

THE IDENTITY OF *SPODOPTERA MAURITIA*
ACRONYCTOIDES GUENEE, *SPODOPTERA PECTEN*
GUENEE AND *SPODOPTERA ABYSSINIA* GUENEE
(LEPIDOPTERA: NOCTUIDAE) BASED ON A
COMPARATIVE STUDY OF THE MALE
AND FEMALE GENITALIA

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The army worm, *Spodoptera mauritia acronyctoides* Guenee, is a serious pest of paddy. Two other species, namely, *S. pecten* Guenee and *S. abyssinia* Guenee are also reported to attack paddy. All the three species are known to occur in India. Colour patterns of wings, on which the determination of *Spodoptera* species is based to a large extent, show variations and therefore are not dependable to confirm the identities. Since the male genitalia, especially the valvae, and the female genitalia present characters of taxonomic importance, a comparative study of the genitalia of the three species was undertaken. In *S. mauritia acronyctoides*, the shape of the valva, the simple finger-like apical spine of the harpe, presence of the labis, absence of distal spine in the aedeagus in the male genitalia and the elongate longitudinally ribbed corpus bursae having a scobinate signum, placed longitudinally in the female genitalia, clearly distinguish this species from the other two. In *S. abyssinia* the pedunculi with dense tufts of hairs, shape of the valva, apical spine of the harpe with two processes at the base, dense long hairs on the mid-dorsal surface of the valvula, a single spine at the distal end of the aedeagus in the male genitalia and the apical position of the scobinate signum in corpus bursae in the female genitalia separate it from *S. pecten*.

INTRODUCTION

Twelve species of *Spodoptera* are so far known from all over the world. The Indian species are represented by *Spodoptera mauritia acronyctoides* Guenee, *S. pecten* Guenee and *S. abyssinia* Guenee. The larva of *S. mauritia acronyctoides*, commonly known as the army worm, is a serious pest of paddy in India and other parts of the world. It is also reported to attack barley, sugarcane, 'juar', 'Kodo', 'Kutki', 'sawani', wheat seedlings and leaves, cowpea, maize, tobacco, various grasses and *Paspalum scrobiculatum*. *S. pecten* attacks paddy, sugarcane and grasses while *S. abyssinia* has been

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recorded on paddy, grasses and *Cyperus rotundus*. In their geographical distribution all the three species are fairly widely distributed and the localities from where all the three species have been recorded are common in many cases. Since all the three species are known to attack paddy, it is essential to know their correct identities in order to take effective control measures.

Classification of the species of *Spodoptera* is based mainly on the structure of the male antennae and the colour patterns of the wings (Hampson 1909). Colour patterns of the wings show variations and may lead to wrong identification of the species. The colour patterns in two forms may even show similarity and yet these may prove to be different species. The insect genitalia, especially the male genitalia, affords definite taxonomic characters to isolate the species. Thus, Fletcher (1957) working on a collection of *Spodoptera mauritia* in the British Museum observed that the two species *S. mauritia* (Boisduval) and *S. triturrata* (Walker) have been confused under the one name, *Spodoptera mauritia*.

He studied the superficial differences in the markings on the forewings and their genitalia and showed that *S. mauritia* and *S. triturrata* are two distinct species. Fletcher has also separated the two subspecies of *S. mauritia*, viz. *S. mauritia mauritia* (Boisduval) and *S. mauritia acronyctooides* Guenee. According to him the latter subspecies occurs in India, Eastern and Far Eastern countries and in the Pacific islands.

Bayer (1960) compared the fundamental regions of the valvae of the genera *Prodenia*, *Spodoptera* and *Laphygma* as proposed by Sibatini *et al.* (1954) and concluded that the six South African species, viz. *Prodenia litura* Fabr., *Spodoptera cilium* Guen., *S. triturrata* (Wlk.), *Laphygma exempta* Walk. *L. leucophlebia* Hamps. and *L. exigua* Guen. constitute a single genus. Mehta (1933) made a general comparative study of the male genitalia of different families of Lepidoptera but has not attempted to separate different species on the basis of genital characters. In the present paper a comparative study of the male and female genitalia of the three Indian species of *Spodoptera* occurring in India has been carried out to work out the genital characters which can be of help in determining the three species.

MATERIAL AND METHOD

The material for study was taken from the identified specimens available in the National Pusa Collection of the Division of Entomology, Indian Agricultural Research Institute. Specimens from the unidentified material were also taken, identified and compared with the identified specimens and dissected out for study. The abdomens of male and female moths were taken, treated with a 10 per cent solution of potassium hydroxide and then dissected out under a binocular microscope. The genitalia thus dissected out were stained with acid fuchsin, treated in glacial acetic acid, carbol-xylol and clove oil and

mounted in canada balsam. Camera lucida sketches of the mounted material were drawn.

MORPHOLOGY OF THE MALE AND FEMALE GENTALIA

Spodoptera mauritia acronyctoides Guenee:

Male genitalia (Figs. 1, 2, 7):

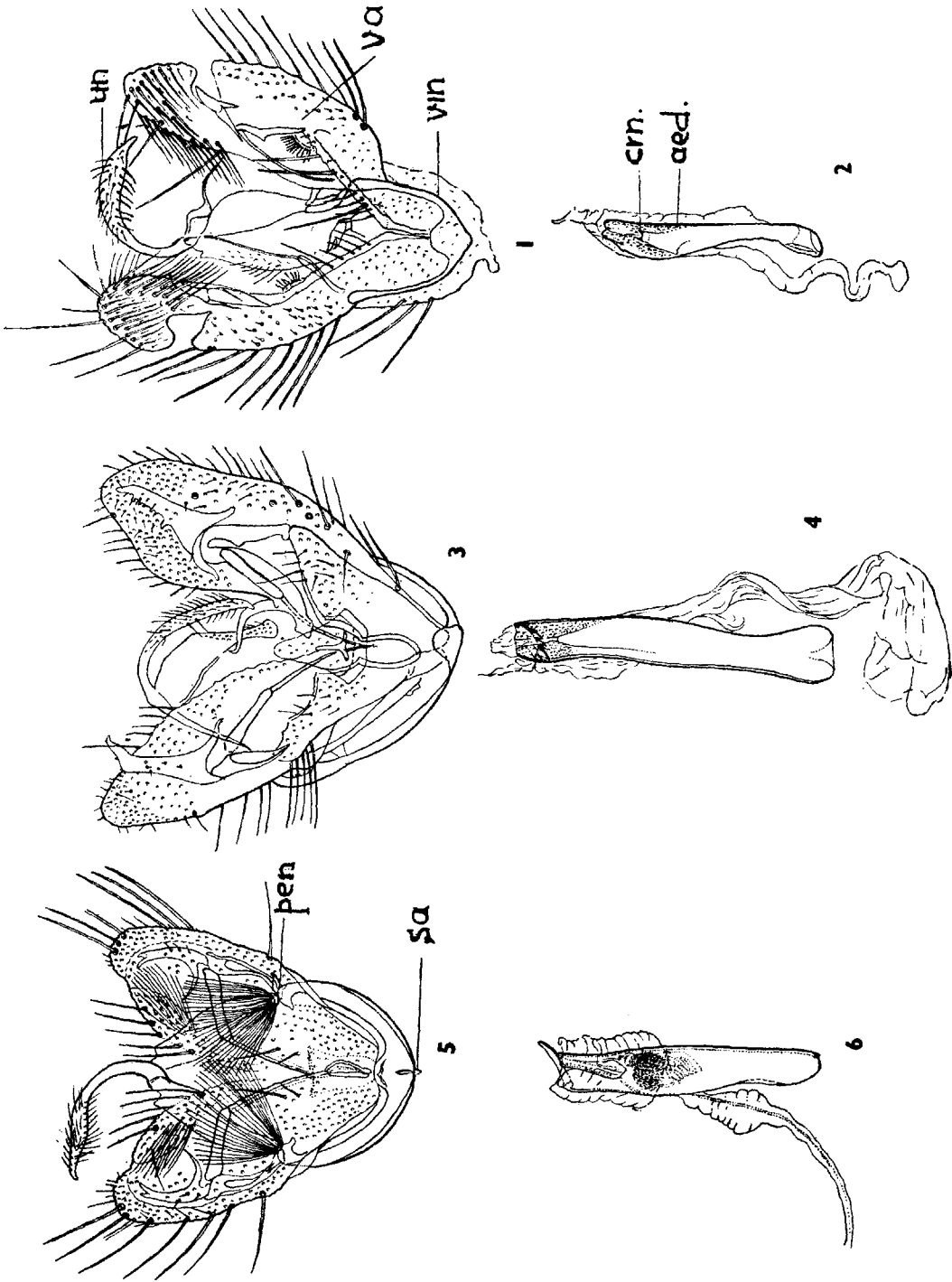
Vinculum (Fig. 1, *vin*) is narrowly U-shaped and the uncus (*un*) is long, curved ventrad, swollen at the apical end for nearly half the length and then tapered to a point. Valva (Fig. 7, *va*) is elongated and narrow except in the middle part of the valvula (*vla*) and is provided with a patch of long hairs on the middorsal surface of the valvula. An indentation, the anal angle, is present between the cucullus (*cu*) and the valvula and a valvular depression is present; the part apicad of the level of indentation is as broad as long. Transtilla (*tr.*) is slender. A small finger-like labis (*lb.*) with a few hairs at the tip is present. The harpe (*hrp*) is narrow all through possessing a finger-like apical spine extending up to the anal angle of the valva; the spine is provided with few setae. Aedoeagus (Fig. 2, *aed.*) is slightly bent and narrow at the proximal end, dilated at the distal end and narrowed at the apex; the apex is bifurcate. The vesica bears three cornuti (*crn.*).

Female genitalia (Fig. 10):

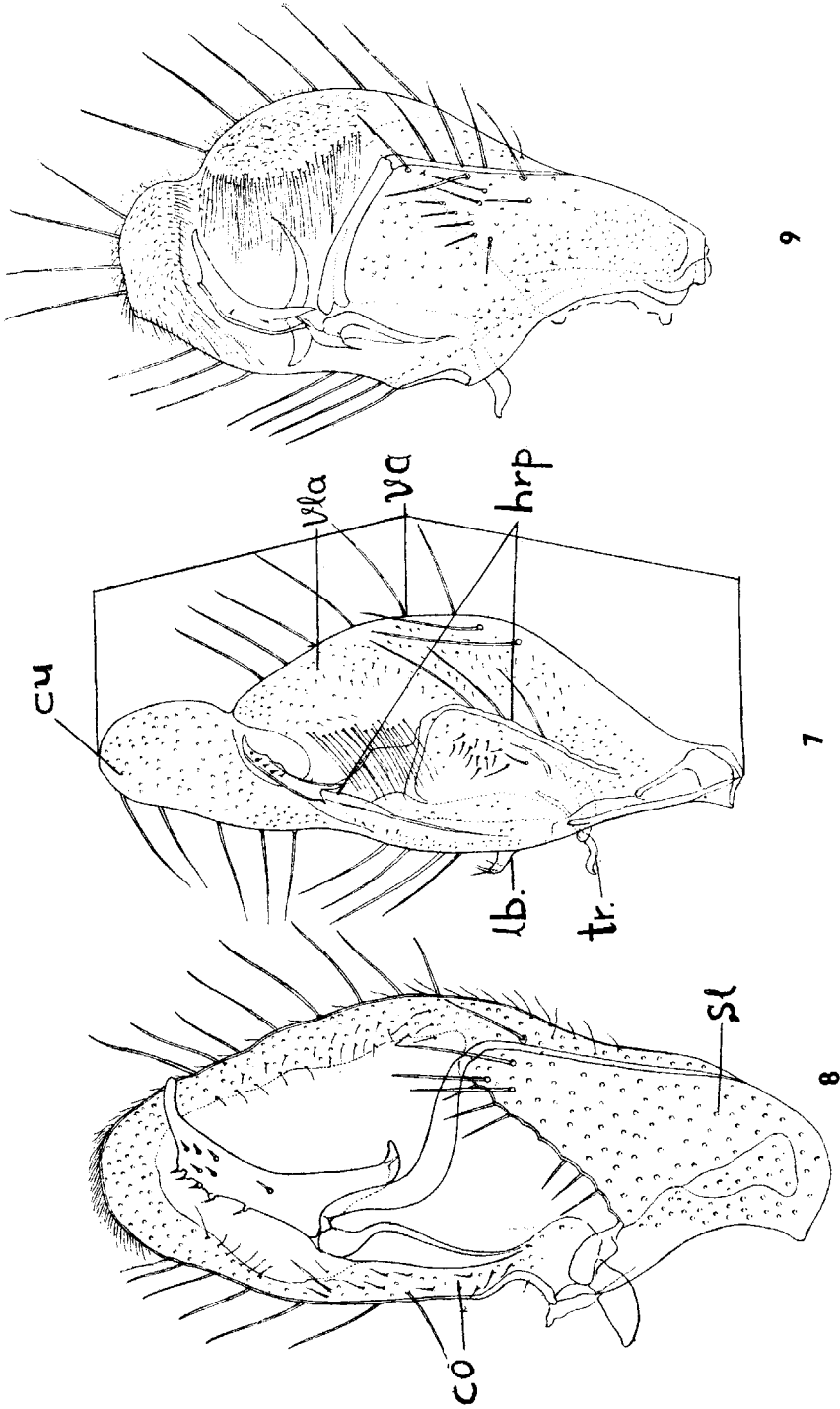
Corpus bursae (*corp. bu*) is an elongate sac longitudinally ribbed along its entire length; signum (*sig*) is scobinate situated longitudinally nearly at the centre of the corpus bursae and bears numerous small denticles. Ductus bursae (*du. bu*) nearly as long as the corpus bursae, strongly sclerotized and longitudinally ribbed for half of its length cephalad. A distinct antrum bursae (*antr. bu*) is present and two strongly sclerotized lateral bands run longitudinally along its entire length.

Spodoptera pecten Guenee *Male genitalia* (Figs. 3, 4, 8):

Vinculum (Fig. 3) is broadly U-shaped. Uncus is long, curved ventrad, slightly swollen at the distal half of its length and then tapered to a point. The valva (Fig. 8) is half as broad at the valvular region as long; the sacculus is broad (Fig. 8, *sl*), transtilla is large and broad; the central region of the harpe is broad and bears an apical spine provided with strong curved processes at the proximal and distal ends; a few strong setae are present on the surface and upper margin of the distal part of the spine; the distal process extends slightly beyond the margin of the valvula. A conspicuous depression is present at the junction of the sacculus and costa (*co*) a little distad of the transtilla. Aedoeagus (Fig. 4) is uniformly broad; its distal end is provided



FIGS. 1-6 (male genitalia). 1, *Spodoptera mauritia acronyctoides* Guenee: Male genitalia after removing aedeagus. 2, *Spodoptera mauritia acronyctoides* Guenee: Aedeagus. 3, *Spodoptera pecten* Guenee: Male genitalia after removing aedeagus. 4, *Spodoptera pecten* Guenee: Aedeagus. 5, *Spodoptera abyssinia* Guenee: Male genitalia after removing aedeagus. 6, *Spodoptera abyssinia* Guenee: Aedeagus.



Figs. 7-9 (right valva of male genitalia). 7, *Spodoptera mauritia acronyctoides* Guenee. 8, *Spodoptera pecten* Guenee. 9, *Spodoptera abyssinia* Guenee.

with a number of strongly sclerotized spines and the vesica is provided with many small sclerotized denticles.

Female genitalia (Fig. 11):

Corpus bursae is a more or less globular sac, the part adjoining the ductus bursae is longitudinally ribbed with large number of minute sclerotized tubercles; signum is transverse, scobinate bearing numerous denticles and located in the middle of the corpus bursae. Ductus bursae is strongly sclerotized and provided with numerous minute sclerotized tubercles. Antrum bursae is small.

Spodoptera abyssinia Guenee *Male genitalia* (Figs. 5, 6, 9):

Vinculum is broadly U-shaped as in *S. pecten*; a small saccus (Fig. 5, *sa*) is present. Uncus is long, curved ventrad, swollen at the distal end and then tapered to a point as in *S. mauritia acronyctoides*. Pedunculi (*pen*) with dense tuft of hairs is present. The valva (Fig. 9) is half as broad at the valvular region as long; a shallow but broad indentation is present between the cucullus and the valvula; the part apicad of the indentation is twice as broad as long. Valvula bears a dense patch of hairs on the mid-dorsal surface. The transtilla is elongate and thumb-like. Sacculus is slightly broad as compared with that of *S. pecten*. The central region of the harpe is broad; it bears a broad and strongly sclerotized apical spine provided with a distal curved process and two proximal processes on either side of it. A shallow conspicuous depression is present at the junction of the sacculus and the costa distad of the transtilla. The costal margin of the sacculus is also broadly depressed. Aedoeagus (Fig. 6) is uniformly broad; the distal end is provided with a fairly long and sclerotized spine. The vesica is provided with a dense patch of slender spines.

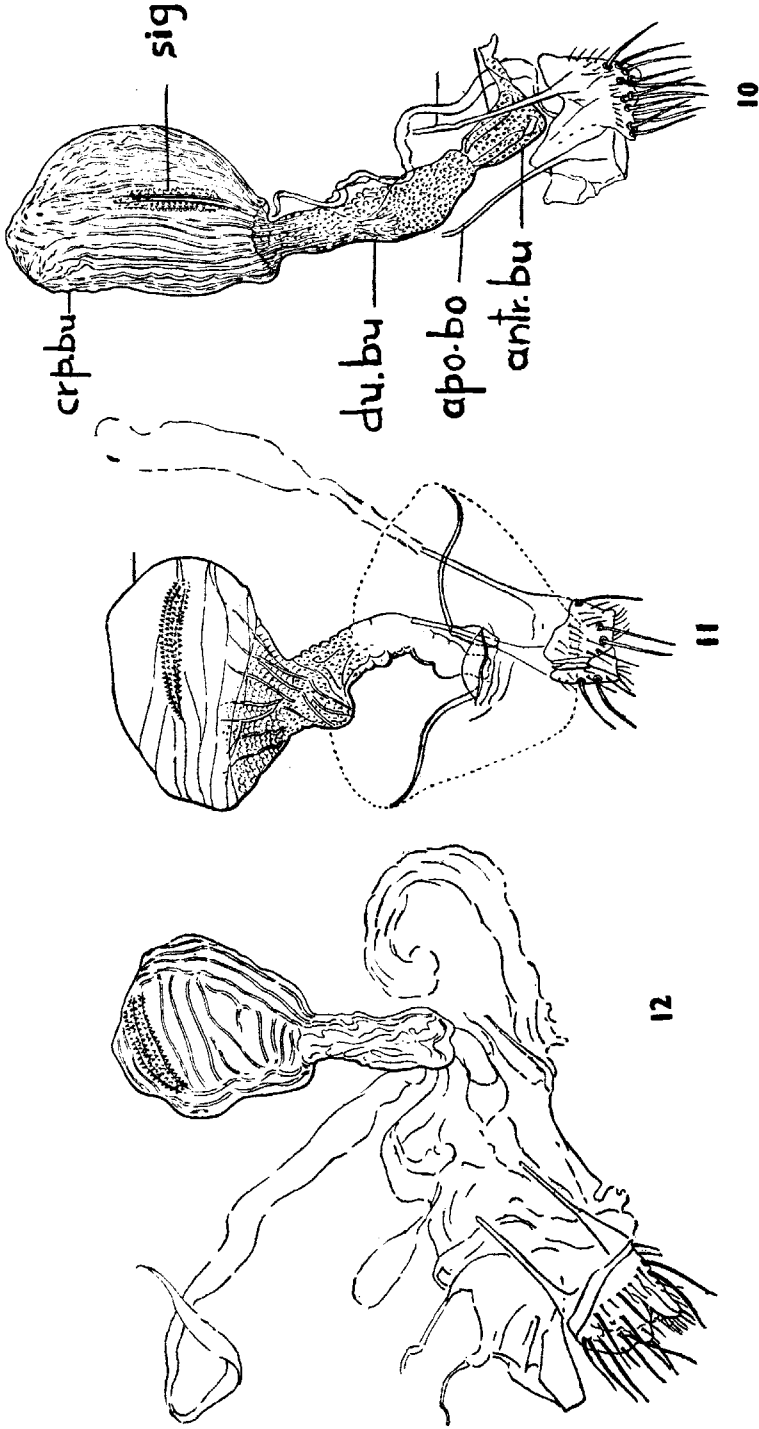
Female genitalia (Fig. 12):

Corpus bursae is more or less globular as in *S. pecten*. A transverse scobinate signum bearing large number of small denticles in several rows is present at the apical region of the corpus bursae. Ductus bursae is not sclerotized but longitudinally ribbed. Antrum bursae is prominent.

DISCUSSION

The colour patterns of wings of moths, on which the identity of the species is based, show variations in different forms, and are, therefore, not considered fully reliable in distinguishing the species. Hence a comparative study of the male and female genitalia was carried out and the observations presented herein show that these possess definite characters of taxonomic importance for the identification of the three species.

In *Spodoptera mauritia acronyctoides* the valva is elongate and narrower than in the other two species; the indentation present between the cucullus



Figs. 10-12 (female genitalia, bursa copulatrix). 10, *Spodoptera mauritia acronyctoides* Guenee. 11, *Spodoptera pecten* Guenee. 12, *Spodoptera abyssinia* Guenee.

and valvula is not broad as in *S. abyssinia*, while there being no indentation in *S. pecten*; the harpe presents a finger-like spine and not so conspicuously developed and bearing processes as in *S. abyssinia* and *S. pecten*; the aedoeagus does not possess spines at the distal end as in the other two species and also the vesica bears three cornuti. A labis is present in this species but absent in the other two. In the female genitalia the elongate corpus bursae, its being longitudinally ribbed and the longitudinal position of the scobinate signum within the corpus bursae distinguishes *S. mauritia acronyctoides* from the other two species. A comparison of the male and female genitalia of *S. abyssinia* and *S. pecten* shows that the pedunculi with dense tufts of hairs, the shape of the valva, the apical spine of the harpe bearing three processes, a dense patch of long hairs on the mid-dorsal surface of the valvula and a single sclerotized spine at the distal end of the aedoeagus in the male genitalia distinguishes the former species from the latter. Although the bursa copulatrix of *S. abyssinia* and *S. pecten* resemble in their general plan, the apical position of the scobinate signum in *S. abyssinia* and the strongly sclerotized ductus bursae with numerous minute sclerotized tubercles in *S. pecten* distinguish the two species.

The comparative studies of the male genitalia, especially the valvae which provide basis for recognition of species, and of the bursa copulatrix of the female genitalia clearly indicate that *Spodoptera mauritia acronyctoides*, *Spodoptera pecten* and *Spodoptera abyssinia* are three distinct species and that these can be distinguished from one another on the basis of these characters.

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LONGISTRIATA INDICA SP. NOV. (HELIGMOSOMATIDAE :
TRICHOSTRONGYLOIDEA : NEMATODA) FROM A
HARE FROM INDIA

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Longistriata indica n. sp. is described from a hare, *Lepus ruficaudatus*, and compared with the already known species of the genus. The various characters of systematic importance are discussed and it is concluded that the creation of subgenera, *Longistriata*, *Brevispiculoides* and *Srivastavanema*, is not justified and hence all subgenera are suppressed.

INTRODUCTION

One hare, *Lepus ruficaudatus*, was shot on the night of 31st December, 1965, and examined the following day when a large number of very small, live red parasites were recovered from the intestine. They on examination proved to belong to a new species of *Longistriata* Schulz, 1926, and are described here as such. Though a large number of specimens of both the sexes were studied, only six of each sex selected at random were measured. The figures in parentheses refer to the average of all the specimens measured. The live parasites were tightly coiled and, even when fixed in hot alcohol, most of them remained much coiled.

Male: The male parasites measure 3.48-4.76 (4.26) mm in length and 0.084-0.104 (0.095) mm in maximum breadth. The lips are rather small and inconspicuous but the papillae are easily seen. The cephalic inflation is quite prominent, measuring 0.048-0.078 (0.063) mm in length, and is well marked off from the rest of the body by an annular ring. The cuticle in the cephalic region is about 0.005 mm wide and shows striations, about six anterior ones being rather wide apart followed by 16-17 striations which are near to one another. The buccal capsule is very small. There are 12 longitudinal ridges which extend from the annular ring up to the prebursal region. The oesophagus is simple and measures 0.268-0.324 (0.288) mm in length. The nerve ring is situated at 0.13-0.21 (0.16) mm from the anterior end and is not always easily seen. The excretory pore is situated at 0.224-0.324 (0.27) mm from the anterior end and may be either anterior or posterior to where the oesophagus joins the intestine.

The copulatory bursa consists of two well-developed and symmetrical lobes, rather tightly inrolled. The dorsal lobe is absent and the prebursal papillae are present. The ventral rays have a common stem but they soon diverge, though both of them are directed somewhat anteriorly. The latero-ventral ray is slightly stouter than the ventroventral and pushes the edge of the bursa in a conspicuous manner. The other rays do reach up to the edge of the bursa but they do not push the edge in the same manner. The lateral rays have a common stem and are stouter than the ventrals, and of these the anterolateral is the stoutest. The anterolateral ray runs parallel and close to the mediolateral but in the distal region it sharply diverges from it and is directed anteriorly while the mediolateral continues in the lateral direction. The posterolateral ray is divergent from the mediolateral and is directed posteriorly. The dorsals arise from a common stem but soon the two externo-dorsal rays branch off and invariably the right branch takes off a little more distally than the left. The externodorsal rays are as stout as the ventrals and extend right up to the edge of the bursa. The dorsal ray bifurcates almost midway along its length into two simple branches which extend up to the edge of the bursa. The branches show a very small tubercle-like process in some specimens only. The two spicules are simple, filament-like and sub-equal. The left spicule, which is longer, measures 0.42–0.44 (0.43) mm in length and the right spicule 0.38–0.43 (0.41) mm. The gubernaculum is well cuticularized, 0.024–0.036 (0.032) mm long, and appears as a high-walled gutter, supporting the spicules on their dorsal and lateral sides. The telamon is present on the ventral side and is 0.05–0.062 (0.058) mm long, extending right up to the end of the genital cone. The telamon is clearly seen only in the lateral view for it is not as well cuticularized as the gubernaculum and is not discernible either in the dorsal or the ventral view. The genital cone is well marked though only 0.01–0.02 (0.016) mm high.

Female: The female parasites measure 4.32–5.15 (4.78) mm in length and 0.084–0.11 (0.095) mm in maximum breadth. The cephalic inflation measures 0.058–0.064 (0.063) mm in length. The oesophagus is 0.31–0.36 (0.33) mm in length. The nerve ring present is 0.13–0.196 (0.164) mm and the excretory pore 0.224–0.298 (0.263) mm from the anterior end. The general morphology is similar to that of the male described above.

The posterior end of the body is tapering and is almost always turned ventrally. The tail is 0.07–0.074 (0.072) mm long. The vulva is present a little anterior to the anus, being 0.142–0.166 (0.151) mm from the posterior end. It leads into a comparatively short though muscular vagina, 0.17–0.196 (0.18) mm in length. The muscular ovejector is 0.024–0.04 (0.33) mm in length. It passes into a single uterus and an ovary. There are comparatively few eggs present in the uterus which are thin-shelled, oval and measure 0.06–0.068 × 0.034–0.038 (0.064 × 0.036) mm.

DISCUSSION

Travassos (1937) and Skrjabin *et al.* (1954) have listed and described the various species of the genus, and more recent lists have been given by Yamaguti (1961) and Mawson (1961). Since then, the following species have been described: *L. myopotami* Petrov and Sadikhov, 1959, from *Myopotamus coypus* from Azerbaidzhan, *L. thomasi* Desportes and Chabaud, 1961 (nom. nov. for *depressa sensu* Thomas, 1953), originally described from *Sorex aranaeus* from the Inner Hebrides, *L. melomyos* Mawson, 1961, *L. uromyos* Mawson, 1961, *L. brachybursa* Mawson, 1961, and *L. polyrhabdote* Mawson, 1961, all from several species of rats from Queensland (Australia), *L. neomi* Lyubarskaya, 1962,* from *Neomys fodiens* from Russia, *L. longispicularis* Singh, 1962a, from *Petaurista petaurista albiventer* and *L. brevispicularis* Singh, 1962b, from *Rattus norvegicus*, both from India, *L. dollfusi* Diaz-Ungria, 1963, from *Mus musculus* from Venezuela, *L. hokkaidensis* Chabaud, Rausch and Desset, 1963, from *Apodemus sylvaticus argenteus* and *L. yamashitai* Chabaud, Rausch and Desset, 1963, from *Sorex unguiculatus*, both from Japan. The present species is the third to be described from the Indian region.

The various species of the genus are usually separated on the comparative length of the spicules, presence or absence of gubernaculum and telamon and the nature of the dorsal ray. The following species possess a dorsal ray which is entire and not divided: *L. depressa* (Dujardin 1845), *L. caudabullata* Dikmans, 1946, *L. gamma* (Travassos 1918), *L. didas* Thomas, 1953, *L. confusa* Desportes and Chabaud, 1961, *L. yamashitai* Chabaud, Rausch and Desset, 1963, and *L. longispicularis* Singh, 1962a.

The present species differs from all these thus: from *L. depressa* in size of the body, comparative size of dorsal and mediolateral rays and presence of telamon; from *L. caudabullata* in nature, comparative size and disposition of the ventral rays, presence of telamon, and absence of papillae from the genital cone; from *L. gamma* in comparative size of the body and the spicules, disposition of ventroventral and mediolateral rays, in the dorsal rays having a common stem, and in the presence of well-defined gubernaculum and telamon; from *L. didas* (as described by Thomas 1953) in having stouter ventral rays and a simple dorsal ray and in the presence of gubernaculum; from *L. confusa* in the symmetry and shape of the bursa which has stouter rays and the nature of mediolateral and dorsal rays; from *L. yamashitai* in size of the body, in having 12 longitudinal ridges, and in the presence of well-defined gubernaculum and telamon; from *L. longispicularis* in comparative size of body and spicules, number of longitudinal ridges and nature of ventral rays. Accordingly, the present material is considered to belong to a new species of the genus.

* Description not available.

Thomas (1953) considered *L. caudabullata* to be a synonym of *L. depressa* but Desportes and Chabaud (1961) have shown that specimens identified by Thomas as *L. depressa* belong to a new species. I agree with Desportes and Chabaud. Also, Desportes and Chabaud redescribed *L. didas* and their description was much different from that of Thomas. (Incidentally, Thomas has used the term ventrolateral for a ray of the ventral system.)

Travassos (1937) described a species which he called *zetta*, and some subsequent authors (Skrjabin *et al.* (1954), Mawson (1961), Yamaguti (1961)) corrected the spelling to *zeta*. But, according to the International Code of Zoological Nomenclature (Stoll 1961), incorrect transliteration cannot be considered as an inadvertent error. Hence, the correct name of this species remains *L. zetta* Travassos, 1937.

The name *Longistriata* was given by Schulz for a subgenus of *Viannaiia* Travassos, 1914, and raised to the generic rank by Travassos and Darriba (1929). Subsequently Travassos (1937) recognized four subgenera, *Longistriata*, *Heligmonella*, *Carolinensis* and *Vexillata*, mainly on the ratio between the width of the body and the length of the spicule and the nature of the rays

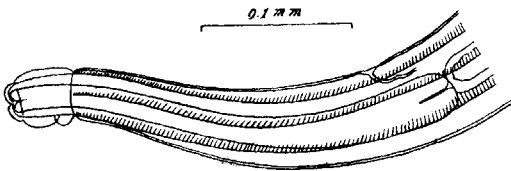


FIG. 1. *Longistriata indica* n. sp.
Male, anterior end.

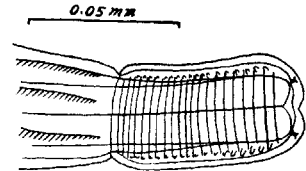


FIG. 2. *Longistriata indica* n. sp.
Female, anterior end.

of the dorsal system. Ortlepp (1939) suppressed the name *Heligmonella* and proposed *Brevispiculoides* instead. Most workers recognize only two subgenera, *Longistriata* and *Brevispiculoides*. Singh (1962a) created a new subgenus *Srivastavanema* mainly on these two characters. Accordingly, the single most important character which separates the subgenera is the comparative length of the spicules: in *Longistriata* they are said to be '... more than 2-3 times as long as width of body', in *Brevispiculoides* '... less than 2-3 times as long as body width', though Ortlepp had said that it had '... short spicules where length is only about twice the body width'. In *Srivastavanema* they are about six times as long as the body width.

The ratio between the spicule length and body width of the various species is not a well-defined character, for body width may mean the maximum breadth of the parasite or the breadth of the body immediately anterior to the bursa as presumed by Mawson (1961), and may include the inflated cuticle also. This ratio shows a gradation between the various species, and hence the character is of little value by itself even in separating the individual species,

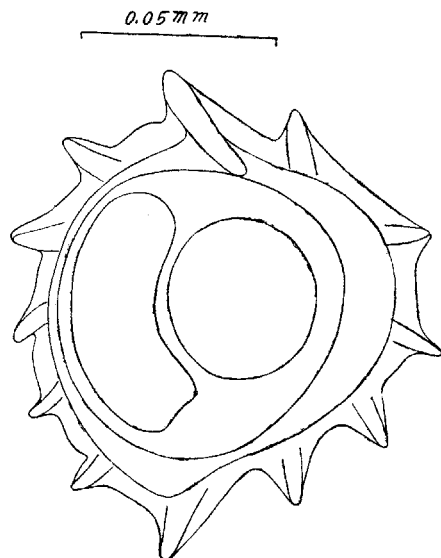


FIG. 3. *Longistriata indica* n. sp. Female, transverse section through posterior region of body.

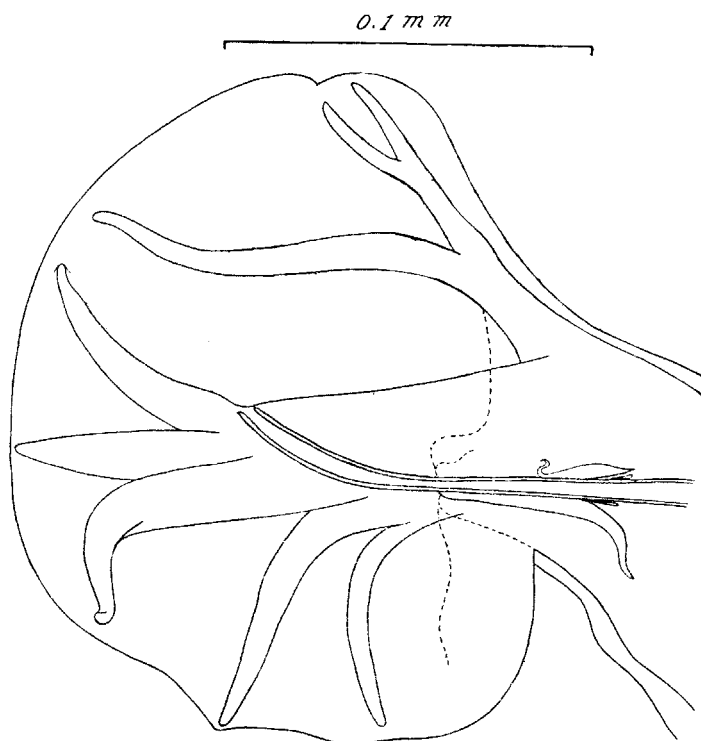


FIG. 4. *Longistriata indica* n. sp. Male, bursa, lateral view.

leave alone the subgenera. Moreover, Mawson (1961) found considerable variations in this index in a population of the same species. She used the following characters for grouping (see her Fig. 1) the various species of the genus (without assigning them to any subgenera): comparative length of dorsal ray, symmetry of bursa, and the presence and symmetry of alae.

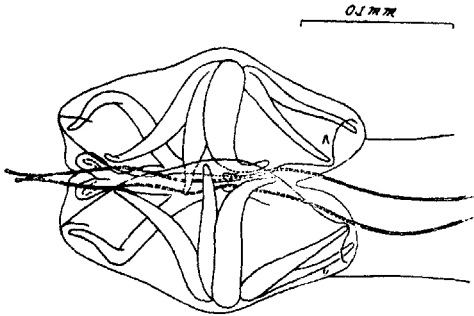


FIG. 5. *Longistriata indica* n. sp. Male, bursa, ventral view.

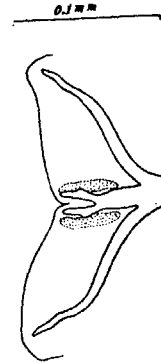


FIG. 6. *Longistriata indica* n. sp. Male, dorsal rays of bursa, dorsal view.

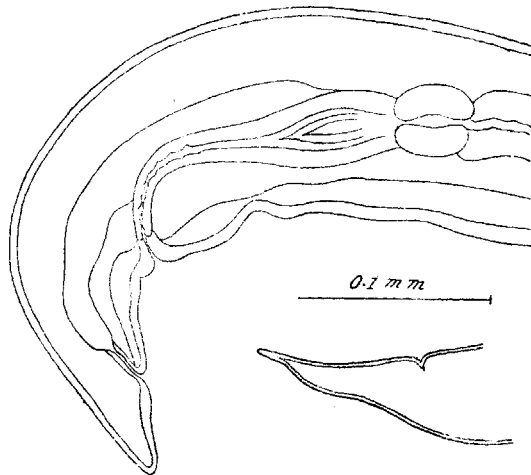


FIG. 7. *Longistriata indica* n. sp. Female, posterior end, lateral view.

(N.B.—Figs. 1–7 drawn with the aid of camera lucida).

According to her system, for example, *epsilon*, *capensis*, *cristata*, *pusillaspirura* and *adunca* belong to one assemblage though their spicule length/body width index varies from 1.7 in *epsilon* to 7.1 in *cristata*. Unfortunately, the characters selected by her are either equally unreliable or difficult to determine categorically. It is, therefore, proposed to suppress all the subgenera and for

the present all the species are included under the genus *Longistriata*, without dividing it into any subgenera.

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