Regan, *Ann. Mag. Nat. Hist.* (7), XIII, p. 193 (1904).

In *Liobagrus* the nostrils are situated distinctly apart and the ventrals are not very far removed from the anal. The most remarkable feature, however, is the absence in *Liobagrus* of the skin-flaps (fig. 3, b) which are found behind the gill-opening in *Amblyceps* (for function see p. 615).

A few specimens of *Amblyceps* were also sent to Mr. J. R. Norman for comparison with the material of *Liobagrus* in the collection of the British Museum. He did not have sufficient time to go into the matter thoroughly, and, therefore, he was unable to give a definite opinion. He has, however, given a tentative opinion, and as this agrees with that expressed above, I take the liberty to reproduce here a passage from his letter. He says: "I have examined the following species of *Liobagrus*:—*nigricauda*, Regan; *reini*, Hilgendorf; *sugubii*, Regan; *andersonii*, Regan; and *formosanus*, Regan; as well as *Liobagrus* or *Amblyceps marginatus*, Günther. I agree that on the whole the species of *Liobagrus* are more stoutly built and possess a broader and more rounded head than *Amblyceps*. The nostrils vary among the different species of *Liobagrus*, but are certainly never quite so close together as in *Amblyceps*. The position of the vent and pelvic fins with regard to the anal fin appears to be variable, and I should be disinclined to place much reliance on this character. Finally, I am unable to find any trace of the skin-flaps in any species of *Liobagrus*, but this is also wanting in the type of *Amblyceps marginatus*, which ought, therefore, to be a *Liobagrus*. It certainly looks rather like one. I am a bit doubtful about the distinction of two genera, but the skin-flaps seem to be a reliable character."

From what has been stated above it is clear that Regan has expressed the relationships of the genus *Amblyceps* more correctly than any other ichthyologist who has referred to these fishes.

HABITAT AND BIONOMICS.

I have indicated above that there is only one species of the genus *Amblyceps*. It was described by Francis Hamilton (once Buchanan)¹ as *Pimelodus mangois* from "the tanks of Northern Behar." In the 'Original Notes' concerning "Gangetic Fishes" the description of the species is dated "Nathpur 26th April 1809," and the habitat given is "Habitat in stagnis methile borealis." In 1809, Nathpur was a large trading village which lay some miles to the west of the river Kosi, and was situated in the extreme north-east of the present district of Bhagalpur close to the boundary of Purnea. In 1875, the town of Nathpur was completely swept away by the violence and destructive power of the Kosi River during heavy floods. It is thus clear that Nathpur was situated in the sub-Himalayan tract where it was subject to heavy floods. In these circumstances it seems likely that the ponds and tanks in the neighbourhood of the town received elements of mountainous fish-fauna during floods. It is also probable that towards the end of April, when the weather is usually hot and dry, certain small channels in the course of the River Kosi were cut up into a series of pools, and that Buchanan may have collected his specimens of *Pimelodus mangois* in

¹ Hamilton, *Fish. Ganges*, p. 200 (1822).

such situations. Day¹ had specimens of *Amblyceps mangois* from Kangra in the Western Himalayas and Darjeeling in the Eastern Himalayas. Smith has collected a large number of specimens in Siam from mountain streams (see addendum). These, as well as other records, from India and Burma show that the fish is restricted throughout its extensive range to the bases of the hills, and has nowhere been found either in the plains or at very high altitudes. I have studied this fish in its natural haunts in the Sevoke Stream at the base of the Darjeeling Himalayas whence a large series of specimens was collected. The Sevoke Stream near Sevoke in the Teesta Valley is a shallow brook with a pebbly bed and clear, rapid-flowing water. Besides the main stream, the brook consists of a series of small channels which are liable to dry up during the hot and dry months. *Amblyceps*, a small, elongated and slimy fish, was found living at the bottom of the stream among stones and pebbles. When a portion of a small channel was artificially drained dry by making a dam across it, several specimens of *Amblyceps* were observed to crawl with great agility over wet stones and to seek shelter in holes and crevices among pebbles and stones. Like loaches of the genus *Nemachilus*, which frequent a similar habitat, they are rather difficult to get at. Moreover, their dark-reddish colour harmonises with stones, and until they wriggle about it is difficult to locate them. *Amblyceps*, no doubt, uses its small paired fins and flat belly for clinging purposes, but during progression it wriggles like an eel, and its muscular body and well-developed tail seem to be well adapted for this purpose. I have not observed this fish crawling on the exposed surfaces of rocks in swift currents, and, in the absence of any special adhesive devices, it is probable that it is incapable of doing so.

It is seen from the above that the hill-streams, in which *Amblyceps* is found, are subject to great rise and fall in the quantity of water they carry. These are liable either to break up into a series of pools and puddles that may dry up altogether or to become rapid torrents after a single heavy shower. The torrential condition of the streams does not affect *Amblyceps* to any appreciable extent, as the fish lives at the bottom among pebbles where the swiftness of the current is a negligible factor.² But when the waters begin to dry up a really critical condition arises for the fish, for it must protect itself against partial or complete desiccation for shorter or longer periods. At such times its habit of wriggling about and seeking narrow crevices is certainly very useful, as the fish in these places finds not only shelter but much needed moisture. It is also possible, though no direct observations exist on this point, that at night when the temperature is comparatively lower and the rocks are wet with dew drops this species wanders about and seeks pools and puddles in the course of the drying-up stream. Such peregrinations are made possible by the fact that *Amblyceps mangois*, as observed by

¹ Day, *Fish. India*, p. 491 (1878). Through the kindness of Mr. Hamid Khan of the Department of Fisheries, Punjab, I have examined three small and partially desiccated specimens of *Amblyceps mangois* from Madhopur in the Kangra Valley.

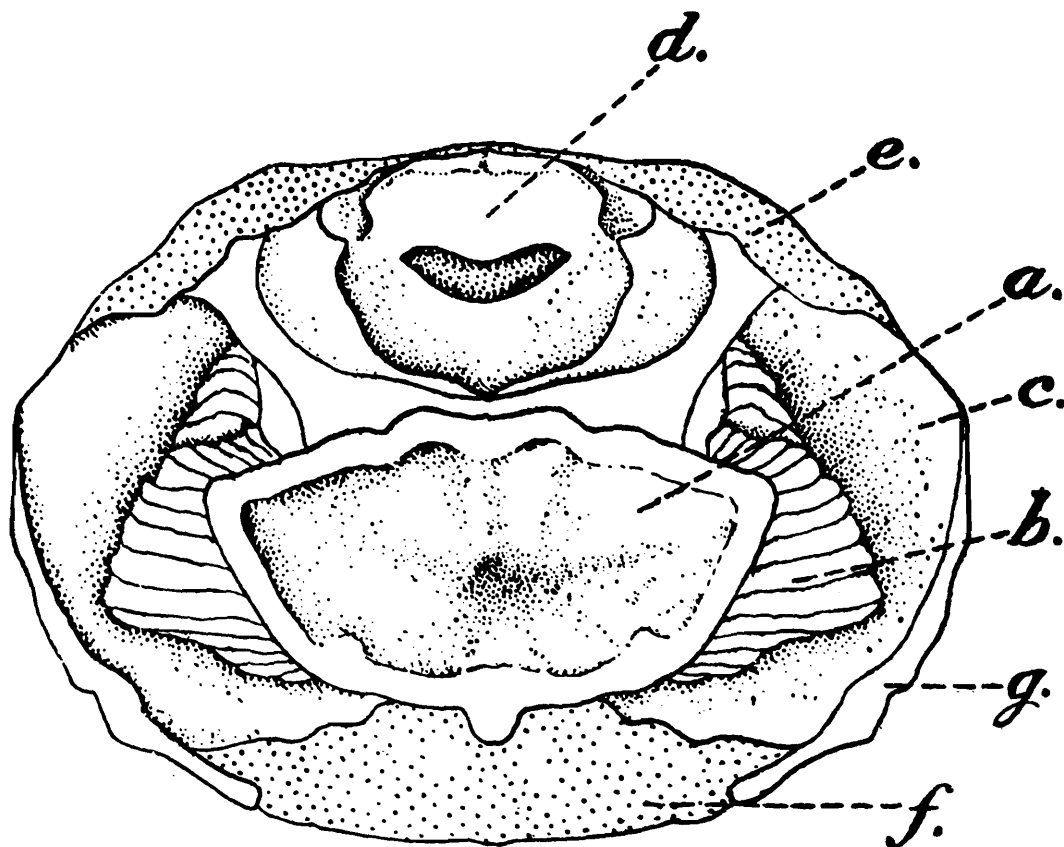
² Hora, *Phil. Trans. Roy. Soc., London* (B), CCXVIII, p. 175 (1930).

Day¹, is capable of living "for some time after its removal from the water."

In order to test the tenacity of life in *Amblyceps*, four young specimens were kept in a small dish at 10 A.M. It was found that for 2 hours they were quite active, but about 1 P.M. they responded only to violent stimulation. I believe, these specimens died of desiccation, and had they been kept moist they would have undoubtedly lived for a much longer time. It appears to me probable that, in such circumstances, oxygenations of the blood goes on through the skin, which is very thin and is of a reddish colour in living specimens.

A few specimens were placed in water, from which air had been expelled by boiling. They lay quietly at the bottom and made no effort to come to the surface. Their activity was retarded, but they continued to respire. It is quite probable that the water received certain amount of oxygen from the blood of the fish through osmosis but I regret that I was unable to determine this point in the field.

The opercular chambers are large and distended outwards; they contain empty spaces in which water or air could be stored for respiration. The walls of these chambers are highly vascular, but the observations made so far do not indicate as to how they assist in respiration—.



TEXT-FIG. 4.—A vertical transverse section through the middle of the opercular-chamber of *Amblyceps mangois* (Ham. Buch.) $\times 16$.

a=alimentary canal; *b*=gills; *c*=pouch of the gill-cover; *d*=brain; *e*=dorsal muscle; *f*=ventral muscle; *g*=operculum.

perhaps when the fish suspends respiration for a short time, water is retained in the opercular chambers and slow respiration goes on.

Aquatic Respiration.—During a visit to Sevoke in March 1932, Mr. D. D. Mukerji made observations on the mechanism of respiration

¹ Day, *Fish. India*, p. 492 (1878).

in *Amblyceps*. He noticed that during respiration the fish keeps its mouth wide open and the maxillary barbels directed forwards. The floor of the mouth moves up and down in quick succession; the portion of the gill-membrane dorsal to the pectoral fin flaps vigorously against the fold of skin developed above and anterior to the base of the pectoral fin. After this short period of breathing, the fish closes its mouth, the movements of the gill-membranes as well as of the floor of the buccal cavity cease and the upper and lower membranous flaps by resting against one another close the gill-openings. The fish now lies quietly for some time—1 to 4 minutes—after which respiratory movements are again started. It was further observed by Mr. Mukerji that during respiration the throat as well as the neighbouring region of the branchiostegal membranes assume a distinctly red colour, and a large number of small blood-vessels can be seen through the transparent skin. This shows that so long as respiration lasts, this region of the body is gorged with blood.

Mr. Mukerji's observations show that the mechanism of respiration in *Amblyceps* is similar to that described by me¹ in the case of other hill-stream fishes such as *Garra*, *Glyptothorax*, *Pseudecheneis*, *Balitora* and *Loricaria*. The essential features of this mechanism are (i) the mouth is kept open throughout the actual period of respiratory movements, (ii) only a portion of the gill-opening is used for the exit of the expiratory current and (iii) the respiratory current is initiated and carried on by a small, specially developed portion of the gill-membrane which beats vigorously. Such a mechanism of respiration is totally different from the normal mode of breathing in a fish.² Another point of interest in the case of most of the hill-stream fishes is that they suspend their respiratory movements for a shorter or a longer period. During this period of rest probably a quantity of the highly oxygenated water is retained in the gill-chamber, and I believe a slow absorption of oxygen is carried on all the time through the gill-filaments and walls of the opercular cavities. As an adaptation for the retention of water in the gill-chambers, the gill-openings are greatly reduced as is the case in several Homalopterid and Sisorid fishes.³ In certain hill-stream fishes, where the gill-opening is large, as in *Glyptothorax*, only a part of the opening is used for respiratory purposes, whereas the remaining portion is kept tightly closed. In *Amblyceps* the gill-openings are wide and the gill-membranes, which are notched as far as the chin, are broad and united with each other. Such a structure does not appear to be in any way specially adapted for the retention of water inside the opercular chambers. To obviate this difficulty a fold of skin is developed behind the gill-opening which is broad and well marked above the base of the pectoral fin. So far as I am aware, this structure is found only in the genus *Amblyceps*. The fold of skin below and the gill-membrane above form the two lips of the gill-opening, and there seems no doubt that they regulate or prevent the flow of water from inside, especially

¹ Hora, *Rec. Ind. Mus.*, XXV, pp. 591-596 (1923); *Proc. Zool. Soc., London*, pp. 205-207 (1932).

² Hora, *Current Science* I, p. 34 (1932).

³ Hora, *Journ. Bombay Nat. Hist. Soc.*, XXXVI, p. 540 (1933).

as the upper portion of the gill-membrane is responsible for the respiratory current.

In April 1933, I had an opportunity of making further observations on *Amblyceps* in the Teesta Valley. When placed in water in a glass dish, the fish was noticed to be very active and restless, and made frantic efforts to seek shelter from light. The respiratory movements were very fast, and the fish always took a deep "breath" at irregular intervals. During a deep breath, the head shook and the entire gill-opening was opened for expiration. Usually only the upper part of the gill-opening functions during respiration. This can be ascertained by watching the movements of the ventral surface of the fish in a mirror¹. The part of the gill-openings on the ventral surface opens only at the time of deep breathing. The respiratory rate varies considerably as the fish is capable of suspending respiration altogether for long periods. The following two observations on the rate of breathing were taken with the help of a stop-watch. The mark of addition (+) separating figure denotes a deep breath.

$$\begin{array}{c} 16 \text{ seconds} \\ \text{(i) } \overbrace{10 + 7 + 13}^{\quad} + \end{array}$$

In 16 seconds, there were 33 respiratory movements (rate about 124 per minute), of which 3 represented deep breaths.

$$\begin{array}{c} 28 \text{ seconds} \\ \text{(ii) } \overbrace{+ 7 + 14 + 10 + 11 + 7}^{\quad} + \end{array}$$

In 28 seconds, there were 53 respiratory movements (rate about 113 per minute), of which 4 represented deep breaths.

PROBABLE EVOLUTION.

The above study of the structure, habitat and bionomics of *Amblyceps* indicates that this fish is very highly specialised, and in the present state of our knowledge, it is difficult to say anything regarding its ancestry. It is probable, however, that it may have developed from such Bagrid forms as *Aoria*, *Macronoides* and *Liocassis*. The fishes of the two last genera are found in the same or similar streams as are inhabited by *Amblyceps*, and it may be presumed that they are evolved from generalized and diverse members of the genus *Aoria*. The genus *Amblyceps* may also have evolved from this stock and developed independently. The most remarkable structure of *Amblyceps* is the development of the fold of skin in front of the pectoral fin referred to above. This is no doubt a special acquisition for respiration in fast currents characteristic of its natural haunts.

DESCRIPTION OF *Amblyceps mangois* (H. B.).

As has been indicated above, *Amblyceps mangois* is a very variable species and has been described under several names. In view of the abundant material now available in the collection of the Zoological

¹ For the use of the mirror see Hora, *Proc. Zool. Soc. London*, Part I, p. 205 (1932).

Survey of India, I give below a detailed description of the species indicating the great range of variation in reference to the various diagnostic characters on which species of this genus had hitherto been based.

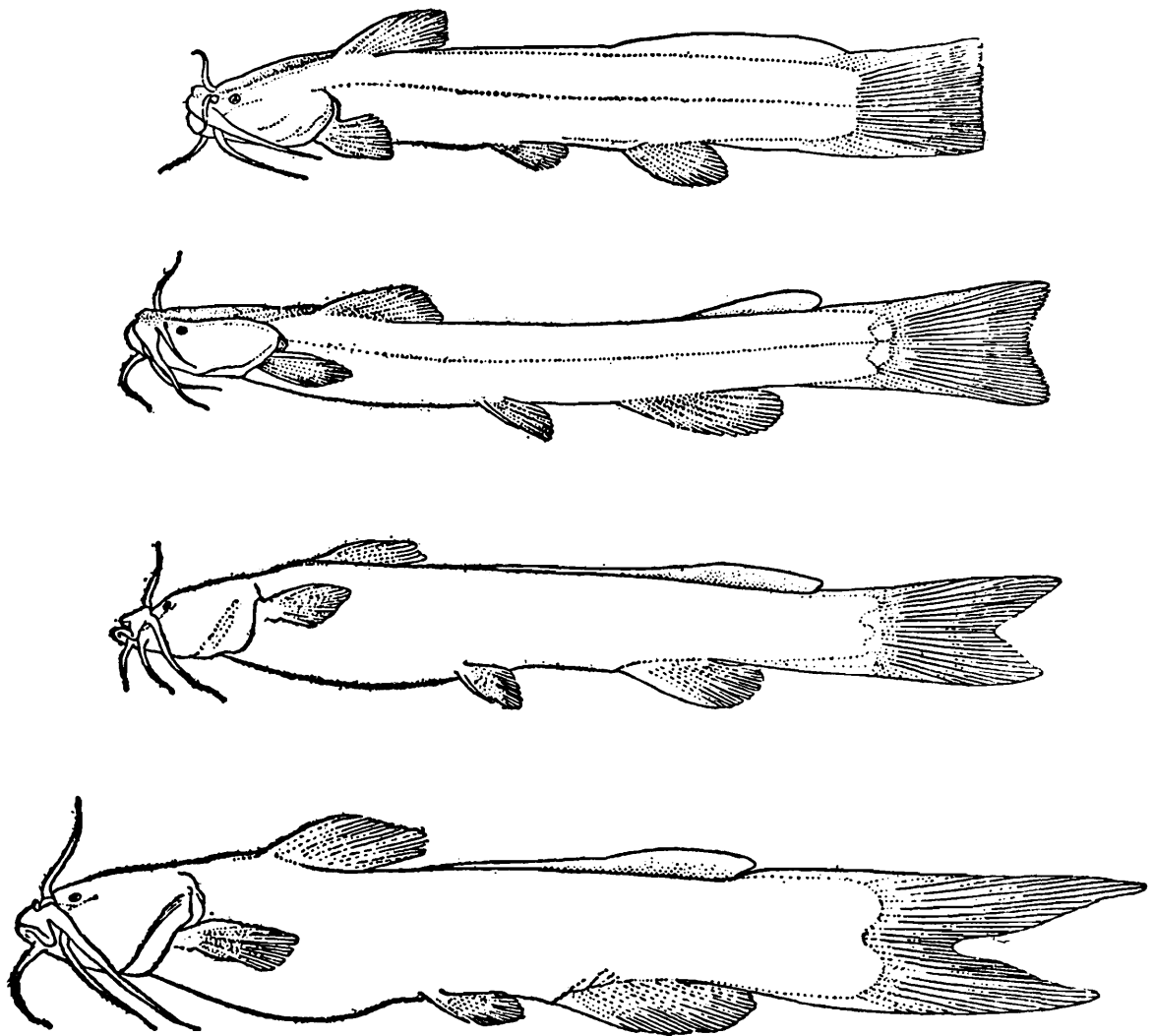
***Amblyceps mangois* (Ham. Buch.).**

D. 1/5-6 ; A. 2-3/6-8 ; P. 1/7 ; V 1/5 ; C. 19 (excluding the smaller outer rays).

1822. *Pimelodus mangois*, Hamilton (Buchanan), *Gangetic Fishes*, pp. 199, 379.
 1853. *Pimelodus mangois*, Bleeker, *Verth. Batavia Gen.*, XXV, p. 58.
 1858. *Amblyceps caecutiens*, Blyth, *Proc. As. Soc., Bengal*, XXVII, p. 282.
 1860. *Amblyceps mangois*, Blyth, *ibid.*, XXIX, p. 153.
 1860. *Amblyceps tenuispinis*, Blyth, *ibid.*, p. 153.
 1864. *Amblyceps caecutiens*, Günther, *cat., Fish. Brit. Mus.*, V, p. 190.
 1864. *Amblyceps tenuispinis*, Günther, *ibid.*, p. 190.
 1864. *Amblyceps mangois*, Günther, *ibid.*, p. 190.
 1869. *Amblycetis mangois*, Day, *Proc. Zool. Soc., London*, p. 524.
 1869. *Amblycetis caecutiens*, Day, *ibid.*, p. 524.
 1869. *Amblycetis tenuispinnis*, Day, *ibid.*, p. 524.
 1871. *Akysis Kurzii*, Day, *ibid.*, p. 703.
 1873. *Amblyceps mangois*, Day, *Rep. Fresh Water Fish & Fisheries of India & Burma*, p. cclxxv.
 1873. *Amblyceps caecutiens*, Day, *ibid.*, p. cclxxv.
 1877. The Mangoi, Hamilton Buchanan, in *Hunter's Stat. Account Bengal*, XX, p. 60.
 1877. *Amblyceps mangois*, Day, *Fish. Ind.*, p. 490, pl. cii, fig. 6 and pl. cxv, fig. 1.
 1889. *Amblyceps mangois*, Day, *Faun. Brit. Ind., Fish.*, I, p. 123, fig. 52.
 1890. *Amblyceps mangois*, Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova* (2), IX, p. 196.
 1893. *Amblyceps mangois*, Boulenger, *Ann. Mag. Nat. Hist.* (6), XII, p. 200.
 1893. *Amblyceps* sp. ?, Bridge and Haddon, *Phil. Trans. Roy. Soc., London* (B), CLXXXIV, p. 156.
 1913. *Amblyceps mangois*, Chaudhuri, *Rec. Ind. Mus.*, VIII, p. 252.
 1919. *Amblyceps murray-stuarti*, Chaudhuri, *ibid.*, p. 272, pl. xxii, figs. 1, 1a, 1b.
 1919. *Amblyceps mangois*, Chaudhuri, *ibid.*, XVI, p. 275.
 1929. *Pimelodus mangois*, Hora, *Mem. Ind., Mus.*, IX, p. 188, pl. xxii, fig. 4 (Hamilton Buchanan's MS. drawing of the species published).
 1931. *Amblyceps mangois*, Smith, *Journ. Siam Soc., Nat. Hist. Suppl.*, VIII, p. 180 (see addendum).
 1933. *Amblyceps mangois*, Hora, *Proc. 20th Ind. Sci. Cong.*, p. 273.
 1933. *Amblyceps mangois*, Hora, *Journ. Bombay Nat. Hist. Soc.*, XXXVI, pp. 550, 551.
 1933. *Amblyceps mangois*, Mukerji, *ibid.* (in press).

Amblyceps mangois is a small, slimy, loach-like fish in which the body is elongated and compressed except in the region in front of the ventral fins. The head is broad and depressed ; it bulges outwards in the form of two bladders in the region of the opercular chambers. The length of the head is contained 4·7 to 5·3 times in the total length without the caudal ; its greatest width, which is in the opercular region, is contained 1·1 to 1·5 times in the length. As the width of the head depends on the distended nature of the cheeks, there is considerable variation in this dimension of the fish. The height of the head is contained 1·7 to 2·2 times in its length. The snout is broad and subtruncate. The eyes are small, superior and subcutaneous ; they are situated in the anterior

half of the head, though their position is subject to considerable variation. The length of the snout is contained 2.7 to 4.2 times in the length of the head. The mouth is transverse and anterior; its gape extends from side to side. The lips are fleshy, slightly fimbriated and continuous; at each corner of the mouth they form a prominent fold. The upper or the lower jaw is slightly longer than the other, but very rarely the two jaws are equal in length. In ten specimens, whose measurements are given below, the lower jaw was found to be longer in five, the upper jaw longer in four and only in one specimen both the jaws were of equal length. The depth of the body is very variable; it is contained from 5.2 to 8.2 times in the total length without the caudal. The nature of the barbels, teeth, gill-openings and fins is the same as given in the diagnosis of the genus.



TEXT-FIG. 5.—Slightly dorso-lateral (upper two figures) and lateral view of four specimens of *Amblyceps mangois* (Ham. Buch.), showing variation in the form and extent of adipose dorsal, the form of the caudal fin and of the body.

The length of the caudal fin depends upon its form; it is shorter where the fin is truncate and longer where the fin is furcate; the length varies considerably and is contained from 4.3 to 8.5 times in the total length of the fish. In a series of ten specimens the caudal fin was found to be truncate in three, concave or slightly emarginate in three and deeply furcate in the remaining four. It seems obvious, therefore, that this character cannot be relied upon for specific distinctions. The adipose dorsal fin is also variable; in some individuals it is continuous with the

caudal and in these forms the fin is long and narrow. In the majority of specimens, however, the adipose fin is distinct from the caudal and is short and high.

The anal opening is followed by a fleshy papilla; it is situated between the ventral fins considerably in front of the anal fin but its actual position is subject to considerable variation. It may be situated almost in the middle of the length of the ventrals, or it may be nearer to their bases or to their tips.

The living specimens are of a darkish flesh colour, deeper above and lighter on the ventral surface. In specimens preserved in spirit the colour is dark gray which becomes considerably lighter on the ventral surface. Hamilton-Buchanan¹ remarked that the colour "is everywhere of an uniform lurid brown colour, inclining to olive."

Distribution.—*Amblyceps mangois* is found in rapid-running streams at the bases of hills. It has been recorded from the base of the Himalayas in India and from Northern Burma and Siam. In the collection of the Indian Museum the species is represented by 161 specimens from the following localities from west to east:—

Punjab: Kangra; *United Provinces*: Gazipore; *Bengal*: Siliguri, Sevoke, Darjeeling (?) and rivers of Terai and Duars; *Assam*: Abor Hills and Manipur Valley; *Burma*: Tributaries of Mali Hka river and streams in Putao Plain.

The majority of the specimens in the collection are from the base of the Darjeeling-Himalayas.

Measurements in millimetres.

	N. E. Bengal.					Manipur, Assam.		Northern Burma.		
Total length without caudal	33.0	34.0	39.0	47.0	82.0	34.0	65.0	40.0	80.0	120.0
Length of caudal	6.5	7.0	11.5	8.0	12.0	6.5	12.0	8.0	12.0	16.0
Depth of body	4.5	5.0	7.5	6.5	10.0	5.0	9.5	5.0	12.0	19.0
Length of head	7.0	6.5	8.0	9.0	16.5	7.0	12.0	8.5	15.0	23.0
Width of head in opercular region.	4.5	4.5	7.0	7.0	12.0	6.0	11.0	7.0	11.5	16.0
Height of head at occiput	3.5	3.0	4.7	4.0	8.0	4.0	7.0	4.0	7.0	11.5
Length of snout	2.0	2.0	2.5	3.0	6.0	1.8	4.0	2.0	4.5	7.5
Interorbital width	2.0	1.5	2.7	2.0	3.7	2.0	4.0	2.0	2.5	4.0
Internasal distance	0.7	1.0	1.0	1.0	2.0	1.0	2.0	1.5	1.5	2.5
Distance of dorsal from tip of snout.	8.7	9.0	11.0	11.0	18.0	10.0	17.0	11.5	8.0	26.0
Longest ray of dorsal	3.0	3.5	5.5	5.5	8.0	6.0	11.0	6.0	9.0	12.5
Longest ray of anal	3.0	3.0	6.0	6.0	8.5	6.0	10.5	4.5	6.0	13.0
Length of pectoral	4.5	4.5	6.5	6.0	9.7	5.0	9.5	6.0	8.5	13.0
Length of ventral	3.0	3.5	4.0	4.0	6.0	4.5	7.0	4.0	6.0	10.0
Length of caudal peduncle	7.5	8.0	7.0	11.0	18.0	7.0	13.0	7.5	17.0	25.0

ADDENDUM.

A Short Description of the Siamese Form.

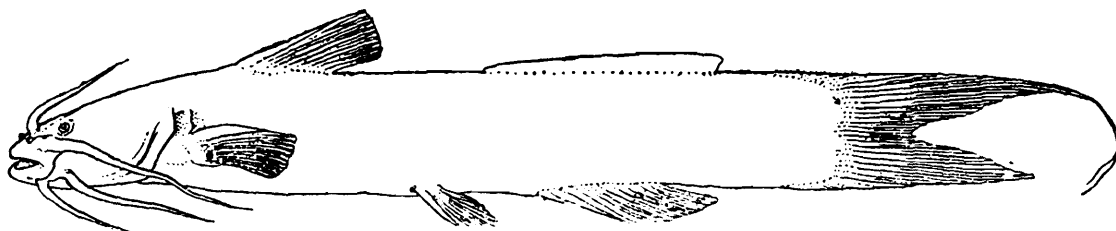
Since the above went to the press, three specimens of *Amblyceps mangois* (H. B.) were received from Siam through the kindness of Dr. H. M. Smith with the remark that "These are from Pak Jong, a mountain district in east-central Siam, March 12, 1927. Other localities represented in our collection are Nakon Sritamarat, Peninsular Siam, and

¹ Hamilton-Buchanan, *Fish. Ganges*, p. 200 (1822).

Chantabun Estuary, south-east Siam. The last locality is peculiar in that the water is brackish, but the single specimen could easily have come down from hill streams in the Chantabun basin, where, however, the species has not yet been collected.

"The species, as found at Pak Jong and Nakon Sritamarat, is mostly in clear running streams at bases of hills or in plains very near the hills."

When Smith¹ recorded the species from Siam for the first time in 1931, he referred only to the local distribution of the fish and no attempt seems to have been made so far to compare the Siamese specimens with examples from India and Burma. The examination of the three specimens referred to above has shown that they differ in several respects from the Indo-Burmese form, but without a comparative study of a large collection from Burma and Siam, it is difficult to separate the Siamese form as a distinct species, variety or even as a local race. Caution is, further, warranted by the fact that the species, as indicated above, is extremely variable even with regard to some of its most characteristic features. It seems advisable, however, to include here a short description of the distinctive features of the Siamese specimens to complete the account of the genus and the only species, and to facilitate further reference to the Siamese form.



TEXT-FIG. 6.—Lateral view of a Siamese specimen of *Amblyceps mangois* (Ham. Buch.)
×1½.

Caudal Fin.—The caudal fin is deeply bifurcate in all the three specimens and the lobes are sharp and pointed; the upper lobe is considerably longer than the lower and is produced into a long, thread-like process. Such a long and filamentous extension of the upper lobe of the caudal fin is not to be found in any of the Indo-Burmese specimens.

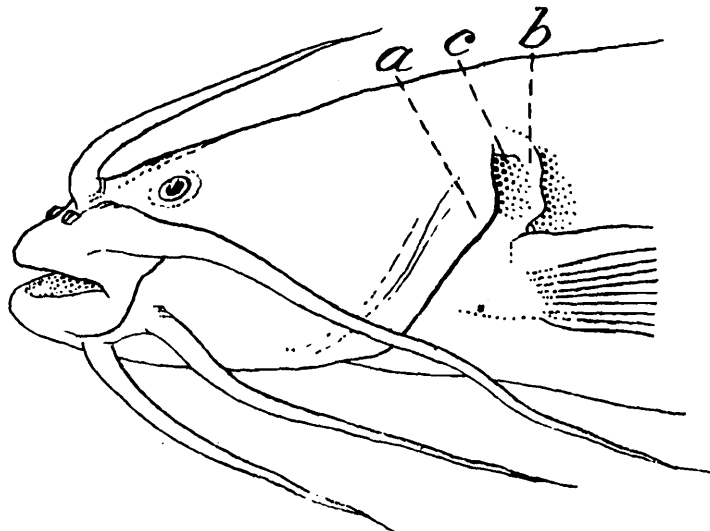
Adipose Dorsal.—The adipose dorsal is short and low. Reference has already been made to the variability exhibited by this structure (p. 618), but in none of the Indian specimens the adipose fin is so low.

Anal Fin.—In the Siamese examples the anal fin is somewhat more extensive and has eight to nine branched rays besides three spines. In the Indian specimens, there are usually two to three spines and six to eight branched rays.

Gill-opening and associated structures.—The portion of the gill-opening above the base of the pectoral fin is modified still further for respiratory function. It is situated in a shallow, cup-like depression, the posterior margin of which is formed by a fold of skin homologous to the structure mentioned above, which is situated above and anterior to the base of the pectoral fin and immediately behind the gill-opening.

¹ Smith, *Journ. Siam Soc., Nat. Hist. Suppl.*, VIII, pp. 180, 181 (1931).

In the Indo-Burmese examples, the membranous flaps of the gill-covers lie above the skin-flaps, whereas in the Siamese specimens the latter are situated at a considerable distance away from the former. It seems probable that in the Siamese form of *Amblyceps* the functional region of the gill-opening has become still further localised.



TEXT-FIG. 7.—Lateral view of head and anterior part of body of a Siamese specimen of *Amblyceps mangois* (Ham. Buch). $\times 4$.

a=opercular flap; *b*=skin-flap; *c*=shallow cup-like depression.

Barbels.—In the Siamese specimens, the barbels are relatively thin and long; the nasal barbels reach the base of the pectoral fin; the maxillary barbels extend beyond the middle of the length of the pectorals; the outer mandibulars are slightly shorter than the maxillaries, while the inner mandibulars are still shorter.

General Remarks.—In all the three specimens from Pak Jong, the lower jaw is slightly longer than the upper, and the anal opening is situated almost in the middle of the distance between the bases of the ventral fins and their tips. The colouration in spirit is the same as that of the Indo-Burmese examples.

For the relative proportions of the various parts, I give below a detailed table of measurements.—

Measurements in millimetres.

Total length without caudal	58.0	54.0	47.0
Length of caudal excluding thread-like process	18.0	18.0	15.0
Approximate depth of body	9.0	8.5	6.5
Length of head	12.0	11.5	9.0
Width of head in opercular region	9.0	9.0	7.0
Height of head at occiput	5.0	5.0	5.0
Length of snout	3.0	3.0	3.0
Interorbital width	3.0	3.0	3.0
Internasal distance	1.7	1.7	1.7
Distance of dorsal from tip of snout	18.5	17.0	14.0
Longest ray of dorsal	6.5	6.5	6.5
Longest ray of anal	8.0	8.0	7.0
Length of pectoral	9.0	8.5	7.5
Length of ventral	6.5	6.5	5.2
Length of caudal peduncle	11.0	10.0	9.0
Least height of caudal peduncle	7.5	7.0	6.0