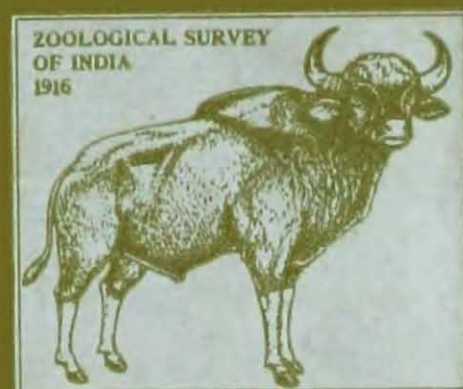


BULLETIN

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OF INDIA



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BIOECOLOGY OF BANANA INHABITING MILLIPEDE, *ANOPLODESMUS SAUSSUREI*
(HUMB.) (DIPLOPODA : PARADOXOSOMATIDAE)

M. PRASAD, P. DEY, AND T. N. KHAN

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ABSTRACT

A detailed study of life history and ecology of banana inhabiting millipede, *Anoplodesmus saussurei* (Humb.) found at Nischindapur (Howrah : West Bengal) has been made in the laboratory as well as in the field. Its various developmental stages, food and feeding habits and reproductive behaviour have also been studied.

INTRODUCTION

Millipedes are found in damp and humid situations under the rotten bark of logs, old trees and soil litter. They feed on decaying vegetable matter, soil and soil litter. Blower (1955) described millipedes as essential animals of the forest floor. Life history of several species of millipedes have been successfully studied and described by Davenport *et al.*, (1952); Blower and Gabbutt (1964); Blower (1970); Blower and Miller (1974 & 1977); Brookes (1974), Heath *et al.*, (1974) and Spaul (1976). Although the genus *Anoplodesmus* is represented in India only by 4 species (Attem, 1936), surprisingly enough there appears to be no work so far, on their life histories except for the work of Puttarudriah and Shivashankar Sastry (1959) on *Ktenostreptus* sp. damaging chillies, cotton etc. in Mysore state. Besides this some general statement were also given by Fletcher (1914), Ramakrishna (1935) and Puttarudriah (1958) regarding some Indian millipedes.

Thus to determine the number and duration of young stages, morphological

changes in different stadia in the life history, food and feeding habits of a banana inhabiting millipede, *Anoplodesmus saussurei* (Humb.), investigations were undertaken here in Calcutta (West Bengal). It is most commonly found in decaying banana stems moving very frequently in and around the banana plantation during May to November. It is bright chestnut or dark chocolate brown, but the mature specimens are black in colour; lateral keels are pale yellow; head, antennae, legs and underside brown.

MATERIALS AND METHODS

Specimens were collected from the decaying banana stems and also from the banana plantation at Nischindapur (Howrah : West Bengal) during June and July, 1978. Hand samples were taken on each sampling occasion to provide material for assessing breeding condition. The collected live individuals were taken into laboratory and were maintained in the standard wide mouthed glass jars filled to a depth of about 10 cms. with rich, dark

humus litter and pieces of rotten banana stems collected from the same habitat. These jars were covered with muslin cloth tightly. During the course of observation some fresh green leaves (Jute, pumpkin etc.) bread and rotten fish were also provided to study the food and feeding habits. Brood chambers with eggs formed by the adult pair, were kept in separate petridishes alongwith soil, decaying vegetable and litter to study incubation period, hatching, etc. Jars and petridishes were moistened with water at regular intervals to ensure the requisite moisture. During the course of observations the maximum and minimum temperature recorded in the laboratory were 36°C and 24.1°C and the maximum and minimum relative humidity percentage recorded were 99% and 53% respectively.

RESULTS & OBSERVATIONS

Food and Feeding: Millipedes exhibit preference in their choice of food and it varies with species to species (Drift, 1965). Chemical basis of food preference in millipedes have been studied and reported by Sakwa (1974). Detailed food and feeding habits of an interesting millipede have also been given by Puttarudriah and Shivashankar Sastry (1959) and Bano *et. al.*, (1976). They have reported that millipedes are found to feed on decaying vegetable matter, many economic crops and soil.

The *A. saussurei* was found feeding in the field on decaying banana stems, soil under fallen leaves and some green leaves present in the banana plantations at Nischindapur (Howrah) and Chandan Nagar (Hooghly). Under laboratory conditions it was observed that these millipedes were feeding mainly on decaying vegetables and rotten banana logs. Sometimes it was also observed that they

preferred decaying fish, green leaves of jute and pumpkin plants.

Tunneling: Tunneling has been observed in the laboratory. Young individuals start tunneling from third instar stage (3rd Stadium). In this stage they make tunnels, ending in a chamber, only for moulting. From fourth instar stage (4th Stadium) and onwards they make tunnels to build up their nests etc. The horizontal tunnels are inter-communicated inside the soil having a number of vertical tunnels opening to the surface of the soil.

Millipedes start construction of their own tunnels by holding a small mass of soil with the help of its gnathochelarium and labrum and push back from the particular spot with the help of legs (Plate I, fig. D). This process was repeated by the adults several times and they complete the formation of tunnels. A 3 cm deep and 0.5 cm in diameter tunnel was constructed within 6 hrs. of time. When soil is loose and it is full of food materials, the millipedes starts eating the soil to build their tunnels.

Courtship and Mating (Plate I, figs. A-C): The male follows the female moving very close to it with its head end in apposition with that of female and feels it with antenna. When female permits male try to come on her back from posterior end of the body. After sometime the anterior portion of the male touches the ground and pair turns laterally holding each other with the help of legs. However, the posterior part of the body of the male remains on the back of the female. Then, their anterior parts of the body come in close contact laterally. Afterwards the male move a little forward so that genital openings of both come in contact. Thus the copulation is established. They remain in this position for about 5 minutes after which

male separates itself and moves away. Whereas the female remains at rest for about 5 to 7 minutes. It has been observed that process of courtship and mating may last for about 4 hours. On the basis of field observations it has been found that mating occurs during May to October.

Ovipositor : Egg laying in *A. saussurei* generally commenced during June to October, showing nearly 2 to 3 weeks interval between mating and egg laying. Process of egg laying in the millipedes is very interesting and has been recorded by several workers. Theobald (1904) and Sinclair (1922) have observed that the females of *Julus terrestris* deposit eggs in a nest, made up of small particles of soil mixed with saliva. The nests are rounded with a small hole at the top and just after oviposition hole was closed by the female.

The process of egg laying in *A. saussurei* was observed in the laboratory. Both male and female make a tunnel into the soil at a depth of about 2 cm to 5 cm and construct an earthen chamber at the end of the tunnel with the help of soil and saliva. The depth of the chamber of inside the soil depends upon the moisture contents of the soil—drier the soil, deeper the position of the chamber. The inner surface of the chamber is smooth and about 1.5 cm in diameter. It has a small opening to its upper surface through a curved tunnel. The eggs were laid in 3 batches with an interval of 2 to 3 days. In each chamber only one batch of 250-300 eggs were laid in a cluster as the eggs were coated with a sticky substance that caused them to clump together (Plate II, figs. A & B). It was interesting to note that the opening at the upper end of the nest was not closed after oviposition in this species.

Incubation Period and Hatching : The incubation period in this species was observed in the laboratory during the month of August 1978. It was found to be 4-5 days.

Mature eggs hatched in the "split stage" (Davenport *et al.*, 1952), by splitting in egg shells into two halves with a small connection between each other, like hinged hemispheres.

Breeding Records : The study was begun with the adult individuals collected from the field on 31. 7. 78 and among them three adult couples were kept separately in three Glass jars half filled with fresh humus, collected from the same field, known to be free of eggs or early stages. Immediately after their captivity in the jars all the three pairs were seen in courtship which ended in copulation on the same day, *i. e.*, 31. 7. 78 evening. Out of these three pairs only one pair survived and the other two female individuals died before egg laying. The survived female millipede laid eggs in three batches on 20. 8. 78, 22. 8. 78 and 25. 8. 78. So from our present observations in the laboratory it can be told that the time between the copulation and egg laying is about 20-25 days. After hatching samples were preserved at regular intervals for detailed study of each stadium. Out of these egg batches some individuals of the second egg batch gradually moulted to miniature adults after passing through 7 stadia and the time taken was about 2 months.

Breeding records of *Anoplodesmus saussurei* (Humb.) reared in the laboratory is tabulated in table 1 & 2.

DEVELOPMENTAL STAGES

Apart from egg and adult seven different 'Stadia' are found in between these two phases in their life cycle.

TABLE—1

No. of egg hatches	I	II	III
Date of egg laying	20.8.78	22.8.78	25.8.78
Date of hatching, i. e., onset of Stadium I	25.8.78	27.8.78	30.8.78
Moulted to Stadium II	26.8.78	28.8.78	31.8.78
„ „ Stadium III	1.9.78	4.9.78	6.9.78
„ „ Stadium IV	11.9.78	11.9.78	12.9.78
„ „ Stadium V	15.9.78	16.9.78	—
„ „ Stadium VI	—	21.9.78	—
„ „ Stadium VII	—	25.9.78	—
„ „ Miniature adult	—	24.10.78	—

(Breeding records of *Anoplodesmus saussurei* (Humb.) in the laboratory)

TABLE—2

Stadium	No. of Post-cephalic segments	Pairs of legs		Body measurements		Duration of each Stadium (in day)
		Male	Female	Length (in) mm	Width (in) mm	
Stadium I	7	3	3	0.58-0.70	0.25-0.30	1
„ II	9	6	6	1.41-1.72	0.29-0.36	6-7
„ III	12	10	11	2.35-2.58	0.41-0.43	7-10
„ IV	15	16	17	3.53-4.70	0.51-0.56	4-5
„ V	17	22	23	6.28-6.85	0.80-0.97	5
„ VI	18	26	27	8.57-9.26	1.10-1.19	4
„ VII	19	28	29	14.28-15.10	1.60-1.77	30
Adult	20	30	31	28.22-32.44	3.66-4.70	—

(Characteristics of developmental stages)

Eggs :—(Plate II, Fig. A & B) The eggs were approximately round, about 0.44 mm to 0.45 mm in diameter. They were appearing pearly with a creamy white smooth surface. All the eggs were coated with a sticky substance that caused them to adhere together among themselves which is also water repellent by nature. As the eggs mature the colour of the egg shell turned brownish.

Stadium I (Fig. 1, A-F) : The young hatched through the rupture of egg shells, non-motile, transparent and whitish in colour. All the individuals of the Stadium I, lying in a group in the chamber where they hatched, curved and comma (,) like in outline. Body covered with fine small white setae. Usually 3 pairs of legs but in some cases rudiment of 4th pair legs present. Body composed of

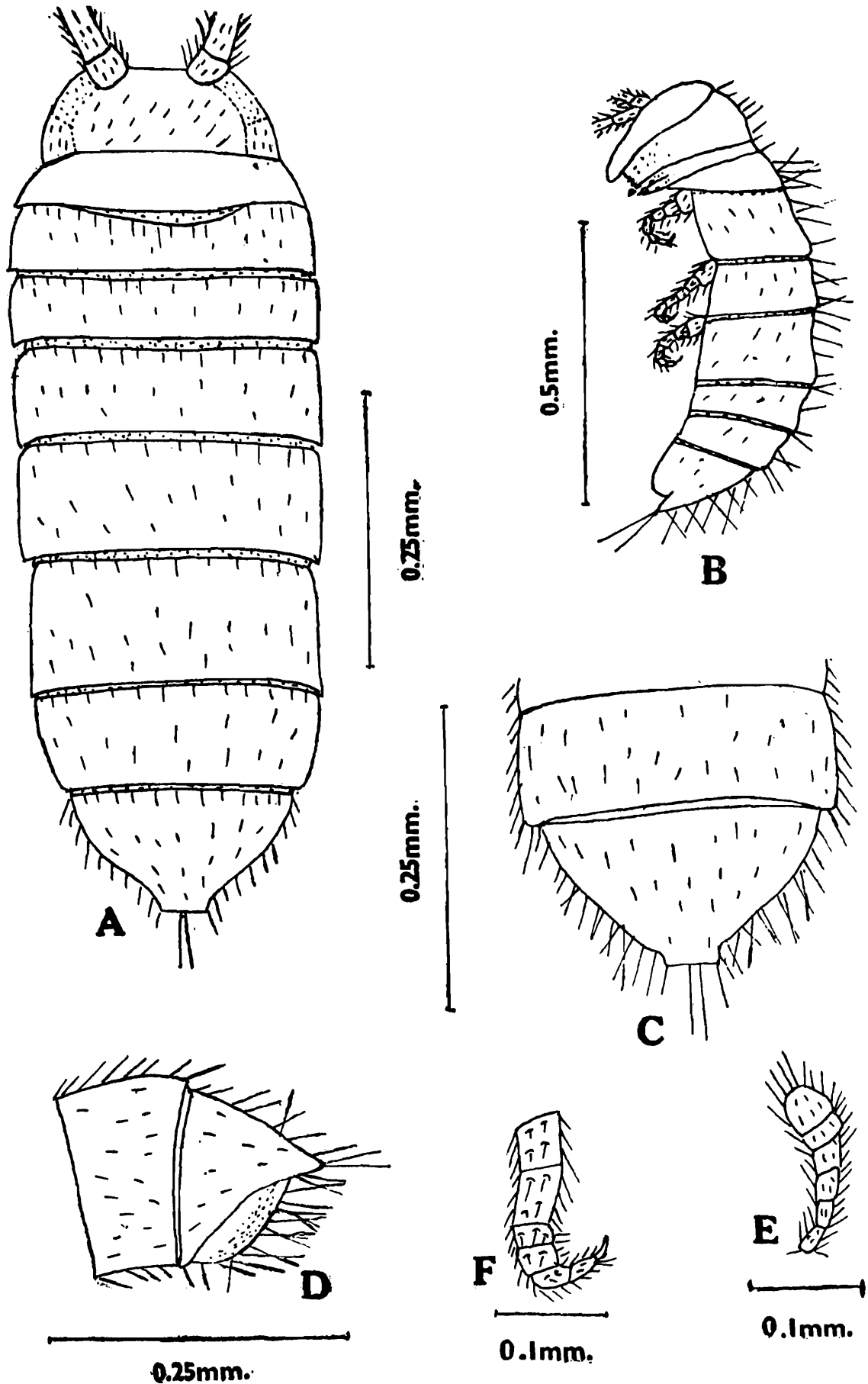


Fig.—1 (A—F): First instar of *Anoplodesmus saussurei* (Humb.) (A—Dorsal view, B—Lateral view, C—Pygidium dorsal view, D—Pygidium lateral view, E—Antenna, F—Leg.)

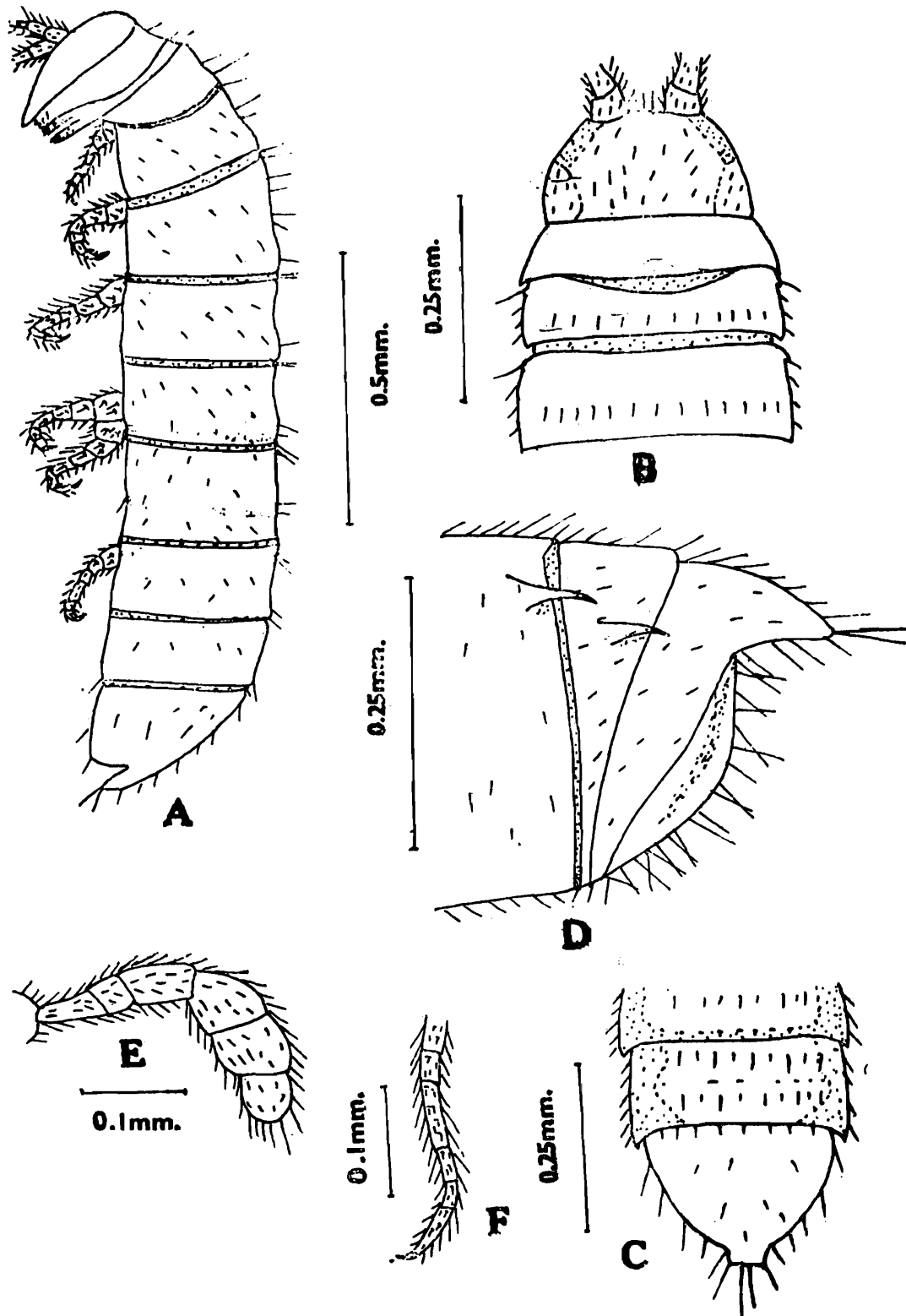


Fig.—2 (A—F): Second instar of *Anoplodesmus saussurei* (Humb.) (A—Lateral view, B—Dorsal view of anterior portion of body, C—Pygidium dorsal view, D—Pygidium lateral view, E—Antenna, F—Leg.)

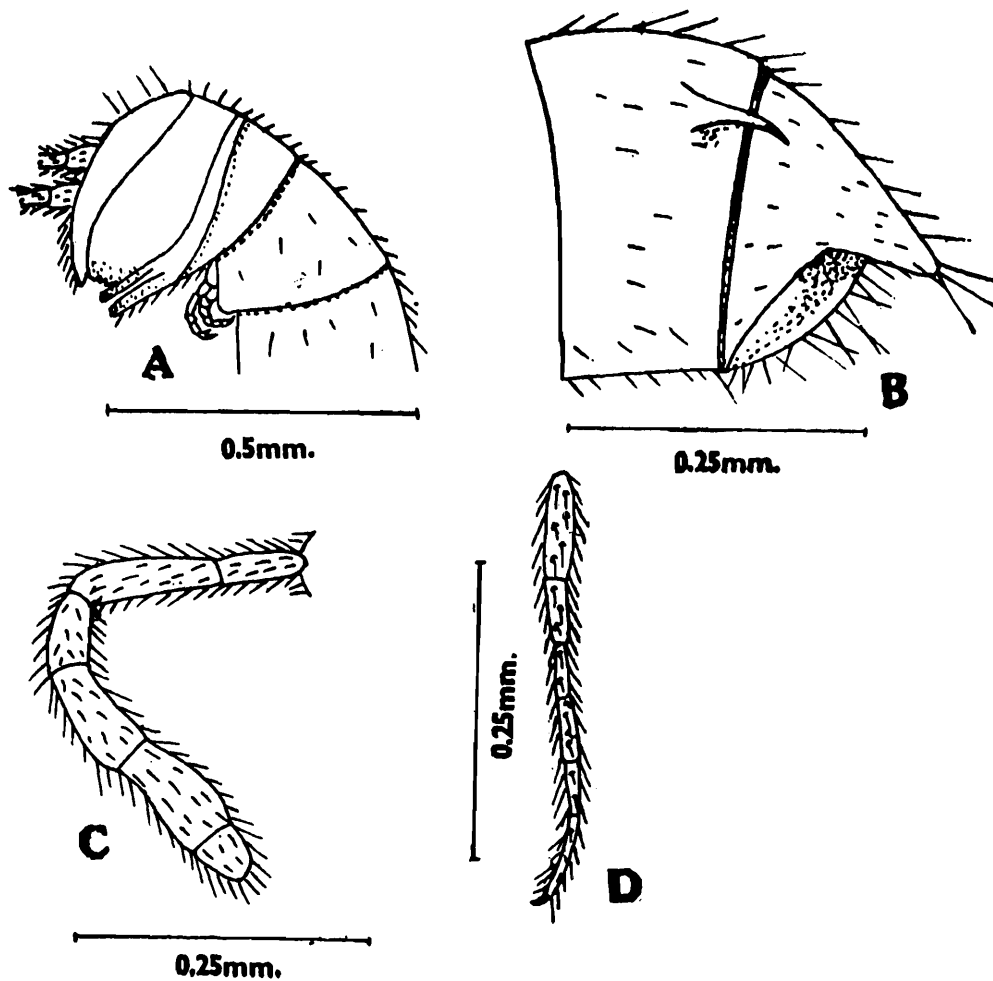


Fig.—3 (A—D) : Third instar of *Anoplodesmus saussurei* (Humb.) (A—Lateral view of anterior portion of body, B—Pygidium lateral view, C—Antenna, D—Leg)

head and 7 post-cephalic segments. Head bears one pair of small 6 segmented club shaped antennae. The individuals of stadium I observe complete starvation before they display community moulting to enter in the Stadium II.

Stadium II (Fig. 2, A-F) (Plate II. fig. C) : All individuals of this Stadium also found in a group inside the chamber. Individuals non-motile just after moulting and become active on following days. Sometimes they move to the soil surface. Body creamish white in colour with 9 post-cephalic segments and 6 pairs of legs. Antenna 6 segmented and

club shaped. Individuals do not feed in the earlier part but in later phase they start feeding.

Individuals do not build separate chambers for moulting, show community moulting in any suitable covered place inside the soil.

Stadium III (Fig. 3, A-D) : Body 12 post-cephalic segmented with 10 and 11 pairs of legs in male and female respectively. Body light brown, gradually changing to light yellow near lateral keels. Antenna 6 segmented gradually attaining a cylindrical form, rather than club shape.

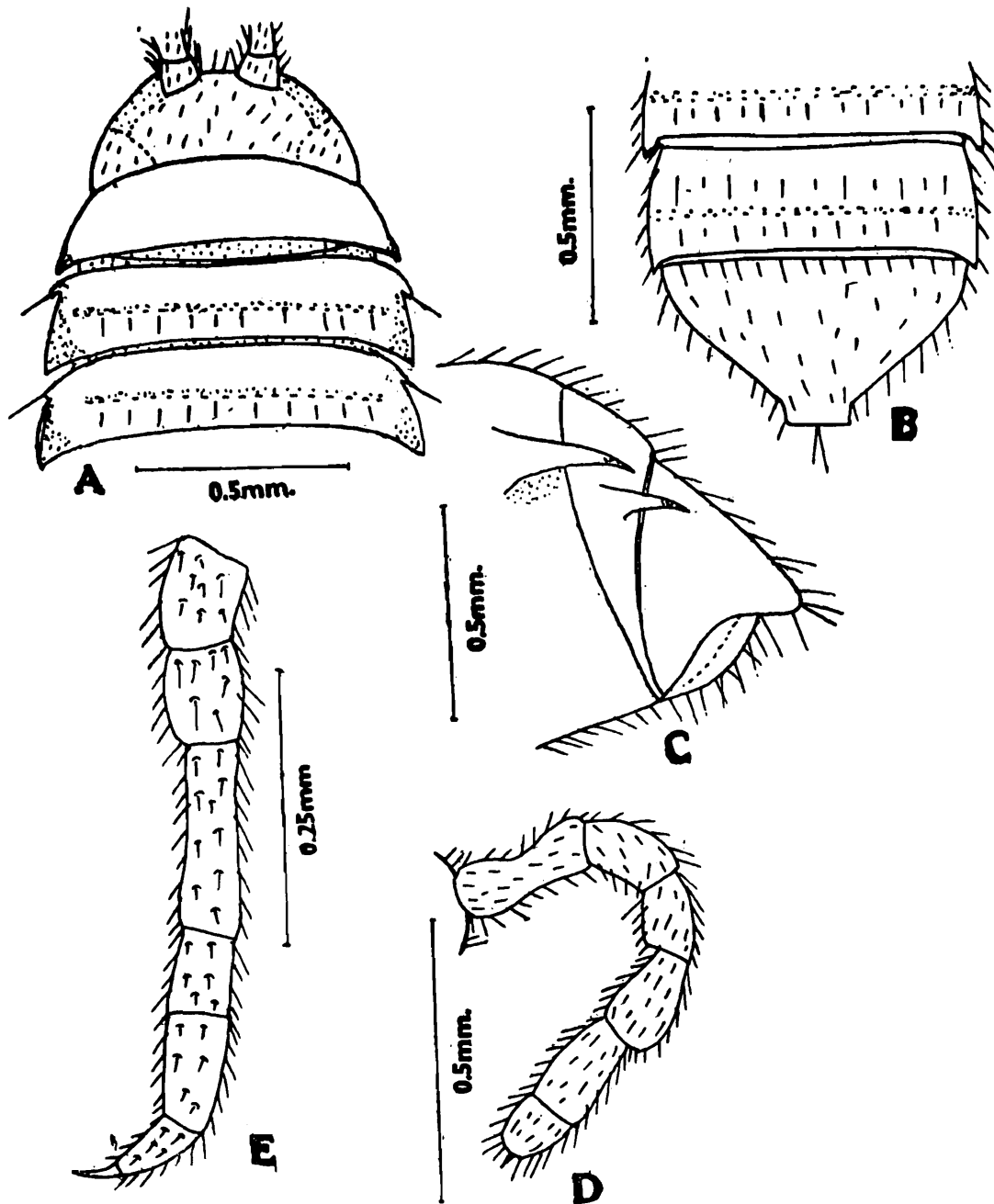


Fig.—4 (A—E): Fourth instar of *Anoplodesmus saussurei* (Humb.) (A—Dorsal view of anterior portion of body, B—Pygidium dorsal view, C—Pygidium lateral view, D—Antenna, E—Leg,

Individuals construct their own moulting chambers individually right from this Stadium and onwards.

Stadium IV (Fig. 4, A-E): Young ones very active and brownish in colour; darker than the previous stadium, Lateral keels developed. Body 15 segmented with 16 and

17 pairs of legs in male and female respectively. Anterior pair of the appendages of seventh post cephalic segment in male shows an impression of future gonopod.

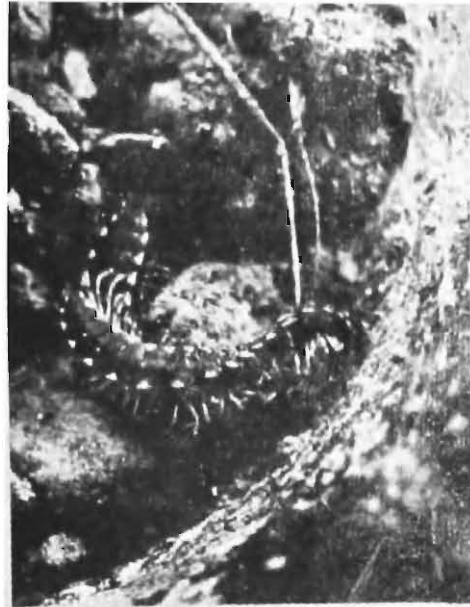
Stadium V: Body brownish with 17 post-cephalic segments and 22 and 23 pairs of legs in male and female respectively. Antenna

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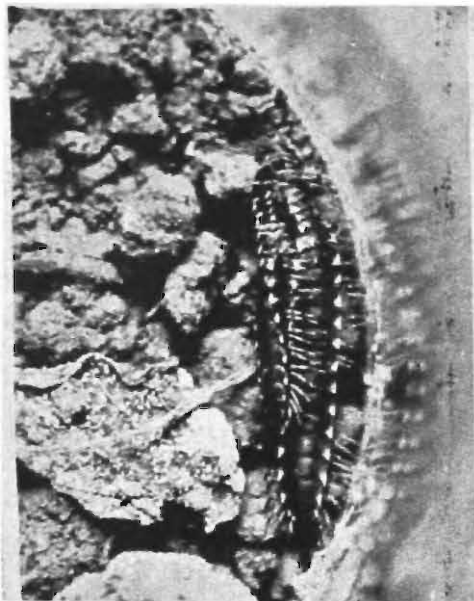
PLATE I



A



B

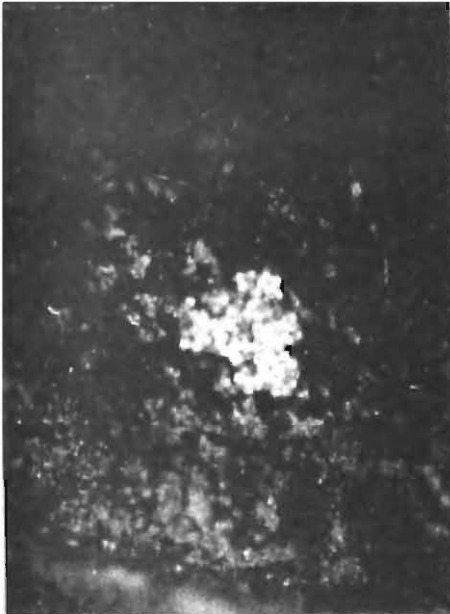


C

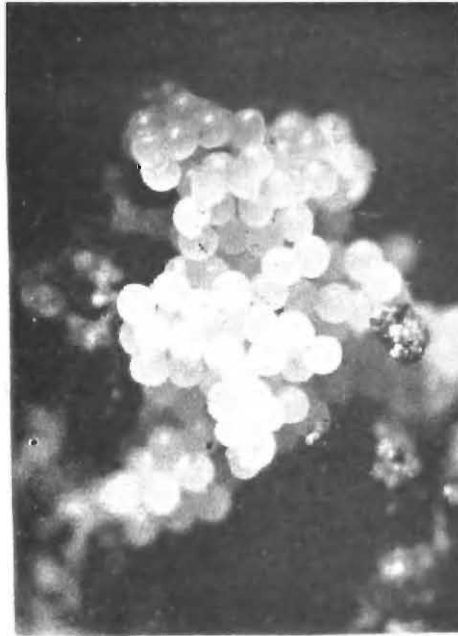


D

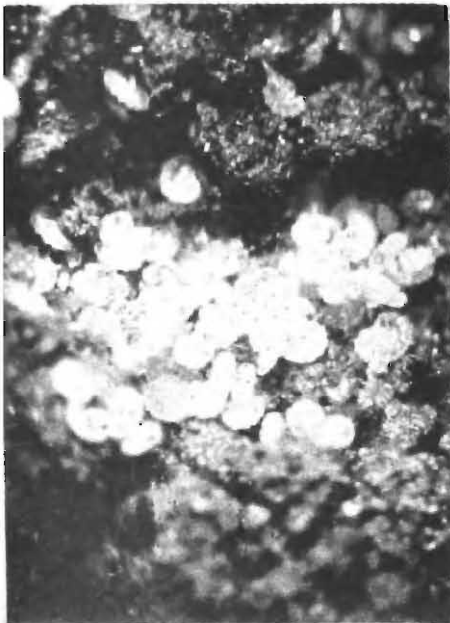
(A—D): Showing courtship, mating and tunneling of *Anoplodesmus saussurei* (Humb.)
(A—Courtship, B & C—Mating, D—Tunneling).



A



B



C



D

(A--D): Showing eggs, second instars and moulting of *Anoplodesmus saussurei* (Humb.)
(A—Egg cluster *in situ*, B—Enlarged view of egg cluster, C—Second instars just after moulting *in situ*, D—Seventh instar adult moulting inside the moulting chamber *in situ*.)

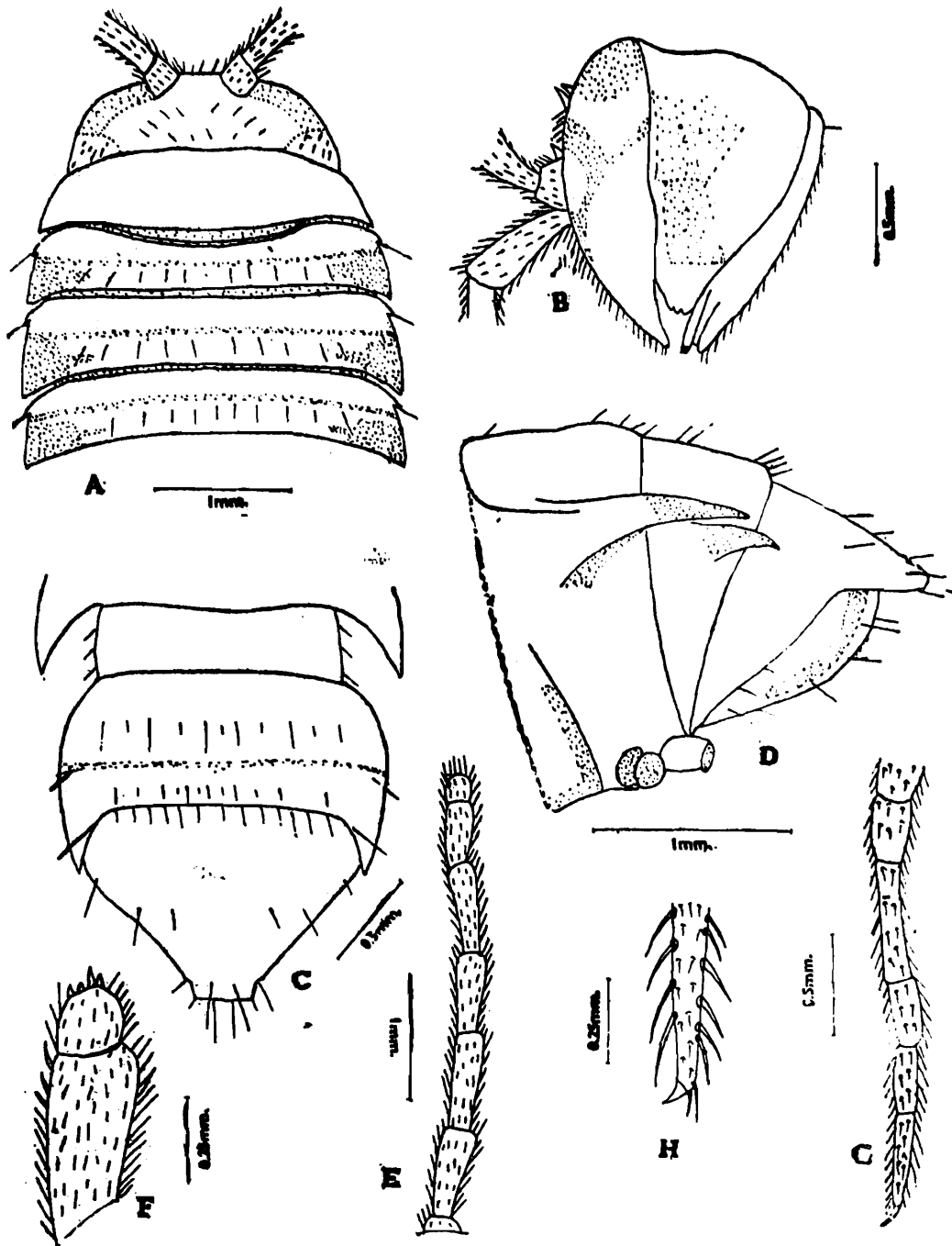


Fig.—5 (A—H) : Seventh instar of *Anoplodesmus saussurei* (Humb.) (A—Dorsal view of anterior portion of body, B—Lateral view of anterior portion of body, C—Pygidium dorsal view, D—Pygidium lateral view, E—Antenna, F—Enlarged view of anterior segments of Antenna, G—Leg, H—Enlarged view of tarsus.)

more elongated ; lateral keels well developed.

Stadium VI : Body with 18 post-cephalic segments and 26 and 27 pairs of legs in male and female respectively. Other details almost like the previous Stadium.

Stadium VII (Fig. 5, A-H) : Body chocolate brown with 19 post-cephalic segments and

28 and 29 pairs of legs in male and female respectively. Lateral keels very prominent and pale yellow in colour. Head, antenna, legs and underside of the body brown. 4 medium sized spines present at the anterior end of the 6 segmented antennae. Gonopods more developed in male,

Miniature adult: Body colour dark chocolate brown with 20 post cephalic segments and 30 and 31 pairs of legs in male and females respectively. Individuals undergo further 5 or 6 moults to attain its full adult size, gonopods well developed. During these moultings there is no further addition of any post cephalic segments or legs but only the size is increased. In each successive moults the body colour becomes darker, gradually leading to deep chocolate brown or nearly black.

DISCUSSION

Detailed life cycle and ecology of *Anoplo-desmus saussurei* (Humb.) collected from banana field at Nischindapur (Howrah : West Bengal) was studied alongwith its food and feeding habits, tunneling, moulting and reproductive behaviours in the laboratory as well as in field. In the field it was feeding on decaying banana stems, soil under fallen leaves and green leaves present in the banana plantation and in laboratory on decaying vegetables, rotten banana stems, decaying fish, green leaves of jute and pumpkin plants. The process of courtship and mating were continued for about 4 hours. Both male and female construct a tunnel into the soil at a depth of about 2 cm to 5 cm with the help of soil and saliva for egg laying. The eggs were laid in 3 batches with an interval of 2 to 3 days. In each chamber only one batch of 250-300 eggs were laid in the form of a cluster which were coated with a sticky substances that caused them to clump together. It was interesting to note that opening at the upper end of the nest was not closed after oviposition. The eggs gradually moulted into full miniature adults after passing through 7 stadia and the time taken was about two months.

It was observed that young ones of earlier egg batches which were laid just at the starting of monsoon (May-June) reach maturity before starting of winter (October-November). Young ones of later egg batches which were laid in late monsoon period (August-September) did not attain maturity in the same year. They go for hibernation during the winter and summer. As soon as the monsoon starts in the following year, they complete their development through successive moults. So it takes about 5/6 months or a year for the maturity of this group of millipede.

ACKNOWLEDGEMENTS

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THREE NEW GASTROTRICHS FROM ORISSA COAST, INDIA

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ABSTRACT

This paper describes three new species of marine interstitial macrodasyid gastrotricha collected from the intertidal sands on Orissa coast (Bay of Bengal). They are, *Cephalodasys caudatus* n. sp., *Turbanella indica* n. sp., and *Tetranchyroderma littoralis* n. sp.

INTRODUCTION

Our knowledge of the marine interstitial Gastrotricha inhabiting the intertidal sands on Orissa coast is restricted to the earlier work by Rao (1969). During a short subsequent survey of the interstitial meiofauna carried out by the present author on Orissa coast in winter 1977, more species of the Gastrotricha were encountered in the sand collections. The present paper describes three of these gastrotrichs discovered new to science.

SYSTEMATIC ACCOUNT

Order : MACRODASYIDA

Family : LEPIDODASYIDAE Remane, 1927

Genus : *Cephalodasys* Remane, 1926

Cephalodasys caudatus n. sp. (Fig. 1)

DESCRIPTION

Adult specimens reach a length of 700—800 μm and a maximum width of 80—90 μm depending on the state of contraction. Body transparent, elongated and dorsoventrally flattened. Head distinct, about 80 μm long and delineated from trunk by means of ventrolateral grooves. Short sensory hairs 5—8 μm in length occur on the margin of head. Body slightly tapers posteriorly and ends in a medial process clearly demarcated from trunk region by means of ventrolateral grooves ; it is about

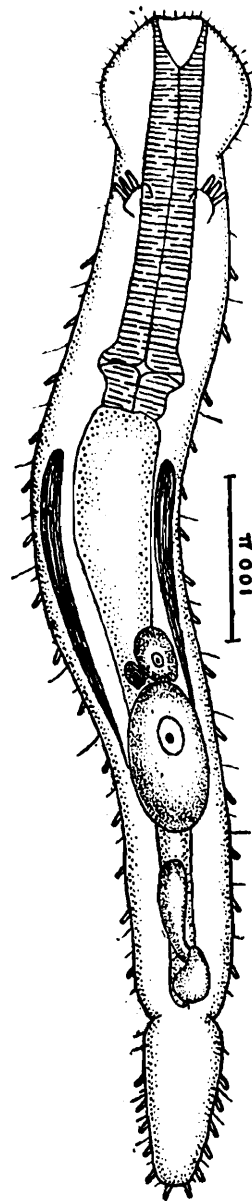


Fig. 1. *Cephalodasys caudatus* n. sp. Adult, dorsal view, showing anterior adhesive tubes on ventral surface.

100 μm long and 45 μm in maximum width. Cuticle thin, finely granular and without dorsal epidermal glands, papillae, scales, spines, etc. Body bears numerous lateral sensory hairs 10—20 μm long. Ventral ciliation is entire, but more dense on the ventrolateral region.

Three pairs of anterior adhesive tubes about 12 μm in length occur just behind neck constriction and borne on extensible feet.

Twelve to 15 pairs of lateral adhesive tubes about 12 μm in length present; they are nearly even spaced and located along the second posterior half of pharyngeal and the intestinal regions. Dorsal adhesive tubes absent. Five to six pairs of posterior adhesive tubes about 12 μm in length occur distributed along the lateral and posterior borders of the posterior end; half of these tubes arranged on either side of midline, but merge indistinguishably around the tail lobe.

Mouth is 25—30 μm wide, terminal, slightly inclined to ventral surface and surrounded by a corona of short sensory hairs about 5 μm in length. Buccal cavity small and nearly conical. Pharynx is about 220 μm long and occupies about 1/3 of the total gut length. Conspicuous pharyngeal pores occur close to the posterior end of pharynx. Intestine is about 440 μm long, granular and divisible into a broad anterior region and a narrower posterior region. Anus subterminal and located on the ventral surface at the beginning of the tail lobe.

Reproductive system follows the usual pattern. Testes paired and located laterally along the anterior part of intestine. Vasa deferentia converge behind the posterior egg cells and the male pore located medioventrally close and anterior to anus. Penis absent. Ovary unpaired and dorsal, with 2—3 egg

cells located about halfway of the intestinal region. An elongated seminal receptacle about 70 μm long present behind the ovary. A pear-shaped copulatory bursa about 35 μm long occurs close to anus.

Holotype: Specimen 720 μm long, with gonads, collected by the author on 21 January, 1977. Deposited with the Zoological Survey of India, Calcutta. Regd. No. P 3029/1.

Type locality: Coarse and medium sand, 10 cm below surface between low and half-tide levels of intertidal zone, Puri Beach (Lat. 19°48'06" N and Long. 85°51'14" E), Orissa, India.

Remarks: Hitherto, seven species are known assigned to the genus *Cephalodasys* Remane (see Hummon, 1974 a). These are, *C. maximus* Remane (1926), *C. turbanelloides* (Boaden, 1960), *C. cambriensis* (Boaden, 1963a), *C. palavensis* Fize (1963), *C. littoralis* Renaud—Debyser (1964), *C. minicerus* Hummon (1974b) and *C. pacificus* Schmidt (1974). Of these species, *C. caudatus* n. sp. approaches *C. turbanelloides* in general organization of body. But, the new species clearly differs from the latter and all the other species of the genus in the shape of tail lobe, number and disposition of adhesive tubes and the structure of genital apparatus.

Diagnostic features: Body up to 800 μm long, 90 μm wide, transparent and dorsoventrally flattened. Head distinct. Hind end ends in a median process. Anterior paired feet on ventral surface with 3 adhesive tubes each. Lateral adhesive tubes 12—15 pairs. Tail lobe with 10—12 posterior adhesive tubes. Mouth terminal. Cuticle thin and granular; dorsal armament absent. Ventral ciliation more dense on ventrolateral region. Pharynx/total gut length about 1/3. Conspi-

cuous pharyngeal pores at posterior end of pharynx. Testes paired. Unpaired dorsal ovary. Elongated seminal receptacle and pear-shaped copulatory bursa present.

Family : TURBANELLIDAE Remane, 1925

Genus : *Turbanella* Schultze, 1853

Turbanella indica n. sp. (Fig. 2)

DESCRIPTION

Adult specimens reach a length of 320—360 μm and a maximum width of 50—55 μm . Body is transparent, elongated, strap-shaped, widest in middle region and slightly tapers towards the posterior end. Head distinct, short and somewhat triangular in outline with lateral protuberances. It measures about 35 μm in length and 55 μm in width between the posterolateral corners. Posterior end bilobed as usual and separated with deep cleft; each lobe reaches about 30 μm in length. A median anal cone is absent between the two caudal lobes. Cuticle thin and without dorsal armament as spines, scales etc. Numerous small epidermal glands about 2 μm in size present, the lateral ones being more numerous than the dorsal ones. Head bears numerous marginal cilia 4—5 μm in length; they occur in a longer bunch attaining about 15—20 μm at the tip of lateral protuberances. Lateral sensory hairs 8—10 μm in length occur along the trunk region and are free from ventrolateral adhesive tubes. Ventral ciliation is somewhat sparse and arranged in two longitudinal bands.

Anterior adhesive tubes occur on two typical extensible ventrolateral feet; each foot bears 3—4 tubes reaching about 6 μm in length. Eight to 10 pairs of ventrolateral adhesive tubes 6—8 μm in length occur in a single longitudinal row and are nearly even

spaced along the trunk. The tubes start behind the ventral feet nearly halfway along the pharyngeal region; they lack sensory hairs at their tips seen in some other species of the genus. Dorsal adhesive tubes not seen. There are 5 posterior adhesive tubes on the inner edge of each tail lobe; the tubes progressively increase in length towards the outermost tube and measure about 6—12 μm

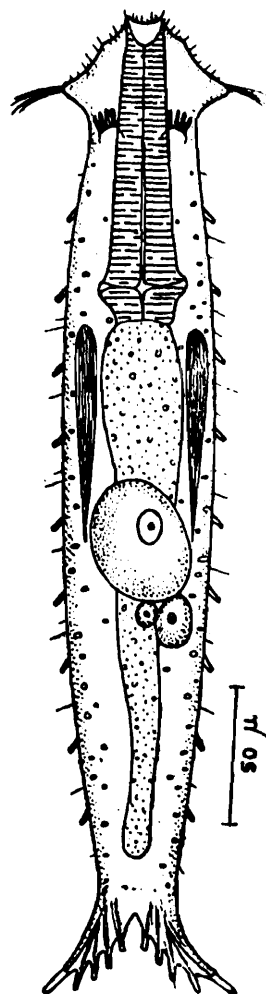


Fig. 2. *Turbanella indica* n. sp. Adult, dorsal view, showing anterior adhesive tubes on ventral surface.

in length. No adhesive tubes occur on the outer edge of the caudal lobes.

Mouth is terminal, 12 μm wide and encircled by a corona of short sensory setae 3 μm in length. Buccal cavity small and cup-shaped. Pharynx is about 100 μm long and occupies

about a third of the total gut length. Pharyngeal pores conspicuous at the posterior end of pharynx. Intestine is granular and vacuolated; it is about 200 μm long and divisible into a broad anterior region and a narrower posterior region. Anus subterminal and opens on the ventral surface in front of the caudal lobes about 20 μm from the posterior border.

Genital system follows the usual pattern. Paired testes extend lateral to the anterior part of intestine. Male pore not seen. Eggs occur about the middle part of intestine and attain about 45 μm in maximum diameter. Protonephridia not seen.

Holotype : Specimen 350 μm long, with gonads, collected by the author on 31 January, 1977. Deposited with the Zoological Survey of India, Calcutta. Regd. No. P. 3030/1.

Type locality : Medium sand, 20 cm below surface, half-tide level, intertidal zone, Gopalpur Beach (Lat. 19°15'28" N and Long. 84°55'14" E), Orissa, India.

Remarks : Of the 18 species of *Turbanella* Schultze hitherto known (see Schmidt, 1974), *T. indica* n. sp. approaches the group of species as *T. bocqueti* Kaplan (1958) and *T. veneziana* Schrom (1972) in the reduction of adhesive tubes. However, the new species clearly differs from both the species in other details. It differs from *T. bocqueti* in the shape of head and tail lobes and the structure and number of adhesive tubes. *T. indica* differs from *T. veneziana* in the shape of body, possession of lateral cephalic protuberances, absence of a median anal cone and the number of adhesive tubes.

Diagnostic features : Shape of body typical of the genus. Body up to 360 μm long and

55 μm wide. Head distinct with lateral protuberances. Posterior end bilobed and deeply cleft. Median anal cone absent. Anterior adhesive tubes 3—4 pairs, ventrolateral adhesive tubes 8—10 pairs and posterior adhesive tubes 5 pairs. Dorsal adhesive tubes absent. Dorsolateral epidermal glands small and numerous. Ventral ciliation in two longitudinal bands. Pharynx occupies 1/3 of total gut length. Conspicuous pharyngeal pores at posterior end of pharynx.

Family : THAUMASTODERMATIDAE Remane, 1926

Genus : *Tetranchyoderma* Remane, 1926

Tetranchyoderma littoralis n. sp. (Fig. 3)

DESCRIPTION

The specimens attain a total length of 320–360 μm and a maximum width of 70–85 μm , depending on the state of contraction. Body elongated, contractile, dorsoventrally flattened and slightly tapers towards both the ends. Head distinct. Both the head and tail are bluntly rounded. Head without pestle organs and tentacles, but bears dorsally two flagelliform hairs about 40 μm in length on its anterolateral corners. Body has a complete dorsal covering of 4-pronged cuticular hooks or tetrancres. The hooks have prongs of equal size and measure about 3 μm in the anterior region and 5–8 μm in middle and posterior regions. There are about 60 transverse rows of tetrancres, each row consisting 15–20 hooks. As in other species, cuticular hooks are absent or sparse in the narrow strip of anterior region on head. Two rows of small and numerous dorsolateral epidermal glands present; they are about 15–18 pairs on each side, attaining about 3–5 μm in diameter. Dorsal glands absent. Ventral surface has a complete and uniform covering of cilia,

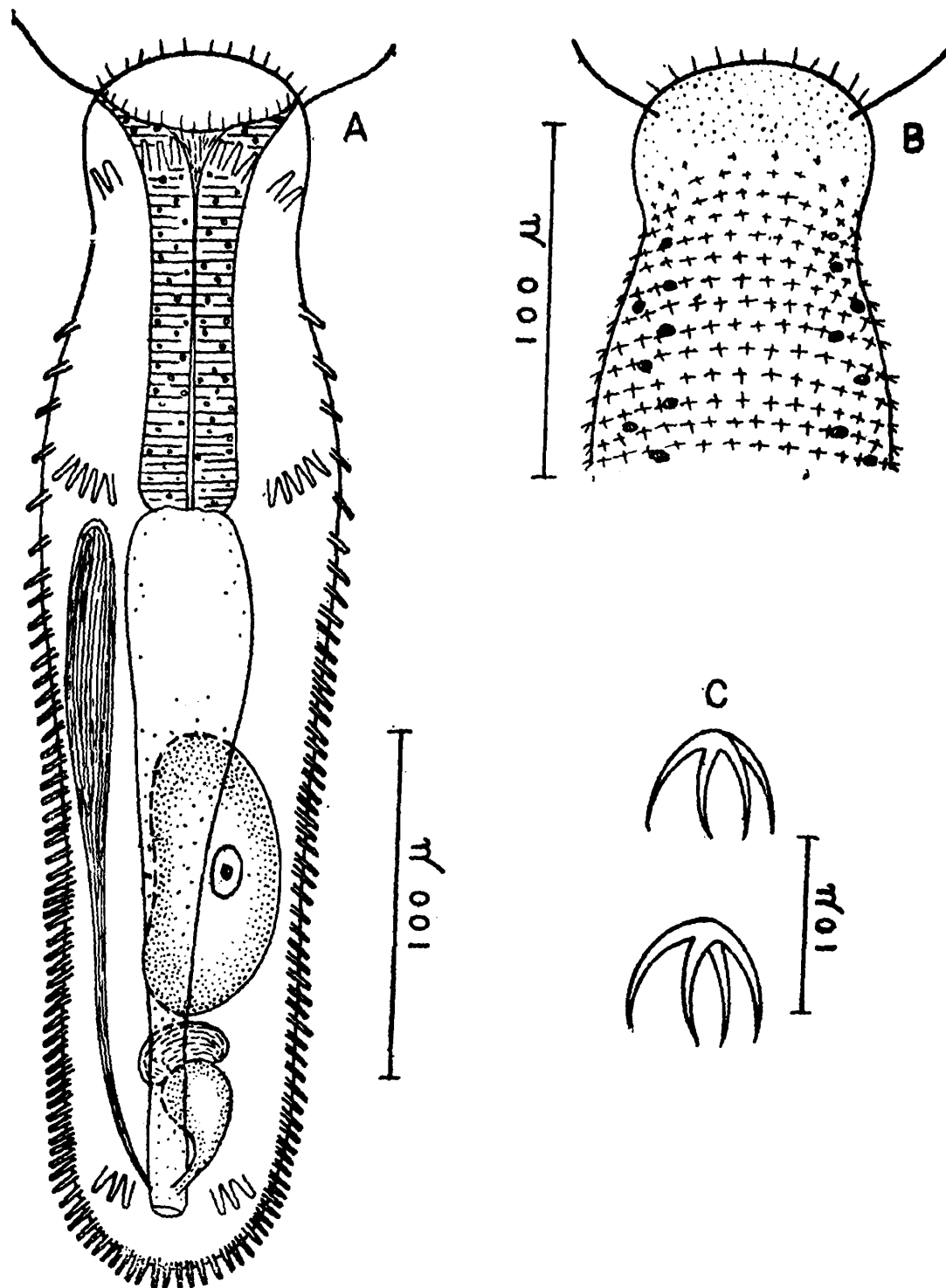


Fig. 3. *Tetranchyoderma littoralis* n. sp. A. adult, ventral view ; B. anterior region, dorsal view ; C. Two cuticular hooks or tetrancres.

Short sensory hairs 5—12 μ m in length occur along the anterior margin of head and lateral sides of body.

Anterior adhesive organ consists of 5 tubes

on either side, arranged in an arc on the ventral surface just behind mouth. They occur in two groups, three being ventral and two ventrolateral in position. The tubes

attain 6—8 μm in length. Fifty to 60 pairs of ventrolateral and posterior adhesive tubes 5—8 μm in length occur in a single row. The tubes start at the level about halfway of the pharynx; they are somewhat sparse anteriorly and more numerous towards the posterior end. The ventrolateral and posterior adhesive tubes merge around the posterior border and are indistinguishable. Lateral and dorsal adhesive tubes, cirri and posterior pedicles seen in some other species of the genus are absent. In addition to the anterior, ventrolateral and posterior adhesive tubes, two pairs of ventral feet resembling those reported for *T. coeliopodium* Boaden (1963 b) and *T. thysanogaster* Boaden (1965), are present. The more anterior feet are located at the level lateral to the posterior end of pharynx, while the posterior ones occur lateral to anus. The anterior foot bears 5 adhesive tubes about 8 μm in length, while the posterior one has 3 tubes 6—8 μm in length. The tubes are directly borne on ventral body surface.

Mouth is about 50 μm wide, quite extensible, terminal, inclined to ventral surface and encircled by a corona of sensory setae about 3 μm in length. Pharynx, intestine and gonads follow the usual pattern. Pharynx is about 110 μm long and occupies nearly 1/3 of the total gut length. Pharyngeal pores inconspicuous at the posterior end of pharynx. The unpaired right testis extends up to the level of the posterior end of pharynx. One dorsal ovum about 80 \times 35 μm in size situated nearly halfway along intestinal region, observed. A reniform seminal receptacle 28 \times 12 μm in size and a pitcher-shaped granular copulatory bursa with stalk reaching about 45 μm in length, present. Both the genital pores open on the ventral surface close and adjacent to anus. Protonephridia not seen.

Holotype : Specimen 330 μm long, with gonads, collected by the author on 21 January, 1977. Deposited with the Zoological Survey of India, Calcutta. Regd. No. P 3031/1.

Type locality : Medium sand, 10 cm below surface between low and half-tide levels of the intertidal zone, Puri Beach (Lat. 19°48' 60" N and Long. 85°51'14" E), Orissa, India.

Remarks : Hitherto, the genus *Tetranchyroderma* Remane included 24 species. Of these species, *T. littoralis* n. sp. appears closely related to *T. apus* Remane (1927) in the shape and structure of body, particularly the disposition of adhesive tubes and the absence of posterior pedicles. But, the new species clearly differs from the latter in the absence of head tentacles, presence of tetrancre and the number of adhesive tubes. *T. littoralis* is distinguished from all other known species of its genus by the presence of two pairs of additional ventral feet, each with 5 and 3 adhesive tubes, respectively.

Diagnostic features : Body up to 360 μm long and 85 μm wide, with both the ends rounded. Cuticular armament of tetrancre present. Fifteen to 18 pairs of small dorsolateral epidermal glands present. Head tentacles and pestle organs absent. Five pairs of anterior adhesive tubes present. Fifty to 60 pairs of ventrolateral and posterior adhesive tubes merge indistinguishably at posterior end. Dorsal and lateral adhesive tubes and posterior pedicles absent. Two pairs of additional ventral feet with 5 and 3 adhesive tubes present. Pharynx about 110 μm long. Reniform seminal receptacle and pear-shaped copulatory bursa present.

ACKNOWLEDGEMENTS

The author is grateful to the Director, Zoological Survey of India, for the facilities provided to carry out this work.

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A NEW SPECIES OF THE GENUS *ITALOCHRYSA* PRINCIPI
(NEUROPTERA : CHRYSOPIDAE) FROM INDIA.

S. K. GHOSH

Zoological Survey of India, Calcutta

ABSTRACT

Italochrysa flavobrunnea, sp. nov., is described in this paper.

INTRODUCTION

In course of the taxonomical studies on the neuropteran material from the northern and southern peninsular India, the author came across an interesting species belonging to the genus *Italochrysa* Principi. Tjeder (1966) claimed to have seen other species of the genus from India and elsewhere, but he did not furnish any published record of their distributional data from India.

Presently, the paper incorporates a detailed illustrated account of the species, *Italochrysa flavobrunnea*, sp. nov., from Madhya Pradesh and Tamil Nadu. The specimens bearing registration no. 614/H₁₂ and 850/H₁₂ will be duly deposited at Zoological Survey of India.

***Italochrysa flavobrunnea* sp. nov.**

Female : Labrum and palpi : brown ; frons, clypeus and vertex : yellow ; antenna : scape and pedicel yellow but flagellum black ; pronotum : yellow with dark brown anterior margin and a transverse band on the disc ; mesonotum : yellow with blackish markings on anterior margin of prescutum, on hinder part of scutum and on anterior part of scutellum ; metanotum : scutum and scutellum similarly spotted as in mesonotum ; wings (Plate III) : elongate with subacute apex ;

forewing : longitudinal veins pale, yellowish white but portion of Rs beyond middle black ; second to sixth costals upto middle portion, cross vein between cell m₁ and m₂, basal cubital crossvein and all gradates in inner row and distal five in outer row black ; cell m₂ longer than m₁ ; pterostigma elongate and brownish ; hind wing : with pale venation, leg : femur yellow with a blackish spot just before apex but in addition to it a brown longitudinal line present on the inner side of foreleg ; tibia yellow but foreleg with a longitudinal brown line on the inner side ; tarsus brown ; claw brown with a tooth at base ; abdomen (Fig. 1, A) : black but apex of each segment yellow ; tergite 9+ ectoproct with narrow dorsal portion and obliquely expanded lower portion ; Sternite 7 with almost rounded distal margin ; spermatheca and subgenital plate as in Text-figs. 1, B and C.

Measurement : length of forewing, 16-17 mm : of hindwing, 14-15 mm.

Material : Holotype ♀ (Reg. No. 614/H₁₂) : INDIA : Top slip, Coimbatore, Tamil Nadu, coll. nil, 18. xi. 1969 ; Paratype ♀ (Reg. no. 850/H₁₂) : Kanker rest house, Bastar, Madhya

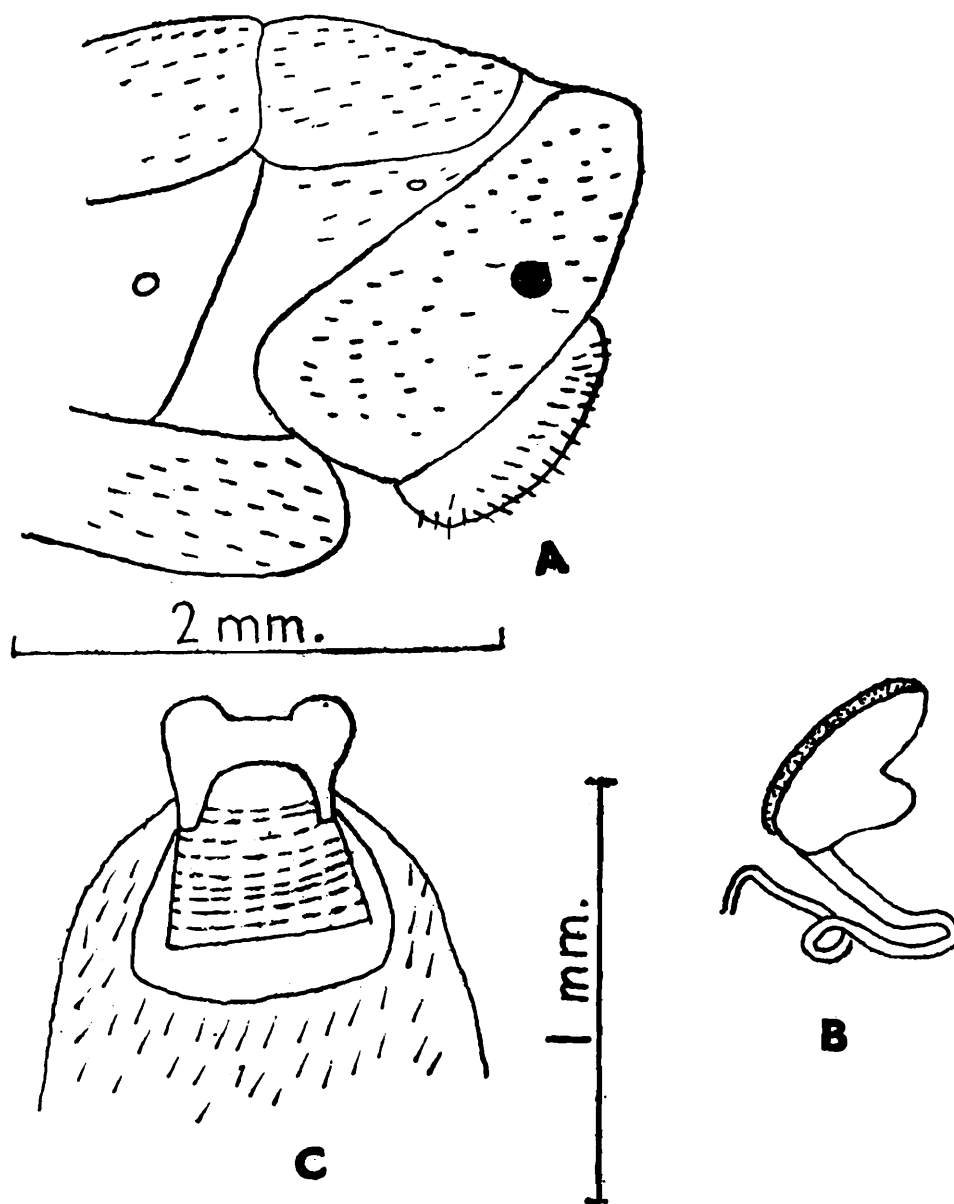


Fig. 1. A. apex of abdomen, lateral ;
B. spermatheca, lateral ; C. subgenital plate, ventral.

Pradesh, coll. M. S. Shishodia and party,
4.i.1979.

Remark : The species is very much allied to *Italochrysa vartianorum* Holzel from Afghanistan. It differs from it by the frons, clypeus and ground colour of the thorax yellow ; forewing with second to sixth costals upto middle, cross veins between cell m_1 and m_2 , basal cubital cross veins, all gradates in inner row and distal five in outer row, and abdomen black.

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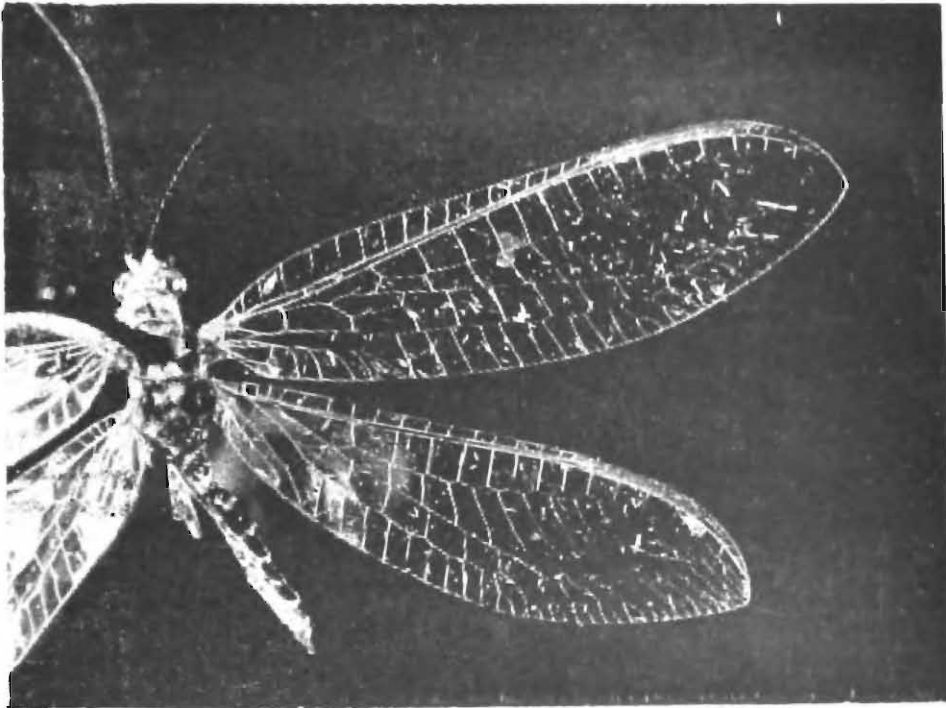
The author is indebted to the Director, Zoological Survey of India, Calcutta, for providing necessary facilities to work on the group.

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S. K. GHOSH

PLATE III



Italochrysa flavobrunnea, sp. nov.

THE ELECTRIC RAYS OF THE GENUS *HETERONARCE* REGAN (RAJIFORMES : TORPEDINIDAE), WITH THE DESCRIPTION OF A NEW SPECIES

P. K. TALWAR

Zoological Survey of India, Calcutta

ABSTRACT

Heteronarce prabhui, a new species of *Terpedinidae* from India, is described from six specimens recently trawled at 300 m off Quilon, Arabian Sea, and constitutes the first record of the genus *Heteronarce* Regan from India. A key is given to the three recognised species, all of which have been collected in recent years from our region. Further, the relationship of *Heteronarce* to other torpedinoid genera is reviewed and characters for the separation of the five Indian genera are keyed.

INTRODUCTION

Two species of the rather rare genus *Heteronarce* Regan, 1921, have generally been recognised from four nominal species, known only from the Western Indian Ocean : *H. garmani* Regan, 1921, *H. regani* von Bonde and Swart, 1924, *H. natalensis* (Fowler, 1925) all from Natal, and *H. mollis* (Lloyd, 1907), previously known only from three specimens taken from the Gulf of Aden. Very little taxonomic work has been done on this poorly known deep-water genus. However, since 1971 several specimens of *H. mollis* and *H. garmani* have been collected off the south-west coast of India. Also, six specimens of a new species have been collected recently also off the south-west coast of India. This new torpedinoid is named in honour Dr. M. S. Prabhu, Director, Integrated Fisheries Project, Cochin.

The specimens described below are referable to the genus *Heteronarce* primarily because the specimens have the disc rounded anter-

iorly, a very shallow groove around the mouth, jaws short and weakly protractile, eyes well developed and almost contiguous with the spiracles, the nasal curtain only slightly broader than long, and two dorsal fins. The techniques employed for measuring the morphological characters were similar to that used by Wallace (1967). Opportunity is taken here to briefly review the classification of the torpedinoids as they concern the genera found in India and present a key to their identification.

Key to the Species

- | | | |
|-------|---|-------------------|
| 1 (a) | Disc wider than long ; spiracles large, about 1.25 times eye ... | <i>H. prabhui</i> |
| | b) Disc longer than wide ; spiracles small, equal eye ... | 2 |
| 2 (a) | Length of disc more than 50% total length ; dorsal fins sub-equal ... | <i>H. mollis</i> |
| | b) Length of disc less than 50% total length ; first dorsal fin slightly smaller than second dorsal fin ... | <i>H. garmani</i> |

SYSTEMATIC ACCOUNT

Family : TORPEDINIDAE

Heteronarce garmani Regan

Heteronarce garmani Regan, 1921, *Ann. Mag. nat. Hist.*, (9) 7 : 414 (type locality : Natal, 220-238 m) ; Wallace, 1967, *Oceanogr. Res. Inst. Invest. Rep.*, (17) : 55, fig. 28.

Material : 4 ex., 193—212 mm in total length, off Quilon (Kerala), 300 m., 12—13 Mar. 75, coll. P. K. Talwar ; ZSI regd no. F 7205/2—F7208/2.

DESCRIPTION

Disc subcircular, about 1.1 times longer than wide ; length of disc 44.0—48.8% total length. Eyes and spiracles small, of equal size. Mouth small and slightly undulate, its corners completely overlapped by nasal curtain.

Origin of first dorsal fin just behind base of pelvic fins ; first dorsal fin slightly smaller than second dorsal fin. Outer edges of pelvic fins concave.

Colour : in alcohol, dark brown above ; ventral surface creamy white with their outer edges greyish brown ; outer posterior edges of dorsal fins hyaline, outer edges of pelvic fins whitish.

Distribution : Natal (Western Indian Ocean) and the south-west coast of India ; 74—300 m.

Remarks : This species was earlier known only from the Western Indian Ocean. Of the four specimens from India, three are males and are similarly coloured whereas in the fourth specimen (F 7208/2) which is a female, the dorsal surface of the disc is considerably lighter in colour with faint reticulations and the ventral surface of the disc is also much paler in colour. These specimens agree very well with Wallace's (1967) description and figure of the species.

Heteronarce mollis (Lloyd)

Narcine mollis Lloyd, 1907, *Rec. Indian Mus.*, 1 : 5, 8 (type locality : Gulf of Aden, 235 m.) ; Lloyd, 1909, *Mem. Indian Mus.*, 2 : 144 ; *Illust. Zool. "Investigator"*, 1909, pl. 46, fig. 1. la.

Heteronarce mollis : Regan, 1921, *Ann. Mag. nat. Hist.*, (9) 7 : 414 (name only) ; Norman, 1939, *John Murray Exped. Sci. Rep.*, 7 (1) : 12.

Material : 7 exs., 120—205 mm in total length, off Quilon (Kerala), 300 m, 3—4 Mar. 1971, coll. P. K. Talwar ; ZSI regd. F 6299/2.

DESCRIPTION

Disc ovoid, about 1.1 times longer than wide ; length of disc 51.6—54.0% total length. Eyes and spiracles small, of equal size. Mouth small and slightly undulate, its corners completely overlapped by nasal curtain.

Origin of dorsal fin just behind base of pelvic fins ; dorsal fins subequal. Outer edges of pelvic fins convex.

Colour : in alcohol, dark brown above, greyish brown on ventral surface ; margins of dorsal, pelvic and caudal fins with white margins.

Distribution : Gulf of Aden and the south-west coast of India ; 238—288 m.

Remarks : Lloyd (1907) described this species on two specimens from the Gulf of Aden. Subsequent to its original discovery it has been reported only once (Norman, 1939) by the *John Murray Expedition* also from the Gulf of Aden. The fate of the two syntypes is unknown (Talwar, 1977). One syntype (ZSI F 1456/1), a male, 225 mm in total length, is not traceable in the ZSI collections and the fate of other syntype (ZSI F 1457/1) which was given to the British Museum (Natural History) on 9 March 1909, is also unknown.

Heteronarce prabhui sp. nov.

Material : *Holotype* (Fig. 1) : an example, 220 mm in total length, collected from the Arabian Sea off Quilon (approx. 09°N. 76°E), otter trawl haul, 300 m, 7 March, 1979, coll. P. K. Talwar, Zoological Survey of India regd. no. F 7614/2.

DESCRIPTION

Based on the holotype and five paratypes. Measurements are presented in the table.

Disc almost circular, 1.05—1.07 times wider than long ; length of disc 48.1—52.4% total length. Eyes small, contiguous with

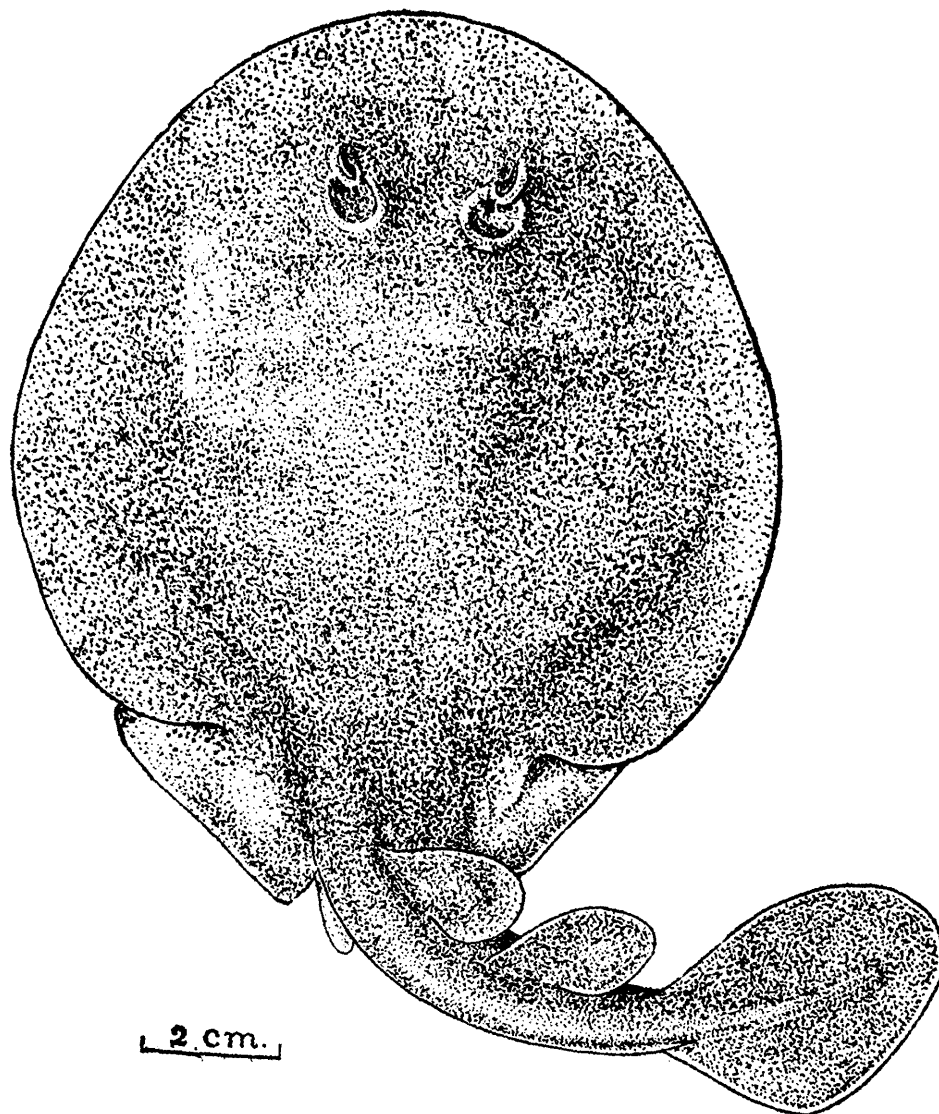


Fig. 1. *Heteronarce prabhui*, holotype, dorsal view.

Paratypes : 5 examples, 141—218 mm in total length, collected along with the holotype ; ZSI regd. no. F 7615—9/2.

spiracles ; spiracles large, about 1.25 times in eye diameter. Mouth small and slightly undulate, its corners completely overlapped

by the nasal curtain; mouth apparently suctorial.

Teeth in $\frac{10-12}{11-12}$ transverse rows, each with a sharp median cusp.

Dorsal fins subequal, origin of first dorsal fin just above or slightly anterior to rear ends of pelvic fin bases. Pelvic fins with outer edges convex.

Colour: in alcohol, dorsal surface greyish, uniform; ventral surface greyish with whitish margins to the disc, pelvic fins and tail.

Distribution: South-West coast of India, 300 m.

ed a classification in which three families were defined by the number of dorsal fins wherein he also considered *Heteronarce* near *Narcine*. Compagno (1973), however, has shown that the genus *Heteronarce* is more closely related to the genus *Narke* (a genus with one dorsal fin only) than with *Narcine*. He placed *Narke* and *Heteronarce* in the family Narkidae, *Narcine* and *Benthobatis* in the Narcinidae, and proposed new characters for separating them. Lindberg (1976), however, continued to follow the older classification whereas Nelson (1976) employed Compagno's basis of division but at a subfamily/tribal level. It seems best to regard the torpedinoids as constituting a

TABLE: Selected measurements (in mm) of holotype and paratypes of *Heteronarce prabhui*

	HOLOTYPE		PARATYPES			
	F 7614/2	F 7615/2	F 7616/2	F 7617/2	F 7618/2	F 7619/2
Total length	220.0	205.0	202.0	202.0	218.0	141.0
Length of Disc	108.0	100.0	106.0	106.0	102.0	74.0
Snout to origin first dorsal fin	125.0	122.0	121.0	120.0	124.0	85.0
Snout to origin second dorsal fin	148.0	141.0	141.0	138.0	148.0	96.5
Snout to anterior end orbit	24.0	23.0	26.0	24.0	23.0	15.5
Snout to origin upper caudal fin	174.0	161.0	159.0	160.0	169.0	112.5
Disc width	112.0	105.0	108.0	114.0	105.0	75.0
First dorsal fin base	12.5	11.5	12.5	12.0	13.5	9.0
Interspace between dorsal fin bases	10.5	7.5	8.0	8.5	12.0	7.0
Second dorsal fin base	12.5	12.5	13.5	13.5	13.5	7.5
Distance between spiracles	13.5	13.0	13.5	12.5	13.0	9.5
Snout to tip lower jaw	25.0	22.0	27.0	24.5	27.0	18.5
Snout to anterior end vent	102.0	101.0	94.0	93.0	102.0	70.0
Mouth width	10.5	8.5	9.5	9.5	9.0	6.0
Between inner ends first pair gill slits	33.0	28.5	27.5	28.5	29.5	18.5
Between inner ends fifth pair gill slits	18.0	16.5	16.5	17.0	17.0	15.0

DISCUSSION

Earlier workers arranged the torpedinoids (electric rays) in a single family Torpedinidae and the genus *Heteronarce* has usually (Regan, 1921; Fowler, 1941; Norman, 1957) been placed in the vicinity of the genus *Narcine* Henle. Bigelow and Schroeder (1953) introduc-

single distinct family. Misra (1969) listed five genera of Torpedinidae in the *Fauna of India* of which *Bengalichthys* Annandale is considered a subgenus of *Narke* Kaup by Garrick (1951), and subsequent workers by implication. The following key will serve to distinguish the five Indian genera;

- 1 (a) Disc truncate or emarginate anteriorly ; jaws extremely slender ; mouth arcuate (Subfamily Torpedininae) ... *Torpedo*
- (b) Disc rounded anteriorly ; jaws stout ; mouth transverse (Subfamily Narcininae) ... 2
- 2 (a) Deep groove around mouth ; jaws long and strongly protractile ... 3
- (b) Shallow groove around mouth ; jaws short and weakly protractile ... 4
- 3 (a) Eyes obsolete (degenerate) ; disc elongate ... *Benthobatis*
- (b) Eyes well developed ... *Narcine*
- 4 (a) One dorsal fin ... *Narke*
- (b) Two dorsal fins ... *Heteronarce*

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TWO NEW SPECIES OF AMPHIBIA FROM
SILENT VALLEY, S. INDIA

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ABSTRACT

Two new species of Anurans, *Micrixalus thampii* (Ranidae) and *Bufo silentvalleyensis* (Bufonidae) are being described from Silent Valley forests. *M. thampii* comes very close to *M. fuscus*. *B. silentvalleyensis* possesses a parietal ridge and is compared with those Bufonids with parietal ridge viz. *B. parietalis*, *B. fergusonii* and *B. biporcatus*.

Keywords : Silent Valley, *Micrixalus thampii*, *Bufo silentvalleyensis*.

INTRODUCTION

As a member of the multi-disciplinary joint expedition to the Silent Valley organised by the Geological Survey of India in January, 1979 the author was able to make a good collection of Amphibia and while working it out discovered two species new to science belonging to the genera *Micrixalus* and *Bufo* which are being reported here. The Silent Valley, which is in the Palghat District of Kerala State, is one of India's largest, undisturbed evergreen forests spread over 8952 hectares. Kunthi River which is a tributary of Bharathapuzha takes its origin in the valley and flows north-south. There has not been earlier studies on the Amphibian fauna of this forest because of its inaccessible nature and difficult terrain.

Family : RANIDAE

Genus : *Micrixalus* Boulenger
Micrixalus thampii sp. nov.

(Plate IV, A and B)

Diagnosis : Small frogs with tympanum fairly distinct, dorso-lateral glandular folds present but not complete, lingual papilla absent, upper eyelid narrower than inter-orbital space and toes half to three-fourths webbed, with digital discs bearing circum-marginal grooves.

Material : The material consists of two specimens, a male and female collected at a point about 6 kilometre (as the crow flies ; about 15 kilometre on foot) north of the proposed dam site. The female was taken from Madiri Mavam Thodu which is a tributary of the Kunthi River. The male specimen

was collected from a stream which drains into Madiri Mavam Thodu.

DESCRIPTION

Head : Not depressed, as long as broad, width at level of tympanum twice that of the distance from tip of snout to anterior corner of eye. Snout subacuminate, slightly longer than the horizontal diameter of eye ; canthus rostralis blunt and rounded, lores almost vertical, concave between eye and nostril ; nostril at the upper margin of lores, halfway between tip of snout and eye ; inter-orbital space wider than upper eyelid ; tympanum small, its rim fairly distinct through the enveloping skin, its diameter less than half of eye and about half the inter-orbital distance. Pupil horizontal, vomerine absent. Tongue free, bifid, devoid of papilla.

Forelimbs : About half total length, fingers free, tips dilated into discs, that of third twice as wide as the narrowest part of the penultimate phalanx, discs with deep circum-marginal grooves. First finger a little shorter than second, the latter as long as fourth ; subarticular tubercles fairly prominent.

Hindlimbs : More than $1\frac{1}{2}$ times the length from tip of snout to coccyx, heels hardly touching when limbs are folded at right angles to body ; tibio-tarsal articulation of the adpressed limb reaching just beyond anterior corner of eye. Tibia about half of total length, about 4 times as long as broad. Disc of toes larger than that of fingers, with deep circum-marginal pocket-like grooves. No intercalary ossicle present, Toes in males three-fourths webbed, only narrow fringes of web reaching discs on the outer side of first, second, third and the inner side of fifth toe. Three digits of fourth toe free. The webbing

comparatively briefer (half) in females where two distal digits of first, second, third, fifth, and a little more than three digits in the fourth toe are free. Subarticular tubercles prominent ; a small oval inner metatarsal tubercle present, no outer tubercle. Outer metatarsal separated by web in the distal half. No outer metatarsal fold or tubercles. No tarsal fold.

Skin : Smooth above with few small granules which are devoid of minute spines. Dorsal side of tibia with larger granules. An incomplete weak dorsolateral glandular fold originating at shoulder level upto groin. Tympanic fold faint. A row of three pustules from angle of mouth to insertion of arm.

Colour : Dorsum greyish brown without much markings. Flank below the dorsolateral fold black which encloses the darkish tympanum. Sides of snout darker on the upper half. Upper sides of femur and tibia with narrow brown cross bands. Hind surface of thigh black with a narrow whitish oblique line from base to half or less its length. Under surface of body white, mottled and marbled with brown on breast and more so on throat. Under side of thighs white while that of calf brownish with a distinctive clear, white band running its entire length.

Secondary sex characters : Dorsum in male darker with indistinct markings. Vocal sacs internal opening to the floor of mouth by paired openings near the angle of jaws. Nuptial pads present on the upper side of first finger extending from wrist to base of penultimate digit. Webbing on toes in male more extensive in comparison with female. Male smaller.

Measurements : See Table I

TABLE 1. Body measurements in mm. of *Micrixalus thampii* Pillai

	Male	Female
Total length ...	20.0	29.0
Length of head (tip of snout to angle of jaws) ...	7.5	8.0
Width of head (at angle of jaws) ...	7.0	8.0
Length of Snout (tip of snout to anterior corner of eye) ...	9.5	4.0
Diameter of eye ...	3.0	3.0
Width of upper eyelid ...	1.8	2.0
Minimum inter-orbital distance ...	2.2	2.5
Diameter of tympanum ...	1.0	1.2
Length of forelimb ...	10.5	11.0
Length of hind limb ...	34	40
Length of tibia ...	11.0	13.0
Width of tibia ...	3.0	3.5

Type-specimens :

Holotype : An adult ♂ frog, loc. Silent Valley, S. India, Alt. 900 metres. 27 January 1979, Coll. R. S. Pillai.

Paratype : An adult ♀ frog, loc. Silent Valley, 26 January 1979. Other data same as above.

The Type specimens are deposited with the Southern Regional Station, Zoological Survey of India, Madras.

Both the specimens were taken from water. The long legs and webbed feet suggest that they are good swimmers and leapers.

It is a pleasure to name this frog after Shri P. K. Thampi who led the expedition to the Silent Valley.

AFFINITIES

Pillai (1978) while describing *Micrixalus nudis* from Wynad has presented a key to the seven Indian and the single Ceylonese species of *Micrixalus*. Running down the Key with reference to the characters enumer-

ated above, the present species is seen to occupy a position very close to *Micrixalus fuscus* (Boulenger, 1890). But a comparison with the material of *M. fuscus* which the author collected from Courtallam (S. India) shows that the present species is quite distinct. *M. fuscus* has a long, pointed snout, inter-orbital space only as broad as upper eyelid, toes nearly entirely webbed and the stripe on the hindside of thigh is horizontal, broad and extending to the articulation of the femur and tibia. *M. thampii* comes close but differs from *M. herrei* erected by Myers (1942) on the basis of a single male specimen collected from Kallar (near Trivandrum, Kerala), the female of which is still unknown, in the incomplete and weak dorso-lateral and tympanic folds, inter-orbital space being broader than upper eyelid, the tibio-tarsal articulation not extending beyond tip of snout, in the shorter webbing on toes, the discs on toes being larger than those on fingers, the outer metatarsal being separated in the distal half (as against one-third or one-

fourth in *M. herrei*) and in colouration, particularly back of thighs and lower side of tibia. The present species resembles *M. silvaticus* (Boul.) in the incomplete dorso-lateral folds but could easily be distinguished by the more extensive webbing on toes, larger digital discs, longer legs and colouration. *M. thampii* also differs from *M. saxicola* (Jerdon), *M. sarasinorum* (Muller), *M. nudis* (Pillai) and *M. borealis* Annandale in the presence of dorsolateral glandular folds and from *M. opisthorhodus* (Gunther) in the absence of a lingual papilla.

Family : BUFONIDAE

Genus : **Bufo** Laurenti

Bufo silentvalleyensis sp. nov.

(Plate IV, C and D)

Diagnosis : A fairly large toad with smooth skin, broad head and slender limbs. Cranial ridges present, the parietal ridge being directed obliquely inwards.

DESCRIPTION

Head : Broader than long, with bony cranial ridges in the form of a canthal, pre-orbital, supra-orbital, post-orbital, parietal and supra-tympanic. Ridges on either side elevated rendering the inter-orbital area depressed and excavated. Parietal ridges directed obliquely inwards making an obtuse angle with the supra-orbital. Snout rather blunt not projecting beyond lower jaw. Canthus rostralis prominent, loreal region almost vertical, nostrils, lateral, near the tip of snout, distance between them less than minimum inter-orbital distance and slightly more than diameter of tympanum. Eyes with pupil horizontal, its diameter equal to minimum inter-ocular distance. Upper eyelid broad, oval, overhanging and about closing the

corneal surface. Tympanum distinct, smooth, about half diameter of eye. Upper jaw devoid of teeth, vomerines absent, tongue small, pyriform.

Forelimbs : Slender, about three-fourths length from tip of snout to vent. Fingers free, tips obtuse. First finger a little longer than second, third much longer. Inter-articular tubercles prominent, two pads on palm.

Hindlimbs : Long, slender, about $1\frac{1}{2}$ times length of head and body. Tibia very thin being 5 times as long as broad and as long as foot. Tibia-tarsal articulation of adpressed limb reaching anterior margin of tympanum, heels not touching when limbs are folded at right angles to body. Toes long, tips obtuse, webbed at base. Outer metatarsal fused for more than half its length, Subarticular tubercles small.

Skin : Dorsal surface smooth, a few tubercles behind the angle of jaws, limbs with minute tubercles. A few tubercles on flanks. Parotoids prominent, narrow and smooth. A distinct hump above cloaca representing the tip of coccyx. Diapophysis of sacral vertebrae dilated and projecting. Skin of ventral parts rough.

Colour : (In spirit) Dorsum uniformly greyish brown, flanks and upper side of limbs darker, devoid of markings. Cranial crests lighter. Throat light brown, chest faintly marbled, belly white with brownish blotches, underside of thighs white.

Measurements : See Table 2

Holotype : An adult frog, loc. near Valiaparai Thodu, Silent Valley Forests, S. India, Alt. 800 metres. 17 January 1979, Coll. R. S. Pillai,



A and B. Dorsal and ventral views of *Micrixalus thampii* Pillai (♀)
C and D. Dorsal and ventral views of *Bufo silentvalleyensis* Pillai

TABLE 2. Body measurements in mm. of *Bufo silentvalleyensis* Pillai

Total length	...	66.0
Length of head (tip of snout to angle of jaws)	...	21.0
Width of head (at angle of jaws)	...	27.0
Length of snout (tip of snout to anterior corner of eye)	...	9.0
Diameter of eye	...	8.8
Width of upper eyelid	...	5.0
Minimum inter-orbital distance	...	8.5
Diameter of tympanum	...	9.7
Length of forelimb	...	46.0
Length of hindlimb	...	90.0
Length of tibia	...	30.0
Width of tibia	...	6.0

The single specimen was collected from under a stone in a grassy plot of open forest adjoining the Valiaparai stream which is a tributary of Kunthi River. No information about the habits of this species is available. The weak legs and little webbing suggest that adults are terrestrial living in forest litter.

AFFINITIES

Toothless jaws, pyriform tongue, parotoids and free fingers indicate that the present specimen belongs to genus *Bufo*. Presence of a parietal ridge on the head brings it close to *Bufo parietalis* Boul., *Bufo fergusonii* Boul. and *Bufo biporcatus* Gravenh. The two former species are known from hills of S. India while *B. biporcatus* is distributed in Java, Borneo and Burma. That *B. silentvalleyensis* is not conspecific with any of these three and requires the erection of a new taxon to accommodate it is evident from the following. A comparison with several examples of *Bufo parietalis* which were collected from Silent Valley forests show that the present example is quite distinct from it. The robust body, stout limbs, profusely warty skin and the very prominent and cornified cranial ridges

are quite unmistakable. *B. fergusonii* is a much smaller species with stout body and limbs, skin beset with spinose tubercles, rounded parotoids and the first finger equal to second. In *B. biporcatus* the parietal ridge forms a straight line together with the supra-orbital ridge while it forms an angle in *B. silentvalleyensis*. The larger tympanum (equal to eye), smaller first finger, more extensive webbing, spinous tubercles on dorsum are all characters which easily distinguish *B. biporcatus* from *B. silentvalleyensis*.

The body profile and slender limbs do not conform to that in *Bufo*, but is strongly reminiscent of that of the Pelobatid genus *Leptobrachium* to which it was thought to belong at the time of its collection. But the toothless upper jaw, horizontal pupil, distinct tympanum, parotoid glands and the cranial ridges are unmistakable characters of the genus *Bufo*.

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RECORD OF THREE GENERA OF CHIRONOMINAE (CHIRONOMIDAE : DIPTERA)
FROM INDIA

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and

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ABSTRACT

Systematic position of *Chironomus* (= *Tendipes*) *brunetti* Kieffer has been revised by placing it in the genus *Endochironomus* Kieffer. Two new species, *Pentapedilum macrotrichium* and *Xenochironomus loripes* are described from West Bengal, India.

INTRODUCTION

There are no records of the species of genera, *Endochironomus* Kieffer, *Pentapedilum* Kieffer and *Xenochironomus* Kieffer from India, though they have been reported from the Orient in one, two and one species respectively (Sublette and Sublette, 1973). In course of our studies of the chironomid fauna of India at the Zoological Survey of India and the collections of those from different ecological niches of West Bengal, we came across the above species.

For explanations of abbreviations and morphological terminologies, the works of Frommer (1967) and Saether (1967 and 1977) have been referred.

***Endochironomus brunetti* (Kieffer) n. comb.**
(Figs. 1 a-c)

Tendipes brunetti Kieffer, 1913. *Rec. Indian Mus.*, 9 : 133.

Male : Unknown.

Female : Yellow in colour.

Head : Vertex white with a number of setae. Maxillary palp dark yellow, long, palpomere III longer, palpomere V longest. Eyes contiguous, wider near vertex, reniform extended dorsally, extension being 0.02 mm long. Frontal tubercle absent. Antenna (Fig. 1a brown, flagellomeres II-IV vase-shaped with long neck, flagellomere V almost equal to flagellomere I; length ratio of flagellomeres I—V 35 : 22 : 22 : 25 : 38, AR 0.36.

Thorax : Anteprenotum collar-like with an emargination at the middle, mesonotum with three short bands.

Wing : Hyaline with veins yellow. Setae on veins not traceable R_{2+3} ends well beyond R_1 almost closer to R_{4+5} ; ending of R_{4+5} and C pointed and with setae; r-m slightly proximal to f-cu. Wing with markings or

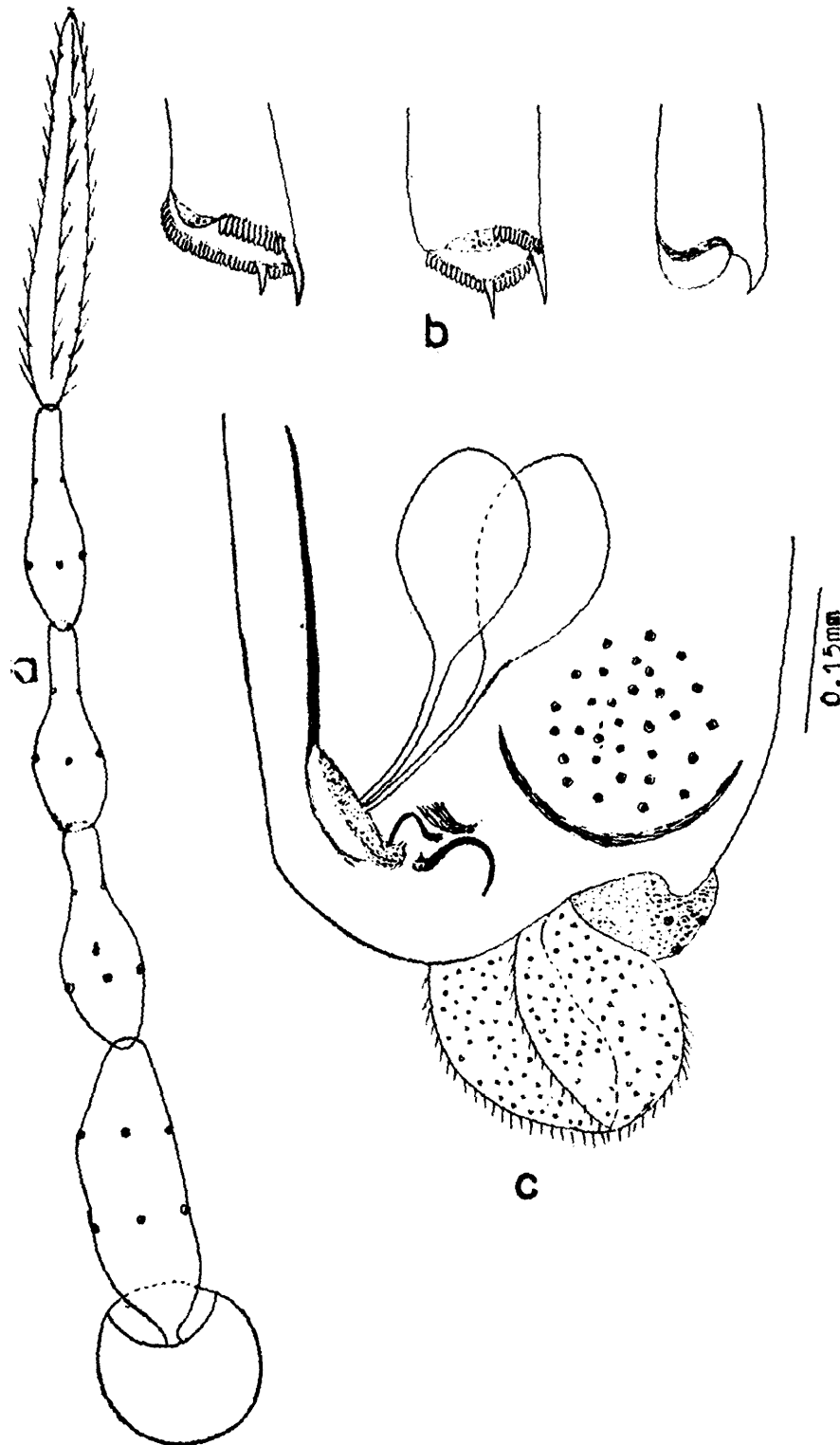


Fig. 1 *Endochironomus brunetti* (Kieffer) n. comb ♀ :
 a) antenna, b) tibial ends of hind, mid and fore legs,
 c) genitalia and seminal capsules.

spots as follows : i) smoky bands in cell M_{3+4} extending over Cu and Cu i but not reaching the margin of the wing, ii) spots two in number one being in cell M near the base of

M_{3+4} and another near the apex of M_{3+4} . Squama with setae. Haltere white. Length of wing 1.64 mm, breadth 0.82 mm. Legs (Fig. 1b) : Fore femur with a broad subapical dark brown band, fore tibia and tarsomeres I-IV dark, hind tibia with a subapical dark brown band. Fore tibial scale with a small sharp spur. Spurs of mid tibia equal to subequal being 0.024 mm and 0.020 mm long, ratio of length of spurs to the apical diameter of mid tibia 6 : 22 and 5 : 22 ; spurs of hind tibia remarkably unequal being 0.028 mm and 0.008 mm long, ratio of length of spurs to the apical diameter of hind tibia 7 : 10, and 12 : 11. Pulvilli wide, little shorter than empodium which is equal to claws.

Abdomen : Yellow in colour. Setae present on terga, marginal setae longer. Genitalia (Fig. 1c) : Notum 0.12 mm long. Coxosternapodeme bow shaped. Cerci long. Seminal capsules oval, equal measuring 0.10 mm by 0.08 mm ; ducts of seminal capsules straight without loop and opening separately.

Material examined : 4 ♀ ♀, India, Bihar, Madhupur, 1913, Coll. N. Annandale.

Remarks : This species was described as *Tendipes brunetti* by Kieffer (1913) from India. Since the descriptions of the species as given by Kieffer is utterly inadequate Sublette and Sublette (1973) could not possibly determine its true systematic position. Though the type-specimen are not available in the Zoological Survey of India, Calcutta, on examining the named collections preserved in spirit in the Zoological Survey of India and correlating the observations on them with the descriptions of Kieffer, One may be tempted to place the species under the genus *Endochironomus* Kieffer as a new combination on the basis of following characters ; i) antepnotum collar-like with dorsal emargination, ii) antenna

of female, iii) ending of R_{2+3} with C far beyond R_1 , iv) fore tibial scale with a short spur, v) hind tibial spurs strikingly unequal and vi) r-m slightly proximal to f-cu. The present authors however, could not locate any spot or clouds in the wing of the material examined as reported by Kieffer (1913). The illustrations could not also be made in detail as the exotic materials are almost bleached due to long preservation in spirit.

***Pentapedilum macrotrichium* n. sp.** (Fig. 2 a—e)

Male : Unknown

Female : Body length 1.59 mm

Head : Greyish in colour. Vertex with 8-9 (Outer verticles 6, post orbitals 2-3) setae. Clypeus with 25-26 (25) setae arranged in 4-5 rows, clypeal ratio 1. Maxillary palp pale grey ; length ratio of palpomeres I-V 2 : 4 : 6 : 4 : 11, L/W ratio 3.0. Eyes bare, reniform slightly extended dorsally, extension being 0.01mm long. Frontal tubercle absent. Antenna (Fig. 2a) pale grey in colour, flagellomeres II-IV flask-shaped with long neck, flagellomere V pear-shaped with a furrow at the middle ; length ratio of flagellomeres I-V 20 : 15 : 18 : 11 : 25, AR 2.1. Pedicel ratio 0.67. CA 1, CP 0.98.

Thorax : Brown with grey bands. Antepnotum collar-like without seta. Acrostichals 12 in pairs, dorsocentrals 13-14 in a row, prealars 2, prescutellars 0, Scutellum with 10 setae in one transverse row, postscutellum grey in colour.

Wing (Fig. 2b) : Pale with yellowish tinge. Brachiolum with 4 setae. Wing membrane with densely distributed macrotrichia even in veins including cross-veins. R_{2+3} very close to R_1 at a distance of 0.02mm from R_1 ;

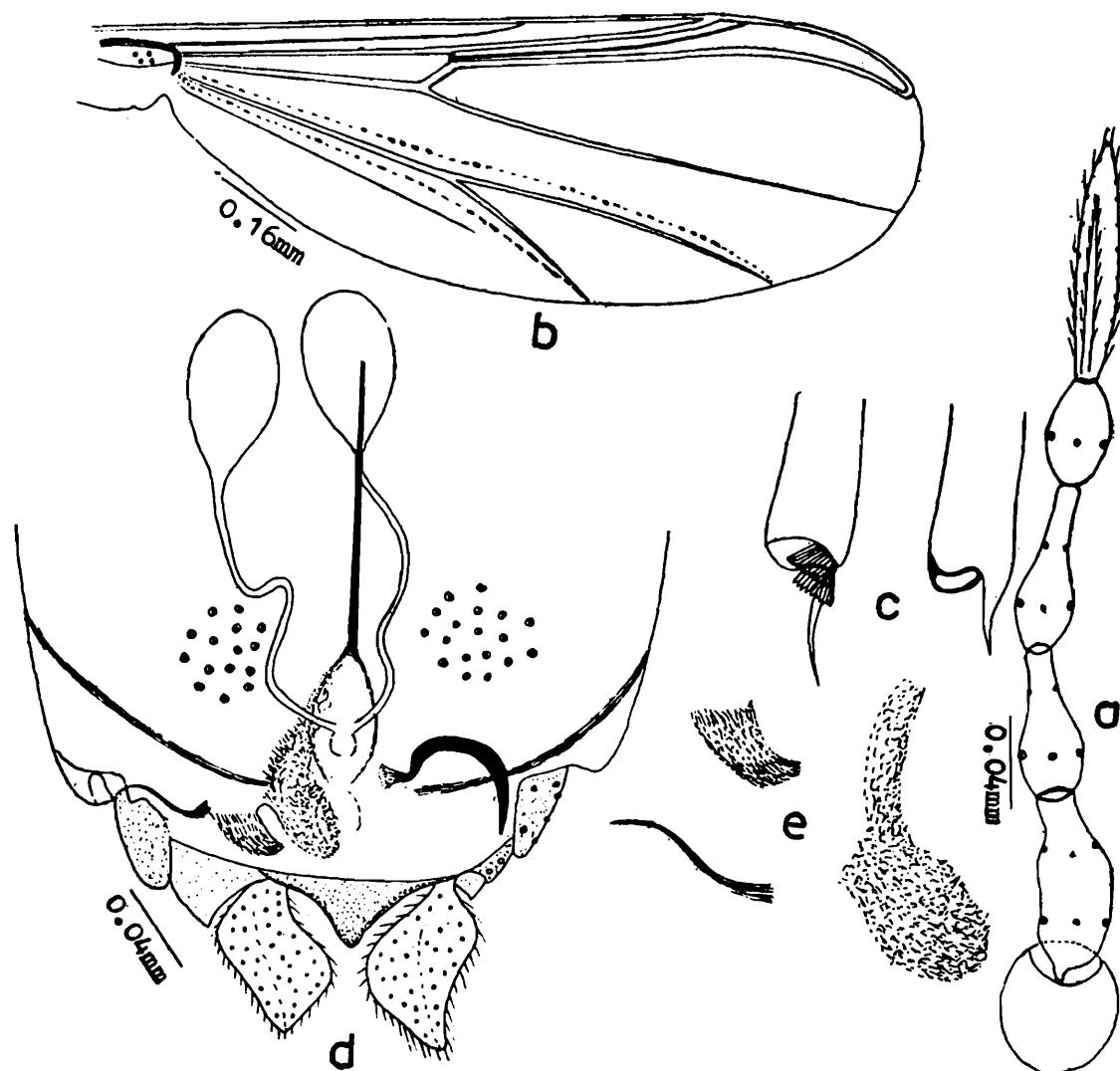


Fig. 2 *Penapedilum macrotrichium* n. sp. ♀ :

a) antenna, b) wing, c) tibial ends of mid and fore legs and d—e) genitalia.

ending of R_{4+5} with C blunt ; r-m proximal to f-cu ; one faint vein present below M_{2+3} and above Cu ; An ends proximal to f-cu. Anal lobe obsolete. Squama with 4-5 (4) setae. Haltere with pale stem and grey knob. CR 0.97, V R 1.38. Wing length 1.03 (0.94-1.12, $n=6$) mm, breadth 0.40 (0.33-0.45, $n=6$) mm.

Legs (Fig. 2c) : Brown in colour with numerous setae. Fore tibia with elongated scale being 0.60 mm long, bearing a short

spine. Spurs of mid and hind tibia equal, ratio of length of spurs to the apical diameter of mid and hind tibia 4 : 3. Pulvilli longitudinally split with an empodium. LR 0.4 in fore, LR 0.5 in mid and LR 0.64 in hind legs.

Abdomen : Brown in colour, margin dark brown. Terga with numerous weak setae arranged in irregular rows. Genitalia (Figs. 2d-e) : Notum 0.13 mm long. Gonocoxite IX with 4-6 setae. Coxosternapodeme with one median broad bend. Gonocoxa-

podeme wide with 12-14 setae divided mesally. Gonapophysis VIII divided into a large dorso-mesal and a small brush like ventrolateral lobe. Tergum IX and X with numerous setae. Postgenital plate conical and protruded. Cerci with 20 setae. Labia with profuse setae. Seminal capsule oval, moderately sclerotized with small neck measuring 0.06 mm by 0.03 mm; ducts of seminal capsules straight normally sometimes with one or two bends.

Holotype : ♀, (Z. S. I. Reg. 6523/H6) West Bengal, Burdwan, 11. iii. 1978, Coll. A. Chatterjee.

Paratypes : 12 ♀♀, data same as holotype; paratypes in the collection of Zoology department, University of Burdwan, Burdwan.

Remarks : This species is named as *Pentapedilum macrotrichium* on the basis of dense macrotrichia distributed all over the wing membrane and veins. It seems close to *Pentapedilum convexum* and *P. nodosum* described by Johannsen (1932) from Sumatra and Java respectively but can easily be distinguished from them by, i) thorax with grey vittae, ii) macrotrichia densely distributed on wing as well as veins, iii) grey haltere knob, iv) flagellomeres II-IV flask-shaped with long neck and v) equal and oval seminal capsules.

***Xenochironomus loripes* n. sp.** (Figs. 3 a-e)

Male : Body length 3.61(3.51-3.70, n=5) mm.

Head : Dark brown in colour. Vertex brown with 12 (postocular 3, outer verticles 5 and inner verticles 4) setae. Clypeus with 14 setae, clypeal ratio 0.87. Maxillary palp (Fig. 3a) pale brown to brown, palpomeres I-IV dark brown, palpomere III with a preapical pit bearing flagella-like sensilla, palpomere V with 2 straight apical setae; length

ratio of palpomeres I-V 10 : 11 : 27 : 33 : 46, L/W ratio 3.71. Eyes bare, contiguous, hemispherical extended dorsally, extension being 0.11mm long. Frontal tubercle absent. Antenna dark brown, length ratio of oflagellomeres I-XI 14 : 6 : 8 : 6 : 8 : 8 : 7 : 7 : 8 : 8 : 164, AR 2.07. Pedicel ratio 1.6 CP 1.1, CA 0.59.

Thorax (Fig. 3b) : Brown with one median longitudinal band and two lateral vittae. Antepronotum very thin, V shaped without any seta and divided by a median suture. Acrostichals 10-12 beginning from tip of the middle of mesonotum, dorsocentral 18-20 (20) in a row, humerals 0, prealars 4. Scutellum with 8 setae in an oblique row, postscutellum dark brown with a median suture.

Wing (Fig. 3c) : Pale brown with the veins conspicuous and infuscated. Brachiolum with 2 setae. R with 13, R₁, 13, and R₄₊₅ without setae; R₂₊₃ meets C very close to R₁ being 0.1mm away from R₁; ending of R₄₊₅ with C blunt and with 3 setae; r-m distinct, dark and proximal to f-cu; An ends distal to f-cu. Squama with 10-12 setae. Haltere with yellow stem and knob and without seta. Wing length 1.44(1.42-1.46, n=8) mm, breadth 0.77(0.77-0.78, n=8) mm. CR 0.95, VR 1.8.

Legs (Fig. 3d) : Brown in colour. Fore coxa with 2 long setae, fore femur with an apical dark brown band, mid and hind femur dark brown forming a broad band at its distal part, fore tibia dark brown, mid and hind tibia brown with an apical and basal brown band. Fore tibial scale blunt with 2 long setae at the tip. Spurs of mid tibia subequal, slightly curved being 0.021 mm and 0.017 mm long, ratio of length of spurs to the apical diameter of mid tibia 3 : 4, and 2 : 4; spurs of hind tibia unequal being 0.25 mm and 0.14 mm long, ratio of length of spurs

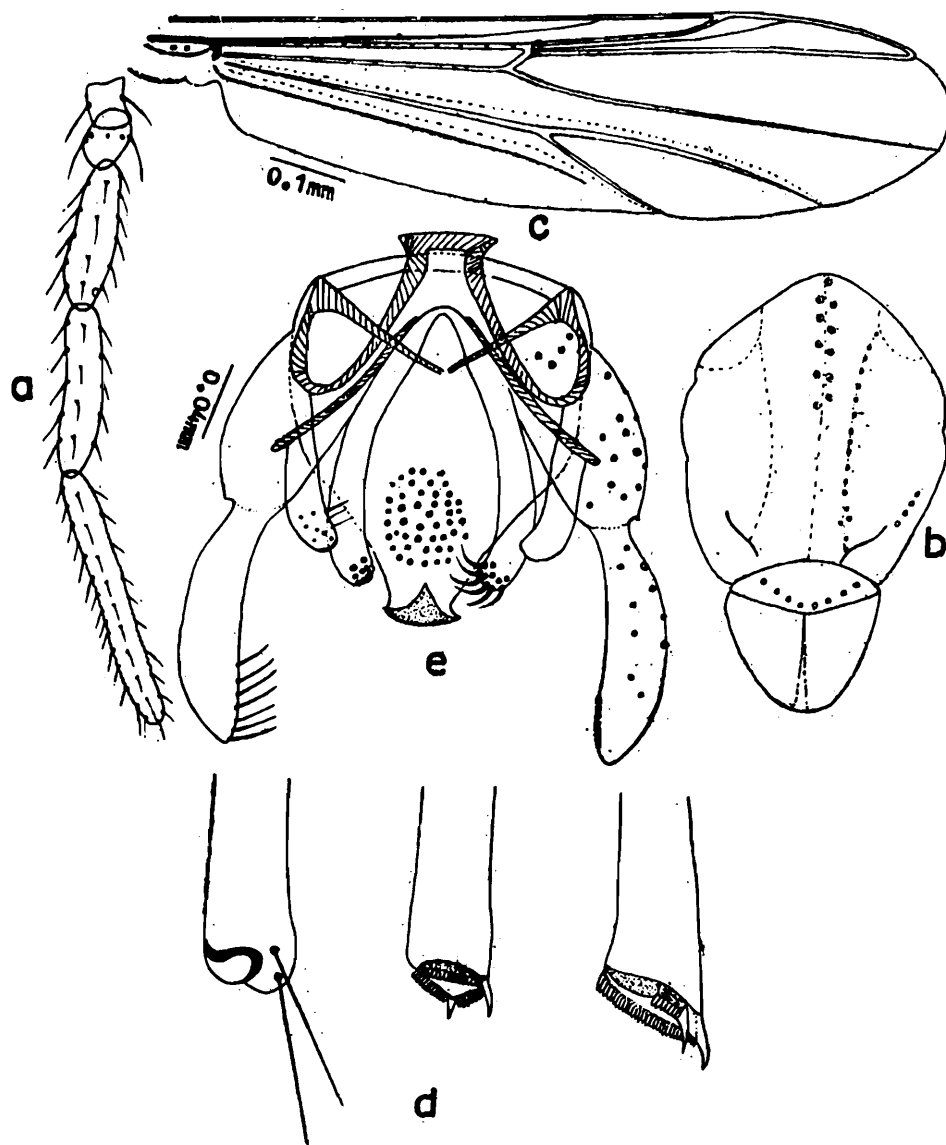


FIG. 3

Figs. 3 *Xenochironomus loripes* n. sp. ♂ :

a) maxillary palp b) thorax, c) wing, d) tibial ends of fore, mid and hind legs and e) hypopygium.

to the apical diameter of hind tibia 7 : 16 and 4 : 16. Tarsomere I with an apical band and tarsomeres II—V dark brown. Pulvilli well developed and wide. LR 1.7 in fore, LR 0.46 in mid and LR 0.65 in hind legs.

Hypopygium (Fig. 3e) : Anal point short broad and strongly downturned. Tergum IX with 10 long setae concentrated at the middle.

Gonocoxite stout with 10—12 setae ; gonostylus long with uniform diameter, tip slightly attenuated and blunt having 7-8 (8) inwardly directed setae at its inner apical margin. Appendage 1 reduced to a small wide and slightly bent at the tip bearing a few setae ; appendage 2 well developed, elongated narrow at the base, bowed ventrally reaching beyond

the end of gonocoxite, apex bearing 11 curved setae. Transverse sternapodeme 0.17 mm long, lateral sternapodeme 0.14 mm long, coxapodeme 0.04 mm and phallapodeme 0.1 mm long. HR 0.5; HV 2.32.

Female : Unknown

Holotype : ♂, (Z. S. I. Reg, 6525/H6) West Bengal, Bolpur, 18. viii. 1977, Coll. D. Chatterjee.

Paratypes : 8 ♂♂, data same as holotype ; 3 ♂♂, West Bengal, Raniganj, 10. viii. 1975 and 11. viii. 1977, Coll. P. K. Chaudhuri in the collection of Zoology department, University of Burdwan, Burdwan.

Remarks : The species is named as *Xenochironomus loripes* on the basis of the dark brown bands on the femur of its legs. It comes close to *Xenochironomus australiensis* Freeman, 1961 from Australia especially in the structure of male hypopygium but can easily be separated from the above by, i) brown colour of the body, ii) dark brown antenna, iii) colour bands on femur and the colour of the legs, iv) dark r-m and distinct other veins of wing, v) shape of appendages 1 and 2 and their chaetotaxy and vi) attenuation of the tip of the gonostylus.

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SCHISTORCHIID TREMATODES OF MARINE FISHES OF INDIA, WITH CONSIDERATIONS ON THE STATUS OF THE GENUS *MEGACREADIUM* NAGATY, 1956 AND FAMILY SCHISTORCHIIDAE YAMAGUTI, 1942

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ABSTRACT

The present study is a brief report on the digenetic trematode fauna of marine fishes of the Gulf of Manaar and Coromandel Coast belonging to the family Schistorchiidae Yamaguti, 1942. It comprises four species out of which one is described as new. This forms the first record of this family from the Indian coasts. *Schistorchis carneus* Luhe, 1906, described from Sri Lanka Coast falling on the side of the Gulf of Manaar is being recorded from the puffer fish, *Tetrodon hispidus* from Mandapam situated along the Gulf coast. The new species is *Schistorchis longivesiculurus* from the fish *Siganus oramin* from Tuticorin and Karaikal, and *Schistorchis* sp. from an unidentified parrot fish from Keelakkarai is not assigned to any species it is based on a single specimen which is crushed. *Schistorchis skrjabini* Parukhin, 1963, originally described from South China Sea, is being recorded from Vellar Estuary at Porto-Novo.

Interesting observations have also been recorded regarding the nature of musculature surrounding the oral opening, and its bearing on the validity of the genus *Megacreadium* Nagaty, 1956 *vis-a-vis* *Schistorchis* Luhe, 1906. On the basis of a combination of characters present in *Schistorchis*, the family Schistorchiidae has been held valid.

INTRODUCTION

The present study is a brief account of the trematode fauna of marine fishes of the Gulf of Manaar and Coromandel coast (Bay of Bengal) belonging to the family Schistorchiidae Yamaguti, 1942. This forms the first record of the occurrence of the members of this family along the Indian Coasts. So far the family has eight valid species. Of these, three have been reported from Ghardaga (Red Sea), one from South Modragam, Pearl Banks of Sri Lanka (Gulf of Manaar) and the rest from Naha, Okinawa (East China Sea); South China Sea; Macassar, Celebes (Java Sea); Queensland, Australia (Coral Sea) and

Hawaii. The distributional pattern of the members of the family that emerges is that they occur in the fishes of the Indian Ocean and Pacific Ocean. No member of this family has been reported so far from the Atlantic Ocean. The present report of four species is an important and interesting contribution to the knowledge of the family Schistorchiidae from the Bay of Bengal. At the same time it also shows that the schistorchiid fauna of the Bay of Bengal resembles that of the Far East countries in the Pacific Ocean.

The various species of the family Schistorchiidae have been found to occur in the stomach and intestine of the fishes of the

unrelated families Tetrodontidae, Scaridae, Siganidae, Triacanthidae, Balistidae, Monacanthidae and Zanclidae.

All measurements are in micron unless otherwise stated. The diagrams have been drawn with the aid of a Camera lucida.

Family : SCHISTORCHIIDAE Yamaguti, 1942

Subfamily : SCHISTORCHIINAE Skrjabin, 1959

Schistorchis longivesiculurus n. sp.

(Figs. 1 & 2)

Host : *Siganus oramin* Schneider ;
streaked spine foot ; Siganidae.

Location : Intestine.

Locality : Tuticorin (Gulf of Manaar) ;
Karaikal (Coromandel coast).

Number of
specimens : Several from both localities.

Specimens
deposited : Z. S. I. Reg. Nos. W 7281/1
and W 7282/1.

DESCRIPTION

Body 7.658-15.482 mm long, 1.100-1.306 mm wide, elongate, sides almost parallel, ends rounded. Cuticle unarmed. No eye-spot pigment. Acetabulum 453-825 in diameter, globular, nearer anterior end of body. Oral sucker 508-868 in diameter, globular. Suckers widths ratio 1 : 0.81-0.94 taking width of oral sucker as one. Oral aperture ventroterminal. No prepharynx. Pharynx 261-387 long, 343-524 wide, squarish ; esophagus absent ; cecal bifurcation immediately behind pharynx ; ceca arcuate, extending up to posterior end of body (in the specimens from Tuticorin the condition of cecal ends is undetermined because they are obliterated by vitelline follicles, but in some of the specimens from Karaikal the cecal ends seem to be in comm-

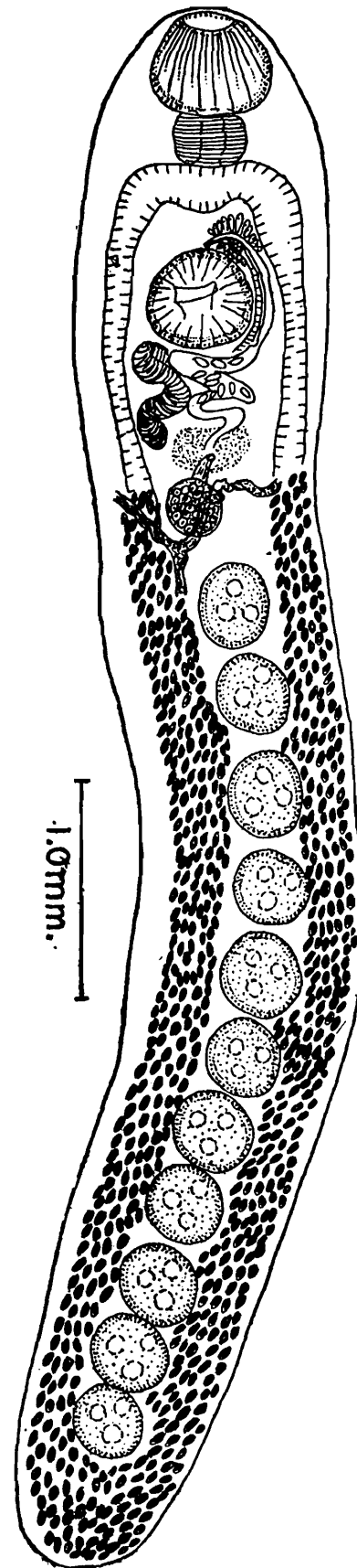


Fig. 1. *Schistorchis longivesiculurus* n. sp.
Ventral view of the specimens from Karaikal

unication with the exterior). Some space between cecal bifurcation and acetabulum present.

Testes 11, 447-799 in diameter, round, entire, in one row along median line from behind ovary to short of posterior end of body, contiguous or not. Seminal vesicle long, winding, with thick muscular walls, extending far behind acetabulum, obliterated by close coils of uterus in some specimens. Pars prostatica surrounded by prostate gland cells towards anterior end of male duct. No cirrus sac. Genital pore immediately preacetabular. Ovary 247-481 in diameter, globular, preacetabular, median, smaller than testis. Seminal receptacle present. Mehlis' gland immediately anterior to ovary. Vitelline reservoir in the ovarian region. Vitellaria follicular, follicles cecal, from posterior level of acetabulum or some distance behind it to posterior end of body. Uterus preovarian, terminal part joining with male duct to form a common duct. Eggs 42-77 by 28-51.

Excretory vesicle undetermined.

Remarks : The present species is characterised by : (i) a wide space between intestinal bifurcation and acetabulum, and (ii) a wide, long winding, tubular seminal vesicle with thick muscular walls. In some specimens it is rendered indiscernible due to the close coils of uterus.

It comes very close to *S. sigani* Yamaguti, 1942 from an allied species of fish host, *Siganus puella*, from Naha, Japan, but markedly differs from it in (i) having a long winding seminal vesicle (retort-shaped in *S. sigani*), (ii) having the walls of the seminal vesicle very muscular and thick (only a membrane in *S. sigani*), (iii) having only one row of 10-11 testes (two rows in *S. sigani*), (iv) having eggs measuring 59×35 in Karaikal specimens and

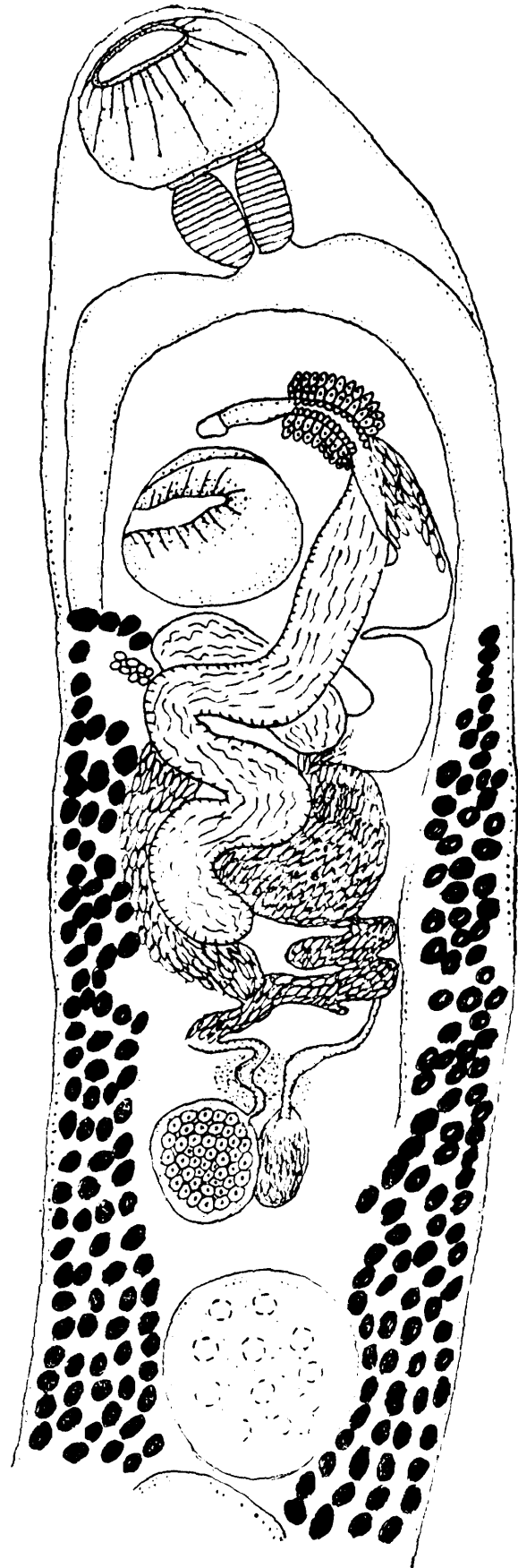


Fig. 2. *Schistorchis longivesiculurus* n. sp.
Anterior half of the specimen from Tuticorin.

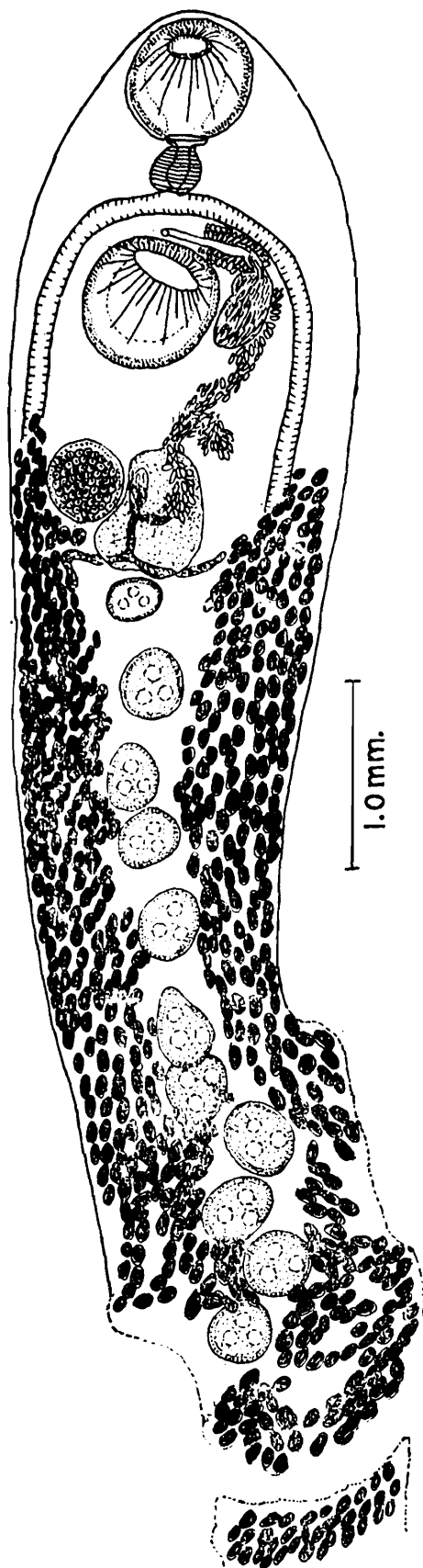


Fig. 3. *Schistorchis* sp. Ventral view.

63×42 in Tuticorin specimens (75-81×42-50 in *S. sigani*), and (v) in having vitellaria extending upto acetabulum in bigger specimen but remain short of it in smaller specimens as in *S. sigani*.

The new species can also be compared with *Schistorchis stenosoma* Hanson, 1953 from *Cantherines pardalis* from Hawaii, which resembles it in having a single row of 10-12 testes, extent of vitellaria, and in communication of ceca to the exterior. But the new species differs from Hanson's species in the sucker ratio (oral sucker is much larger than acetabulum in *S. stenosoma*), nature and shape of seminal vesicle (saccular in *S. stenosoma*), and in the presence of characteristic wide space between cecal bifurcation and acetabulum (absent in *S. stenosoma*).

The other important thing is that in mounted specimens from Tuticorin, the cecal ends are obliterated by vitellaria but in the specimens from Karaikal it is discernible that they open to the exterior. This is in contrast to the condition of cecal ends as described by Yamaguti (1942) in his species *Schistorchis sigani* in which they have been mentioned to be ending blindly. Probably this is so because he described his species on the basis of a single specimen and ani are often not easy to be detected.

Schistorchis sp. (Fig. 3)

Host	:	<i>Callyodon</i> sp. ; parrot-fish ; Scaridae
Location	:	Intestine.
Locality	:	Keelakkarai (Gulf of Manaar, Bay of Bengal).
Number of specimen :		One, crushed in the posterior part ; collec- ted by Dr. T. D. Soota and Party in 1975.

Specimen Z. S. I. Reg. No. W
deposited : 7283/1

DESCRIPTION

Body roughly 8.50 mm long, 1.760 mm wide. Cuticle smooth. No eye-spot pigment. Oral sucker 687 in diameter. Mouth ventro-terminal. Acetabulum 756 in diameter, situated at a distance of 1,251 from anterior end of body. Suckers almost equal. Prepharynx present. Pharynx pear-shaped, 233 long, 275 wide; oesophagus absent. Cecal bifurcation almost in middle of suckers. Ceca arcuate after cecal bifurcation (the condition of the cecal ends could not be ascertained because the posterior part of the body of the solitary specimen is crushed, presumably ending blindly).

Testes 11, in one row in mid-line, 316-412 long, 275-316 wide, almost spherical, entire. Cirrus sac absent. Seminal vesicle saccular, retort-shaped, extending up to almost mid-level of and sinistral to acetabulum, pars prostatica short, surrounded by prostate gland cells, ejaculatory duct narrow. No cirrus. Genital pore immediately in front of acetabulum.

Ovary 453 long, 412 wide, spherical, smooth, between acetabulum and anterior most testis, submedian, larger than the largest testis. Seminal receptacle larger than and sinistral to ovary. Vitelline reservoir anterior to anterior testis; vitelline duct traversing laterally; vitellaria follicular extending from posterior end of body to level of ovary. Uterus preovarian, terminal part differentiated into metraterm joining with terminal part of male genitalia to form common duct. Eggs 45-77 by 35-52.

Excretory vesicle could not be ascertained.

Remarks : The solitary specimen detailed above is comparable to *Schistorchis callyodontis* Yamaguti, 1942, the other species in the genus described from a parrot-fish from Naha, Japan, and there-after reported from Ghardaga, Red Sea by Nagaty (1962). However, the present specimen markedly differs from Yamaguti's species in sucker ratio, posterior extent of seminal vesicle, single linear row of testes, shape of the body, and position of ovary with respect to the anterior extent of vitellaria, and anterior extent of vitellaria with respect to the acetabulum. It also resembles *Schistorchis haridis* Nagaty, 1957 from the fish *Pseud-scarus harid* from Red Sea, but Nagaty's species differs from the present specimen in having acetabulum larger than the oral sucker, large pharynx, ovary much nearer to acetabulum, shape and extent of seminal vesicle, and position of genital pore which is to the left of acetabulum rather than median. Thus it is clear that the present single specimen represents a species quite distinct from related ones in the genus. The author is inclined to consider it a new species but because the description is based on a single specimen which is crushed and broken in the posterior part, it is not assigned to a new species for the time being.

***Schistorchis skrjabini* Parukhin, 1963**

(Figs. 4 & 5)

- Host : *Triacanthus brevirostris* Schlegel, short-nosed tripod fish, Triacanthidae.
- Location : Intestine.
- Locality : Vellar estuary at Porto-Novo (Coromandal coast, Bay of Bengal).

Number of specimens : Six ; collected by Dr. T. D. Soota & Party in 1975.

Specimens deposited : Z. S. I. Reg. Nos. W7284/1 and W7285/1

DESCRIPTION

Body 1.925-6.682 mm long, 0.536-1.966 mm wide. No eye-spot pigment. Cuticle smooth. Acetabulum 137-275 long, 110-357 wide,

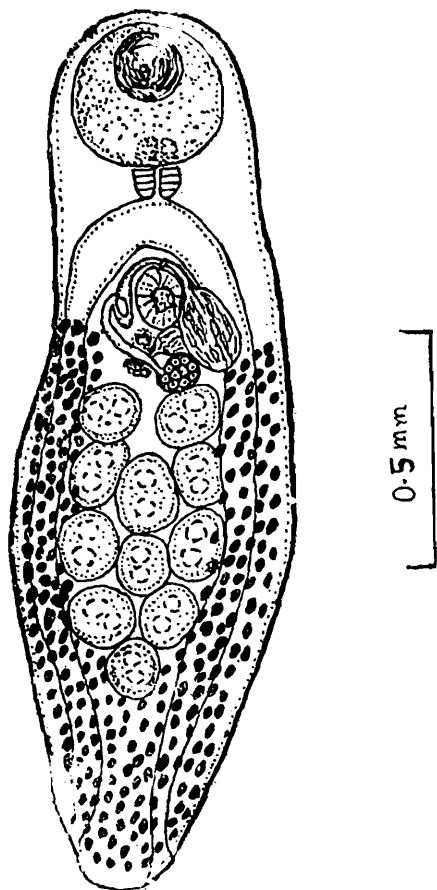


Fig. 4. *Schistorchis skrjabini* Parukhin, 1963.
Ventral view showing three rows of testes.

situated at 756-1058 from anterior end of body, differentiated into a muscular portion surrounding mouth without lobes and a highly cellular portion. Oral sucker larger

than acetabulum. Suckers width ratio 1 : 0.036-0.463 taking width of oral sucker as one. Prepharynx absent ; pharynx 91-206 long, 96-343 wide ; no oesophagus ; cecal bifurcation immediately behind pharynx ; ceca arcuate ; ani formed.

Testes 11, 96-550 in diameter, round to irregular in shape, in some specimens inden-

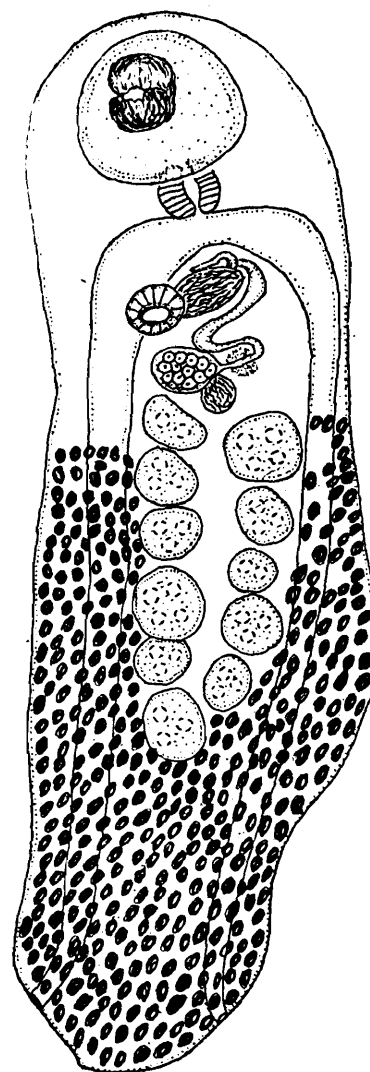


Fig. 5. *Schistorchis skrjabini* Parukhin, 1963.
Ventral view showing two rows of testes.

ted, arranged in 2-3 rows in middle part of body, inter-cecal. No cirrus sac. Seminal vesicle globular, extending beyond acetabulum posteriorly, and continued anteriorly as pars prostatica surrounded by prostate cells and

ejaculatory duct in form of a narrow tube. No cirrus. Genital pore immediately in front of acetabulum.

Ovary globular to elongate, 96-233 long, 96-371 wide, smaller, than testes, pretesticular. Mehlis' glands present. Vitellaria follicular, commencing from posterior level of acetabulum to posterior end of body. Uterus preovarian, anterior portion joining with terminal part of male tube to form common duct. Eggs not formed. Seminal receptacle present.

Excretory vesicle undetermined.

Remarks : The present specimens broadly conform to the original description of *Schistorchis skrjabini* Parukhin, 1963 which has been reported from South China Sea from fishes *Triacanthus brevirostris* and *Abalistis stellaris*. The oral sucker in the present specimens is differentiated into a small muscular part around short mouth opening and the rest of it is highly cellular. In some specimens there seems to be a tendency of forming muscular lips or small lobes around the mouth. This differentiation in the structure of the oral sucker has not been mentioned in *Schistorchis skrjabini* by Parukhin (1963), but in the illustration some demarcation seems to have been shown around the mouth. It may be pointed out that the differentiation of the structure of the oral sucker into a muscular part around the mouth and a cellular part is in varying degrees in all the six specimens.

***Schistorchis carneus* Luhe, 1906**

(Fig. 6)

- Host : *Tetrodon hispidus* Linn.,
spotted puffer fish, Tetrod-
ontidae
- Location : Intestine.
- Locality : Mandapam (Gulf of Manaar)

No. of speci-
mens : 2, one broken into two
pieces ; collected by Dr. T.
D. Soota & Party in 1975.

Specimens
deposited : Z. S. I. Reg. Nos. W 7286/1

DESCRIPTION

(Based on contracted specimens) Body 5.596-6 mm long, 2.076-3.052 mm wide, almost rectangular in shape with roundish or truncated ends. Tegument thick, aspinose, crenulated (probably due to contraction). Acetabulum 343-522 in diameter, globular with weak musculature, situated near anterior end just behind arch of cecal bifurcation. Oral sucker 1,196-1,306 in diameter, much larger than acetabulum, subterminal ; mouth opening small surrounded by strong circular muscles, margin of anterior part of musculature notched or indented, remaining part of oral sucker highly cellular. Sucker ratio 1 : 0.43, with oral sucker as 1, or 7 : 3 approx. Prepharynx indiscernible, pharynx large, partly overlapped by oral sucker and acetabulum ; oesophagus indiscernible ; ceca arcuate just after bifurcation, extending up to posterior end of body ; ani formed.

Testes 11, 206-330 long, 206-316 wide, in two lateral groups of 5 and 6 on either side of mid-line, intercecal, unequal, entire. No cirrus sac. Seminal vesicle elongated pear-shaped extending posterior to acetabulum from left side, narrowing anteriorly to form short pars prostatica surrounded by prostate gland cells ; ejaculatory duct short. Terminal male duct skirting round left side of acetabulum. Genital pore immediately preacetabular.

Ovary, 316-412 long, 302-330 wide, pretesticular, dextral to median line, globular or a

bit transversely elongated, entire. Shell gland follicular, extending to level of acetabulum.

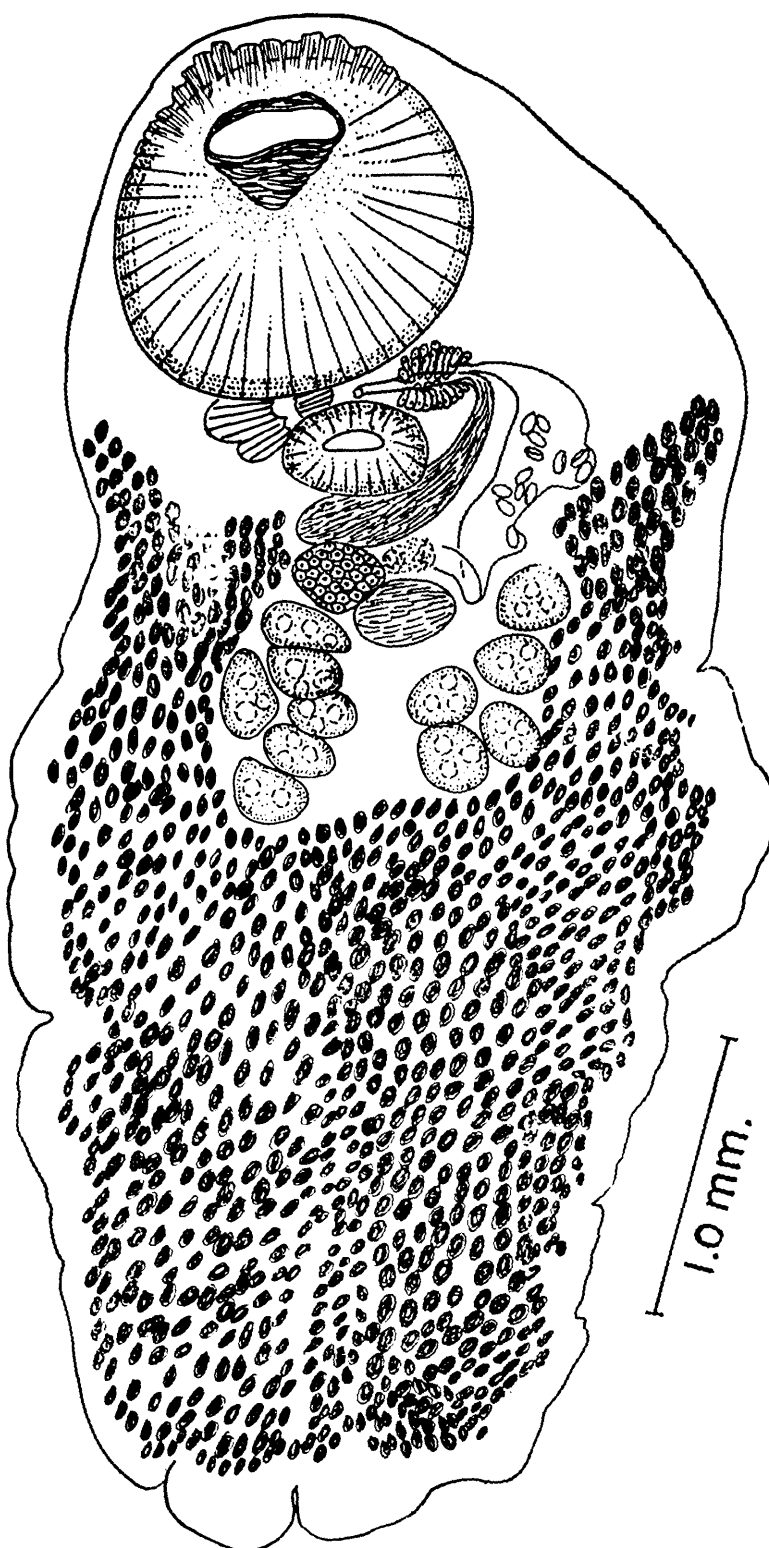


Fig. 6. *Schistorchis carneus* Luhe, 1906. Ventral view.

lying sinistral to ovary. Seminal receptacle present between ovary and testes. Vitellaria terminal part joining male duct to form

Uterus short, preovarian, winding anteriorly,

terminal part joining male duct to form

common duct, or male and female ducts enter into a genital sinus. Eggs 56-59 by 38-42.

Excretory vesicle undetermined.

Remarks : The present two specimens are referred to *Schistorchis carneus* Luhe, 1906 (= *Pleorchis oligarchis* Johnston, 1913 from *Tetradon hispidus* from Queensland, Australia). Odhner (1928) considered Johnston's species conspecific with *Schistorchis carneus* Luhe, 1906. He cut serial sections of his specimens and found that ani, which were originally described to be absent, were present. It is on the basis of this synonymy and revelation that ani are present in *Schistorchis carneus* that the present two specimens are assigned to this species. Moreover, they have been collected from a nearby locality in the same short stretch of water (Gulf of Manaar) and from the same fish genus.

Status of Megacreadium Nagaty, 1956 vis-a-vis Schistorchis Luhe, 1906.

Luhe (1906) established the genus *Schistorchis* and described the type species *S. carneus* from the puffer fish *Tetrodon stellatus* from South Modragam Paar, Pearl Banks of Sri Lanka (Ceylon), the Gulf of Manaar. This description contained a few errors, particularly with respect to the formation of ani, absence of cirrus sac and differentiation of strong muscles around the small mouth opening. The adequate and correct description of *Pleorchis oligarchis* Johnston, 1913 and its subsequent synonymy with *Schistorchis carneus* Luhe, 1906 brought to light the correct nature of the structure of the oral sucker in this type species. The opening of the oral sucker is small and surrounded by strong circular muscles sometimes covering the mouth opening, and the rest of the structure is highly cellular. In my specimens, which have been collected and from the same small

stretch of waters from where the type species was described and from the same fish host from which Johnston (1913) described his species, the muscles around the mouth have assumed a somewhat different form (*i.e.*, anterior lobation or indentation) but essentially the whole structure remaining the same.

Parukhin (1963) described species *Schistorchis skrijabini* from South China Sea from fishes *Triacanthus brevirostris* and *Abalistis stellaris* apparently without differentiation of oral sucker into a muscular part around mouth opening and the remaining cellular part. In my specimens recovered from *Triacanthus brevirostris* from Porto-Novo (which I have assigned to *S. skrijabini*) such differentiation is present in varying degrees. Even in some the strong muscles around the lower lip are deeply indented giving rise to two posterior lobulate structures. The rest of the worm is exactly as detailed by Parukhin (1963).

The oral sucker in *Schistorchis stenosoma* Hanson, 1953 was not described to be differentiated into a muscular part around the mouth, but Manter (1963) examined its paratypes and found that distinct semicircular muscles along the posterior edge of the mouth are present.

Nagaty (1956) proposed *Megacreadium* (type species *M. tetradontis*) the specimens of which were collected from the fish *Tetrodon* sp. from Ghardaga, Red Sea. He mainly characterised his genus in having circumoral muscular lobes. In the light of the nature of the structure of the oral suckers in my specimens assigned to *S. carneus* and *S. skrijabini*, the circumoral muscular lobes in the type species of *Megacreadium* appear to be a degree of indentation of the circumoral muscles in *S. carneus* and *S. skrijabini*, and thus there appears to be some substance for considering *Megacreadium* Nagaty, 1956 synonymous with

Schistorchis Luhe, 1906 by Sogandares-Bernal and Hutton (1959). The author also cast doubt on the validity of *Megacreadium*. The presence of eight testes in Nagaty's species is a variable character as noted by Johnston (1913). The enormous size of eggs and extension of uterus beyond genital pore anteriorly may be distinguishing *S. tetodontis* (syn. *Megacreadium tetodontis* Nagaty, 1956) from other species of the genus *Schistorchis*.

Status of the Family Schistorchiidae Yamaguti, 1942.

Luhe (1906), when proposed the genus *Schistorchis*, kept it under a new subfamily Acanthocolpinae. Poche (1925) thought that the two multitesticular genera, *Pleorchis* Railliet, 1896 and *Schistorchis* Luhe, 1906, are related to each other, and therefore he kept them under his new family Pleorchiidae. It were Cable and Hunninen (1942) who first pointed out that *Pleorchis* and *Schistorchis* are not at all closely related. They separated them and placed *Pleorchis* in the family Acanthocolpidae and proposed to keep *Schistorchis* in the subfamily Homalometrinae under Lepocreadiidae Nicoll, 1914. Almost at the same time but independently, Yamaguti (1942) also considered *Pleorchis* and *Schistorchis* as unrelated genera and proposed a new family Schistorchiidae to accommodate the latter genus. Hanson (1953) followed Cable and Hunninen, and considered *Schistorchis* a genus of Homalometrinae in the family Lepocreadiidae. She further suggested that Schistorchiidae Yamaguti, 1942 should be suppressed in favour of Lepocreadiidae. Pritchard (1963) again record *Schistorchis stenosoma* Hanson, 1953 and *S. zancli* from Hawaiian fishes under the family Lepocreadiidae. Mehra (1966) did not accept a separate family Schistorchiidae Yamaguti, 1942 for the genus *Schistorchis* Luhe, 1906. On the contrary, he treated the

genus under the sub-family Schistorchiinae Skrjabin, 1959 in the family Opecoelidae. Manter (1963) indicated that *Schistorchis* has some characters of the family Megaperidae Manter, 1934. Earlier Manter and Van Cleave (1951) had observed that *Schistorchis* is more closely related to *Decemtestis* Yamaguti, 1934 because both the genera have unarmed body and possess seminal receptacle thereby suggesting the affinity of *Schistorchis* to the family Opecoelidae. Nagaty (1957, '62) who has studied the genus *Schistorchis* and described species in this genus, maintains the family Schistorchiidae Yamaguti, 1942. Skrjabin (1959) has also accepted the family Schistorchiidae. The author has studied a good number of specimen of the genus *Schistorchis*, and on this basis feels to hold that the family Schistorchiidae should be maintained, at least, because of the following combination of characters :

- (1) Differentiation of highly developed semicircular muscles around the small mouth opening, or not ;
- (2) Follicular testes ;
- (3) Formation of ani, or ceca terminating blindly ;
- (4) The male female terminal ducts open into a genital sinus or unite to form a common duct skirting around the left side of the acetabulum.

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ON A NEW SPECIES OF *PUNTIUS* (FAMILY : CYPRINIDAE)
FROM BASTAR DISTRICT, MADHYA PRADESH

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Zoological Survey of India, Calcutta

ABSTRACT

A new species *Puntius saberi* collected from Bastar district of M. P. is described.

INTRODUCTION

During the course of taxonomic studies on the fishes of Bastar we came across 13 examples of fish belonging to the genus *Puntius* measuring 28 to 45 mm in total length collected by Shri A. K. Karmakar from Cheroguru Talao, near Pujaripal village, 23 kms. from Sukma on 21.7.1978. These examples represent hitherto unknown species. Description of the systematic characters of this new species to accomodate it in the genus *Puntius* is given in this text.

SYSTEMATIC POSITION

Order : CYPRINIFORMES

Sub-order : *CYPRINOIDEI*

Family : CYPRINIDAE

Genus : *Puntius* Hamilton

Puntius saberi sp. nov. (Fig. 1)

MATERIAL

Holotype : 43 mm total length Reg. No. Z. S. I. FF 1398.

Locality : Cheroguru Talao, Pujaripal village, 23 Kms. from Sukma; Coll. A. K. Karmakar, Date : 21. VII. 1978.

Paratypes : 12 examples, 28-45 mm total length. Reg. No. Z. S. I. FF 1399, Locality, collector and date as in holotype.

DESCRIPTION

D. 3/8, P. 13-14, V. 8-9, A. 2/6, C. 18. L. 1. 31-32.

Body laterally compressed, dorsal profile arched anteriorly behind dorsal fin gradually falls till base of caudal fin. Length of head 3.9 (3.6—4.1) in total length and 3.05 (2.7-3.5) in standard length. Width of head 2.1 (1.8-2.5), height of head 1.4 (1.2-1.5) in head length. Height of head 1.5 (1.4-1.7) in depth of body. Diameter of eye 3.9 (3.6-4.3) in length of head. Snout slightly convex in the anterior side, length of snout 3.8 (3.3-4.3) in the length of head, devoid of tubercle. Upper jaw slightly longer than lower jaw. Lower labial

fold interrupted. Interorbital space flat, 1.2 (1.0 to 1.4) in the diameter of the eye. Height of the body 3.5 (3.3-4.0) in total length and 2.7 (2.6-3.0) in standard length.

Barbels two pairs; rostral shorter than maxillary. Rostral barbel 4.9 (3.5-6.0) in head length and 0.8 (0.7-1.1) in eye diameter. Maxillary barbel 3.5 (2.7-4.3) in head length and 1.2 (1.0-1.5) in eye diameter. Height of

eye diameter. Length of anal 6.4 (5.8-7.0) in total length and 4.9 (4.6-5.4) in standard length. Caudal not deeply forked and the lobes are almost equal. Length of caudal 4.6 (3.7-5.7) in total length and 3.5 (2.6-4.6) in standard length.

Lateral line complete with 31-32 scales, pre-dorsal scales 9-10, $4\frac{1}{2}$ scales between lateral line and base of ventral fin. Height

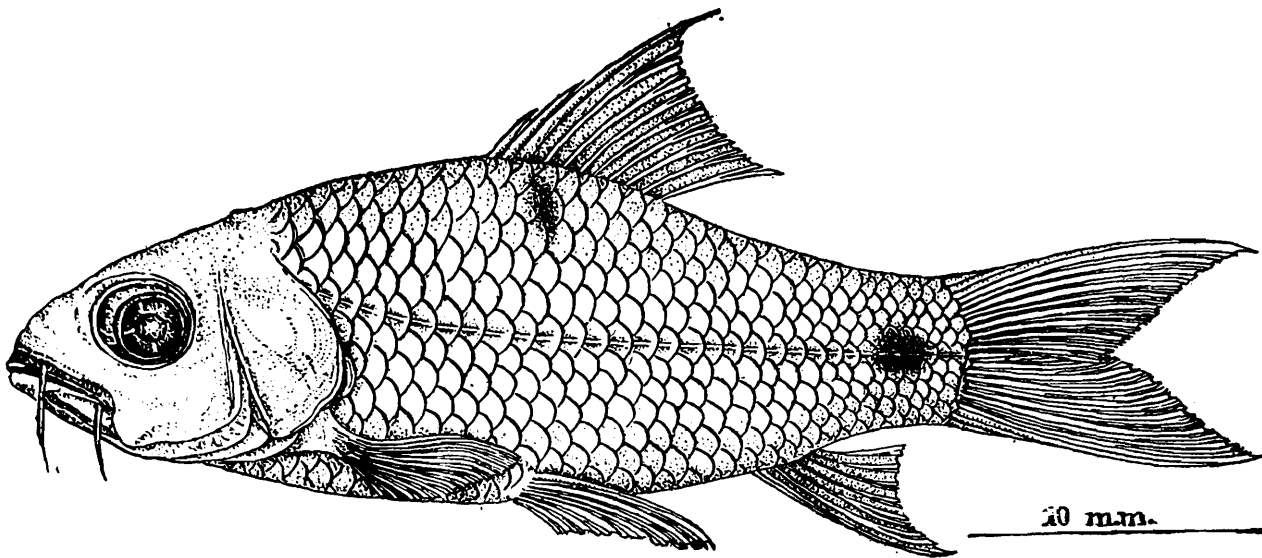


Fig. 1. *Puntius saberi* sp. nov. Lateral view.

dorsal fin 4.4 (3.7-4.5) in total length and 3.3 (2.9-3.5) in standard length. Base of dorsal fin 6.7 (5.6-7.5) in total length and 5.2 (4.4-5.8) in standard length.

Dorsal fin insertion opposite to ventral fin insertion, lies nearer caudal base than to the tip of the snout. The last undivided ray of dorsal fin is articulated and bony, weak tipped. Pectoral fin 6.2 (5.4-7.4) in the total length, 4.8 (4.4-5.8) in standard length, 1.6 (1.4-1.8) in head length and 1.2 (1.0-1.4) in head length excluding snout. Pectoral does not reach base of ventral. Ventral fin. 6.3 (5.7-6.6) in total length, 4.9 (4.6-5.2) in standard length. Distance between ventral fin insertion to anal fin insertion 2.5 (2.0-3.2) in

of caudal peduncle 1.0 (0.8-1.3) in its length. Two black spots, one below the insertion of dorsal fin, the other after 25 scales on the lateral line.

RELATIONSHIP

Pillay (1951) considered *Puntius pinnauratus* as a race of *Puntius sarana*. He merged *P. chrysopoma*, *P. caudomarginatus*, *P. oatesi*, *P. myitkyinae*, *P. sewelli* and *P. binduchitra* with *Puntius sarana*. The criteria of merging these species with *Puntius sarana* was based on morphometric and biometric comparisons. Wherein the distinguishing characters differentiating these species on morphometric data were untenable because the significant charac-

TABLE—1. Range of Morphometric Characters of the sample

	Total Length							Standard Length						
	Caudal length	Depth of Body.	Length of Head	Length of Longest Ray of Dorsal	Length of Pectoral	Length of Ventral	Length of Anal	Caudal Length	Depth of Body	Length of Head	Length of Longest Ray of Dorsal	Length of Pectoral	Length of Ventral	Length of Anal
<i>P. sarana</i>	3.7-5.2	3.1-4.1	4.0-5.4	4.1-6.4	5.0-6.8	5.8-7.8	7.0-10.2	2.8-4.3	2.4-3.7	3.2-5.3	3.0-4.8	4.1-5.7	4.4-6.2	5.4-8.3
<i>P. pinna-uratus</i>	4.4-5.5	3.4-4.0	3.9-4.6	4.4-6.1	5.5-6.8	5.8-7.6	6.7-8.4	3.0-4.3	2.8-3.3	3.0-3.8	3.3-5.3	4.4-5.3	4.5-6.2	5.2-6.8
<i>P. chryso-poma</i>	4.3-5.1	3.4-3.7	4.6-5.1	4.9-5.7	5.7-6.8	6.9-7.9	7.4-8.0	3.3-4.1	2.7-3.0	3.6-4.1	3.8-4.6	4.4-5.4	5.5-6.3	5.8-6.8
<i>P. saberi</i> sp. nov.	3.7-5.7	3.3-4.0	3.6-4.5	3.7-4.7	5.4-7.4	5.7-6.8	5.8-7.0	2.6-4.6	2.2-3.1	2.7-3.3	3.1-3.8	4.4-5.8	4.6-5.6	4.6-5.4

	Length of Head				
	Width of Head	Height of Head	Diam. of Eye	Length of Rostral Barbel	Length of Maxillary Barbel
<i>P. sarana</i>	1.5-1.9	1.1-1.5	2.8-5.2	3.0-6.8	2.0-4.5
<i>P. pinna-uratus</i>	1.6-1.8	1.3-1.5	2.8-4.2	3.1-6.0	2.4-3.8
<i>P. chryso-poma</i>	1.5-1.9	1.2-1.4	2.8-4.3	3.1-5.2	2.3-4.3
<i>P. saberi</i> sp. nov.	1.8-2.5	1.2-1.5	3.8-4.3	3.5-6.0	2.7-4.3

TABLE—2. Range of Morphometric Characters of the sample

Depth of Body	Interorbital Distance	Length of Caudal peduncle	Distance between Ventral fin insertion to anal fin insertion	Lateral line Scales	Lateral line Transverse	Rows of Scales between lateral line and base of Ventral	Pre-Dorsal Scales	No of rays in					
								D	P	V	A	C	
Height of Head	Diam. of Eye	Least height of caudal peduncle	Eye diameter										
<i>P. sarana</i>	1.3-2.1	1.0-2.3	1.1-1.9	3.2-5.0	28-34	10-14	3.5-5.5	9-13	3/8 to 4/8	13-17	8-9	3/5-6	18-19
<i>P. pinnauratus</i>	1.5-2.1	1.0-1.9	1.2-1.8	2.8-3.4	28-32	9-12	3.5-4.5	8-12	3/8	14-15	9	3/5-6	18-19
<i>P. chryso-poma</i>	1.5-2.0	1.0-1.8	1.2-1.6	2.5-4.1	29-32	12-13	3.5-4.5	11-13	3/8 to 4/8	15-16	8-9	3/5-6	18-19
<i>P. saberi</i> sp. nov.	1.4-1.7	1.0-1.4	0.8-1.3	2.0-2.8	31-32	10	4.5	9-10	3/8	13-14	8-9	3/6	18

ters of the species intergraded amongst themselves.

Puntius saberi differs from *P. sarana* and *P. pinnauratus* in having longer anal fin and longest ray of dorsal fin in relation to total length. It also differs in having a bigger head in relation to standard length. It varies in the following body proportions : interorbital distance in diameter of eye, length of caudal peduncle in least height of caudal peduncle, length of head in width of head, depth of body in height of head and distance between ventral fin insertion to anal fin insertion in eye diameter. The morphometric measurements to distinguish and to signify its relationship with *P. sarana* and *P. pinnauratus* are detailed in the table No. 1 & 2.

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THE ELECTRIC RAYS OF THE GENUS *TORPEDO* HOUTTUYN
(RAJIFORMES : TORPEDINIDAE) OF INDIAN SEAS

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ABSTRACT

Torpedo fairchildi Hutton and *Torpedo macneilli* (Whitley) are noted from the Indian Ocean on the basis of two specimens trawled off Quilon (India) in the Arabian Sea at a depth of 300 m. Further, the occurrence of *Torpedo fuscomaculata* Peters in Indian Seas is also reported on the basis of a specimen collected at Calicut (Kerala). The morphology of the new specimens is described. In addition, the specific status of the three earlier reported species of *Torpedo* is reviewed and notes are given on the taxonomy and distribution of the four species of our region, and characters for their separation are keyed.

INTRODUCTION

The genus *Torpedo* Houttuyn, 1764, with its fourteen species, is the largest in the family Torpedinidae. Whereas in other regions these torpedinoids are the commonest members of this family, they are most uncommon in the Indian region. The flesh is edible but generally not eaten.

In 1909 the first *Torpedo* from Indian waters was reported (Annandale, 1909) on the basis of a single specimen of *T. marmorata* Risso from the Puri coast (Orissa). Subsequently Englehardt (1912) described a new species, *Torpedo zugmayeri* from Gwadar (Pakistan). Fowler (1926) reported *T. sinus-persici* Olfers on the basis of two examples, 140 mm and 143 mm in length, from Bombay. Misra (1969) recognised only two species of *Torpedo* in the Indian region: *T. panthera* Olfers and *T. sinus-persici* Olfers.

As a result of trawling in the upper continental slope of the south-west coast of India,

one specimen each of *Torpedo fairchildi* Hutton and *T. macneilli* (Whitley) were collected, hitherto known only from the Western Pacific Ocean. Further, a specimen of *Torpedo fuscomaculata* Peters was also collected from the local catches at Calicut (Kerala), a species hitherto reported only from the Western Indian Ocean.

The purpose of this paper is to document these three new distributional records and further to review the status of the earlier recorded species of *Torpedo* of our region. This paper gives notes and a key to the four recognised species of the Indian region.

SYSTEMATIC ACCOUNT

Torpedo Houttuyn, 1764

Torpedo Houttuyn, 1764, *Nat. Hist. Dieren, Planten en Mineral*, 6: 453 (type species: *Raja torpedo* Linnaeus).

These electric rays have a well-rounded disc, broader than long, its anterior margin

truncate or emarginate, an arcuate mouth, extremely slender jaws, two well-developed dorsal fins, and the tail and caudal fin reasonably well-developed.

Key to the Species

- | | | | | |
|-------|--|-----|-----|-------------------------|
| 1 (a) | Edges of spiracles with a row of papillae or knobs (Sub-genus <i>Torpedo</i>) | ... | ... | 2 |
| (b) | Edges of spiracles smooth (Sub-genus <i>Tetronarce</i>) | ... | ... | 3 |
| 2 (a) | Rear end of base of first dorsal fin slightly anterior to rear ends of pelvic fin bases. | ... | | |
| | | | | <i>T. fuscomaculata</i> |
| (b) | Rear end of base of first dorsal fin considerably posterior to rear ends of pelvic fin bases. | ... | | |
| | | | | <i>T. sinus-persici</i> |
| 3 (a) | Rear end of base of first dorsal fin considerably posterior to rear ends of pelvic fin bases | ... | | |
| | | | | <i>T. macneilli</i> |
| (b) | Rear end of base of first dorsal fin level with or slightly anterior to rear ends of pelvic fin bases. | ... | | |
| | | | | <i>T. fairchildi</i> |

Torpedo fuscomaculata Peters

Torpedo fuscomaculata Peters, 1855, *Arch. Naturgesch.*, **21** : 278 (type locality : Mozambique); Fraser-Brunner, 1949, *Ann. Mag. nat. Hist.*, (12) **2** : 943; Bigelow and Schroeder, 1953, *Mem. Sears Fdn. mar. Res.*, (1) (pt. 2) : 97; Wallace, 1967, *Invest. Rep. Oceanogr. Res. Inst.*, (17) : 49, figs. 25 & 26.

Material : 1 ex, 297 mm in total length, Calicut (Kerala), 5 March 1975, coll. P. K. Talwar; ZSI regd. no. F 7647/2.

DESCRIPTION

Disc 1.1 times wider than long, its anterior margin with a slight median bulge. Eyes small, much nearer to spiracles than to anterior margin of disc; spiracles with 7 papillate knobs on its edges. Mouth wide;

nostrils close together, the nasal curtain with a convex posterior margin and slightly overlaps the mouth.

Two dorsal fins, rear end of base of first dorsal fin slightly anterior to rear ends of pelvic fin bases; interdorsal space longer than distance between second dorsal fin and caudal fin. Caudal fin large, its posterior margin weakly truncate, its height less than distance from its own upper origin to origin of first dorsal fin.

Colour : in alcohol, upper surface dark brown with numerous pale or dark brown spots.

Distribution : This species has been reported earlier only from the western Indian Ocean (Zanzibar, Seychelles, Mauritius, Madagascar and Mozambique) and hence the present record from south-western India is of interest.

2. *Torpedo sinus-persici* Olfers

Torpedo sinus-persici Olfers, 1831, *Torpedo* : 15, 17 (type locality : not given); Fowler, 1926, *J. Bombay nat. Hist. Soc.*, **31** (3) : 770; Fraser-Brunner, 1949, *Ann. Mag. nat. Hist.*, (12) **2** : 945; Bigelow and Schroeder, 1953, *Mem. Sears Fdn. mar. Res.*, (1) (pt. 2) : 95; Wallace, 1967, *Invest. Rep. Oceanogr. Res. Inst.*, (17) : 53, fig. 27; Misra, 1969, *Fauna of India, Pisces* (2nd ed), **1** : 221.

Torpedo marmorata Annandale (nec Risso), 1909, *Mem. Indian Mus.*, **2** : 41, pl. 3a, fig. 4 and pl. 5, fig. 3; Prashad, 1920, *Rec. Indian Mus.*, **19** : 98; Rama-Rao, Chakrapany and Chatterjee, 1978, *Indian J. Zootomy*, **16** (3) : 234.

Torpedo zugmayeri Englehardt, 1912, *Zool. Anz.*, **39** : 647 (type locality : Gwadar, Baluchistan).

Torpedo panthera Misra (nec Olfers), 1969, *Fauna of India, Pisces* (2nd ed.), **1** : 219, pl. 19.

Material : 1 ex (♂), 114 mm in total length, Vizagapatnam (Andhra Pradesh), coll. Moti Ram; ZSI regd no 11397 (as *Torpedo*

marmorata); 1 ex (♀), 378 mm in total length, Puri (Orissa), December 1980, coll. *T. Jenkins*, ZSI regd. no. F 2354/1 (as *T. marmorata*); 2 ex, 112-133 mm in total length, Vizagapatnam, 10 July 1963, coll. *A Daniel*, ZSI regd. no. F 6924/2 (as *T. marmorata*).

DESCRIPTION

Disc subcircular, 1.1-1.2 times wider than long, its anterior margin slightly truncate, the remainder of its perimeter uniformly rounded. Eyes small, much closer to spiracles than to anterior margin of disc; margin of spiracles with 9 or 10 papillae. Nostrils close together; nasal curtain with a convex posterior margin, part of which overlaps the mouth. A wide muscular fold overlaps each corner of mouth and makes it appear small superficially, but it does in fact have a wide gap.

Two dorsal fins, rear end of base of first dorsal fin considerably posterior to rear ends of pelvic fin bases; interspace between first and second dorsal fins shorter than distance between second dorsal and caudal fins. Caudal fin large, its posterior margin slightly convex in juveniles and truncate in adults, its height less than distance from its own upper origin to origin of first dorsal fin.

Colour : in alcohol, dorsal surface brownish, densely marbled with short tortuous cream coloured lines. Circular markings often present and irregularly shaped spots occur near the margins of the disc, on the pelvic and caudal fins.

Distribution : Pakistan, coasts of India Sri Lanka, the Gulf of Aden and the east coast of Africa.

Remarks : The colour and pattern of this species is most distinctive. Study of Annandale's (1909), Prashad's (1920) and Rama-Rao *et al* (1978) study material of *Torpedo marmor-*

ata clearly shows it to be identical with *T. sinus-persici* Olfers as the eyes are much nearer to the spiracles than to the anterior margin of the disc and the spiracles are with 9 or 10 (vs 7) papillae. Fraser-Brunner (1949) followed by Bigelow and Schroeder (1953), has shown that *T. marmorata* is restricted to the Atlantic Ocean. Misra (1969) treated Annandale's (1909) (nec Risso) *marmorata* identical with *T. panthera* Olfers without any basis, a species restricted to the Red Sea (Fraser-Brunner, 1949; Bigelow and Schroeder, 1953).

Torpedo zugmayeri Engelhardt, 1912, was considered conspecific with *T. marmorata* Risso by Fowler (1941) and identical with *T. panthera* Olfers by Misra (1969). Fraser-Brunner (1949) overlooked the species in his revision of the genus *Torpedo*. Two specimens of *Torpedo*, 288 mm and 340 mm in total length, in our collections earlier determined as *T. zugmayeri* Engelhardt and without any apparent history, defy identification. These have now been incorporated in our collections (regd no. F. 7649/2) under the latter name. The status of *T. zugmayeri* needs further study.

3. *Torpedo fairchildi* Hutton

Torpedo fairchildi Hutton, 1872, *Colonial Mus. Geol. Surv. N. Z.* : 83, pl. 12, fig. 134 (type locality : Napier Harbour, New Zealand); Bigelow and Schroeder, 1953, *Mem. Sears Fdn. mar. Res.*, (1) (pt. 2) : 97.

Torpedo panthera Talwar (nec Olfers), 1974, *J. mar. biol. Ass. India*, 14 (2) : 779 (name only).

Material : One female, 188 mm in total length, off Quilon (approx. 09°N., 76°E), otter trawl haul, 300 m, 3 March, 1971, coll. *P. K. Talwar*; ZSI regd. no. F 7648/2.

DESCRIPTION

Disc subcircular, about 1.1 times as broad as long, its edge fleshy and thick in front but

thinning progressively rearward to posterior parts of pectoral fins, where it is exceedingly thin. Eyes small, very much closer to spiracles than to anterior margin of disc. Edges of spiracles smooth (without papillae), equal eyes, head anterior to spiracles about 2.2 times as long as distance between inner ends of spiracles. Nostrils small; nasal curtain distantly placed from upper jaw.

Two dorsal fins, rear end of base of first dorsal fin level with rear ends of pelvic fin bases; interspace between second dorsal fin about 1.25 times as long as base of first dorsal fin. Caudal fin large, its posterior margin weakly emarginate, its height less than distance from its own upper origin to origin of first dorsal fin.

Colour: in alcohol, dorsal surface brownish, ventral surface white with the outer edges of the pelvic fins blackish.

Distribution: New Zealand and the present record from south-western India extends its range to the Indian Ocean.

Torpedo macneilli (Whitley)

Notastrape macneilli Whitley, 1932, *Rec. Australian Mus.*, 18 : 327 (type locality: Off Green Cape, New South Wales, 88 m).

Torpedo macneilli Bigelow and Schroeder, 1953, *Mem. Sears Fdn. mar. Res.*, (1) (pt. 2) : 95; Andrews, 1972, *Papers Proc. Roy. Soc. Tasm.*, 106 : 2.

Material: One male, 204 mm in total length, trawled off Quilon (Kerala), 300 m, 5 February, 1977, coll. P. K. Talwar; ZSI regd. no. F 7559/2.

DESCRIPTION

Disc broad and subcircular, about 1.25 times as broad as long, its edge fleshy and thick. Eyes small, much closer to spiracles than to anterior margin of disc. Spiracles

smooth (with no papillae); head anterior to spiracles about 2 times as long as distance between inner ends of spiracles. Nostrils small and close together; nasal curtain widely placed from upper jaw.

Two dorsal fins, rear end of base of first dorsal fin considerably posterior to rear ends of pelvic fin bases, about half of first dorsal fin-base over pelvic fin-base. Interspace between second dorsal fin and caudal fin slightly less than base of first dorsal fin. Caudal fin large, its outer edge weakly convex, its height considerably greater than distance from its upper origin to the origin of first dorsal fin.

Colour: in alcohol, dorsal surface uniformly brown with scattered minute chocolate brown spots, ventral surface creamy white.

Distribution: New South Wales, Victoria, South Australia, Southern Western Australia, Tasmania (Munro, 1956; Mc Kay, 1966; Andrews, 1972) and present record from south-western India extends its range to the Indian Ocean.

Remarks: This species is considered by some authors, notably Whitley (1940) and Fowler (1941), to be doubtfully distinct from the evidently closely allied *T. fairchildi* Hutton, from New Zealand. According to Bigelow and Schroeder (1953) and Mc Kay (1966) the principal difference separating the two species appears to be the point of termination of the base of the first dorsal fin which is stated to be posterior to the end of the pelvic fin base in *T. macneilli* and level with this point in *T. fairchildi*.

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THE THALASSINID BURROWING SHRIMP, *CALLIANASSA (CALLICHIRUS) MAXIMA* M. EDWARDS, 1870 (CRUSTACEA : DECAPODA : CALLIANASSIDAE) AS A PEST IN THE SALT FACTORIES IN VOYALUR IN CHINGLEPUT DISTRICT OF TAMIL NADU AND IN MANGINAPUDI IN KRISHNA DISTRICT OF ANDHRA PRADESH

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ABSTRACT

The occurrence of the thalassinid shrimp, *Callianassa (challichirus) maxima* Milne-Edwards, 1870, as a prolific burrower in the salt pans at Voyalur in Tamil Nadu and at Manginapudi in Andhra Pradesh, is reported in this paper. Due to the heavy infestation of this shrimp along with *Uca annulipes* and *Marphysa gravelyi*, the salt pans are made porous rendering the impoundment of brine difficult. Details of its taxonomy, morphology and ecology of the adult and its larval stages are included in the paper. Suggestions for the effective control of this shrimp in the salt pan beds are also provided in the paper.

INTRODUCTION

The Deputy Salt Commissioner of the Government of India Salt Department, Madras, Shri D. V. Kirtikar, discussed with the author in October 1977, about the salt pans at Voyalur in Chingleput District of Tamil Nadu and in the Manginapudi Salt Factory in Krishna District of Andhra Pradesh being infested with burrowers, making the land porous and impoundment of brine in the pan area difficult, since the brine seeped through these holes to the lower layers of the earth thus rendering salt manufacturing operations impossible. He requested that investigations should be conducted on the marine burrowers hindering salt manufacture

and to recommend remedial measures for eradicating the burrowers. Accordingly, on-the-spot detailed investigations on the burrowers infesting the salt pans, their horizontal and vertical areas of operation were conducted from November, 1977 onwards. The sampling of the sites at the heavily infested areas at both these salt factories revealed that two species of crustaceans and one species of polychaete were burrowing in the salt pans and had made tunnels ranging from 0.5 mm to 55.0 mm in diameter from the surface to the subsoil brine level, which at both the areas was at a depth of 300 mm during high tide and about 700 mm at low tide. In highly infested saltpan areas, these burrows extended

down to a depth of at least 1500 mm where at the surface an average of 400 holes (each hole ranging from 0.5 mm to 5.0 mm) per square metre were counted (Pl. V). These three burrowing organisms were identified as (i) *Callianassa (Callichirus) maxima* M. Edwards, 1870, (ii) *Uca annulipes* (H. Milne Edwards, 1852) = syn = *Gelasimus annulipes*, and (iii) *Marphysa graveleyi* Southern 1921.

Of these three burrowers, the most prolific and thus the most important in these two areas under investigation, is the decapod Thalassinid mud shrimp, *Callianassa (Callichirus) maxima*, which was responsible for the larger sized holes ranging from 3.0 mm to even 55.0 mm in diameter (Pls. V & VI).

Specifically, this paper reports (i) the occurrence of *Callianassa (Callichirus) maxima* as a prolific burrower in saltpans in Tamil Nadu and Andhra Pradesh, and the occurrence and collection of berried females during October and November, (ii) the details of its taxonomy, descriptions and figures of this species which had so far been described only from single adult specimens or from single chela or from young specimens, (iii) correlation during the adult stage with its true fossorial habitat in the salt pans, near the sea or estuarine muddy areas developed for salt manufacture and (iv) details of some of the planktonic larval stages, the first stage of larvae i.e., zoea with all three pairs of maxillipeds, biramous and functional from low salinity brine pools in the saltpans and also from plankton collections in the coastal inshore seas off Madras from the "R. V. Chota Investigator" collections during December and January. The investigations conducted on the crab, *Uca annulipes* and the polychaete *Marphysa graveleyi* Southern 1921 is being published separately as collaboration papers.

TAXONOMY

Order DECAPODA

Sub-order REPTANTIA

Section MACRURA

Tribe THALASSINIDEA

Compressed carapace. First pair of legs in form of Chelipeds but unsymmetrical; third pair not Chelate-Marine, burrowing shrimps.

Family CALLIANASSIDAE

This family consists of two subfamilies, namely, Callianassinae and Upogebinae the larvae of the former being hatched out as a zoea with all three pairs of maxillipeds, biramous and functional, a character in which they differ not only from the other subfamily but also from the remaining tribes of Anomura (In Axiidae also there are 3 maxillipeds).

Genus *Callianassa* (Leach) Borradaile, 1903

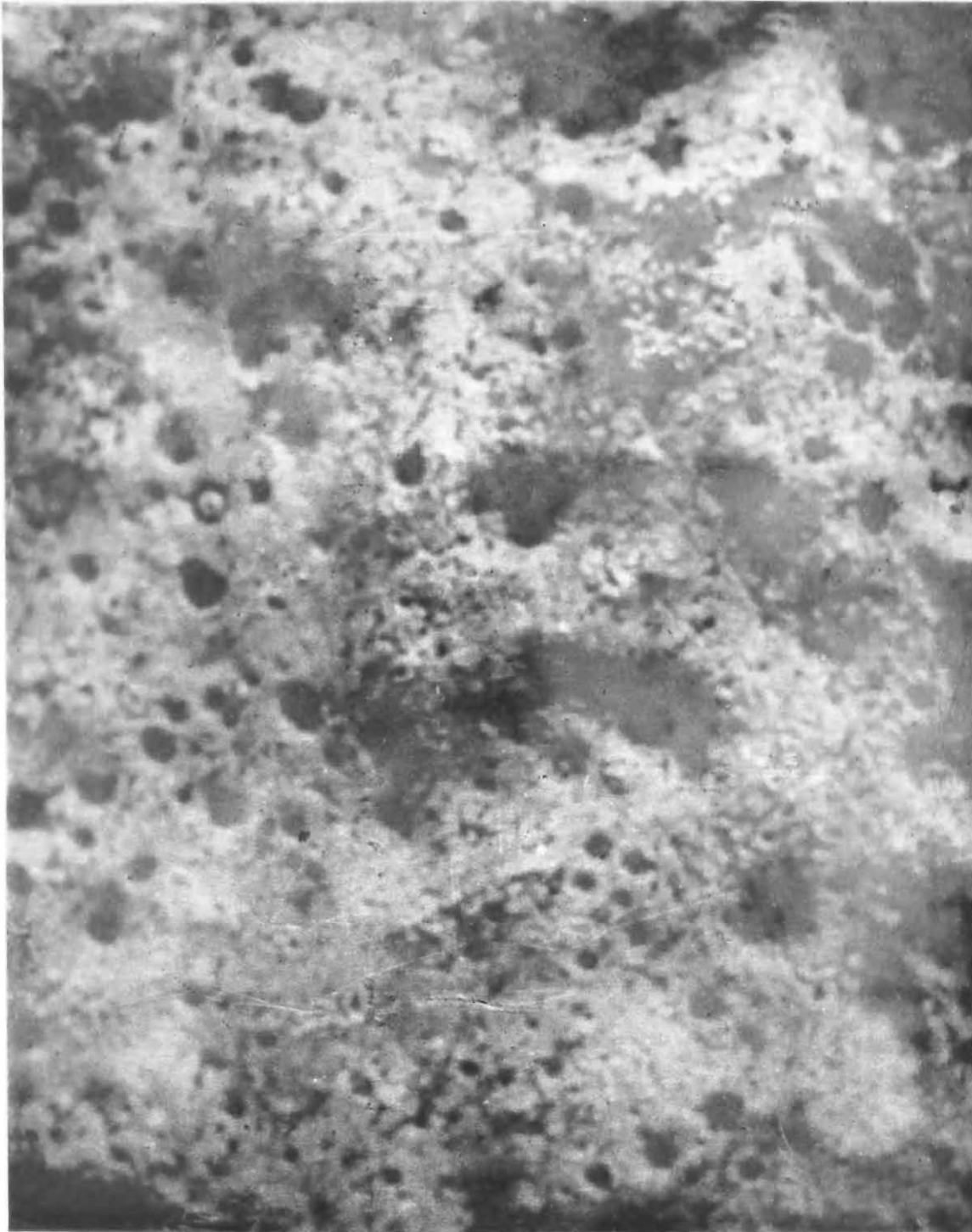
Callianassa Borradaile, 1903, p. 544.

The genus *Callianassa* enjoys a world wide distribution, but many of the species are imperfectly known as the fossorial mode of life makes their capture difficult. It includes three subgenera *Calliactites*, *Cheramus*, and *Callichirus* (vide Edmondson, 1944). According to the generic scheme of de Saint Laurent, 1973, the subgenus *Callichirus* along with the other two subgenera have been elevated as distinct genera (vide Felder, 1979).

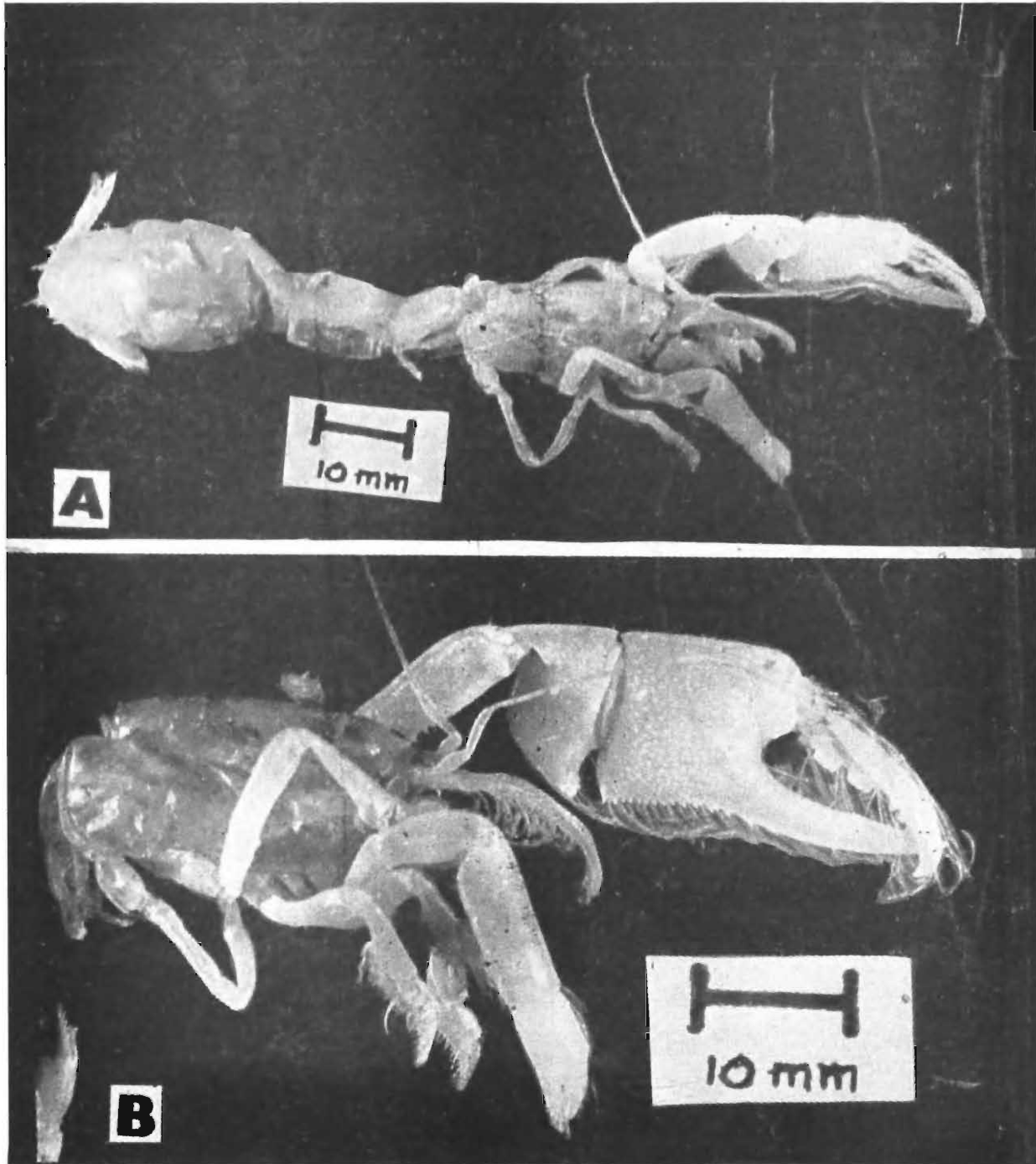
In the Indian Seas, so far, only two species of the genus *Callianassa* have been reported. They are (i) *Callianassa (Callichirus) maxima* Milne Edwards (Ratton, 1882, Revised publication, 1921, identified as burrowing prawn): Kemp, 1915; Pillai, N. K., 1954) on the adults, and Menon, M. K. 1933 and 1940 on the larval forms of the same species from the

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PLATE V



Showing highly infested salt pan area.



(A & B) *Callinassa (Callichirus) maxima*—M. Edwards, 1870 ; A—Entire adult animal ;
B—Enlarged anterior area of same specimen

Madras plankton; and (ii) *Callianassa* (*Callichirus*) *audax* De Man, 1911 (Vedavysa Rao & Raschandra Kartha 1966). However, none of the two species of this genus *Callianassa* recorded from India have been noted to cause extensive infestation of salt pans, burrowing tunnels, thus causing the brine to seep out from the pans during low tide and gushing up of the subsoil and sea water during high tide.

***Callianassa* (*Callichirus*) *maxima* A. Milne**

Edwards, 1870

(Pl. VI & Figs. 1A-I)

Callianassa maxima, 1870. A. Milne Edwards, VI, p. 97.

Callianassa maxima, 1915. Kemp. S. p. 252, pl. XIII. figs. 1—5.

Callianassa maxima. 1954. Pillai, N. K. 3 (1) C : 23—26.

The shrimp *Callianassa* (*Callichirus*) *maxima* was first named by M. Edwards (1870) from a single chela obtained in a sub-fossil condition from Siam. Ratton, in his book entitled "A Hand-book of common Salt", originally published in 1882, and revised, enlarged and reprinted in 1921, mentioned the occurrence of a "Prawn as a salt-pan pest in India, which usually drilled burrows from the shelving bank of the estuary into the condenser and thus let out the brine. This burrower was also considered by him as difficult to dislodge." There is no evidence in literature of this salt-pan burrowing prawn of India, having ever been identified and given its rightful place in crustacean taxonomy, although, Kemp (1915) described in detail this species from a single complete specimen obtained from "some part of Madras", the exact locality being unknown. Kemp's collections included a large chela and two young specimens collected from the Chilka Lake. No mention was however made by him on these specimens

being pests of salt-pans. Much later, in 1954 Krishna Pillai obtained a single specimen of this species from the Kayamkulam Lake from Central Travancore; and although assigning this specimen to this species pointed out nine differences from the descriptions given by Kemp in 1915. All the specimens obtained from these two salt pan areas, *viz.*, the Voyalur Salt Factory and the Manginapudi Salt Factory, resemble in minute detail the characters given in detail by Kemp (1915). Thus, hitherto, this burrowing shrimp *Callianassa maxima* which had been described from single specimens or from single chela, was not correlated with its true habitat in the salt pans, although it was apparently well known among Zoologists that the species of the genus *Callianassa* were fossorial in habit. Berried females were obtained during October and November, in both the salt pan areas.

Description of the adult : The rostrum is sharply pointed, without lateral teeth, and is short, reaching barely to one-third the length of the eyes (Fig. 1A). There is no tooth on the frontal margin of the carapace between the eyes and the antennal peduncles.

The eyes are subquadrilateral in dorsal view with their inner distal angles produced to a bluntly pointed process and their anterior margins oblique and concave. The inner margins are almost contiguous; they are straight and parallel with the outer margins. In the middle of the distal half there is a small round patch of black retinal pigment. The apices of the eyes reach a little beyond the articulation between the first and second antennular segments. The latter segment is stout, scarcely twice as long as broad. The third segment is more slender, but compared with some other species of the genus, is comparatively short, less than one and half times

the length of the second. The distal extremity of the third segment reaches about to the middle of the terminal segment of the antennal peduncle. The antennal flagellum is considerably longer than the subequal flagella of the antennules and is fully one and a half times the length of its peduncle (Pl. VI A & B).

The form of the outer maxillipede is shown in Pl. VI and Fig. 1 H. The ischium, merus and propodus are extremely broad and on the inner face of the first of these segments is a longitudinal row of small granules commencing close to the articulation with the basis.

The first legs are very unequal (Pl. VI A & Fig. 1B). In the larger, the ischium is slender, but considerably expanded towards its distal end. The inferior edge is finely but irregularly tuberculate, the tubercles sometimes taking the form of small spinules on the outer surface in the proximal two-thirds there is a sharply defined crenulate carina. Between this carina and the lower margin, the surface is covered with close-set granules that extend nearly to the ischio-meral joint. The merus is a trifle longer than the ischium and is rather more than two and a third times as long as broad. In form, it is trigonal, the outer surface being traversed longitudinally by a conspicuous ridge, smooth distally, but crenulate at its proximal end. The upper border is finely crenulate in its basal half; otherwise the surface above the median ridge is quite smooth. Below it, the surface is covered with tubercles, which are larger towards the proximal end, and near the inferior margin there is an oblique granular crest. The inferior margin is granular and setose and near the ischial articulation is produced to a large acute tooth. On its

inner face the merus bears two conspicuous grooves that run close to and parallel with, the upper and lower borders; the surface is granular at the proximal end, otherwise quite smooth.

The carpus of the same limb is one-third broader than long; its length is about two-thirds that of the merus. The outer surface is smooth and evenly convex. The posterior margin below the merocarpal joint is setose and a little uneven and the infero-distal angle bears a few spinules at its apex. On the inner surface the upper limit of the excavation into which the merus fits is defined by a strongly granular ridge and there are also scattered tubercles near the sharp crest that forms the upper margin and near the inferior angle. The distal margin, next the propodus, is finely crenulate internally; externally it is smooth.

The palm of the chela, (Pl. VI A & Fig. 1B) measured along its upper margin, is one quarter longer than the carpus and is equal in breadth with that segment; it is rather more than two-thirds the length of the dactylus. The upper margin of the palm, in its basal two-thirds only, bears a sharp ridge that is obscurely notched. The outer surface of the palm is evenly convex and the whole of its middle part is covered with granules which increase in size distally. Close to the gape of the fingers there is a cluster of large spinules and at the proximal end of a smooth blunt ridge that extends the entire length of the fixed finger, there is a short row of rounded tubercles. On the inferior edge of the palm there is a series of close-set spinules. The inner face of the palm is covered with granules larger than those on the external surface and there are a few tubercles near the gape of the fingers. The inner edge of the fixed finger is without teeth and is feebly crenulate at the

proximal end. In the gape at the base of the dactylar articulation is a blunt lobe serrated at the distal end. When the claw is closed the fingers meet only at the tip. The dactylus

edge there is a large bluntly trilobed tooth at the proximal end, a single large blunt tooth in the middle of the margin and a series of seven smaller teeth, also blunt, behind the

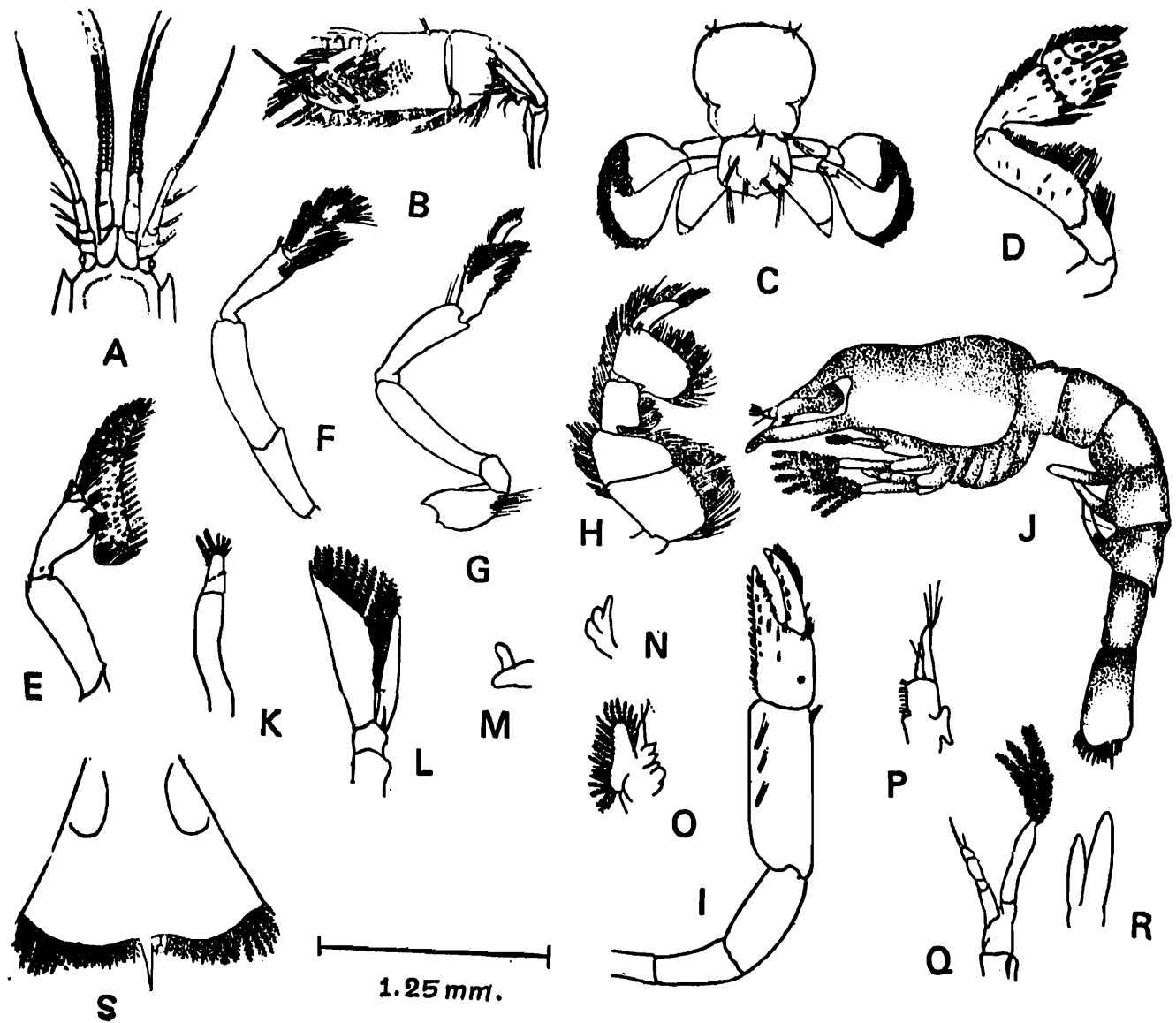


Fig. 1. *Callianassa (challichirus) maxima* : (A-I) Adult : A—Anterior part of Carapace, rostrum, eyes of adult ; B—Large Chelipede of adult ; C—Last abdominal somite, telson and uropods of adult ; D—Second peraeopod of adult ; E—Third peraeopod of adult ; F—Fourth peraeopod of adult ; G—Fifth peraeopod of adult ; H—Third maxillipede of adult ; I—Smaller peraeopod of first pair of adult.

(J-S) Larvae : J—First stage entire animal ; K—Antennule of first stage ; L—Antenna of first stage ; M—Mandible of first stage ; N—First maxilla of first stage ; O—Second maxilla of first stage ; P—First maxillipede ; Q—Second maxillipede ; R—Pleopod of first stage ; S—Telson of first stage.

is curved and pointed at the apex and bears a few coarse and rather obscure tubercles on its upper margin near the base. On the inner

tip. On both upper and lower margins of the palm and on the fingers are numerous tufts of coarse yellowish setae.

The smaller left leg of the first pair (Fig. 1, I) is totally different in form and bears no spinules or tubercles (Pl. VI A). The merus is about as long as broad and is longer than the ischium; the outer surface shows traces of ridge. The carpus is about two and a half times as long as wide; the upper and lower margins are sharply crested and, throughout the greater part of their length, are strictly parallel.

The chela is a little shorter than the carpus and about one and a half times the length of the merus. The fingers are about as long as the palm; they are obscurely serrate internally and bear tufts of coarse setae.

The form of the remaining pairs of legs is illustrated (Figs. 1 D, E, F & G). The propodus in the third pair (Fig. 1F) bears a conspicuous lobe on its inferior margin; the fifth pair is perfectly chelate (Fig. 1G).

The second abdominal segment is the longest, equal to the fourth and fifth combined and a little longer than the sixth (Pl. VI). There is a patch of soft hairs on the posterolateral angles of the third and fourth and a similar patch in the middle of the fifth. The sixth somite is subcircular, narrower than the fifth; it is excavated on either side in the posterior third and in the middle of distal margin there is a short longitudinal furrow. The first two abdominal appendages are slender; the remaining three are broadly foliaceous.

The telson is subquadrilateral little more than half the width of the somite and one quarter broader than long. The lateral margins are gently rounded and the posterior margin slightly convex with a tuft of long setae on either side. In the middle of the upper surface there is a smooth hemispherical swell-

ing, bearing tufts of setae, and behind this swelling are three conspicuous dimples, the middle one larger than the two lateral (Fig. 1C).

The uropods are much longer than the telson. The inner is triangular in shape, the outer ovoid, with a small bilobed tubercle against which the endopod is folded when the tail-fan is closed. (Fig. 1C).

The lower border of the large leg of the merus is armed with large irregular spinules (the proximal one of the series taking the form of a bilobed tubercle); the tubercles on the upper edge of the dactylus, near the base, are more prominent and the surface granulation is in most places more scanty.

LARVAL STAGES

First stage larva. (Fig. 1J).

(Fig. 1J-Q)

The rostrum is as long as the antennules, broad and dorsoventrally flattened. At the anterior end it narrows considerably and ends in a point. A few minute teeth are present on the edges at the anterior end. The antero-lateral edge of the carapace is serrated there being about 10 small teeth, and there is a distinct sub-orbital spine at the anterior end. The posterior end of the carapace is deeply concave and is rounded at the corners. Unlike the larvae of other species of *Callinassa* there is no large dorsal spine on the second abdominal segment. The third fourth and fifth have small dorsal spines at their posterior ends of which the last is larger than the others and is curved down.

The eyes are carried on short thick peduncles and are pigmented.

Antennule: (Fig. 1K) There is a peduncle and two short flagella. The former does not

show segmentation and has neither spines nor setae. The internal flagellum is half as long as the external and carries one long stout plumose seta terminally. The outer shows three faintly marked joints, the first two of which have each two large aesthetes. The third has three which are narrower than those of the lower segment and also three ordinary setae.

Antenna : (Fig. 1 L) The peduncle is two-jointed. Basipodite is produced into a short spine above the base of the flagellum. The latter is about three-fourths as the scale and does not show clear indications of segmentation. Terminally it is armed with two plumose setae. The scale ends distally in a short stout spine and is fringed along the inner edge and tip with seven plumose setae.

Mandible : (Fig. 1 M) Has a well developed unjointed palp. The cutting edge is smooth except for the presence of a minute tooth.

First Maxilla : (Fig. 1 N) The proximal endite is armed with five teeth, one of which is very small. The distal endite has one very small tooth as its lower end and two or three minute tubercles above. There is well developed unjointed palp.

Second Maxilla : (Fig. 1 O) There are four endites, the two middle ones of which are smaller than the others. The basal and the next are unarmed; the other two are armed each with a small seta. The endopodite is unjointed and tipped with two setae. The scale has a fringe of 24 plumose setae.

First Maxillipede : (Fig. 1 P) The coxopodite bears only one seta on its inner margin. The liasipodite has eight which are, however, shorter than that of the former. The endopodite has three terminal setae of which one is rudimentary. The exopodite is twice as long as the endopodite unjointed and is

tipped with four plumose setae. There is a flat epipodite.

Second Maxillipede. (Fig. 1 Q) The endopodite is four-jointed. A slight constriction towards the base of the proximal joint may indicate that it is formed by the fusion of the first two joints. Exopodite has four terminal plumose setae.

Third Maxillipede : (Fig. 1 J) Similar to second. The exopodite has five plumose setae.

Behind the third maxillipede there is no free appendage in the thorax though the full number of appendages appear as prominent swellings beneath the cuticle of the ventral side.

Abdomen : (Fig. 1 J) Consists of six segments besides the telson. The first segment is the shortest, being only half as long as the second and the sixth is the longest. The first two segments are without appendages. The three following ones possess well-developed biramous pleopods (Fig. 1 R) which are not clothed with setae. There are no uropods.

The telson (Fig. 1 R) is a broadly triangular structure with a slight notch in the middle of its posterior edge, where there is a large median spine. This does not show any articulation with the telson, but seems to be a continuation of the edge. On either side of this there are 17-19 spines of which the second from the side is reduced and hair-like. The spines gradually increase in size from the centre to the sides. All spines except the median and the two outermost ones are serrated.

The body is perfectly transparent except for a short streak of pink colour along the lateral margin of the carapace and a patch of similar pigment on the ventral side just behind the mouth (Fig. 10).

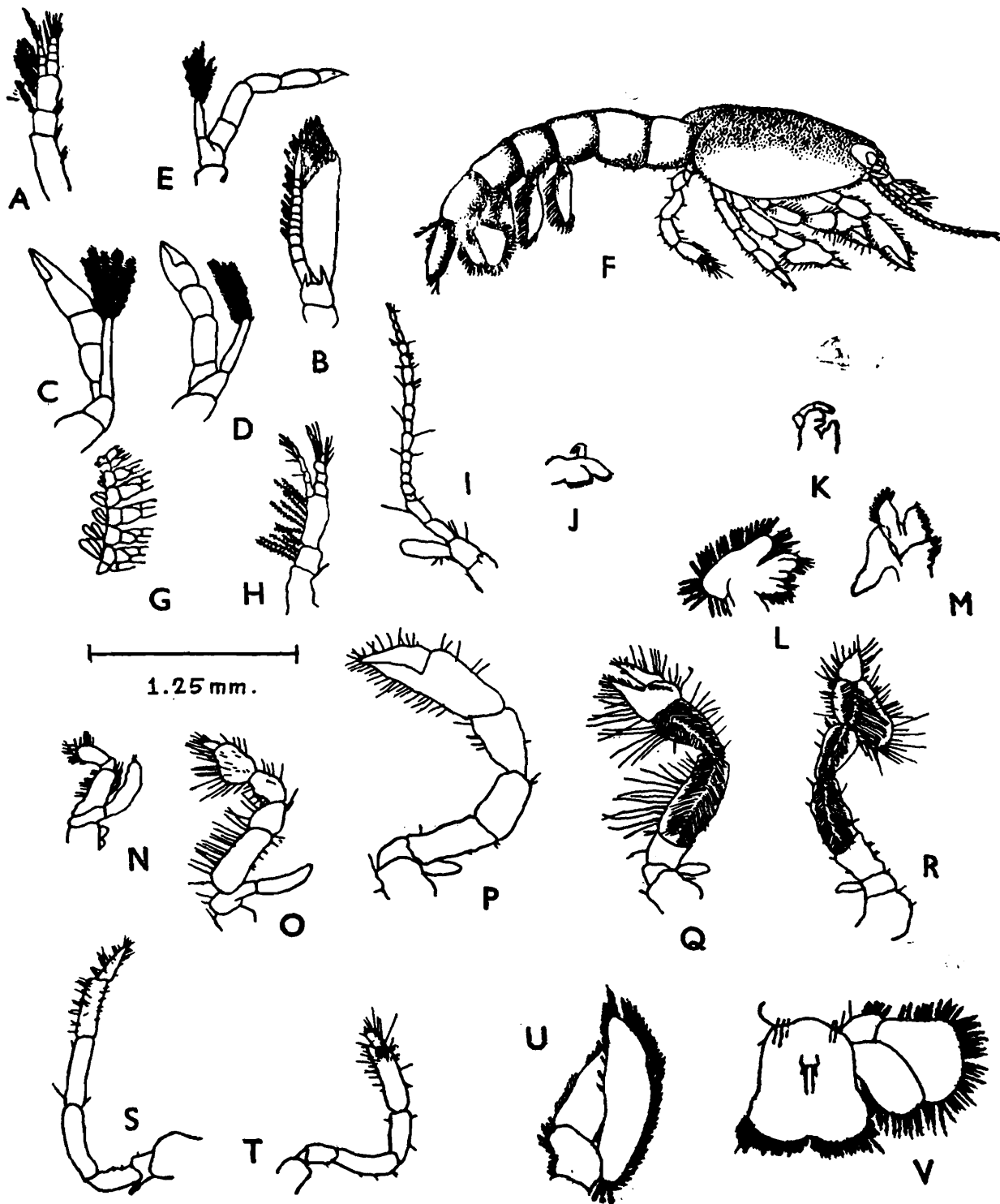


Fig. 2. Larvae : A—Antennule of second stage ; B—Antenna of second stage ; C—First thoracic leg of second stage ; D—Second thoracic leg of second stage ; E—Fourth thoracic leg of second stage ; F—First part larval stage ; G—Arrangement of gills of second stage larva ; H—Antennule of first post larval stage ; I—Antenna of first post larval stage ; J—Mandible of first post larval stage ; K—First maxilla of first post larval stage ; L—Second maxilla of first post larval stage ; M—First maxillipede of first post larval stage ; N—Second maxillipede of first post larval stage ; O—Third maxillipede of first post larval stage ; P—First thoracic leg of first post larval stage ; Q—Second thoracic leg of first post larval stage ; R—Third thoracic leg of first post larval stage ; S—Fourth thoracic leg of first post larval stage ; T—Fifth thoracic leg of first post larval stage ; U—Pleopod of first post larval stage ; V—Uropod and telson of first post larval stage.

Second stage larvae—Total length 7.5 mm.
(Figs. 2A—E & G)

In shape and general appearance the larva has undergone no modification. The most important difference between this and the previous stage is the presence of the full number of free thoracic appendages in this. The lateral margins of the rostrum are toothed along their whole length. The carapace remains as it was in the previous stage ; in the abdomen the spine on the third somite is better developed in addition to those already existing ; a small dorsal spine and a much larger ventral one are present at the posterior end of the sixth somite. An extremely small lateral spine may also be present in the same somite.

Antennule : (Fig. 2A) The peduncle is now clearly three-jointed, the basal joint being the longest. The first and second joints carry four and five short plumose setae respectively, on their outer margin. On the inner margin of the second joint there is one long plumose seta and five similar ones are present on the third. The inner flagellum has elongated and equals the outer in length which is as long as the distal joint of the peduncle. The external flagellum has got the same number of aesthetes as in the last stage and the internal is tipped with two unequal setae, the larger of which is plumose.

Antenna : (Fig. 2B) The basipodite now carries two spines, one above the base of the flagellum and the other above that of the scale. The scale is bordered on the inside and tip with 18—20 plumose setae. The flagellum is as long as the sclae and is tipped with two short setae. Faint indications of segmentations are seen beneath its cuticle.

Mandible : The cutting edge shows two well-defined round smooth lobes, but is devoid of teeth.

First Maxilla : The palp has a small terminal seta. The armature of the endites shows no difference from that of the previous stage except the addition of a tooth on the distal endite.

Second Maxilla : Has not altered appreciably. The fringe of plumose setae on the scale has increased in number to about thirty.

First Maxillipede : The endopodite and exopodite are armed terminally with four and five setae respectively. The other parts remain unchanged.

Second Maxillipede : A small epipodial rudiment has appeared on the coxopodite.

Third Maxillipede : Remains unaltered. Behind the maxillipedes all the other thoracic appendages are now free and functional.

The legs, (Figs. 2C, D & E) except the last, have well-developed exopodites with five terminal plumose setae. The last does not show any trace of an exopodite. The endopodites are all five jointed. The first and second terminate in well-developed chelae, the others in long, pointed, claw-like processes of the dactylopodites. The propodite of the third is expanded and has more or less acquired the characteristic shape it has in the adult. The same segment in the last leg sends a short process from its tip below the base of the dactylopodite so that the tip of this leg already shows its subchelate nature.

Gills : (Fig. 2G) Rudiments of the full number of the adult are present. The maxillipede and the following four legs have each two gill-rudiments. The last leg has none and the single rudiment of the second maxillipede is hardly perceptible,

Abdomen : Shows a slight elongation. The first and second somites are still without appendages. The uropods are not yet fully developed, but appear in the form of thickenings along the sides of the anterior part of the telson.

Telson : So far as shape is concerned there is absolutely no change. Only sixteen spines are now present on either side of the large median spine. In most of the interior spaces between the spines the edge of the telson bears two or three small setiform teeth.

There is no change in colouration.

First Postlarval Stage : (Figs. 2F, H-V)

Total length of the animal is 6 mm. Like the previous stages this is also perfectly transparent and colourless except for the ventral side near the mouth where there is a patch of red colour. There is a short broad rostrum with blunt tip which is bent down between the eyes. The hind end of the carapace is deeply concave and the postero-lateral portions are rounded. The lateral and posterior margins bear a few short setae. The eyes are short and thick and the cornea is well pigmented. The proximal portions of the stalks are flattened on the inside and are closely pressed together (Fig. 2F).

Antennule : (Fig. 2 H) The peduncle is three-jointed and bear about eleven setae on the two distal segments. The flagella are now distinctly segmented, both having five segments. The inner is slightly longer than the outer which is as long as the third joint of the peduncle. Both are armed with setae and the outer has four aesthetes in addition.

Antenna : (Fig. 2, I) The two spine-like processes of the basipodite have now disappeared. The scale persists in the form of a club-shaped structure as long as the peduncle and armed with two or three setae. The

flagellum has increased greatly in length and has got 15-17 joints, most of the joints being armed with short setae.

Mandible : (Fig. 2 J) The masticatory portion is deeply divided into two lobes, both of which carry long, narrow, pointed teeth. The palp is unjointed and bears terminally a rudimentary seta.

First Maxilla : (Fig. 2 K) The palp is three-jointed and is armed with six very short setae at the distal end. The proximal endite is very small and devoid of setae. The distal one is broad and has four small blunt prominences.

Second Maxilla : (Fig. 2 L) All the endites are armed with numerous setae. The scaphognathite is bordered with 37 plumose setae. The endopodite carries five setae of which three are terminal.

First Maxillipede : (Fig. 2 M) Both the coxo and basi-podites have well-developed masticatory lobes armed with several setae, a few of which, springing from the middle of the proximal lobe, are plumose. The extreme basal part of the proximal lobe is bare. The endopodite is small, being not even half as long as the exopodite and is unarmed. The inner is broad and unjointed and carries ten plumose setae which are distributed on the tip and the distal half of the outer margin. Besides these a rudimentary one is present on the inner margin close to the tip. The epipodite has increased considerably in size.

Second Maxillipede : (Fig. 2 N) The endopodite is rather broad, curved inwards and four-jointed. The basal joint is the largest and as in the previous stages shows a slight constriction near the base thus indicating that it is formed by the fusion of two joints. There is a rudimentary epipodite in

the form of a round protuberance. The exopodite is a vestige about as long as the first two segments of the endopodite and tipped with two short setae. All joints of the endopodite except the second bear setae.

Third Maxillipede : (Fig. 2, O) Is rather broad due to the flattening of the first four joints, among which the propodus is a little broader than the others. The dactylus as in the preceding limb is very small. All joints are armed with setae, those along the inner margin being larger and more closely arranged. The exopodite is similar to that of the second maxillipede.

Pereiopods : The first and second are chelate.

The chelae are equal. In the first, the ischiopodite is rather slender. The carpus and propodus, especially the latter, are large and massive. The fingers are almost equal in size and about $2/3$ as long as the rest of the propodus. The distal portion of the inner margin of the carpus and the entire inner margin of the propodus as well as the outer borders of the fingers are armed with long setae. The cutting edge of the fixed finger shows three small triangular cusps while that of the other is smooth (Fig. 2 P).

In the second leg all the segments are rather stout. The fingers are equal in size. The inner edge of the fixed finger bears three prominent teeth rudiments, while the dactylus has a smooth cutting edge. The inner margin of the merus and both margins of the carpus and propodus are armed with setae, those on the inner being longer and stouter. The fingers are also provided with setae along the outer edge and a few are present on the inner edge also (Fig. 2 Q).

Third leg : (Fig. 2R) The ischium, merus and carpus are rather slender, but the pro-

podus is greatly expanded at the base so as to form a triangular lobe. The dactylus is small and triangular. Both the propodus and dactylus are thickly set with setae, those along the hinder edge of the propodus being much larger than the others.

The fourth and fifth legs are very slender when compared with the preceding. The last two joints of both are provided with close setae. (Fig. 2S & T).

The fifth leg is distinctly subchelate and its propodite is armed with a cluster of setae arising just behind its distal end.

Each of the first four pereiopods carries a small spineless process on the outer of the basipodite which is the vestige of the exopodite (Fig. 2F).

Abdomen : The sixth segment is longer than those in front. The pleural margin of the first five somites have a few hairs but those of the sixth segment have fringed stout plumose setae through-out their length all of which are curved backwards. The two somites are still devoid of appendages, the succeeding four segments having pleopods.

Pleopods : Each pleopod has a short thick peduncle and two flattened lobes, the inner of which is shorter than the outer. Both the lobes are borne with long plumose setae except on the proximal half of the inner margin of the outer. The inner margin of the endopodite has a small appendix interna carrying five keels (Fig. 2U).

Uropods : (Fig. 2V) These are large. The outer lobes are much broader than inner, their outer margins being almost twice as broad as those of the inner interior, outer and distal halves of the posterior margins are set with plumose setae of which are considerably shorter than the others. The inner lobe is shorter than outer and bears setae only on

its posterior border. A few plumose setae are present in the peduncle.

Telson : (Fig. 2V) Shows variations in length in different specimens. It may be as long as or slightly longer or shorter than the inner lobe of the uropods. It is not rectangular as in other species of *Callinassa*, the posterior end being about a third as broad again as the anterior end. The posterior edge has still got a shallow central notch in which a vestige of the median spine persists. On either side of this there are short, plumose setae and a few smooth, slender setae arising in front of the edge. On the dorsal side arising from a prominence there are four or two of which are shorter than the other two.

EXPERIMENTAL OBSERVATIONS

Experimental investigations on the tolerance of the burrowing shrimp to increase in salinity (density) was conducted by introducing the animals at 10°Be at normal temperature, 28°C. This experiment was repeated thrice in the field, and revealed that at 20° Be the shrimps survived for 8—10 minutes after which period they became moribund and died. In the 10°Be brine water, the shrimps survived for 120 minutes although the beating of the appendages became erratic after 30 minutes. In another series of experiments, in which the experimental shrimps were subjected to alternate submersion in 10°Be brine water for 30 minutes and exposure to atmospheric air for 20 minutes (with wet gills) these animals survived for 4—5 hours.

In a third series of experiments, these burrowing shrimps were introduced into plastic containers which had been half filled with loose clayey mud along with brine water of 5°Be which were collected from the salt-pan area. The shrimps burrowed into this loosely

laid layer. At this stage sandy clay was set compactly above the layer to a height of 40 cm. above which salt mixed with sandy clay in the proportion of 1 : 10 was set for 2 cm. Brine water of 5°Be was poured once in every three hours. Under these conditions the experimental shrimps died within 12 hours.

RECOMMENDATIONS

The following recommendations are therefore given for killing the prime burrower *Callinassa maxima* inhabiting the upper six feet (180) cm vertical zone and driving the hardier adults deeper below the six feet depth so that the salt water and subsequently the brine can be retained in the pans without seepage during low tide and diluted with lower saline water during the subsequent high tide.

1. Ploughing of the infested area should be done and the ploughed land has to be left undisturbed for two days during the hot season, preferably April-May. At this stage, by the use of a suitable heavy roller or by the age-old method of using a plank weighted down by 8-10 persons and pulled over the fields by mechanical or manual means which would make the upper surface region compact, these alternate ploughing and ramming operations should be carried out, eight to ten times. At this stage after blocking the burrows and by letting condensed brines at 8°Be flow into infested places, this shrimp pest can be vanquished slowly, so that in the third month of salt manufacture the "Shrimp past" disappears. By such a method, the burrowers upto a depth of one foot will be killed or driven below 1 foot depth and the tunnels fortified with the shells would crumble and cave in resulting in the vertical zone of one

foot from the surface becoming compact, non-porous without any tunnels, so that the burrowers are not able to set up a current facilitating feeding and respiratory activities, due to lack of plankton, detritus and lack of oxygen. Now, salt should be sprayed on the infested beds and the roller applied again so that the salt is driven into the top most layers of the surface and any surviving burrowers would be killed on contact. Later the pans should be prepared for the introduction of high density brine, so that any accidental percolation of the brine into the lower layers would not allow the animals to rehabilitate themselves in the one foot vertical zone.

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The author is grateful to Prof. Dr. T. N. Ananthakrishnan, Director, Zoological Survey of India, Calcutta for providing facilities to carry out these investigations, constant encouragement, and for guidance in the preparation of this paper. He is also thankful to Dr. K. K. Tiwari, Joint Director, Zoological Survey of India, Calcutta for the benefit of discussions on the ghost shrimps, especially *Thalassinia anomala* Herbst recorded from Bombay and Sagar Island area. Thanks are also due to my colleagues of the Marine Biological Station, Zoological Survey of India, Madras for extending help while conducting investigations on Salt pans at both sites.

I am deeply grateful to Shri Kirtikar I.S.S., Deputy Salt Commissioner, of the Government of India Salt Department, for extending all facilities and personally visiting these sites during the period of our investigations and subsequent discussions regarding the remedial measures to be adopted for eradicating the burrowers.

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THREE NEW SPECIES OF TUBULIFERA FROM INDIA
(THYSANOPTERA : PHLAETHRIPIDAE)

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ABSTRACT

Three species viz., *Crotonothrips erraticus*, *Liothrips renukae* and *Thlibothrips (Athlibothrips) yercaudensis* are described as new to science.

***Crotonothrips erraticus* sp. nov.**

Female (Macropterous): (Fig. 1) General body colour brown, posterior abdominal segments and tube darker, antennal segments 1, 2, 7 & 8 brown, 3-6 golden yellow with brown shade at margin, 3 brighter; all femora, mid and hind tibiae brown with golden yellowish tinge, foretibiae golden yellow with brownish shade at margin, all tarsi golden yellow. Forewings grey. All setae hyaline and blunt.

Head about as long to very little broader 224-232* long, 224-228 wide across eyes, 236-244 across cheeks, 232-236 across base; cheeks crenulate with 2-3 very minute spines, surface strongly reticulate. Eyes large 104-108 long, 68-72 wide; all ocelli 32 wide, median ocellus overhanging between antennae, paired ones placed above middle of eyes; postoculars well developed 88-96 long. Antennal segments 3-7 subpedicellate, 7 & 8 forming an unit; segments 1-8 length (width): 1 : 54 (38-46); 2 : 58 (36-38); 3 : 76-84 (38); 4 : 76-80 (42); 5 : 72-76 (32-34); 6 : 68-72 (32); 7 : 62-64(28); 8 : 38 (16); sense

cones on 3-6 moderately thick 30-34 long. Mouthcone broad, moderately long, 148-168 long, 190-208 wide at base, 106-114 at apex. Maxillary stylets retracted below postoculars, close at middle.

Prothorax about as long as head, 220-228 long, 240-258 wide at anterior margin, 418-456 at posterior margin. Anteroangulars 38-50, anteromarginals 24-28, midlaterals 46-52, postangulars 96 and epimerals 114 long respectively. Forefemora 286-304 long, 142 wide, foretarsal tooth straight, 46 long. Pterothorax 376-388 long, 524-540 wide across meso- and 518-560 across metathorax. Forewings broad, phlaeothripine 1.05-1.15 mm. long, 106-134 wide with 16-18 double fringes; basal wing setae well developed 72, 84, 84-88 long respectively. Mesoparaesternum complete, thin at middle.

Abdomen 564-594 wide at base, 526-532 at middle, 384-396 across segment VIII, 248-252 across segment IX; segments 3-7 with a black streak along apical margin. Pelta roughly bell shaped with reticules. B₁-B₃ of segment

*All units in microns unless otherwise mentioned.

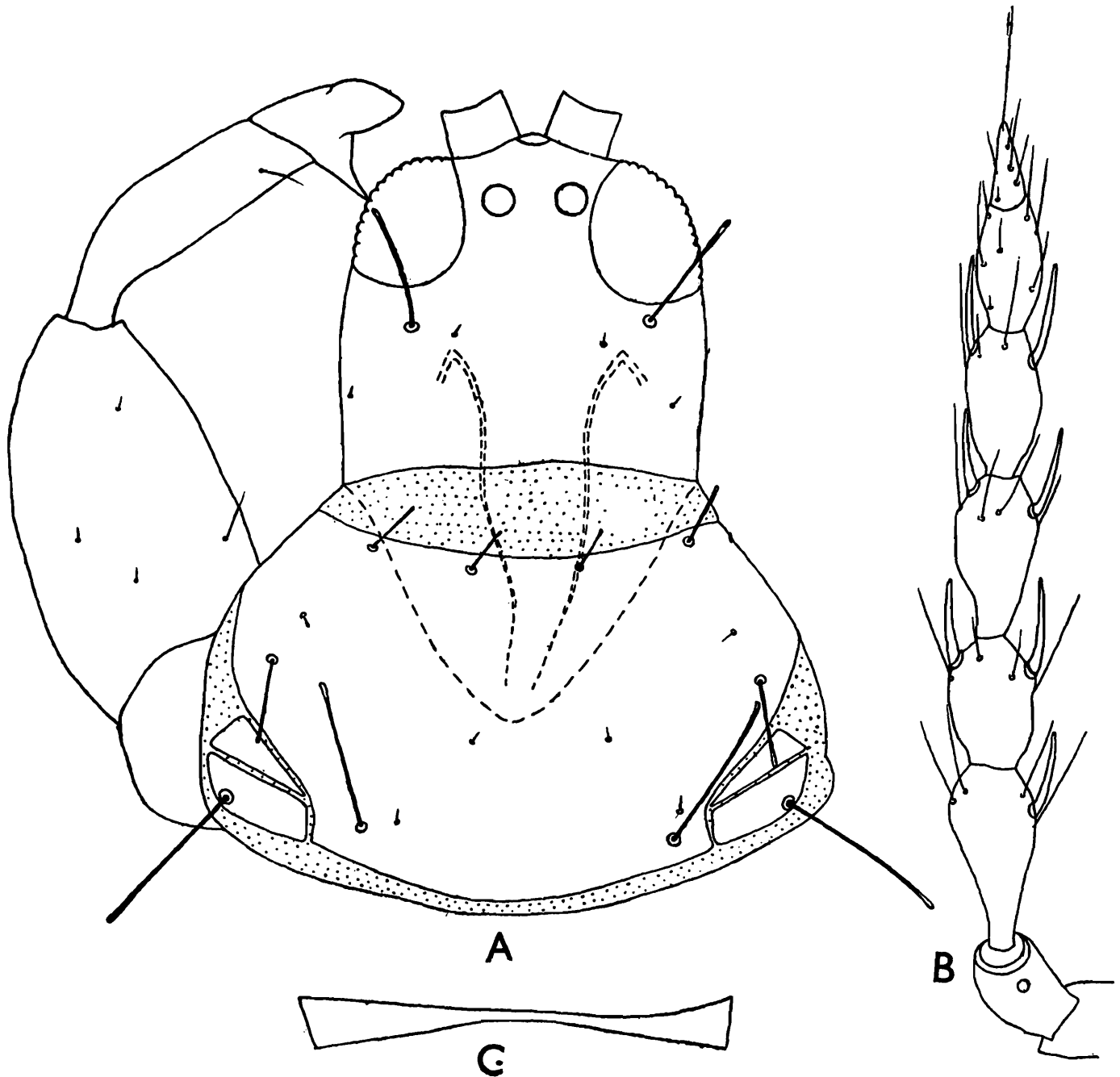


Fig. 1. *Crotonothrips erraticus* sp. nov. A. Head and pronotum, B. Antenna, C. Mesopraesternum.

IX: 152-172, 148-152 and 248-256 long respectively. Tube 266-278 long, anal setae 152-160 long.

Total body length: 2.75-2.79 mm.

Material: *Holotype*—♀ (Z.S.I. Reg. No. 251/H₁₇), *paratype*—1 ♀ (Z.S.I. Reg. No. 252/H₁₇), Gamartilla, Teliamura, Tripura, 19.x. 1977, ex. leaf galls; Coll. N. Muraleedharan; deposited in the National Zoological

Collections of Zoological Survey of India, Calcutta.

The new species differs from all the known species of *Crotonothrips* Ananthakrishnan by the presence of well developed postoculars, postangulars only a little shorter than epimerials and B₂ of IX as long as B₁ and B₃.

In a recent review Ananthakrishnan (1976)

has defined the genus *Crotonothrips* as characterised by reticulate head, vestigial postocul-

general build up it lacks most of the essential generic characters of *Crotonothrips*. Never-

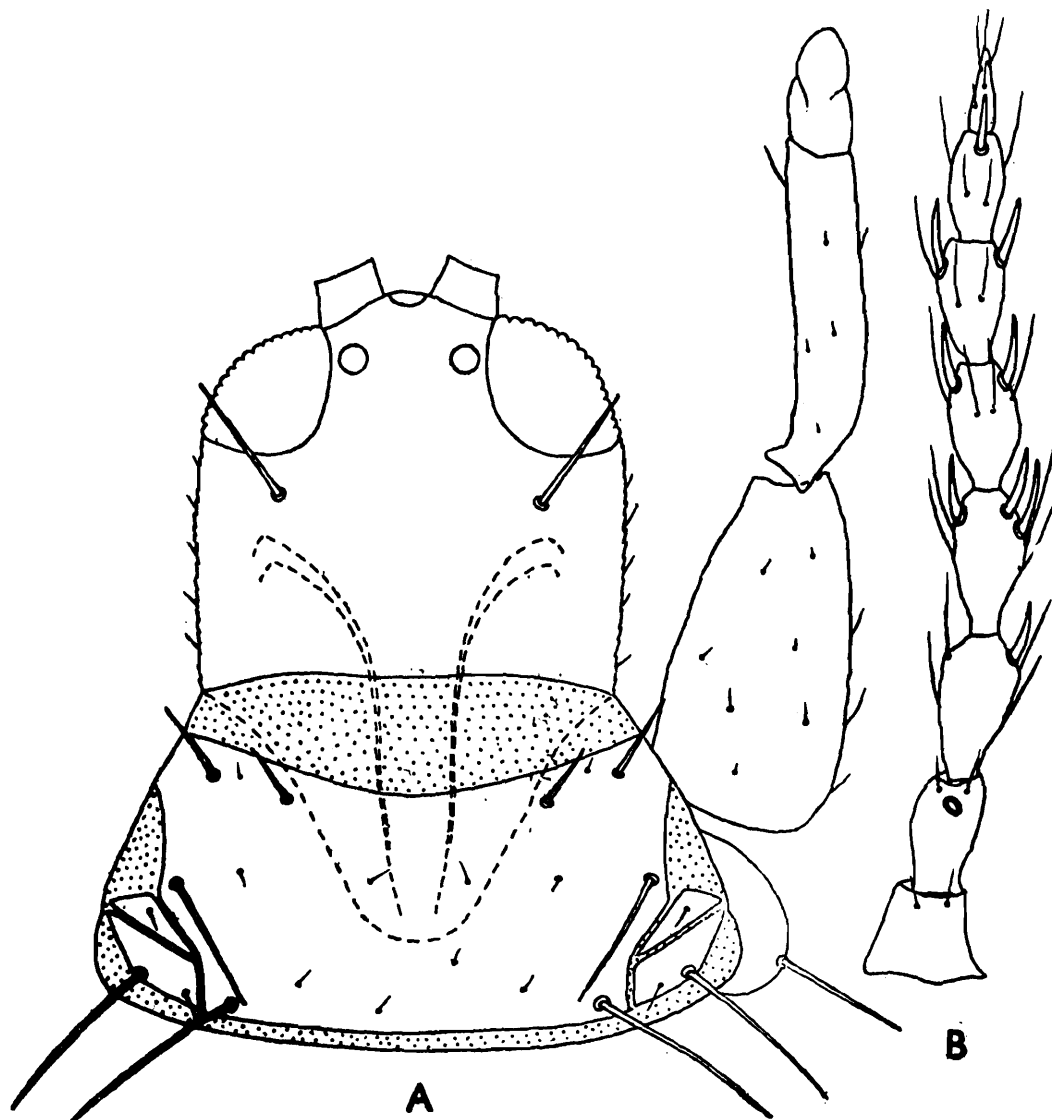


Fig. 2. *Liothrips renukae* sp. nov. A. Head and pronotum, B. Antenna.

lars, postangulars half as long as epimerals, tube longer than head and B_2 of abdominal segment IX half as long as B_1 and B_3 . The presence of species with typical generic characters and those with one or the other of the essential *Crotonothrips* features missing makes this genus highly complex, demanding further subgeneric division. The species under discussion though resembles this genus in

theless this species is provisionally placed under *Crotonothrips* and with the discovery of males and additional material it has to be transferred to a separate genus.

Liothrips renukae sp. nov.

Female (Macropteros): (Fig. 2) General body colour brown, head and tube a little darker; antennal segment 1 brown, base of

segment 2, apex of 7 and segment 8 pale brown; all femora brown, foretibiae yellow, mid and hind tibiae brown and all tarsi yellow; wings clear. All setae brown and pointed.

Head about 1.1 times wider than long, surface transversely striate, 180-200 long 180-180, wide across eyes, 204-208 across cheeks, 200 across base, sides finely cremulate and with one or two small cheek setae. Eyes slightly ventrally extended, 60-68 long, 48-56 wide, all ocelli 20 wide, median ocellus overhanging between the antennae, placed 16-20 away from paired ones and the latter placed 28-32 apart. Postoculars pointed, 64-80 long, placed 20 below eyes. Antennal segments length (width) : 1 : 36-40 (40) ; 2 : 44 (28) ; 3 : 56 (30-32) ; 4 : 48-52 (32) ; 5 : 46-48 (28) ; 6 : 44-48 (24-28) ; 7 : 40 (24) ; 8 : 28 (12) ; sense cones 12-16 long. Mouthcone pointed, 120-140 long, 192-200 wide at base, 64-80 wide at apex. Maxillary stylets retracted to the level of postoculars, not meeting at middle; maxillary bridge absent.

Prothorax 124-128 long 204-212 wide at anterior margin, 296-320 at posterior margin. Anteroangulars 44-52 long, anteromarginals 32-44 long, midlaterals 80-88 long, postangulars 96-104 long, epimerals 104-116 long. Epimeral suture complete. Forefemora 160-168 long, 80-84 wide. Pterothorax 323-340 long, 388-404 wide across meso- and 396-412 wide across metathorax. Forewings 680-714 long, 80 wide, the number of double fringes varying from 2-4, often present only in one wing. Basal wing setae B_1 - B_3 , 72, 72-84, 72-76, long respectively. Mesopraesternum complete, narrow at middle.

Abdomen 400-425 wide at base, 380-408 at middle, 288-296 across VII, 164-168 across IX. B_1 - B_3 of segment IX, 164-192, 144-180,

180-192 long respectively. Tube 172-180 long and anal setae 120-124 long.

Total body length : 1.75-1.83 mm.

Male (Macropteros) : Colour as in female. Head 168 long, 176 wide across eyes, 192 wide across cheeks, 180 across base. Eyes 60 long and 40 wide. Ocelli 20 wide, median ocellus 16 away from paired ones and the latter 24 apart. Postoculars 64 long, placed 20 below eyes. Antennal segments length (width) : 1 : 28 (32) ; 2 : 40 (24) ; 3 : 52 (28) ; 4 : 48 (28) ; 5 : 44 (28) ; 6 : 48 (24) ; 7 : 40 (24) ; 8 : 28 (12). Sense cones 16 long. Mouthcone 120 long, 176 wide at base and 64 wide at apex.

Prothorax 120 long, 196 wide along anterior margin, 280 wide at posterior margin. Anteroangulars 44 long, anteromarginals varying in length 20-40 long, midlaterals 64 long, postangulars 88 long and epimerals 104 long. Forefemora 152 long, 76 wide. Pterothorax 306 long, 360 wide across meso and 356 wide across metathorax. Forewings 646 long, 68 wide with 2 double fringes. Basal wing setae B_1 - B_3 , 64, 72, 60 long respectively.

Abdomen 380 wide at base, 368 across middle, 240 across VIII, 148 across IX. B_1 - B_3 of IX 172, 48, 164 long respectively. Tube 148 long and anal setae 120 long.

Total body length : 1 mm.

Material : *Holotype*—♀, (Z.S.I. Reg. No. 692/H₁₇) Renuka, Sirmur Dist., Himachal Pradesh; 25. vi. 1979; ex. leaf gall; Coll. N. Muraleedharan, *allotype*—♂, (Z.S.I. Reg. No. 693/H₁₇), data same as for holotype; *paratypes*—7 ♀♀ (Z.S.I. Reg. Nos. 694-700/H₁₇), data same as for holotype; deposited in the National Zoological Collections of Zoological Survey of India, Calcutta.

The new species closely resembles *Liothrips minys* Ananth. and *Liothrips nanus* Ananth. All the three species have short head, wider than long. *L. nanus* and *L. renukae* have the

The present species differs from the latter species in colouration, presence of clear wings, lesser number of double fringes and comparatively longer tube.

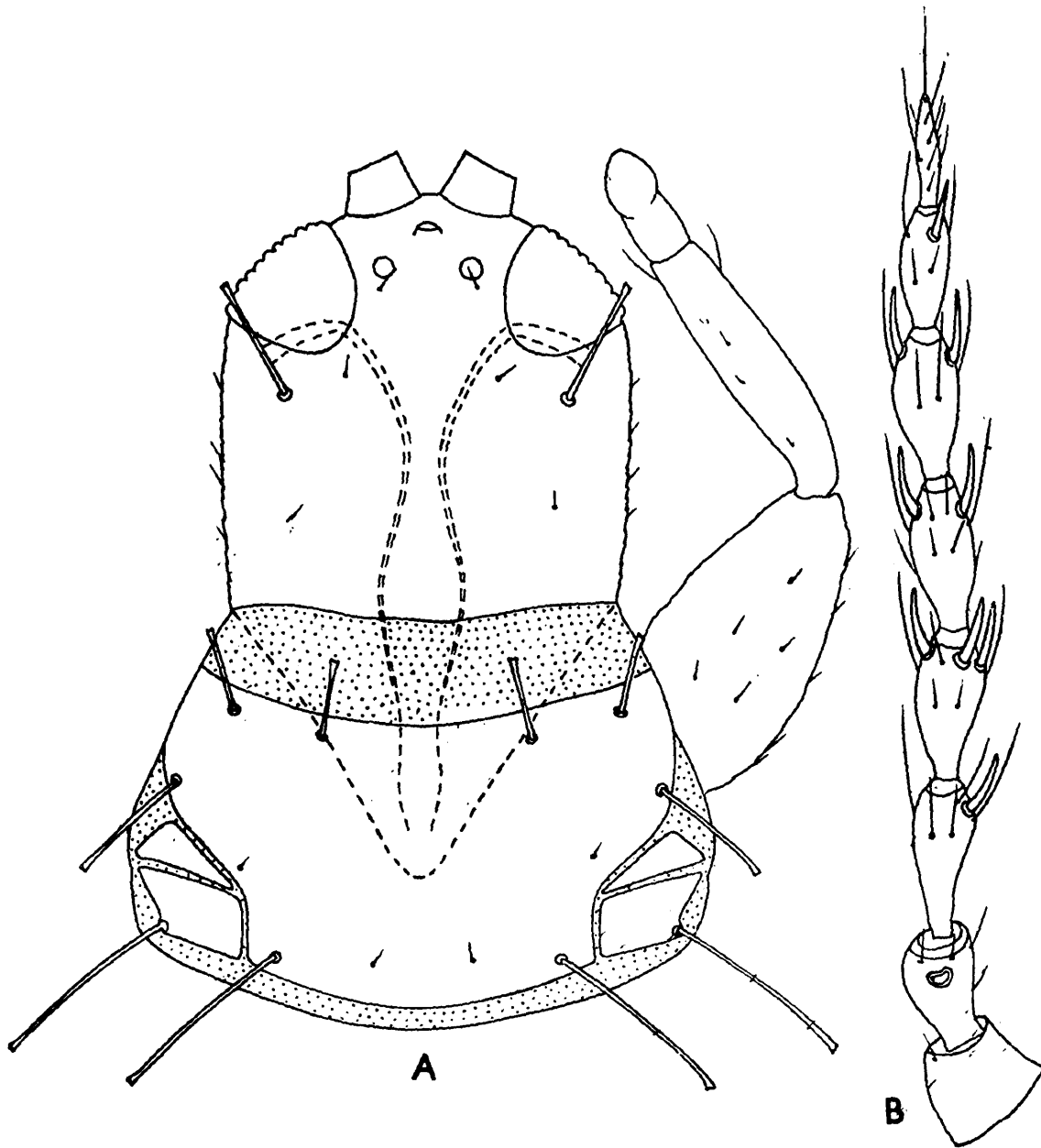


Fig. 3. *Thlibothrips vereaudensis* sp. nov. A. Head and pronotum, B. Antenna.

mesopraesternum complete, epimerals longer than postangulars, and postoculars longer than eyes. In *L. minys* postoculars are shorter than eyes and postangulars and epimerals are subequal and mesopraesterunm incomplete.

***Thlibothrips (Athlibothrips) vereaudensis* sp. nov.**

Female (Macropterous): (Fig. 3) General body colour brown. All femora, mid and hind tibiae brown, apex of foretibiae yellow, rest brown, all tarsi yellow. Antennal seg-

ments 1 and 2 brown, 3-7 yellow, 8 pale brown. Wings clear; all setae hyaline, blunt at apex.

Head almost as long as wide, 180-200 long, 148-168 wide across eyes, 176-192 across cheeks, 176-192 wide at base, sides almost parallel, cheeks finely crenulate, with 2-3 small setae. Eyes of moderate size, 60-76 long, 48-64 wide, angular behind posteriorly. Median ocellus 16-20 wide, placed 16-20 from paired ocelli, lateral ocelli 20 wide and placed 28-32 apart. Postoculars as long as eyes 60-64 long. Antennal segments length (width); 1: 32-40 (28-36); 2: 40-48 (28); 3: 52-56 (24-28); 4: 52-56 (28-32); 5: 44-52 (24-32); 6: 44-52 (24-28); 7: 40-44 (10-16); 8: 40-42 (10-12). Sense cones 20 long. Mouthcone pointed, 132-152 long, 172-196 wide at base, 48-60 wide at apex. Maxillary stylets retracted to the level of eyes, meeting at middle; maxillary guides very prominent.

Prothorax 128-160 long 184-240 wide at anterior margin, 260-304 wide at posterior margin. Anteroangulars 28-32 long, anteromarginals 28-36 long, midlaterals 36-40 long, postangulars 64-72 long, epimerals 64-76 long. Epimeral suture complete. Forefemora 140-168 long, 64-80 wide. Pterothorax 288-357 long, 288-368 wide across meso- and 284-368 wide across metathorax. Forewings 629-697 long, 68-80 wide, with 12-15 double fringes. B_1 - B_3 of forewings 36-44, 44-48, 44-48, long respectively. Mesopraesternum complete with a median crest.

Abdomen 336-408 wide at base, 320-399 across middle, 212-260 across segment VIII and 116-152 across segment IX. B_1 - B_3 of segment IX 112-124, 104-120, 120 long

respectively. Tube shorter than head, 140-172 long and anal setae 112-140 long.

Total body length 1.46-2.14 mm.

Material: *Holotype*—♀, (Z. S. I. Reg. No. 701/H₁₇) Top slip, Anamalai, Tamil Nadu, 4. 12. 1973, Coll. N. Muraleedharan; *paratypes*—10 ♀♀, (Z.S.I. Reg. Nos. 702/H₁₇-711/H₁₇) data same as for holotype; 8 ♀♀, (Z.S.I. Reg. Nos. 712/H₁₇-719/H₁₇) Yercaud, Salem Dist., Tamil Nadu 19. 7. 1963; ex, Gooseberry, Coll. T. N. Ananthakrishnan; deposited in the National Zoological Collections of Zoological Survey of India, Calcutta.

Thlibothrips (Athlibothrips) yercaudensis is similar to *T. inquilinus* Ananthakrishnan & Varadarasan (1978) in the presence of pointed mouthcone and maxillary stylets retracted far into the head, but differs from the latter in the colouration of antennal segments, presence of blunt setae, well developed anteromarginals and nature of mesopraesternum.

ACKNOWLEDGEMENT

We are grateful to the Director, Zoological Survey of India, Calcutta for confirming the identity of new taxa, offering valuable suggestions and providing necessary facilities to carryout this work.

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FIRST RECORD OF *AMBASSIS INTERRUPTA* BLEEKER (PISCES : CHANDIDAE)
FROM SEAS OF INDIA

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Zoological Survey of India, Southern Regional Station, Madras

ABSTRACT

Ambassis interrupta Bleeker were collected from Kovelong near Madras and recorded for the first time from this area.

During an intensive faunistic survey, three specimens of *Ambassis interrupta* Bleeker were collected on 7.3.75 from the brackish water creek near Kovelong about 37 Km. south of Madras. The specimens were obtained by operating cast net. Other dominant species in the catch were *Nematolosa nasus* (Bl.) and *Tilapia mossambica* (Peters).

Day (1889) had given its habitat as 'Sea at the Andamans and Batavia'. Herre (1941) has indicated 'Andamans to the Phillipines and New Caledonia' as its habitat. Weber and Beaufort (1929) have not mentioned India in the distribution of this species. This is the first record of *Ambassis interrupta* from the main coast of India. Day (1889) described 11 species, *A. nama*, *A. ranga*, *A. baculis*, *A. thomassi*, *A. nalua*, *A. interrupta*, *A. dayi*, *A. commersoni*, *A. myops*, *A. gymnocephalus* and *A. urotaenia* from Indian waters, of which *A. nama*, *A. ranga*, *A. baculis* and *A. thomassi* are fresh water species and referable to genus *Chanda*. A brief description of *A. interrupta* along with a key to the species of *Ambassis* is presented in this paper.

***Ambassis interrupta* Bleeker**

Ambassis interrupta Bleeker, 1852, *Nat. Tijdsch. Ned. Indic*, 3, : 696.

Ambassis interrupta, Day, 1889, *Fauna Brit. India, Fish.*, 1 : 487.

Ambassis interrupta, Weber and Beaufort, 1929, *The fishes of the Indo-Australian Archipelago*, 5 : i-xiv, 1-459, 98 figs.

Material : ZSI, SRS, Madras : 3 exs., 40 mm to 60 mm. S. L., Creek near Kovelong, 7.3.75, T Venkateswarlu coll.

Description : D. 7/1/9-19. P. 13. A. 3/9-11. G. 18. L. I. 28 to 30. Length of head $3\frac{1}{2}$, height of body $2\frac{1}{2}$ in total length. Eye diameter $2\frac{1}{2}$ in length of head. Mouth much oblique. Small pointed teeth in a few rows in jaws, in a single row on vomer and palatines. Teeth on tongue. Preorbital with both its upper and lower edges serrated. Anterior edge of orbit serrated, and two spines at its posterior superior angle. Vertical margin of pre-opercle entire, the double edge of its horizontal limb serrated. Supraorbital ridge with a single spine posteriorly. Interoperculum with 4-13 serrations. 2 rows of

scales on cheek. Dorsal separated by 12-15 scales from occiput. Second dorsal spine stronger and longer than the others. Pectorals longer than ventrals. Caudal deeply forked. Lateral line incomplete below 8th dorsal spine, continued again. Colour silvery with a narrow lateral band, the membrane between second dorsal spine and third black, a dark longitudinal band along either caudal lobe.

Distribution : Eastern Indian Ocean (Madras)

KEY TO THE SPECIES OF *AMBASSIS*

- | | | |
|--|-------------------------|---|
| 1. Supraorbital ridge dentate at least posteriorly ... | ... | 2 |
| Supraorbital ridge smooth, with a single backwardly-directed spine posteriorly ... | ... | 3 |
| 2. Hind edge of preoperculum denticulate ... | <i>A. dussumieri</i> | |
| Hind edge of preoperculum smooth ... | <i>A. gymnocephalus</i> | |
| 3. Lateral line continuous. ... | ... | 4 |
| Lateral line interrupted. ... | ... | 7 |
| 4. Inter-opercle serrated. ... | ... | 5 |
| Inter-opercle not serrated. ... | ... | 6 |
| 5. L. I. 26—28. ... | <i>A. nalua</i> | |
| L. I. 30. ... | <i>A. dayi</i> | |

- | | |
|---|----------------------|
| 6. 13—16 predorsal scales. ... | <i>A. miops</i> |
| 17—22 predorsal scales. ... | <i>A. commersoni</i> |
| 7. 8—9 predorsal scales. ... | ... 8 |
| 11—16 predorsal scales. ... | <i>A. interrupta</i> |
| 8. Teeth on tongue. Each caudal lobe with a longitudinal dark band. ... | <i>A. urotaenia</i> |
| No teeth on tongue. Tip of spinous part of dorsal deep black. ... | <i>A. kopsi</i> |

The specimens are deposited in the Southern Regional Station, Zoological Survey of India, Madras.

ACKNOWLEDGEMENTS

My thanks are due to the Director, ZSI, Calcutta and O/C, SRS, ZSI, Madras for providing facilities and encouragement.

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ON TWO NEW POLYCHAETES (NEREIDAE : ANNELIDA) FROM
ESTUARINE WATERS OF INDIA

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ABSTRACT

In this paper *Lycastonereis indica* Gen. nov., sp. nov. and *Namalycastis fauveli* sp. nov. belonging to the family Nereidae collected from the estuarine localities of Orissa, India, are described. The differentiating characters of *N. fauveli* with the other reported species of the genus are discussed.

INTRODUCTION

Polychaetes though practically are marine inhabitants, also occur abundantly in estuarine and brackish waters, the reason being obviously their extreme tolerance to a wide range of salinity. Southern (1921) and Fauvel (1932) recorded many interesting Polychaetes from such habitats of various localities of the country viz., Gangetic West Bengal, Chilka Lake, Adayar estuary, Kerala back waters and the Salt lakes of Calcutta.

During the course of studies on the Polychaetes of Orissa, the author came across some interesting specimens of the family Nereidae. On examination, these have been found to belong to a new genus *Lycastonereis* and two new species viz., *L. indica* and *Namalycastis fauveli*.

The types and the other material dealt here are deposited in the National collections of the Zoological Survey of India, Calcutta,

Lycastonereis Gen. nov.

Body slender and elongated with many segments. Prostomium plate-like with a pair of bulbous palps, a pair of small antenna and two pairs of eyes. Tentacular Cirri small, nearly of equal size and are three pairs only. Two pairs of the tentacular Cirri situated laterally between the prostomium and the first segment, while the third pair is situated on the dorsolateral side of the first segment. Proboscis with a pair of Chitinous jaws, few fleshy papillae. Chitinous paragnaths absent. Parapodia biramous in all the segments. Dorsal and ventral cirri small and not modified. Setae spinigers and falcigers.

Type species : *Lycastonereis indica* sp. nov.

Lycastonereis indica sp. nov.

(Fig. 1 A-D)

Material : Two specimens : Bytarani river beach, Chandbali, Orissa ; Coll,

S. Biswas : 2. 1. 1976. *Holotype*—length 40 mm. width 1-2 mm ; Z. S. I. Reg. No.—An 1201/1 ; *Paratype* : 1, Z. S. I., Reg. No.—An 1202/1.

Description : Specimens elongated, very much narrow with many segments. Length

dark brown spots on the dorsal side of the prostomium and few anterior segments. Prostomium plate-like with a pair of bulbous palps, a pair of small antennae and two pairs of eyes. Tentacular cirri three pairs only and are of nearly equal size. Two pairs of

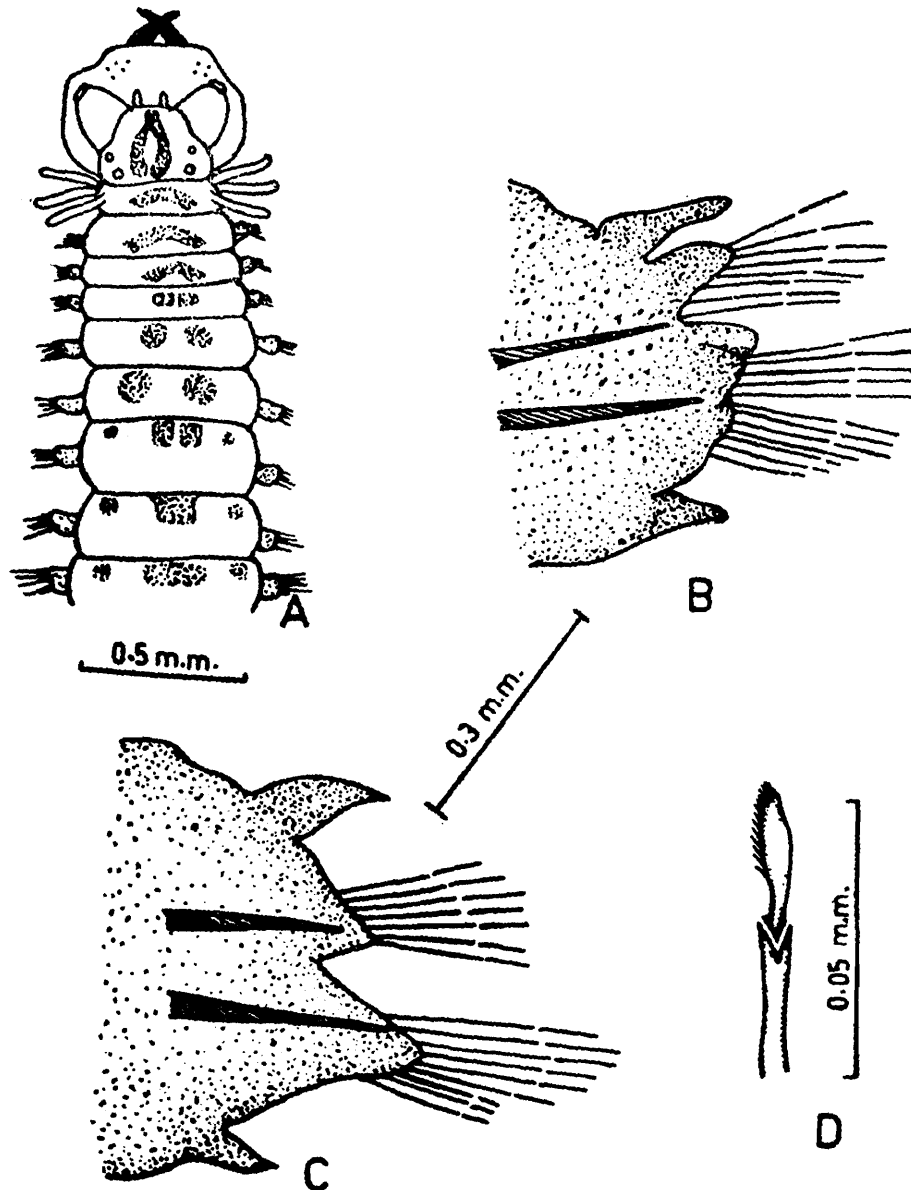


Fig. 1. A-D. *Lycastonereis indica* : A. anterior end showing everted proboscis ; B. anterior parapodium ; C. posterior parapodium ; D. heterogomph falceiger.

40-45 mm. and width 1-2 mm. Body soft with anterior segments narrow and arranged closer, while the posterior ones are broader. The worm is light brown in colour with some

cirri are situated laterally between the prostomium and the first segment, while the third pair is situated on the dorso-lateral side of the first segment. Everted proboscis with a

pair of light brown coloured, transparent chitinous jaws, and without any chitinous paragnaths. Oral ring of the proboscis with few fleshy papillae. First segment apodus. Feet biramous allover. Anterior parapodia with two ligules in each ramus. Dorsal ramus with homogomph spinigers and the ventral ramus possesses homogomph, hemigomph spinigers and heterogomph falcigers with oar-shaped end pieces. In the parapodia of the mid region the size of the ligules in both rami decrease thus bringing the posterior parapodia with each ramus having a single ligule. The type of setae in the posterior parapodia are similar to that described for the anterior parapodia. Dorsal cirri are slightly bigger than the ventral cirri. The tail ends of both the specimens could not be observed as they are devoid of their posterior tips.

Remarks : The characters of the present specimens have been found to fall in between those of the two genera viz., *Nereis* Linnaeus and *Lycastopsis* (Augner). The former is characterised by having 4 pairs of tentacular cirri, biramous para-podia and chitinous paragnaths, while the latter with 3 pairs of cirri, Uniramous parapodia and without any chitinous paragnaths. However, Hartmann (1959) merged *Lycastopsis* with *Namanereis* Chamberlin. The genus *Namanereis* is characterised by the presence of 3 or 4 pairs of tentacular cirri, Uniramous parapodia, uniform type of dorsal cirri in all the feet and the absence of Chitinous paragnaths in the proboscis. Thus the present specimens with 3 pairs of tentacular cirri, biramous parapodia and without any chitinous paragnaths appears to be new and hence a separate genus is proposed.

***Namalycastis fauveli* sp. nov.**

(Fig. 2 A-E)

Material : 5 specimens ; Bytarani river beach, Haripur, Chandbali, Orissa ; Coll. S. Biswas ; 4. 1. 1976. *Holotype*—length 55 mm ; width 2 mm ; Z. S. I. Regd. No. An 1203/1 ; *Paratypes*-4 ; Z. S. I. Regd. No. An 1204/1.

Description : Slender, elongated worms with many segments. Length 40-60 mm ; width 2-3 mm. Body light brown coloured without any markings. All segments are of nearly uniform breadth except those of the extreme posterior ones which shows proliferation of new segments. Prostomium broad with bulbous palps, a pair of very small antenna. Two eyes on each side of the prostomium and are arranged closely. Four pairs of the tentacular cirri, the longest touching the first setigerous segment. Proboscis with a pair of chitinous jaws. Chitinous paragnaths or fleshy papillae absent. Parapodia uniramous all through. Anterior parapodia with a small dorsal cirrus : Notopodia represented by an aciculum and 1-2 homogomph spinigers, while Neuropodia with a single ligule supported by the aciculum, many heterogomph spinigers and heterogomph falcigers. The ventral cirri is smaller than the dorsal cirri. The heterogomph falcigers of the neuropodia present a unique structure and thus a diagnostic feature to the species. In the heterogomph falcigers, of the two limbs at the forked end of the lower piece, one is short while the other, very long and its size being more than half of the end piece, sometimes nearly equal to the size of the end piece. Towards the posterior end the parapodia exhibits a different structure by having an expanded dorsal cirri with pointed ends. Dorsal ramus of

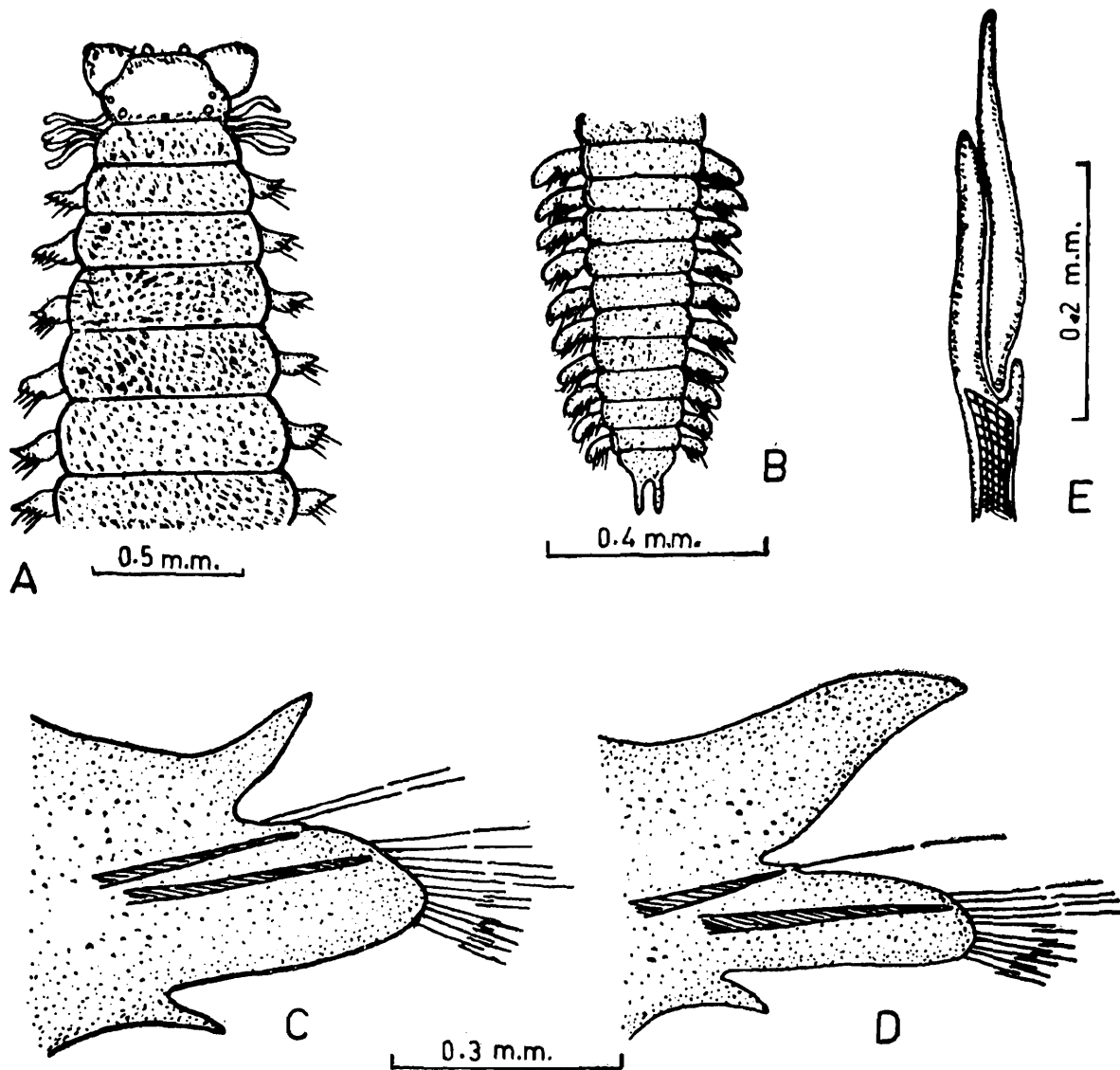


Fig. 2. A-E. *Namalycastis fauveli*: A. anterior end; B. posterior end; C. anterior parapodium; D. posterior parapodium; E. heterogomph falciger.

the posterior feet with a single homogomph spiniger and an aciculum, ventral ramus with heterogomph spinigers and heterogomph falcigers of the type as seen in the anterior parapodia. Ventral cirri small. A pair of annal cirri at the posterior end.

Remarks: The present *N. fauveli* appears closer to *N. rigida* Pillai, reported from the brackish water localities of Philippines, in the body size, arrangement of eyes, shape of the posterior dorsal cirri and the number of notosetae in the anterior segments. However,

N. rigida is characterised by the cloven prostomium at its anterior tip, absence of notosetae in the posterior segments and the presence of medullary columns within the shafts of heterogomph spinigers and falcigers. The widely distributed *N. indica* (Southern) differs from the present *N. fauveli* from its bigger size, narrow and pointed posterior dorsal cirri, and simple type of heterogomph falcigers. The only common feature among these two species is the number of notopodial setae. *N. merukensis* (Horst) reported

from New Guinea and Thailand is quite different from the present material by its larger size (150-200 mm length, 20-22 mm width) and the presence of 6-8 notopodial setae. The present material appears different from *N. abiuma* (Grube) recorded from estuarine habitats of Florida. According to Pillai (1965) in *N. abiuma* the anterior part of prostomium is cloven into two halves, the eyes on each side are nearly coalescent and notopodial setae are absent generally. *N. tirtea* Winterbourn reported from a point in Tirtea river, 74 kms. away from its confluence point to the sea, in Newzealand is also different from *N. fauveli* by having only 3 pairs of tentacular cirri, absence of eyes and dorsal cirri.

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NEW LOCALITY RECORDS FOR *ICHTHYOXENUS MONTANUS*
SCHIOEDTE & MEINERT (CRUSTACEA, ISOPODA, CYMOTHOIDEA).

LAKSHMAN RAM

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ABSTRACT

Ichthyoxenus montanus Schioedte & Meinert has been reported for the first time from the gangetic plains from the host *Pseudeutropius atherenoides*.

Ichthyoxenus montanus Schioedte & Meinert was described from Himalayas (exact locality unknown) in 1884. After the lapse of nearly a century the parasite has been reported recently by the author (Ram, 1979) from Suraha lake in U. P. parasitizing siluroid fishes, *Pseudeutropius atherenoides* and *Mystus bleekeri*. In the month of May 1979 the author purchased a small quantity of fishes which included small fish fries of many fish species alongwith some specimens of *Pseudeutropius atherenoides*. All the fishes were freshly infiltrated from the tributaries of river Ganga near Patna, Bihar. On examination it was found that about 25-30% specimen of only *Pseudeutropius atherenoides* were infected with the isopod parasite, *Ichthyoxenus montanus*. The hosts measured 5.0 to 6.7 cm. in length. Each host usually harboured a single large female parasite with eggs in its brood pouch. In some cases a smaller parasite was accompanied by a still younger form. The youngest parasite infecting the host measured about 3 m.m. in length while newly hatched youngs were only 2 mm.

From the 60 specimens recovered from the hosts about 50% of the parasites were females with eggs. The largest parasite was 8.5 mm. in length. The site of infection was behind the pelvic fin as reported earlier (Ram, 1979).

From the above account the following conclusions seem to emerge :

1. The isopod, parasite, *Ichthyoxenus montanus*, has a wider distribution in the Gangetic Plains.
2. The parasite attacks the young as well as adult hosts.
3. The parasite can infect its host soon after hatching out from the brood pouch.
4. The parasite seems to be developing host specificity for *Pseudeutropius atherenoides*.

ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India, Calcutta, and Dr. P. D. Gupta, Deputy Director, Gangetic Plains Regional Station, Patna, for facilities and encouragements.

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ON THE SPECIES OF *APORCELAIMELLUS* HEYNS, 1965 FROM WEST BENGAL
(APORCELAIMIDAE : NEMATODA)

A. JANA AND Q. H. BAQRI
Zoological Survey of India, Calcutta

ABSTRACT

A new species of the genus *Aporcelaimellus* Heyns, 1965, *A. tropicus*, is described from Burdwan district, West Bengal (India) and the male of *Aporcelaimellus chauhani* Baqri & Khera, 1975 is reported for the first time.

INTRODUCTION

The species of the genus *Aporcelaimellus* Heyns, 1965 are widely distributed in West Bengal. During the present course of investigations, the following species have been recorded: *Aporcelaimellus adoxus* Tjepkema *et al.*, 1975; *A. chauhani* Baqri & Khera, 1975; *A. coomansi* Baqri & Khera, 1975 and *A. heynsi* Baqri & Jairajpuri, 1968. Three populations collected from soil around roots of paddy at Burdwan district in West Bengal represent a new species of *Aporcelaimellus* which is described hereunder as *A. tropicus*. Besides, the male of *A. chauhani* is also reported for the first time.

MATERIAL

The type specimens have been registered and deposited with the National Zoological Collection, Zoological Survey of India, Calcutta. *A. tropicus*: Holotype female along with 3 paratype females and 2 paratype males on slide No. WN-385. Specimens of Kantapur and Maghlampur populations on slide No. WN-386 and WN-387 respectively.

Aporcelaimellus tropicus n. sp.

(Fig. 1, A—H)

Measurements :

Saldah Population (Type)

Holotype female; L=1.51 mm; a=46; b=4.1;
c=76;
14 12
V= 57

Paratype females (3); L=1.55–1.76 mm; a=43–
50; b=4.1–4.9; c=74–82;
7-14 12-16
V= 55-57

Paratype males (2); L=1.60–1.63 mm; a=47–
49; b=4.8; c=64–71; T=
54–56;

Kantapur population;

Females (3) L=1.44–1.66 mm; a=39–45; b=3.8
–4.9; c=63–72; V= 11-13 11-15
56-62

Males (5); L=1.67–1.80; a=44.0–53.6; b=4.7
–4.9; c=64–77; T=51–59;

Maghlampur populations;

Females (2); L=1.68–1.70 mm; a=48–50; b=
4.5; c=67–78; V= 13-14 11-12;
56-57

Males (2); L=1.61–1.64; a=49–51; b=4.2–4.6;
c=60–75; T=54,

Description :

Female : Body ventrally curved in the posterior half of its length, tapering gradually 2-5 μm (thickest on tail). Lateral chords 1/5th to 1/4th of the body-width near middle. Lateral body pores irregularly arranged along

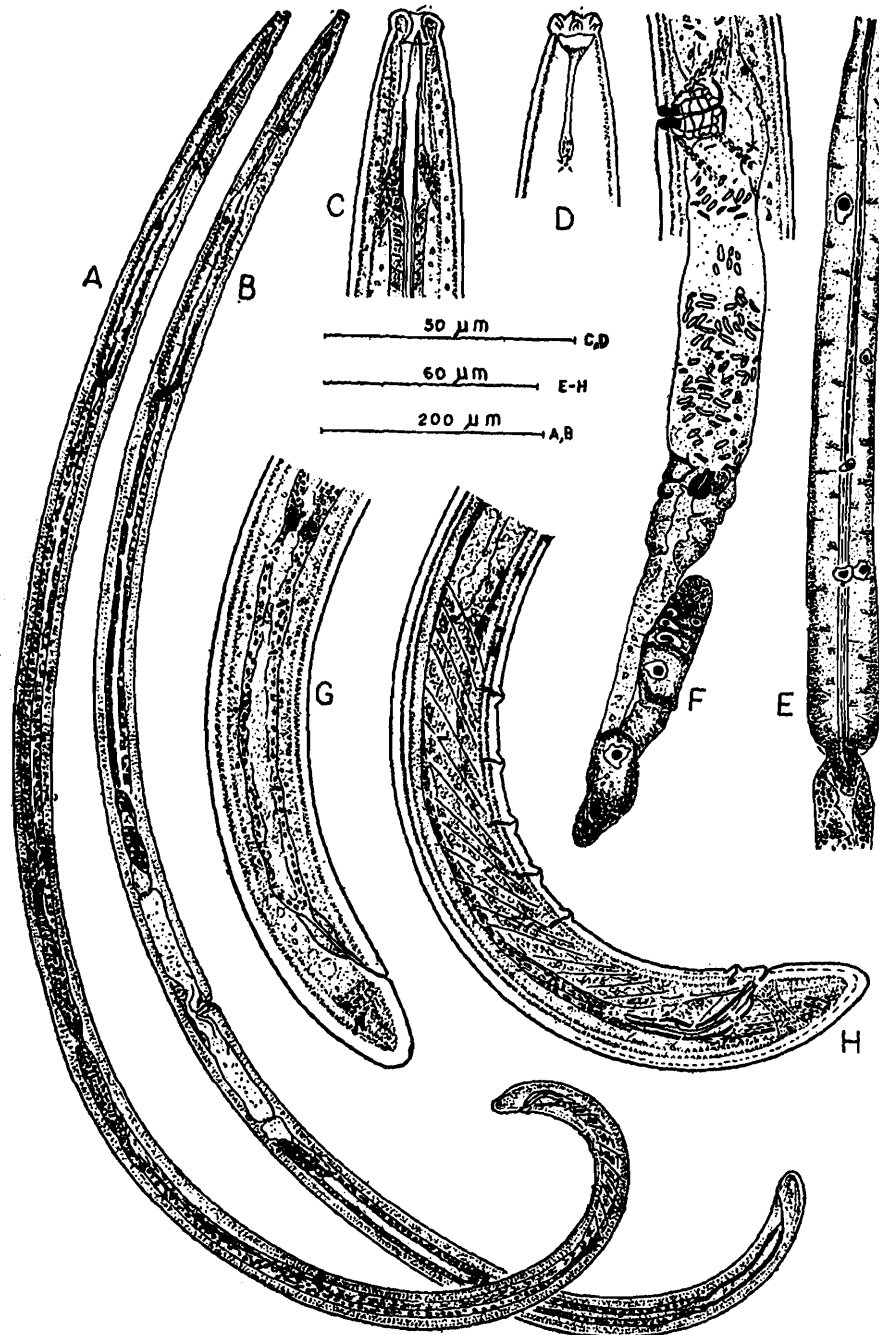


Fig. 1. (A-H) *Aporcelaimellus tropicus* n. sp. A : Entire male ; B : Entire female ; C : Anterior end of female ; D : Surface view of female showing Amphid ; E : Basal expanded portion of oesophagus ; F : Posterior female reproductive system ; G : Female tail ; H : Male tail.

anterior to slender part of oesophagus. Cuticle distinctly striated transversely ; its thickness

both sides of lateral chords, 32-38 in number of which 6 to 8 in oesophageal region, 20 to 24

in the intestine region, 4 to 5 in prerectum and rectum and 2 in caudal region.

Lip region off-set, wider than adjoining body, its width about 1/3rd of body-width at base of oesophagus. Amphid 6-8 μm wide, stirrupshaped and apparently divided by a thin partition wall; apertures occupying 60-70% of the corresponding body-width. Sensillar pouches 21-23 μm from amphidial aperture.

Odontostyle 12-14 μm or 1.0-1.4 lip-region-width long; apertures 7-8 μm or 58-62% of odontostyle length. Guiding ring 6-7 μm or 0.5-0.6 lip region-width from anterior end. Odontophore 20-22 μm or 1.4-1.8 times the odontostyle length. Nerve ring 106-118 μm or 30-34% of neck region from anterior extremity. Basal expanded part of oesophagus 46-54% of the total oesophageal length. Locations of oesophageal gland nuclei and their orifices as follows :

DO—53.8-57.3	S ₁ N ₁ —69.7-72.7	S ₂ N—86.9-87.3
DN—59.3-62.4	S ₁ N ₂ —78.7-80.0	S ₂ O—88.0-88.7
DO-DN—5.1-5.6	K—48-58	K'—60-68.

Cardia tongue-shaped enveloped by intestinal tissue. Oesophago-intestinal disc absent. Prerectum 83-113 μm or 4-5 times the anal body-width, in one paratype female 171 μm or 7 times the anal body-width. Rectum 25-33 μm long or 1.0-1.3 times the anal body-width.

Vulva a transverse slit. Vagina 17-23 μm , about half of the corresponding body-width; surrounded by sphincter muscles; moderately sclerotized at vulva-vagina junction. Female reproductive system amphidelphic, typical. Uterus and oviduct separated by sphincter muscles. Uteri filled with sperms.

Tail bluntly conoid, 22-24 μm or 0.8-1.0 anal body-width long, with two caudal pores on each side.

Male : Similar to female in general shape and morphology. Male genital system typical, dorylaimid. Spicules 42-47 μm or 1.6-2.0 anal body-width long when measured along the median line. Lateral guiding pieces well developed, 9-12 μm long. In addition to adanal pair, 3-5 regularly spaced ventro-median supplements. Copulatory muscles 19-23 and reaching up to the last supplement. Prerectum 98-167 μm or 4.8 to 5.2 anal body-widths long. Tail similar to female in shape, 22-27 μm or about one anal body-width long.

Type locality and habitat : From soil around roots of paddy, *Oryza sativa* L., at Saldah, Block Memari, District Burdwan, West Bengal, collected by Dr. Q. H. Baqri & party during December, 1977.

Kantapur and Maghlampur populations were collected from soil around roots of paddy at Kantapur and Maghlampur respectively, Block Memari, District Burdwan, West Bengal.

Differential diagnosis : *Aporcelaimellus tropicus* n. sp. comes close to *A. heynsi* Baqri & Jairajpuri 1968 and *A. paraconicaudatus* (Meyl, 1956) Heyns, 1965. From the former it differs in having longer body (L=0.98-1.22 mm in *A. heynsi*), larger odontophore (Odontophore 17-19 μm in *A. heynsi*), differently shaped amphids and vagina, no oesophago-intestinal disc, shorter and bluntly conoid tail (tail 29-41 μm long and conoid in *A. heynsi*). From *A. paraconicaudatus* the present new species differs in shorter odontostyle (odontostyle 16 μm in *A. paraconicaudatus*), longer and differently shaped tail (c=25, and conoid tail in *A. paraconicaudatus*); shorter spicules and 3 to 5 ventromedian supplements in males (spicules more than 50 μm and 14 to 16 ventromedian supplements in *A. paraconicaudatus*).

Aporcelaimellus chauhani Baqri & Khera, 1975
(Fig. 2. A, B)

Measurement :

Females (3) ; L=1.51-1.90 mm ; a=26-34 ; b=3.9
8-11 8-12.
-4.3 ; c=31-38 V= 50-54

Male : (1) ; L=1.88 mm ; a=34 ; b=4.01 ; c=38,
T=57.

Baqri and Khera (1975) described *A. chauhani* on the basis of females. The present

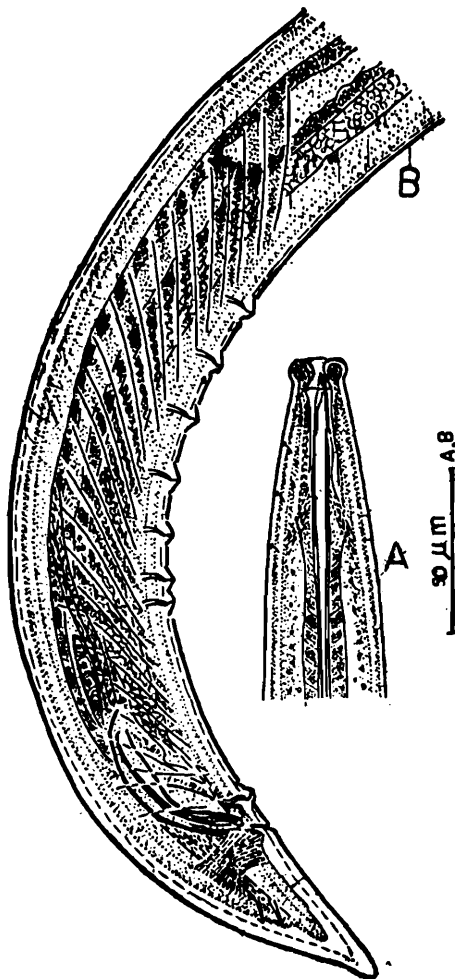


Fig. 2. A & B. *Aporcelaimellus chauhani* Baqri and Khera, 1975.

A : Anterior end of male ; B : Posterior region of male tail.

population which included a single male resembles in every respect with the type

specimens of *A. chauhani* except in having longer body. (L=0.96-1.42 mm).

Male : Similar to female in general shape and morphology except the male genital system. Spicules 55 μm or near about 1.6 anal body-width long when measured along the curved median line. Lateral guiding pieces 14 μm long, In addition to an adanal pair, seven regularly well-spaced ventromedian supplements present. Copulatory muscles 24, reaching up to the last supplement. Prerectum 179 μm or about 5 anal body-widths long.

Tail dorsally convex-conoid with subacute terminus, 56 μm or 1.6 anal body-widths long.

Habitat and locality : From soil around roots of Ladies finger, *Hibiscus esculentus* L. at Beledanga, District Hooghly, collected by A. Jana in March, 1977.

Aporcelaimellus adoxus Tjepkema, Ferris,
and Ferris, 1971

Two females from soil around roots of unidentified grass at Memari, District Burdwan.

Aporcelaimellus heynsi Baqri & Jairajpuri,
1968

Autpara population : Five females from soil around roots of paddy, *Oryza sativa* L., at Autpara, Block Jamalpur District Burdwan.

Masagram population : Thirteen females from soil around roots of paddy, *Oryza sativa* L., at Masagram, Block Jamalpur, District Burdwan.

Aporcelaimellus coomansi Baqri & Khera,
1975

Four females from soil around roots of banana, *Musa* sp., at Reang, District Darjeeling.

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ON SOME ACANTHOCEPHALANS FROM INDIAN MARINE FISHES

T. D. SOOTA AND S. B. BHATTACHARYA

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ABSTRACT

The paper deals with five species of acanthocephalans from Indian marine fishes. One species is new and the rest form new locality records and also show interesting variations. A brief review of the genus *Serrasentis* Van Cleave, 1923, has also been included.

During 1972-76 a few faunistic surveys of some coastal areas of Peninsular India were undertaken by the senior author in the course of which some acanthocephalans were collected from marine fishes. The present paper deals with these specimens as well as some others from the area, now present in the unnamed collection of the Zoological Survey of India. The entire material comprises five species of five genera and three families, of which one species is new and the rest form new locality records and also show interesting variations. This paper also includes a brief review of the genus *Serrasentis* Van Cleave, 1923.

All measurements are in millimeters.

Order PALAEACANTHOCEPHALA
Meyer, 1931

Superfamily ECHINORHYNCHOIDEA
(Cobbold, 1876) Golvan and
Houin, 1963

Family RHADINORHYNCHIDAE Travassos,
1923

Subfamily RHADINORHYNCHINAE
Lühe, 1912

Genus *Rhadinorhynchys* Lühe, 1911

Rhadinorhynchus hiansi sp. nov.

(Fig. 1)

Material : Holotype ♂ (ringed) and paratype ♂ mounted on the same slide ; Z. S. I. Reg. No. WN 360/1 ; host—*Ablennes hians* ; location—intestine ; locality—Trivandrum ; 24. i. 1976 ; coll. T. D. Soota.

Description : Male. Body 8.5-10.0 long, 0.44-0.55 wide ; proboscis 2.2-2.25 long ; proboscis hooks in 20-22 longitudinal rows of 40-44 hooks each ; hooks apparently of two dissimilar types, ventrals slightly thicker, 0.033-0.055 long, dorsals thinner, 0.033-0.066 long, both gradually decreasing in size posteriorly, and then last few rows progressively increasing in size until the subsequent hooks at the basal crown become very conspicuous with a length of 0.066-0.077 ; proboscis receptacle 3.0-4.3 long ; neck spineless, 0.22 long ; lemnisci 2.5-2.6 long ; body spines on the anterior in two zones ; anterior testis 0.47-0.49 × 0.27-0.29, posterior 0.44-0.46 × 0.27-0.33 ; cement glands 4, tubular ; genital pore terminal.

Remarks : The present specimens approach *Rhadinorhynchus dujardini* Golvan, 1969, in body size, but differ from it in number of longitudinal rows of proboscis hooks. They

latter in each row, but differ from both in body size. In this character of proboscis hooks they also approach *R. ornatus* Van Cleave, 1918, but as this species is based

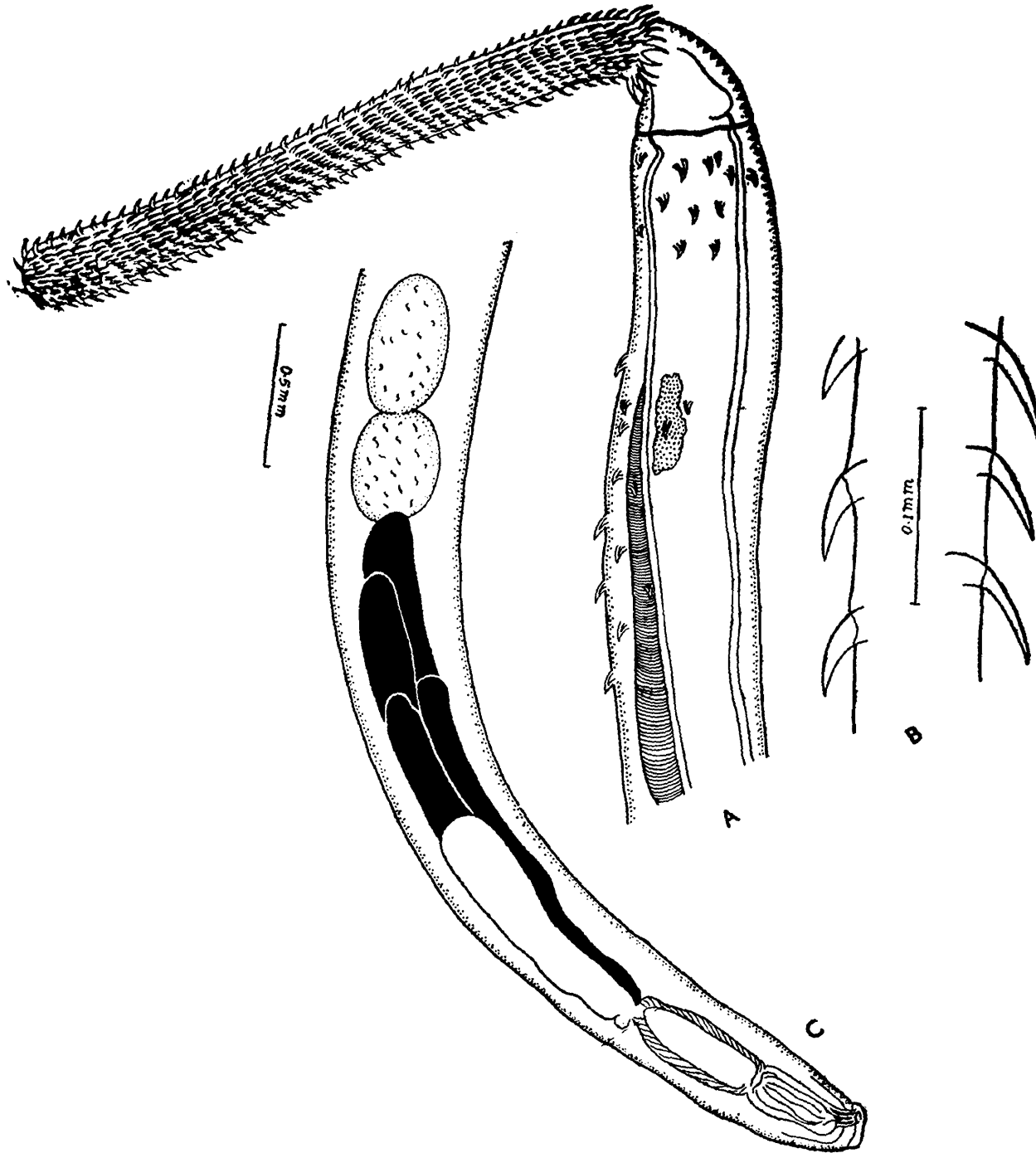


Fig. 1. Holotype male. *Rhadinorhynchus hiansi* Soota and Bhattacharya.
A. anterior end ; B. proboscis hooks ; C. posterior end showing male genitalia.

also come closer to *R. katsuwonis* Harada, 1928, and *R. vancleavei* (Van Cleave, 1940) Golvan, 1969, in number of longitudinal rows of proboscis hooks and the number of the

entirely on female specimens, nothing definite can be said and especially as the present new species is based entirely on male specimens only.

Genus *Raorhynchus* Tripathi, 1959

Raorhynchus polynemi Tripathi, 1959

(Fig. 2)

Material : 3 ♂♂ & 1 ♀ ; Z. S. I. Reg. No. WN 361/1 ; host—*Polynemus* sp. ; location—

intestine ; locality—Mangalore ; 2. i. 1976 ; coll. T. D. Soota. 1 ♂ & 1 ♀ ; Z. S. I. Reg. No. WN 362/1 ; locality—Madras ; 26. viii. 1972. 1 ♂ & 1 ♀ ; Z. S. I. Reg. No. WN 363/1 ; locality—Madras ; 16. viii. 1972 ; host, location & collector—same as above.

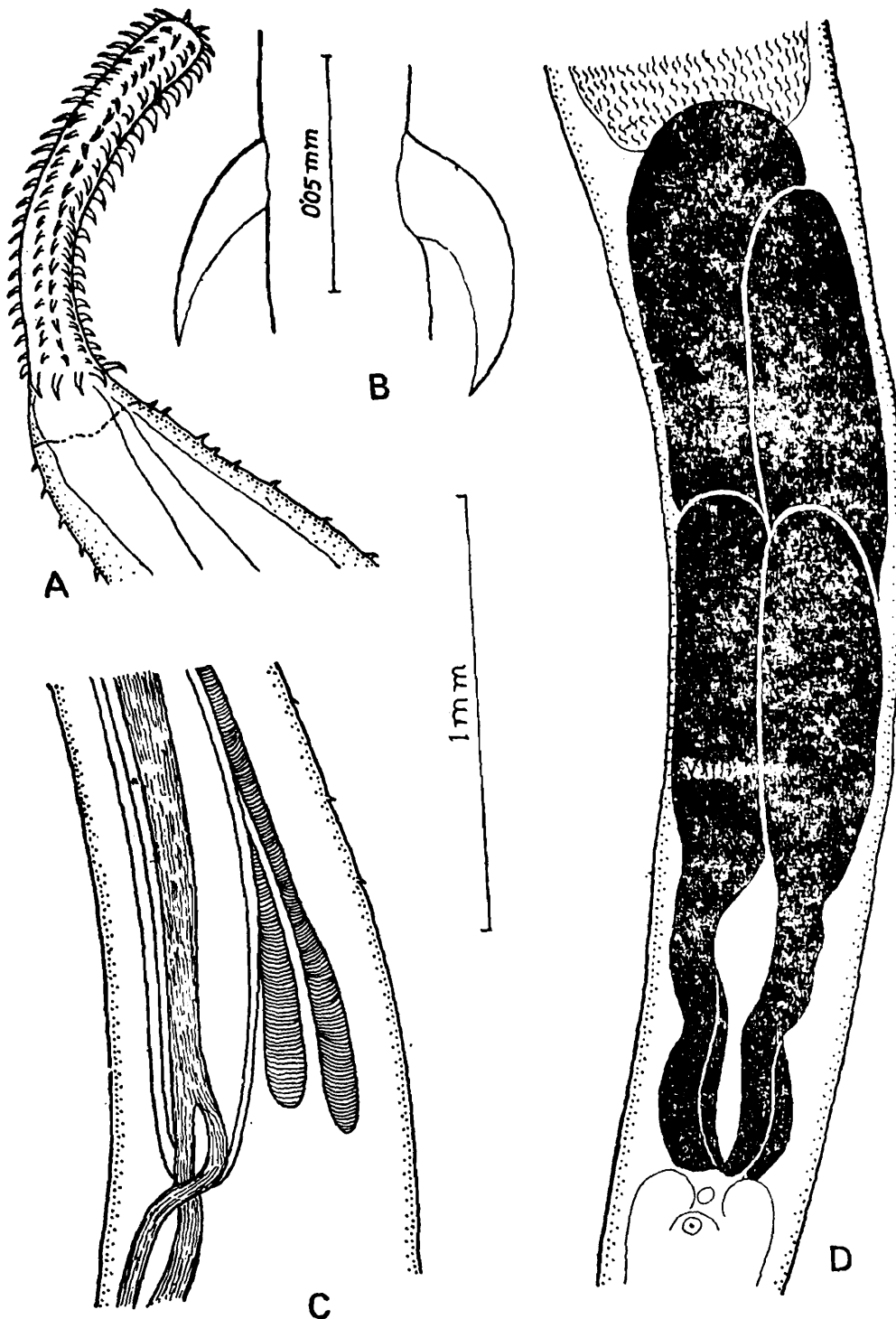


Fig. 2. *Raorhynchus polynemi* Tripathi, 1959. A. male anterior end ; B. proboscis hooks ; C. anterior end showing lemnisci ; D. male genitalia showing cement glands.

1 ♂ & 2 ♀ ♀ ; Z. S. I. Reg. No. WN 364/1 ; host—*Polynemus plebius* ; location—intestine ; locality—Karaikal ; 27. xi. 1975 ; coll. M. Hafeezullah. 3 ♂ ♂ & 1 ♀ ; Z. S. I. Reg. No. WN 365/1 ; host—*Alectis indica* ; locality—Pondicherry ; 6. xii. 1975. 1 ♂ ; Z. S. I. Reg. No. WN 366/1 ; host—*Harpadon* sp. ; locality—Pondicherry ; 6. xii. 1975 ; location & collector—same as above. 1 ♀ ; Z. S. I. Reg. No. WN 367/1 ; host—*Alectis indica* ; location—intestine ; locality—Tuticorin ; 24.ii. 1975 ; coll. T. D. Soota. 1 ♀ ; Z. S. I. Reg. No. WN 368/1 locality—Trivandrum ; 28. i. 1976 ; host, location & collector—same as above.

Description : *Male* : Body 6.5-8.7 long, 0.6-0.65 wide ; proboscis 0.93-1.2 long ; proboscis hooks in 10-12 longitudinal rows of 22-24 hooks each ; hooks of two types, ventrals thicker 0.022-0.055, dorsals thinner 0.022-0.066 long, and gradually decreasing in size posteriorly excepting those at the basal crown which are abruptly long, measuring 0.044 ; proboscis sheath 2-2.25 long ; neck spineless, 0.11-0.14 long ; lemnisci 1.98-2.25 long ; body spines on the anterior, in 8 rows dorsally and 12 rows ventrally ; anterior testis 0.72-0.86 × 0.44-0.7, posterior 0.55-0.96 × 0.38-0.6 ; cement glands 4, tubular ; genital pore subterminal.

Female : Body 11.5-19.6 long, 0.7-1.1 wide ; proboscis 0.99-1.2 long ; proboscis hooks same as in male ; proboscis sheath 2.8-3.7 long ; neck spineless, 0.11 long ; lemnisci 2.7-3.0 long ; body spines on the anterior, in 10-12 rows dorsally and 18-22 rows ventrally ; genital pore subterminal.

Remarks : Tripathi (1959) created the genus *Raorhynchus* with *R. terebra* (Rudolphi, 1819) as its type species, and characterised it as having two cement glands. Gupta and Lata (1967) described a new species *Rhadinor-*

hynchus polynemi in which they reported four cement glands. However, Golvan (1969) after examining prepared sections of the genital apparatus of a dissected specimen reported the presence of four cement glands in the genus *Raorhynchus*. He, therefore, not only emended the characters of *Raorhynchus*, but also considered *Rhadinorhynchus polynemi* as probable synonym of *Raorhynchus polynemi* with which the present authors agree. Subsequently, Gupta and Gupta (1971) while redescribing *Raorhynchus polynemi* also discerned only two cement glands as already reported by Tripathi (*op. cit.*), but this was probably due to their not being aware of Golvan's observations. In fact, the present authors have also found four cement glands in their specimens and so they accept Golvan's findings.

However, the species is recorded from new hosts and localities.

Subfamily SERRASENTINAE Petrotschenko, 1956

Genus *Serrasentis* Van Cleave, 1923

Serrasentis sagittifer (Linton, 1889)

Linton, 1932

1889. *Echinorhynchus sagittifer*, Linton, *Rep. U. S. Fish. Comm.* 1886, pt. 14 : 493.
1924. *Serrasentis socialis*, Van Cleave, *Proc. Acad. Nat. Sc.*, **76** : 326.
1932. *Serrasentis socialis*, Meyer, *Dr. H. G. Bronns "Klassen und Ordnungen d. Tierreichs"* 4ter., Bd., 2te. Buch : 41.
1932. *Serrasentis sagittifer*, Linton, *Science*, **76** : 193.
1954. *Serrasentis chauhanii*, Datta, *Rec. Indian Mus.*, **51** : 52.
1959. *Serrasentis longa*, Tripathi, *Rec. Indian Mus.*, **54** : 75.
1961. *Serrasentis socialis*, Yamaguti, *Systema Helminthum*, **5** : 111.

1969. *Serrasentis sagittifar*, Golvan, *Mem. Mus. natn. Hist. nat. Paris (A)*, 57 : 120.
1971. *Serrasentis longiformis*, Bilqees, *Pakistan J. Zool.*, 3 (1) : 64.
1972. *Serrasentis mujibi*, Bilqees, *Pakistan J. Sci.*, 24 (3-6) : 121.
1972. *Serrasentis sciaenus*, Bilqees, *Pakistan J. Sci.*, 24 (3-6) : 124.
1972. *Serrasentis giganticus*, Bilqees, *Agricultural Res. Council, Govt. of Pakistan*, 1972 : 60.
1976. *Serrasentis engraulisi*, Gupta & Gupta, *Proc. 63rd Indian Sci. Congr. Ass.*, III, Abstract, p. 205.
1977. *Serrasentis socialis*, Gupta & Jain, *All India Symposium Helminthology*, Srinagar, p. 3.
1980. *Serrasentis fotedari*, Gupta and Fatma, *Indian J. Helminth.* (1979), 31 (1), p. 45.
1980. *Serrasentis socialis*, Farooqi, *Indian J. Parasit.*, 3, Supplement, p. 17.

Material : Adults. 3 ♂♂ & 2 ♀♀ ; Z. S. I. Reg. No. WN 369/1 ; host—*Elecate nigra* ; location—intestine ; locality—Calicut ; 15—16. i. 1976 ; coll. T. D. Soota. 5 ♀♀ , only one entire ; Z. S. I. Reg. No. WN 370/1 ; host—*Istiophorus gladius* ; 19. i. 1976 ; location, locality & collector—same as above.

Juveniles. 2 ♂♂ ; host—*Elecate nigra* ; location—intestine ; locality—Calicut ; 16. i. 1976 ; coll. T. D. Soota. 2 ♂♂ & 1 without gonads ; host—*Pseudorhombus* sp. ; locality—Madras ; 13. xii. 1975. 1 ♂ host—*Psettodes erumei* ; locality—Portonovo ; 11. v. 1975. 2 ♂♂ ; locality—Calicut ; 21. i. 1976. 1 ♀ ; locality—Cochin ; 16. i. 1976. 1 ♂ & 1 ♀ ; host—*Johnius dussumieri* ; locality—Calicut ; 15. i. 1976. 1 ♂ & 1 ♀ ; host—*Lutjanus* sp. ; locality—Pondicherry ; 1. xii. 1975. 1 ♂ & 1 ♀ ; host—*Nemipterus* sp. ; locality—Madras ; 15. iii. 1975 ; location & collector—same as above. 2 ♂♂ & 1 ♀ ; host—*Synaptura cornuta* ; location—intestine ; locality—Kaki-

nada ; 30. i. 1975 ; coll. M. Hafeezullah. 2 ♂♂ ; host—*Trachinocephalus myops* ; locality—Pondicherry ; 1. xii. 1975 ; location & collector—same as above.

Description : Male : Body 40.5-65.5 (3.2-8.7) long ; proboscis 1.1-1.3 (0.55-1.15) long ; proboscis hooks 22-24 longitudinal rows of 14-18 hooks each ; neck 0.42-0.44 (0.22-0.44) long ; body spines in 6-8 rows ; body combs in 19-25 rows ; anterior testis 0.93-1.5 (0.066-0.14), posterior 1.0-1.3 (0.077-0.15) long.

Female : Body 24.7-52.0 (4.4-6.5) long ; proboscis 1.1 (0.9-1.0) long ; proboscis hooks as in male ; body spines 6-8 rows ; body combs in 20-26 rows.

Remarks : Meyer (1932) included two species under the genus *Serrasentis* viz., *S. lamelliger* (Dies., 1854) and *S. socialis* (Leidy, 1851). Subsequently, two more species from Indian marine fishes were added viz., *S. chauhani* by Datta (1954) from *Psettodes erumei* and *Lutjanus johnii* from Bombay, and *S. longa* by Tripathi (1959) from *Rhynchobatus djeddensis* from Puri, Orissa. Although, this was accepted by Yamaguti (1963), Golvan (1969) while dealing with the genus, not only opined that both the Indian species under it were probably based on juveniles of *S. sagittifer*, but also treated *S. socialis* as synonym of this species. The present authors also accept this opinion. Subsequently, six more species were added to the genus namely, *S. longiformis* (1971), and *S. giganticus*, *S. mujibi* and *S. sciaenus* (1972) by Bilqees from Karachi, Pakistan, *S. engraulisi* (1976) by Gupta and Gupta from Quilon (Kerala), and *S. fotedari* by Gupta and Fatma (1980) from Mandapam (Tamil Nadu). The present specimens as well as the existing descriptions of the

species referred herein lead the authors to opine that these six species are also based on the juveniles of *S. sagittifer*. However, Gupta and Jain (1977) while treating only *S. charuhani*, *S. longus*, and *S. longiformis* as juveniles, and *S. giganticus* as synonym of *S. socialis*, probably unaware of Golvan's work (*op. cit.*) wrongly treated it as valid.

It may be of interest to record here that examination of the three juvenile specimens from *Pseudorhombus* sp. has revealed that there is the trace neither of gonads nor of body combs in the smallest specimen, a slight trace only of gonads in the second, and of both structures in the third.

Family FESSIDENTIDAE Van Cleave, 1931

Genus *Filisoma* Van Cleave, 1928

Filisoma indicum Van Cleave, 1928

Material : 1 ♀ ; Z. S. I. Reg. No. WN 371/1 ; host—*Scatophagus argus* ; location—intestine ; locality—Portonovo ; 13. iii. 1975 ; coll. T. D. Soota.

Description : *Female* : Body 90 long ; proboscis 0.9 long ; proboscis hooks in 12-14 longitudinal rows with 24-26 hooks in each.

Remarks : The species is recorded for the first time from Portonovo.

Family POMPHORHYNCHIDAE Yamaguti, 1939

Genus *Longicollum* Yamaguti, 1935

Longicollum indicum Gupta and Gupta, 1971

Material : 2 ♂♂ and 2 ♀♀ ; Z. S. I. Reg. No. WN 372/1 ; host—*Protonibea diacanthus* ; location—intestine ; locality—Calicut ; 16. i. 1976 ; coll. T. D. Soota. 1 ♂ and 4 ♀♀ ; Z. S. I. Reg. No. WN 373/1 ; host—*Scatophagus argus* ; 18. i. 1976 ; location, locality & collector—same as above. 2 ♂♂ and 3 ♀♀ ; Z. S. I. Reg. No. WN 374/1 ; host—*Lethrinus*

reticulatus ; location—intestine ; locality—Ernakulum ; 22. i. 1976 ; coll. T. D. Soota. 6 ♀♀ ; Z. S. I. Reg. No. WN 375/1 ; host—*Strongylura strongylurus* ; 22. i. 1976. 2 ♂♂ and 2 ♀♀ ; Z. S. I. Reg. No. WN 376/1 ; host—*Pennahia macrophthalmus*. 2 ♂♂ ; Z. S. I. Reg. No. WN 377/1 ; host—*Lobotes surinamensis*. One ♂ and 6 ♀♀ ; Z. S. I. Reg. No. WN 378/1 ; host—*Epinephelus chlorostigma* ; 23. i. 1976 ; location, locality & collector—same as above.

Description : *Male* : Body 9.5-10.5 long ; proboscis 0.77-1.0 long ; anterior testis 0.3-0.72 and posterior 0.37-0.67 long.

Female : Body 8.0-10.5 long ; proboscis 0.95-1.1 long.

Remarks : This species was described by Gupta and Gupta (1971) from *Strongylura strongylurus* from Ernakulum. The present specimens agree in most of the details with their description of the species excepting in some body measurements etc., but these are considered here as intraspecific variations. The species is recorded here for the first time from Calicut and from new hosts.

ACKNOWLEDGEMENT

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ON A COLLECTION OF TETRANYCHID MITES FROM JAMMU AND KASHMIR
WITH DESCRIPTION OF ONE NEW SPECIES OF *EOTETRANYCHUS*
(ACARINA : TETRANYCHIDAE)

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ABSTRACT

Ten species belonging to seven genera are reported from Jammu and Kashmir which includes one new species of *Eotetranychus*. All are new reports for the State.

INTRODUCTION

Tetranychid fauna of Jammu and Kashmir is very inadequately known and only *Eutetranychus orientalis* (Klein), (Prasad, 1974) is in record. So far only 37 species of tetranychid mites are known from India (Prasad, 1974 ; Gupta, 1976). The author along with Dr. S. K. Gupta made a good collection from different areas of Jammu and Kashmir during 1976 and the present paper is based on that collection. Altogether 10 species belonging to 7 genera were treated in this paper which includes a new species, *Eotetranychus ladakheensis* sp. n. and the same is described here. Incidentally all the species are recorded here for the first time from the State. Types and other material treated in this paper are deposited in the Zoological Survey of India, Calcutta. Classification as¹ of Pritchard and Baker (1955) was followed.;

Family TETRANYCHIDAE

***Bryobia eharai* Pritchard and Keifer**

Bryobia eharai Pritchard and Keifer, 1958, *Ann. ent. Soc. Am.*, 51 : 506.

Bryobia eharai Pritchard and Keifer : Menon and Ghai, 1968, *Indian J. Ent.*, 30 : 86,

Material examined : 6 ♀ ♀, India : Jammu and Kashmir : Achhabal, 7. xi. 1976, on chrysanthemum.

Distribution in India : Delhi, Punjab, Karnataka, Gujarat, Jammu and Kashmir (new record).

***Bryobia praetiosa* Koch**

Bryobia praetiosa Koch, 1836, *Deutsche Crustacea Myriopoda, Arachnida*, 1 : 8.

Bryobia praetiosa Koch : Menon and Ghai, 1968, *Indian J. Ent.*, 30 : 88.

Material examined : 1 ♀, Pahalgam, 30. x. 1976, on cherry ; 1 ♀, Gulmarg, 20. x. 1976, on an unidentified plant.

Distribution in India : Delhi, Punjab, West Bengal, Assam, Jammu and Kashmir (new record).

***Petrobia (Petrobia) latens* (Müller)**

Acarus latens Müller, 1867, *Zool., Dan. Prodr.*, 187.

Petrobia latens Müller : Oudemans, 1915. *Arach. Natur.*, 81 : 44.

Petrobia latens Müller : Ehara, 1961, *Rec. Indian Mus.*, 59 : 143-144.

Material examined : 6 ♀ ♀, Phalgam; 30. x. 1976, on grass.

Distribution in India : Punjab, Rajasthan, Madhya Pradesh, Bihar, Jammu and Kashmir (new record).

Eutetranychus orientalis (Klein)

Anychus orientalis (Zacher) : Klein, 1936, *Bull. Agr. Res. Sta. Rehovot*, 21 : 3.

Anychus ricini Klein : Rahman and Sapra, 1940, *Proc. Indian Acad. Sci.*, 11B : 194.

Eutetranychus orientalis Klein : Baker and Pritchard, 1960, *Hilgardia*, 29 : 464-467.

Material examined : 10 ♀ ♀, Katra, 30. x. 1976, on grass.

Distribution in India : Punjab, West Bengal, Orissa, Gujarat, Delhi, Andaman Islands, Assam, Jammu and Kashmir, Karnataka, Maharashtra.

Panonychus citri (McGregor)

Tetranychus citri McGregor, 1916, *Ann. ent. Soc. Am.*, 9 : 284.

Panonychus citri (McGregor) : Ehara, 1956, *J. Fac. Sci. Hokkaido Univ. Zool.*, 12 (6) : 500.

Metatetranychus citri McGregor : Gupta, 1970, *Sci. Cult.*, 36 : 98.

Material examined : 12 ♀ ♀, 2 ♂ ♂, Bijbehara Soil Conservation Farm, 5. xi. 1976, on apple.

Distribution in India : Assam, Meghalaya, Manipur, Tripura, West Bengal, Jammu and Kashmir (new record).

Eotetranychus frosti (McGregor)

Tetranychus frosti McGregor, 1952, *Proc. ent. Soc. Wash.*, 54 : 142.

Eotetranychus frosti McGregor : Gupta and Gupta 1976, *Acarology Newsletter*, No. 3 : 6-7.

Material examined : 10 ♀ ♀, 1 ♂, Srinagar : Nishat Bag, 21. x. 1976, on apple.

Distribution in India : Gujarat, Madhya Pradesh, Jammu and Kashmir (new record).

Eotetranychus ladakhensis sp. n.

(Figs. 1 A—H)

Male : Body 408 μ long, 204 μ wide, terminal sensillum of palpus twice as long as wide. Dorsal sensillum slender. Tibia I with three sensory and seven tactile setae ; tarsus I with two sensory and five tactile setae proximal to the duplex setae. Tibia II with one sensory and six tactile setae ; tarsus II with one sensory and four tactile setae proximal to the duplex setae. Dorsal setae of idiosoma longer than interval between their longitudinal bases. The aedeagus in very long and slender as figured.

Female : Body 510 μ long, 280 μ wide. Terminal sensillum of palpus three times as long as wide. Dorsal sensillum slender. Peritreme ends in a simple bulb. Tibia I with one sensory and five tactile setae, tarsus I with one sensory and five tactile setae proximal to the duplex setae. Tibia II with one sensory and seven tactile setae, tarsus II with one sensory and three tactile setae proximal to the duplex setae. Dorsal setae of idiosoma much longer than interval between their longitudinal bases. Outer and inner sacral same in length. Post anal setae thin and small. Medio ventral setae moderate in size. Genital flap with transverse striae.

Holotype : ♂ (Reg. No. 3139/17), India : Jammu and Kashmir : Ladakh, Kalsi, on an undetermined plant, 28. x. 1976 coll. S. K. Gupta and Y. N. Gupta.

Paratypes : 1 ♀ (Reg. No. 3140/17) on slide and 15 ♀ ♀ in Spirit, data same for holotype.

Remarks : This species resembles *Eotetranychus carpini* (Oudemans, 1905) redescribed by Pritchard and Baker, 1955 but differs from it in shape of aedeagus, and dorsolateral and dorso-central setae being not equal in length.

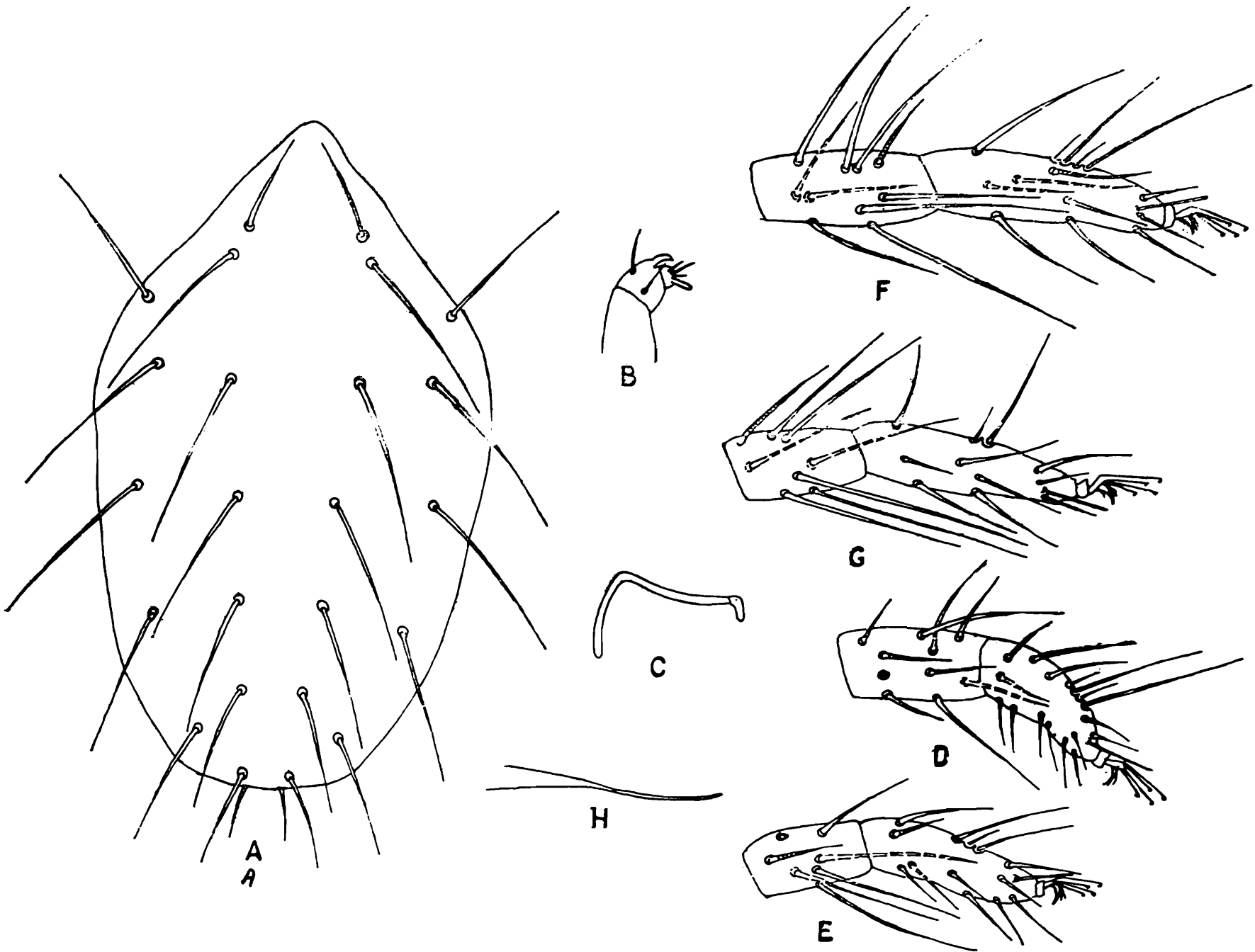


Fig. 1. *Eotetranychus ladakhensis* sp. n. A. Dorsum of Female, B. Terminal Portion of Palp, C. Peritreme, D. Tibia and Tarsus I of male, E. Tibia and Tarsus II of male, F. Tibia and Tarsus G. Tibia and Tarsus II of female, H. Aedeagus, I. of female

Oligonychus mangiferus (Rahman and Sapra)

Paratetranychus mangiferus Rahman and Sapra, 1940, *Proc. Indian Acad. Sci.*, 11B : 192.

Oligonychus mangiferus Rahman and Sapra : Pritchard and Baker, 1955, *Pacific Coast Ent. Soc. Mem. Soc.*, 2 : 330.

Material examined : 15 ♀♀, 2 ♂♂, Katra, 12. xi. 1976, on mango; 28 ♀♀, 2 ♂♂, Nagrota, 14. x. 1976, on mango.

Distribution in India : Punjab, Himachal Pradesh, Haryana, West Bengal, Jammu and Kashmir (new record).

Tetranychus neocaledonicus Andre

Tetranychus neocaledonicus Andre, 1923, *Bull. Mus. natn. Hist. nat.*, Paris 5 (2) : 302.

Tetranychus cucurbitae Andre : Rahman and Sapra, 1940, *Proc. Indian Acad. Sci.*, 11B : 179-182.

Tetranychus equatorius McGregor : Khot and Patel, 1956, *Indian J. Ent.*, 18 : 149-160.

Material examined : 1 ♀, 1 ♂, Anantnag, 3. xi. 1976, on chiner; 12 ♀♀, 1 ♂ Jammu Rly. Station, 10. xi. 1976, on an unidentified plant; 8 ♀♀, 1 ♂ Phalgam, 31. x. 1976 on grass; 28 ♀♀, 2 ♂♂, Pahalgam, 30. x. 1976, on "Sag".

Distribution in India : Punjab, Delhi, West Bengal, Assam, Karnataka, Maharashtra, Jammu and Kashmir (new record).

Tetranychus cinnabarinus (Boisduval)

Acarus cinnabarinus Boisduval, 1867, *Ent. Hort.*, : 88.

Tetranychus biomaculatus Harvey : Wood Mason, 1884, *Report on tea mite and bug of Assam*, : 1-20.

Tetranychus biomaculatus Boisduval : Mishra, 1913, *Agric. J. India*, 8 : 309.

Tetranychus cinnabarinus Boisduval : Tuttle and Baker, 1968, Tucson, *Ariz. Univ. Ariz. Press* : 129.

Material examined : 12 ♀♀, 1 ♂ Achhabal, 7. xi. 1976, on Dahlia; several ♀♀, ♂♂ Bijbehara, 4. xi. 1976, on chrysanthemum, several

♀♀, ♂♂, Leh, 26. x. 1976, on cucurbit plant; 22 ♀♀, 2 ♂♂, Leh : I. T. B. F. compound, 26. x. 1976, on cucurbit plant; several ♀♀, ♂♂ Batkut, 3. xi. 1976, on undetermined plant; 4 ♀♀, 1 ♂ Srinagar : Pologround, 18. x. 1976, on rose.

Distribution in India : ihBar, Haryana, Karnataka, Meghalaya, Punjab, Rajasthan, Tamil Nadu, New Delhi, West Bengal, Jammu and Kashmir (new record).

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NEMATODES FROM WEST BENGAL (INDIA) VII. MORPHOMETRIC AND ALLOMETRIC VARIATIONS IN *TYLENCHORHYNCHUS NUDUS* ALLEN, 1955 (TYLENCHORHYNCHIDAE : TYLENCHIDA)

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ABSTRACT

The study of a single population of *Tylenchorhynchus nudus* Allen, 1955 from West Bengal (India) reveals that the length of stylet, the position of dorsal oesophageal gland orifice and the median oesophageal bulb, value of 'V', and lip height and width are less variable characters. The length of sexual branches, tail annules and the position of phasmids are highly variable characters.

MATERIAL

The nematodes were fixed in hot 4% formalin, dehydrated slowly in desiccator and mounted in anhydrous glycerine. The specimens have been registered and deposited with the National Zoological collection, Zoological Survey of India, Calcutta.

INTRODUCTION

Intraspecific variations occur frequently in nature within the same or different populations of a species. Several workers have studied the qualitative and quantitative variations in different species of nematodes (Goodey, 1952 ; Rhode & Jenkins, 1957 ; Triantaphyllou & Sasser, 1960 ; Bird & Mai, 1967 ; Baqri & Jairajpuri, 1970 ; and Roman & Hirschmann, (1969). Loof & Maas (1972), while studying the intraspecific variations among the different populations of *Xiphinema* species, observed that the qualitative characters are also important in distinguishing nematode species. Recently from

India, the morphometric and allometric studies have been made by Azmi & Jairajpuri (1976) in *Helicotylenchus indicus* Siddiqi, 1963 ; Rashid & Khan (1976) in *Pratylenchus coffeae* (Zimmermann, 1898) Filipjev & Stekhoven, 1941 ; and Bajaj & Jairajpuri (1977) in *Xiphinema basiri* Siddiqi, 1959.

The present paper deals with the morphometric and allometric variations observed in *Tylenchorhynchus nudus* Allen, 1955 from Shaktigarh, district Jalpaiguri, West Bengal.

***Tylenchorhynchus nudus* Allen, 1955**

(Figs. 1-5)

Dimensions : Table I.

Description : *Female* : Body curved in posterior half of its length upon fixation and tapering slightly towards both extremities. Cuticle marked with distinct transverse striae, 1-2 μ m apart. Longitudinal striations absent. Lateral fields originate with two incisures below the base of stylet, become three near

TABLE—I
Morphometric and Allometric Variations in Adults of *Tylencorhynchus nudus*

Character	Female				Male			
	Range	Mean \pm S. D.	S. E.	C. V. (%)	Range	Mean \pm S. D.	S. E.	C. V. (%)
Length (μ)	602-863	688 \pm 45.0	4.96	6.5	516-726	645 \pm 46.0	7.10	7.0
a	26-35	29 \pm 2.1	0.24	7.4	25-35	30 \pm 2.6	0.41	8.7
b	5.1-6.4	5.6 \pm 0.3	0.04	6.0	4.3-6.0	5.3 \pm 0.4	0.06	8.0
c	12.5-16.4	12.9 \pm 1.3	0.15	10.5	11-17	14.6 \pm 1.4	0.23	10.0
V/T	58-57	55 \pm 1.2	0.13	2.0	48-59	51 \pm 5.5	0.88	10.9
G ₁	18-28	22 \pm 3.2	0.37	15.0	—	—	—	—
G ₂	16-26	22 \pm 2.3	0.26	11.0	—	—	—	—
Outicle at mid body (μ)	1-2	1.8 \pm 0.3	0.04	19.0	1-2	1.8 \pm 0.2	0.04	15.0
Annules (μ)	2-2.5	2.0 \pm 0.08	0.01	4.4	1.8-2	1.99 \pm 0.03	0.0	1.5
Lateral fields (μ)	4-7	5.4 \pm 0.5	0.06	9.0	4.3-6.0	5.1 \pm 0.5	0.08	9.8
Incisures	4	4 \pm 0	0.0	0.0	4	4 \pm 0	0.0	0.0
Labial annules	0-2	—	—	—	0-2	—	—	—
Head height (μ)	3.5-4.0	3.41 \pm 0.09	0.09	2.8	3.4-4.0	3.41 \pm 0.09	0.01	2.7
Head width (μ)	6-8	7 \pm 0.3	0.08	4.5	6-7	6.8 \pm 0.3	0.06	5.3
Stylet (μ)	18-21	19 \pm 0.6	0.07	3.4	18-20	19 \pm 0.4	0.07	2.0
Stylet knobs (μ)	3.5-4.0	3.41 \pm 0.1	0.01	2.0	3.4-3.5	3.4 \pm 0.09	0.01	2.7
Metenchium (μ)	8.5-10.5	9.5 \pm 0.4	0.05	4.6	8.6-10	9.2 \pm 0.2	0.04	3.0
Dorsal oesophageal gland opening (μ)	2-3	2.4 \pm 0.1	0.01	4.0	2.0-2.5	2.4 \pm 0.1	0.04	5.0
oesophagus* (μ)	103-144	123 \pm 8.1	0.37	6.5	111-142	124 \pm 8.0	1.23	6.4
Median bulb* (μ)	54-75	64 \pm 4.5	0.05	7.0	56-71	64 \pm 4.2	0.68	6.7
Median oesophageal bulb length (μ)	13-15	14 \pm 0.7	0.08	5.3	12-14	13 \pm 0.5	0.08	4.0
Median oesophageal bulb width (μ)	9-12	9.7 \pm 0.6	0.07	7.0	9-10	9.2 \pm 0.4	0.04	4.3
Nerve ring* (μ)	69-94	81 \pm 4.9	0.54	6.0	73-91	83 \pm 5.3	0.18	6.4
Excretory pore* (μ)	87-124	101 \pm 7.0	0.77	7.0	85-115	102 \pm 6.6	1.02	6.4
Hemizonid	0-2 annules from excretory pore				0-2 annules from excretory pore			
Hemizonid width	1-2 annules				1-2 annules			
Vulva*	319-475	376 \pm 25.0	0.73	6.6	—	—	—	—
Anterior gonad (μ)	99-211	148 \pm 24.0	2.68	16.0	—	—	—	—
Posterior gonad (μ)	112-189	147 \pm 17.0	1.89	11.5	—	—	—	—
Vagina (μ)	8-11	9 \pm 0.6	0.07	6.7	—	—	—	—
Vulva body-width (μ)	20-26	23 \pm 1.6	0.19	7.0	17-23	22 \pm 1.6	0.26	7.7
Anal body diameter (μ)	10-15	14 \pm 0.9	0.11	7.0	14-18	16 \pm 1.0	0.16	7.7
Rectum (μ)	9-14	10 \pm 1.3	0.16	13.0	—	—	—	—
Tail (μ)	40-59	47 \pm 3.7	0.40	8.0	36-51	44 \pm 4.1	0.66	9.5
Tail annules	13-23	18 \pm 2.5	0.29	14.5	—	—	—	—
Phasmids (from terminus) (μ)	34-48	37 \pm 4.2	0.46	11.0	26-39	30 \pm 3.1	0.50	10.6
Spicules (μ)	—	—	—	—	22-27	25 \pm 1.4	0.24	6.0
Gubernaculum (μ)	—	—	—	—	11-14	12.8 \pm 0.99	0.16	7.7

*Distances from anterior end (μ)

S. D. = Standard deviation

S. E. = Standard error

C. V. = Coefficient of variability

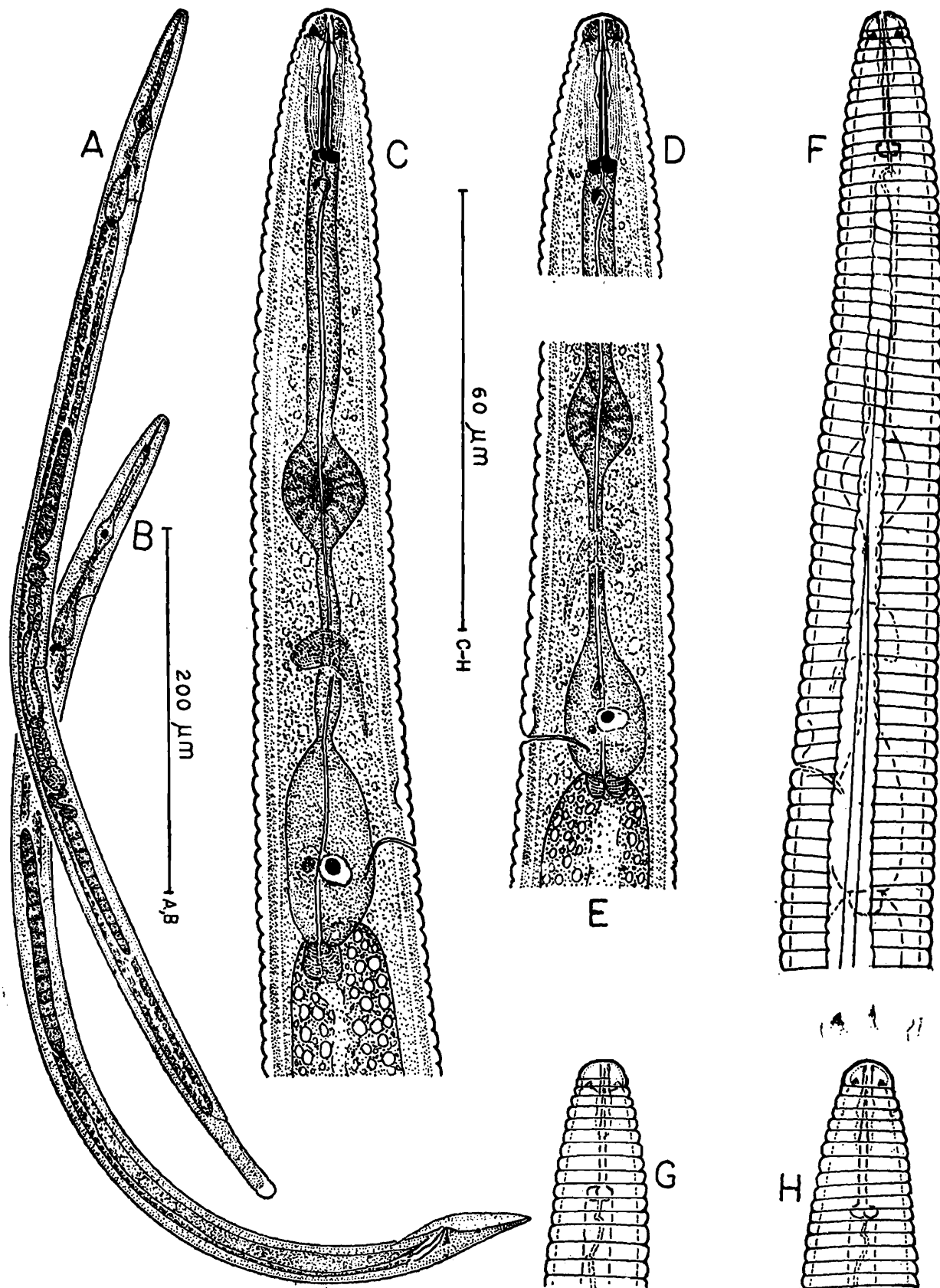


Fig. 1. *Tylenchorhynchus nudus* Allen, 1955 : A. Entire female ; B. Entire male ; C. Oesophageal region ; D. Anterior end ; E. Oesophageal region showing variation in position of hemizonid and excretory pore ; F. Anterior region, surface view ; G. Anterior end, lip region with incomplete stria ; H. Anterior end, lip region without stria.

middle of procorpus and four between median bulb and nerve ring (Fig. 1, F). The outer incisures are crenate. The four incisures extend up to the terminus (Fig. 2, D) but sometimes the inner two unite just below the phasmids (Fig. 2, F). Aerolations absent. Lateral fields 1/5th-1/4th of body-width near middle.

Lip region continuous with body, 6-8 μm wide and 3-4 μm high, generally bearing two annules (Fig. 1, F). Smooth lip region has also been noted in some specimens (Fig. 1, H). Sometimes the stria is incomplete and it appears from one side as if the lip region is smooth (Fig. 1, G). Head framework slightly sclerotized. Stylet 18-21 μm long, about 2.4-3.0 times the head-width; its anterior part (metenchium) 9-11 μm long or 47-52% of the stylet length. The basal knobs rounded, 3-4 μm wide. Oesophagus typical to genus. Median oesophageal bulb at 45-57% of the oesophageal length from anterior end, 12-15 \times 9-12 μm . Orifice of the dorsal oesophageal gland 2-3 μm from stylet base. Nerve ring 69-94 μm or 58-71% of the oesophageal length from anterior end. Excretory pore 85-124 μm or 65-94% of the oesophageal length from anterior extremity, position varies from anterior end to posterior end of oesophageal terminal bulb (Fig. 1, B & E). Hemizonid 1-2 annules long, situated 0-2 annules above the excretory pore (Fig. 1, C & E).

Vulva a transverse slit. Vagina 1/3rd—1/2 of corresponding body-width. Reproductive system amphidelphic, out stretched. Each sexual branch consists of an ovary, oviduct, spermatheca and uterus. Spermatheca ovate or spherical and mostly filled with sperms. Oocytes arranged in a single row (Fig. 2, A & B), in one specimen in double rows with reflexed anterior part of ovary (Fig. 2, C). Tail cylindrical, ending in a clavate terminus,

marked with 13-23 striae ventrally and 2.5-4.0 anal body-widths long. In one specimen, some apparent abnormal markings were noticed at the tail terminus (Fig. 2, E). Rectum 9-14 μm or about half to one anal body-width long. Phasmids 33-48 μm or 72-93% of the tail length from tail terminus. Generally both the phasmids occur at the same level but in some specimens noticed about one annule apart (Fig. 2, G & E).

Male: Similar to female in general shape and morphology except the reproductive system and tail shape. The two inner incisures of the lateral fields terminate before cloaca, the third one terminates before phasmids and outer most continues up to the tail terminus. Spicules 22-27 μm long medially. Gubernaculum stout, 11-14 μm long, proximal half slightly or distinctly curved with distinct spine-like structure near curvature. Tail with subacute terminus, 2.3-3.4 anal body-widths long, enveloped by bursa. Phasmids 26-39 μm or 58-83% of tail length from tail terminus.

DISCUSSION

Table No. 1, shows all the measurements and statistical calculations. The occurrence of the lip region bearing two annules has been calculated in 77% specimens while for the smooth lip region or with incomplete stria in 23% specimens. The absence of stria or incomplete stria in the lip region have been observed for the first time in this species. The frequency of specimens having 18 μm long stylet has been noted in only 3%, maximum being 19 μm in 71%, with 20 μm in 21% and 21 μm in 5% (Fig. 3).

Among all the morphometric characters, the length of stylet and its metenchium, head width, head height, and position of dorsal oesophageal gland opening and median oesophageal bulb are found to be less variable

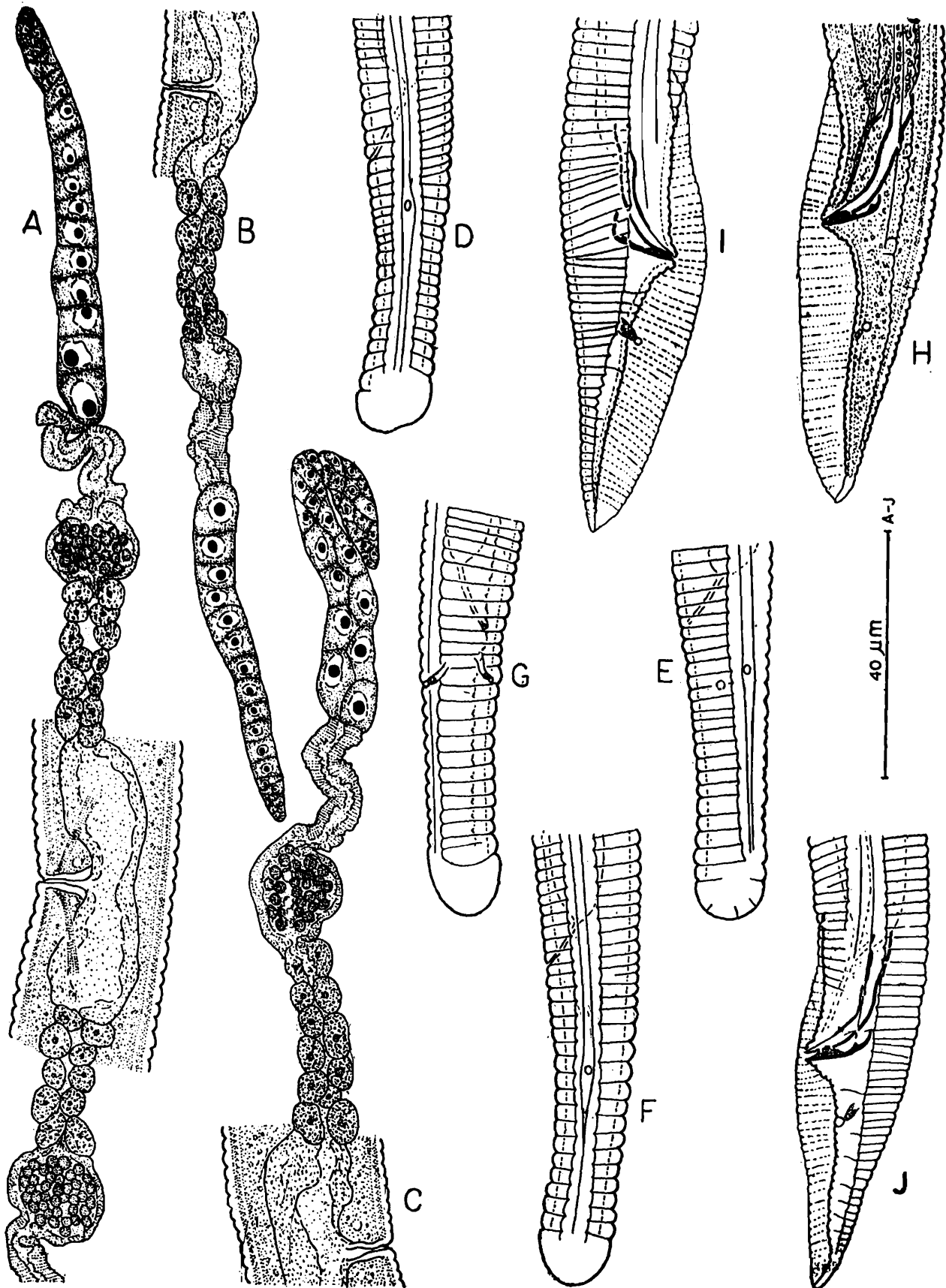


Fig. 2. *Tylenchorhynchus nudus* Allen, 1955 : A. Female reproductive system showing spermatheca filled with sperms ; B. Female reproductive system showing spermatheca without sperms ; C. Female anterior reproductive system with reflexed ovary and double rows of oocytes ; D-E. Female tails ; H-J. Male tails.

characters (C. V. = 2–5%). Hence these characters can be used safely in the identification of this species. The highly variable characters are the length of sexual branches

from 6–10%, are the lateral fields, length of oesophagus, position of nerve ring and excretory pore, tail length, length of vagina, and length of spicules and gubernaculum.

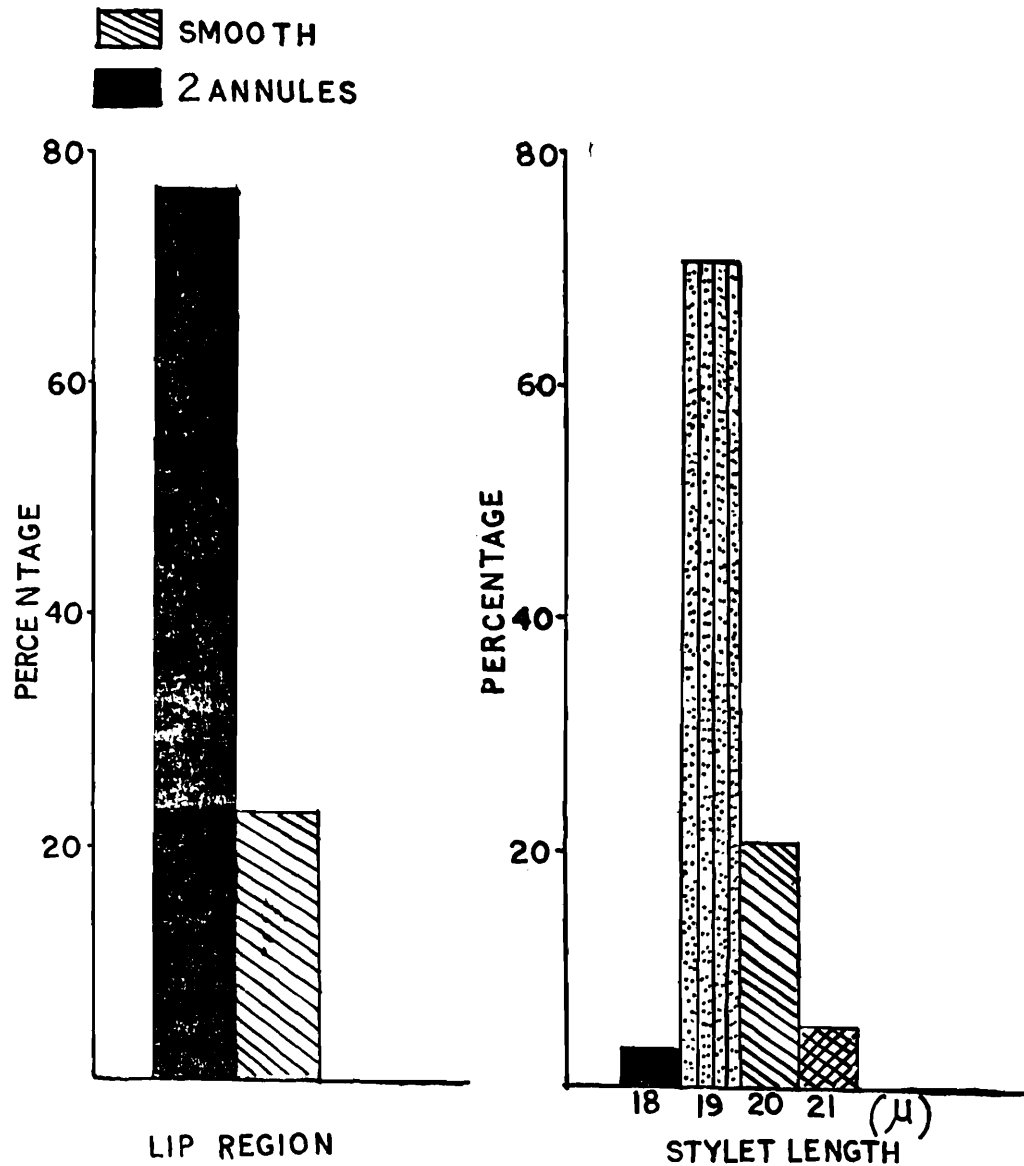


Fig. 3. Histograms showing the percentage of specimens having lip region with or without annules, and different stilet lengths.

(C. V. = 11–16%), rectum (C. V. = 13%), the number of tail annules (C. V. = 15%) and the position of phasmids from tail terminus (C. V. = 11%). The characters which showed a moderate degree of variations, C. V. ranging

As far as allometric characters are concerned, it has been observed that position of vulva is positively correlated with the body length, while the length of tail and female sexual branches has been found negatively

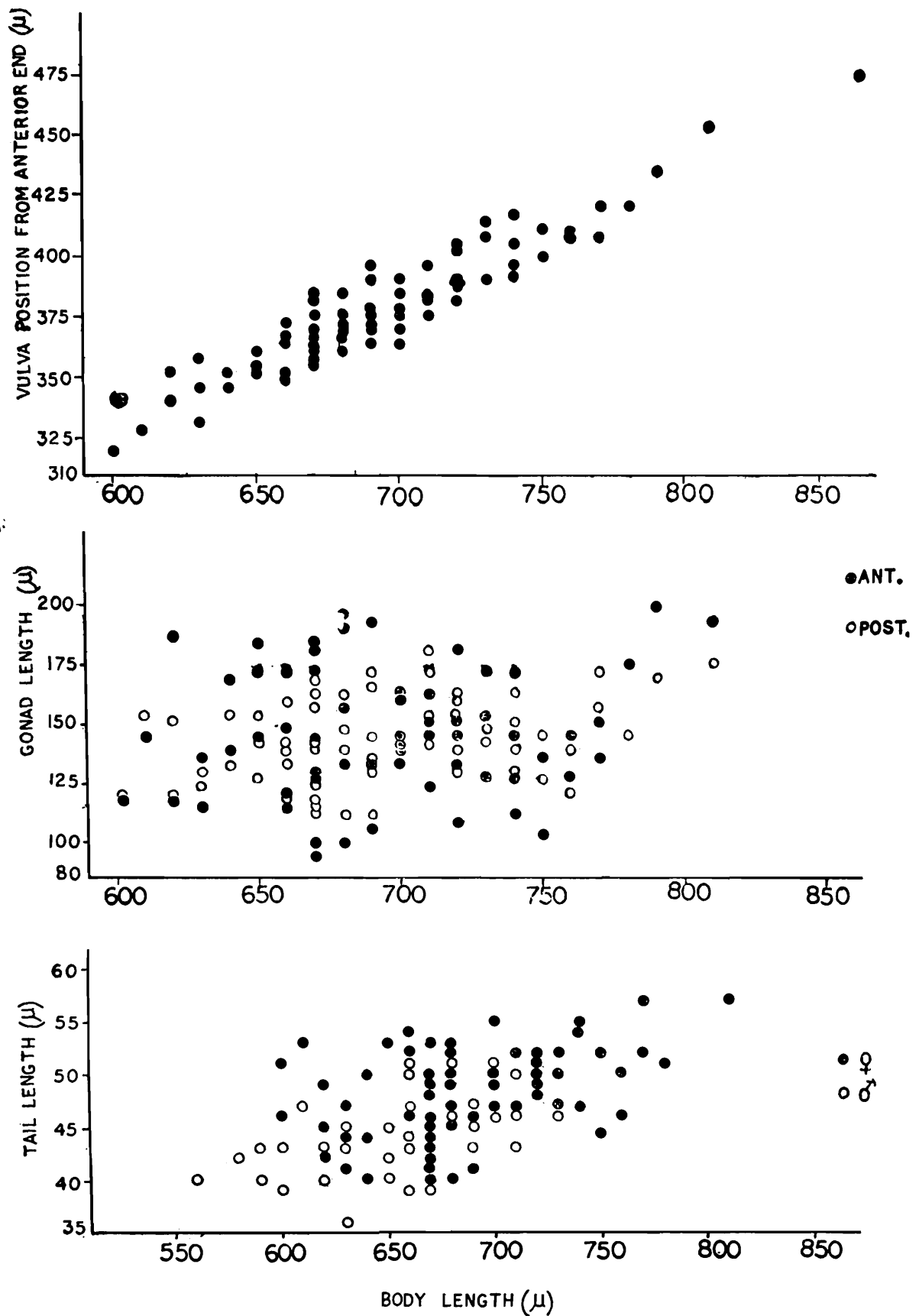


Fig. 4. Relation of body length with tail length, gonad length and vulva position.

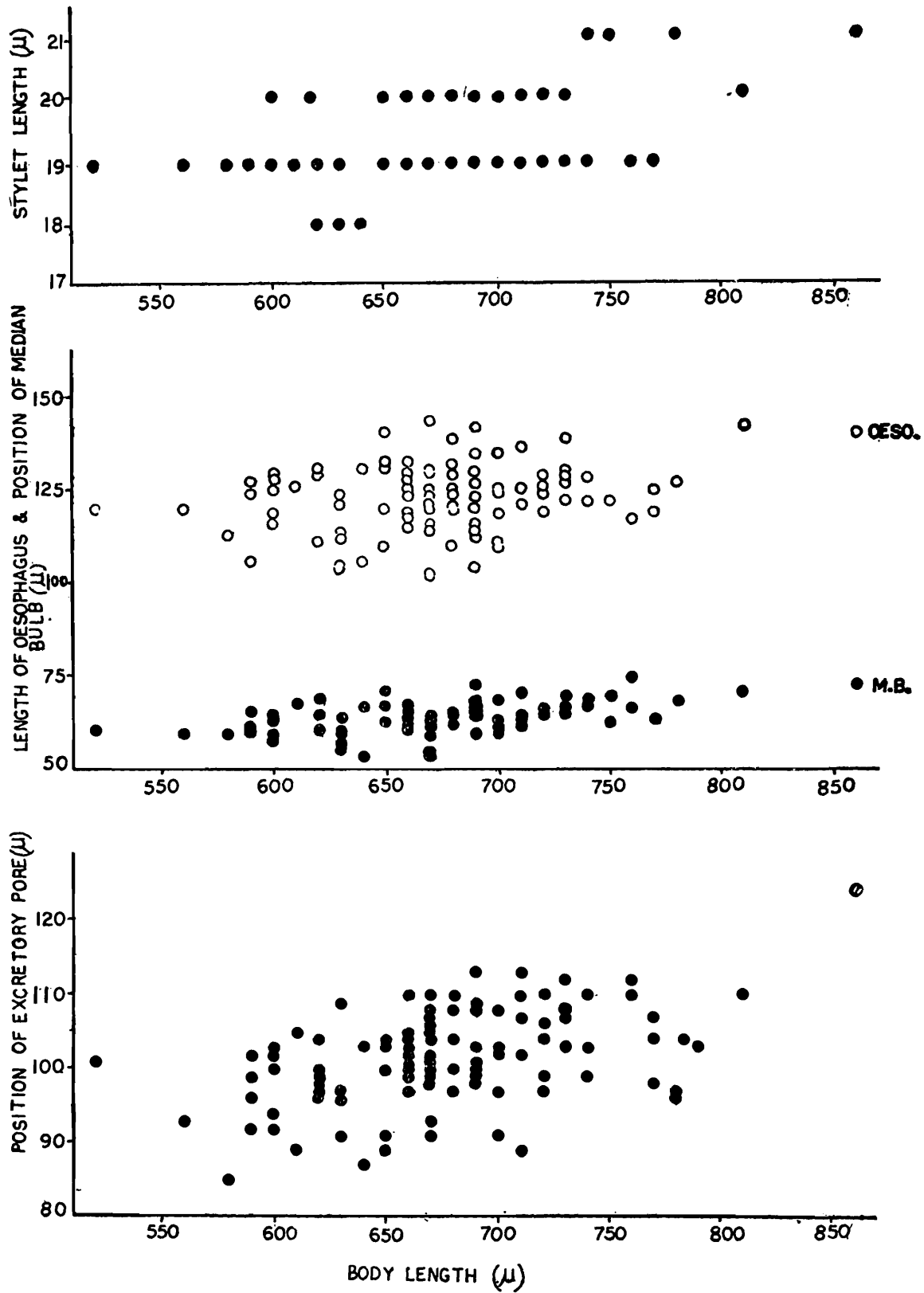


Fig. 5. Relation of body length with position of excretory pore, length of oesophagus and position of median oesophageal bulb, and stylet length.

correlated to the body length (Fig. 4). Among all the allometric characters, the value of 'V' is the least variable character (C. V. = 2%) while the G_1 and G_2 exhibit maximum variations (C. V. = 15% and 11% respectively). These results agree fully with the findings of Bird & Mai (1967) in *Trichodorus christei* Allen, 1957 = syn. of *Paratrachodorus minor* (Colbran, 1956) and partly with Mujib & Jairajpuri (1976) in *Helicotylenchus indicus* Siddiqi, 1963. The length of stylet and oesophagus, the position of median oesophageal bulb and excretory pore were also found independent of body length (Fig. 5), and thus can be used to differentiate this species from closely related species. These observations are also in accordance with Mujib & Jairajpuri (1976) and many others (Wu, 1960 ; Sturhan, 1963 ; Tarjan, 1969 ; and Bajaj & Jairajpuri, 1977).

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CHROMOSOMES OF SIX SPECIES OF APHIDS
(HOMOPTERA : APHIDIDAE)

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ABSTRACT

Somatic chromosomes from the embryos of apterous viviparous females of six species of aphids were studied viz., *Aphis spiraeola* Patch. ($2n=8$); *Tetraneura hirsuta* Baker ($2n=14$); *Brachycaudus helichrysi* (Kalt.) ($2n=12$); *Uroleucon sonchi* (L) ($2n=12$); *Lachnus similis* v. d. Goot ($2n=12$) and *Sitobion rosaeformis* Das ($2n=18$). Morphometric analysis of their individual chromosome pairs was carried out and karyotypes for these species were constructed. In *Brachycaudus helichrysi* (Kalt.), *Uroleucon sonchi* (L) and *Lachnus similis* v. d. Goot one pair of chromosomes was found to have an unequal arm.

INTRODUCTION

So far thirty four species of Indian aphids are known chromosomally, but the details of chromosome morphology and karyotypes are available only in eight species (Kulkarni & Kacker, 1979 and in press and Kurl and Misra, 1980). In the rest of the cases only the diploid number or the probable sex-determining mechanism is discussed (Kurl & Misra, 1979; Khuda-Buksh, 1979 and Behura & Bohidar, 1979). The present paper deals with the chromosomes of six species of aphids viz., *Aphis spiraeola* Patch., *Tetraneura hirsuta* Baker, *Brachycaudus helichrysi* (Kalt.), *Uroleucon sonchi* (L), *Lachnus similis* v. d. Goot and *Sitobion rosaeformis* Das.

Material and Methods: Apterous viviparous females of aphids were collected and their embryos were used for the study of somatic chromosomes. Collection data for these species are given in table I. The technique employed in the cytological preparations

was similar to that described earlier (Kulkarni & Kacker, 1979 and in press).

OBSERVATIONS

1. *Aphis spiraeola* Patch. The diploid chromosome number in this species was observed to be 8 (Plate VII A). The morphometric analysis of the chromosomal pairs revealed that the first pair was 30.28% of the total complement and the last pair was only 14.45%. The second and the third pairs measured 27.00% and 24.75% respectively (Table II). Karyotype for this species is figured (Plate VIII A).

2. *Tetraneura hirsuta* Baker. Diploid chromosome number in this species was found to be 14 (Plate VII, B). The relative percentage lengths of first and second pairs were found to be 27.31 and 21.52 respectively. Third and fourth pairs were 13.90 and 12.00 percent of the total complement. The last three pairs did not differ much in their

TABLE—I

Sr. No.	Name of the species	Host	Date of collection	Locality
1.	<i>Aphis spiraeicola</i> Patch.	<i>Spinaecaea oberacea</i> L.	9.3.79	Kunihar, Solan (H. P.)
2.	<i>Tetraneura hirsuta</i> Baker	<i>Synodon dactylon</i>	20.10.79	Mahananda wild life sanctuary, Sukna (W. B.)
3.	<i>Brachycaudus helichrysi</i> (Kalt.)	<i>Croton</i> sp. (from leaf galls)	17.3.79	Renuka Lake, Dadhau (H. P.)
4.	<i>Uroleucon sonchi</i> (L.)	<i>Sonchus arvensis</i> L.	17.3.79	Renuka Lake, Dadhau (H. P.)
5.	<i>Lachnus similis</i> v. d. Goot.	<i>Delbergia sisso</i>	15.3.79	Renuka Lake, Dadhau (H. P.)
6.	<i>Sitobion rosaeformis</i> Das	<i>Rosa</i> sp.	3.11.79	Tindharia, Kursiong, (W.B.)

percentage lengths and were found to be 9.76, 8.19, and 7.42 respectively (Table II). Karyotype for this species is constructed (Plate VIII, B).

3. *Brachycaudus helichrysi* (Kalt.) 2n number in this species was found to be 12 (Plate VII, C). The percentage lengths of the individual chromosome pairs are given in Table II. In some pairs of chromosomes the chromatids were observed to be separated to a considerable extent. The relative percentage lengths of the chromosomal pairs revealed uniform difference of size between 1st and 2nd and 4th and 5th pairs. However, the third pair was unequal with one of the elements much longer (Plate VIII, C).

4. *Uroleucon sonchi* (L.): The diploid chromosome number in this species was observed to be 12, (Plate VII, D) the relative percentage lengths of the chromosome pairs showed the first pair 28.00%. Pairs 2,3 and 4 were observed to be in uniform decreasing order, while the last two pairs had comparatively low difference (Table II). The fourth pair in the compliment was observed to be unequal (Plate VIII, D).

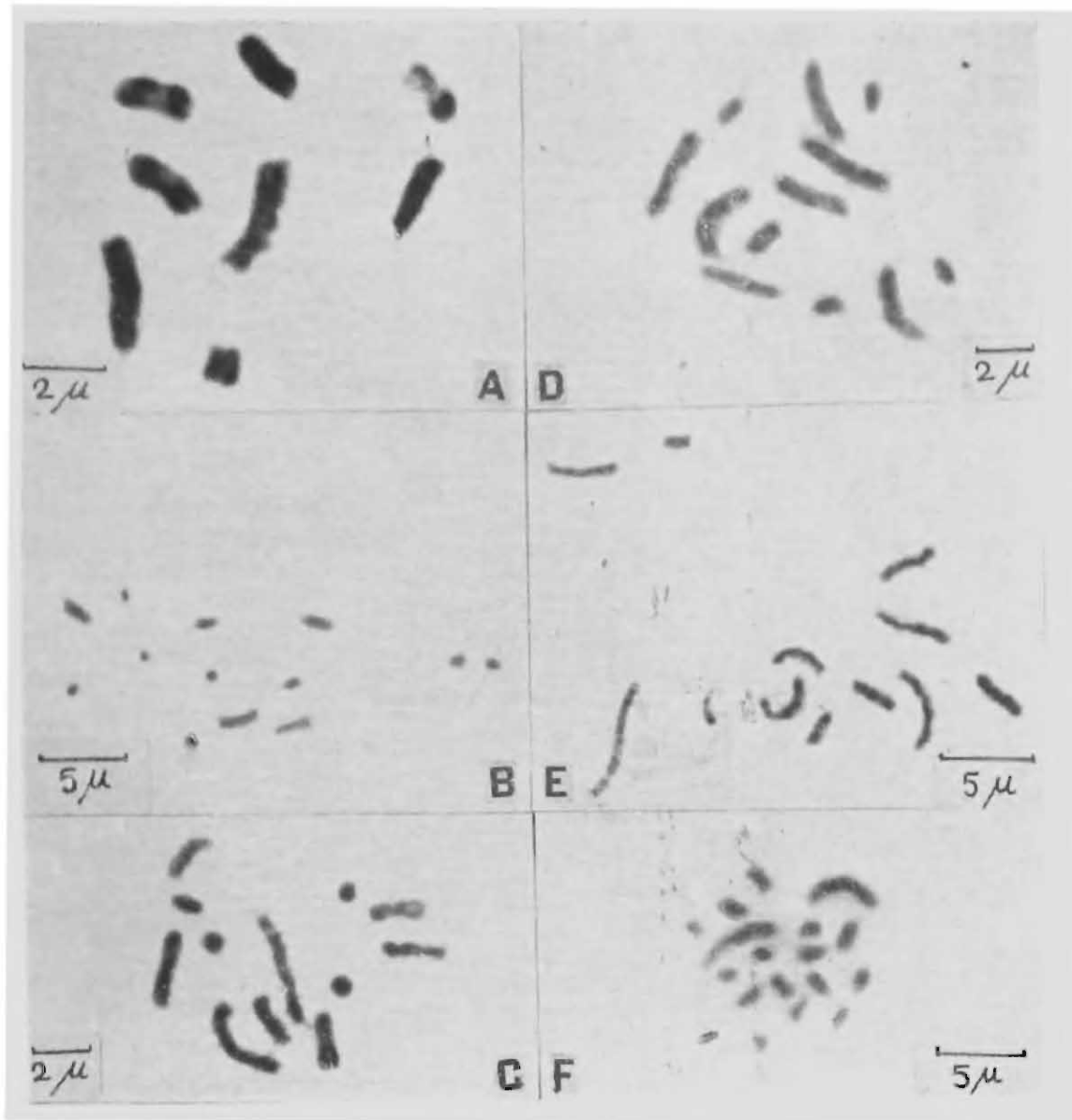
5. *Lachnus similis* v. d. Goot: 2n number in this species was observed to be 12. The longest pair measured 22.61% and the shortest pair measured 9.20% of the total

compliment. Rest of the pairs showed almost uniformly decreasing lengths when compared with each other (Table II). The karyotype for this species is given in Plate VIII, E.

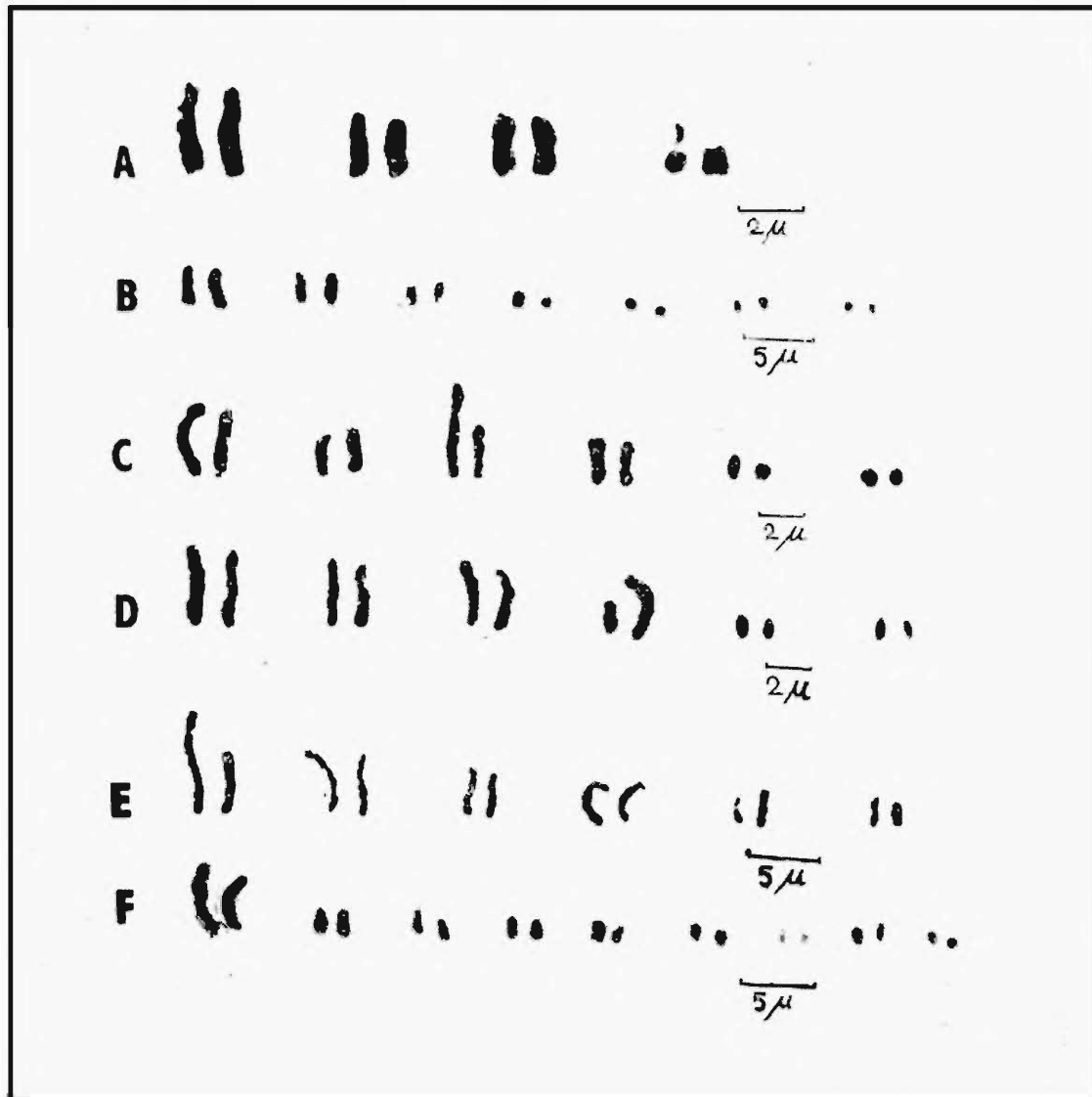
6. *Sitobion rosaeformis* Das.: Diploid chromosome number in this species was observed to be 18 (Plate VII, F). This confirms the earlier observation of Kurl & Misra, 1979. However, the karyotype for this species was not available earlier, which is given in Plate VIII, F. The relative percentage lengths of its chromosomal pairs showed gradual reduction in their size but the first pair was observed to be considerably longer (Table II).

DISCUSSION

Kulkarni & Kacker 1979 and in press have reported chromosomes of three species of *Aphis*. The present species, *Aphis spiraeicola* Patch also shows more or less similar type of arrangement and relative percentage lengths of its chromosome pairs. Out of the six species studied here, the chromosomes of three species viz., *Uroleucon sonchi* (L), *Brachycaudus helichrysi* (Kalt.) and *Lachnus similis* v. d. Goot have shown one unequal pair in their compliments. The percentage length of this pair was found maximum in



- A. *Aphis spiraeicola* Patch ($2n=8$)
- B. *Tetraneura hirsuta* Baker ($2n=14$)
- C. *Brachycaudus helichrysi* (Kalt.) ($2n=12$)
- D. *Uroleucon sonchi* (L.) ($2n=12$)
- E. *Lachnus similis* v. d. Goot ($2n=12$)
- F. *Sitobion rosaeformis* Das ($2n=18$)



Karyotypes ;

- A. *Aphis spiraeicola* Patch
- B. *Tetraneura hirsuta* Baker
- C. *Brachycaudus helichrysi* (Kalt.)
- D. *Uroleucon sonchi* (L.)
- E. *Lachnus similis* v. d. Goot.
- F. *Sitobium rosaeformis* Das

TABLE—II
Relative Percentage Lengths of Chromosome Pairs

Sr. No.	Name of the species	Chromosome pair Nos.								
		1	2	3	4	5	6	7	8	9
1.	<i>Aphis spiraeicola</i> Patch.	30.28	27.07	24.75	14.45					
2.	<i>Tetraneura hirsuta</i> Baker.	27.31	21.52	13.90	12.00	9.76	8.19	7.42		
3.	<i>Brachycaudus helichrysi</i> (Kalt.)	24.33	20.61	17.53	16.56	12.40	8.26			
4.	<i>Uroleucon sonchi</i> (L.)	28.00	21.20	19.10	15.51	8.96	7.24			
5.	<i>Lachnus similis</i> v. d. Goot.	22.61	22.21	18.16	15.03	13.11	9.20			
6.	<i>Sitobion rosaeformis</i> Das.	23.84	14.97	11.50	10.88	9.03	8.90	8.14	6.83	6.25

Lachnus similis v. d. Goot and it was the longest within its compliment.

In spite of the existence of unequal pairs, no differential staining pattern could be observed with the technique followed in the present studies. Further, definite sex-determining mechanism is not known in these species. This situation prevents us from arriving at any conclusion as to whether these are the sex chromosomes or the differential lengths are due to fusion or inversion. However, when the total lengths of the unhomologous pairs (averages of the both the components) are considered, these fill in the gaps in the gradual reduction of the chromosome pairs within the compliments. This fact supports the later view of involvement of fusion or inversion mechanism.

In addition to the above observations, partial separation of the chromatids within the chromosomes were noticed (Plate VII A, B and C) which may apparently look unexpected considering the holocentric nature of the chromosomes within the group.

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ON HABITS OF BLANFORD'S RAT, *RATTUS BLANFORDI* THOMAS

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Jabalpur*

ABSTRACT

The paper deals with field observations on the habits of an interesting indigenous Indian Peninsular species of field rat, *Rattus blanfordi* Thomas. A comparison of habits and morphological characters of the rat with those of other field rats of genus *Rattus* found in its range is given.

INTRODUCTION

This rat is confined to India and Sri Lanka. Within Indian limits, it has wide distribution : "peninsular India north to Bihar and central Provinces". Despite its wide distribution, no races have been recognised. However, its habits differ markedly in different parts of its range (Prater, 1971, p. 209). Dry, moist deciduous, evergreen forests, scrub jungle, rocks, boulders, treeless hilly country have all been occupied. Besides, it constructs very different types of shelters in different parts of its range and types of shelters do not appear to depend upon the nature of habitat. It may construct an untidy nest in an opening in a tree or live among boulders or rocks, bushes, with or without a nest, the nest if present in the latter habitat being only a few sticks or dry leaves. It is, however, not known to possess burrowing habits. In fact, its claws are much weaker as compared with forms well adapted to burrowing habits. Nevertheless, during a faunistic survey of Pench National

Park, Nagpur District, Maharashtra State, from 21 st February, 1973 to 4th March, 1973, the author found that the animal can also be a fairly good burrower, if soft soil is available even if its other habitats (trees, boulders, rocks and hills, etc.) are also plentiful in the area. The details of observations made on the burrowing habits of the rodent in this area are given below.

OBSERVATIONS

At night the rat was observed a number of times to come out from and enter burrows dug in sand heaps and soft soil along the forest roads in dry deciduous forest (Pl. IX). The burrows are 5 cm. to 10 cm. in diameter and about 1/3 m. below the surface of the ground. They are sometime more or less straight tunnels blind at one end but usually have a number of ramifications many of which have external openings (Fig. 1). No grass or nest was found inside. In one of the burrows a small live lizard (*Calotes* sp.) was found

and in another two large dung beetles had taken shelter. Four burrows were dug out. The rat was also trapped on the sandy bed of the Pench river, with bushes and trees around, where there were number of heaps of sand thrown by a field rat but there were no external openings as described above for the burrows of the rat. It is possible that external openings may have collapsed because of loose sand in which they were dug. Burrows were also found near human dwellings into

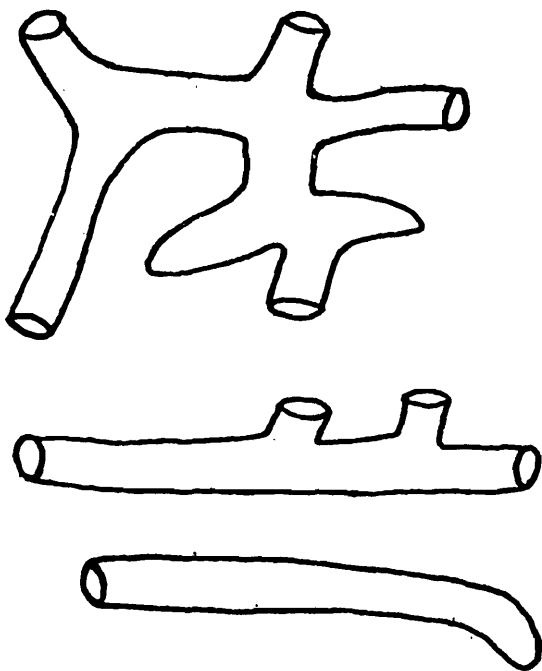


Fig. 1. Various types of burrows constructed by *Rattus blanfordi*.

which the rat is reported to enter frequently at night. It is a common rodent of the area.

Two adult females examined were not pregnant and no young ones were seen. The stomach contents of one adult male showed remains of insects and vegetable

matter. Break-neck traps with baits of slightly burnt coconut and ground nut were used for collection of the rodent.

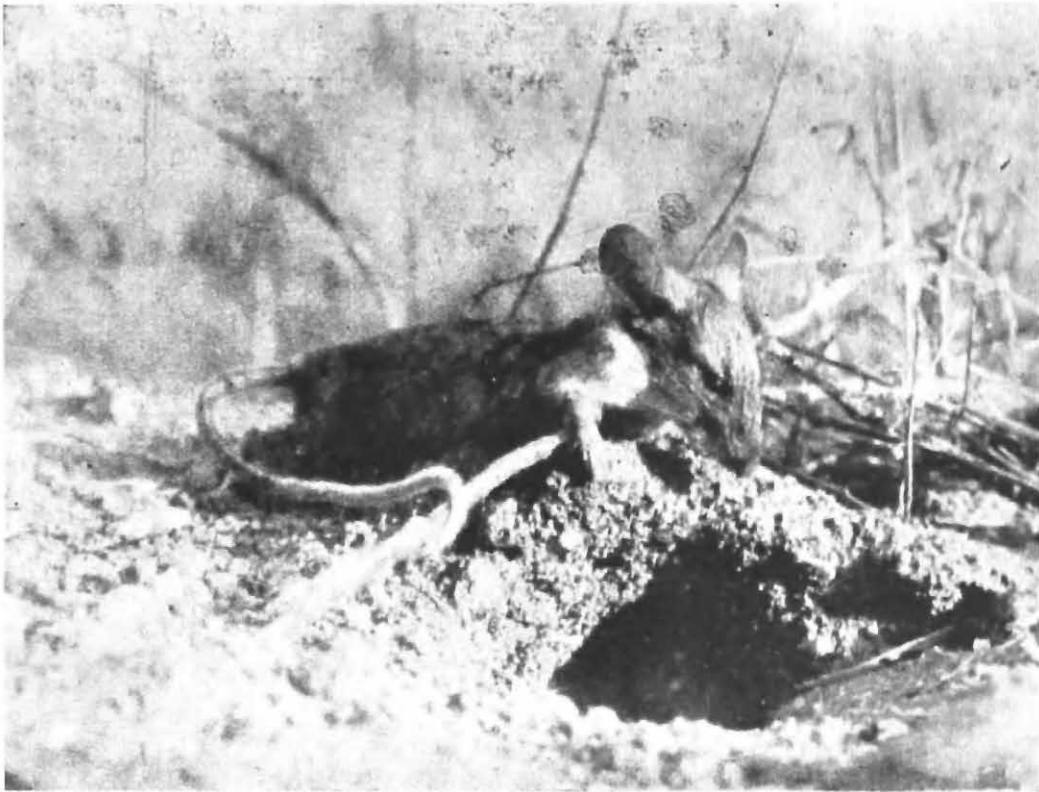
It was rather difficult to imagine as to how the inadequately protected shelters of the rodent can protect it from vagaries of weather in areas of heavy rainfall where it is also common. The answer can be found in Brosset's (1961) study according to which it seeks shelter in caves in rainy season (June-September) which also happens to be its breeding season. A comparison of the habits and important morphological characters of this rodent with those of other field rats belonging to the genus *Rattus* found in its distributional range is given in table I.

Ellerman (1961, pp. 606-607) states that it is an aberrant species with combination of character, not found in any other species of the subgenus. Brosset (1961) has, suggested, possibly on the basis of his ecological observations, that it may be possible to separate the species generically. However, on the basis of the present study, I am inclined to think that it is a generalized type keeping in view particularly its ability to colonize areas ranging from practically arid to heavy rainfall ecological conditions and its capacity to construct or select shelters of highly varied types. It is probable that the species represent a group of sibling taxa which are very rare in higher vertebrates.* Its specialized character, strongly enlarged bulla, is probably an adaptation for life in ill-protected shelters where better sense of hearing is essential. It is difficult to speculate on the adaptive signi-

* Another similar instance which has come to my notice is the tomb bat, *Taphozous longimanus* Hardwicke (Khajuria, 1975) which, however, only selects, but cannot construct, very different and several types of roosts. As a group of sibling taxa, this taxon may deserve a subgeneric rank.

KHAJURIA

PLATE IX



A freshly killed specimen of *Rattus blanfordi* near its burrow.

TABLE I. Comparison of habits and morphology of field rats of genus *Rattus* found in distributional range of *R. blanfordi*.

	<i>R. blanfordi</i>	Subgenus <i>Cremnomys</i> (<i>R. cuthicus</i> Wroughton)*	Subgenus <i>Millardia</i> , Thomas (<i>R. mellada</i> Gray)
Habitat	Rocks, hollows in trees, bushes with or without rudimentary nest, burrows in soft soil, caves in rainy season, enters human dwellings.	Rocks, possibly also a burrower	Slight hole under a bush or heap of stones, fissure in ground.
2. Food	Vegetable matter, some insects.	Unknown	Pest of paddy and cotton.
3. Reproduction	More than one litter of 2-3 young from June to October.	Unknown	2-7 litters of 1-8 young in spring and autumn
4. Social life	Usually a pair with or without young, male may live apart during infancy of young.		Pairs or small colonies
5. Distribution	Sri Lanka, Peninsular India, Bihar.	Usually arid or semi-arid areas of peninsular India, Bihar.	Sri Lanka, peninsular India, Sind, Punjab, Nepal.
6. Important morphological characters	Strongly enlarged bulla, long palatal foramen, tail tip white.	Bulla smaller, palatal foramen unusually long, palate short.	Palate long, fifth tow short, plantar pads less than six.

ficance of its hairy white tail tip, another specialized character. Hairy tail appears to be an adaptation to jumping on rocks or trees. The white tip can be imagined to be an extension of white of underparts as seen for instance, in *R. rattoides* (Hodgson) and its gradual restriction to the tail tip. I have observed on occasions the white tail tip protruding from its inadequate shelters. It is probable that it looks something unlike the tail of a rat to a predator and, thus, saves the species from their attacks. Again, the nature of its nest, which is probably constructed for the newly born young, small size of litter and restricted breeding season in caves appear to be adaptations to its inadequate shelters. The possible adaptive nature of the specialized characters

of *R. blanfordi*, should not, as in other cases, however, minimize their taxonomic importance but it may help to show that the species is not so isolated as it appears.

As Ellerman (*loc-cit*) suggestes, it may be allied to the subgenus *Cremnomys* which in my opinion is probably its offshoot adapted to semiarid conditions (Khajuria, 1955). I agree with Ellerman (*op. cit*, pp. 679 & 689) that affinities of subgenus *Cremnomys* (and, thus, of *R. blanfordi*) and of another subgenus of *Rattus*, *Millardia* Thomas, found in its range to African species of genus *Rattus* probably indicate parallelism and not closer relationship. My view is based on comparatively shorter geological history of genus

*The other species of the subgenus, *R. elvira* Ellerman, is very poorly known.

Rattus. It is, however, well known that some other Indian peninsular species do have African affinities possibly because of possible former land connection between peninsular India and Africa.

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COLLECTION OF DYTISCIDAE (COLEOPTERA) FROM MADHYA PRADESH

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ABSTRACT

In connection with my studies on Indian Dytiscidae, collections were borrowed from the Central Regional Station, Zoological Survey of India, Jabalpur. It contains 37 species spread over 14 genera. These collections are mostly confined to Jabalpur and its surrounding area which appears to be quite rich in the Dytiscid fauna. The following species constitute new records from the state. Subfamily NOTERINAE—*Canthydrus laetabilis* Walker, *C. luctuosus* (Aube), *C. morsbachi* (Wehncke); Subfamily LACCOPHILINAE—*Laccophilus basalis* Motschulsky, *L. wewalki* Vazirani; Subfamily HYDROPONINAE—*Hyphydrus flavicans* Regimbart, *Hydrovatus rufescens* Motschulsky, *H. sinister* Sharp, *Guignotus inconstans* Regimbart, *Hyphoporus severini* Regimbart, *Peschetius quadricostatus* Aube, *P. toxophorus* Guignot; Subfamily DYTISCINAE—*Hydaticus (Guignotites) incertus* Regimbart, *Rhantaticus congestus* (Klug), *Sandracottus festivus* (Illiger), *Cybister (Meganectes) concessor* Guignot, and *Cybister (Melanectes) posticus* Aube. The subfamily Colymbetinae is conspicuous by its absence and it is expected that more species will be collected in future, including this subfamily.

INTRODUCTION

This is a report on the collection of Dytiscidae received for identification from the Central Regional Station of the Zoological Survey of India, in connection with the fauna India Project. It comprises 36 species spread over 14 genera out of which 17 are being reported from Madhya Pradesh for the first time for which remarks have been given; only the material examined has been mentioned for the other species. These collections have been made over a number of years, most of which are from localities around Jabalpur and in the Districts of Narsinghpur, Mandla, Raigarh. In one case for bibliography and distribution, reference may be made to the recent Catalogue of Oriental Dytiscidae by the author (1977) the collection is from Gujarat: Broach Dist. Narbada river is the main perennial source of aquatic habitat in

the region and dispersal is presumed to be caused by its floods.

The following abbreviations have been used for the collectors.

ANTJ=A. N. T. Joseph; DKG=D. K. Ghoshal; DSM=D. S. Mathur; HK=H. Khajuria; HPA=H. P. Agrawal; HSS=H. S. Sharma; JSB=J. S. Bhatti; MLK=M. L. Koshta; NKS=N. K. Sinha; RR=Raja Ram; VSD=V. S. Durve; and VVR=V. V. Rao.

Order COLEOPTERA

Family DYTISCIDAE

Subfamily NOTERINAE

Canthydrus laetabilis Walker

Material examined: Jabalpur Dist.: 3 ex, Jabalpur, 20. i. 1967 (HK) 5 ex, Lamataghat, 11. i. 1967 (VSB); 9 ex, 7. v. 1969 (VVR), 1

ex, 14. x. 1966 (VVR); 2 ex, 14. xii. 1966 (VVR); 1 ex, Tilwaraghat, 16. iv. 1968 (HPA); 1 ex, Amkhas, 2. vi. 1971, (DKG); 20 ex, 17. ix. 1970 (VVR); 1 ex, 4. vii. 1969 (VVR); 6 ex, Shahpura, 28. i. 1967 (VSD); 1 ex, Katanga Vill., 5. ii. 1969; (HSS); 1 ex, 24. ix. 1970 (DKG); 4 ex, Bandha Vill. 3. viii. 1966 (HPA); 5 ex, Bhiloda, 13. iii. 1964 (JSB); 3 ex, Garha, 20. iv. 1966 (MLK); Suptal, 29. iv. 1968 (HPA); 3 ex, Parait nala, 31. x. 1969 (HSS); 1 ex, Panagar, 15. iv. 1968 (HPA); 2 ex, 8. i. 1969 (HPA); 1 ex, Katni road, 5. x. 1966 (VSD); 1 ex, Budagar tank, 8. x. 1974 (DSM). Mandla Dist: 1 ex, 23. x. 1963 (JSB).

Remarks: Though very common and widely distributed in India Sri Lanka, Nepal, Pakistan, Burma and Congo it is being recorded from Madhya Pradesh for the first time. Vazirani (1977: 6) has reported it from Andhra Pradesh, Assam, Bihar, Kerala, Maharashtra, Meghalaya, Gujarat, Orissa, Punjab, Rajasthan, Uttar Pradesh and W. Bengal.

Canthydrus luctuosus Aube

Material examined: Jabalpur Dist: 3 ex, Lamataghat, 11. i. 1967 (VSD); 3 ex, 14. xii. 1966 (VVR); 9 ex, 7. v. 1969 (VVR); 3 ex, Bilpather, 26. iii. 1964 (JSB); 1 ex, Madan Mahal, 3. v. 1966 (HPA); 2 ex, Katangi, 5. x. 1966 (VSD); 1 ex, Parait tank, 31. x. 1969 (HSS); 2 ex, Padaria, 14. x. 1970 (VVR); 1 ex, Garha, 20. iv. 1966 (MLK); 4 ex, Bhita, 27. xi. 1964 (RR); 3 ex, Panagar, 19. vi. 1968 (HPA); 1 ex, Amkhas, 8. v. 1968, (HPA); 4 ex, Shahpura, 28. i. 1968 (VSD); 1 ex, Tewar, 3. xi. 1966 (HSS); 2 ex, Jabalpur-Mandla road, 6. ii. 1965, (HPA).

Mandla Dist: Koschia, 28. x. 1966 (JSB); 4 ex, Garakhpur, 23. x. 1963 (JSB).

Remarks: This species is quite common in the plains of India and extends in the west to Iran and in the South to Sri Lanka. In India it is so far known from Andhra Pradesh, Bihar, Kerala, Maharashtra, Tamil Nadu, Goa, Karnataka, Orissa & W. Bengal. (*Vide* Vazirani 1977: 6). It is now being reported from Madhya Pradesh for the first time.

Canthydrus morsbachi Wehncke

Material examined: Jabalpur Dist: 6 ex, Tilwara ghat, 16. iv. 1963 (HPA).

Remarks: Though very widely distributed from Congo to Indonesia it is not so common as the other 2 species of this genus recorded above. The author (1977: 7) records its Indian distribution as Kerala, Tamil Nadu, Maharashtra, Goa & Orissa. Subsequently Vazirani (in press) has recorded it from Gujarat. It is thus being now reported from Madhya Pradesh for the first time.

Laccophilus basalis Motschulsky

Material examined: Jabalpur Dist: 1 ex, Budagar tank 17. iv. 1971 (VVR); 1 ex, Shahpura, 28. i. 1967 (VSD); 1 ex, Tilwara ghat, 3. ii. 1966 (HSS); 1 ex, Panagar tank, 8. i. 1969 (HPA); 1 ex, Baleha tank, 30. xii. 1969 (HPA); 1 ex, Madan Mahal, 17. ii. 1967 (HK).

Remarks: This species is known from India: W. Bengal, Andaman Islands, Punjab, Uttar Pradesh; Sri Lanka; Indonesia: Sumatra (*vide* Vazirani 1977: 10, 94) Vazirani in press a, b, has reported it from Maharashtra and Gujarat respectively. It is thus being now reported from Madhya Pradesh for the first time, indicating that it more widely distributed in India than known earlier.

Laccophilus ellipticus Regimbart

Material examined : Jabalpur Dist : Budagar tank, 20. xii. 1969 (HPA).

Laccophilus flexuosus Aube

Material examined : Jabalpur Dist : 25 ex, Lameta ghat, 6. i. 1967 (HSS) ; 12 ex, 14. xii. 1966 (VVR) ; 20 ex, 30. i. 1967 (VVR) ; 1 ex, 11. i. 1967 (VSD) ; 8 ex, 18. x. 1966 (VSD) ; 1 ex, 16. vii. 1966 (VVR) ; 2 ex, 14. x. 1966 (VVR) ; 1 ex, 14. xii. 1966 (VVR) ; 9 ex, Amkhas, 19. viii. 1966 (HPA) ; 12 ex, Madan Mahal, 17. ii. 1967 (HK) ; 60 ex, 20. x. 1964 (HPA) ; 5 ex, Patan Vill. 26. vii. 1966 (HPA) ; 2 ex, Bilpather, 18. iii. 1967 (VSD) ; 6 ex, Heron, R., 5. x. 1966, (VSD) ; 5 ex, Gandhigram, 5. viii. 1966 (VVR) ; 7 ex, Shahpura, 28. i. 1961 (VSD) ; 1 ex, 8. iii. 1968 (VSD) ; Jabalpur, 29. iv. 1970 (VVR) ; 2 ex, Budagar tank, 20. xii. 1969 (HPA). Raigarh Dist : 1 ex, Malwara, 17. ii. 1971 (DKG).

Laccophilus inefficiens Walker

Material examined : Jabalpur Dist : Lamata ghat, 31. ii. 1967 (VVR) ; 2 ex, 6. i. 1967 (HSS) ; 4 ex, 11. i. 1967 (VSD) ; 3 ex, 14. xii. 1966 (VVR) ; 1 ex, Parait Nala, 15. i. 1970 (HPA) ; 1 ex, Madan Mahal, 17. ii. 1967 (HK) ; 2 ex, Patan, 26. vii. 1966 (HPA) ; 3 ex, Bhita, 27. xi. 1964 (RR) ; 1 ex, Tilwara ghat, 16. iv. 1969 (HPA) ; 1 ex, Jabalpur-Mandla road, 6. ii. 1965 (HPA) ; 1 ex, Bilpather, 18. iii. 1967 (VSD) ; 10 ex, Shahpura, 28. 1. 1967 (VSD) ; 1 ex, Bangar, 8. i. 1969 (HPA).

Narsinghpur Dist : Barman Bridge, 16. xii. 1966 (HK).

Raigarh Dist : 2 ex, Malwara, 17. ii. 1971 (DKG).

Laccophilus parvulus Aube

Material examined : Jabalpur Dist : 2 ex, Jabalpur, 20. i. 1967 (HK) ; 3 ex, Panagar, 20. ii. 1968 (HPA) ; 4 ex, 8. i. 1969 (HPA) ; 1 ex, 19. vi. 1968 (HPA) ; 4 ex, Patan, 26. vii. 1968 (HPA) ; 1 ex, Lamata ghat, 6. i. 1967 (HSS) ; 1 ex, 14. xii. 1966 (VVR) ; 1 ex, 11. i. 1967 (VSD) ; 1 ex, Parait Nala, 15. i. 1970 (HPA) ; 1 ex, Shahpura, 28. i. 1967 (VSD) ; 5 ex, Madan Mahal, 17. ii. 1969 (HK) ;

Mandla Dist : 2 ex, Garakhpur, 23. x. 1963 (JSB).

Raigarh Dist : 13 ex, Malwara, 17. ii. 1971 (DKG)

Laccophilus sharpi Regimbart

Material examined : Jabalpur Dist : 1 ex, Jabalpur, 20. i. 1967 (HK) ; 1 ex, Budagar tank, 14. iv. 1970 (VVR) ; 2 ex, Shahpura, 28. i. 1967 (VSD) ; 1 ex, Lamata ghat, 16. vii. 1966 (VVR) ; 1 ex, 11. i. 1967 (VSD) ; 2 ex, Bilpather, 18. iii. 1967 (VSD) ; 1 ex, Amkhas, 2. vi. 1971 (DKS) ; 2 ex, Baleha tank, 30. xii. 1969 (HPA) ;

Raigarh Dist : 18 ex, Malwara, 17. ii. 1971 (DKG).

Laccophilus wewalki Vazirani

Material examined : Jabalpur Dist : 2 ex, Parait R., 5. x. 1966 (VSD) ; 1 ex, Bangar Vill., 8. i. 1969 (HPA).

Remarks : Recently described by the author (1974 : 487), it is so far known only from its Types locality Goa. The present record indicates its wider distribution in India.

Neptosternus circumductus Regimbart

Material examined : Jabalpur Dist : 35 ex, Parait R., 5. 10. 1966 (VSD).

Subfamily HYDROPORINAE

Hyphydrus (Apriophorus) renardi Severin

Material examined : Jabalpur Dist : 1 ex, Jabalpur, 20. i. 1967 (HK) ; 8 ex, 28. iv. 1966 (HK) ; 1 ex, Jabalpur, Heron R., 13. iii, 1964 (JSB) ; 1 ex, Tilwara ghat, 16. iv. 1968 (HPA) ; 1 ex, Budagar tank, 17. i. 1970 (HSS) ; 1 ex, 20. xii. 1969 (HPA) ; 2 ex, Bhita, 27. xi. 1966 (VVR) ; 4 ex, Lamata ghat, 14. x. 1966 (VVR) ; 2 ex, 15. vi. 1966 (VSD) ; 2 ex, Bheraghat, 23. iv. 1970 (HPA) ; 1 ex, Panagar, 19. vi. 1968 (HPA) ; 7 ex, 8. i. 1969 (HPA) ; 29 ex, 20. ii. 1968 (HPA) ; 1 ex, Madan Mahal, 17. ii. 1967 (HK) ; 3 ex, 20. x. 1964 (HPA) ; 1 ex, Bilpather, 26. iii. 1964 (JSB) ; 8 ex, Shahpura, 18. iii. 1967 (VSD) ; 1 ex, Parait R., 5. x. 1966 (VSD) ; 4 ex, Amkhas, 19. viii. 1966 (HPA) ; 1 ex, Gandhigram, 7. ii. 1968 (VVR).

Narsinghpur Dist : Barman Bridge, 16. xii. 1966 (HK).

Hyphydrus (Apriophorus) flavicans Regimbart

Material examined : Jabalpur Dist : 1 ex, Jabalpur, 20. i. 1967 (HK) ; 9 ex, Madan Mahal, 1. iv. 1966 (HPA) ; 1 ex, Amkhas 19. viii. 1966 (HPA).

Remarks : It is known from India : Bihar, New Delhi, Punjab, Uttar Pradesh, Tamil Nadu, Orissa, Rajasthan, Gujarat ; Pakistan (*vide* Vazirani 1977 : 21,95). It is now being reported from Madhya Pradesh for the first time.

Hydrovatus rufescens Motschulsky

Material examined : Jabalpur Dist : 1 ex, Tilwara ghat, 16. iv. 1969 (HPA) ; 4 ex, Gwari ghat, 23. iv. 1966 (HK).

Remarks : Vazirani, 1975 records it from New Delhi. Earlier no definite locality was reported from India. This constitutes its

first record from Madhya Pradesh. It is also known from Burma (Pegu).

Hydrovatus sinister Sharp

Material examined : Jabalpur Dist : 2 ex, Gwari ghat, 23. iv. 1966 (HK).

Remarks : The author (1977 : 30) has reported it from India : W. Bengal ; Sri Lanka ; Indonesia : Borneo. Its present record fills the gap between W. Bengal & Sri Lanka.

Guignotus flammulatus (Regimbart)

Material examined : Jabalpur Dist : 1 ex, Jabalpur, 20. i. 1967 (HK) ; 1 ex, Panagar, 8. i. 1969 (HPA) ; Jabalpur-Mandla road, 6. ii. 1965 (HPA).

Raigarh Dist : Malwara, 6. ii. 1965 (HPA).

Guignotus inconstans (Regimbart)

Material examined : Jabalpur Dist : 1 ex, Jabalpur, 17. v. 1970 (VVR) ; 2 ex, Bhelawadari, 13. iii. 1964 (JSB).

Mandla Dist : 4 ex, Korhia 28. x. 1963 (JSB) ; 2 ex, Garakhpur, 23. x. 1963 (JSB).

Raigarh Dist : 1 ex, Malwara, 17. ii. 1971 (DKG).

Remarks : This species is quite widely distributed between India & Indonesia. The author 1977 : 33,97 records it from India : Bihar, Orissa, Rajasthan, Maharashtra, Goa, Tamil Nadu and Karnataka. It is being reported from Madhya Pradesh for the first time. It has also been recorded from Gujarat by the author (in press).

Guignotus pendjabensis Guignot

Material examined : Jabalpur Dist : 1 ex, Tilwara ghat, 16. iv. 1968 (HPA) ; 1 ex, Heron R., 13. iii. 1964 (JSB)

Raigarh Dist : 1 ex, Malwara, 17. ii. 1971 (DKG).

Hyphoporus severini Regimbart

Material examined : Jabalpur Dist : 13 ex, Jabalpur, 23. ii. '71 (HK) ; 13 ex, Bhera ghat 23. iv. 1970 (HPA) ; 5 ex, 28. iv. 1970 (HPA) ; 1 ex, Devas, 5. i. 1966 (HK) ; 3 ex, Shahpura, 10. v. 1968 (VSD) ; 1 ex, Lamata ghat 14. x. 1966 (VVR) ; 1 ex, i. iv. 1966 (HPA) ; 1 ex, 18. iii. 1967 (VSD) ; 1 ex, Jabalpur, 29. iv. 1970 (VVR) ; 1 ex, Katangi, 15. vi. 1966 (HSS) ; 1 ex, Heron R., 13. iii. 1964 (JSB) ; 10 ex, Gwari ghat, 23. iv. 1966 (HK).

Amroti Dist : 1 ex, Chikhaldia, 22. ii. 1971 (HK).

Remarks : As shown by the author (1977 : 47, 97), this species occurs from Afghanistan to Bangla Desh. In India it is so far known from Bihar, Rajasthan, New Delhi, and Uttar Pradesh. It has subsequently been recorded from Maharashtra (Vazirani in press). It is thus being reported now from Madhya Pradesh for the first time.

Hyphoporus sp.

Material examined : Jabalpur Dist : 1 ex, Madan Mahal, 11. ii. 1967 (HK) ; 1 ex, Budagar, 21. xi. 1974 (DSM) ; 1 ex, Panagar 15. iv. 1968 (HPA) ; 1 ex, Bandha, 3. viii. 1966 (HPA).

Herophydrus musicus (Klug)

Material examined : Jabalpur Dist : 1 ex, Budagar, 16. xii. '69 (HSS) ; 1 ex, 12. v. 1970 (VVR) ; 1 ex, Bhera ghat, 24. ix. 1976 (HPA).

Peschetius quadricostatus Aube

Material examined : Jabalpur Dist : 1 ex, Shahpura, 8. iii. '68 (VSD) ; 2 ex, 18. iv. 1968, (VSD).

Remarks : It is so far known in India from, Bihar, New Delhi, Maharashtra, Goa, Kerala, Tamil Nadu, Gujarat, Orissa and

Uttar Pradesh. It is now being reported from Madhya Pradesh for the first time.

Peschetius toxophorus Guignot

Material examined : Amroti Dist : 1 ex, Chikhaldia, 22. ii. 1971 (HK).

Remarks : So far recorded in India from, Bihar, Orissa, Rajasthan, Gujarat, Karnataka, Kerala & Tamil Nadu, it is now being reported from Madhya Pradesh for the first time.

Subfamily DYTISCINAE

Evetes sticticus (Linnaeus)

Material examined : Jabalpur Dist : 10 ex, Panagar, 27. ii. '68 (HPA) ; ex, Jabalpur, 29. iv. 1970 (VVR) ; 3 ex, 20. iv. 1966 (MLK) ; 5 ex, 6. vii. 1966 (HPA) ; 5 ex, 29. iv. 1970 (VVR) ; 2 ex, Lamata ghat, 14. x. 1966 (VVR) ; 2 ex, Patan, 26. vii. 1966 (HPA).

Amroti Dist : 1 ex, Chikhaldia, 22. ii. 1971 (HK).

Hydaticus (Guignotites) incertus Regimbart

Material examined : Jabalpur Dist : 1 ex, Devas, 5. i. 1966 (HK) ; 1 ex, Budagar, 16. xii. 1969 (HSS) ; 1 ex, Amkhas, 16. iv. 1966 (HPA), 2 ex, Baleha tank, 30. xii. 1969 (HPA).

Remarks : This species is very common & widely distributed in India, Pakistan & Nepal, Sri Lanka, Thailand, Malaysia. It is replaced to the west by *H. ponticus* Sharp and to east by *H. fabricii* Macleay & *H. rhantoides* Sharp. In India it is reported from Assam, Bihar, New Delhi, Himachal Pradesh, Tamil Nadu, Gujarat, Maharashtra, Goa, Orissa, Punjab, Rajasthan, W. Bengal, Manipur & Sikkim. It is now being reported from Madhya Pradesh for the first time.

Hydaticus (G.) luczonicus Aube

Material examined : Jabalpur Dist : 2 ex, Shahpura, 10. v. 1968 (VSD) ; 4 ex, Bhita, 27. xi. 1964 (RR) ; 1 ex, Tamar R., 26. vii. 1972 (NKS) ; 1 ex, Lamata ghat, 31. i. 1967 (VVR).

Mandla Dist : 2 ex, Kisli market Road, 18. ii. 1974 (NKS).

Hydaticus (G.) vittatus (Fabricius)

Material examined : Jabalpur Dist : 4 ex, Shahpura, 10. v. 1968 (VSD).

Rhantaticus congestus (Klug)

Material examined : Jabalpur Dist : 1 ex, Panagar, 8. i. 1967 (HPA) ; 1 ex, Patan, 26. vii. 1969 (HPA) ; 1 ex, Madan Mahal 20.x 1964 (HPA) ; Garha Vill., 20. iv. 1966 (MLK).

Raigarh Dist : Malwara, 17. ii. 1971 (DKG).

Remarks : This is very widely distributed species from Africa to Australia & in India, it is known from Andhra Pradesh, Bihar, Uttar Pradesh, New Delhi, Orissa, Rajasthan, Maharashtra and W. Bengal. The present record though first from Madhya Pradesh just fills a gap in its known distribution.

Sandracottus dejeani (Aube)

Material examined : Jabalpur Dist : 10 ex, Lamata ghat, 7. vi. 1968 (VSD) ; 14 ex, Gwari ghat, 23. iv. 1966 (HK) ; 7 ex, Anala, 14. x. 1970 (VVR) ; 5 ex, Shahpura, 10. v. 1965 (VSD) ; 11 ex, 10. v. 1968 (VSD) ; 2 ex, 18. iii. 1967 (VSD) ; 8 ex, Dagmaga, 31. v. 1965 (HPA) ; 1 ex, 31. v. 1965 (HPA) ; 1 ex, Bhita, 27. xi. 1964 (RR) ; 1 ex, Madan Mahal, 16. vii. 1965 (MLK). Amroti Dist : 1 ex, Chikhaldia, 22. ii. 1971 (HK).

Hoshangabad Dist : 14 ex, Hoshangabad, 1. i. 1966 (HK).

Narsinghpur Dist : 17 ex, Barman Bridge, 8. xii. 1964 (ANTJ).

Sandracottus festivus (Illiger)

Material examined : Jabalpur Dist : 2 ex, Panagar tank, 27. vii. 1968 (HPA) ; 2 ex, Adhartal, 19. viii. 1968 (VSD) ; 6 ex, Dogmaga 31. v. 1965 (HPA).

Remarks : It is known from India, Pakistan. Sri Lanka & China. In India it has been reported from Himachal Pradesh, Andhra Pradesh, Bihar, Orissa, Punjab and Tamil Nadu. It is less common than *dejeani* which has more or similar distribution in India but has not yet been reported from Sri Lanka or China.

Cybister (Melanectes) posticus Aube

Material examined : Jabalpur Dist : 1 ex, Budagar, 22. iv. 1968 (HPA).

Remarks : So far known only from Eastern states in India *viz.*, Himachal Pradesh, Assam, Manipur, W. Bengal and Maharashtra, the present record fills a gap in its wide range of distribution. It also occurs in Bangla Desh.

Cybister (Melanectes) sugillatus Erichson

Material examined : Jabalpur Dist : 1 ex, Budagar, 30. vii. 1969 (HSS).

Cybister (Meganectes) concessor Guignot

Material examined : Jabalpur Dist : 3 ex, Padaria Vill., 17. iv. 1965 (HPA) ; 1 ex, 23. i. 1965 (HPA).

Remarks : This is its first record since it was described from Tamil Nadu. Its male genitalia (penis) is figured here for the first time. This species is very difficult to separate from *tripunctatus asiaticus* from which it can be separated only in the male sexual characters (a) the basal segment of the mesotarsi is without sexual pubescence (b) different shape of penis.

TABLE 1.

Name of Species	ORIENTAL													REMARKS
	ETHIOPIAN	PALAEARCTIC	Ceylonese subreg.			Indo-chinese subreg.			Malaysian subreg.				AUSTRALIAN	
			Ceylon	India S. of Mysore	Indian subreg.	N. E. India	Burma	Thailand	Indo-china	Malaysia	Indonesia	Phillipine		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
NOTERINAE														
<i>Oanthhydrus laetabilis</i>	x		x	x	x	x	x							Congo
<i>O. luctuosus</i>		x	x	x	x									Iran
<i>O. morsbachi</i>	x		x		x		x		x					Congo
LACCOPHILINAE														
<i>Lacophilus basalis</i>			x		x									Andaman Islands
<i>L. ellipticus</i>			x	x	x	x	x		x					China
<i>L. inefficiens</i>			x	x	x	x				x				
<i>L. flavianus</i>		x	x	x	x		x		x	x				Iran, Iraq, Hongkong, Japan
<i>L. parvulus</i>			x	x	x	x	x		x	x				
<i>L. sharpi</i>		x	x	x	x	x	x		x					x Nepal, S. China, Japan, Iraq
<i>L. wevallei</i>					x									
<i>Neptosternus circumductus</i>				x	x									
HYDROFORINAE														
<i>Hyphydrus flavicans</i>				x	x									Pakistan
<i>Hyphydrus pictus gebluendtneri</i>		x			x									Simla hills
<i>Hydrovatus rufescens</i>					x									
<i>H. sinister</i>				x	x									
<i>Guignotus flammulatus</i>		x	x		x	x	x	x	x					S. China, Japan
<i>G. inconstans</i>			x	x	x	x	x							
<i>G. pendjabensis</i>					x									Pakistan, Bangla Desh
<i>H. elevatus</i>					x									
<i>H. severini</i>			x		x									Afghanistan
<i>Herophydrus musicus</i>		x	x	x	x	x	x							
<i>Peschellus quadricostatus</i>					x	x								
<i>P. toxophorus</i>					x	x								

contd.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
DYTISOINAE														
<i>Eretes sticticus</i>	x	x	x	x	x	x	x	x	x	x	x	x	x	Cosmopolitan
<i>Hydaticus incarpus</i>			x	x	x	x	x							
<i>H. luczonicus</i>			x		x			x	x			x		
<i>H. vittatus</i>		x	x	x	x	x	x							Kashmir
<i>Rhantaticus congestus</i>	x			x	x	x					x	x	x	
<i>Sandracottus dejeani</i>					x									
<i>S. festivus</i>			x	x	x									
<i>Cybister posticus</i>		x			x	x								
<i>C. sugillatus</i>				x	x	x	x		x	x		x		Japan, China
<i>C. concessor</i>				x	x									
<i>C. pectoralis</i>					x									
<i>C. tripunctatus asiaticus</i>		x	x	x	x	x	x	x	x	x	x	x	x	Andaman Islands.
<i>C. ventralis</i>			x	x	x	x	x							
	x	5	10	19	25	40	17	17	6	11	6 ^x	11	6	3

Cybister (Meganectes) limbatus (Fabricius)

Material examined: Jabalpur Dist: Bhera ghat, 15. v. 1969 (VSD); 1 ex, Parait, 12. vi. 1968 (HPA); 1 ex, Tilwara ghat, 12. ii. 1970 (HPA); 1 ex, Amkhas, 23. v. 1968 (HSS).

Cybister (Meganectes) tripunctatus asiaticus Sharp

Material examined: Jabalpur Dist: 1 ex, Budagar, 17. iv. 1971 (VVR); 2 ex, 12. v. 1970, (VVR); 1 ex, 4. v. 1968 (HPA); 1 ex, 14. ii. 1970 (VVR); 1 ex, 19. ii. 1970 (VVR); 7 ex, 22. iv. 1968 (HPA); 1 ex, Panager, 8. i. 1969 (HPA); 4 ex, Tilwara ghat, 17. iii. 1970 (HPA); 4 ex, 12. ii. 1970 (HPA); 1 ex, Amkhas, 6. iii. 1967 (VSD); 1 ex, 23. v. 1968 (HSS); 3 ex, Padaria, 23. i. 1969 (HPA); 2 ex, Borela tank, 29. v. 1974 (DSM).

Cybister (Meganectes) ventralis Sharp

Material examined: Jabalpur Dist.: 1 ex, Budagar, 30. viii. 1969 (HSS).

The other species reported from Madhya Pradesh but not represented in the present collections are *Hyphodrus (Apriophorus) pictus gschwendtneri* Guignot, *Clypeodytes indicus* (Regimbart), *Hyphoporus aper* Sharp, *H. elevatus* Sharp, *Cybister (Meganectes) pectoralis* Sharp, thus bringing the number of species known from the state to 40%.

GEOGRAPHICAL DISTRIBUTION

About 40 species have been reported from Madhya Pradesh to this date, constituting nearly 25% the species known from Indian subregion, excluding Ceylon and Burma. An analysis of the distribution of species shows

that 37.5% of the species extend their distribution to the Indo-Chinese/Indo Malaysian subregions, while 25% of the species extend to the Himalayan part of Palearctic region or extend further west and only 12.5% of the species extend to the Ethiopian region. The genus *Peschetius* has also Ethiopian affinities. Only two species viz., *Eretes stictictus* & *Rhantaticus congestus* are almost cosmopolitan. Thus the fauna of this area has greater affinities to the Indo-Chinese/Indo-Malaysian subregions than to the Ethiopian or Palearctic regions. 25% of the species are endemic to the area.

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Bull. zool. Surv. India, 3 (3) : 267-268, 1981

NEW RECORD OF THE SHORT-TAILED BANDICOOT RAT, *NESOKIA INDICA INDICA* GRAY (RODENTIA : MURIDAE) FROM BIHAR

The short-tailed Bandicoot Rat, *Nesokia indica indica* Gray is distributed in India from Kumaun (U. P.), west into the arid region of the Punjab, Haryana, Delhi, Rajasthan etc. (Ellerman and Morrison-Scott, 1951 ; Ellerman, 1961 and Biswas and Tiwari, 1966). It is recently recorded from Nepal (Tamispur-Nawalpur, Parsi) by Agrawal and Chakraborty (1971) but hitherto unknown from Bihar and the remaining parts of India.

Recently one male and one female of this Bandicoot Rat were obtained on 28th May 1979 from Brahabatta, Ca. 12 km. S. E. of Mahuwa, Vaishali District, north of the Ganga river from burrows in a wheat field after harvesting. It was also seen in other crop fields, e.g., Moong (*Phaseolus aureus*) and Jowar (*Sorghum vulgare*).

This bandicoot rat is eaten by Moosahar caste in the villages. These people have adopted a very good method for the collection of this rat in the area. They generally take a long and thin stick and push it very deep in the burrow and allow to remain. After sometime the stick is drawn by the rat and as soon as the movement of the stick is seen, people dig the rat out of the burrow.

Measurements (in mm.) : 1 ♂, 1 ♀ : The figures in parentheses are for female.

Head and body 161 (145) ; tail 98 (85) ; ear 20 (18) ; hindfoot 30 (29) ; occipitonasal length 37.2 (35) ; palatal length 22.5 (21.5) ; length of anterior palatal foramina 5.4 (5) ; Bulla (length) 8.2 (8.7) ; length of molar tooth row 7.8 (8) ; nasal length 13 (10.5) ; greatest zygomatic width 23.2 (22) ; least interorbital width 6.2 (6) ; length of diastema 12.2 (12) ; length of mandible 23.3 (24).

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Bull. zool. Surv. India, 3 (3) : 269-270, 1981

NEW RECORDS OF NEUROPTERA : PLANIPENNIA FROM THE LACCADIVE ISLAND, INDIA, COUPLED WITH A SHORT NOTE ON THE TAXONOMIC VARIATION OF *CENTROCLISIS EUSTALACTA* (GERST.)

The paper communicates an important observation of zoo-geographical interest on two species, *Ankylopteryx octopunctata* (Fabricius) of the family *Chrysopidae* and *Centroclisis eustalacta* (Gerstaecker) of the family *Myrmeleonidae*, together with a brief taxonomical note on the latter. Of these, the first species is hitherto known to be rather wide spread from China and Rhotung to Maharashtra, South India and also the Andaman, Malayan and Papuan groups of islands, while the second one is confined in the Indian subregion including Uttar Pradesh and Sri Lanka.

The material have been collected by Sri B. P. Halder of Zoological Survey of India (Z. S. I.) from the Androth Island, Laccadive, 'at light'—on 21st December, 1979. The collections seem to be rather stray from the hitherto unexplored Island as a whole. Majority of the elements belonging to the genera *Ankylopteryx* Brauer and *Centroclisis* Navas were described by various workers from the Old World and only 3 species of each genus were known so far from India. The former genus is known to extend from the Ethiopian Region in the west as far as upto the Malayan and Papuan groups of

Islands in the east through India and the latter, from part of the Palaearctic region including Arab and also Ethiopian upto the Indian subregion of the Oriental Region proper.

Presently, both the species under study constitute new locality records for the aforesaid Island which is located in the Arabian sea within the jurisdiction of India.

Taxonomically, *Centroclisis eustalacta* (Gerstaecker) shows an interesting variation at the generic level. Holzel (1972) distinguished 3 genera, viz., *Acanthaclisis* Rambur, *Centroclisis* Navas and *Syngenes* Kolbe, by the presence of double and single series of cells in the costal field throughout, and double series of them only in the distal half of forewing respectively. As to the disposition of cells in the costal field on forewing of the first genus, as mentioned by Holzel (*loc. cit.*), the author is fully agreeable. But, regarding the foregone character particularly for the last genus, the specimens of which have not been seen by the author, it is, however, not clear to him about the exact range of "distal half". Also in the second genus, the author has come across certain deviations of this character, for example, two series of variable number

of cells in the distal half near the pterostigma not only in some of the specimens available in the National Collections at Z. S. I., but also on each of the forewings of the individual specimens from Laccadive and other areas of India, though a few others of the species exhibit the character as given by Holzel (*loc. cit.*). The reasons for such variations being not yet known, the author, however, has considered the species under the genus *Centroclysis* Navas at least from the view point of the other identical characters.

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S. K. GHOSH

Bull. zool. Surv. India, 3 (3) : 271-272, 1981

REPORT ON THE OCCURRENCE OF THE LITTLE INDIAN FIELD MOUSE, *MUS BOODUGA BOODUGA* (GRAY) IN ARUNACHAL PRADESH, INDIA

While examining a small collection of rodents from Arunachal Pradesh, present in the Zoological Survey of India, Calcutta, a small grey-bellied mouse with bi-coloured tail was found. On closer examination it turned out to be an example of the Little Indian Field Mouse, *Mus booduga booduga* (Gray).

According to authoritative literature (Blyth, 1863; Sclater, 1891; Blanford, 1891; Hinton and Lindsay, 1926; Roonwal, 1950; Ellerman and Morrison-Scott, 1951; Ellerman, 1963; Biswas and Tiwari, 1969), *Mus booduga booduga* (Gray), occurs throughout India except in such northeastern hill states as Arunachal Pradesh, Nagaland, Manipur and Mizoram. Although Kurup (1968) mentioned its occurrence in Mishmi Hills, Arunachal Pradesh, I have not been able to trace any such record from the extant literature, nor could find any such specimen. It would appear, therefore, that Kurup (1968) had mentioned it erroneously, not based on any definite record. Hence the present material of this species from Tarajuli, Subansiri District, Arunachal Pradesh, would constitute its first authentic record from this area.

The details of the specimen are given below. The external measurements were taken

in the field by the collector which have been noted in millimetres.

Material : 1 ♂ ; Zoological Survey of India Registration Number 20576 ; in alcohol ; 25 January 1978 ; S. S. Saha collector.

Measurements ; External : Head and body 58.0 ; tail 50.0 ; hindfoot 15.0 ; ear 10.5.

Cranial : Occipitonasal 17.5 ; condylobasal 16.9 ; nasal 6.1 ; palate 8.7 ; bulla 3.4 ; molar tooth row 3.1 ; anterior palatal foramina 4.1 ; diastema 4.6.

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Zoological Survey of India,
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AJOY KUMAR MANDAL

Bull. zool. Surv. India, 3 (3) : 273-274, 1981

A CASE OF AN ABNORMAL DEVELOPMENT OF A FORELIMB IN A
FAWN-COLOURED MOUSE, *MUS CERVICOLOR* HODGSON

Although some instances of abnormalities in the limb bones of mammals particularly of rodents are known from literature (Hütter, 1950 and Deol, 1957). However, no case of anomaly in the limb bones of the Fawn-coloured Mouse, *Mus cervicolor* Hodgson, has so far been recorded. The present finding of an example of anomalous forelimb in a specimen of the mouse, is, therefore, of considerable interest.

While working on a small collection of mammals from Bikaner, Rajasthan, made by Dr. P. D. Gupta of the Gangetic Plains, Regional Station, Zoological Survey of India, Patna, (date of collection 15th February 1962) the author came across a very interesting male specimen of the Fawn-coloured Mouse, *Mus cervicolor* Hodgson, Z. S. I. Registration No. 19936, in which the forelimbs were unequal in size, the right one being normal in size and shape, while the left was unusually short (Pl. X). From measurements it was found that the two humerii were more or less normal in size, only the left humerus is 0.5 mm shorter than the right one. The right humerus differs in structure from that of the left one by having an ill-developed deltoid ridge. The radius and ulna of the

left forelimb were much shorter, at least by 3.00 mm, than those of the right one, and were also weaker. They were found lying just by the side of the humerus. The position of the fore-and hindlimbs was another interesting feature. In normal condition the right and left humerii and also the right and left femora are found to be situated in the same horizontal level, but in this case the right humerus and femur have been shifted somewhat forward in relation to that of the left humerus and femur.

It is difficult to say anything definite about the cause of the above-mentioned abnormality. However, this abnormality might have taken place due to some accident during the early part of its life, as a result of which the radius and ulna got detached from the humerus and failed to grow in the normal way.

Measurements :

	Right forelimb	Left forelimb
Humerus	11.9 mm	11.4 mm
Radius and Ulna	14.6 mm	11.6 mm

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PLATE X



A dissected specimen of the Fawn-coloured Mouse showing the unequal growth of the radii.

Bull. zool. Surv. India, 3 (3) : 275-276, 1981

ON A RECORD OF THE RARE FISH *OXUDERCES DENTATUS* (PISCES : GOBIIDAE)
FROM JAMBU ISLAND, WEST BENGAL

Oxuderces dentatus Eydoux & Souleyet, 1842 is known so far from Madras (India), Indonesia (Pulu Weh and Java), Thailand (Paknam and off mouth of Meklong), Macao and China (Foochow, Feng-hsien, Feng-hsien and Amoy) (Springer, 1978). It is worth mentioning here that *O. dentatus* has all along been misidentified with *Apocryptes cantor*^{*} Day, 1871 (type species of *Apocryptichthys* Day, 1876). As a result, the above records of *O. dentatus* have been published either as that of *A. cantor* or as other species of *Apocryptichthys*.

Two well preserved specimens of *Oxuderces dentatus* were obtained during a recent collection of gobiid fishes from the Gangetic delta (West Bengal). Subsequent to Day (1876), this rare fish has not been recorded so far from Indian waters. The present record of *O. dentatus* from West Bengal, therefore, forms the second report of this species from India and also extends its range of distribution further north-eastwards to West Bengal.

A brief description of *O. dentatus* is given below.

***Oxuderces dentatus* Eydoux & Souleyet, 1842**

Oxuderces dentatus Eydoux & Souleyet, 1842, *Zoologie*, 1 (2) : 182 ; pl. 8, fig. 2 [Orig. descr. ; Macao ; holotype in Museum National d'Histoire Naturelle, Paris].

Material : Two specimens, 60-70 mm standard length ; from a shallow depression at the muddy bank of Cheena river at Jambu Island in the Gangetic delta, West Bengal (Lat. 21° 34' N., Long. 88° 16' E.) ; Sept. 7, 1974 ; coll. T. K. Chatterjee ; ZSI Regd. No. 7391/2.

Description : Dorsal VI, 27 ; Pelvic I, 5 ; Anal I, 25 ; Pectoral 22 ; Caudal 16. Body elongated, somewhat compressed ; head somewhat depressed, lower surface flat. Depth of body 15.1-16.7, length of head 25.0—27.4 ; both in percentage of standard length. Eye diameter 7.3—7.5 per cent head length. Mouth wide, nearly horizontal ; posterior end of maxillary reaching far beyond eye.

Gill opening restricted, extending dorsally from the point somewhat dorsal to ventral fin origin to opposite level of about sixth to eighth from ventralmost pectoral fin-ray.

^{*}*Apocryptes cantor* is placed under genus *Boleophthalmus* Valenciennes, 1837 (Springer, 1978).

Apocryptichthys cantor [Not Day, 1871] Day, 1876, *Fish. India*, (2) : 302 [in part ; Madras].

Apocryptichthys sericus Herre, 1927, *Monogr. Bur. Sci. Manila*, (23) : 264 ; pl. 21, fig. 1 [Amoy ; type not extant].

Apocryptichthys livingstoni Fowler, 1935, *Proc. Acad. nat. Sci. Philad.*, 87 : figs. 131-132 [Paknam, Siam ; holotype in Academy of natural Sciences, Philadelphia].

Very small scale pouches visible on the posterior half of body, becoming larger posteriorly; a few cycloid scales on caudal peduncle. No scale or scale pouch visible on head.

Teeth in jaws uniserial. All teeth with obtuse tips; front teeth in upper jaw strong canines; teeth in lower jaw more or less laterally projected, longer than small teeth of upper jaw.

Colour in alcohol: Light violet. Sides of head with brownish spots. Caudal fin deep brown, other fins yellow. A brownish blotch at the posterior extremity of dorsal fin.

Remarks: In original description, *Oxuderces dentatus* was described as lacking pelvic fins and having six spines in the anal fin. Springer (1978) after examining the holotype of *O. dentatus*, states that it is a malformed specimen, and that normally the pelvic fins are present. The presence of six anal spines is an error. These are the major sources of the taxonomic confusion surrounding *O. dentatus*. Moreover, one of the specimens of *A. cantoris* on which Day (1876) based his

genus *Apocryptichthys*, was determined by Springer (1978) as *Oxuderces dentatus*. As a result, *O. dentatus* has often been confused with *Apocryptes cantoris*.

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A SIMPLE TECHNIQUE FOR PREPARATION OF SOMATIC CHROMOSOMES OF APHIDS

A simple squash technique for preparation of somatic chromosomes of aphids is described. The embryos are dissected in 0.67 N. NaCl and are treated with 0.9% Tri Sodium Citrate Solution and fixed in 1 : 3 Acetic acid & methanol. Squash is made in 50% Acetic acid and the slides are stained with 2% Giemsa.

The techniques for preparation of aphid chromosomes were tried since 1905 (Stevens 1905, 1909; Morgan 1909). However the detailed account of aphid chromosomes was given by Shinji (1931) for the first time, using Ringer's solution and Carnoy's (Acetoalcohol and Chloroform) mixture as fixative. The stains used in his studies were Hematoxylin, Orange G, and Acid fuchsin. All these workers based their studies on sectioned material. The squash method was first tried by Smith (1947) using Osmic acid as fixative and Acetocarmine as stain. Dionne and Spicer (1957) advocated the use of Acetoalcohol and chloroform as fixative and staining with Gomori's Hematoxylin after hydrolysis in Hydrochloric acid. Harper and Mac Donald (1965), Sun and Robinson (1966) used Feulgen stain simultaneously. Blackman (1976) introduced Giemsa as a stain, however, his earlier studies (1971-1974) were based on rapid Feulgen squash techniques. More recently Kurl and Narang (1978) have described an air dry technique for cytological preparations which seems to be similar to our method in general except in minor details.

The present technique described here has been in vogue in the Cytotaxonomy laboratory of the Zoological Survey of India, which is simpler in every respect. Slides prepared by this technique have shown good results with satisfactory chromosome spreads revealing their detail morphology.

The embryos are taken out in 0.67 N. NaCl. After two or three minutes these embryos are transferred to hypotonic solution of 0.9% Tri Sodium Citrate for 60-120 minutes, which varies from species to species. The hypotonic treatment enables the cells to swell, thus spreading the chromosomes. Embryos in the early developmental stages have shown better results. A mixture of 1 : 3 acetic acid and methanol is used as a fixative in which the embryos are transferred after the hypotonic treatment. Material is treated with this fixative for a minimum period of one hour and satisfactory results were obtained even up to three months when stored in a domestic refrigerator at 4°C. Subsequently the embryos are transferred in 50% acetic acid for 3-5 minutes depending upon the hardness of the fixed material. The material is then squashed in the usual manner. The slides are put in a vertical slide box which has at its base, a blotting paper dipped in 50% acetic acid and stored in a refrigerator at 4°C for over night. In the next step, the slides are brought to the room temperature and immersed in the fixative (1 : 3 acetic acid & methanol) for an hour. The cover slips are

pried off in the fixative and both slides and cover slips are air dried at room temperature. Staining is done in freshly prepared 2% Giemsa* for 15-20 minutes (pH is maintained between 6.8-6.9) and dipped in distilled water. After staining, the slides are dried in dust proof chamber at the room temper-

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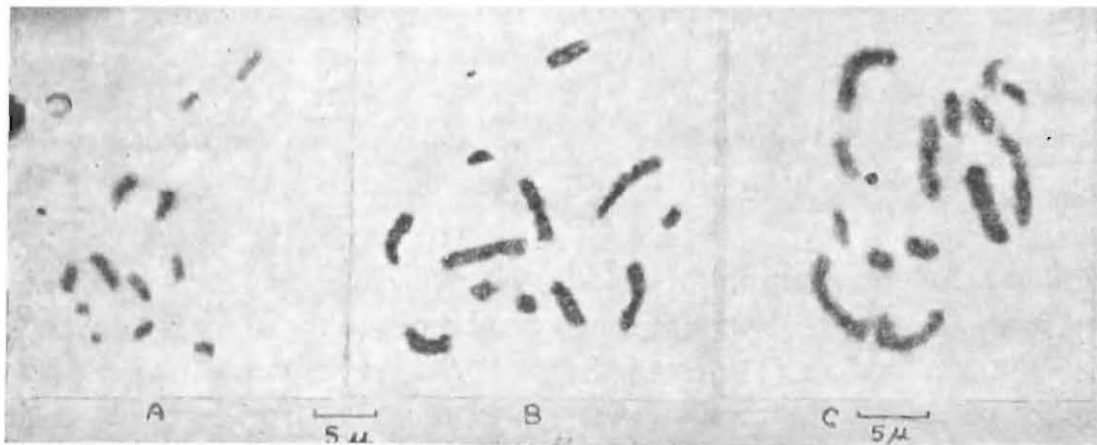


Fig. 1. A & B—*Myzus persicae* Sulz. ($2n=12$)
C—*Megoura lespedezae* (Essig & Kuwana) ($2n=14$)

ature and mounted in the D. P. X. after a dip in Xylene. Slides and coverslips bearing the material are mounted separately. The stained material remains in good condition for more than 40 days.

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*Stock solution : Add 25 ml of Glycerol, 25ml of methanol with 800 mg. of Giemsa powder and keep at 60°C for over night, filter and store in refrigerator.

Working solution : 1.5 ml. of methanol, 1.5 ml. of 0.2 m Disodium hydrogen phosphate, 2.5 ml. of stock solution of Giemsa.

Dissolve the above in 50 cc of distilled water.