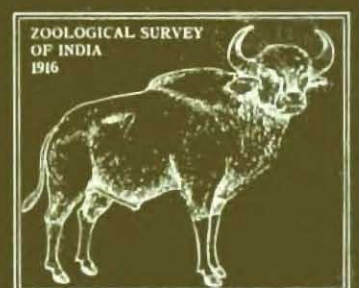


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## FOREWORD

The diversification of avenues of Zoological research in the Zoological Survey of India coupled with the increasing number of scientific papers that are being received from the Scientists has necessitated the publication of this new journal "*Bulletin of the Zoological Survey of India.*" It may not be out of place to mention here that an interdisciplinary trend has been maintained and will continue to be followed regarding the subject matter presented in the journal. Results of Taxonomic, Ecoethological, Biogeographical as well as Physiological studies are included. It is hoped that all Scientists will find this *Bulletin* an useful publication.

T. N. Ananthakrishnan  
*Director,*  
*Zoological Survey of India*

## BIOLOGICAL AND CHEMICAL CONTROL OF THE VECTOR SNAIL *MELANIA SCABRA* (GASTROPODA : PROSOBRANCHIA)

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### ABSTRACT

Studies on Biological and chemical control of the snail, *Melania scabra* have been made in the field as well as in the laboratory.

Water beetles, crabs and fishes like *Ophiocephalus gachua* were found to be the natural enemies of the snail.

Fruit extracts of plants like *Acacia arabica*, *Acacia* sp., *Acacia concinna*, *Sapindus emarginatus* and *Neem margosa* were found to kill the snail population on large scale.

Series of experiments carried on the artificial control of *Melania*, using various poisonous chemicals have revealed that copper sulphate and cupric chloride are the most satisfactory molluscicides to be used in the control of *Melania scabra* in the field.

### INTRODUCTION

In recent years several attempts have been made to control the vector snails of helminths. Dawood and Dazo (1966) performed field tests on two new molluscicides. Repellent action of some chemical molluscicides on Schistosome vector snails has been studied by Etges and Gilbertson (1966). Attempts to control the snails infested with of Bilharzia, have been made by several workers. Although such attempts were performed on the basis of biological information, just how much such attempts will add to the control of snails remains an open question. This uncertainty may be attributed to the fact that very little is known about the ecology of these snails, although a voluminous literature dealing with the control is available. Nagabhushanam and Muley (1975) studied the ecology of the snail, *Melania scabra*. Studies on breeding habits (Muley, 1977) and embryo-

logy and development of the snail have been made by Muley (in press). The snail is a continuous breeder and is widely distributed in various parts of India. As it is reported to be the important vector snail, it was found worthwhile to study its ecology and control in detail. The present paper deals with i) Biological control and ii) artificial or chemical control of the snail.

### MATERIAL AND METHODS

The snails, *Melania scabra*, required for the laboratory studies were collected from the river Godavari near Pravarasangam, Ahmednagar district, Maharashtra, India. Field and laboratory studies were made on the biological control of *Melania*, using fruit extracts of various plants like Babhul, Reetha, Shikakai and Neem. The dry fruits of these plants were grinded to a powder and extracts of required concentrations of these fruits were

prepared in tap water. The snails in groups were put in these extracts and their survival for a specific period in respective concentrations of these fruit extracts was observed. Biological control of the snails by various aquatic animals like water beetles, crabs and fishes was observed in the field. Studies on chemical control of the snail were made using various poisonous chemicals. Various concentrations of these chemicals were prepared, by dissolving the chemical in tap water or distilled water where required. The snails were placed in the known concentration and their activities and behavioural responses were noticed. After 24 hours the snails were brought back to the tap water and the percentage mortality was determined. This data helped to compare the toxicity of various chemicals and to select an effective molluscicide to check the overgrowing population of the snail.

#### OBSERVATIONS

##### 1. *Biological control.*

###### (a) *Control of the snails by poisonous plants :*

Laboratory experiments with extracts of leaves, roots and fruits of various plants have shown that when the snails are put in such extracts they were killed after some time. Five such plants, whose fruits contain some snail destroying substances were *Sapindus emarginatus* (Ritha or soap berry), *Acacia arabica*, *Acacia* sp. (Babhu), *Acacia concinna* (soap nut or shikakai) and *Neem margosa* (Neem). The fruits of these poisonous plants were allowed to soak in snail infested waters in large numbers, but the fruits when applied in crushed and powdered forms and dissolved in water gave quick and satisfactory results (Table 1).

###### (b) *Control of the snails by animal predators :*

###### (i) *Helminth parasites :*

Most of the snails, were found to be infected with certain monostome cercariae.

Studies on the survival of these infected snails have revealed that such snails could not survive for more than 8 to 10 days in the laboratory conditions as compared to the control snails which are non-infected but kept under similar laboratory conditions.

###### (ii) *Water beetles :*

Water beetles like *Diadiscus* sp. belonging to family Diaticidae were found to break the shell of the snail and eat the soft tissue, when kept in the vicinity. The beetles break the hard shell of the snail with their mandibles.

###### (iii) *Crabs :*

The crab, *Barytelphusa cunicularis*, was found to attack and eat the snail. Like the beetles the crab also breaks the hard shell, though the snail tries to withdraw the body in the shell and closes the operculum.

###### (iv) *Fish predators :*

Fish predators like *Ophiocephalus gachua*, were found to break the shell and eat the flesh of *Melania*. Analysis of stomach contents of the fish showed that the fish completely swallows the snail and digests the flesh leaving behind the broken parts of the shell.

##### 2. *Artificial or chemical control.*

An attempt has been made by the application of several chemicals and molluscicides, to control the population of the snail. Most of these chemicals used were found to be lethal for one or other species of slug or snail. The concentrations of these chemicals were so made, that they would not cause any harm to the associated fauna. Application of molluscicides in part was adapted as recommended in WHO report (1961).

Selected concentrations varied from 0.00005% to 1.0%. These were found to be effective in the control of the snail. All the observations were made for twenty four hours. The results of experiments are tabulated in Table 2.

It is evident from the results that cyanides are highly lethal for the snail, but their use needs care. Copper sulphate was found to be more lethal next to cyanides. Salts of mercury were found to be equally lethal to the survival of *Melania*. Chlorides of Ammonia and other chemicals were moderate in their action.

#### DISCUSSION

Biological control, when considered from the ecological view point as a phase of natural control, can be defined as "the action of parasites, predators or pathogens in maintaining another organism's population density at a lower average that would occur in their absence" (Paul De Bach, 1964). Regulation of an organism's abundance below the level of economic injury is the target of the field of applied biological control. Similarly check of overgrowing population of the species by its natural enemies is the basic principle of biological control. Several beetles families are notorious for having a species that live largely or entirely upon pulmonate gastropods (Bequaert, 1925, 1926). Water beetles belonging to family Dyaticidae and family Hydrophillidae, crabs like *Barytelphusa cunicularis* and fish like *Ophiocephalus gachua* were found to be natural enemies of the snail, *Melania scabra*. They were found to attack and feed on the snail, naturally controlling the overgrowing population of the snail. Plants like *Acacia arebica*, *Acacia* sp., *A. concinna*, *Sapindus emarginatus* and *Neem margosa* were found to kill the snail population when their fruit extracts were applied in the laboratory and field. Fruits of these plants contain

some snail destroying substances. But it was found that the effect of saponin or other lethal substances from the fruits will not last long and the application of the fruits will have to be repeated many times. Under these conditions this mode of control is no better than chemical control (Anantaraman, 1955). In the present investigation the biological control of *Melania* as observed was found to be temporary in true sense because the predators and plants are annual breeders or seasonally fruiting and thus these natural enemies are often unable to keep the snail population in check.

None of the methods of control outlined above were fully satisfactory. Hence more potent poisons need to be found for use against the snail. An attempt was made by the application of several chemicals and molluscicides, so as to select an effective one.

Voluminous literature on the chemical control of various snail vectors is available. However, the methods of control of the snail differ from country to country. In the present investigation the cyanides of sodium and potassium were found to be the most effective, but as they were so deliquescent in handling, they were found to be useless for large scale trials. Sulphates of Ammonia and Mercury salts were found to be moderate in their action. Copper sulphate and cupric chloride are the most potent poisons next to cyanides against *Melania*. Hence the careful application of these chemicals may be recommended for the control of this snail.

#### ACKNOWLEDGEMENT

I wish to express my sincere thanks to Prof. R. Nagabhushanam, Department of Zoology, Marathwada University, Aurangabad, for his valuable guidance and Dr. B. K. Tikader, Officer-in-Charge, Zoological Survey of India, Poona, for providing necessary facilities.

Table 1 Control of *Melania scabra* using fruit extracts of various plants.

S. No.	Name of the plant	Common name	Lethal concentration of the extract	Time in minutes for 100% mortality
1.	<i>Sapindus emarginatus</i>	Ritha or soap berry	2.0 %	40
2.	<i>Acacia arabica</i>	Babhul	1.0%	30
3.	<i>Acacia sp.</i>	Babhul	1.0%	30
4.	<i>Acacia concinna</i>	Shikakai	0.7%	30
5.	<i>Neem margora</i>	Neem	0.5%	20

Table 2. Effect of various poisonous chemicals on the behaviour and survival of *Melania scabra*.

S. No.	Substate	Lethal concentration for 24 hours	Action	Remark
1.	Sodium cyanide	0.00005%	Retract the body in shell, closes the operculum, no activities died in 25 seconds.	Most lethal.
2.	Potassium cyanide	0.0005%	Retract the body in shell, closed the operculum, no activities, dies in 30 seconds.	Most lethal.
3.	Copper sulphate	0.0001%	Body erected outside for 10 seconds, again retracted, no activities, dies in 3 to 4.5 minutes.	Highly lethal.
4.	Cupric chloride	0.0001%	Body erected out of shell, retract within 2 minutes, closed the operculum died in 6.0 minutes.	Highly lethal.
5.	Ammonium sulphate	0.1%	Animal active, more towards the borders of the container. Less active after 3 hours. Retract the body in shell, close the operculum, died after 4 hours.	Less lethal.
6.	Ammonium chloride	0.005%	No activities, operculum closed, body withdrawn in shell died after 50 minutes.	Moderate in action.
7.	Ammonium oxalate	0.1%	No activities, operculum closed, body withdrawn in shell died within 25 minutes in 1.0' Bolution.	Less lethal.
8.	Ammonium potassium sulphate.	0.1%	Animal active as soon as dropped. Withdraws the body in shell. Closes the operculum 100 percent mortality observed after 24 hours.	Less lethal.
9.	Mercuric sulphate	0.0001%	No activities of the snails, after 40 minutes. Operculi closed. All died after 24 hours.	Highly lethal.
10.	Mercuric chloride	0.00005%.	All the snails active for 10 to 15 minutes. Stretch the body out of shell and again withdraw after 30 minutes. Operculi closed. All died within 24 hours.	Most lethal.
11.	Mercuric acetate	0.01%	Animals less active. Operculi closed after 20 minutes. All died within 20 hours.	Moderate in action.

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## THE MOUND-STRUCTURE AND PRIMARY REPRODUCTIVES (KING AND QUEEN) OF THE TERMITE *ODONTOTERMES KUSHWAHAI* (TERMITIDAE)

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### ABSTRACT

(1) The mature earthen mounds of *Odontotermes kushwahi* Roonwal and Bose (Isoptera, Termitidae, Macrotermitinae), as studied at Pune (Maharashtra), are dome-shaped to subconical (ratio Height/Diameter ca. 0.4—0.5), and have a broad, round base (ca. 2m or more in diameter) and a hard outer surface with several rounded holes (ca. 4-7mm in diameter). The holes lead to blind tunnels. At the basal periphery there is a flat platform, ca. 80 cm. in radius, having several small holes ; it represents the extent of the underground nest. (2) Large, rounded vaults are scattered throughout the mound, each usually contains one, sometimes two, fungus-combs. (3) The royal chamber is a spindle-shaped cavity in the soil without any hard-walled defences, and contains a king and a physogastric queen. It lies eccentrically at, or well above, the ground level. (4) Nymphs are found in the fungus-combs and elsewhere, and are not confined to separate "nurseries". (5) The primary reproductives (imagoes) are described from dealates (kings and physogastric queens), and are compared with those of the allied species, *O. brunneus*. (6) The Pune record fills a gap in the hitherto discontinuous distribution of the species.

### INTRODUCTION

The termite, *Odontotermes kushwahi* Roonwal and Bose 1964 (Isoptera, Termitidae, Macrotermitinae), was originally described from soldiers and workers as a subspecies of *O. brunneus* (Hagen) ; it has now been raised to a full species (Roonwal, 1976 ; Roonwal and Verma, 1977). The primary reproductives were hitherto unknown. A 45-cm high mound was mentioned by Roonwal and Bose (1964) but its structure is unknown (Roonwal, 1970). In the present account we describe mound-structure and the primary reproductives. It is interesting to observe that at Pune mounds of both *O. kushwahi* and its near ally, *O. brunneus*, occur in the same area.

### MATERIAL

Recently (March 1977) one of us (M. L. R.) studied mound-structure in the field and made

collections of all associated castes (soldiers, workers and primary reproductives, e.g. kings and large physogastric queens) at Pune (= Poona), Maharashtra (latitude 18°31' N, longitude 73°55' E, altitude above mean sea-level 570 m) in Peninsular India. The type material (soldiers) of *O. kushwahi* was used for comparison.

### MOUND-STRUCTURE

(Fig. 1 ; and Pls. 1, 2)

Except for the bare mention of a 45-cm high mound in the Udaipur District, Rajasthan, by Roonwal and Bose (1964, p. 33), nothing is known of the mound of *O. kushwahi*. Mounds were common in the open scrub and fallow land at Gokhalenagar on the outskirts of Pune City a little south of the National Chemical Laboratory. They formed a characteristic feature of this 10,000 m<sup>2</sup>

area where 9 mounds (one per 1,111 m<sup>2</sup>) were found. An occasional mound of *O. brunneus* (Hagen) was also present in the same area.

cm, etc.), some of which are empty, but others contain one, or occasionally two, fungus-combs (Pls. 1c, 2b). The combs are brownish grey, rounded to oblong, flat, cake-like, concave,

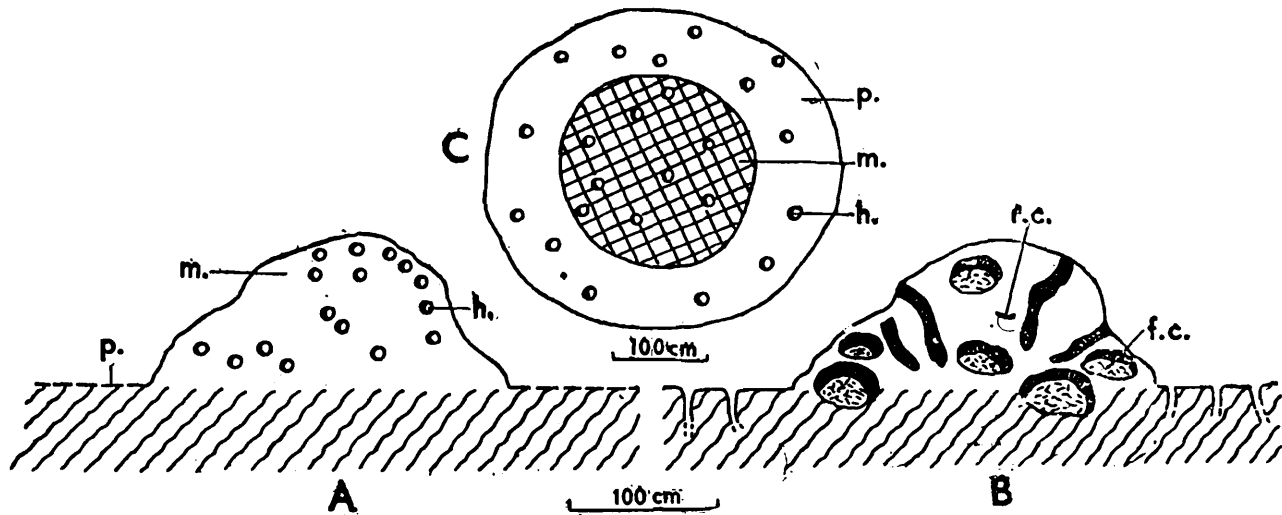


Fig. 1. Mound-structure of *Odontotermes kushwahi*. Semi-diagrammatic. (A) External view, as seen from one side. (B) Same, in vertical section. (C) Same, as seen from above. Note the mound proper and the basal platform.

f.c., fungus-combs ; h., holes on mound surface and on platform ; m., mound proper ; p., basal platform on mound periphery ; r.c., royal chamber.

Mounds of *O. kushwahi* are dome-shaped to subconical, about a metre high, and with a rounded basal diameter of about twice the height (ratio height / diameter *ca.* 0.4-0.5). All around the basal periphery there is generally present a flat platform of about 80 cm radius, at ground-level, marked by numerous small holes, 2-4 cm in diameter ; these holes lead into underground tunnels. The platform represents the extent of the underground nest area.

The mound proper is thick-walled and is made of hard, compacted, dark grey earth which is difficult to dig into without a pickaxe. The mound surface is rough and is covered all over with numerous rounded holes (diameter 4-7 mm) which lead into oblique blind tunnels up to a depth of 30-35 cm. Throughout the mound, right down to the base and a little below, are found rounded, smooth-walled vaults (sizes *ca.* 18×12, 13×12, 28×14

spongy bodies (diameters *ca.* 6 cm×7 cm to 13 cm×27 cm ; height 3-5 cm) composed of soft, granular material ; sinuous lamellae divide the combs into numerous chambers which contain eggs and young larvae besides soldiers and workers.

The royal chamber is a spindle-shaped cavity (length *ca.* 15-16 cm, width 8-9 cm, height 4-5 cm) with a flat floor and an arched roof ; it has no discrete walled structure or defences (cf. *Odontotermes brunneus* and *O. obesus* for example). It lies somewhat eccentrically at the ground-level or well above it nearly in the middle of the mound. Its inside is smooth, almost polished, and is marked by numerous small holes, each leading out to a narrow passageway for the entry and exit of soldiers and workers. In two cases examined, it contained a king, a large physogastric queen (length *ca.* 9 cm), and a few soldiers and workers. No discrete "nurseries" were

found, but larvae were present in small masses either in the fungus-combs or scattered elsewhere in the mound.

The Height/Diameter Ratio : Mature mounds are relatively high, with an H/D ratio of *ca.* 0.4-0.5, thus :

	<i>Mound 1</i>	<i>Mound 2</i>
Height (H) (cm)	89	107
Max. basal diameter (D) (cm)	212	217
Ratio H/D	0.420	0.498

*Comparison* (Table 1) : The mature mounds of an allied species, *O. brunneus* (Hagen), are much flatter, with an H/D ratio of 0.15—0.28 (Roonwal, 1973, 1977, and in press). Younger mounds, though smaller, are tall and have a high ratio (0.42—0.75). A mature mound of *O. brunneus* occurring in Pune in the same area as *O. kushwahi* also gave a low ratio, as follows : Height 100 cm ; diameter 484 cm ; H/D 0.21.

vicinity : Holmgren (1912, *O. brunneus*, Khadki (=Kirkee, near Pune), Deoras (1962, "*O. malabaricus*") and Ketkar (1962, "*O. redemanni*"). We suspect that the last two are misidentifications (see also Roonwal, 1973).

DESCRIPTION OF PRIMARY REPRODUCTIVES (Fig. 2 ; and Table 2)

*Odontotermes kushwahi* Roonwal and Bose, 1964.

*Odontotermes brunneus kushwahi* Roonwal and Bose 1964, p. 33 ; 1969, p. 442 ; Roonwal, 1970, p. 361.

*O. kushwahi* R. & B., Roonwal, 1976, p. 494 ; Roonwal and Verma, 1977, p. 451.

*Material* : 3 vials, Pune (=Poona), Maharashtra : (i) Field No. R1/31.3.77. King, queen, several soldiers and workers, ex mound. (ii) R2/31.3.77. Soldiers and workers, ex earthy termite encrustation on ground. (Both M. L. Roonwal coll. 31.iii.1977). (iii) King,

TABLE 1. Comparison of *mature* earthen mounds of *Odontotermes kushwahi* and *O. brunneus*.

<i>O. kushwahi</i>	<i>O. brunneus</i>
1. Broad-based but relatively higher (ratio Height/Diameter high, <i>ca.</i> 0.4—0.5). Height 89-107 cm ; basal diameter 212-217 cm.	1. Broad-based but low and sprawling (ratio Height/Diameter low, <i>ca.</i> 0.15—0.28). Height 50—100 cm ; basal diameter 320—390 cm.
2. Semi-dome-shaped to sub-conical ; rather high.	2. Dome-shaped, rather flat.
3. A flat platform at ground level (radius <i>ca.</i> 80 cm ; with small 5 cm wide surface holes) generally present all around the mound-base.	3. No such platform around the mound-base.
4. Outer surface smooth, without papillae or turrets, and with small 4-7 cm wide holes.	4. Structure varies greatly. Outer surface either smooth, or very rugose, with small papillae or turrets ; either without holes, or with small to large (up to 25 cm wide) holes.
5. Royal chamber lying at or well above ground-level.	5. Royal chamber lying variously (at, below, or above ground level).

There are three other accounts of *Odontotermes* termite mounds - from Pune and its

queen, several soldiers and workers, ex mound, M. S. Malhotra coll., 23.iii. 1977.

Imago (dealate kings and queens) (Fig. 2. and Table 2.). Sexes alike. Dorsum of head dark brown, peripheral area paler; anteclypeus whitish, postclypeus and legs pale fuscous; rest of body dark brown; eyes almost black. Head and body rather densely hairy, with small hairs all over. Total length without wings: ♂♂ 16-17 mm; ♀♀ (physogastric queens) 73-75 mm.

edges; broken, with 11-15 segments only; segment 2 longer than 3 or 4, 3 shortest, 4 smaller than 2. Anteclypeus narrow, whitish, translucent. Postclypeus swollen and very hairy; medially divided by a dark longitudinal line; maximum width (1.13 mm) about twice the median length (0.57 mm). Labrum tongue-shaped, hairy, broader than long; with a rounded, hyaline distal edge and a horizontal

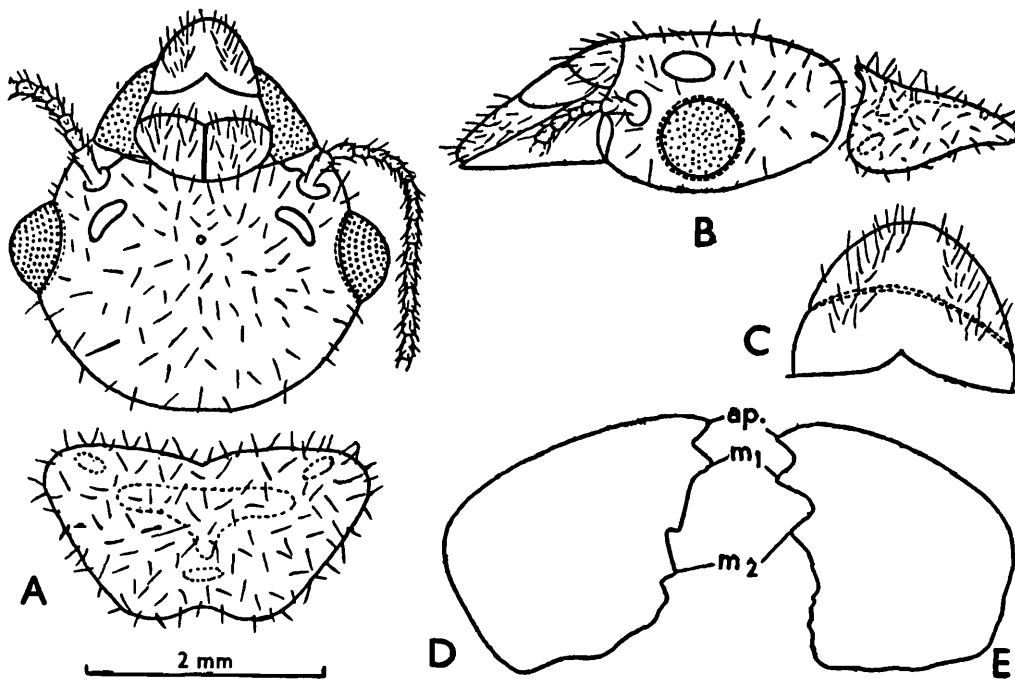


Fig. 2. *Odontotermes kushwahai*, ♀ imago (queen). Pune. (A) Head and pronotum, dorsal view. (B) Same, side view. (C) Labrum. (D) Left mandible. (E) Right mandible.

Head subround, narrowing anteriorly and posteriorly; densely covered with numerous short hairs; sides rounded; Y-suture absent. Fontanelle minute, point-like, submedial, not raised; below this lies a pale subcircular area. Eyes rounded, bulging considerably (cf. *O. brunneus* where they are flatter); maximum diameter 0.93-0.94 mm. Ocelli whitish translucent, roundish-oval (0.24-0.30 × 0.30-0.36 mm; lying obliquely; minimum eye-ocellus distance 0.13 mm, less than half the maximum diameter of ocellus, index 0.36-0.43; minimum eye-antennal distance 0.06 mm. Antennal segments pale brown with whitish anterior

groove-like depression about its middle. Mandibles of typical *Odontotermes*-type, with an apical and two marginal teeth; the apical and 1st marginal large and subequal. Left mandible with 2nd marginal separated from 1st by a wide distance; in right mandible these two teeth much closer. Pronotum trapezoidal, densely hairy, and with well rounded corners; with a median subtriangular whitish patch in anterior half and a roundish patch at the antero-lateral angles; anterior margin with a deep, and posterior one with a weak, median notch. Legs slender and longish. Apical tibial spur formula 3:2:2. Tarsi 4-

TABLE 2. *Odontotermes kushwahi*. Some measurements (in mm.) of imagoes (dealate kings and queens, from Pune).

Body-part	Measurements (mm) (4 exs.)
1. Length of head to mandible-base.	1.45—1.71
2. Max. width of head (with eyes)	2.94—3.00
3. Max. height of head	1.24—1.30
4. Labrum (Length × Width)	0.60 × 0.72
5. Eyes (Min. × Max. diameters)	0.71-0.78 × 0.93—0.94
6. Ocelli (Min. × Max. diameters).	0.24—0.30 × 0.30—0.36
7. Min. eye ocellus distance	0.13
8. Min. eye-antennal distance	0.06
9. Pronotum (Length × width)	1.24-1.33 × 2.70-281
10. Max. length of forewing scale	1.58 (1 ex.)
11. Max. length of hindwing scale	1.30 (1 ex.).

segmented, ending in a pair of short blackish claws. Arolium between claws absent. Wings ; only scales present. Abdomen longish, very hairy, Cerci short, 0.30 mm. long, 2-segmented. Styli short, length<sup>n</sup> 0.10 mm.

### Comparison

*O. kushwahi* is close to *O. brunneus* of which it was originally described as a subspecies (on the basis of soldiers) but subsequently raised to a full species (*vide supra*) ; the comparison of imagoes confirm this separation. It differs from *O. brunneus* as follows :

Imagoes : (i) Smaller (head-width 2.94—3.00 vs. 2.81 mm). (ii) Much paler (*O. brunneus* much darker almost deep chestnut). (iii) Eyes flatter (vs. more bulging). (iv) Head and body densely hairy (vs. very weakly hairy).

Soldiers (Fig. 3) : (i) Head-capsule and thorax sparsely hairy (vs. densely hairy). (ii)

Mandibles longer and more slender and more strongly curved in front (index Mandible length/Head-length to mandible base 0.61—0.87

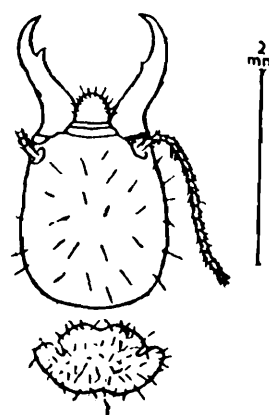


Fig. 3. *Odontotermes kushwahi*. Soldier, head and pronotum, Pune.

vs. 0.52—0.70). (Soldiers from Pune are slightly larger than those from elsewhere, e.g., Rajasthan Gujarat and Tamil Nadu : head-width 1.45—1.71 vs. 1.33—1.48 mm ; head-height 1.00—1.13 vs. 0.83—0.93 mm ; mandible-length 1.24—1.30 vs. 1.08—1.18).

## DISTRIBUTION AND ECOLOGY

(Fig. 4)

*O. kushwahi* was hitherto known from Western India (Rajasthan : Udaipur District ; and Gujarat : Kaira District) and then deep south (Tamil Nadu : Salem District) and Roonwal and Verma (1977 p. 451) had remarked on its curiously "discontinuous distribution". The present new record from Pune Maharashtra fills a gap in the discontinuity.

in hilly regions and has been recorded up to about 600 m altitude.

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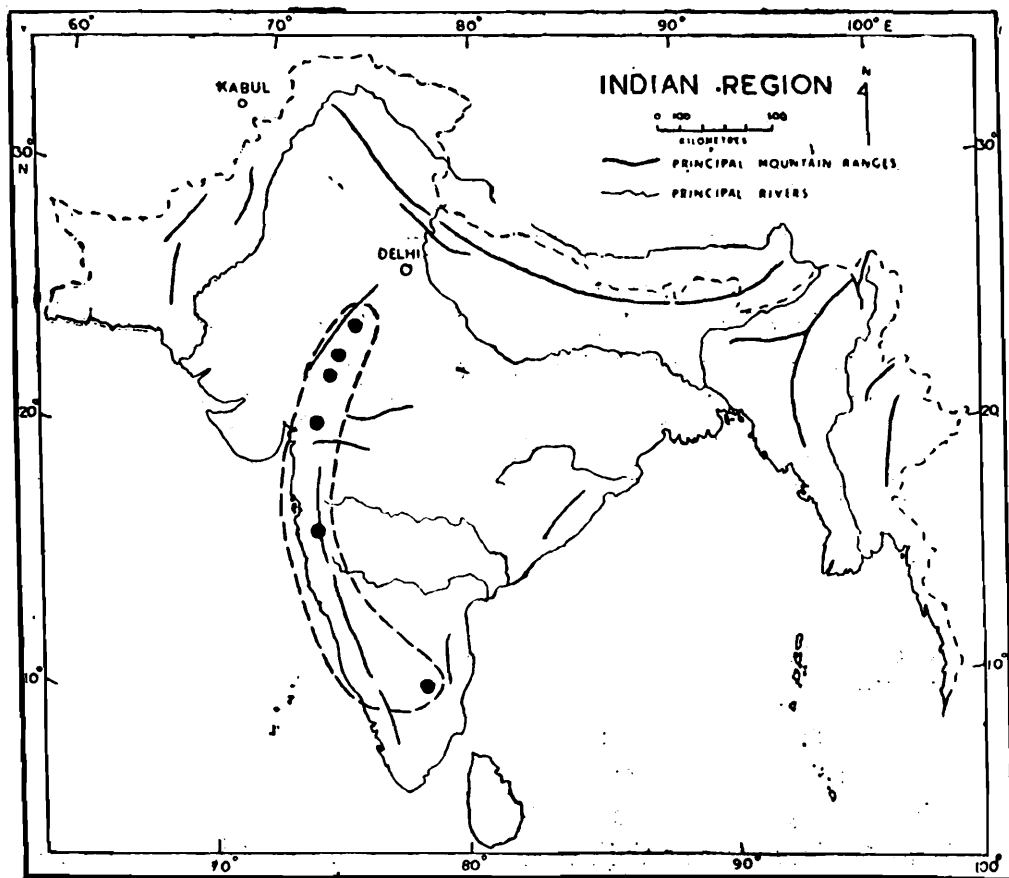


Fig 4.. Distribution (solid circles) of *Odontotermes kushwahi*.

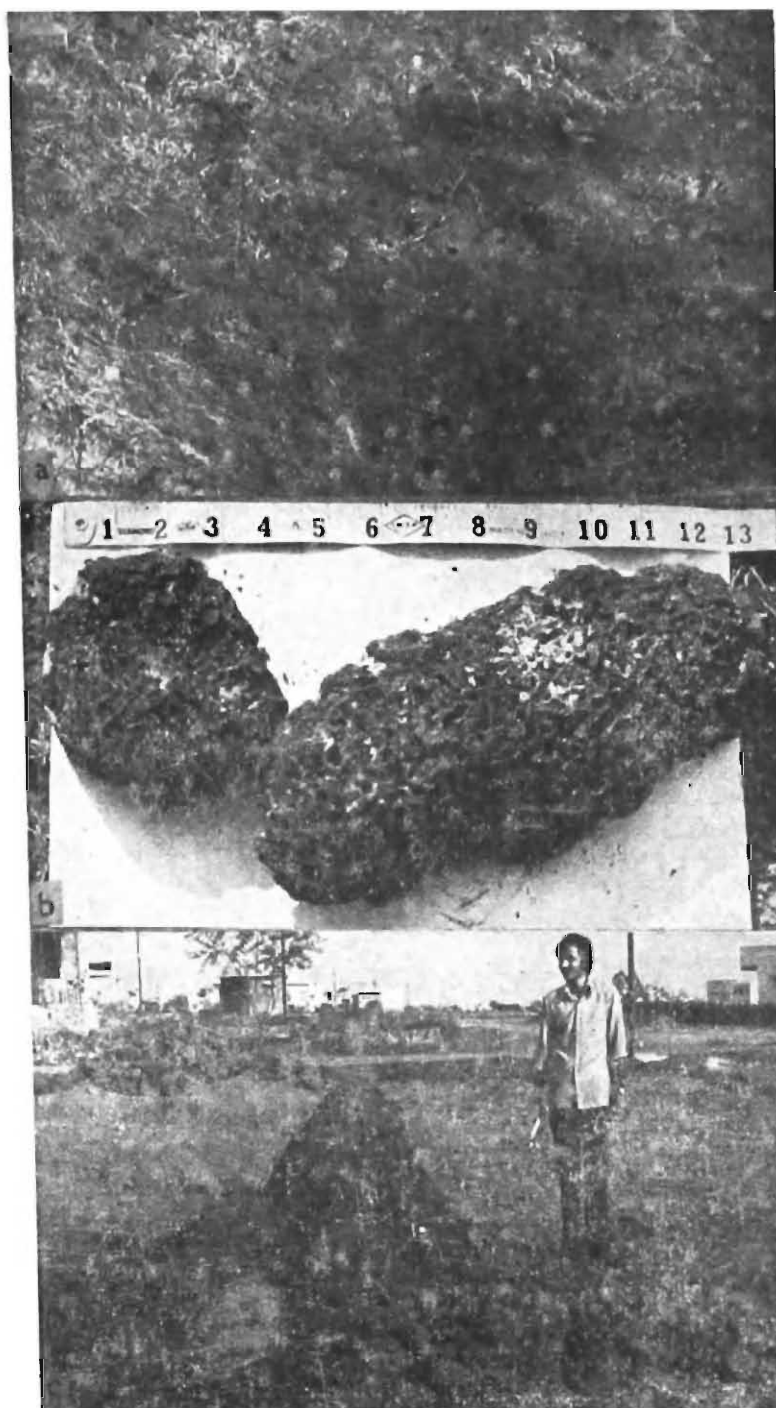
Roonwal (1976) has shown (p. 494) that "it occurs in hot and humid areas with an annual rainfall above *ca.* 60 cm."; and that it "prefers moderate temperatures (mean May below 34°C; mean January above 16°C)". To this may be added that it tends to occur

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Mound-structure of *Odontotermes kushwahi*  
Roonwal & Bose. Pune (Field No. R1/31.3.77).  
(a) Mound (height 89 cm). (b) same, closer view.  
Note the holes. (c) Part, in vertical section to  
show vaults, fungus-combs and royal chamber  
(white arrowhead),



Mound-structure of *Odontotermes kushwahi* Roonwal & Bose. Pune. (a) Mound Field No. R 1/31.3.77. (same as in Plate I). Part of basal peripheral platform. Note the holes. (b) Two fungus-combs from mound No. R1/31.3.77 (scale is in inches). (c) Another mound (No. R3/31.3.77), partly scrapped vertically. Note its subconical shape.

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PHYSICAL AND CHEMICAL CONSTITUENTS OF FUNGUS COMBS OF  
*ODONTOTERMES MICRODENTATUS* ROONWAL AND SEN-SARMA AND  
*ODONTOTERMES OBESUS* (RAMBUR) (ISOPTERA : TERMITIDAE)\*†

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ABSTRACT

The moisture content in the fungus comb of *Odontotermes microdentatus* and *Odontotermes obesus* remain very high throughout the year. The ash content is also high. The nitrogen content is higher than in normal wood. The lignin content is low and carbohydrate content is high indicating that masticated plant material forms the major component of the fungus combs in addition to some quantity of faecal matter. The calcium is higher than the potassium and phosphorus. Few polysaccharide sugars possibly serving as binding material in the construction of the fungus combs are detected.

INTRODUCTION

The fungus combs found in the mounds of the termites belonging to the sub-family Macrotermitinae have attracted the attention of naturalists and biologists since Koenig (1779) first reported their existence. Since then a large group of workers have studied the shape size and origin of fungus combs in many species of termites (Petch, 1906, Hegh, 1922, Kemner, 1934, Heim, 1941, 1942 Grasse, 1944, Cheo, 1948). Fungus combs of the Indian termites belonging to the genus *Odontotermes* have been earlier investigated by Koenig (1779), Peth (1906, 1913), Annandale (1923, 1924), Mukerjee & Ray Chaudhari (1943), Mukerjee & Mitra (1949), Bakshi (1951), Das *et al.* (1962), Roonwal (1962), and Batra & Batra (1966). Sands (1969) has recently presented an excellent review on the association of termites and fungi. Hesse (1957) and Becker & Seifert (1962) have investigated some aspects of chemical constituents of fungus combs. Notwithstanding these,

wide lacuna exists on the physical and chemical constituents of fungus combs which are likely to throw light on the origin and formation of fungus combs.

MATERIAL AND METHODS

Four samples of fungus combs of each species were collected every month from inner periecie region of mounds occurring at New Forest, Dehra Dun for determination of moisture content and three samples of fungus combs were analysed for physical and chemical constituents.

Moisture content of fungus combs were determined by the standard oven-dry method. The inorganic constituents were estimated by following the methods of Wright (1939) and Piper (1966). The ash and lignin contents were determined by Tappi methods (T<sup>15</sup> for ash content and T<sup>3</sup> for lignin content). The total carbohydrate was calculated by subtracting the lignin percentage from the absolute

\* Part of Ph.D thesis approved by Meerut University. Meerut.

† The study was carried out at Forest Entomology Branch, Forest Research Institute and College, Dehra Dun.

percentage of material taken. Thus total carbohydrate also includes certain undetermined substances. The qualitative analysis of sugar was done by hydrolysing the material with 72% sulphuric acid and subsequently analysing the filtrate (Whatmann No. 1). The solvent system used was n-butanol: Pyridine: Water (6:4:3). The sugars were located on the chromatogram by spraying Aniline-oxalate and heating the paper in an oven at 105°C for 10 minutes.

### RESULTS AND DISCUSSION

Data on the seasonal variation of the moisture content have been presented in the figure for both the species. Data on the

chemical constituents of fungus combs are given in Table.

*Moisture contents*: It is evident from Fig 1 that the moisture content of the fungus combs always remains high (50% and above). This is in conformity with the observations of Roonwal (1962) in *O. obesus*. High moisture content of the surrounding soil (Hesse, 1955) and high humidity inside the mound (Agarwal unpublished, Agarwal & Sen Sarma unpublished); materially contribute to the high moisture content of the fungus combs which are known to be high hygroscopic as well. High moisture content in the fungus combs is needed not only to serve as a humidity regulator (Ghidini, 1938) but also to act as

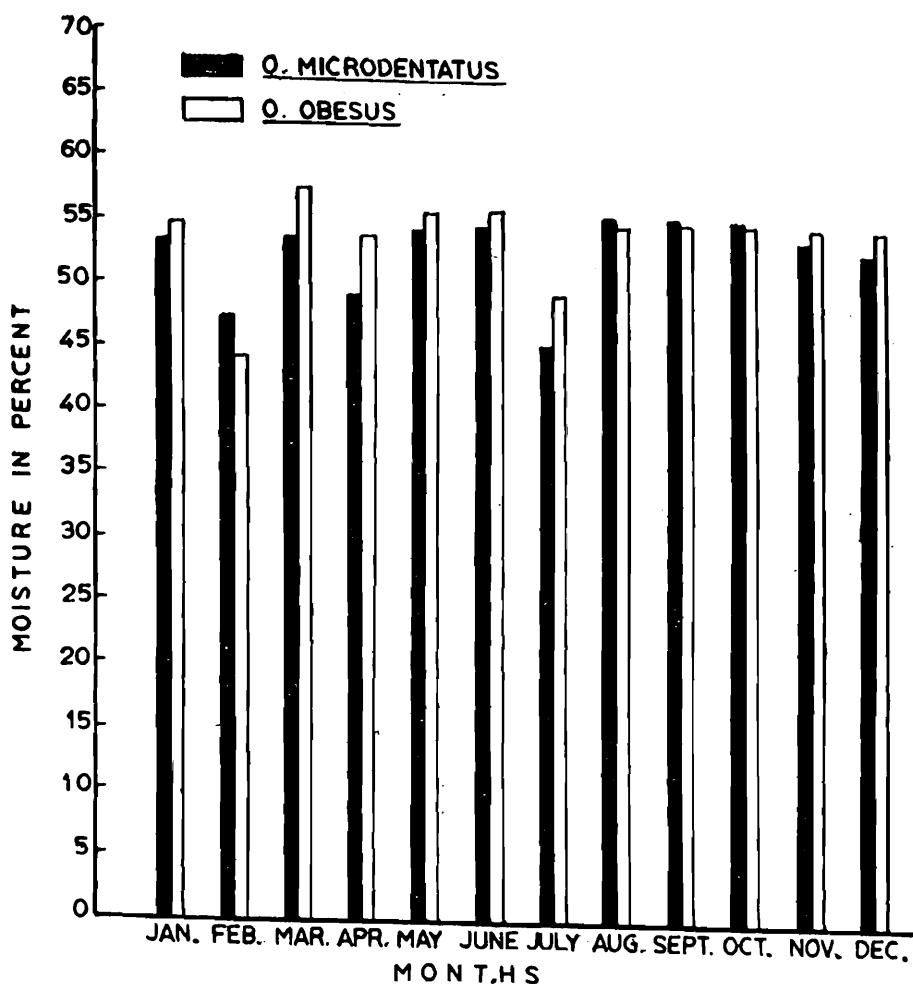


Fig. 1. The seasonal fluctuations of moisture content in the fungus combs of *Odontotermes microdentatus* and *Odontotermes obesus*.

a suitable substratum for the growth of fungus belonging to genus *Termitomyces*.

**Ash content :** The high ash content indicates presence of greater quantity of inorganic matter in the shape of soil particles in the fungus combs.

**Nitrogen :** The fungus combs of *O. microdentatus* and *O. obesus* are rich in nitrogen content. Hesse (1957) also reported more than one percent nitrogen content in the fungus combs of three species of *Macrotermes*. Hungate (1941) has found higher nitrogen content in wood ingested by *Zootermopsis*, which he attributed to the presence of soil particles. The high nitrogen and ash content in the fungus combs of *Odontotermes* is probably due to soil particles present either as contaminant or used for the construction of the fungus combs. The high nitrogen content is of advantage to maintain nitrogen cycle for the colony (Batra and Batra, 1966).

**Calcium Potassium and Phosphorus :** Calcium more important of the mineral constituents is much higher than the potassium and phosphorus. Hesse (1957) also reported higher calcium than phosphorus in three species of *Macrotermes* in Africa which he explained due to the presence of calcium bicarbonate in the mound soil and consequently in the fungus garden.

**Lignin and Carbohydrate :** Low lignin content in the fungus combs as compared to high lignin content reported from the faecal matter of wood inhabiting termite and carton nests (Becker & Seifert, 1962) indicate that faecal matter which is primarily lignin does not form a major component in the construction of fungus combs although it is present in the fungus combs.

The average carbohydrate content in the fungus combs is high i.e. 60.0% and above in both the species. This supports the con-

TABLE 1 Analysis of fungus combs material of *O. microdentatus* and *O. obesus*.

*Odontotermes microdentatus*

Sample	Ash content %	Nitrogen %	Percentage soluble in Alcohol & Benzene mixture	Calcium %	Potassium %	Phosphorus %	Lignin %	Carbohydrate %
1.	16.56	2.6	23.00	2.4	0.15	0.10	40.80	59.20
2.	18.68	3.0	20.00	2.2	0.17	0.103	38.00	62.00
3.	17.42	—	21.00	—	—	—	41.00	59.00
Mean	17.55	2.8	21.33	2.3	0.16	0.11	39.93	60.07

*Odontotermes obesus*

1.	17.84	2.19	20.00	2.2	0.16	0.11	35.00	65.00
2.	16.00	2.20	20.20	2.9	0.12	0.9	34.50	65.60
3.	16.34	—	21.00	—	—	—	37.00	63.00
Mean	16.73	2.20	20.40	2.6	0.14	0.10	35.50	64.50

tention of Grasse (1949) that undigested masticated plant material is also used in considerable proportion for the construction of the fungus combs.

*Polysaccharide sugars*: Among the polysaccharide sugars glucoses, galactose, mannose, arabinose and Xylose are detected in the fungus combs. This shows that these sugars are however not fully utilized by the workers of *Odontotermes* during their digestion. As the polysaccharide of hemicellulose group including Pentosans have the binding property (Singh & Bahuguna, 1973). their presence is useful as the binding material in the construction of fungus combs.

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## BENTHIC FAUNA OF A MEROMICTIC LAKE, LANGSEE, AUSTRIA

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### ABSTRACT

Benthic fauna and the influence of meromictic characters of the lake, Langsee in Austria observed in May, 1976 are dealt with. Oxygen and temperature are found the most important parameters influencing the distribution of benthic fauna of Langsee. Number and variety of benthic forms are more in the mixing layer than in the monolimnion layer of the lake.

### INTRODUCTION

Within the Austrian Alps, meromictic lakes are relatively abundant and concentrated chiefly to the federal province of Carinthia. Langsee, with an area around 1.5 km<sup>2</sup> was studied during May 1976 to assess the existing benthic fauna and the influence of the meromictic characters of the lake on their distribution. The maximum depth noted was 21 m. and generally during the period of investigation the weather was bright with sunshine. During 1972 Limnology excursion some benthic studies were made (Löffler, 1973).

### MATERIAL AND METHODS

Two stations were selected for the study based on the depth contour of the lake. Station I was with gradual depth contour and station II was with steep depth contour. Through using an Ekman dredge of 100 cm<sup>2</sup> samples were collected at following depths namely 1, 3, 6, 11, 15 and 20 m. After washing, the bottom samples were filtered through the sieves of 500  $\mu$ , 200  $\mu$  and 100  $\mu$  and benthic fauna were separated for identification. The data pertaining to temperature, dissolved oxygen, conductivity and alkalinity were recorded for different depths.

### RESULTS

The distribution of benthic fauna is influenced by various parameters like nature of sediment, temperature, Oxygen, pH and Oxidation-reduction potential. Among these Oxygen and temperature are the most important parameters. Considering the physico-chemical data (Table I) the temperature values tend to decrease gradually upto 3 m. and from here the decrease is rapid upto 11m. After this depth the temperature is almost the same. The dissolved oxygen values show a peak at 6 m. (12.9/mg/l) and suddenly drops down from 11 m. onwards. Alkalinity and conductivity values increase in accordance with the depth. But conductivity values increase rapidly from 11 m. onwards. Berger (Löffler *et al.* 1973) reported about the meromictic characters of this lake and about the monolimnion layer.

Benthic fauna (Table II, III) of Langsee consists mainly of the following types namely Oligochaeta, Nematoda, Chironomid larvae, Chaoborus larvae and Ostracoda. Nematoda, Bdelloidea, Naidea, Tubificidae, Tardigrada, Ostracoda, Cladocera and Chironomid larvae were recorded from this lake by Schiemer (Löffler *et al.* 1973).

\* Work carried out at Limnology Institute, Vienna, Austria.

TABLE 1.—Physico-Chemical Data

Depth m	Temperature C	Oxygen mg/l	Alkalinity	Conductivity mS 20
1	17.8	10.8	3.5	338
3	17.2	11.8	3.6	352
6	10.4	12.9	3.6	395
11	5.2	6.0	3.9	495
15	5.0	0.8	4.4	526
20	5.0	0	5.0	582

TABLE 2.—Benthic Fauna-Station I

Animal Types	Depth in m.						Total
	1	3	6	11	15	20	
Oligochaeta	5	1	—	—	2	—	8
Nematoda	4	20	—	3	2	4	33
Platyhelminthes	—	—	—	—	1	—	1
Chironomid larvae	5	25	—	5	2	2	39
Chaoborus larvae	—	—	—	5	64	2	71
Ceratopogonid	—	—	—	—	—	—	—
Corixidae	—	—	—	—	—	—	—
Tardigrada	—	1	—	—	—	—	1
Halacaridae	1	—	—	—	—	—	1
Macrothricidae	—	22	—	2	1	2	27
Chydoridae	—	55	—	12	20	7	94
Cyclops	—	12	—	9	—	2	23
Calanoids	—	—	—	—	—	—	—
Ostracoda	—	65	—	25	—	—	90
Herpeticoides	—	2	—	—	—	—	2
Nauplii	—	11	—	2	1	1	15
<b>Total</b>	<b>15</b>	<b>214</b>	<b>—</b>	<b>63</b>	<b>93</b>	<b>20</b>	<b>405</b>

TABLE 3.—Benthic Fauna—Station II

Animal Types	Depth in m.						Total
	1	3	6	11	15	20	
Oligochaeta	—	2	—	—	—	—	2
Nematoda	3	13	1	—	—	1	18
Platyhelminthes	—	—	—	—	—	—	—
Chironomid larvae	12	1	4	—	—	—	17
Chaoborus larvae	—	—	—	2	—	—	2
Ceratopogonid	3	—	1	—	—	—	4
Corixidae	—	—	—	1	—	—	1
Tardigrada	—	1	—	1	—	—	2
Halacaridae	1	—	—	—	—	—	1
Macrothricidae	18	8	1	—	—	—	27
Chydoridae	—	11	—	—	1	—	12
Cyclops	5	4	3	1	—	—	13
Calanoids	3	—	—	—	—	—	3
Ostracoda	8	37	10	—	18	3	76
Herpeticoida	—	—	1	—	—	—	1
Nauplii	—	2	1	—	—	—	3
Total	53	79	22	5	19	4	182

## DISCUSSION

The distribution pattern of benthic animals clearly indicate different zonations in accordance with the meromictic characters. For instance, though Oligochaeta, Chironomid larvae, Nematoda and Ostracoda are distributed upto 6 m. depth, maximum number is noted, at 3m. depth. The mixing layer of the lake is having more percentage of benthic forms both in number and in variety than the monomolimnion layer. Chaoborus larvae are present in large numbers in monomolimnion layer besides the occasional forms. They exhibit a peculiar phenomena of mi-

grating to deeper waters during day time and coming up during night (Löffler *et al.* 1973). Also, the role of the depth contour in the distribution of benthic fauna is evidenced by the differences in number in between two stations namely 405 in Station I and 182 in Station II.

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## PLANT PARASITIC NEMATODES FROM THE RHIZOSPHERE OF VEGETABLE CROPS AROUND CALCUTTA. 2. FAMILY TYLENCHORHYNCHIDAE

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### ABSTRACT

*Tylenchorhynchus swarupi* sp. n. is described. It can be distinguished by its smaller body size, 0.42-0.54 mm long, set off head with 5-6 indistinct annules, long post-anal sac and smaller rectum. Incisures four, inner two incisures fuse at phasmid and continue as one incisure thereafter. Tail annules very fine. Tail terminus conoid and striated.

*T. mashhoodi* is reported from rhizosphere of tomato, egg-plant and okra from various localities around Calcutta.

### INTRODUCTION

During the course of intensive survey of vegetable crop fields near Calcutta and environs, a few populations of nematodes belonging to two species of the genus *Tylenchorhynchus* Cobb, 1913 were collected by the first author. One of the species has been identified as *Tylenchorhynchus mashhoodi* Siddiqi & Basir, 1959 and the other is new to science.

The nematodes were killed and fixed in hot F. A. (Formaline 10 ml, glacial acetic acid 10 ml & distilled water 80 ml). The fixed specimens were processed by slow glycerine method and were mounted in dehydrated glycerine. The dimensions given in parentheses in the description of the new species are of paratypes.

*Tylenchorhynchus swarupi* sp. n.  
(Fig. 1, A-J)

*Dimensions* : Holotype (♀) : L=0.48 mm ; a=31 ; b=4.8 ; c=14 ; V=295<sup>24</sup> ; stylet=13 μm.

Paratypes : 10 ♀ ♀ : L=0.42—0.54 mm ; a=28—31 ; b=4.9—5.6<sup>7</sup> ; c=14—15 ; V=24—36<sup>52</sup>—56<sup>19-29</sup> ; stylet=13—15 μm.

10 ♂ ♂ : L=0.46—0.60 mm ; a=28—34 ; b=4.6—5.8 ; c=14—16 ; T=56—66 ; stylet=13—14 μm ; spicula=20—23 μm ; gubernaculum=7—11 μm.

*Description* : Female : Body cylindrical tapering gradually at both the extremities and curved ventrally on thermal killing. Cuticle very finely striated, Lateral field 1/4th-1/3rd the width at mid-body, consists of four smooth incisures. Two incisures originate a little below the stylet ; the inner two incisures fuse at the phasmid and continue as one middle incisure. Head clearly set off, comprises 5—6 indistinct annules, 3—4 μm high and 6—7 μm in diameter. Cephalic framework weakly sclerotized. Stylet moderately developed, knobs 2—3 μm across, sloping posteriorly. Dorsal oesophageal gland orifice 2—3 μm posterior to stylet knobs. Oesophagus comprises a tubular corpus 31 (26—35) μm, a median bulb 11×8 (10-13×7-10) μm in diameter with well developed crescentic valve plates and a

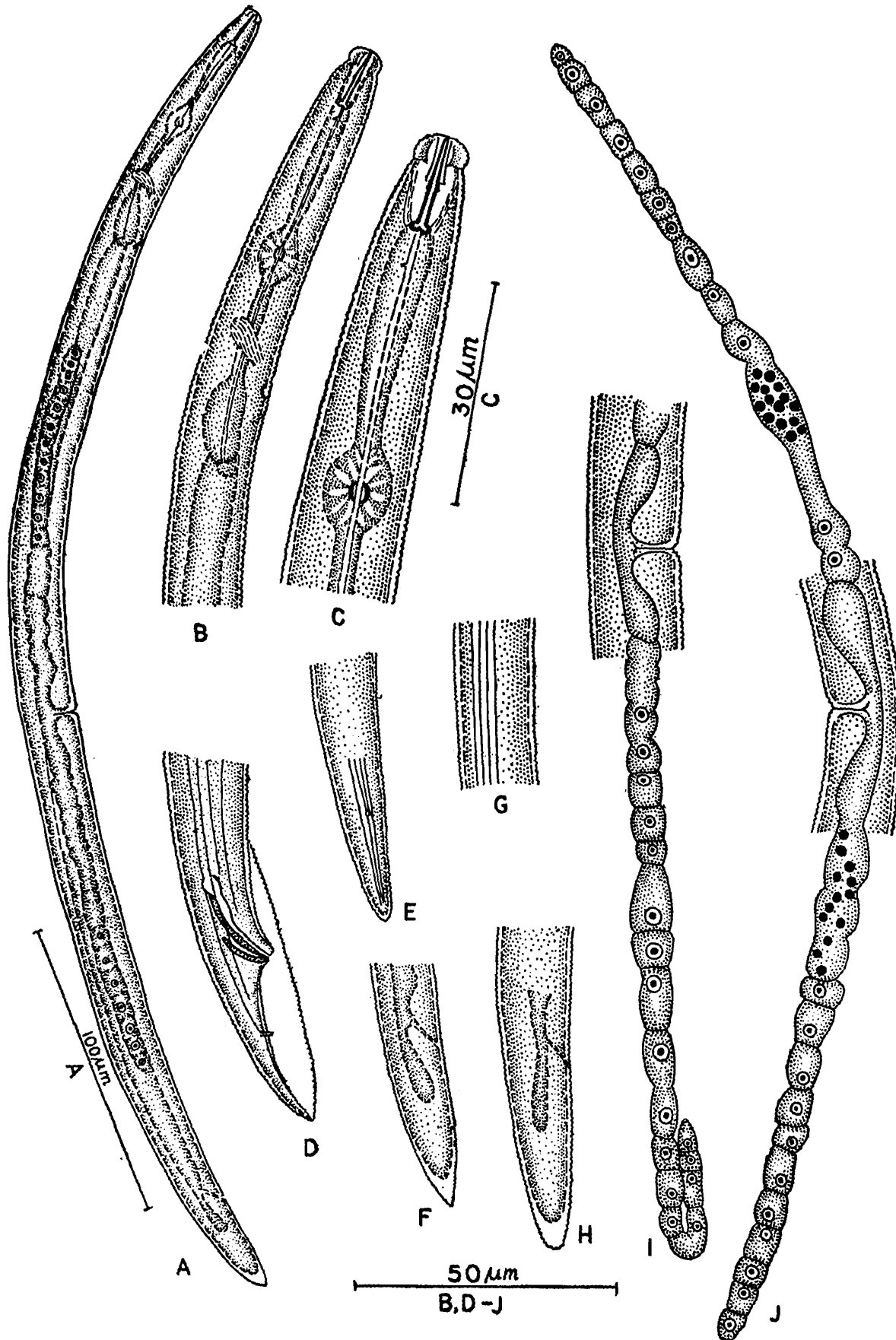


Fig. 1. *Tylenchorhynchus swarupi* sp. n. A. Entire female ; B. Female anterior region ; C. Female head region ; D. Male tail ; E. Female tail showing lateral field ; F & H. Variations in tail shape of females ; G. Lateral field—mid body ; I. Vulva region and reflexed posterior ovary ; J. Vulva region and female gonads.

pyriform terminal bulb with small rounded cardia. Nerve ring 69(56—81)  $\mu\text{m}$  from anterior end, encircling short narrow isthmus. Hemizonid 2—3 annules wide.

Excretory pore 73—86  $\mu\text{m}$  (not visible in holotype) from anterior end. Position of excretory pore varies from 1.5 annules posterior to hemizonid.

Vulva flush with body surface. Gonads didelphic, amphidelphic and outstretched. Vagina 7 (7—10)  $\mu\text{m}$  long and about half the body width at the same level. Spermatheca continuous, filled with rounded sperm. Oocytes arranged in one row. Tip of posterior ovary in one specimen reflexed. Rectum 7 (6—7)  $\mu\text{m}$  and about half the anal body width long. Post-intestinal sac extending into more than half of tail. Tail cylindrical with conoid, striated terminus. One female with acute terminus. Tail annules very fine.

Male : General morphology similar to that of female. Spicula tylenchoid, gubernaculum trough shaped. Bursa crenate, 40—60  $\mu\text{m}$  long, extending up to tail end. Tail elongate, conoid with acute terminus, 2.5—3 times the anal body diameter long. Phasmid in the anterior half of tail.

*Differential diagnosis and relationships* : *Tylenchorhynchus swarupi* sp. n. closely resembles *T. vulgaris* Upadhyay *et al.*, 1974 mainly in having set off head and post-intestinal sac. However, it differs from *T. vulgaris* in having smaller rectum and gubernaculum, and a striated tail terminus (female : tail with unstriated terminus ; rectum one body width long ; male : gubernaculum = 13-16  $\mu\text{m}$  in *T. vulgaris*). *T. swarupi* sp. n. comes close to *T. brevilineatus* Williams, 1960, and *T. brassicae* Siddiqi, 1961 in possessing set off head and some of the body dimensions. From *T. brevilineatus* the new species differs by the absence of longitudinal lines

in the anterior region of the body, in possessing a striated tail terminus and in the shape of the gubernaculum (female : eight longitudinal striations at neck ; tail terminus bluntly rounded and smooth and proximal end of gubernaculum curved in *T. brevilineatus*). From *T. brassicae* it can be distinguished by its smaller body size, number of lip striations, fine body striations, and in the presence of postintestinal sac (female : L = 0.56-0.76 mm ; lip region striae 3-4 in *T. brassicae*).

The species is named after Dr. Gopal Swarup.

*Type Habitat* : Collected from the rhizosphere of cauliflower (*Brassica oleracea* L. Var. *botrytis*).

*Other habitats* : Egg-plant (*Solanum melongena* L.), potato (*Solanum tuberosum* L.), pea (*Pisum sativum* L.), fenugreek (*Trigonella foenum graecum* L.), radish (*Raphanus sativus* L.), chillies (*Capsicum annum* L.) and okra (*Abelmoschus esculentus* (L) Moench).

*Type locality* : West Bengal : Dist. 24-Parganas : Narendrapur ; collected on 3. iii. 1975.

*Other localities* : West Bengal : Dist. 24-Parganas ; Nilganj, and Kamalgazi ; Dist. Hooghly : Bhanzipur and Tarakeshwar.

*Type material* : Holotype—female on slide collected on 3rd March, 1975, deposited with the National Zoological Collections, Zoological Survey of India, Calcutta.

Paratypes : Ten females and ten males ; other particulars as for holotype.

***Tylenchorhynchus mashhoodi* Siddiqi & Basir, 1959**

*Tylenchorhynchus mashhoodi* Siddiqi & Basir, 1959, *Proc. 46th Indian Sci. Congr.* : 35 ; Siddiqi, 1961,

*Z. Parasitkde.* 21 : 46-64 ; Baqri & Jairajpuri ; 1970, *Rev. Brasil. Biol.*, 30 (1) : 61-68.

*T. dactylurue* Das, 1960, *Z. Parasitkde.*, 19 : 553-605.

*T. digitatus* Das, 1960, *Z. Parasitkde.* 19 : 553-605.

*T. crasicaudatus* Williams, 1960. *Occ. Pap. Maurit. Sug. Ind. Res. Inst.* 4 : 1-30.

*T. elegans* Siddiqi, 1961. *Z. Parasitkde.*, 21 : 46-64.

*T. xasae* Sethi & Swarup, 1968, *Nematologica*, 14 : 77-88.

*Dimensions* : 10 ♀♀ : L 0.54-0.76 mm ;  
a=25-35, b=4.7-5.7, c=13-19 ; V=  
19-35, 5-58<sup>20-36</sup> ; stylet=17-21 µm.

4 ♂♂ : L=0.49-0.52 mm ; a=29-32 ;  
b=4.7-4.8, c=16-18 ; T=50-54 ; stylet=  
15-16 µm, spicula=15-21 µm ; gubernaculum=6-10 µm.

*Remarks* : Synonymy followed here is after Baqri & Jairajpuri (1970). These specimens closely agree with the description of the species by Baqri and Jairajpuri (*loc. cit.*). They

described several populations from Uttar Pradesh and from sugarcane field in Andhra Pradesh. Outer incisures are crenate and more prominent in the present populations.

*Habitat* : Rhizosphere of tomato (*Lycopersicon esculentum* Mill.), egg plant (*Solanum melongena* L.), potato (*Solanum tuberosum* L.), and okra (*Abelmoschus esculentus* (L.) Moench).

*Locality* : West Bengal, Dist. 24-Parganas, Nilganj ; Mahamayatolla, Narendrapur ; Baruipur ; Dist. Howrah, Belur.

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# ACANTHOCOLPID TREMATODES OF MARINE FISHES OF INDIA, WITH CONSIDERATIONS ON SYNONYMIES IN THE GROUP

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## ABSTRACT

The present study is based on a collection of specimens belonging to the family Acanthocolpidae, Luhe, 1909 collected from the marine fishes of the east and west coasts of India. These species are spread over four genera, *Stephanostomum* Looss, 1899 *Tormopsolus* Poche, 1962, *Stephanostomoides* Mamaev and Oshmarin, 1966, and *Acanthocolpus* Luhe, 1906. It has been discussed that the rules of Zoological Nomenclature [ Article 56 (a) ] do not invalidate the name *Stephanostomum* Looss, 1899 as against *Stephanochasmus* Looss, 1900. It is also proposed to suppress Stephanochasmidae Dollfus, 1972 in favour of Acanthocolpidae Luhe, 1909. *Stephanostomum cloacum* (Srivastava, 1938) is reported for the second time from a different host and locality with interesting observations. It has been shown that *Tormopsolus* is very close to *Acanthocolpus*. Morphological evidences have also been furnished to show that *Acanthocolpus luhei* Srivastava, 1939 is distinct from *A. liodorus* Luhe, 1906 in more than one character. The former was considered as a synonym of the latter by Caballero (1952), Yamaguti (1958) and Manter (1963). *Acanthocolpus caballeroi* Gupta and Sharma, 1972 has been considered as synonym of *A. luhei*. Ample evidences have been provided to suggest that *Acanthocolpus tenuis* Manter, 1963 does not belong to the genus *Acanthocolpus* Luhe, 1906 but to *Stephanostomoides* Mamaev and Oshmarin, 1966.

## INTRODUCTION

The present study is based on a collection of trematodes belonging to the family Acanthocolpidae Luhe, 1909 collected from marine fishes of the east and west coasts of India. The acanthocolpid collection brought by Dr. T. D. Soota, Superintending Zoologist, Zoological Survey of India, Calcutta from Mandapam, Kozhikode and Mangalore have also been included. The aim of this study is to assess the stability of the members of the family Acanthocolpidae reported so far from the Indian region.

All measurements are in microns unless otherwise stated. Diagrams have been drawn with the aid of a camera lucida.

Looss (1899) named the genus *Stephanos-*

*tomum* for the species *Distomum cesticellum* Molin, 1858, and included in it other four species also. In 1900, thinking that the name *Stephanostomum* is preoccupied as *Stephanostoma* Danielssen and Koren, 1880, he renamed his genus as *Stephanochasmus*. Manter (1934, 1940, 1947) opined that as the rules of nomenclature did not invalidate a name only due to slight change in the spelling, *Stephanochasmus* must be considered a synonym of *Stephanostomum*. For quite some time both the names were used by workers, but during recent years all the leading workers on Digenea have used only the name *Stephanostomum*.

The author agrees with Manter that the name *Stephanostomum* (syn. *Stephanochasmus*) should be held valid. He expressed his apprehension also that some workers would use the name *Stephanochasmus* in literature. Dollfus

(1972) does not agree with Manter, and gives more weight to Recommendation No. 3 (Appendix D, pages 104, 105) than to Article 56 (a) of the International Code of Nomenclature of 1964, accepting *Stephanochasmus* as valid name and *Stephanostomum* its synonym. According to Article 56 (a), the name *Stephanostomum* does not get invalidated as against *Stephanochasmus* which Looss (1900) confusedly thought to be preoccupied as *Stephanostoma* Danielssen and Koren, 1880. As the relevant Rule of Nomenclature is very clear, the author agrees with Late Prof. H. W. Manter, and maintains that the literature should be kept confusion free. In this light Dollfus' (1972) action seems to be unjustifiable.

Looss (1972) makes a correction in the excretory system of the subfamily Stephanochasminae Nicoll (1910) as emended by Yamaguti (1934). He says that the subfamily has I-shaped or saccular excretory system instead of Y-shaped one. He further believes that Distomes with Y-shaped excretory vesicle do not belong to those with tubular excretory vesicle. With this belief he raises, the subfamily Stephanochasminae to the status of a new family Stephanochasmidae to accommodate *Stephanochasmus* Looss, 1900.

As the author considers *Stephanochasmus* Looss, 1900 a synonym of *Stephanostomum* Looss, 1899, the family Stephanochasmidae Dollfus, 1972 should be suppressed in favour of Acanthocolpidae Luhe, 1909 to which *Stephanostomum* belongs. There are genera like *Manteria* Caballero, 1950, *Pseudacaenodera* Yamaguti, 1965 and *Stephanostomoides* all with I-shaped excretory vesicle which are included in the family Acanthocolpidae.

***Stephanostomum cloacum* (Srivastava, 1938)**  
Manter and van Cleave, 1951

(Fig 1, A)

Host : *Rachycentron canadus* (L), Black Kingfish,  
(Pisces ; Rachycentridae).

Location : Intestine

Locality : Kakinada (Bay of Bengal)

Number of specimens : 1, collected on February, 1978.

Distribution : Puri, and Kakinada (Bay of Bengal), Karachi (Arabian Sea).

The species was originally described from the fish *Lates calcarifer* in 1938. Since then it was never reported again from any part of the world. This is the second time that this species is being reported from a locality neighbouring to Puri, and from a different fish host. Morphologically, the present single specimen agrees fairly well with the original description of *Stephanostomum cloacum* (Srivastava, 1938) except in two notable differences. Firstly, the male and female terminal ducts are spined in the present specimens whereas the absence or presence of spines on them was not mentioned in the original description. The spined metraterm is almost as long as the cirrus sac as has been originally described. Secondly, there is some difference regarding arrangement of the peribuccal spines which are 34 in all. On the ventral side six oral spines alternate with six aboral ones. Similarly, on the dorsal side also six orals alternate with the six aborals. The rest of the spines are in single row on the lateral side. It can therefore be said that the peribuccal spines are arranged in two alternating rows dorsally and ventrally, while laterally the ring is single as occurs in *S. hispidum*. In the original description, the peribuccal spines are in two alternating rows on the dorsal side whereas on the ventral and lateral sides the row is single. I believe that these characters indicating the differences from the original description simply escaped Srivastava's observation.

Thus, in the arrangement of the peribuccal spines also *Stephanostomum cloacum* (Srivastava, 1938) resembles *Stephanostomum hispidum* (Yamaguti, 1934) to a great extent. The

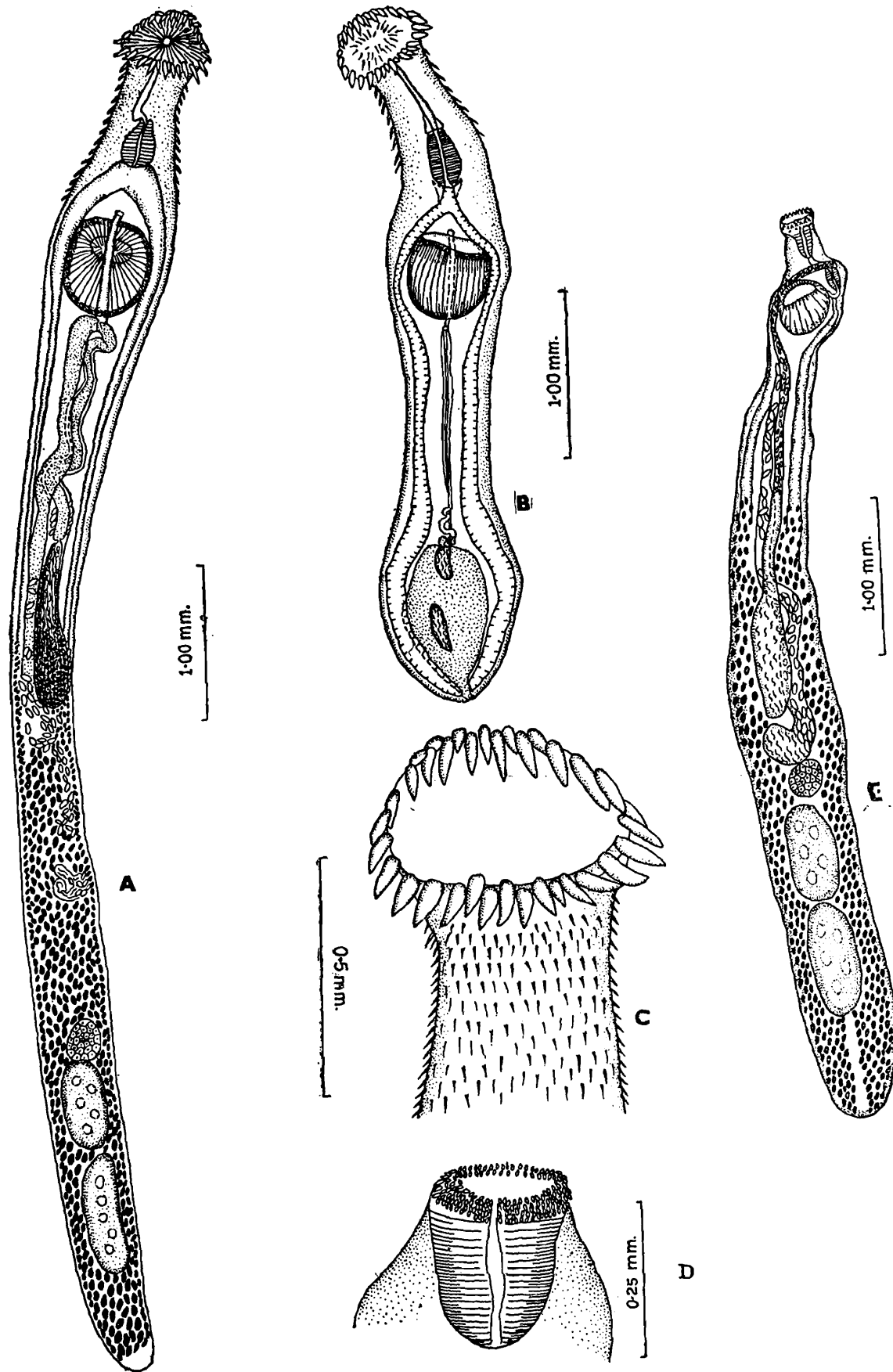


Fig. 1. A *Stephanostomum cloacum* (Srivastava, 1938)—Entire worm, dorsal view, B. *Stenphanostomum metacercaria*—Entire larva, ventral view. C. Same—Anterior part showing peribuccal spines in ventral view. D. *Stephanostomoides tenuis* (Manter, 1963)—Anterior part showing arrangement of peribuccal spines. E. Same—Entire worm, ventral view.

main difference between the two species lies in the number of peribuccal spines which is 42 in Yamaguti's species and 34 in Srivastava's one. Genital atrium long, unspined. Collapsed eggs measure 63-68×34-36 as compared to 60-73×38 in original description.

Apparently, *S. cloacum* and *S. attenuatum* Hafeezullah, 1971 look similar, but the latter is distinguishable from the former in having a feeble and attenuated body, in not having an as long spined cirrus and metraterm, in the anterior extent of the vitellaria with respect to the posterior extent of the cirrus sac, and in the number and arrangement of the peribuccal spines.

Hafeezullah (1971) enumerated the differences between *S. adinterruptum* Hafeezullah, 1971 and *S. fistulariae* (Yamaguti, 1940). Both these flukes have been described from the same fish genus. Hafeezullah's species further differs from Yamaguti's one in having longer and armed cirrus and more posterior extent of the cirrus sac.

Only abstract of the account of *Stephanostomum indicum* (Srivastava, 1973) Yamaguti, 1958 collected at Puri (Bay of Bengal) and Karachi (Arabian Sea) from the fish *Pristis cuspidatus* was published by Srivastava (1937). Since then its morphological details were never published. Yamaguti (1971) considered it as *Nom. Sol.*

### **Stephanostomum metacercaria**

(Fig 1—B, C)

Host : *Minuous monodactylus* (Bl. & Schn.),  
Gray goblin fish, Pisces : Synanceidae)

Location : Cysts balls attached with liver and heart muscles

Locality : Kozhikode (Arabian Sea)

Number of specimens : 9, collected in 1965

*Description* : (with measurements on 3 specimens only) Body 4.085-5.048 mm long 0.946-1.032 mm wide at testicular level, elongate with swollen posterior part. Cuticle spinose ; spines probably lost in posterior part of body, larger in forebody, comparatively much smaller behind acetabulum. Eye-spot pigment present. Acetabulum 516-612 in diameter, spherical, preequatorial, at 1482-1620 from anterior end of body. Oral sucker 266-275 long, 576-670 wide, terminal. Peribuccal spines 34, in two alternating rings. Oral spines a bit smaller than aboral ones, 4 orals alternating with aborals on ventral side, 6 oral alternating with aborals on dorsal side, row of spines single on lateral sides. (Thus the number of peribuccal spines and their arrangement is exactly as occurring in *S. cloacum* Srivastava, 1938). Prepharynx 559-696 long ; pharynx 361-378 long, 215-232 wide, pear-shaped ; oesophagus 43-120 long ; caecal bifurcation between pharynx and acetabulum ; caeca reaching posterior end of body.

Testes 258-387 long, 96-132 wide, tandem, separated, situated in swollen posterior part of body. Cirrus sac extending posteriorly up to base of swollen part of body, enclosing seminal vesicle, pars prostatica and long cirrus. Spines on cirrus not yet developed. Genital atrium long. Genital pore immediately preacetabular.

Ovary 45-53 in diameter, preacetabular, separated from anterior testis. Uterus pre-ovarian ; metraterm almost as long as cirrus sac ; spines on metraterm not yet developed.

Excretory pore terminal ; excretory vesicle saccate. These larvae were found encysted in ball-like cysts infesting liver and heart. They were obtained in living condition by bursting the cyst balls. The cyst-balls had membranous wall having two concentric layers. The larvae lived in a pool of translucent liquid.

**Discussion :** The peribuccal spines and body spines are developed, but at the same time the male and the female ducts are devoid of them. It indicates that they do not begin to grow and develop on terminal genital ducts simultaneously with the body and peribuccal spines. From the study of the morphology of metacercariae reported by various workers, it seems highly probable that the intestinal caecae establish communication with the saccate or tubular excretory vesicle forming uroproct during late metacercarial stage. Obviously, the spination on the anterior male and female ducts seem to be correlated with the sexual maturity of the fluke.

It has been mentioned above that *Stephanostomum cloacum* (Srivastava, 1938) has been reported both from the east and west coasts of India. The number of oral spines, their arrangement around the mouth, and the long as well as equal sizes of cirrus sac and metraterm are the chief characteristics of Srivastava's species. The presence of these characteristics in the present *Stephanostomum* metacercaria along with the geographical distribution of both of them from the west coast (Arabian Sea) of India suggest that this metacercaria might be the one of *S. cloacum* (Srivastava, 1938).

***Stephanostomoides* (Manter, 1963) n. comb.**

*Stephanostomoides dorabi* Mamaev and Oshmarin, 1966 (Syn. Novo)

*Stephanostomum tenuis* Manter, 1963 (Syn. Novo) (Fig. 1—D, E)

Host : *Chirocentrus dorab* Cuv., wolf herring, (Pisces : Chirocentridae)

Localities : Mandapam (Gulf of Mannar) ; Gopalpur And Pondicherry (Bay of Bengal) ; Kozhikode and Mangalore (Arabian Sea)

Location : Intestine

Number of specimens : 4+2+1+4+3=14

Distribution : Fiji ; North Vietnam ; India

Hafeezullah (1971) reported *Acanthocolpus tenuis* Manter, 1963 from the fish *Chifocentrus dorab*, but missed to give the locality from where collected. The flukes were collected from Tuticorin (Gulf of Mannar) in 1965.

From a single specimen of *Chirocentrus dorab*, a population of four specimens of *Stephanostomoides tenuis* (Manter, 1963) was collected at Mandapam (Gulf of Mannar) by Dr. T. D. Soota in March, 1975. They have long cirrus and metraterm, and both these organs are studded with two kinds of spines as shown by Manter (1963) in his Figures 4a and 4b. Out of these, three have five rings of short spines on the oral sucker whereas the remaining one does not possess any spines on it. This single specimen exactly resembles *Acanthocolpus tenuis* Manter, 1963. In another population of two specimens collected by the author in November, 1973 at Gopalpur (Bay of Bengal), one has the five rings of oral spines whereas the other one lacks them and exactly resembles Manter's species. The third population of single specimens from Pondicherry (Bay of Bengal) is normal with all the five rows of oral spines. The fourth population comprises four specimens collected by Dr. T. D. Soota at Calicut (Arabian Sea). Of these, one is decapitated, one has a few oral spines and the remaining two have all the five rows of oral spines. The fifth population of three specimens was also collected by Dr. T. D. Soota at Mangalore (Arabian Sea) on January 4, 1976. All these three specimens have lost all the five rows of oral spines, and look like Manter's *Acanthocolpus tenuis*.

It is of interest to note that Manter (1963) described *Acanthocolpus tenuis* on the basis of only one out of fourteen specimens which were in a highly macerated condition. It means it is highly probable that the rings of the spines on the oral sucker might have been lost due to high degree of maceration as is very common regarding body spines as well as

those on the oral sucker in the family Acanthocolpidae. In view of this strong evidence the author is inclined to believe that the species *Acanthocolpus tenuis* Manter, 1963 should belong to the genus *Stephanostomoides* Mamaev and Oshmarin, 1966. It will be named then as *Stephanostomoides tenuis* (Manter, 1963) h. comb. (Syn. Nov. : *Stephanostomoides dorabi* Mamaev and Oshmarin, 1966).

It may also be noted that this species sometimes occurs mixed with the population of *Acanthocolpus liodorus* Luhe, 1906 in India in the fish *Chirocentrus dorab*.

#### **Tormopsolus spatulum** Bilquees, 1972.

Host : *Rachycentron canadus* (L.), Black Kingfish ; (Pisces : Rachycentridae)

Location : Intestine

Locality : Kakinada (Bay of Bengal)

Number of specimens : 8, collected in February, 1975

Distribution : Arabian Sea ; Bay of Bengal

These specimens with spatulate body in the prepharyngeal region agree fairly well with the description of *Tormopsolus spatulum* Bilquees, 1972 described from Karachi, except in certain characters and details. Bilquees described that the tegument of this species is unspined whereas the cuticle of the specimens in the present collection is armed with spines throughout the body. Probably the spines in her specimens were lost. Again, it seems from the description that the seminal vesicle is undivided whereas actually it is bipartite although in some specimens the division is indiscernible. The third and the important thing which Bilquees missed is the spination of the terminal ducts. In the present specimens a small part of the male duct just behind the acetabulum is beset with spines which have broad base with minute spicuous part, and look like tubercles. The terminal part of the female duct seems to be unspined.

#### **Acanthocolpus liodorus** Luhe, 1906.

Host : *Chirocentrus dorab* Cuv. wolf herring, (Pisces : Chirocentridae)

Location : Intestine

Localities : Konarak, Ennore, Madras (Bay of Bengal) ; Kozhikode (Arabian Sea)

Number of specimens : Several, collected in 1973 and 1976

Distribution : Sri Lanka ; East and west coasts of India ; North Viet-Nam Bay

It may be important to note that the specimens are spined (although shed off in most cases), have profuse eye-spot pigment just posterior to oral sucker, and the seminal vesicle is bipartite but indiscernible in most cases.

#### **Acanthocolpus luhei** Srivastava, 1939.

*A. caballeroi* Gupta and Sharma, 1972 (Syn. Novo)

Host : *Chirocentrus dorab* Cuv., wolf herring, (Pisces : Chirocentridae)

Location : Intestine

Localities : Pondicherry (Bay of Bengal) ; Mandapam (Gulf of Mannar)

Number of specimens : Several

Distribution : East and west coasts of India

The cuticle of body is spined, eye-spot pigment is present, the seminal vesicle is bipartite (although indiscernible in most specimens) and the acetabulum is borne on a protuberance which, at times, may be retracted.

Caballero (1952), Yamaguti (1958) and Manter (1963) have considered *A. luhei* Srivastava, 1939 synonymous with the type species *A. liodorus* Luhe, 1906 merely on the basis of assumption. Mamaev and Oshmarin (1966), Hafeezullah (1971) and Gupta and Sharma (1972) have disagreed with this synonymy. On the basis of the present collection, the author maintains his view as given by him (1971)

that *A. luhei* appears to be distinct from *A. liodorus* in the anterior extent of vitellaria with respect to the posterior extent of cirrus sac and in sucker ratio. In fact the populations of the two species sometimes co-occur in the same fish, *Chirocentrus dorab*, along the Indian coasts. It may be so if the intermediate hosts of the two species form the favourite food of the host fish. Gupta and Sharma (1972) have not furnished sufficient scientific criteria for erecting their new species, *Acanthocolpus caballeroi*, distinct from *A. luhei*. Therefore, their species is considered a synonym of the latter.

In my exhaustive collection of digenetic trematodes of marine fishes of east and west coasts of India, *Acanthocolpus indicus* Srivastava, 1939 and *A. orientalis* Srivastava, 1939 are not represented, in spite of the fact that I examined good number of species of sciaenid fishes from the reported hosts of the respective trematode species.

In his key to the genera Acanthocolpinae Luhe, 1906, Yamaguti (1971) characterised (probably from literature) *Acanthocolpus* Luhe, 1906 as not having body spines and eye-spot pigment. It is reported above that *Acanthocolpus liodorus*, the type species of the genus, and *A. luhei* do have body spines and eye-spot pigment. Yamaguti (1971) has also mentioned in a foot note on page 121 that in the genus *Tormopsolus* Poche, 1926 the seminal vesicle is "definitely unipartite". The author has reported in this paper that, at least, in *Tormopsolus spatulum* Bilquees, 1972 the seminal vesicle is bipartite. Thus the characters i. e. presence of body spines, eye-spot pigment and bipartite seminal vesicle, are common in *Acanthocolpus* and *Tormopsolus*. This fact further leads to the conclusion that these two genera are very close to each other differing mainly in the absence or presence of communication of the intestinal caeca with the excretory vesicle near the hinder end of the body. In

this respect the genus *Acanthocolpus* has not been studied at all. There may be substance in the suggestion of Mamaev and Oshmarin (1966) that *Tormopsolus* is a synonym of *Acanthocolpus*, which Yamaguti (1971, p. 121) has so vehemently refuted.

#### ACKNOWLEDGEMENTS

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*ASPIDOSIPHON (PARASPIDOSIPHON) HAVELOCKENSIS*, A NEW  
SIPUNCULA FROM THE ANDAMANS, INDIA

BADRI PRASAD HALDAR

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ABSTRACT

In this paper *Aspidosiphon (Paraspidosiphon) havelockensis* — a new species belonging to the family Aspidosiphonidae (Sipuncula) collected from Havelock and Neil Islands, South Andamans, India, is described.

INTRODUCTION

During the course of the studies on Sipuncula of the Indian coast an examination of the material collected from the Andamans revealed the presence of a new species belonging to the genus *Aspidosiphon* Diesing. Stephen, 1964 created a new genus *Paraspidosiphon* to include species of *Aspidosiphon* with longitudinal musculature of the body wall grouped into bands. Cutler, 1973 proposed reduction of the genus *Paraspidosiphon* to subgeneric status as the nature of the longitudinal muscle of the body wall is not clear-cut. Some true aspidosiphonids show a tendency for the longitudinal muscle layer to separate into more or less distinct units. In accordance with Cutler's view, the species is described here under the subgenus *Paraspidosiphon* Stephen, 1964.

*Aspidosiphon (Paraspidosiphon) havelockensis* sp. n.

*Material examined* : 1 ex., Eastern side of Neil Island, South Andaman, "from dead coral rock", Coll. B. P. Haldar, 30. ix. 1972 ; 3 exs., Havelock Island, South Andaman, "from dead coral rock", Coll. B. P. Haldar, 5. x. 1972.

*Description* : Length of the trunk 18.5-31 mm and maximum width 6.5-10 mm at rear end. Introvert slender, cylindrical and about one-third to half as long as trunk and 2-3.25 mm width at base.

Trunk yellowish/creamy-white in colour with extremities usually being darker. Introvert pale white with thinner wall than that of body. Body wall thin and translucent through which longitudinal muscle bands clearly visible. Surface of trunk, except in anterior most end, nearly smooth to unaided eye, but closer examination shows numerous skin papillae, each of which bears a small opening at its centre surrounded by irregular shaped platelets. Papillae found at the level of nephridiopores (fig. 1A) and posterior and of trunk are large ; platelets yellow and sometimes overlapped. Papillae (fig. 1-B) on middle region of trunk are smallest, with nearly transparent platelets arranged loosely. Anterior most end of trunk except for anal shield and anus, marked by some elevated areas (fig. 2F, ea) each made up of 2-4 closely placed yellow papillae (fig. 1C). Sometimes platelets are also overlapped.

Anal shield (fig. 2F, as) thick, oval, light-

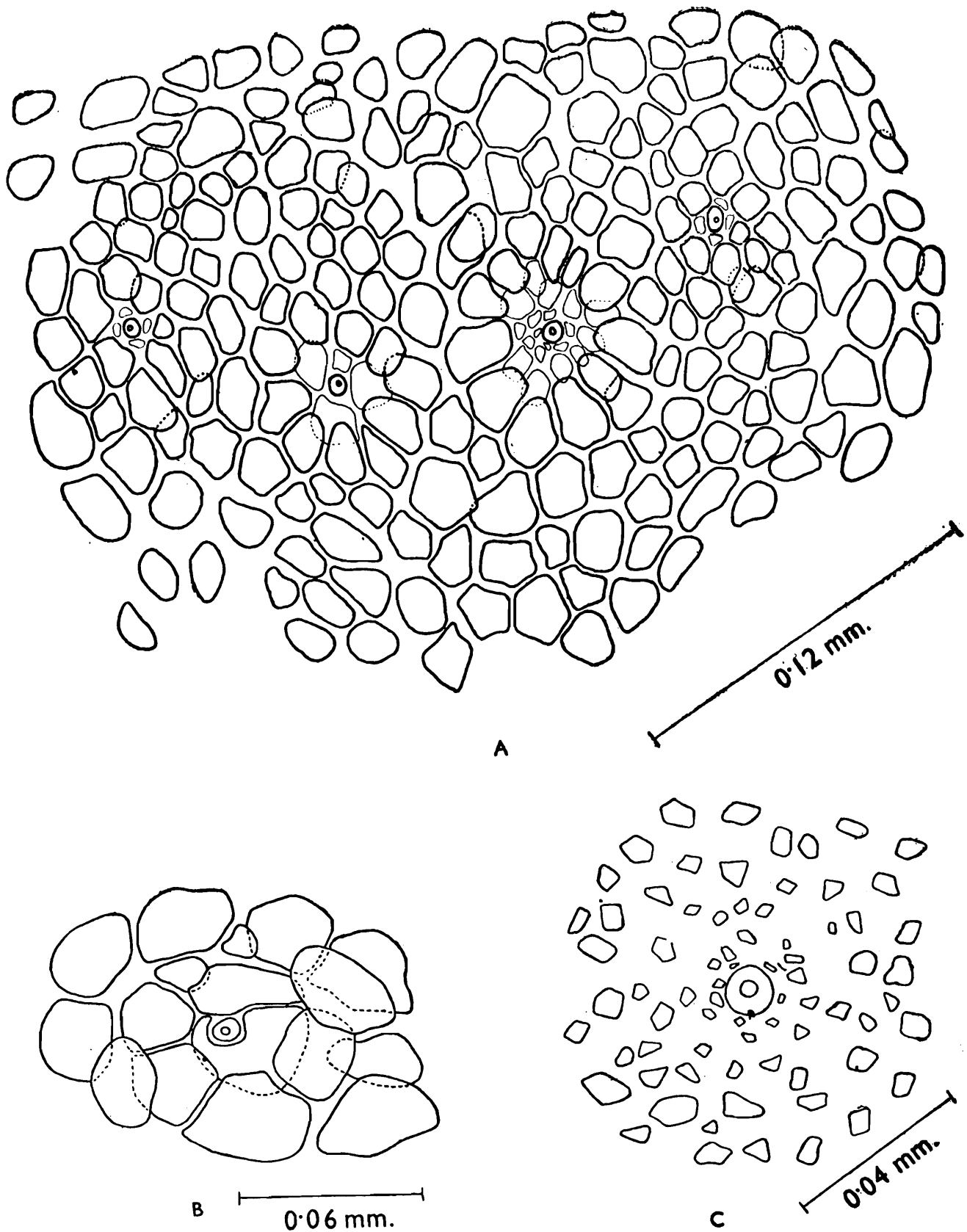


Fig. 1 A. A portion of the skin from anterior most end of the trunk above nephridiopore and adjacent to annal shield showing skin papillae, B. A skin papilla from the caudal shield. C. A skin papilla from the middle region of the trunk.

brown to dark-brown, granulated and without any furrows. No calcareous substance attached to shield. Caudal shield round in surface view and yellow coloured; without any radial and concentric furrows. Careful examination

reveals caudal shield made up of closely placed yellow papillae (fig. 1A)

Tip of introvert bears 8-10 short tentacles forming a semicircular crown. Posterior to

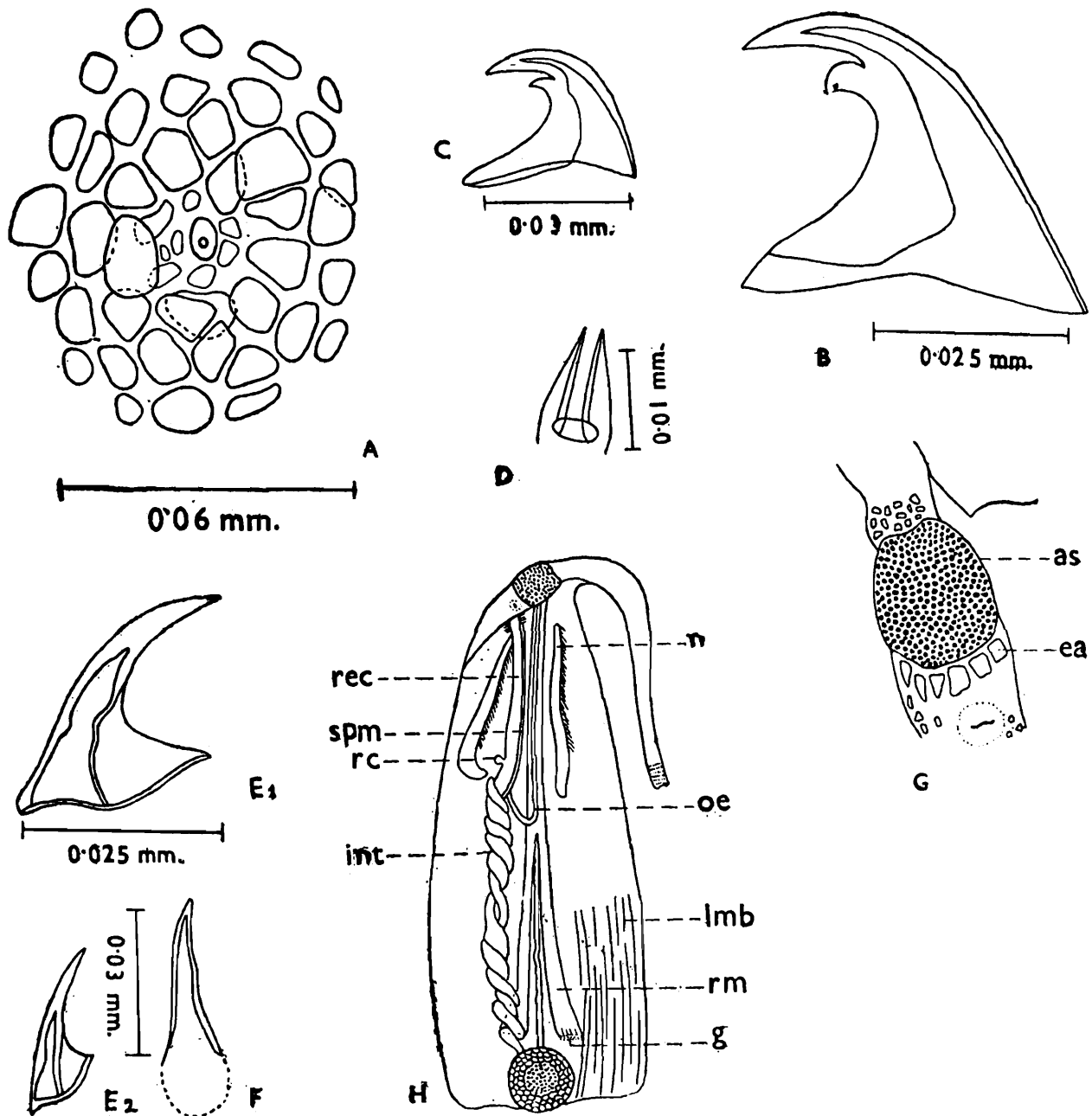


Fig. 2 A. A skin papilla at the level of nephridipore B & C. Hooks from the introvert— from anterior hook row & C.—from posterior hook row. D. A small perforated skin papilla. E & F Spines from posterior region of the introvert: E<sub>1</sub> and E<sub>2</sub> side view and F—front view. G. Anal shield and its adjacent area. as, anal shield; ea, elevated area. H. Specimen dissected to show the internal organs  $\times 3\frac{1}{2}$  g, gonad; int, intestinal convolution; lmb, longitudinal muscle band; n, nephridium; oe, oesophagus; rc, rectal caecum; rec, rectum; rm, retractor muscle; spm, spindle muscle.

tentacular crown, introvert carries 20-45 rows of double pointed hooks. Except for one or two anterior transparent rows, hooks are yellowish. Each of these hooks has a broad base, expanded transparent streak and strongly bent pointed apex (fig. 2B & C). Posterior to hook rows, rest of introvert covered with spines more or less regularly arranged (fig. 2D). Between every two rows of hooks and spines occur minute tubular papillae (fig. 2E, F).

Internally, the longitudinal muscle layer of body wall divided into 17-26 separate bands (fig. 2G, 1mb), of which a few anastomose; bands equally strong all over the trunk. Two retractor muscles (fig. 2G rm) arise very close to caudal shield from bands 2-6 (3-7) and greater part of their length fused into single retractor unit. Oesophagus (fig. 2G, oe) long and narrow; runs dorsal to retractor unit upto point of their fusion, later upwards before coiling. Intestinal convolution (fig. 2H, int) consists of 14-23 spirals reaching almost to tip of caudal shield. Spindle muscle (fig. 2H, spm) attached anteriorly and posteriorly, firmly anchoring intestinal coil. Fixing muscle absent. Long rectum (fig. 2H, rec) has a caecum (fig. 2H, rc) and a pair of broad wing muscles. Thin yellow nephridia (fig. 2H, n) one-third to half as long as trunk; their posterior third to fourth free from body wall; nephridiopores situated between third and fourth muscle bands posterior to anal opening. Gonads (fig. 2H, g) lie at the base of retractor muscles. Body cavity full of eggs measuring  $0.12 \times 0.1$  mm.

*Type-specimens* : Holotype : vide "material" above Z.S.I. Regd. No. An 799/1 in National Zoological Collections, Zoological Survey of India, Calcutta.

*Paratypes* : 3 exs., vide "material" above also in Z.S.I., Calcutta. Reg. No. An 800/1 and An 801/1.

*Type-locality* : Havelock Island, South Andaman, India.

*Distribution* : Havelock and Neil Islands, South Andaman, India.

*Comparison* : Until now only two species viz. *Aspidosiphon* (*Aspidosiphon homomyarius* Johnson (type-locality—Okha, Gujarat) and *Aspidosiphon* (*Paraspidosiphon*) *exostomus* Johnson (type-locality—Port Blair, S. Andaman) were described from India. Four more species of the subgenus *Paraspidosiphon* are known from the Andaman Islands viz. *A. (P.) formosanus* Sato, *A. (P.) makoensis* Sato, *A. (P.) klunzingeri* Sel. & de Man and *A. (P.) steenstrupii* Diesing (Haldar, 1975 & 1976).

The present species can be differentiated from *A. (P.) formosanus* by the presence of rectal caecum; from *A. (P.) makoensis* by the nephridia not completely fastened to the body wall; from *A. (P.) exostomus* and *A. (P.) steenstrupii* by the origin of retractor muscles very close to the caudal shield and from *A. (P.) klunzingeri* by the presence of double pointed introvert hooks. Considering the above variations, the present material has been assigned to a new species. Part of the key to the species of the subgenus *Paraspidosiphon* given by Stephen and Edmonds (1972) is also modified to accommodate the new species.

1. Rectal caecum present ..... 2  
    Ractal caecum absent .....  
    — ..... *A. (P.) formosanus* Sato.
2. Caudal shield partially furrows ..... 3  
    — Caudal shield without furrows ....  
        ..... *A. (P.) havelockensis* n. sp.
3. Introvert hook with a thin, clear, wavy line  
    along its mid-line .....  
        ..... *A. (P.) ambonensis* Augener.  
    — Introvert hook with much expanded, clear  
        area ..... *A. (P.) speculatur* Selenka.

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FIRST RECORD OF MALE OF *MONILOTHRIPS KEMPI* MOULTON (THYSANOPTERA : THIRIPIDAE) FROM INDIA

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ABSTRACT

Male specimens of *Monilothrips kempi* Moulton recorded for the first time from India, hitherto known only from Basutoland (S. Africa) and California.

INTRODUCTION

Moulton erected the unique and extremely rare genus *Monilothrips* and described the species *Monilothrips kempi* based on a single female, taken from an unknown host plant on 4.v.1917 from Sureil, Mangpu, Darjeeling District, West Bengal. Since then the species has not been reported from any where else in India, until Bhatti (1972) collected a large number of females in 1967 from Mussoorie, U.P., without even a single male in a large collection of 170 females inspite of concerted efforts. Hood and Jacot-Guillarmod (1959) reported for the first time the male of *Monilothrips kempi* Moulton from Basutoland (S. Africa), and subsequently reported from California (Wilson, 1975). Studies on a recent collections from Darjeeling District has revealed the presence of three male specimens and this forms the first record of male of *Monilothrips kempi* Moulton from India and described below.

*Monilothrips kempi* Moulton

*Monilothrips kempi* Moulton, 1929, *Rec. Indian Mus.*, 31 : 94

*Monilothrips kempi*, Bailey & Cott, 1952. *Bull. Calif. Dept. Agri.*, 41 (3) : 2

*Monilothrips kempi*, Bailey, 1957. *Bull. Calif. Ins. Survey*, 4 (5) : 186.

*Monilothrips montanus* Jacot-Buillasmod, 1942 *J. ent. Soc. S. Afr.*, 5 : 64.

*Monilothrips kempi*, Hood & Jacot-Guillarmod, 1959, *J. ent. Soc. S. Afr.*, 22 (2) : 489.

*Monilothrips kempi*, Bhatti, 1972. *Oriental Ins.* 6 (1) : 72,

*Monilothrips kempi*, Wilaon, 1975. *Mem. Amer. Ent. Inst.*, 23 : 173.

*Male (Macropterous)* : Colour uniformly orange brown, antennal segments I-III and base of IV & V whitish yellow, rest unicolourous to the body ; legs golden yellow, wings uniformly whitish yellow, all setae dark. Head distinctly produced in front between antenna, anterior margin of projection concave ; cheeks slightly arched, posterior margin of heap with a distinct reticulated collar-like band. Head 156\* long, 208 wide across cheeks, antecular projection 20 long, 20 wide. Eyes little extended ventrally, 80-88 long, 52-56 wide, all ocelli 16 wide. Antecellars 24 long, interocellars placed in the middle of the ocellor triangle 28-32 long, postocellars 20-24 long ; postoculars 28-32 long. Antennae 8-segmented, segments III & IV vane-shaped, sense cones forked ; length (width) : I : 32

\*All measurements are in micron unless otherwise mentioned.

(32) ; II : 56 (36) ; III : 96 (28) ; IV : 80 (28) ; V : 64 (24) ; VI : 40-44 (20-24) ; VII : 20 (16) ; VIII : 52 (12). Mouthcone 92 long, 192 wide at base, 64 at apex.

Prothorax 120 long, 252-260 wide, forward directed anteroangulars 40-44 long, backward directed anteroangulars 52 long, anteromarginals 28-32 long, midlaterals 36-44 long, inner-postangulars 40 long, outer-postangulars 60-72 long. Pterothorax 372 long, 360 wide across mesothorax and 368 across metathorax. Forewings 1003-1020 long ; costa with 28-30, upper vein with 17 (15+1+1) ; lower vein with 16 setae.

Abdomen shape and sculpture essentially as in female. Postmarginal flanges restricted

laterally on sterna IV-VIII, glandular areas absent in sternites. Abdomen 304 wide at base, 360 at middle, 180 across segment IX. Tergum IX (Fig. 1A) with six strong specialised setae disposed as follows :—4 in the middle (2 in upper row and 2 in lower row) and the other 2 placed laterally.  $B_1$ — $B_3$  of segment IX-108—116, 80 & 40 long and  $B_1$ — $B_2$  of segment X 44-52 & 80 long.

Total body length 1.6—1.65 mm.

*Material examined* : 1 ♂, Maibhanjang, ca. 1951 m., Darjeeling District, West Bengal, 19.v.1975 (J.K. Jonathan Coll.) ; 2 ♂ ♂, Rangiroom, ca. 1913 m., Darjeeling District, West Bengal, 7.vi.1975 (J. K. Jonathan Coll.).

The males from Darjeeling District differs

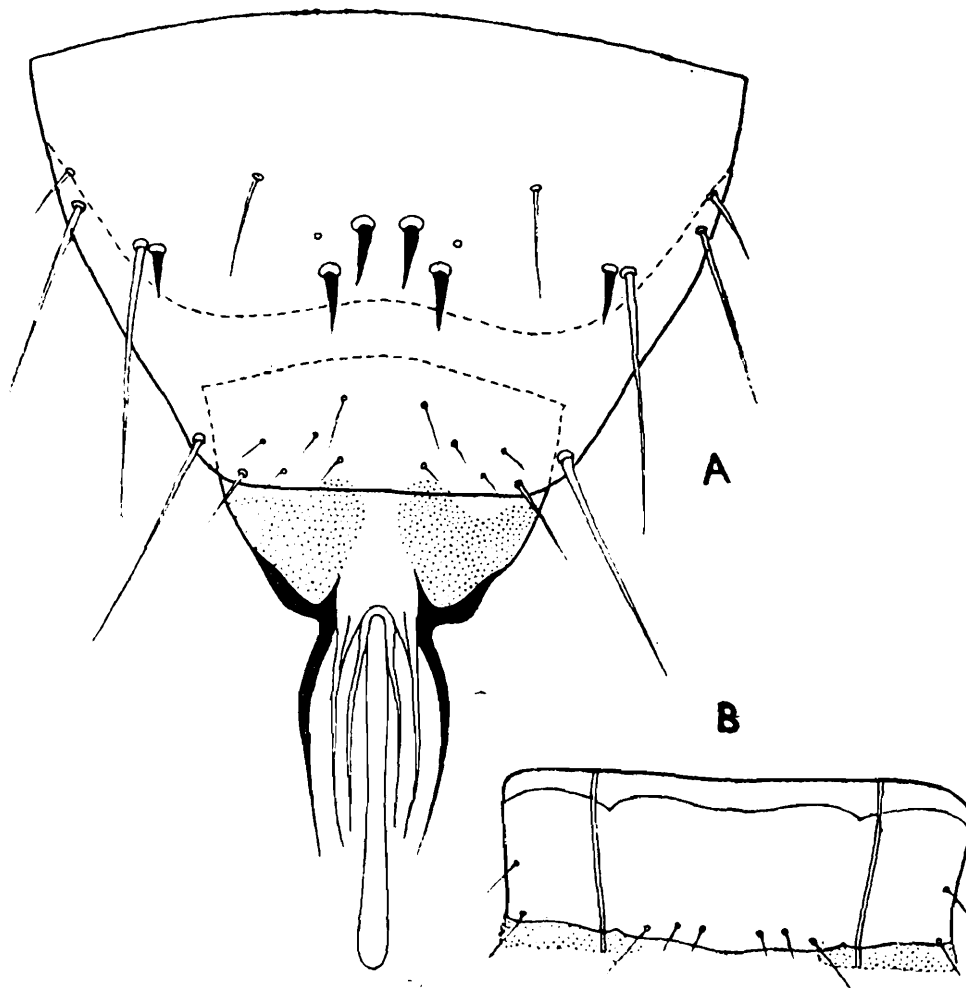


Fig. 1 *Morilothrips kempii* Moulton ♂ : A. Terminal abdominal segments ; B. Abdominal sternum V

from that of Basutoland and California in having six specialised setae in tergite IX, instead of four.

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\*Original not seen by the author.



STUDIES ON INDIAN PHYTOSEIIDAE (ACARINA : MESOSTIGMATA) : SOME  
*TYPHLODROMUS* MITES FROM SOUTH INDIA WITH DESCRIPTIONS OF  
NEW SPECIES

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ABSTRACT

Four species of *Typhlodromus* from south India are described as new to science. In addition, collection data are provided for another four species, three of these are reported for first time from there.

INTRODUCTION

The mites of the genus *Typhlodromus* are of great economic importance as they are efficient predators of phytophagous mites. Excepting one species, viz. *Typhlodromus rickeri* Chant, which is known from Karnataka, nothing about *Typhlodromus* mites is known from other parts of south India. The author while surveying Phytoseiidae of India, made some collection from different parts of south India, and the present paper is based on the material of the genus *Typhlodromus*. The material of the other genera will be treated elsewhere.

Altogether, eight species are discussed here, of these, four are described as new to science and three are recorded here for the first time from south India. The entire material treated here were collected by the author himself. The measurements given in the text are all in microns. Chant *et al* (1974) has been followed both for concept of the genus as well as for setal nomenclature.

The types and other material treated here are being deposited in the National Collection of the Zoological Survey of India, Calcutta.

1. *Typhlodromus kodaikanalensis* sp. nov.

(fig. 1 A-E).

*Female* : Body elongated oval. Peritreme extends anteriorly upto the base of  $j_1$ . Dorsal shield 300 long, 165 wide, well sclerotized, reticulate, with 18 pairs of setae,  $Z_5$  thickest and serrate, all other setae smooth and simple ; excepting  $j_3$  which touches base of  $Z_2$ , no other setae on dorsal shield reach upto the bases of succeeding setae ;  $s_6=S_2=S_4=Z_4$ ,  $S_5=z_2$ , bases of  $j_1$  very close to each other,  $Z_5$  shorter than distance between their bases ; measurements of setae :  $j_1$ -21,  $j_1$ - $j_6$ -16 each,  $J_2$ -20,  $J_5$ -6,  $j_3$ -20,  $z_2$ -20,  $z_3$ -20,  $s_3$ - $s_2$   $s_4$ -24,  $s_6$ -28,  $S_2$ -28,  $S_4$ -28,  $S_5$ -16,  $Z_5$ -48.  $z_4$ -16,  $Z_4$ -28,  $r_3$ -25,  $R_1$ -24. Sternal shield weakly sclerotized with 3 pairs of sternal setae, metasternal plates with setae distinct. Genital shield 60 wide, narrower than greatest width of ventrianal shield, with a pair of genital setae. A fold and some small platelets present between genital and ventrianal shields. Ventrianal shield 92 long, 76 wide, anterior margin rounded, lateral margins almost straight with 4 pairs of preanal setae (14 long) ; 4 pairs of setae present around ventrianal shield  $JV_4$ -34 long ; 2 pairs of metapodal plates present : larger one : 25 long, smaller one

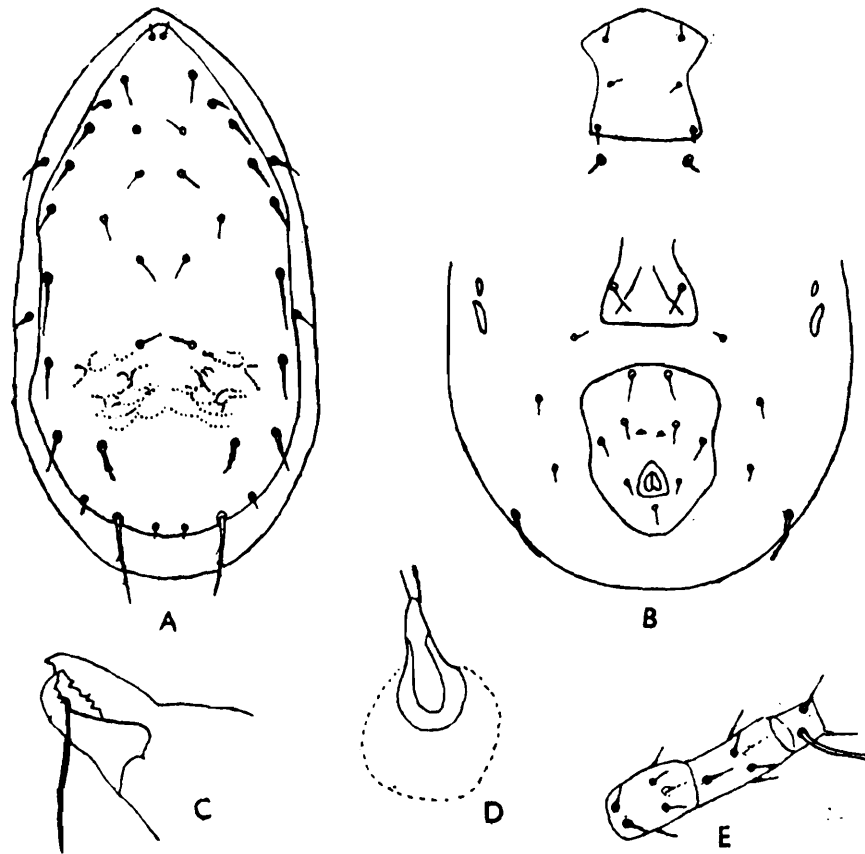


Fig 1 (A-E) *Typhlodromus neotransvaalensis* sp. nov. A. dorsal shield, B. ventral surface, C. chelicera, D. spermatheca, E. leg IV.

16 long. Fixed digit of chelicera multidentate with a pilus dentilis, movable digit with 3 teeth. Spermatheca as in figure. Macroseta present only on basitarsus IV-40 long. Leg chaetotaxy : genu II-7 setae (4 dorsal, 3 lateral), genu III 7 setae (4 dorsal, 2 lateral, 1 ventral), genu IV 7 setae (4 dorsal, 2 lateral, 1 ventral), tibia II 7 setae (3 dorsal, 2 lateral, 2 ventral), tibia III 7 setae (4 dorsal, 2 lateral, 1 ventral), tibia IV 6 setae (3 dorsal, 2 lateral, 1 ventral),

*Male* : Unknown.

*Material* : *Holotype* : ♀ , INDIA : Tamil Nadu, Kodaikanal, on pear 7.xii.1975; *Paratypes* : 3 ♀ ♀ , data same as for holotype.

*Remarks* : This new species is close to *Thyphlodromus homalii* Gupta, 1970 but differs from

it in shape of spermatheca, in having both the digits of chelicera equal with 3 teeth on movable digit (toothless in *homalii*), in having macroseta on basitarsus IV double the length of the segment (equal to the length of segment in *homalii*) and  $j_1$  being much close to each other. It also differs from *T. caudiglans* Schuster, 1959 in having  $S_5$  much shorter than  $S_4$  (equal in *caudiglans*) and in having sternal shield with 3 pairs of sternal setae (2 pairs in *caudiglans*). Further, it differs from *T. yamashitai* Ehara, 1972 in having macroseta on leg IV longer,  $Z_4$ ,  $s_3$ ,  $s_4$ ,  $s_6$ ,  $S_2$  relatively shorter and in lacking posterior lateral extension on sternal shield.

This mite was associated with *Tetranychus* sp. which infested the pear plant. The adult of this *Typhlodromus Kodaikanalensis* sp.

nov. found to chase the larvae of *Tetranychus* sp. but no feeding was observed.

2. *Typhlodromus neotransvaalensis* sp. nov.  
(figs. 2, A-E)

*Phytoseius* :

*Female* : Body oval. Peritreme extends anteriorly upto  $j_1$  and posteriorly upto coxa IV. Dorsal shield heavily sculptured as in *Phytoseius*, 328 long, 190 wide with 18 pairs of setae, sublateral setae lie on lateral integument ; all the setae on dorsal shield appear to be weakly serrate and never touch the bases of following setae. Seta  $Z_5$  being longest, thickest and slightly knobbed at the tip,  $Z_4 = S_4$  ; measurements of setae :  $j_1-j_6$  and  $J_2-16-20$  each,  $J_5-12$  ;  $j_3, z_2, z_3, s_2-18$  each,  $s_4-20,$

$s_6-24, s_1-20$  each,  $S_2-24, S_4-28, S_5-24, Z_5-36, z_4-18, Z_4-28, r_3-20, R_1-20$ . Sternal shield smooth, weakly sclerotized with 3 pairs of long sternal setae, metasternal plates with setae distinct. Genital shield 68 wide with a pair of genital setae. Ventrianal shield 112 long, 92 wide, smooth with 4 pairs of setae, anterior margin straight with 4 pairs of short preanal setae (8 long) ; 4 pairs of setae present around ventrianal shield ; some small platelets and 4 pairs of setae present around ventrianal shield, 2 pairs of metapodal plates present, larger one 28 long ;  $JV_4$  32 long with knobbed tip. Spermatheca as in figure with flask shaped cervix. Leg chaetotaxy : genu II 7 setae (4 dorsal, 3 lateral), genu III 7 setae (4 dorsal, 2 lateral, 1 ventral), genu IV 7 setae (4 dorsal, 2 lateral, 1 ventral), tibia II 7 setae (3 dorsal, 2 lateral, 2 ventral), tibia III 7 setae (3 dorsal,

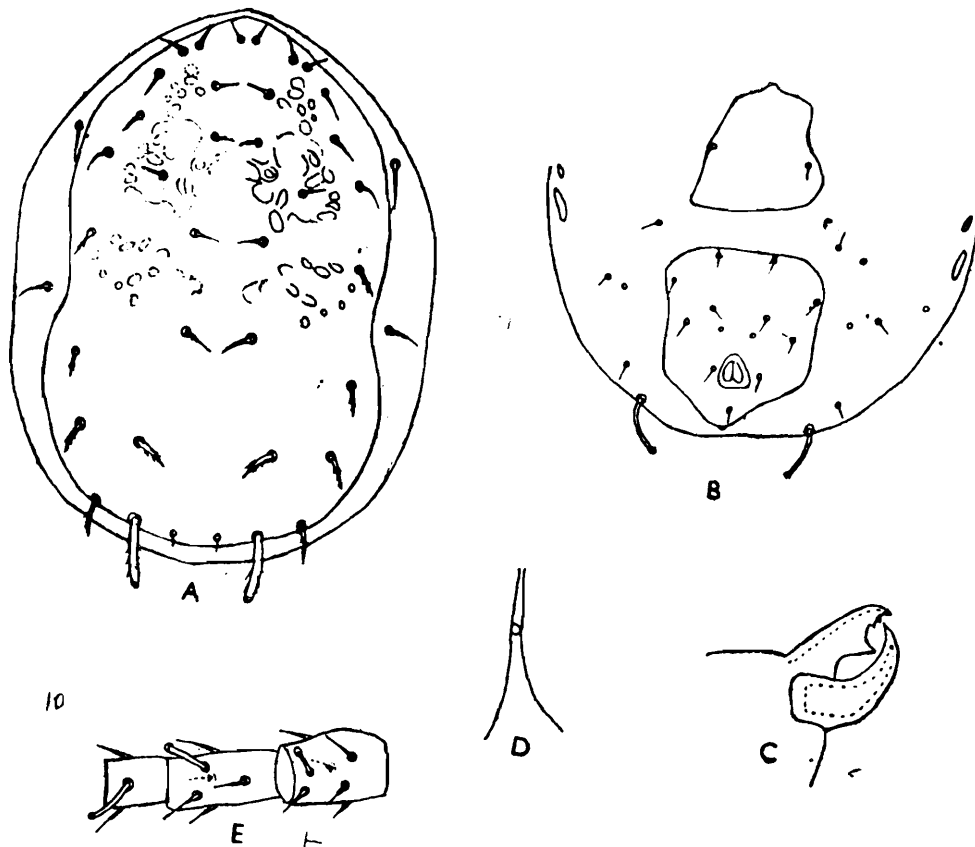


Fig. 2 (A-E) *Typhlodromus kodaikanalensis* sp. nov. A. dorsal shield, B. Ventral surface, C. chelicera, D. spermatheca, E. leg IV.

2 lateral, 2 ventral), tibia IV 6 setae (3 dorsal, 2 lateral, 1 ventral); macrosetae on leg IV: genu-16, tibia-20, basitarsus-26, all with flattened tip.

*Male*: Unknown

*Material*: *Holotype*: ♀, INDIA: Tamil Nadu, Ootacamund, Botanical garden, on *Casurina* sp. 28. xii. 1975; *Paratypes*: 1 ♀ Aruvankadu, on tea, 26. xii. 1975.

*Remarks*: This new species differs from *T. transvaalensis* (Nesbitt, 1951) in having lateral setae shorter than distance between their bases,  $j_3$  and  $z_2$  being equal ( $j_3 > z_2$  in *transvaalensis*) and in presence of 4 pairs of preanal setae on ventrianal shield (3 pairs in *transvaalensis*).

### 3. *Typhlodromus rhododendroni* sp. nov. (figs. 3, A-D)

*Female*: Body small. Peritreme extends anteriorly upto  $j_1$ . Dorsal shield 272 long, 160 wide, weakly sclerotized, reticulate with 18 pairs of setae. Excepting  $Z_5$  and  $Z_4$  which are serrate, all other setae smooth and imple. Bases of  $j_1$  very close and almost touching each other;  $Z_5 > Z_4 \geq S_4$ ,  $z_2 < S_5$ ; anterior lateral setae barely touch the bases of succeeding setae;  $J_2 = s_6 = S_2$ ;  $r_3$  and  $R_1$  lie on interscutal membrane; measurements of setae:  $j_1$ —16,  $j_4$ —16,  $j_5$ —18,  $j_6$ —20,  $J_2$ —25,  $J_5$ —8;  $j_3$ —25,  $z_2$ —16,  $z_3$ —20,  $s_3$ —20,  $s_4$ —24,  $s_6$ —25,  $S_2$ —26,  $S_4$ —32,  $S_5$ —20,  $Z_5$ —44;  $z_4$ —20,  $Z_4$ —36;  $r_3$ —20,  $R_1$ —18. Sternal shield weakly sclerotized, smooth, with 3 pairs of long sternal setae, 4th pair lie on metasternal plates. Genital shield narrower (56 wide) than greatest width of ventrianal shield with a pair of setae. Ventrianal shield 84 long, 60 wide, lateral margins concave with 4 pairs of short preanal setae (6 long); 4 pairs of setae and some small platelets present around genital and ventrianal shields; 2 pairs of small metapodal plates present;  $JV_4$ —32 long. Fixed digit of

Chelicera with 3 teeth placed anteriorly, movable digit with one tooth. Spermatheca as in figure. Leg chaetotaxy: genu II 7 setae (4 dorsal 3 lateral), genu III 7 setae (3 dorsal, 2 lateral, 2 ventral), genu IV 7 setae (4 dorsal, 2 lateral, 1 ventral), tibia II 7 setae (3 dorsal, 2 lateral, 2 ventral), tibia III 7 setae (3 dorsal, 2 lateral, 2 ventral), tibia IV 6 setae (3 dorsal, 1 lateral, 2 ventral), macroseta on leg IV: 25 long.

*Male*: Unknown.

*Material*: *Holotype*: ♀, INDIA: Karnataka Gundelpet, on *Rhododendron arboreum*, 30.xii. 1973. *Paratypes*: 2 ♀♀ data same as for holotype.

*Remarks*: This new species comes closer to *Typhlodromus bakeri* (German, 1948), but differs in having  $z_2$  much shorter than  $j_3$  (equal in *bakeri*) and  $S_5$  about  $\frac{1}{2}$  of  $Z_5$ . It also differs from *T. rhenanus* (Oudemans, 1905) in having shorter macrosetae on leg IV and in shape of spermatheca. Further, it is distinguished from *T. caudiglans* Schuster, 1959 by presence of all the three pairs of sternal setae on sternal shield (2 pairs present in *caudiglans*).

### 4. *Typhlodromus channabasavanni* sp. nov. (fig. 4 A-E)

*Female*: Body elongated oval. Peritreme extends anteriorly upto  $j_1$  and posteriorly upto coxa IV. Dorsal shield 300 long, 160 wide with 2-3 pairs of pores and 18 pairs of setae, all being smooth and pointed; setae  $Z_5$  being the longest,  $Z_4 > s_6 = S_2$ ,  $s_6 > s_4$ ,  $j_1 = j_6 = J_2 > j_4 = j_5$ ,  $j_3 = z_3$ ,  $s_3$  and  $z_4$  minute,  $r_3$  and  $R_1$  lie on interscutal membrane; measurements of setae:  $j_1$ —16,  $j_4$ — $j_5$ —8 each,  $J_6$ — $J_2$ —18 each,  $J_5$ —6;  $J_3$ —36,  $z_2$ —8,  $z_3$ —36,  $S_3$ —8,  $s_4$ —45,  $s_6$ —48,  $S_2$ —48,  $S_4$ —32,  $S_5$ —12,  $Z_5$ —70;  $z_4$ —8,  $Z_4$ —56, Sternal shield with 3 pairs of sternal setae. Genital shield 64 wide, smooth with a pair of long genital setae. Ventrianal

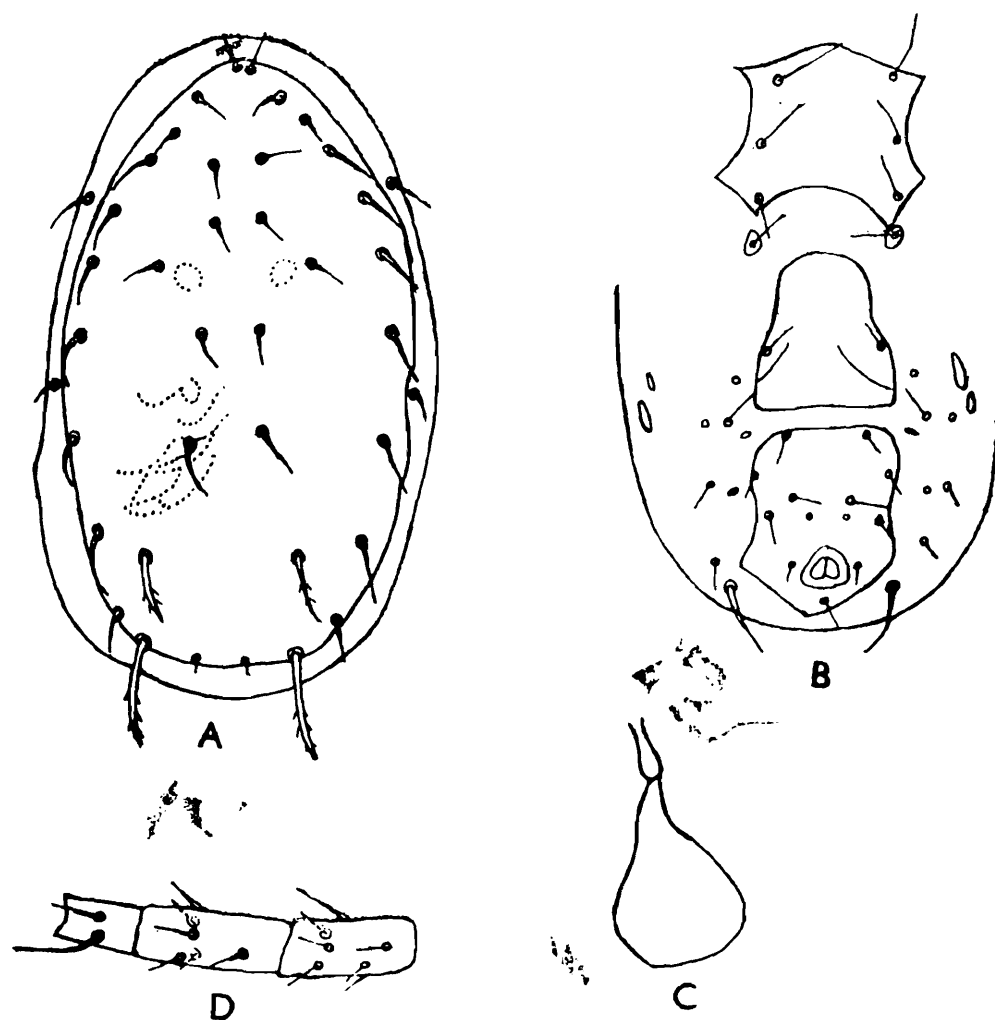


Fig. 3 (A-D) *Typhlodromus rhododendroni* sp. nov. A. dorsal shield, B. ventral surface, C. spermatheca, D. leg. IV.

shield much longer (100) than broad (72), anterior margin rounded, lateral margins concave with 4 pairs of preanal setae (16 long) ; 4 pairs of setae present around ventrianal shield,  $JV_4$ -44 long ; metapodal plates paired, larger one 18 long, smaller one 14 long. Fixed digit of chelicera multidentata with a long pilus dentilis, movable digit with a single small tooth. Spermatheca with a flask shaped cervix, atrium rounded with long duct. Leg IV with macroseta present only on basitarsus-56 long.

**Male** : Unknown.

**Material** : *Holotype* : ♀, INDIA : Tamil

Nadu, Aravankadu, on tea, 26. xii. 1975. **Remarks** : This new species is easily distinguished from *Typhlodromus pruni* Gupta, 1970 by difference in relative length of dorsal idiosomal setae specially  $S_1$  and  $S_2$  which are longer than those of *pruni*,  $Z_5$  and  $Z_4$  being not serrate, by difference in shape of spermatheca and by absence of macrosetae on genu IV and tibia IV.

The species is named after Dr. G. P. Channabasavanna in recognition of his very valuable contribution in the field of Acarology.

This mite was associated with tea scarlet

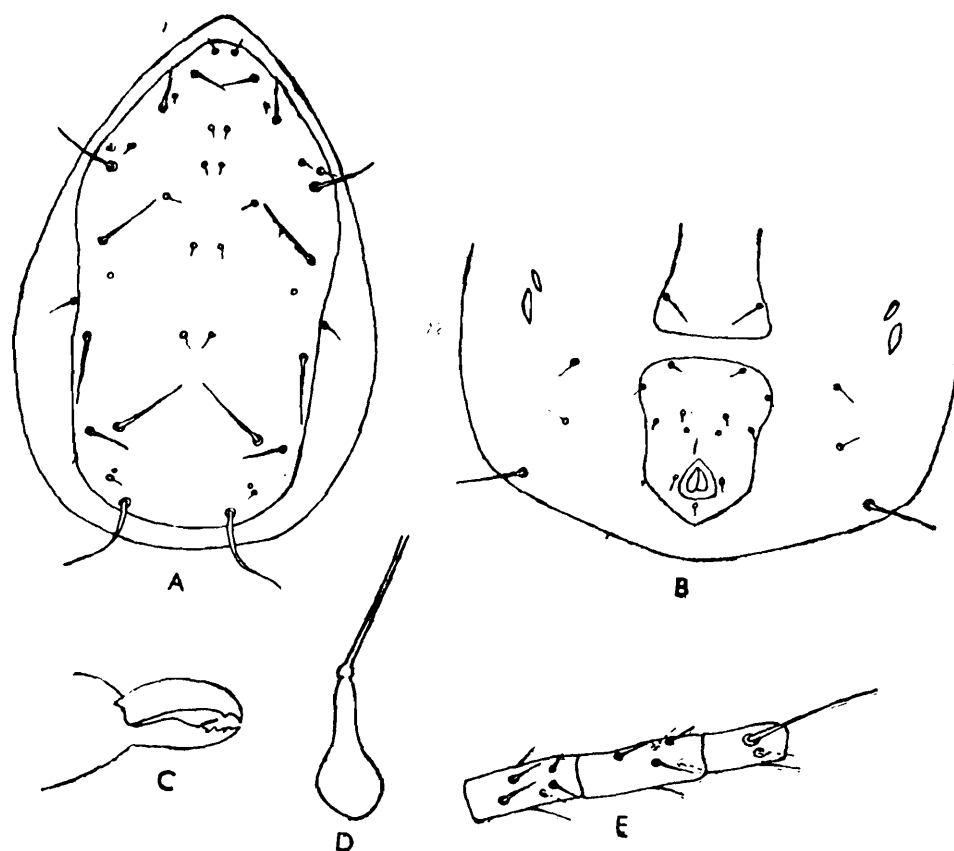


Fig. 4 (A-E) *Typhlodromus channabasavanni* sp. nov. A. dorsal shield, B. post ventral surface, C. chelicera D. spermatheca, E. leg IV.

mite, *Brevipalpus phoenicis* (Geij.) but as the population of this new species was extremely low, it was not certain whether it was feeding on it.

##### 5. *Typhlodromus homalii* Gupta (fig. 5, F)

*Typhlodromus homalii* Gupta, 1970, *Oriental Ins.* 4 : 188-189.

**Female** : Dorsal shield 320 long, 170 wide with 18 pairs of setae. Measurements of setae :  $j_1-16$ ,  $j_4-j_5-13$  each,  $j_8-17$ ,  $J_2-21$ ,  $J_5-10$  ;  $j_3-17$ ,  $z_2-20$ ,  $z_3-16$ ,  $s_3-12$ ,  $s_4-20$ ,  $s_6-24$ ,  $S_2-24$ ,  $S_4-24$ ,  $S_5-16$ ,  $Z_5-40$  ;  $z_4-16$ ,  $Z_4-26$ . Sternal shield 80 long, 60 wide. Genital shield 80 wide. Ventrianal shield 104 long, 84 wide with 4 pairs of setae. Macroseta on basitarsus IV—17 long. Spermatheca as figured.

**Material** : 1 ♀, Kerala ; Trivandrum, on an unknown host, 14. xii. 1975 ; 1 ♀, Tamil Nadu : Top slip, Ambuli Perai, on an unknown host, 24. xii. 1975 ; 1 ♀, Kodaikanal, on an unknown host, 7. xii. 1975.

**Distribution** : India : West Bengal, Kerala (New record), Tamil Nadu (New record).

**Remarks** : The specimens examined under present investigation conformed well with the original description showing no marked variation from there.

This mite was feeding on the eggs of *Oligonychus* sp. infesting the unknown shrub at Trivandrum.

##### 6. *Typhlodromus rickeri* Chant (fig. 5, B)

*Typhlodromus* (*Typhlodromus*) *rickeri* Chant, 1960, *Canadian Entomol.* 92 : 62-64.

**Female :** Dorsal shield 280 long, 160 wide with 18 pairs of setae. Measurements of setae :  $j_1$ -20,  $j_4$ -12,  $j_5$ -24,  $j_2$ -32,  $j_6$ -6,  $j_3$ -44,  $z_2$ -8,  $z_3$ -52,  $s_3$ -10,  $s_4$ -60,  $s_6$ -66,  $S_2$ -61,  $S_4$ -36,  $S_5$ -16,  $Z_5$ -76,  $z_4$ -8,  $Z_4$ -60. Genital shield 60 wide. Ventrianal shield 92 long, 64 wide. Macrosetae on leg IV : genu-32, tibia-28, basitarsus 48. Spermatheca as illustrated.

Tamil Nadu : Topslip, on *Eucalyptus robustus*, 21.xii.1975 ; 1 ♀, Ambuli Perai, on *Dalbergia latifolia*, 24.xii.1975.

**Distribution :** India : Meghalaya, Tamil Nadu (New record), Kerala (New record), Andhra Pradesh (New record).

**Remarks :** As Chant (1960) did not give the measurements of dorsal idiosomal setae in details, it is not possible to state if there is any variation in respect of setal length in the specimens examined under present investigation.

This mite was associated with a tetranychid mite infesting *Dalbergia latifolia* at Ambuli Perai.

### 7. *Typhlodromus communis* Gupta (fig. 5 C-D)

*Typhlodromus communis* Gupta, *Ent. Mon. Mag.* (In press).

**Female :** Dorsal shield 300 long, 160 wide with 18 pairs of setae. Measurements of setae :  $j_1$ -16,  $j_4$ -10,  $j_5$ -16,  $j_6$ -16,  $J_2$ -20,  $J_5$ -6 ;  $j_3$ -18,  $z_2$ 12-,  $z_3$ -20,  $s_3$ -24,  $s_4$ -28,  $s_6$ -28,  $S_2$ -32,  $S_4$ -24,  $S_5$ -16,  $Z_5$ -48,  $z_4$ -20,  $Z_4$ -32. Sternal shield as long as wide. Genital shield 68 wide. Ventrianal shield as long (80) as wide. Macrosetae on basitarsus IV-33 long. Spermatheca as in figure.

**Male :** Spermatophoral process as illustrated.

**Material :** 5 ♀♀, 1 ♂, Karnataka, Bandipur, on *Eucalyptus*, 29. xii.1975 ; 4 ♀♀, Gundelpet, on an unknown host, 30.xii.1975 ; 3 ♀♀, Tamil Nadu : Kodaikanal, on *Dalbergia* sp., 7.xii.1975.

**Distribution :** India ; West Bengal, Karnataka (New record), Tamil Nadu (New record).

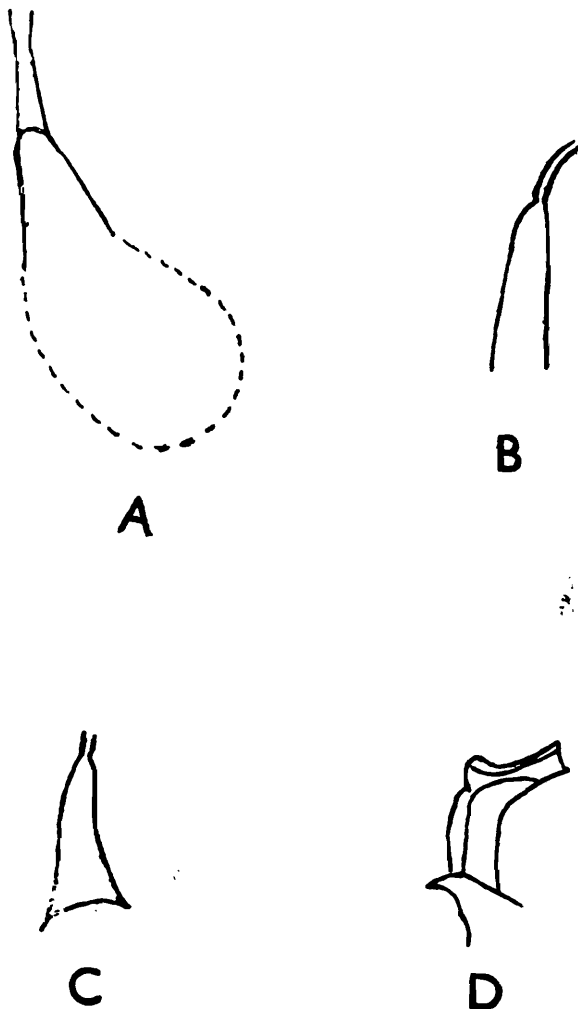


Fig. 5 A *Typhlodromus homalii* Gupta—spermatheca. B. *Typhlodromus rickeri* Chant—spermatheca. (C&D) *Typhlodromus communis* Gupta—C. spermatheca, D. spermatophoral process.

**Material :** 1 ♀, Karnataka : Bandipur, on *Mahonia leschenaultii*, 30. xii. 1975 ; 3 ♀♀, Gundelpet, on an unknown host, 30.xii.1975 ; 1 ♀, Kerala : Walaya, on an unknown host, 14.xii.1975 ; 3 ♀♀, Andhra Pradesh : Simachalam, on cashewnut, 5.i.1976 ; 1 ♀,

8. *Typhlodromus eharai* Gupta

*Typhlodromus eharai* Gupta, *Ent. Mon. Mag.*  
(In press).

**Female** : Dorsal shield 320 long, 194 wide with 18 pairs of setae. Measurements of setae :  $j_1$ -16,  $j_4$ -12,  $j_5$ -16,  $j_6$ -17,  $J_2$ -19,  $J_5$ -8 ;  $j_3$ -15,  $z_2$ -3-15 each,  $s_3$ -16,  $s_4$ -20,  $s_6$ -24,  $S_2$ -24,  $S_4$ -26,  $S_5$ -16,  $Z_5$ -49,  $z_4$ -16,  $Z_4$ -29. Genital shield 68 wide. Ventrianal shield 112 long, 84 wide, with 4 pairs of preanal setae. Macrosetae on leg IV : genu-12, tibia-16 and basitarsus-28.

**Material** : 2 ♀♀, Karnataka : Bandipur on *Cassia*, 30.xii.1975 ; 1 ♀, Tamil Nadu : Kodaikanal, Oothu, on coffee, 8.xii.1975.

**Distribution** : India : West Bengal, Karnataka (New record), Tamil Nadu (New record).

**Remarks** : Excepting  $Z_5$  and  $Z_4$ , which are slightly longer, no other variation from the original description was observed in the specimens examined under present investigation.

This mite was associated with coffee mite, *Oligonychus coffeae* (Nietner) but it did not feed on it.

## ACINOWLEDGEMENTS.

The author is grateful to the Director

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A NEW SPECIES OF *SPANIOCELYPHUS* HENDEL FROM INDIA (DIPTERA : CELYPHIDAE)

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ABSTRACT

A new species of *Spaniocelyphus* Hendel, *Spaniocelyphus tenorioi*, is described from India and a key to Indian species of the genus is given.

INTRODUCTION

Celyphidae is a small family of beetle-like acalyptrate flies, characterised by the enlarged scutellum covering wings and abdomen. Though 67 species are recorded by Tenorio (1972) in his revisional study of Oriental Celyphidae, so far only 5 species are known from India. With its vastness and varied climatic conditions, it is natural to expect many more interesting species of these flies from India. The Zoological Survey of India, Calcutta, possesses a new species of *Spaniocelyphus* Hendel, which is described below.

Genus *Spaniocelyphus* Hendel

*Spaniocelyphus* Hendel, 1914, *Supplta. ent.* 1 : 92.

Type species : *Celyphus scutatus* Wiedemann (Original designation)

Key to the Indian species of *Spaniocelyphus* Hendel based upon male genitalia.

- 1. Gonopods bifurcate at apex in ventral view ..... 2  
Gonopods not bifurcate at apex .. .. . 3
- 2. Surstyli curved at apex in ventral view ; gonopod in lateral view with a bump at dorsoapical region .... *scutatus* (Wiedemann)  
Surstyli almost straight at apex in ventral view ; gonopod plane at dorsoapical region ..... *janthinus* Vauschuythroeck.
- 3. Gonites hooked at apex in lateral view .. 4  
Gonites straight in lateral view, a long

- curved slender extension projects from mid-dorsal surface .. .. . *prostatus* Tenorio.
- 4. Gonites hooked with a concavity at apico-dorsal two-thirds .. .. . *cognatus* (Karschl)  
Gonites without such concavity .. .. . 5.
- 5. Surstyli almost triangular at apex in ventral view ..... .. *fuscipes* (Macquart)  
Surstyli bulbous at apex in ventral view .. .. . *tenorioi* n. sp.

*Spaniocelyphus tenorioi* sp. nov. (Figs. 1.A, B)

♂ ♀ Head testaceous, eyes shining brown, face light brown, bucca dark, vertex more than one and half as broad as long. Antenna with the basal segment short, middle longer and the apical longest ; flat portion of arista conical, the rest missing.

Thorax smooth shining black, humeri dark brown ; scutellum smooth, basal half shining black, rest blackish-brown. Legs dark brown, tibia brown, tarsus pale brown. Venation typical as in the genus.

Abdomen dark brown. Male genitalia (Fig. 1A) with the surstyli reaching to the tip of gonites, slightly bent inward at about the middle and knob-like at apices ; lateral margin of gonites entire, dorsoapically pointed. Female genitalia (Fig. 1 B) with the genital sternite as in figure.

The present species superficially resembles to *Spaniocelyphus fuscipes* (Macquart), *S. cognatus* (Karsch), *S. palmi palmi* Frey and

scutellum length 2.4-2.6 mm ; height 1 mm ; width 2 mm.

*Holotype* ♂ (antennae damaged), Reg. No. 5148/H6, Assam : Garo Hills, 1067 m, viii. 1917, Coll. S. Kemp.

*Paratype* ♀ (antennae damaged) Reg. No. 5149/H6, 1067-1189 m, 15. vii—30. viii. 1917, rest of data as in holotype.

This species is named after Mr. J. M. Tenorio, who has recently revised the Oriental Celyphidae.

#### ACKNOWLEDGEMENTS

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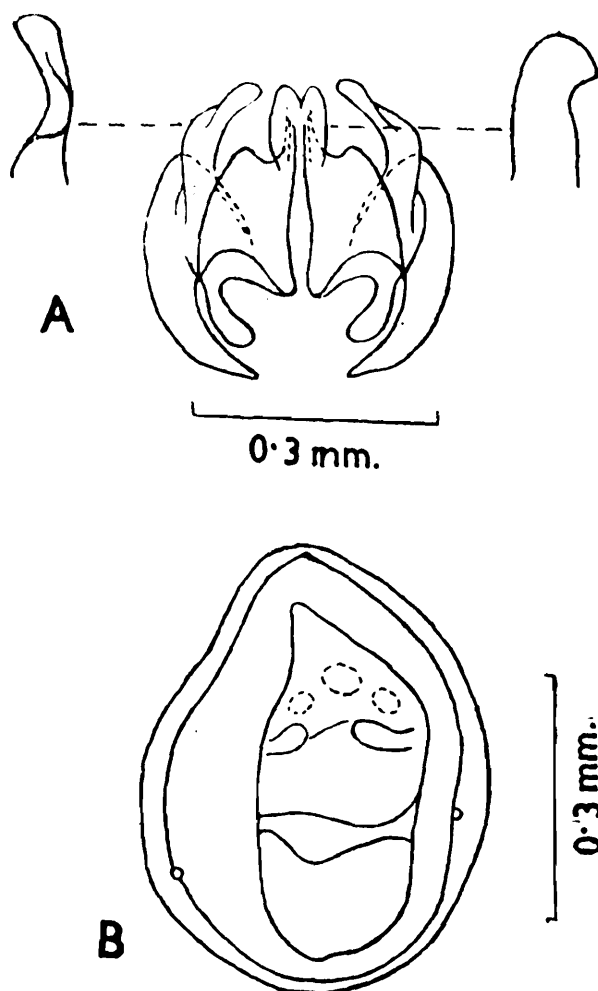


Fig. 1 *Spaniocelyphus tenorioi* n. sp. : A, ♂ genitalia ventral view ; B, ♀ genital sternite (diagrammatic).

*S. scutatus* (Wiedemann) ; it also resembles to *S. trigonalis* de Meijere in the knobbed surstyli. Of these, *S. tenorioi* n. sp. is most similar to *S. fuscipes* (Macquart from which it can be readily distinguished by the apically knobbed surstyli and genital sternite.

Length : head 0.8 mm ; body 3.2-3.4 mm ;

CHROMOSOMES OF *XIPHIDIOPSIS STRAMINULA* (WALKER)  
(ORTHOPTERA, TETTIGONIIDAE, MECONEMATINAE)

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ABSTRACT

A study of chromosomes in the females of *Xiphidiopsis straminula* has been carried-out. The diploid number is 34 with two outstandingly large metacentric sex-chromosomes. Discussion has been made on the probable mode of origin of such metacentric sex-chromosomes.

INTRODUCTION

Cytological studies on the Indian Tettigoniidae are far less satisfactory as compared to those carried out on the family Acrididae. Earlier Asana *et al.* (1938), Makino (1956) and recently Dave (1965), Chatterjee and Manna (1971) have provided some information on this group. This investigation, therefore, was undertaken to obtain information on the nature of mitotic chromosomes. Tettigoniids, in general, have a higher diploid number  $2n\sigma$  20-35 (White, 1973) and a well established XO ; XX sex-determining mechanism with a few exceptions. Occurrence of large metacentric X in tettigoniids is, however, not a rare phenomenon. This is a first report dealing with the chromosomes of a tettigoniid belonging to the sub-family Meconematinae.

MATERIAL AND METHODS

Only female specimens were available which were collected from Calcutta, and injected with 0.1 cc of 0.1% Colchicine and sacrificed after three hours. Midgut tissues were dissected out and treated with 0.9% sodium citrate solution for 30-35 minutes, then fixed 1:3 aceto-methanol with three

changes. The material was squashed, air-dried and stained with Giemsa and mounted in D. P. X. The measurements and classification of the Karyotype are after Levan *et al.* (1964).

OBSERVATION

Diploid chromosome number in the female was observed to be 34 which included two large metacentric (M) X-Chromosomes (Plate III a & b). The autosomes were grouped into two categories ; submetacentric (sm) and telocentrics (t). The morphometric measurements revealed that the X-chromosomes were the longest of the complement and nearly twice the length of the longest autosome. The 2nd pair of autosome was sub-metacentric. The rest were telocentrics. The details of relative percentage lengths ( $L^R$ ) of each chromosome and centromeric indices ( $I^C$ ) of 2nd autosomal pair and the sex-chromosome are given in the table. The idiogram is shown in figure 1.

DISCUSSION

In Tettigoniids, unlike Acridids, the X-chromosome is frequently found in both the forms i.e. acro and metacentrics. The evo-

Measurements of a chromosome complement of *Xiphidiopsis straminula*.

Chromosome number	1	2	3	4	5	6	7	8	9
$L^R$	126.20	110.60	72.60	56.30	50.90	47.80	41.80	39.99	32.60
$I^C$	—	34.57	—	—	—	—	—	—	—

Chromosome number	10	11	12	13	14	15	16	X
$L^R$	32.60	30.973	29.82	28.16	23.09	21.41	21.41	222.10
$I^C$	—	—	—	—	—	—	—	49.53

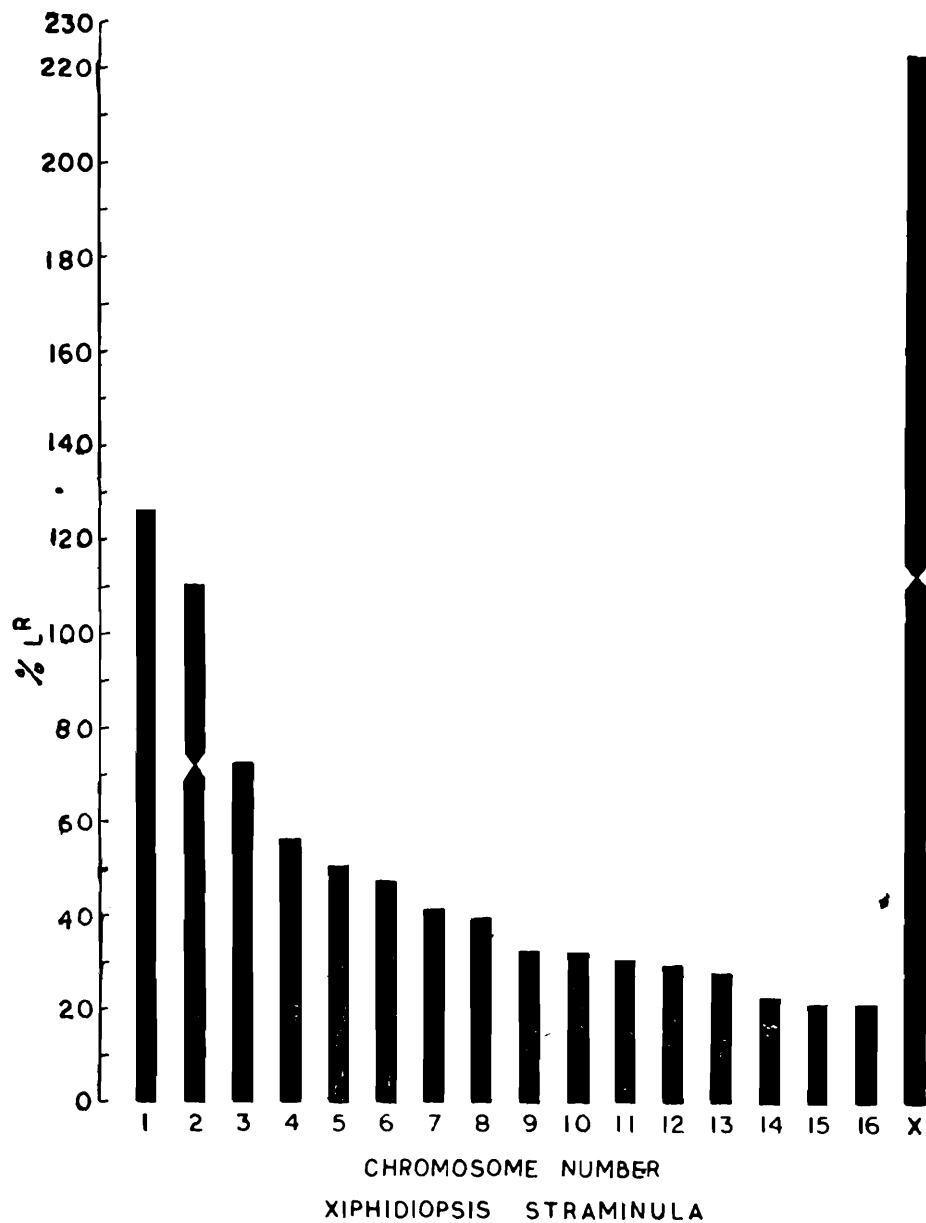


Fig. 1. Idiogram showing relative length and centromeric indices of *Xiphidiopsis straminula*.

lution of metacentric X-chromosome is of considerable importance. In Tettigoniids the sex-chromosome has an independent evolution. The X/A ratio suggests that there is no transfer of material from autosomes to X-chromosome (White, 1941). Further, in the longhorned grasshoppers the X is possibly heteropycnotic in all the dividing stages. Since it is totally heterochromatic throughout its length, if any addition of euchromatic material had taken place in course of evolution there would have certainly been a differential staining behaviour in some part of the X, but there is no such evidence. Presumably internal mechanism in the X-itself causes a change in centromeric position through pericentric inversion. The 2nd autosomal pair in our species which is submetacentric is believed to be due to fusion of two acrocentric autosomes. All the smaller chromosomes are acrocentrics.

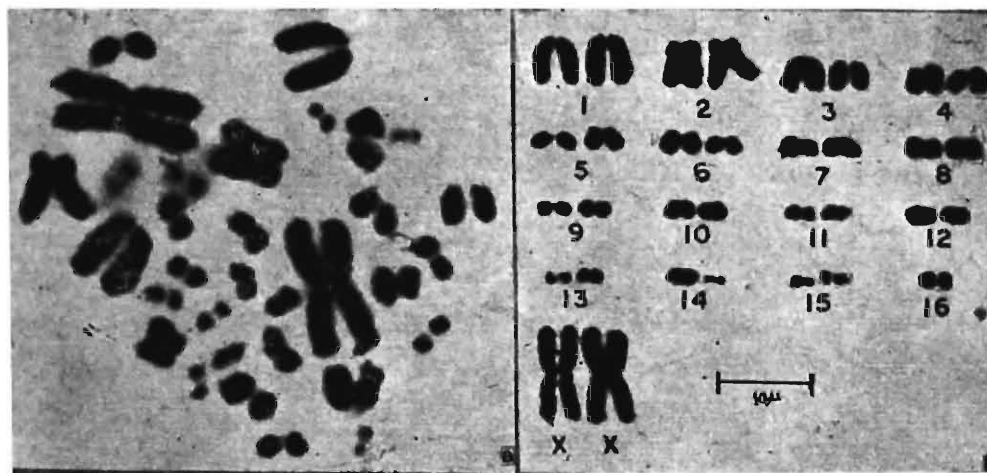
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a

b

- a. Somatic metaphase of *Xiphidiopsis straminula* showing two large metacentric X-chromosomes ;
- b. Karyotype of the same.

A NEW SPECIES OF *CATALOIPUS* BOLIVAR, 1890 (ORTHOPTERA :  
ACRIDOIDEA : EYPREPOCNEMIDINAE) FROM NORTH WEST INDIA

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ABSTRACT

A new species of *Cataloipus* Bolivar is described from India. It is named *Cataloipus himalayensis* sp. n. Characters for differentiating from its closely allied species *C. indicus* Uvarov, 1942 are discussed.

INTRODUCTION

Genus *Cataloipus* Bolivar, is an African genus which contains a large number of species distributed throughout Africa. So far only one species, *C. indicus* Uvarov belonging to this genus has been reported from India and is known to occur at Jaipur, Delhi, Kanpur and Unao. Study of the acridids collected from Kumaon and Siwalik Hills has revealed the presence of second Indian species of this genus which is being described here as new.

*Male (Holotype)* : Six medium. Antennae filiform, slightly flattened, a little longer than head and pronotum together. Head smooth, shorter than pronotum, vertex horizontal passing smoothly into the frontal costa, space between the eyes wider than the width of frontal costa, between the antennae frontal costa well raised, wide, slightly and gradually widening below, smooth, with a few, very shallow puncta. Lateral carinae ill defined, eyes oval, not prominent.

Pronotum coarsely punctured except for a comparatively smooth medium strip on both sides of the median carina, slightly tectiform, with a well developed median carina, cut by three transverse sulci, principal sulcus placed well behind the middle lateral carinae poorly developed, slightly diverging posteriorly and completely obliterated in the posterior half of the metazona ; hind margin broadly rounded. Prosternal tubercle spatulate, with broadly rounded tip, inclined backwards.

Metathoracic pleura coarsely punctured. Mesosternal lobes broader than long (Fig. 2D), their inner angles broadly rounded. Mesosternal space longer than broad. Metasternal lobes contiguous posteriorly. Tegmina slightly shorter than abdomen, but not extending beyond hind knees. Wings hyaline, slightly shorter than tegmina. Hind femora elongated, extending well beyond the abdomen, dorsal carina almost smooth. Hind tibiae slightly shorter than hind femora, with strongly developed white spines, tipped with black,

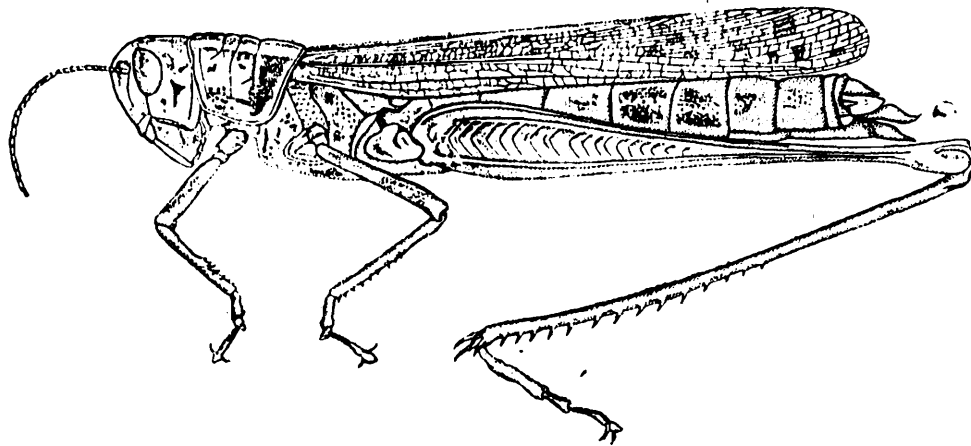


Fig. 1. *Cataloipus himalayensis* sp. n. Female, lateral view.

external apical spine absent. Arolia almost as long as the claws.

Abdomen with a well developed median carina. Tympanum large, well developed, tympanal lobe short. Tenth tergum with a pair of small, dorsal, posteriorly directed processes. Epiproct broadly triangular, longer than broad, with a well defined median sulcus in the basal half posterior angle obtuse. Cerci as long as epiproct, laterally compressed, turned ventrally at the posterior extremity. Subgenital plate long, bilobed posteriorly, the lobes pointed behind and separated by a well marked, deep, triangular notch (Fig. 2A and B). Phallic complex (Fig. 2E and F): apical valves of penis moderately long and narrow, subapically truncate but acute at apex valves of cingulum shorter; basal valves of penis robust and expanded from near middle to a little before the apex, the latter narrow and rounded; zygoma of cingulum narrow in the middle, apodemes short, arch of cingulum simple. Epiphallus (Fig. 2G) with moderately broad bridge; ancorae large, articulated with bridge, with acute, turned inwards apices; lophi large, lobiform.

General coloration dark brownish. Head pale, with a broad, median, dark brown band on the vertex extending anteriorly over frontal costa where it becomes lighter and eventually disappears a little below the median ocellus. Eyes light brown, with short dark bands below. Pronotum with two bright yellow bands running along inner sides of the lateral carinae. Tegmina with two bright yellow bands, on the costal area and the other in the vannal area; with irregularly scattered brown patches of different shapes. Hind femora yellowish, with an ill defined dark band along the ventral edge of the externo-dorsal carina in the basal half. Hind tibiae bluish with a very broad, poorly defined whitish band near the proximal end.

*Measurements*: Body, 31.00 mm; Pronotum, 5.5 mm; Tegmina 22.0 mm; Hind femora, 21.0 mm.

*Female (Allotype)*: Similar to the holotype but much larger. Metasternal lobes separated (Fig. 2C). Tenth tergum with posteriorly directed processes. Epiproct with poorly developed basal sulcus, rounded posteriorly. Cerci smaller than epiproct, conical. Subgenital plate almost truncated behind.

ovipositor valves rather short. Coloration is rather dull as compared to that of the holotype. Median band of the vertex is poorly developed. Yellow bands of the pronotum and tegmina are quite dull. Hind tibiae are dull blue.

Females ; Body, 46.5-48.0 mm ; Pronotum 8.5-9.0 mm ; Tegmina, 34.0-34.5 mm ; Hind femora, 31.0-33.0 mm.

*Material studied* : *Holotype* Male ;

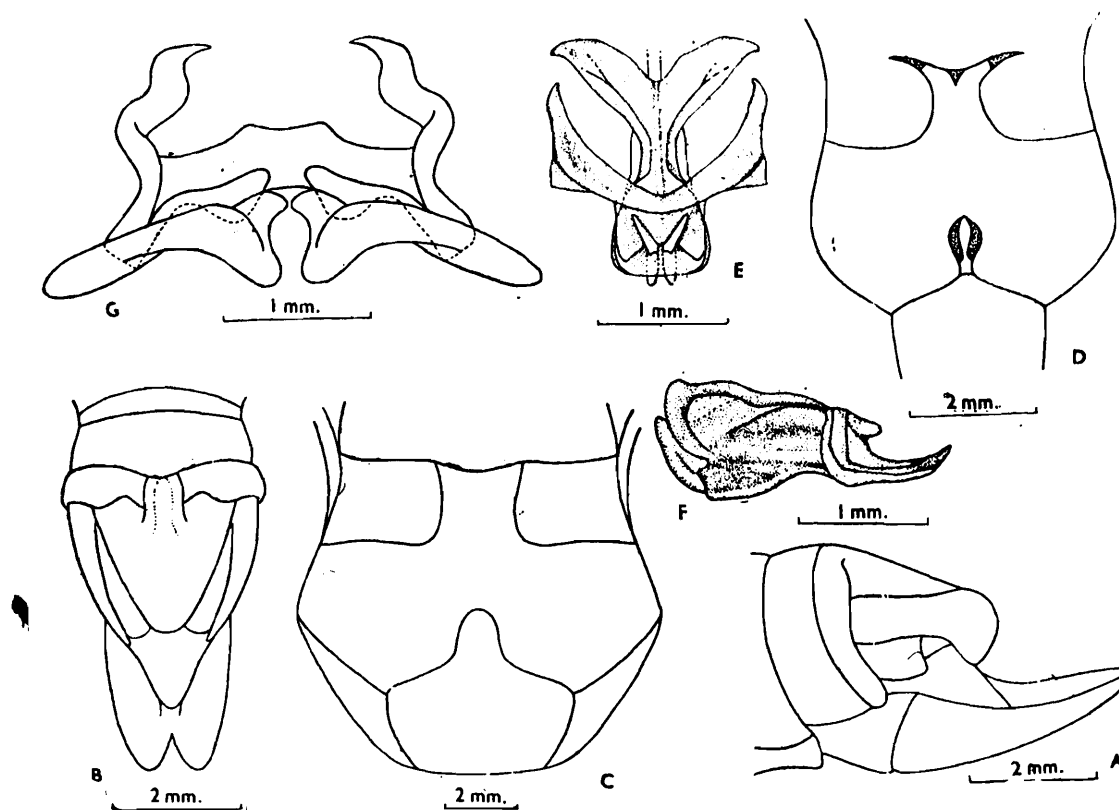


Fig. 2. *Cataloipus himalayensis* sp. n. (A) end of male abdomen, dorsal view ; (B) end of male abdomen, dorsal view ; (C) male mesosternum ; (D) female mesosternum ; (E) phallic complex, dorsal view ; (F) the same, lateral view ; (G) epiphallus.

*Measurements* : Body, 51.0 mm ; Pronotum, 8.5 mm ; Tegmen, 37.0 mm ; Hind femur, 33.0 mm.

*Paratypes* : They are similar to the holotype and allotype but differ slightly in coloration and length of the tegmina which may be slightly shorter than the abdomen. In some dorsal carina of the hind femora is very weakly serrated.

*Measurements* : Males ; Body, 31.0-35.00 mm ; Pronotum, 5.5-6.0 mm ; Tegmen, 21.5-25.0 mm ; Hind femur, 21.0-22.6 mm.

INDIA ; U. P. Distt. Nainital, Kakrighal, 1000 m. 14.xi. 1976. Coll. Asket Singh ; Zoological Survey of India, Northern Regional Station Dehra Dun. Field Collection No. 282.

*Allotype* : Female ; INDIA ; U.P. Distt. Almora, Bageshwar, 950 m. 16. xi 1976. Coll. Asket Singh ; Zoological Survey of India, Northern Regional Station, Dehra Dun. Field Collection No. 322.

*Paratypes* : 1 ♂ ; Same date as the holotype 3 ♂♂ ; same data as the allotype, 2 ♂♂ ; and 1 ♀ INDIA, Distt. Kangra,

Nagrota, 26.8. 1967. Coll. Asket Singh. 1 ♂ ; INDIA, Dist. Kangra, Polian, 18.9.1867, Coll. M. Prasad. 2 ♀ ♀ ; INDIA, Distt. Rupar, Nangal, 1200'. 22.9.1967. Coll. M. Prasad ; Distt. Hoshiarpur Gujjar 1300', 17.9.1967, Coll. M. Prasad, 1 ♂ .

*Remarks* : The new species is closely related to *Cataloipus indicus* Uvarov 1942, from which it can be differentiated by the following characters. *C. himalayensis* sp.n. is smaller in size, its tegmina do not extend beyond hind knees ; face is smoother and has very few but fine puncta ; fastigium of the vertex lacks shallow depressions and the median carina.

Genus *Cataloipus* Bolivar is essentially African in distribution with only one species viz. *C. indica* Uvarov so far known from India. This species has been recorded from Delhi, Unao, (U.P.) and Rajasthan. The occurrence of *C. cognatus* (Walker) which has been included in the checklist of Indian species by Tandon (1976) is rather doubtful. Kirby

(1914) recorded *Heteracris elegans* Walker, [a junior synonym of *Cataloipus cognatus* (Walker)] from North India, but Uvarov (1921) states that the only specimen of *H. elegans* in the British Museum on the basis of which Kirby (1914) could have included in species in the Indian Fauna does not bear any locality label. It would thus not be correct to regard this species as Indian. *H. cognatus* is known to from Nyasaland, Rhodesia, Transvaal, Oranga free State and Natal (Dirsh, 1965).

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ON THE TRIBES CARDIASTETHINI AND ALMEIDINI FROM  
SOUTH INDIA (HEMIPTERA : ANTHOCORIDAE)

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ABSTRACT

Ten species under eight genera belonging to Cardiaastethini and Almeidini are dealt with. A new genus *Indocoris* with type species *tarsatus* and two other new species *Physopleurella indica* and *Physopleurella loyola* are described. The new taxa belong to Cardiaastethini.

Since the excellent contributions of Reuter (1884) a few Hemipterists like Poppius (1909) and Van Duzee (1917) had attempted on the classification of Anthocoridae. Recently Carayon (1972) revised the classificatory system of Anthocoridae on the basis of anatomical, morphological and ecological characters and proposed a new subfamily and eight new tribes. The present paper deals with *Cardiaastethini* and *Almeidini*, belonging to the subfamily Lyctocorinae from South India. Our knowledge of these tribes is solely due to the studies of Distant (1906, 1910).

The members of Cardiaastethini and Almeidini are small, ranging from 2-4 mm long and commonly occurring in leaf litter and nests of birds. The material included in this study was collected from haystacks, under loose bark of trees, leaf litter, decaying vegetation and leaf galls.

CARDIASTETHINI Carayon

*Cardiaastethini* Carayon, 1972, *Ann. Soc. ent. Fr.*, 8 (2) : 331.

Rostrum comparatively short, reaching mid coxae, second segment straight, more than one-third of the third segment in length. Clavus devoid of round punctures. Foretibiae usually with fossula spongiosa; posterior tibiae devoid of spines. Ovipositor vestigial.

*Amphiareus* Distant, *Buchananiella* Reuter, *Cardiaastethus* Fieber, *Orthosolenopsis* Poppius, *Physopleurella* Reuter and a new genus *Indocoris* are reported from South India.

KEY TO THE GENERA FROM SOUTH INDIA

1. Forefemora without long spines . . . . . 3  
— Forefemora provided with long spines . . . . . 2
2. Foreacetabula highly expanded. Rostrum not reaching fore coxae . . . . .  
..... *Physopleurella* Reuter  
— Fore acetabula not expanded. Rostrum surpassing fore coxae . . . . .  
..... *Orthosolenopsis* Poppius
3. Foretarsi and claws together equal in length to foretibiae; claws very long . . . . .  
..... *Indocoris*, gen. nov.  
— Foretarsi and claws shorter than fore tibiae . . . . . 4

4. Metasternum with bifurcated projection.....  
 ..... *Amphiareus* Distant  
 — Metasternum without bifurcated projection  
 ..... .. 5
5. Rostrum short, surpassing anterior coxae.  
 Scent gland canal curved posteriorly .....  
 ..... *Buchananiella* Reuter  
 — Rostrum long, surpassing anterior coxae.  
 Scent gland canal curved forward .....  
 ..... .. *Cardiastethus* Fieber

### Amphiareus Distant

*Amphiareus* Distant, 1904, Ann. Mag. nat. Hist  
 (7) 14 : 220.

Type : *Xylocoris fulvescens* Walker

#### 1. *Amphiareus constrictus* (Stal)

*Xylocoris constrictus* Stal, 1860, Rio. Jan.  
*Hemipt.*, 2 : 44.

*Amphiareus constrictus* (Stal); Herring, 1965,  
*Proc. ent. Soc. Wash.*, 67 (3) : 202

**Material** : 3 ♀♀, INDIA : Kerala,  
 Trivandrum, 16.i.1971 ; 6 ♀♀, 2 ♂♂, Kerala,  
 Kottayam, Tekkady, 7.xii.1972, 5 ♀♀, 3 ♂♂,  
 Tamil Nadu, Kallar, 6.xii.1973.

**Distribution** : Sri Lanka, Burma, Celebes,

India, Sumatra, Singapore, Japan, Hawaii,  
 Guam, Madagascar and Tropical Africa,

**Remarks** : Specimens were collected from  
 sheaths of coconut palms, areca palms,  
 haystacks and dryleaves. In one case (Kallar)  
 these bugs were found feeding on *Stigmo-*  
*thrips consimilis*.

### Buchananiella Reuter

*Buchananiella* Reuter, 1885, Acta. Soc. Sic.  
*Fenn.*, 14 : 668.

Type : *Cardiastethus continus* White

#### 2. *Buchananiella crassicornis* Carayon

*Buchananiella crassicornis* Carayon, 1958, Bull. Mus.  
*Hist. nat.* 30 (2) : 153

**Material** : 1 ♂, 5 ♀♀, INDIA : Tamil  
 Nadu, Kallar, 13.iii.1973 ; 3 ♂♂, 1 ♀,

Kerala, Palghat, 31.ii.1972 ; 9 ♀♀, Tamil  
 Nadu Madras, 10.i.1972 ; 2 ♀♀, Kerala,  
 Devikolam 2.iv.1972.

**Remarks** : This species was first recorded  
 from Ivory Coast (Carayon 1958) and later  
 from South India (Muraleedharan & Anantha-  
 krishnan 1974). This species was also found  
 feeding on the larvae of *Stigmothrips*.

### Cardiastethus Fieber

*Cardiastethus* Fieber, 1860, Wein. ent. Monatschr.  
 4 : 266.

Type : *Cardiastethus luridellus* Fieber

#### 3. *Cardiastethus affinis* Poppius.

*Cardiastethus affinis* Poppius, 1909, Acta. soc.  
*Sci. Fenn.*, 37 (9) 17

**Material** : 3 ♂♂, INDIA : Tamil Nadu,  
 Madras, 7.xii.1972.

**Distribution** : East Africa.

**Remarks** : This species is recorded from  
 India for the first time.

#### 4. *Cardiastethus pygmaeus pauliani* (Lansbury)

*Cardiastethus pauliani* Lansbury, 1954, Ent. mon.  
*Mag.*, 1079 (90) : 90

*Cardiastethus pygmaeus pauliani* (Lansbury)  
 Carayon, 1957, Ann. Soc. ent. Fr., 126 : 167.

**Material** : 5 ♀♀, INDIA : Tamil Nadu,  
 Madras, 23.ii.1971 ; 1 ♂, 3 ♀♀, Madras  
 8.x.1971 ; 4 ♀♀, Madras, 15.iv.1974 ; 3 ♀♀,  
 Andhra Pradesh, Tirupathy, 7.iv.1973 ; 2 ♀♀,  
 Kerala, Tekkady, 2.k.1971.

**Distribution** : Ethiopia, Senegal, Sudan,  
 Guinae, Liberia and Ivory Coast.

**Remarks** : This species was reported earlier  
 from the nests of *Ploceus philippinus* (Mura-  
 leedharan, 1975). A new record from South  
 India.

**Indocoris**, Gen. nov.

Body elongate, oval and surface shining. Short bristles present on head and pronotum. Anterior and posterior angles of pronotum, each with a long seta and abdominal apex with macrochaetae.

Head very little produced; eyes large, ocelli situated on posterior border of eyes. Antennae with first segment short, reaching apex of head, second stouter and longer than third and fourth segments, the latter segments fusiform. Rostrum very short, reaching only anterior margin of prosternum; first segment shorter than first antennal segment; second and third equal in length.

Pronotum trapesiform, anterior collar distinct, lateral margins straight and posterior margin concave. Scutellum beset with minute setae. Hemelytra completely covering abdomen, uniformly clothed with small setae. Ostiolar canal long, moderately broad, extending outward and runs forward to reach lateral margin. Legs simple, femore neither thickened nor spinose. Claws on foretarsi enormously developed, almost as long as terminal rostral segment. Mid and hind tibiae devoid of long spines. Abdomen pubescent. Ovipositor vestigial.

Type species : *Indocoris tarsatus*, sp. nov.

*Indocoris* is closely allied to *Cardiastethus* Fieber in general appearance but the extremely short rostrum, highly developed claws and shape of ostiolar canal separates it from the latter.

5. **Indocoris tarsatus**, sp. nov.  
(Fig. 1, A-C)

Colour : Yellowish brown. Head and pronotum yellowish brown and scutellum more yellowish. Rostrum yellowish brown; antennal

segments I, II and III pale brown, IV yellow. Clavus and corium pale yellow, embolium deep yellow and cuneus dark brown; membrane clear. Legs uniform yellow. Ventral side of thorax brown and abdomen yellowish brown.

MEASUREMENTS in mm	MALE	FEMALE
Length of head	0.23—0.25	0.27
Width of head across eyes	0.30—0.30	0.32
Length of rostrum	0.24—0.25	0.25
Length of antennal segment		
	I 0.07—0.07	0.07
	II 0.25—0.27	0.23
	III 0.13—0.13	0.13
	IV 0.20—0.20	0.18
Length of pronotum	0.22—0.24	0.24
Width of pronotum across posterior margin	0.64—0.64	0.64
Total length of body	1.75—1.82	2.20

*Structure* : Body mildly setose. Head distinctly broader than long. Rostrum short, reaching anterior margin of posternum. Second segment of antennae longer in males. Pronotum and scutellum with short setae. Hemelytra completely covering abdomen; membrane with three veins. Forefemora a little thickened than mid and hind femora; foretibiae with a few strong spines at apex. Ostiolar canal as in generic description. Ventral side of thorax not pubescent. Abdomen pubescent, long bristles present at apex. Ovipositor vestigial. Paramere simple. Holotype ♂, (Reg. No. 286 H 15) INDIA : Tamil Nadu, Courtallam, from leaf galls of *Vitis* sp. 14.vii.1971; Paratypes 2 ♀♀ (Reg. No. 287/H15-288/H15) data same as in holotype. (All in Z. S. I. Collection).

In the shape of male paramere this species shows some resemblance to *Cardiastethus affinis* Poppius.

**Orthosolenopsis** Poppius

*Orthosolenopsis* Poppius, 1909, *Mcta. soc. Sci. Fenn.*, 37 (9) : 21.

Type : *Orthosolenopsis australis* Poppius.

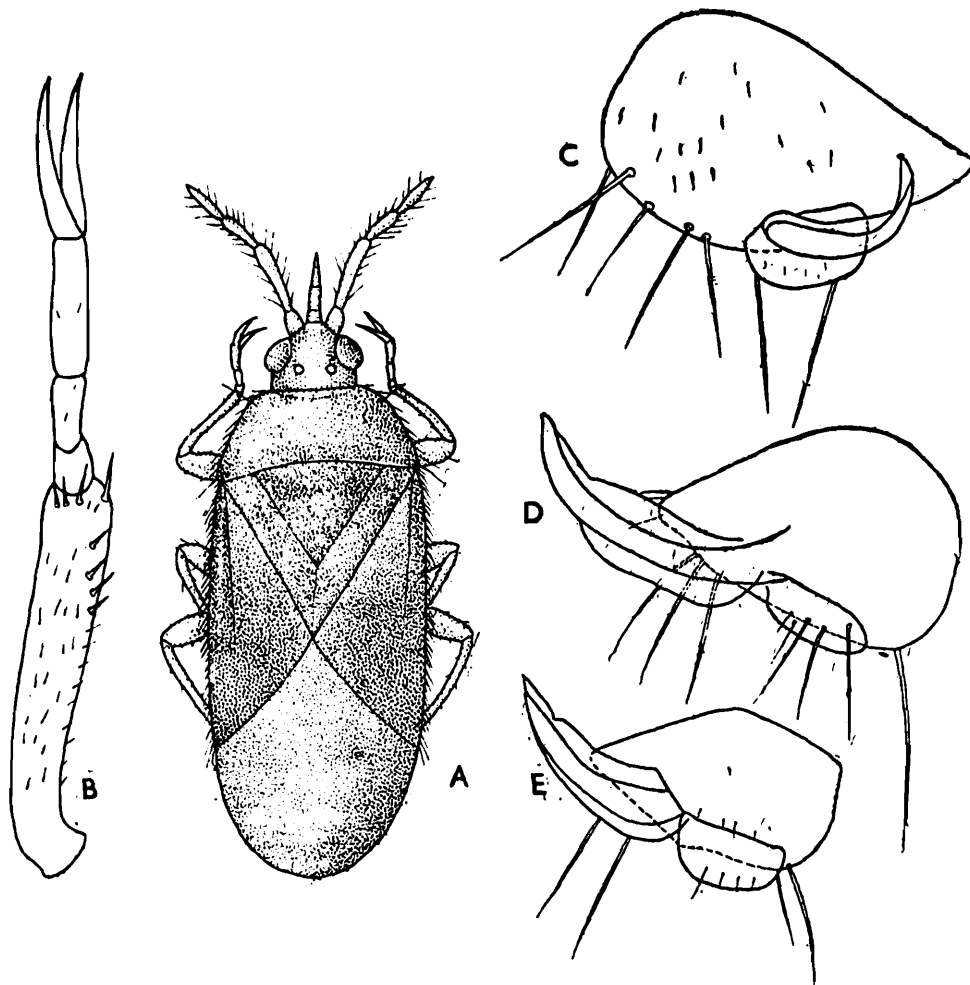


Fig. 1. (A-C) *Indocotis tarsatus*: A. female, dorsal view; B. male genitalia; C. foretibia and tarsus, D. *Physopleurella loyola*: male genitalia. E. *Physopleurella indica*: male genitalia.

6. *Orthosolenopsis carayoni* (Muraleedharan & Ananthakrishnan) Comb. nov.

*Bucananiella carayoni* Muraleedharan & Ananthakrishnan, 1974, *Oriental Ins.* 8 (1) : 34.

This is the second species to be known under the genus which was first reported from Australia (Poppius, 1909).

**Physopleurella Reuter**

*Physopleurella* Reuter, 1884, *Acta. soc. Sci. Fenn.*, 14 : 678

Type: *Cardiastethus mundulus* Buchanan & White.

7. *Physopleurella loyola*, sp. nov.

(Fig. 1, D)

Colour: Body yellow; head and pronotum

pale brownish yellow. Rostrum yellow; antennal segments I and II yellow and III and IV pale yellow. Scutellum yellowish brown. Hemelytra uniformly yellow; membrane clouded. Legs brownish yellow.

MEASUREMENTS in mm		MALE	FEMALE
Length of head		0.40—0.43	0.45—0.48
Width of head across eyes		0.35—0.37	0.35—0.39
Length of rostrum		0.33—0.36	0.36—0.40
Length of antennal segment			
	I	0.09—0.10	0.10—0.10
	II	0.35—0.38	0.38—0.38
	III	0.21—0.23	0.23—0.23
	IV	6.24—0.24	0.24—0.24
Length of pronotum		0.35—0.38	0.37—0.41
Width of pronotum		0.75—0.79	0.80—0.84
Total length of body		2.25—2.32	2.51—2.67

Structure: Body longly setose; head beset with long hyaline setae. Eyes large, protrude

ding; rostrum short, reaching anterior margin of prosternum. Antennal segment II longest, III subequal to IV. Lateral margins of pronotum sinuate and posterior border deeply concave. Scutellum with a posterior depression. Forefemore incrassate and with two rows of spines; foretibiae curved and devoid of spines. Hemelytra uniformly clothed with long setae; membrane with three veins. Male genital clasper simple. Ovipositor vestigial.

*Holotype* : ♂, (Reg. No. 289/H 15) INDIA : Madras, Loyola College Campus 10.i.1972; Paratypes 4 ♂♂, 20 ♀♀, H 15 data same for holotype. (Reg. No. 299/H15-313/H15)

This species is closely similar to *Physopleurella pessonii* Carayon in the general appearance but can be readily recognised by the shape of male genitalia and presence of a deep depression on pronotum.

### 8. *Physopleurella indica* sp. nov. (Fig. 1, E)

*Colour* : Head brown, antennae and rostrum pale yellow. Thorax brown with legs uniformly pale yellow. Hemelytra yellow except dark cuneus.

MEASUREMENTS in mm.	MALE
Length of head	0.42—0.42
Width of head	0.35—0.37
Length of rostrum	0.39—0.39
Length of antennal segment	1 0.10—0.10
	2 0.37—0.39
	3 0.20—0.20
	4 0.20—0.20
Length of pronotum	0.37—0.39
Greatest pronotal width	0.73—0.75
Total length of body	2.38—2.42

*Structure* : Body elongate and setose. Head a little broader than long. Rostrum very short, reaching anterior margin of prosternum. Antennae shorter than width of pronotum, second segment longest, third and fourth equal in length. Pronotum setose, lateral margins sinuate and posterior margin deeply concave. Lateral margins of scutellum crenu-

late. Hemelytra uniformly clothed with long setae; membrane with three veins. Forefemore incrassate, beset with two rows of spines, each row bearing 23-25 spines; foretibiae curved. Mid and hind legs simple. Paramere simple.

*Holotype* : ♂ (Reg. No. 314/H 15) INDIA, Kerala, Thenmalai, 24.vi.1972; Paratype ♂ (Reg. No. 315/H 15), data same for holotype.

*Physopleurella indica* closely resembles the preceding species in general appearance, shape of pronotum and colour, but the two species can be separated by the differences in the shape of paramere.

### ALMEIDINI Carayon

*Almeidini* Carayon, 1972, *Ann. Soc. ent. Fr.*, 8 (2) : 339

Rostrum long, slightly curved at base, second segment twice as long as third, surpassing intermediate coxae.

Terminal segments of antennae filiform. Clavus, posterior border of pronotum and scutellum provided with rounded punctures. Paramere simple; ovipositor well developed. Ectos permalege absent.

The tribe is represented in India by two genera, *Almeida* and *Lippomanus* both being recorded from South India for the first time.

### *Almeida* Distant

*Almeida* Distant, 1910, *Fauna Brit. India*. Rhynch. 5 : 300

Type : *Cardiastethus pilosus* Poppius

### 9. *Almeida pilosa* (Poppius)

*Cardiastethus pilosus* Poppius, 1909, *Acta. Soc. Sci. Fenn.*, 37 (9) : 21.

*Almeida pilosa* (Poppius) : Distant 1910 : *Fauna Brit. India* Rhynch. 5 : 301.

**Material :** 1 ♀ (brachypterous) INDIA : Andhra Pradesh, Tirupathy, 22.i.1973.

**Distribution :** Calcutta ; Tropical Asia (Carayon. 1972).

**Remarks :** Alary polymorphism is met with in this species.

### Lippomanus Distant

*Lippomanus* Distant, 1904, *Ann. Mag. nat. Hist.* (7) 14 : 221.

Type : *Lippomanus hirsutus* Distant.

### 10. *Lippomanus hirsutus* Distant

*Lippomanus hirsutus* Dist, 1904, *Ann. Mag. nat. Hist.* (7) 14 : 221.

**Material :** 2 ♀ ♀, INDIA, Tamil Nadu, Kodaikanal, 4.iv.1972.

**Distribution :** Burma and India.

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## ON A NEW GENUS AND THREE NEW SPECIES OF DERMAPTERA FROM INDIA WITH NOTES ON *EPILABIS* BURR

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### ABSTRACT

The present paper deals with two new species belonging to the genus *Epilabis* Burr. A key to the identification of all the known Indian species has been given. Besides, a new genus and species under the subfamily Opithocosmiinae have been described.

### INTRODUCTION

The material upon which the present study is based, was collected by Mr. P. S. Nathan and placed at author's disposal through the kindness of Dr. I. J. Cantrall, Museum of Zoology, Ann Arbor (U.S.A.).

All types are deposited in the Museum of Zoology, Ann Arbor (U.S.A.) except otherwise as stated.

### SYSTEMATIC ACCOUNT

Super family	LABIOIDEA
Family	CARCINOPHORIDAE
Subfamily	CARCINOPHORINAE

### Genus *Epilabis* Burr

*Epilabis* Burr, 1915. *J. R. micr. Soc.*, 1915 : 348

The genus *Epilabis* was erected by Burr (1915) for the reception of *Euborellia penicillata* Borelli (1911) as the type and *Euborellia sisera* Burr (1914). Recently, Ramamurthi and David (1973) have divided this genus by erecting the subgenus *Cryptolabis* for *E. (C.) sisera* (Burr) as the type and their's two new species, viz., *E. (C.) ramachandrai* and *E. (C.) vallakadaiensis* which lacked apical tuft of

setae on the posterior margin of penultimate sternite, although they possessed heterogenous parameres. In my opinion their's this action does not seem to be justified when the generic differentiation in the subfamily Carcinophorinae is primarily based on the shape of male genitalia, especially parameres. Therefore, it is proposed to retain the genus *Epilabis* in the old sense of Burr (*l.c.*) with a little modification and the subgenus *Cryptolabis* is treated here as its synonym.

The genus *Epilabis* can now be redefined as follows, to accomodate two new species described in the present paper : parameres longer than broad, almost of uniform width throughout except at extreme apices gently narrowed with tip somewhat rounded, external margin straight and apical angles rounded, inner margin sinuate or convex, distal lobes with chitinous rods, virga may be present or absent.

*Epilabis (Cryptolabis) ramachandrai* is transferred to the genus *Apolabis* Burr (1915) on the basis of shape of parameres which are long and tapering apically with tip acuminate, and broadest near base. The shape of parameres in *Epilabis (Cryptolabis) vallakadaiensis*

suggests its inclusion in *Gelotolabis* Burr. The genera *Epilabis* and *Gelotolabis* are very similar but the latter can be very easily differentiated in having the apical external angles of parameres a little projecting with apex pointed and produced in the form of a snout.

#### KEY TO THE SPECIES (ON ♂♂ ONLY)

1. Head with a deep cavity .....  
..... *E. sisera* (Burr)  
Head without a cavity... .. 2
2. Elytra present as narrow ovate flaps on the sides of mesonotum ..... *E. burri* Srivastava  
Elytra abbreviated, anal angles rounded off, showing a portion of mesonotum and in apical half meeting along the sutural margin... .. 3
3. Penultimate sternite with a tuft of hairs in the middle of posterior margin.... .. 4  
Penultimate sternite without a tuft of hairs in the middle of posterior margin. ... 6
4. Posterior margin of penultimate sternite in middle acute..... 5  
..... *E. emarginatus* Ramamurthi and David  
Posterior margin of penultimate sternite rounded or slightly emarginate in middle
5. Posterior margin of penultimate slightly emarginate in middle. .. ..  
..... *E. penicillata* (Borelli)  
Posterior margin of penultimate sternite rounded in middle | .....  
..... *E. analis* Ramamurthi and David
6. Body finely punctate : sides of abdominal segments obtuse, rugosely punctate ; preputial sacs without a chitinous rod ; virga not visible ..... *E. punctata* sp. n.  
Body smooth (except abdomen, finely punctate) ; sides of abdominal segments acute, with a longitudinal carina on segments 5th to 7th only ; preputial sacs with a chitinous rod ; fine virga also visible ..... *E. nilgiriensis* sp. n.

#### *Epilabis penicillata* (Borelli)

*Euborellia penicillata* Borelli, 1911. *Bol. Musei. zool. Anat. comp.*, Torino, : 3 (♂ ♀ Coonoor),

*Epilabis penicillata* : Burr, 1915, *J. R. micr. Soc.*, 1915 : 539.

*Material examined* : Tamil Nadu, Nilgiri Hills, Naduvatam, 6000', 74 ♂♂, 78 ♀♀, 49 nymphs, iv & v. 1958.

*Remarks* : Judging from the present

material and the known records it appears to be quite common in South India.

#### *Epilabis analis* Ramaurthi and David

*Epilabis analis* Ramamurthi and David, 1973,, *Zool. Anz.*, 190, (516) : 43; (♂, ♀ India Nilgiris, Ponniah, 2100 m.)

*Material examined* : Tamil Nadu, Nilgiri Hills, Naduvatam, 6000', 1 ♂, ...v. 1958.

#### *Epilabis sisera* (Burr)

(Figs. 1-A-C)

*Euborellia sisera* Burr, 1914. *Rec. Indian Mus.*, 10 : 286 (♂, India, Anamalai Hills).

*Epilabis sisera* : Burr, *J. R. micr. Soc.* 1915 : 539

*Material examined* : Tamil Nadu, Anamalai Hills, Cinchona, 3500', ♂♂, 13 ♂♂, 7 nymphs, iii. 1956.

*Remarks* : The present specimens are the topotypes of the species. Colour ranges from blackish to reddish brown. The penultimate sternite is triangular, slightly incrassate and obtusely rounded posteriorly and provided with a faintly raised, median stripe extending from middle to apex.

#### *Epilabis nilgiriensis* sp.n.

(Fig. 1,D-I)

*Material examined* : Tamil Nadu, Nilgiri Hills, Naduvatam, 6000', *Holotype* ♂, paratypes 9 ♂♂, 10 ♀♀, 2 nymphs, iv. & v. 1958. Paratype 2 ♂♂, 2 ♀♀ with the author at the Zoological Survey of India, Calcutta.

General colour blackish brown. Legs testaceous brown.

♂ : Head triangular, convex, smooth, sutures fine but distinct ; eyes much smaller than genae in length ; antennae 17-segmented, 1st equal to 2nd to 4th together ; 3rd slightly longer than 4th and equal to 5th, remaining segments long, slender, gently narrowed basally,

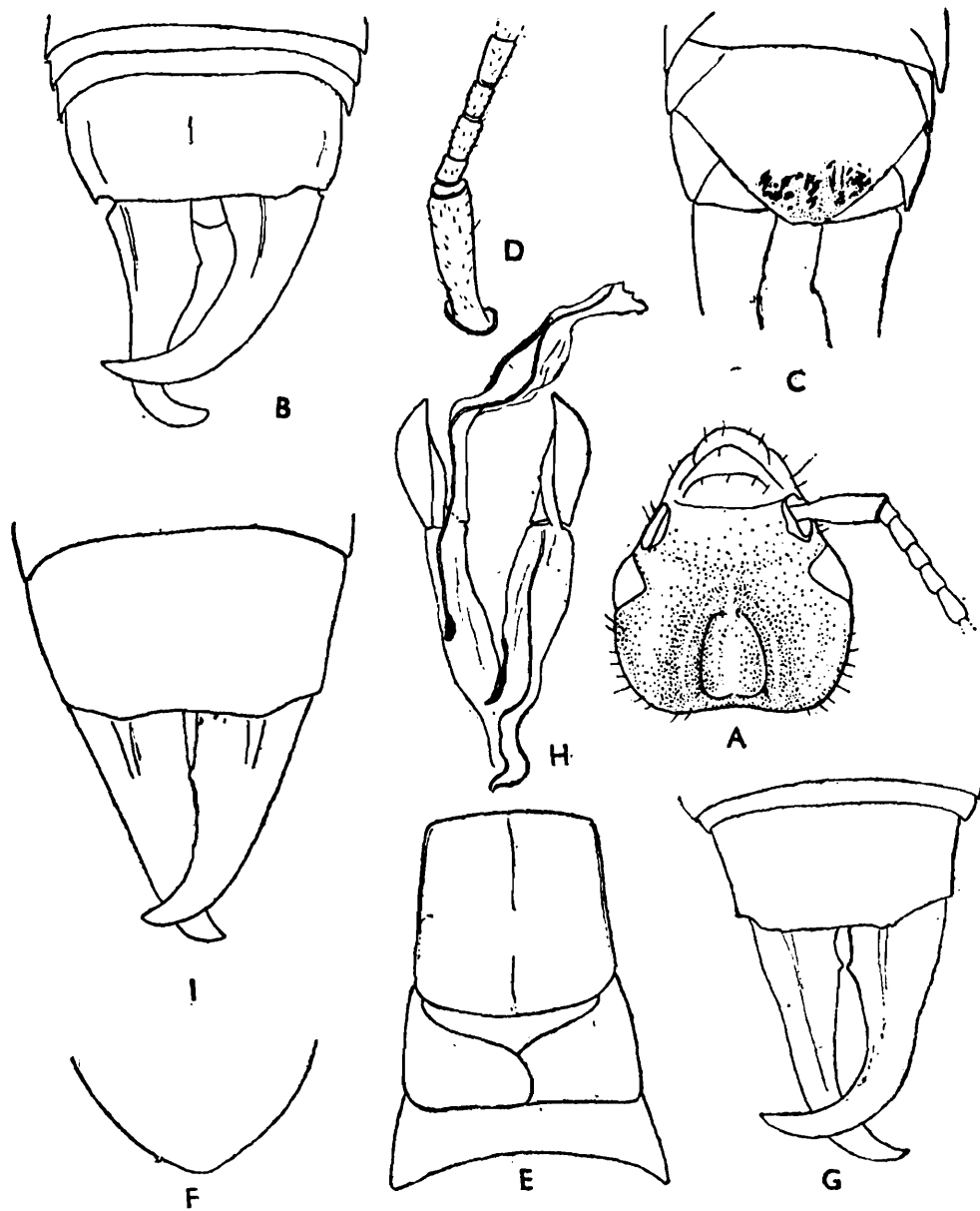


Fig. 1. A-C. *Epilabis sisera* (Burr) ♂, A. Head, B. Ultimate tergite and forceps, C. Penultimate sternite ; D-I *Epilabis nilgiriensis* sp. n. Holotype ♂, D. A few basal antennal segments, E. Thorax, F. Posterior margin of penultimate sternite, G. Ultimate tergite and forceps, H. Genitalia, ♀ : I. Ultimate tergite and forceps.

gradually increasing in length distally. Pronotum as long as broad, anterior and lateral margins straight, flat, posteriorly subtruncate and gently widened, median sulcus faint ; prozona weakly raised. Elytra same as in *E. penicillata* (Borelli). Metanotum transverse, finely punctulate, broadly emarginate posteriorly. Abdomen finely punctulate, en-

larged in middle, sides of segments acute, carinate on 5th to 7th only. Ultimate tergite sparsely punctate, transverse, gently contracted posteriorly, hind margin faintly emarginate, median sulcus distinct in anterior half only. Penultimate sternite obtusely rounded posteriorly, manubrium twice as long as the sternite and dilated at apex. Forceps sub-

contiguous, trigonal at base, gradually tapering, left branch almost straight in basal two thirds, afterwards curved, right branch strongly curved at about middle and crossing above the left, apices pointed, gently hooked, internally with a faint tooth at about basal one fourth, otherwise unarmed. Genitalia (Fig. 1, H).

♀ : As male except that the sides of abdominal segments convex and ecarinate, forceps somewhat symmetrical.

*Measurements* (in mm.)

	Holotype	Paratypes	
	♂	♂♂	♀♀
Length of body	13.6	12.7—18.3	12.5—18.0
Length of forceps	2.9	2.7—3.0	2.5—2.6

***Epilabis punctata* sp. n.**  
(Fig. 2, A-F)

*Material examined* : Tamil Nadu, Yercaud, Shevroy Hills, 4500' Holotype ♂, paratypes 12♂♂, 26♀♀ 75 nymphs, 1 & ii.1955.

Paratypes 2♂♂, 2♀♀, 4 nymphs with the author at Zoological Survey of India, Calcutta.

General colour dull blackish to reddish brown. Legs testaceous yellow. Finely punctate all over the body including elytra.

♂ : Head triangular, longer than broad, sutures faint, hind margin straight ; eyes much smaller than genae in length ; antennae 17-segmented, stout, 3rd longer than 4th & 5th but equal to 6th, remaining gradually increasing in length distally. Pronotum finely punctate, slightly broader than long, anteriorly straight, laterally straight but diverging posteriorly, hind angles well rounded and margin subtruncate. Elytra and metanotum same as in the preceding species. Abdomen convex, very slightly enlarged in middle, sides of segments obtuse, ecarinate, often rugosely punctate.

Ultimate tergite transverse, gently contracted posteriorly, sparsely punctate, median sulcus deep, hind margin straight, laterally oblique gently sinuate. Penultimate sternite triangular, obtusely rounded posteriorly, finely punctate, pubescent along the posterior margin. Forceps weakly asymmetrical, remote and trigonal at base with a ridge in basal one fourth only, afterwards depressed tapering, right branch more curved than the left, apices gently hooked and pointed, inner margin with a faint tooth at basal one fourth only. Genitalia (Fig. 2, E)

♀ : Agrees with male in most characters except that the sides of abdominal segments rounded and forceps almost symmetrical.

*Measurements* : (in mm.)

	Holotype	Paratypes	
	♂	♂♂	♀♀
Length of body	14.5	14.2—17.7	14.1—19.3
Length of forceps	3.4	3.3—3.5	3.3—4.0

*Remarks* : This species resembles closely with *Paralabis greeni* (Burr) in having the whole body punctate but the shape of parameres are quite distinctive. The latter was originally described from Sri Lanka and probably it does not occur in India. Perhaps all other records of *E. greeni* from India (Burr, 1914, Hebard, 1923) are referable to the described species.

Subfamily OPISTHOCOSMINAE

***Parasondax* gen. n.**

Build slender. Antennae 13-segmented, long and slender ; eyes smaller than genae in length ; pronotum anteriorly as wide as head, all margins straight except hind margin lightly rounded. Elytra present as narrow, ovate lateral flaps on mesonotum. Wings absent. Legs long and slender, hind metatarsal segment slightly longer than 3rd ; 2nd briefly rounded. Abdomen convex,

greatly dilated in middle, tubercular folds on 3rd tergite weakly and 4th strongly developed. Forceps long, slender, contiguous and straight at base for a short distance with or without vertical tooth, turned backward ; afterwards branches strongly bowed.

Type-Species : *Parasondax cantralli* sp.n.

*Remarks* : This genus comes very close to *Sondax* Burr (1910) but differs in having abbreviated elytra and hind metatarsal segment slightly longer than the 3rd. The genus *Synotus* Burr, however, can be also compared with the described genus but the shape of elytra is quite different.

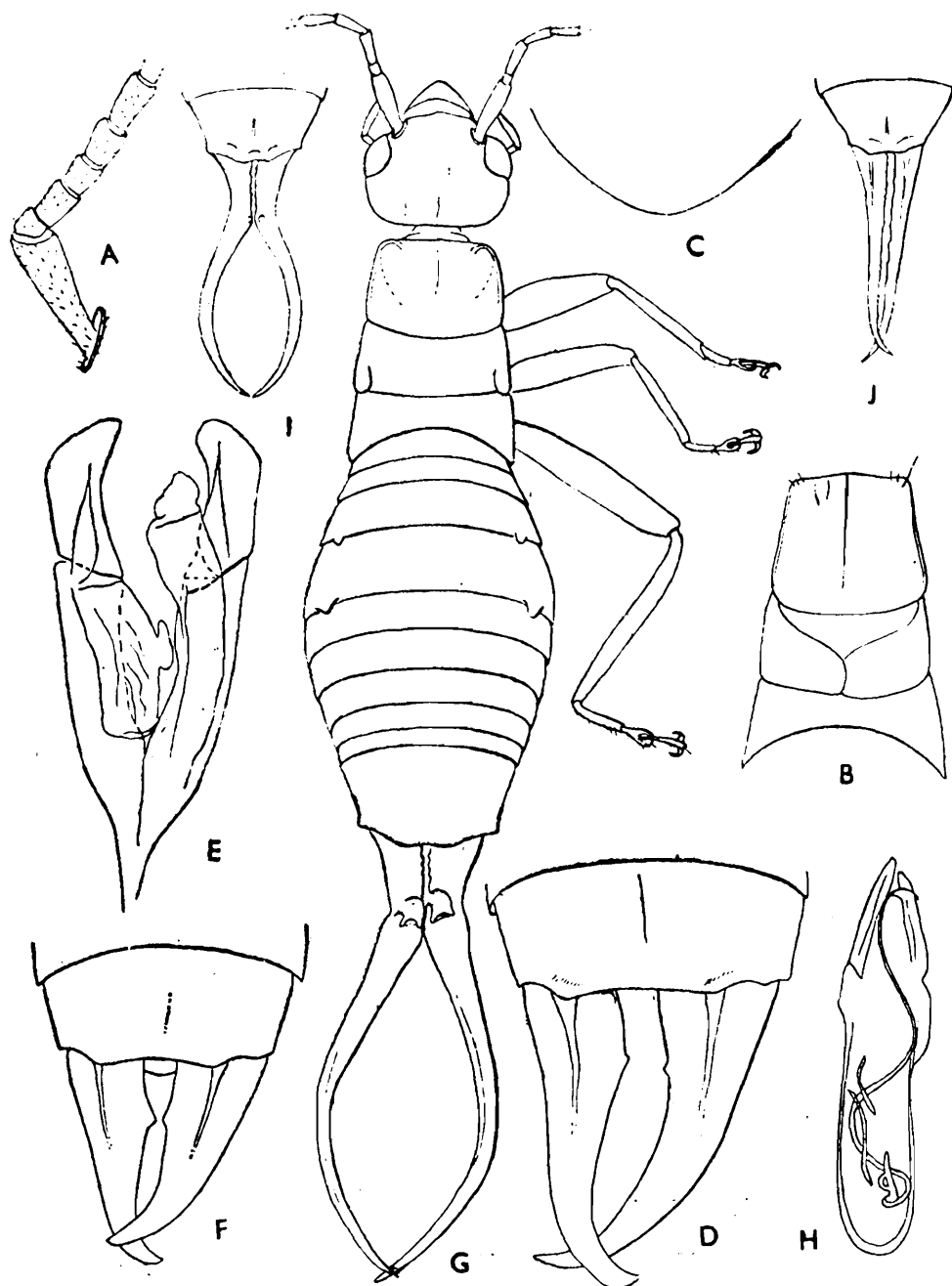


Fig. 2. A-F. *Epilabis punctate* sp. n. Holotype ♂. A, A few basal antennal segments, B. Thorax, C. Posterior margin of penultimate sternite, D. Ultimate tergite and forceps, E. Genitalia, ♀ : F. Ultimate tergite and forceps ; G-J *Parasondax cantralli* sp. n., Holotype, ♂, G, Dorsal view, H. Genitalia, [Paratype ♂, I. Ultimate tergite and forceps, ♂ : J. Ultimate tergite and forceps.

**Parasondax cantralli sp. n.**  
(Fig. 2, G-J)

*Material examined* : Tamil Nadu, Nilgiri Hills, Naduvatam, 6000', Holotype ♂, paratypes 4 ♂♂, 9 ♀♀, 2 nymphs, v. 1958 and 2 ♂♂, iv. 1958. Paratypes 2 ♂♂, 2 ♀♀ with the author at Zoological Survey of India, Calcutta.

General colour testaceous brown with traces of black in part.

Head about as long as broad, smooth, frons weakly convex, sutures obliterated, hind margin scarcely emarginate in middle. Eyes much shorter than genae in length. Antennae 13-segmented, long and slender; 1st stout, equal to 2nd-4th together; 3rd and 4th sub-equal but both shorter than 5th, remaining gradually increasing in length distally. Pronotum weakly transverse, quadrate with all margins straight, laterally gently reflexed, median sulcus obliterated; prozona convex and metazona flat. Mesonotum transverse, posteriorly straight, with abbreviated ovate elytra laterally. Metanotum with hind margin emarginate. Legs long, slender, hind metatarsus slightly longer than the 3rd segment; 2nd briefly lobed, with long and short pubescence on under side. Abdomen convex, greatly enlarged in middle, smooth above, sides rounded, finely striate. Penultimate sternite broadly rounded posteriorly. Ultimate tergite strongly declivient and narrowed posteriorly, low tumid elevations above the roots of forceps present, hind margin trisinate. Forceps with branches depressed, contiguous, straight, internally dentate in basal one fourth with a vertical tooth, apex of which bifid and turned backwards, afterwards branches strongly bowed, compressed, tapering with apices pointed and crossing. Genitalia (Fig. 2, H).

♀ : Agrees with male in most characters but forceps simple, straight, contiguous and internally finely dentate throughout.

*Measurements* (in mm.) :

	Holotype	Paratypes	
	♂	♂♂	♀♀
Length of body	8.8	5.8—9.0	7.5—9.1
Length of forceps	4.8	3.7—5.6	2.6—3.0

*Remarks* : In some male specimens the vertical tooth of forceps is almost wanting and in its place only a vestige of tubercle could be observed. Pronotum sometimes is very slightly expanded posteriorly.

ACKNOWLEDGEMENTS

I am indebted to Dr. Irving J. Cantrall of Museum of Zoology, the University of Michigan, Ann Arbor (U.S.A.) for placing this interesting collection at my disposal. I am also thankful to the Director, Zoological Survey of India, Calcutta for providing necessary facilities.

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## FUNCTIONAL RESPONSES OF CAT FISH BARBELS\*

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### ABSTRACT

Catfish barbels are generally considered as intended for tactile purposes. Evidences have indicated that the barbels have diverse functions. These gustatory, locomotory, aggressive and sexual aspects are discussed.

### INTRODUCTION

It is well known that all siluriform fishes have barbels ranging from one pair (as in *Silonia* Swainson, *Osteogobius* Bleeker) to four pairs in number and from most minute (*Leiocassis rama* (Hamilton)) to as long as body length, if not longer in size (*Mystus cavasius* (Hamilton)). The maxillary barbels which are nearly always the longest are usually between half and twice the length of the head. It has been generally considered that these barbels act mainly as feelers for searching food in the media they live which are generally sluggish, ill-lit stream bottoms. Diverse functions other than merely of a tactile nature have come to light which are discussed here.

### STRUCTURE

In investigating the functions of the barbels it becomes necessary to know their histological structure. Sato (1937), Sato and Kapoor (1957), Nagar and Mathur (1958) found that the maxillary barbels possess an axial rod of cartilagenous tissue. Alexander (1965) found this central rod as a thick sheath of Collagen fibres. Ghiot (1976) observed that the Bag-

roidei (*sensu* Chardon, 1968) have such an elastic axial rod. The epidermis is studded with cutaneous pear-shaped taste buds. These taste buds are found to be more numerous on the apical region than on the basal region, and are with mucus cells and club cells, the presence or absence of either of them being not uncommon. For instance *Bagarius bagarius* (Hamilton) does not have any mucus or club cells unlike *Ompok bimaculatus* (Bloch) and *Heteropneustes fossilis* (Bloch) which have many of these cells. Pfeiffer (1963) considered club cells as distinct from mucus secreting cells as the nucleus in the former lies in the center unlike the latter where it is on the periphery. Moreover, barbel epidermis contains no club cells or only a few very small ones, while the body epidermis are abundantly supplied with these cells.

Baecker (1926) divided the barbels into different categories on the basis of the structure of the barbel. Thus *Ompok bimaculatus* and *Heteropneustes fossilis* are grouped by him to be with barbels of the flexible type as they have an axial rod of cartilagenous tissue. Other nonsiluriform fishes such as *Botia* and *Barbus* are considered as with barbels of the

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tender type since the central core of the maxillary barbels in these fishes has only a channel for the blood vessel besides nerve fibres. The movement of the barbels in these fishes are effected by the blood vessels becoming turgid unlike in Catfishes where generally the adductor muscles act as a rotatory axil for the barbels.

### FUNCTIONS

**Gustation** :—Taste buds as their name indicate helps in the selection of food items for these fishes. These are found all over the body in most catfishes (Bhatti, 1938), but are plentiful on the barbels. A wide variety of

bottom feeding fishes bear these taste buds on their barbels near the mouth. Herrick (1903) demonstrated that in *Ictalurus* the nose informs the fish the proximity of food which is then searched for and located with barbels. The long barbels on the maxilla cause a stream of water containing food such as insects, crustaceans, etc. to come near the mouth by their rotatory movements (Burne, 1909). These observations are substantiated by their feeding habits. For instance *Mystus* species feed largely on crustaceans (Kamal Pasha, 1964); *Ictalurus* and *Porcus* mainly on bottom living invertebrates (Corbet, 1961). Besides the maxillary barbels, the mental barbels on the ventral side are admirably arranged for exploring the bottom, near the mouth for

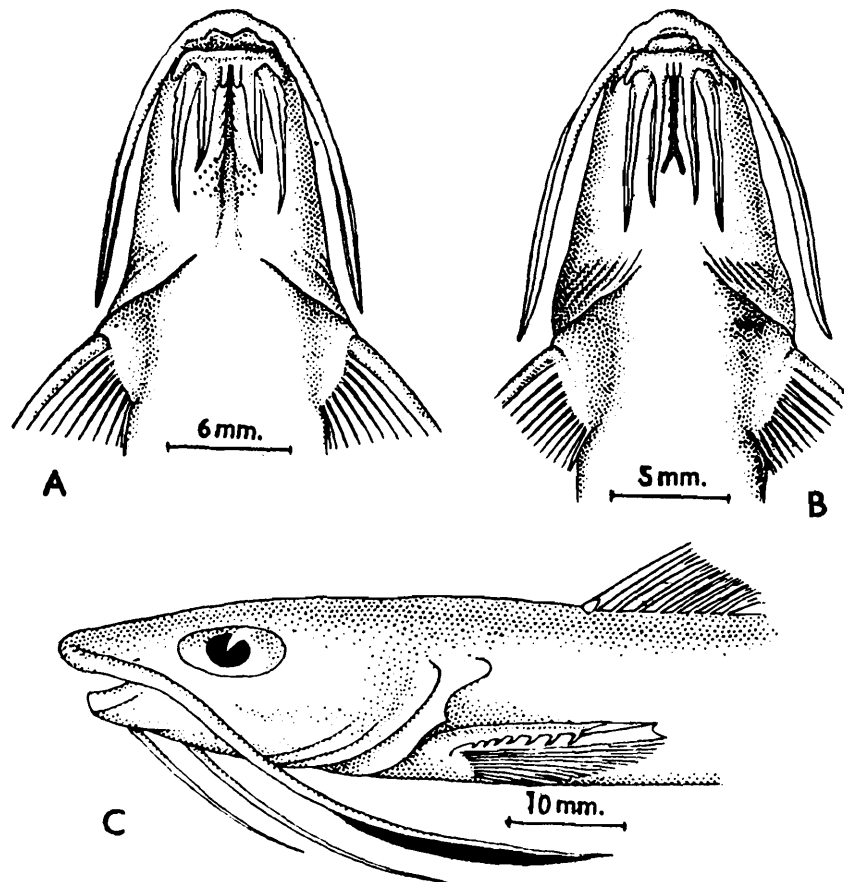


Fig. 1. Ventral view of head and anterior part of body of *Gagata cenia* (Hamilton), B. Of *Nangra viridescens* (Hamilton), showing the small papillae-like barbels in between the mandibular pair and the sieve-like formation. C. Lateral view of *Phyllonemus typus*. Beulenger showing the leaf-like expansion of the maxillary barbels.

food. In *Nangra* and *Gagata* besides the usual pair, a small pair of papillae-like barbels are found in between, which additionally help in discriminating the food. Added to these, a stiff sieve-like formation of the in between skin-fold assist in sieving extraneous matters. Considering that *Nangra* and *Gagata* are inhabitants of rocky streams, with many pebbles, and sand particles, this adaptation of the mandibular barbels is very striking.

**Locomotion** :—Longer barbels of fishes such as *Pimelodella* of South America, *Porcus* of Africa, *Mystus* of India, have a secondary function to avoid obstacles, before the fish could move into crevices and mud holes in search of food. *Phyllonemus* of Tanganyika, Africa has the maxillary barbel flattened like a leaf at its anterior edges. Though, the exact nature of this modification is not known,

it seems probable this flattened edge acts as a pad to clear obstacles and also to immobilise insects, crustaceans which form the food-items.

**Fright** : Pfffer (1963) based on a number of experiments indicated that fright reaction occurred because of release of alarm substance when the skin is injured and not to barbel skin. Sato (1937) found *Plotosus anguillaris* recognising and reacting more by chemical sense such as the release of alarm substance, rather than by the barbels. Even when the barbels were severed, cognition of food substances took place. It would thus appear that barbels play no part in fright reaction.

**Aggression** : However, the barbels are put out stiffly in an aggressive manner for defense when irritated or in inescapable situations of

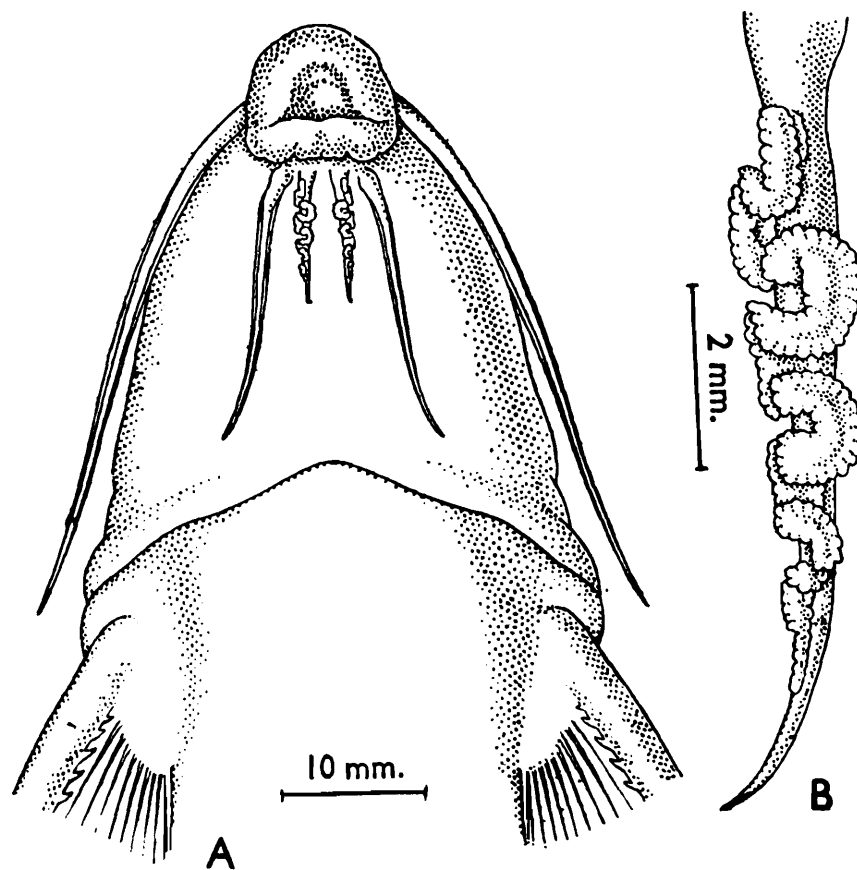


Fig. 2. A ventral view of head and anterior part of body of *Bagrichthys hypselopterus* Balcker showing the modified inner mandibular barbel. B. Enlarged view of the barbel to show the cup-like structure with papillae.

danger. Day (1878) recorded *Mystus vittatus* known as the fiddler fish in Mysore to act in this manner. He observed (p. 449) "I touched one which was on the wet ground, at which it appeared to become very irate, erecting its dorsal fin and making a noise resembling the buzzing of a bee evidently a sign of danger. Having put some small carp into an aquarium containing one of these fishes it rushed at a small example, seized by the middle of its back and shook it like a dog killing a rat, at the time its barbels were stiffened out laterally like a Cat's whiskers". *Clarias batrachus* and *Heteropneustes fossilis* are also known to put out their barbels and spines stiffly in a defensive or aggressive posture when irritated. Fishermen would rather cut the meshes of their nets and allow a fighting dreadful *singi* escape with its pectoral fins poised, than dare to handle it.

**Sexual attraction :** Breder (1935) considered that tactile stimulation of the barbels played a part in mating of catfishes. *Bagrithys hypselopterus* from Thailand has the inner mandibular barbels frilled with cup-like borders. Though this also may help in procuring food, the modification of only the inner mandibular pair seems to suggest that it may be for sexual attraction. Further, this adaptation is present only in the females; the males have plain barbels.

#### CONCLUSIONS

The barbels of catfishes which are largely responsible for their popular name are their most conspicuous feature. Though considered primarily for tactile purposes, it appears that some have other functions such as aggressive, locomotory and even sexual. Experimental work on these aspects is much needed and may help in ascertaining the diverse functions of the whiskers of catfishes.

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IDENTITY OF THE SCHIZOTHORACID FISH GENUS *SCHIZOTHORAX* HECKEL, 1838, WITH CONSIDERATIONS OF THE STATUS OF *SCHIZOTHORAICHTHYS* MISRA, 1962

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ABSTRACT

The taxonomic position of the commercially important fishes of the genus *Schizothorax* Heckel, 1838, has long been in a state of uncertainty. Its systematic position is elucidated and the genus is diagnosed on the basis of its valid type-species. The nominal genera *Schizopyge* Heckel, 1848, *Opisthocheilus* Bleeker, 1860, and *Schizothoraichthys* Misra, 1962, are placed in the synonymy of *Schizothorax*. The genus *Oreinus* McClelland, 1839, is resurrected from the synonymy of *Schizothorax*. Diagnostic features of these two genera are enumerated.

INTRODUCTION

The cyprinoid fishes of the composite genus *Schizothorax* Heckel, 1838, inhabit the mountain streams usually above an altitude of 670 metres along the Himalayan range. These fishes are commonly called the "Indian Trout" and are of great economic importance as food fishes. These fishes have had a rather long uncertain taxonomic history.

The genus *Schizothorax* was established by Heckel (1838), without any type designation, to contain ten new species from Kashmir. Heckel grouped these ten species in three groups, "A", "B", "C", the first group characterised by a sucker at the chin and the latter two groups without it. This situation has led to the description of several genera. Undoubtedly much of the confusion arose due to misinterpretation of the type-species of the genus *Schizothorax*. The present paper is an attempt to reclarify the generic relationship of the fishes of the composite genus *Schizothorax* and to demonstrate that Mc-

Clelland's (1842) designation of *Schizothorax esocinus* Heckel, 1838, as the type-species of the genus *Schizothorax* Heckel is the first (and valid) designation of a type-species for the genus in accordance with Article 69 of the *International Code of Zoological Nomenclature*, 1961. The genus *Schizothoraichthys* Misra, 1962, is, therefore, a subjective synonym of *Schizothorax* Heckel from that premise.

NOMENCLATURAL HISTORY—A RETROSPECT

The genus *Schizothorax* was established by Heckel (1838), without any type designation, and it included ten new species: *plagiostomus*, *sinuatus*, *curvifrons*, *longipinnis*, *niger*, *nasus*, *hugelii*, *micropogon*, *planifrons* and *esocinus*. He grouped these ten species in three species-groups, 'A', 'B' and 'C'. In group 'A' he allocated the first two species (*plagiostomus* and *sinuatus*) which are characterised as having a suctorial mouth; in group 'B' he placed the next four listed species (*curvifrons*, *longipinnis*, *niger* and *nasus*) which are characterised by the absence of a suc-

torial mouth but in which the lips are rounded and fleshy ; and lastly in group 'C' he placed the last four listed species (*hugelii*, *micropogon*, *planifrons* and *esocinus*) which are also characterised by the absence of a suctorial mouth but in which the lips are soft and pointed.

McClelland (1839) in his monograph on Indian Cyprinidae, evidently unaware of Heckel's (1838) paper, proposed a new genus *Oreinus*, without any type designation, for these schizothoracic fishes and mentioned thereunder four species : *O. guttatus* McClelland, 1839, *O. richardsonii* (Gray, 1832), *O. maculatus* McClelland, 1839 and *O. progastus* McClelland, 1839. The original description of the genus *Oreinus* is inadequate regarding the presence or absence of the suctorial mouth in the four species described. However, the former three species described by McClelland (op. cit.) possess a suctorial mouth and hence fall in Heckel's group 'A' while the fourth species (*O. progastus*) lacks a suctorial mouth and falls in groups 'B' and 'C' (Tilak and Sinha, 1975). Gistel (1848) erroneously regarded the genus *Oreinus* as preoccupied by *Oreina* in Coleoptera and, therefore, suggested the replacement name *Englottogaster*.

McClelland (1842) reclassified these fishes into two distinct subgeneric groups : *Schizothorax* and *Oreinus*. He compared the head and jaw bones of *Schizothorax esocinus* Heckel with *S. plagiostomus* Heckel in support of this subgeneric grouping and remarked, "The first is the type of *Schizothorax proprius* and the latter of *Oreinus*" This is the first (and valid) designation of a type-species for the genus *Schizothorax* Heckel. McClelland's designation of *Schizothorax plagiostomus* Heckel as the type of the subgenus *Oreinus* McClelland is, however, invalid since *plagiostomus* was not originally included in McClelland's genus *Oreinus* vide Article 67 (e) & (h) of the Code.

Heckel (1843) restricted the genus *Schizothorax* to those species with soft lips and proposed a new genus, *Schizopyge* for the accommodation of species with the lower lip strengthened by cartilage. The genus *Schizopyge* was established without any type-species designation and in it were included the six species (*plagiostomus*, *sinuatus*, *curvifrons*, *longipinnis*, *niger* and *nasus*) of Heckel's (1838) groups 'A' and 'B'.

Bleeker (1860 : 425) proposed a new genus, *Opisthocheilus* for McClelland's '*Schizothorax proprius*' mistaking the term 'proprius' for a specific name. According to Gunther (1868), McClelland 'never described a fish under such a name, but distinguished a subgenus '*Schizothorax proprius*' from Heckel's genus *Schizothorax*.' The connotation 'proprius' evidently means 'proper' (Tilak and Sinha, 1975), the term 'proprius' having been used earlier also by McClelland (1839 : 274) for the genus *Cyprinus*. The genus *Opisthocheilus* is hence a junior objective synonym of the genus *Schizothorax* McClelland, 1842 *sensu stricto*.

Bleeker (1863) equated his *Opisthocheilus* with *Schizothorax* Heckel and designated *Schizothorax plagiostomus* Heckel as the type-species of the latter genus. Bleeker (op. cit.) also recognized the genus *Oreinus* McClelland and designated *Oreinus guttatus* as its type species. This is the first valid designation of a type-species of the genus *Oreinus*. Further, Bleeker (op.cit) designated *Schizothorax curvifrons* Heckel as the type-species of the genus *Schizopyge* Heckel.

Gunther (1868) and Day (1877) recognised the genus *Oreinus* McClelland for section 'A' and the genus *Schizothorax* Heckel for sections 'B' and 'C' of Heckel's composite genus *Schizothorax*. This generic arrangement was widely used till recently (Chaudhuri, 1913 ; Tchang, 1931 ; Hora, 1933, 1934, 1935, 1937 ; Mukerji, 1936 ; Fang, 1936 ; Shaw and Shebbeare,

1937 ; Misra, 1949 ; Vijayalakshman, 1952 ; Fowler and Steinitz, 1956 ; Silas, 1960 ; Jayaram and Mujumdar, 1964 ; Mirza, 1966 ; Das and Subla, 1966).

Another type-species designation for the genus *Oreinus* McClelland was made by Jordan (1919 : 195) who selected *Oreinus guttatus* McClelland, 1839. Jordan (op cit : 192) recognised Bleeker's (1863) designation of *Schizothorax plagiostomus* Heckel as the type species of the genus *Schizothorax* and consequently considered the latter genus a probable senior synonym of the genus *Oreinus*.

Chu (1935) pointed out that according to Bleeker's restriction (*Nat. Tijds. Dierk.*, 1, p. 196, 1863) the name *Schizopyge* Heckel should be used in place of "*Schizothorax*" of authors and *Schizothorax* Heckel should replace the name *Oreinus* of McClelland. Mukerji (1936 : 333) agreed with the statement but was in favour, in view of the general application, to conserve the names *Schizothorax* and *Oreinus* in their hithertofore accepted sense.

Misra (1962) recognised Bleeker's (1863) designation of *Schizothorax plagiostomus* Heckel, 1838, as the type-species of the genus *Schizothorax* Heckel, 1838, and *Oreinus guttatus* McClelland, 1839, as the type-species of the genus *Oreinus* McClelland, 1839, and consequently considered *Oreinus* as a junior synonym of *Schizothorax* since the type-species of both these genera are characterised as having a suctorial disc. Misra (op. cit.) established the genus *Schizothoraichthys* with *Schizothorax esocinus* Heckel, 1838, as its type-species, to accommodate 'the species without suctorial disc which were put under the genus *Schizothorax* by Heckel and which are now left without any generic name.' Recent workers (Saksena, 1968 ; Menon, 1971, 1974 ; Tilak and Sinha, 1975 ; Jhingran, 1975) followed Misra's generic arrangement for these fishes. Tilak and Sinha (op. cit.) reviewed the nomenclatural

history of the genus *Schizothorax* Heckel and in an attempt to justify Misra's disposition of these fishes, remarked, "At the same time, in 1863, he (Bleeker) equated *Opisthocheilus* with *Schizothorax* Heckel and designated *Schizothorax plagiostomus* as its type-species (by subsequent designation). *S. plagiostomus* Heckel is a species with a sucker at the chin. Bleeker (1863) has also recognised *Oreinus* McClelland and fixed *Oreinus guttatus* as its type-species (by subsequent designation). Thus Bleeker (1863), without understanding the differences between the fishes with a sucker at the chin and those without it, put the whole situation in a big confusion. He even appears to have disregarded McClelland (1842) who drew a clear distinction between the two sub-generic groups. However, the fixation of the type-species of the genus *Schizothorax* Heckel (*Schizothorax plagiostomus*) as done by Bleeker in 1863 has to be accepted." These authors did not invoke the use of the International Commission on Zoological Nomenclature plenary powers, but, as interpreted herein, should have done so. If Misra's contention was to be regarded as correct, this would necessitate changing the concept of the genus *Schizothorax* from that accepted since 1868, and further accepting a new name for the genus currently known as *Schizothorax*. Das and Subla (1966) had earlier expressed doubt regarding the validity of the genus *Schizothoraichthys* Misra, 1962. Since Bleeker's (1863) designation of *Schizothorax plagiostomus* Heckel, 1838, as the type-species of the genus *Schizothorax* is a subsequent designation, it is invalid in accordance with Article 69 of the Code.

The synonymy of the genera *Schizothorax* and *Oreinus* have, therefore, been drawn out below so as to clearly depict their taxonomic positions and the diagnostic features of these two genera are given.

#### Genus *Schizothorax* Heckel

*Schizothorax* Heckel, 1838, *Fische aus Caschmir* :  
11 (type species : *Schizothorax esocinus*)

Heckel, 1838. designated by McClelland (1842).

*Schizopyge* Heckel, 1843, *Reisen in Europa, Asian und Africa* : 285 (type species : *Schizothorax curvifrons* Heckel, 1838, designated by Bleeker (1863)).

*Opisotcheilus* Bleeker, 1860, *Naturk. Tijdschr. Nederl. Indie*, 20 : 425 (type species : *Opisotcheilus propius* McClelland by original designation).

*Schizothoracichthys* Misra, 1962, *Rec Indian Mus.*, 57 : 48 (type species : *Schizothorax esocinus* Heckel, 1838, by original designation).

**Diagnosis :** Abdomen rounded. Mouth arched, inferior or subinferior ; lower lip non-suctorial ; lower labial fold interrupted or entire in the middle. Two pairs of barbels, a rostral and maxillary pair. Pharyngeal teeth in three rows, 5-3-2/2-3-5. Dorsal fin short, arising opposite the ventral fin, with a strong or moderate spine, serrated posteriorly. Scales minute ; lepidosis irregular.

The following species are presently recognised from the faunal limits of India : *S. esocinus* Heckel, *S. curvifrons* Heckel, *S. longipinnis* Heckel, *S. niger* Heckel, *S. nasus* Heckel, *S. hugelii* Heckel, *S. micropogon* Heckel, *S. planifrons* Heckel and *S. progastus* (McClelland).

### Genus *Oreinus* McClelland

*Oreinus* McClelland, 1839, *Asiatic Res.*, Calcutta 19 (2) : 273 (type species : *Oreinus guttatus* McClelland, 1839 (= *Oreinus richardsonii* Gray, 1832) designated by Bleeker (1863)).

*Englottogaster* Gistel, 1848, *Naturg. Thierr. höhere Schulen*, Stuttgart : X (Substitute name for *Oreinus* allegedly preoccupied in Coleoptera).

**Diagnosis :** Abdomen rounded. Mouth inferior, margin of lower jaw having a firm and hard horny covering (thickest internally) and a thick lower lip with a free posterior edge, forming a sucker. Two pairs of barbels, a rostral and maxillary pair. Pharyngeal teeth in three rows, 5-3-2/2-3-5. Dorsal fin short, arising opposite the ventral fin ; dorsal fin spine strong, serrated posteriorly. Scales minute ; lepidosis irregular.

Two species are presently recognised from the faunal limits of India : *O. richardsonii* (Gray) and *O. kumoanensis* (Menon, 1971). Further, Saxsena (1968) cites *Oreinus nigromarginalis* Das & Subla, 1966, a specific name not given in the reference cited by Saxsena (op. cit.) nor am I able to locate the original reference to this species.

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STUDIES ON THE MALE ACCESSORY GENITAL STRUCTURES OF *NEUROTHEMIS FULVIA* (DRURY), *NEUROTHEMIS INTERMEDIA INTERMEDIA* (RAMBUR) AND *NEUROTHEMIS TULLIA TULLIA* (DRURY) FROM WESTERN HIMALAYA (ODONATA : LIBELLULIDAE SYMPETRINAE)

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ABSTRACT

Male accessory genital structures of the *Neurothemis fulvia* (Drury), *Neurothemis intermedia intermedia* (Rambur) and *Neurothemis tullia tullia* (Drury) from Western Himalayas along with the key have been dealt with in this paper.

INTRODUCTION

The organs which are actually concerned with sexual mating and deposition of eggs are known as genitalia. The genital structures of the Odonates are peculiar, because they have two sets of male genitalia, the primary and the secondary or accessory genitalia situated on the ventral aspects of ninth and tenth and on the ventral surface of entire second and apical portion of third abdominal segments respectively. The secondary or accessory male genitalia shows the same variation and functions as the primary genitalia in the other group of insects. Kennedy (1916a, 1916b and 1917) has dealt with the comparative study of penes in the suborder Zygoptera and suggested that the detailed monographic study of the entire group of Zygoptera might reveal how far the male genitalia would show the true relationship between species and genera. Fraser (1936) has given brief descriptions of male genitalia of the dragonflies while dealing with the detailed external morphology in the Fauna of British India. Cowley (1937), while studying the genitalia of the family Chlorocyphidae, suggested that genitalia should be used along

with the other characters in the taxonomic study of this group. Fraser (1940 and 1956) has also described in detail the penes of the family Gomphidae as well as structure and function of different parts of generalized male and female genitalia of the order Odonata.

The detail description of primary and secondary copulatory complex in *Neurobasis chinensis chinensis* (Linn.) and *Megalestes major* Selys has been given by Khan (1974 and 1976). Recently Prasad (in press) has also made a detailed study of male accessory genital structure in the genus *Trithemis* Braver from Western Himalaya. The male accessory genital structure of the species of genus *Neurothemis* has not been studied so far. The male accessory genital structures of the *Neurothemis fulvia* (Drury), *Neurothemis intermedia intermedia* (Rambur) and *Neurothemis tullia tullia* (Drury), collected from the Western Himalaya have been described in this paper. The taxonomically important genital parts are the following :

1. Fenestra (Fen) (=genital fossa, Khan, 1977)
2. Anterior lamina (Al)
3. Posterior lamina (Pl)

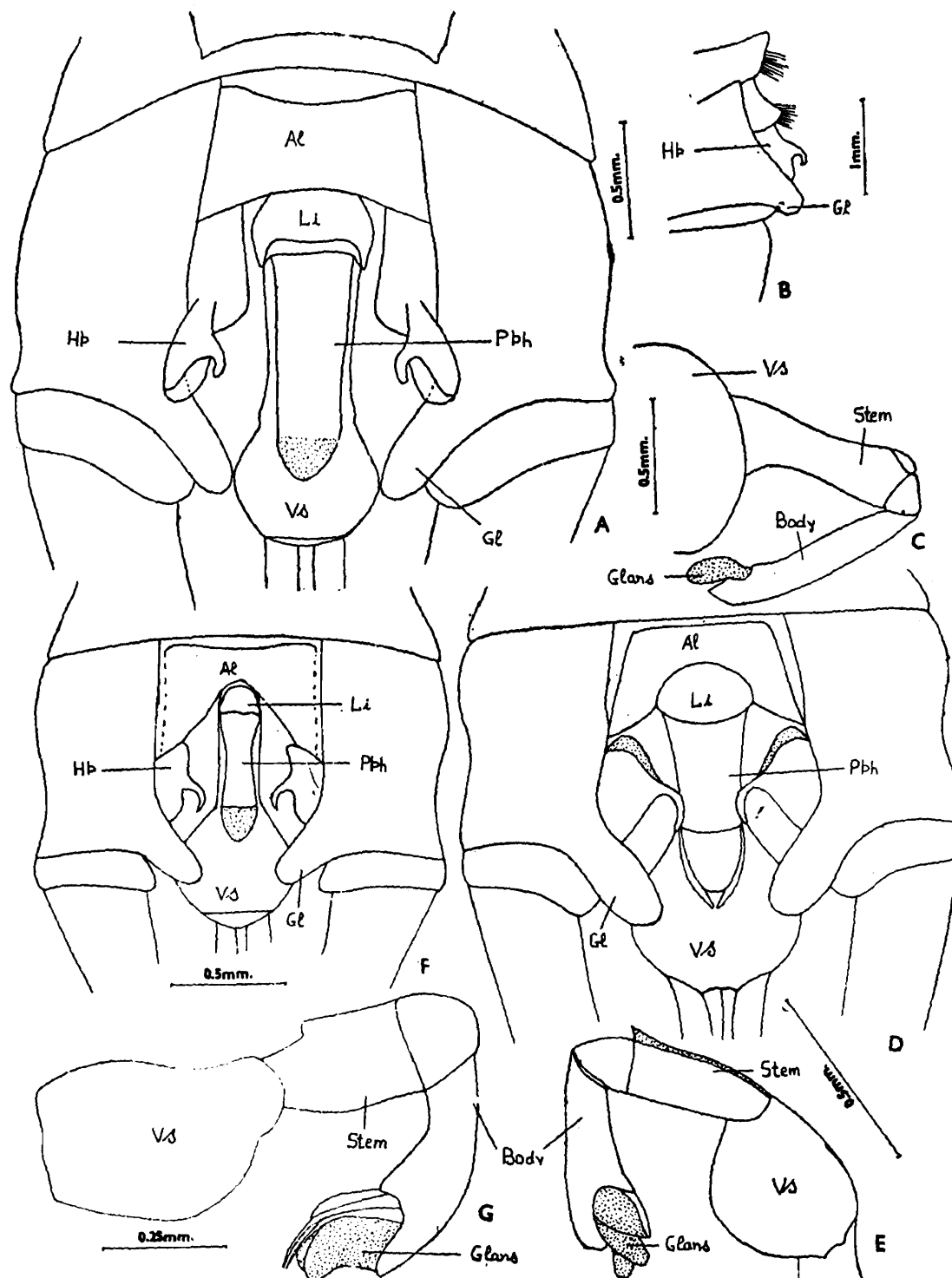


Fig. 1. (A-C) Male accessory genital structures of *Neurothemis fulvia* (Drury) : (A) Ventral view ; (B) lateral view ; (C) prophallus and Vesicula spermalis ; (D & E) Male accessory genital structures of *Neurothemis intermedia intermedia* (Rambur) : (D) Ventral view ; (E) prophallus and vesicula spermalis ; (F & G) Male accessory genital structures of *Neurothemis tullia tullia* (Drury) : (F) Ventral view ; (G) prophallus and vesicula spermalis.

4. Ligula (Li)
5. Prophallus (Pph) (=intromittent organ, Snodgrass, 1935 ; penis, Khan, 1974)
6. Hamulus posterior (Hp)
7. Genital lobe (Gl)
8. Vesicula spermalis (Vs) (=sperm receptacle, Snodgrass, 1935 ; penis vesicle, Khan, 1974).

**Neurothemis fulvia (Drury)**

(Fig 1, A-C)

Anterior lamina is depressed, highly arched and hood-shaped structure. Ligula is broad squarish in outline but posteriorly has a deep groove. Hamulus posterior are small and some what broad structure. Hamular hook is also small, curved and pointed at the tip. Genital lobe is narrow, long, oval in shape with rounded apex. Prophallus is very long and tubular. It is divided into stem, body and glans. Glans of prophallus has one pair of flagella with pointed tips. Vesicula spermalis is broad and flask shaped.

**Neurothemis intermedia intermedia (Rambur)**

(Fig. 1, D & E)

Anterior lamina is hood-shaped and slightly arched in the middle. Ligula is broad and semi-circular in outline. Genital lobe is highly depressed from both the sides and dilated near the apex of the lobe. Apex of the genital lobe is rounded. Hamulus posterior is broad at the base and somewhat triangular in outline. Hamular hook is long, highly curved with rounded tip. Prophallus is divided into stem, body and glans. Glans of prophallus is tubular and rounded at the margins. It has one pair of very small flagella with rounded tips. Vesicula spermalis is flask-shaped with two small pointed teeth like projections at the base (as in the diagram).

**Neurothemis tullia tullia (Drury)**

(Fig 1, G & H)

Anterior lamina is hood shaped and deeply arched. Ligula is somewhat conical in outline. Genital lobe is small, cylindrical and slightly curved with rounded apex. Hamulus posterior is broad at the base and tapers into a hamular hook. Hamular hook is highly curved with acutely pointed tips. Prophallus is divided into stem, body and glass. Glans of prophallus is somewhat triangular in outline and slightly depressed in the middle, and obtusely pointed at the margin. It has one pair of flagella which is long and acutely pointed at the tip. Vesicula spermalis is flask shaped.

KEY TO THE SPECIES

1. Hamular hook long and acutely pointed at the tips, glans of prophallus somewhat triangular in outline and slightly depressed in the middle  
..... *tullia tullia* (Drury)  
Hamular hook short, curved and with blunt tips, glans of prophallus tubular and rounded at the margins.... 2.
2. Genital lobe narrow long and oval, vesicula spermalis without any teeth like projection at the base..... *fulvia* (Drury)  
Genital lobe long, highly depressed from both the sides and dilated at the apex, vesicula spermalis with a small pointed teeth like projection at the base.....  
..... *intermedia intermedia* (Ramb).

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RECORD OF THE CROCODILE FISH, *GARGARISCUS PRIONOCEPHALUS*  
(DUMERIL) IN INDIAN WATERS

The crocodile fish of the monotypic genus *Gargariscus* Smith, belonging to the family Triglidae, is known only from the Celebes, the Arafura Sea and the Philippines (De Beaufort & Briggs, 1962). It was, therefore, interesting to discover an undetermined specimen of *Gargariscus prionocephalus* (Dumeril) collected by the R. I. M. S. *Investigator* from Station 389 (off Tranvancore coast) at a depth of 81 fms in our collections. This specimen, 72 mm in standard length, is now registered under F 7284/2. The present record constitutes a valuable addition to the ichthyofauna of India.

*Description* : D VI I 14 ; A 14 ; P 12+2 ; V 15 ; lateral line scutes 29. Upper jaw with

villiform teeth, lower jaw edentate. Head, body and tail covered by bony plates and scutes, except on chin and breast, which are naked. Depth between eyes 18.1, length of head 50.0 ; both in percent of standard length. Eye-diameter 18.0, interorbital width 18.0, length of snout 50.0, length of pectoral fin 58.3 ; in percent of length of head.

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REFERENCE

DE BEAUFORT, L. F. & BRIGGS, J. C. 1962 : in Weber, M & de Beaufort, L. F. *Fishes of the Indo-Australian Archipelago*, XI, E. J. Brill, Leiden. pp. 481.

BOOK REVIEW : *Bull. zool. Surv. India*, 1 (1) ; 1978

REVIEW

PROF. EICHLER'S *Parasitologisch-insektizikundliches Woerterbuch*, Veb Gustav Fischer Verlag, Jena, 1977 : 525 pp., Price (Inland) DDR 29 M, (Other Countries) DDR 39 M.

Prof. Wd. Eichler's publication "**Parasitologisch-insektizikundliches Woerterbuch**" (a glossary of terms used in Parasitology, medicine, and insecticide industry) is a valuable addition to our parasitological literature.

The glossary includes 5886 serially numbered and alphabetically arranged German terminologies (both scientific and vernacular) used in parasitology, medicine, bio-chemistry,

toxicology, and insecticide industry, followed by the English and Russian equivalents. The meaning of the term was given in German. Separate indices for the English, Russian, and scientific nomenclature used in this work were also provided. The difficulty in translating German parasitological works is often keenly felt by those not familiar with that language and this glossary will undoubtedly serve as a ready reckoner in future.

Prof. Eichler with his nearly half-a-century experience in the fields of parasitology and applied entomology, together with his well known collaborators Dr. M. J. Ass, H. Beitz, V. Bozdech, J. Jira, and Prof. K. Odening, deserve all congratulations for bringing out such a useful compilation. The value of this work would have greatly enhanced, had the

German explanation of the terms are also given in the other two languages, and it is hoped that the authors and the publishers will fill the lacuna in future editions.

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## Instructions to Contributors

The *Bulletin of the Zoological Survey of India* is a journal for the publication of original papers of research on Bio-Ecology, biogeography evolutionary biology and animal taxonomy. Original articles, critical reviews of modern researches and short communications are accepted for publication.

Manuscripts not exceeding 20 typed pages in foolscap size must be neatly typed, double spaced on one side of the paper with wide margin. Abbreviations and symbols used must conform to the generally accepted scientific standard. Metric system should be used throughout.

Each article must have an abstract (except in short communications where no abstract is necessary) which should be precise, informative and in a form which can be taken as such by international abstracting journals. Tables and illustrations must be restricted to the essential minimum.

Descriptions of new taxa or new combinations should conform to the Rules of the International Code of Zoological Nomenclature and to its recommendations also. Generic and specific names of animals, may be underlined and must be given in full at least once on their first citation in the paper and include name(s) of author(s) in full. The title of the paper should indicate the major group with which it deals.

Line diagrams must be in Indian Ink ; when several of them are included in the same sheet they must be numbered serially with capital English alphabetical letters as A, B, C, etc. All figures must have a scale in metric units ; the name and address of the author and title of the paper should be written in pencil at the back of every illustration. Explanation of figures and its legends should be provided. The format must be 18.5×14 Cm. and size of text-figures 28×18.5 Cm.

Photographs must be prepared on glossy contrast paper and must not be lesser than 15×9 Cm. Coloured photographs are not accepted.

References cited in the text must indicate only the author and year, thus : Chopra (1947). Where more than three collaborating authors are cited, the first name only should be given followed by *et al.*, thus : Hora *et al.* (1945). All references cited in the text only should be listed at the end of the article. The abbreviations of journals must be as given in the *World List of Scientific Periodicals* (1964).

A few examples are given below :

ANNANDALE, N. 1909. Report on a small collection of sponges from Travancore. *Rec. Indian Mus.*, Calcutta, 3 : 101-104, 2 pls.

PRAKASH, ISHWAR, 1974. The Ecology of vertebrates of the Indian desert. *IN : Ecology and Biogeography in India* : 369-420. M. S. Mani (Es.), Dr. W. Junk, b. v. publishers, The Hague.

WIGGLESWORTH, V. B. 1950. *The Principle of Insect Physiology* (4th ed.) : viii+1-544, London (Methuen & Co.).

At the discretion of the Editor, galley proofs only may be sent to authors, which must be returned within *seven days* of their receipt. In the event of delay in receiving the corrected galley from the authors the Editor shall do the necessary corrections as per the original manuscript. Alterations or additions not included in the original manuscript shall be charged for at author's cost.

Author/Authors (in the case of joint authorship also) will be given *gratis* 50 reprints only without cover. Extra reprints must be intimated to the editor when the galley proof is returned.

Two copies of the Manuscript should be sent to the Director, Zoological Survey of India, 34-Chittaranjan Avenue, Calcutta PIN 700012 (India). Proofs also should be returned to the same address.

Papers are accepted on the understanding that they are subject to editorial revision and are contributed to this journal only. Papers accepted for publication will become the copyright of the Publishers.

Abbreviation of this journal will be *Bull. zool. Surv. India*.