

BULLETIN

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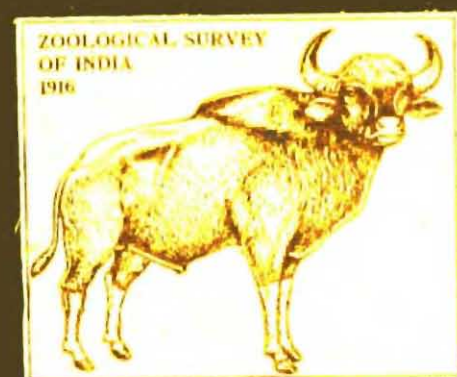
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OCCURRENCE OF AN ENTEROPNEUST HEMICHORDATE IN THE MANGROVE SWAMP OF SUNDERBANS, INDIA.

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ABSTRACT

The paper deals with an enteropneust hemichordate of the genus *Saccoglossus* invented for the first time from any tropical mangrove environment like deltaic Sunderbans of West Bengal. All together eighteen specimens have been collected so far from the midlittoral mudflat of Prentice Island since November 1981. Detailed morphological description of the hemichordate worm and its habitat environment have been communicated.

INTRODUCTION

During a cruise on board R. V. Sagarputra for an intensive survey of the mangrove swamps of deltaic Sunderbans for the macrobenthic fauna, a hemichordate worm was unearthed on 15 November, 1981 from the midlittoral mudflat of Prentice Island. Subsequently 17 more worms of different size have been collected from the same Island spread over an area of about two kilometers. This is a first record of an enteropneust hemichordate from any tropical mangrove environment.

So far seven species of enteropneusts have been reported from the Madras coast by different workers (Menon, 1904 ; Ramanujam, 1935 ; Kuriyan, 1949 ; Sundara Rao and Ranga Rao, 1949 ; Rao, 1953, 1954 ; 1955a, b, c ; Balasubrahmanyam, 1959). These are *Saccoglossus bournei* (Menon, 1904) ; *S.*

madrasensis Rao, 1955 ; *Glandiceps coramandelicus* Menon, 1904 ; *G. stiasnyi* Rao, 1953 ; *Glossobalanus elongatus* Spengel ; *G. minutus* (Kowalevsky), and *Ptychodera flava* Eschscholtz.

Detailed morphological analysis of the worm confirms its identity as a member of the genus *Saccoglossus* Schimkewitsch, 1892.

Materials : 18 examples. Prentice Island (Sunderbans, 24 Parganas), B. Singh and A. Choudhury, 15 November, 1981, unregistered, at S. D. Marine Biological Research Institute, Sagar Island.

Physiography : Prentice Island, a small fraction of the virgin mangrove forest area of Sunderbans, lies between 21.43° to 21.46°N latitude and 88.18° to 88.19°E longitude. It is a typical estuarine delta bordered on all sides by the Saptamukhi river waters and experiences tidal interplay twice in 24 hours.

During highest high tide water level rises upto 4.5 meters innundating the deeper part of the island which is criss-crossed by smaller, repeatedly ramified tidal creeks. Vegetational cover of the island is dominated on all sides by *Avicennia marina* and *A. alba* in the tidal zones followed by *Acanthus ilicifolius*, *Bruguiera gymnorhiza* and *Cereops decandra* in the ridges. Exposed slopes of the island is sparsely populated with *Suaeda maritima*, *S. nudiflora* and a saline grass *Porteresia coarctata*.

Habitat : The Hemichordate worm inhabits the midlittoral zone of the estuarine mudflat on the eastern flank of the Prentice Island just near the forest edge. Worms remain completely burried 10 to 20 cm deep in the muddy substratum in association with other infauna viz., Nemertins, Polychaetes, Actiniarians, rajor calms and other bivalves, Crustaceans like crabs and shrimps etc. During low tide exposure, among the several pores which become prominent on the substratum surface, no specific design for the pore of hemichordate worm or any of its excreta pattern could so far been identified.

Soil texture (Following Wentworth's scale) : The sediment in which the hemichordate worm resides, consists of about 24.59% medium silt and clay, 21.72% coarse silt, 50.26% very fine sand, 1.57% fine sand, 1.53% medium sand and 0% coarse sand.

Hydrology of the interstitial water (November 1981) :

Salinity	— 23.0%.
Temperature	— 24°C
pH	— 7.1
D. O.	— 0.9 ml/L

Description : Body is long and vermiform and characteristically divisible into three dis-

tinct zones, viz., proboscis, collar and trunk. Length of the larger specimens so far unearthed ranges between 13.5 and 19.5 cm. Proboscis colour is creamy white, collar is light orange and the trunk is yellowish, in the branchial sector in particular.

Proboscis is highly extensible, measuring upto 5.4 cm in the largest living specimen and bears median longitudinal groove or depression throughout its length, both dorsally and ventrally.

Behind the proboscis is the collar, a broad and plain band-like structure without having any wavy margin at its proximal rim. Length of the collar in the largest worm is 4 mm and the diameter is 3.5 mm. Mouth aperture is situated at the anterior end of the collar on the ventral side of the proboscis stalk and is preceded by the preoral ciliary organ at the base of the latter.

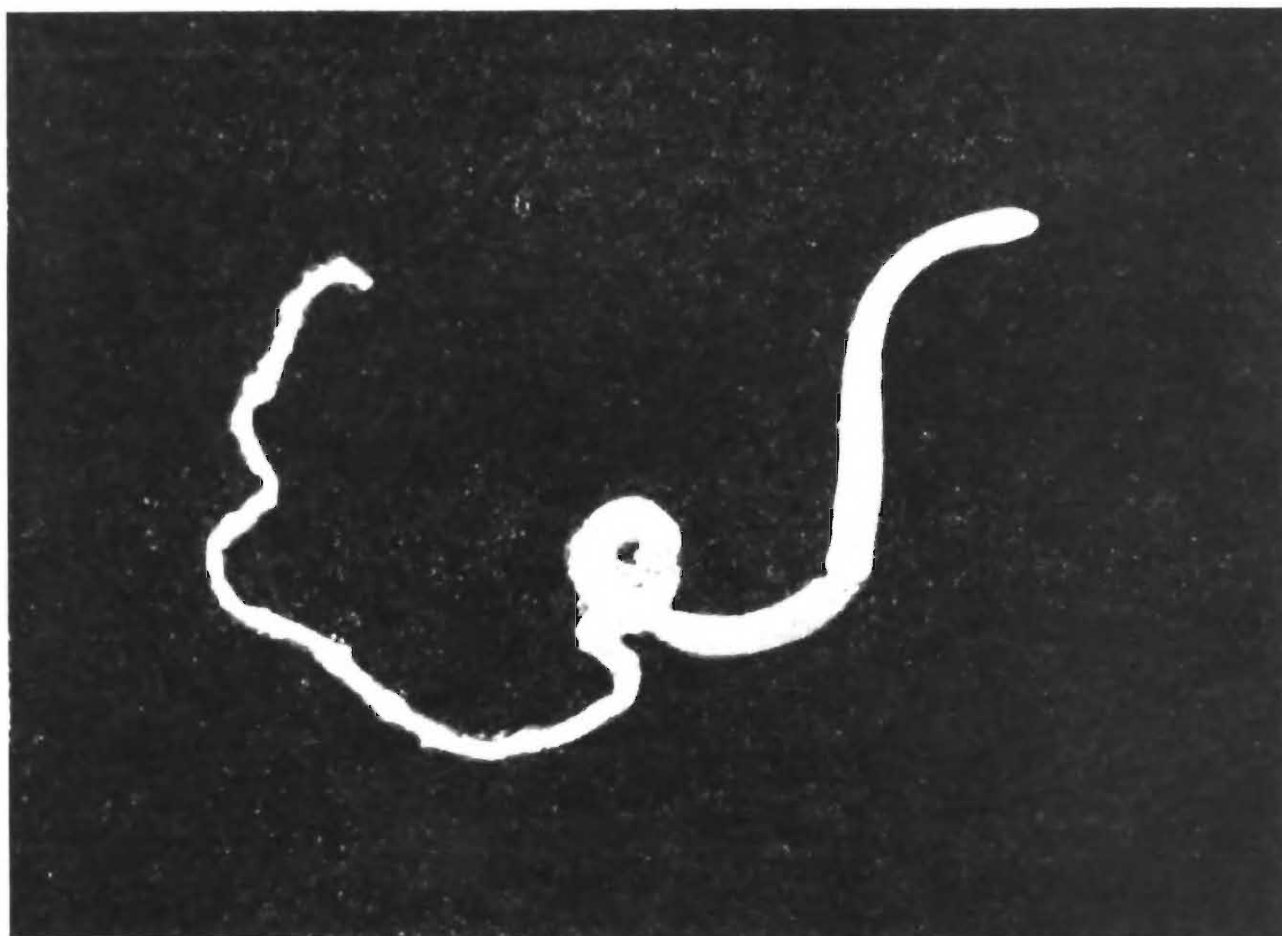
Trunk is of variable length in different specimens and in very few cases complete animals could be unearthed as the posterior trunk section is very fragile which gets detached because of the mud-load gut. It measures 14.5 cm in one preserved specimen from behind the collar to the vent which is terminal in position. Entire length of the trunk bears a conspicuous median dorsal groove formed by the right and left elevated and slightly incurved genital ridges or wings. Mid-dorsal line of the trunk wall is slightly convex bearing the impression of the dorsal epidermal nerve cord. Proximal part of the trunk is recognised as the branchial sector because of the presence of paired branchial pores on each side in this region, inbetween the genital ridge and the middorsal wall of the body. Exact extent of the region can only be determined through micro-anatomical study. Distal part of the trunk is gradually

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PLATE I



An adult male Hemichordate worm *Saccoglossus* sp.



An adult female Hemichordate worm, *Saccoglossus* sp.

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PLATE III



Littoral mudflat of Prentice Island the favourite habitat of the Hemichordate worm, exposed during low tide.

tapered and is dominated by the genital ridges or wings, as is evident from the visibly mature eggs in the gravid females, arranged dorso-laterally in the genital wings ending posteriorly. On the ventral side of the trunk, the proximal part of the body wall is slightly concave, but in the distal sector it is first flattened and then markedly convex. The midventral body wall also shows the impression of ventral epidermal nerve cord.

DISCUSSION

The literature survey of enteropneust hemichordates indicates the existence of fourteen species of the genus *Saccoglossus* including one from India (Horst, 1939 ; Brambell and Cole, 1939 ; Brambell and Goodhart, 1941). Burdon-Jones and Patil (1960) are responsible for reducing this number to twelve valid species by synonymising *S. cambrensis* and *S. serpentinus* with *S. ruber*, all from British Isles.

Out of the seven species of enteropneusts reported so far from India, no published account on the description of *S. madrasensis* and *Glandiceps coramandelicus* is available. Moreover, there is some confusion left over the actual authorship for the species *G. coramandelicus*. A meticulous examination of the twelve *Saccoglossus* spp. reported so far, including *S. bournei* (Menon, 1904) from India, indicates that the enteropneust specimen communicated in this paper by the present authors is different from the other members of the genus. Though this hemichordate material has been discovered from a unique habitat of mangrove mudflat of Sunderbans ecosystem, the authors refrain from attributing the animal with a new species identity pending further study and intend to denote it for the present as *Saccoglossus* sp.

ACKNOWLEDGEMENT

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EXPERIMENTAL STUDIES ON EFFECTIVENESS OF THE PREDATORY
LEECH, *GLOSSIPHONIA WEBERI* IN THE BIOLOGICAL
CONTROL OF VECTOR SNAIL
LYMNAEA LUTEOLA

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ABSTRACT

Effectiveness of predation of the leech, *Glossiphonia weberi*, in the biological control of vector snail, *Limnaea luteola* has been studied experimentally in the laboratory. Several weekly courses of experiments were conducted with leeches of different size groups by supplying snails of different shell length, together or in various combinations. The results indicate that the leeches preferred juvenile, snails of 3-5 mm size group. A size selective predation was found. In an average, a single 12-15 mm leech killed 1.46 ± 0.09 snails of 3-5 mm, 1.17 ± 0.08 snails of 6-8 mm and 0.14 ± 0.05 snails of 9-12 mm size groups. Groups of leeches proportionately kill more prey of 9-12 mm size groups was found to be statistically significant. An assessment has been made on the efficiency of predation of *G. weberi* as biological control agent.

INTRODUCTION

Although there are many potential predators and parasites of snails (Cooke, 1895; Pelseneer, 1926; Fischer, 1951; Chernin *et al.*, 1956a, b, 1960; Michelson, 1957, 1961, 1963; Malek, 1962; Berg, 1964; Jordon and Webbe, 1969; Abdallah and Tawfik, 1972; Lim and Heynemann, 1972), the part played by predators in prey population regulation has long been debated by ecologists. The fact that considerable disagreement remains is sufficient evidence of the need for adequate assessment of the effective-

ness of such biological control agents. In fact, the properties of animals have neither been sufficiently well known before hand to forecast the degree of success, nor have studies after the introduction revealed the mechanisms involved. The interactions that operate between predator and prey populations have largely been ignored and measurements necessary to test the effectiveness of such biotic agents remain unmade. Having established that *Glossiphonia weberi* is predator of snails (Raut and Nandi, 1980), laboratory studies were conducted to evaluate the

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effectiveness of leech predation on *Lymnaea luteola* as means of biological control. A study of the prey preferences, number of prey eaten, and the possibility that groups of leeches may proportionately kill more prey has been communicated.

MATERIALS AND METHODS

The leeches *Glossiphonia weberi* (Blanchard), were collected initially from the Museum pond attached to Indian Museum, Calcutta. Subsequently they were cultured in the laboratory to obtain various size groups.

The snails (*Lymnaea luteola*) were also collected from the same pond and reared in the laboratory so as to maintain a ready stock of various size groups during the course of experiments. The rearing and maintenance of both predator (leech) and prey (snail) were made in enamel trays and polythene buckets. The predators were supplied with prey as food while snails were supplied with lettuce leaves regularly as their food.

Experiments were carried out in transparent plastic containers, specimen jars and polythene buckets containing an equal quantity of water for each set of experiments. The experiments were initiated by supplying a fixed number of snails i. e. higher than what may be killed per day by the leech/leeches even for a particular size group separately. The snails killed per day were counted group-wise during the course of experiments and replaced daily to supply a constant number of prey. Most of the experiments were conducted with 12-15 mm size leeches at which stage they could act as predators (Raut and Nandi, 1980). The leeches were not normally observed to die during experi-

ment and in case death occurred, they were also substituted from the stock.

For convenience the leeches were classified into 4 different categories viz., i) lower size group, 12-15 mm ; ii) middle size group, 16-20 mm ; iii) upper size group, 21-25 mm and iv) order size group, 26 mm and above. The snails were also grouped into i) juvenile, 3-5 mm ; ii) intermediate, 6-8 mm and iii) adult, 9-12 mm on the basis of their shell length. The experiments were categorized as either single predator experiments or multiple predator experiments and designed as follows :

- I. *Single predator experiments* : With a single leech of 12-15 mm
 - Group A. Experiments consisted of 5 replicates and carried out in 3 specimen jars by supplying 3-5 mm, 6-8 mm and 9-12 mm size groups of prey snails separately.
 - Group B. Experiments carried out in 2 specimen jars by supplying all the 3 size groups of snails together in a proportion of 30 snails a day for the 2 sets.
- IIa. *Multiple predator experiments* : With 10 leeches of 12-15 mm size.
 - Group C. Experiments consisted of 3 sets by separately supplying prey snails of one size group only.
 - Group D. Experiments consisted of 3 sets by supplying prey snails of 2 size groups together in various combinations.

IIb. *Multiple predator and Mixed prey experiments* : With 10 leeches of 12-15 mm, 16-20 mm, 21-25 mm and 26 mm and above size groups separately.

Group E. Experiments consisted of 4 sets for the 4 size groups of snails together.

OBSERVATIONS

Experiments on predation potentials :

I. *Single predator experiments* : With a single leech of 12-15 mm

Group A Experiments with predator (12-15mm leech) by supplying prey snails of 1 size group only.

Experiments AI-AIII : Three sets (AI-AIII) with 5 replicates for each set, were designed wherein a constant supply of 10 snails was maintained during the course of experiments viz. 10 snails of 3-5 mm size group (expt. AI), 10 snails of 6-8 mm size group (expt. AII) and 10 snails of 9-12 mm size group (expt. AIII).

Results : The single 12-15 mm sized leech, on an average, killed a total of 51 snails of 3-5 mm size in 5 replicates under AI experiment i. e. 10.2 snails weekly or 1.46 ± 0.09 snails per day per leech with the range 1.0-1.8 snails per day per leech (Table 1). While the total kills were 41 snails of 6-8mm and only 5 snails of 9-12mm. The averages of range and mean per day per leech out of the total kill were 0.8-1.6 with a mean of 1.17 ± 0.08 snails of 6-8mm (Table 1) and 0.0-0.6 with a mean of 0.14 ± 0.05 snails of 9-12mm (Table 1) respectively. The differences in the rate of predation between 3-5mm and 6-8mm was not statistically significant when Wilcoxon Sign test was applied. But the differences in the rate of predation between 3-5mm and 9-12mm and also between 6-8mm and 9-12mm were significant in both the cases. The mean intervals between predation by the leeches were calculated as 17 hours 8 minutes, 20 hours 29 minutes and 168 hours for 3-5mm, 6-8mm and 9-12mm size groups of snails respectively (Figs. 1a-1c).

TABLE 1. Rate of predation (based on 5 replicates) by a single 12-15 mm leech by a constant supply of 10 snails of 3-5 mm, 6-8 mm size groups separately.

Expt. No.	Size group of snails (mm)	Data pooled (from 5 replicates)	No. of snails killed in a week							Total kill	
			1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	Weekly	Daily $\pm$ SE
AI	3-5	Range	1-3	0-2	0-2	1-2	0-3	0-2	1-2		
		Mean	1.8	1.4	1.2	1.6	1.6	1.0	1.6		
		Total	9	7	6	8	8	5	8	51	1.46 ± 0.09
AII	6-8	Range	1-2	0-2	0-2	0-1	0-2	0-2	0-2		
		Mean	1.6	1.0	1.2	0.8	1.4	1.2	1.0		
		Total	8	5	6	4	7	6	5	41	1.17 ± 0.08
AIII	9-12	Range	0-1	0	0	0-1	0-1	0	0		
		Mean	0.6	0	0	0.2	0.2	0	0		
		Total	3	0	0	1	1	0	0	5	0.14 ± 0.05

Group B. Experiments with predator (12-15 mm leech) by supplying snails of all the 3 size groups together.

Experiments BI and BII: A single 12-15mm leech was offered a constant supply of 30 snails, 10 from each of the 3-5mm, 6-8mm and 9-12mm size groups in expt. BI

and by doubling the number of prey snails i. e. 60 snails, 20 from each of the 3 size groups in expt. BII.

Results: In expt. BI, the leech killed a total of 8 snails in a week of which 6 snails from 3-5mm, 2 from 6-8mm and none from 9-12mm size group of snail. The day-wise predations as observed in expts. BI and BII

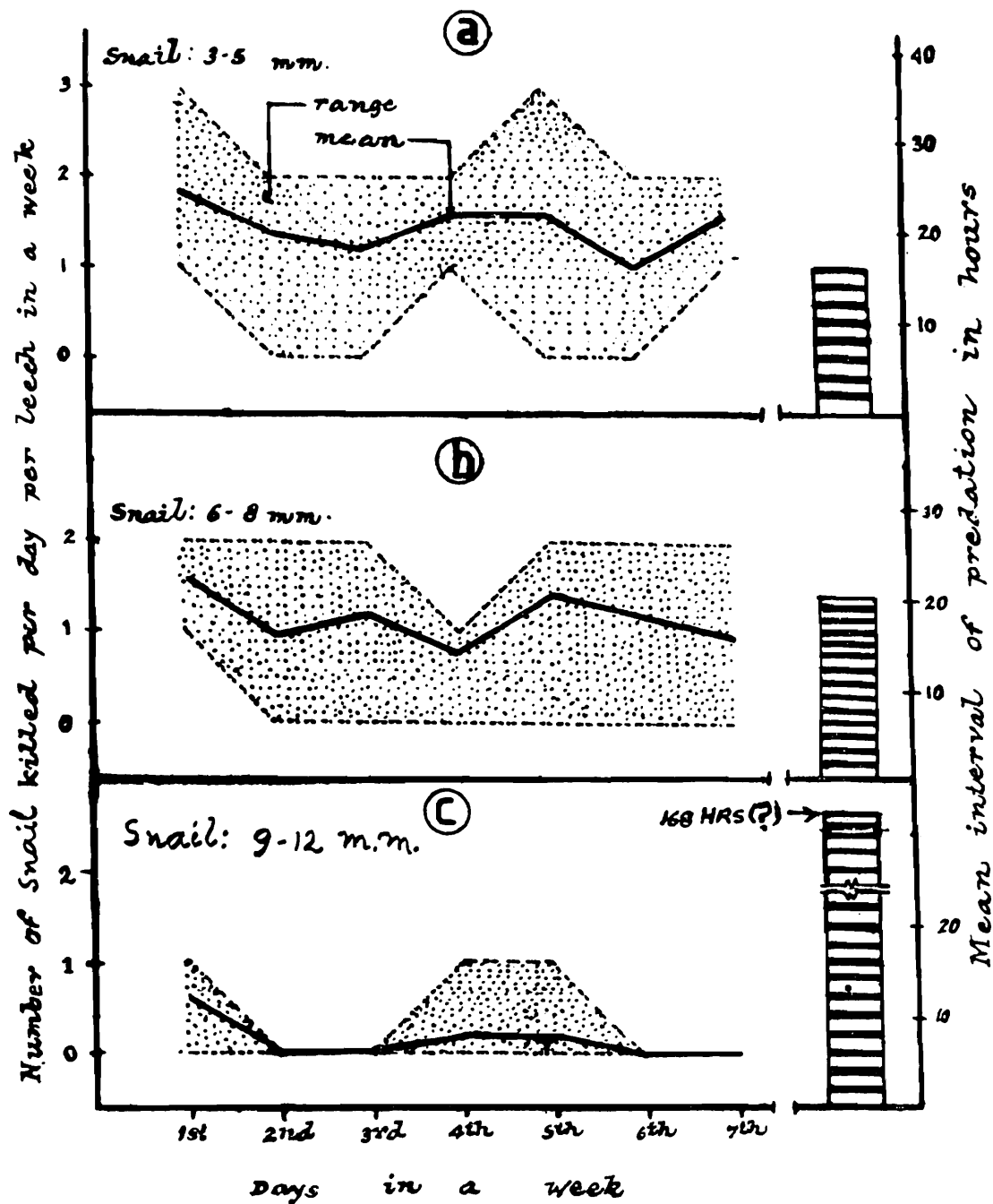


FIG. I

Fig. 1. Rate of predation (per day per leech) and mean interval of predation (in hours) by a single 12-15 mm leech on snails of 3-5 mm (a), 6-8 mm (b) and 9-12 mm (c) size groups.

TABLE 2. Effect of prey population on predation of a single 12-15 mm leech in a week on snails of 3-5 mm, 6-8 mm and 9-12 mm size groups supplied together in two different proportions.

Expt. No.	Size group of snail (mm)	No. of snails supplied/day	No. of snail killed in a week							Total kill	
			1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	Weekly	Daily $\pm$ SE
BI.	3-5	10	2	1	0	2	0	0	1	6	0.86 ± 0.03
	6-8	10	0	0	1	0	0	1	0	2	0.28 ± 0.14
	9-12	10	0	0	0	0	0	0	0	0	—
BII	3-5	20	2	0	1	0	0	1	2	6	0.86 ± 0.03
	6-8	20	0	0	0	1	0	0	0	1	0.14
	9-12	20	0	0	0	0	0	0	0	0	—

TABLE 3. Predation potentials by 10 leeches of 12-15 mm size group of snails of 3-5 mm, 6-8 mm and 9-12 mm size groups supplied separately in a week.

Expt. No.	Size group of snail (mm)	No. of snails supplied	No. of snails killed (consumed) in a week							Total	
			1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	Killed	Consumed
OI	3-5	40	16 (10)	16 (8)	13 (10)	13 (9)	13 (8)	15 (10)	15 (10)	106	65
OII	6-8	40	17 (9)	15 (7)	14 (7)	14 (9)	14 (6)	17 (6)	15 (9)	88	53
OIII	9-12	40	10 (5)	6 (8)	5 (2)	6 (4)	6 (2)	7 (3)	6 (3)	46	22

in a week on the snails of different size groups supplied together in 2 proportions i. e. 30 and 60 snails constantly, are shown in Table 2. The date-wise kill though varied, the amount of total kill per week was more or less alike.

Comments : A preference for snails in the 3-5 mm size group by leeches of 12-15 mm size is shown in Table 1. Though the leeches (12-15 mm size) occasionally kill 9-12 mm snails when no alternate prey exist, but they seem not to prey on snails in the 9-12 mm size group when smaller snails are present i.e. 3-5 mm and 6-8 mm as may be apparent from Group B experiments (Table 2). And these leeches appear to exhibit relatively the same amount of predation per week even if the number of snails supplied per day has been doubled from 10 to 20.

IIa. *Multiple predators experiments :* With 10 leeches of 12-15 mm size group.

Group. C. Experiments with predators (12-15 mm leeches) by separately supplying prey snails of 1 size group only.

Experiments CI-CIII : Three experiments (CI-CIII) were conducted, each with 10 leeches of 12-15 mm size group, in which a constant supply of prey population (40 snails daily in each experiment) was maintained. The experiments CI, CII and CIII were with 40 snails of 3-5 mm, 6-8 mm and 9-12 mm size groups respectively.

Results : In a week the leeches killed 106, 88 and 46 but consumed 65, 53 and 22 snails only in experiments CI, CII and CIII respectively. The daily kill recorded 13-16

(15.14 $\pm$ 0.56), 14-17 (12.57 $\pm$ 1.0) and 5-10 (6.57 $\pm$ 0.52) respectively in CI, CII and CIII. The frequency of predation has been shown in Table 3.

Group D. Experiments with predators (12-15 mm leeches) by supplying prey snails of 2 different size groups together.

Experiments DI-DIII. Three experiments were performed, each with 10 leeches of 12-15 mm size group, in which 40 snails of 2 different size groups in various combinations, each group consisting of 20 snails, were kept as constant supply daily. The experiment DI consisted of 20 snails of 3-5 mm and 20 snails of 6-8 mm size group. While experiment DII comprised of 20 snails of 3-5 mm and 20 snails of 9-12 mm and experiment DIII with the same number of snails from 6-8 mm and 9-12 mm size groups.

Results : In expt. DI, 10 leeches of 12-15 mm size in a week, killed a total of 101 snails, 77 (76.2%) from 3-5 mm size group and 24 (23.8%) from 6-8 mm size group. While a total of 85 snails, comprising 73 (85.9%) snails from 3-5 mm size group and 12 (14.1%) from 9-12 mm size group, and 89 snails, 68 (76.4%) from 6-8 mm and 21 (23.6%) from 9-12 mm size groups were killed in expts. DII and DIII respectively. Ten leeches in a week

consumed 67 (52 from 3-5 mm and 15 from 6-8 mm size group), 60 (54 from 3-5 mm and 6 from 9-12 mm size group) and 51 (45 from 6-8 mm and 6 from 9-12 mm size group) snails respectively in expts. DI, DII and DIII. The number of snails killed daily has been shown in Table 4. The differences in the rate of predation of 12-15 mm leeches between any two of the 3 snail-groups (3-5 mm, 6-8 mm and 9-12 mm) were statistically significant.

Comments : From the above experiments viz., CI-CIII and DI-DIII, it can be stated that the juvenile (3-5 mm) snails are preferred by 12-15 mm leeches as for the single predator experiments, the predation on snails of the adult (9-12 mm) group was comparatively less, even less than a half, than that of juvenile group.

IIb. Multiple predators and Mixed prey experiments : With 10 leeches of 4 different size groups separately.

Group E. Experiments with 4 different size groups of predators (12-15 mm, 16-20 mm, 21-25 mm and 26 mm and above size groups of leeches) by supplying prey snails of all the 3 size groups together.

TABLE 4. Predation potentials of 10 leeches (12-15 mm) snails of two size groups supplied together in a week.

Expt. No.	Size group of snail (mm)	No. of snails supplied	No. of snails killed (consumed) in a week							Total	
			1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	Killed	Consumed
DI	3-5	20	12 (8)	10 (5)	10 (8)	10 (6)	11 (8)	12 (8)	12 (9)	77	52
	6-8	20	4 (2)	6 (4)	3 (2)	3 (3)	2 (1)	3 (1)	3 (2)	24	15
DII	3-5	20	12 (8)	9 (6)	10 (8)	9 (8)	10 (8)	10 (7)	11 (9)	73	54
	9-12	20	4 (1)	2 (1)	3 (2)	1 (1)	0 (0)	0 (0)	2 (1)	12	6
DIII	6-8	20	11 (6)	9 (5)	9 (6)	11 (8)	11 (8)	8 (6)	9 (6)	68	45
	9-12	20	8 (3)	4 (0)	3 (1)	2 (0)	1 (0)	0 (0)	3 (1)	21	6

Experiments EI-EIV. Four experiments, EI-EIV were designed for the 4 size groups of leeches viz., 12-15 mm size group (expt.EI), 16-20 mm size group (expt. EII), 21-25 mm size group (expt.EIII) and 26 mm and above size group (expt.EIV). In each experiment, 10 leeches were given a constant supply of 60 snails of 3 size groups, 20 snails from each of the 3 size groups for a period of one week,

Results : The 10 leeches of 12-15 mm size group in expt.EI killed a total of the 88 snails ; 58 (65.8%) from 3-5 mm, 20 (22.6%) from 6-8 mm and 10 (11.6%) from 9-12 mm size groups. Of the total kill, the leeches consumed 65 snails comprising of 48, 12 and 4 snails from the aforesaid groups respectively. In experiment EII, 10 leeches of 16-20 mm size group killed a total of 80 snails 46 (57.5%), 24 (30%) and 10 (12.5%) snails from juvenile (3-5 mm), intermediate (6-8 mm) and adult (9-12 mm) groups respectively. However, they consumed 34, 21 and 5 snails,

in all 60 snails, respectively from juvenile to adult group. In experiment EIII, 10 leeches of 21-25 mm size group killed 84 snails in proportion of 32 (38.1%) juvenile, 33 (38.1%) intermediate and 19 (22.5%) adult group and they consumed 22, 21 and 14 snails respectively from the three size groups. While in experiment EIV, 10 leeches of 26 mm and above size group killed, in all, 74 snails which constituted of 21 (28.3%) juvenile, 38 (51.3%) intermediate and 15 (20.2%) adult snails. They could consume a total of 53 snails, 16 from juvenile, 26 from intermediate and 11 from adult groups for a period of a week. The daily predation potentials of these 10 predator leeches of 4 different size groups are shown in Table 5. When the leeches were supplied in group the kill of 3-5 mm size of snails was highest by 12-15 mm and 16-20 mm size of leeches. The kill by 21-25 mm size of leeches was significantly higher in 3-5 mm than 9-12 mm size of snails. The other differences among snails in this size of

TABLE 5. Predation potentials of 4 different size groups of leeches on 3 size groups of snails supplied together in a week.

Expt. No.	Size group of leech (mm)	Size group of snail (mm)	No. of snails supplied	No. of snails killed (consumed) in a week							Total Killed	Cons-umed	Daily Killed $\pm$ SE	Daily Consumed $\pm$ SE
EI	12-15	3-5	20	11 (9)	8 (7)	8 (6)	9 (8)	7 (6)	6 (5)	9 (7)	58	48	8.28 $\pm$ 0.56	6.86 $\pm$ 0.47
		6-8	20	2 (1)	3 (1)	4 (2)	2 (1)	4 (2)	2 (0)	3 (3)	20	12	2.86 $\pm$ 0.31	1.71 $\pm$ 0.26
		9-12	20	1 (0)	0 (0)	2 (1)	1 (0)	2 (1)	2 (1)	2 (1)	10	4	1.43 $\pm$ 0.18	0.57 $\pm$ 0.32
EII	16-20	3-5	20	7 (5)	6 (4)	5 (3)	8 (6)	6 (5)	6 (5)	8 (6)	46	34	6.57 $\pm$ 0.39	4.86 $\pm$ 0.37
		6-8	20	4 (3)	4 (4)	3 (2)	3 (3)	3 (3)	3 (2)	4 (4)	24	21	3.43 $\pm$ 0.19	3.0 $\pm$ 0.32
		9-12	20	2 (1)	1 (1)	2 (1)	1 (0)	2 (1)	0 (0)	2 (1)	10	5	1.43 $\pm$ 0.18	0.71 $\pm$ 0.24
EIII	21-25	3-5	20	5 (4)	3 (2)	4 (3)	4 (2)	5 (4)	6 (4)	5 (3)	32	22	4.56 $\pm$ 0.34	3.14 $\pm$ 0.49
		6-8	20	5 (3)	6 (4)	6 (4)	5 (4)	6 (4)	3 (1)	2 (1)	33	21	4.71 $\pm$ 0.56	3.0 $\pm$ 0.49
		9-12	20	3 (2)	3 (2)	2 (2)	3 (2)	1 (1)	4 (2)	3 (3)	19	14	2.71 $\pm$ 0.38	2.0 $\pm$ 0.20
EIV	26+	3-5	20	2 (2)	2 (1)	2 (2)	2 (1)	4 (3)	5 (3)	4 (4)	21	16	3.00 $\pm$ 0.45	2.28 $\pm$ 0.39
		6-8	20	7 (5)	5 (3)	4 (3)	6 (4)	4 (4)	7 (5)	5 (2)	38	26	5.43 $\pm$ 0.45	3.71 $\pm$ 0.39
		9-12	20	2 (1)	2 (2)	3 (2)	2 (2)	2 (1)	1 (1)	3 (2)	15	11	2.14 $\pm$ 0.24	1.57 $\pm$ 0.19

leech were not significant. The leeches of 26 mm and above size kill more of 6-8 mm size of snails than other snails. The difference between 3-5 mm and 9-12 mm snails was not significant.

Comments : The weekly predation and consumption rates of 4 different size groups, on prey snails in terms of snail killed and snail consumed have been presented in Figs. 2 and 3. The number of snails killed and consumed from juvenile group is inversely related with the size of the predator. But the predation rate shows positive correlation with the size groups of predators. While the adult snails (9-12 mm) were relatively substantially killed by the 2 older size groups than the 2 lower size groups (Fig. 2). The preference of predation shows a declining trend with snail size so far as the 2 lower size groups (12-15 mm and 16-20 mm) of leeches are concerned. However, the leeches of 21-25 mm size groups showed a different trend of predation by showing almost equal

preference for the lower size groups of snails along with relatively higher predation of adult snails. While older predator group, 26 mm and above, sets another trend of predation wherein more than half of the total kill, 38 (51.3%) out of 74, was from intermediate group i.e. 6-8 mm snails (Fig. 3).

Assessment of the efficiency of predation as biological control agent :

Biological control in the economic sense obtains when suppressive effect of natural enemy accounts for the difference between economic and non-economic prey or pest populations. A natural enemy can accomplish permanent biological control only if it has evolved morphological and behavioural adaptations to its host or prey and other components of its life system by means of which it can consistently find, attack and suppress its host's or prey's populations and maintain them at sub-economic densities, and which permit permanent residency with the

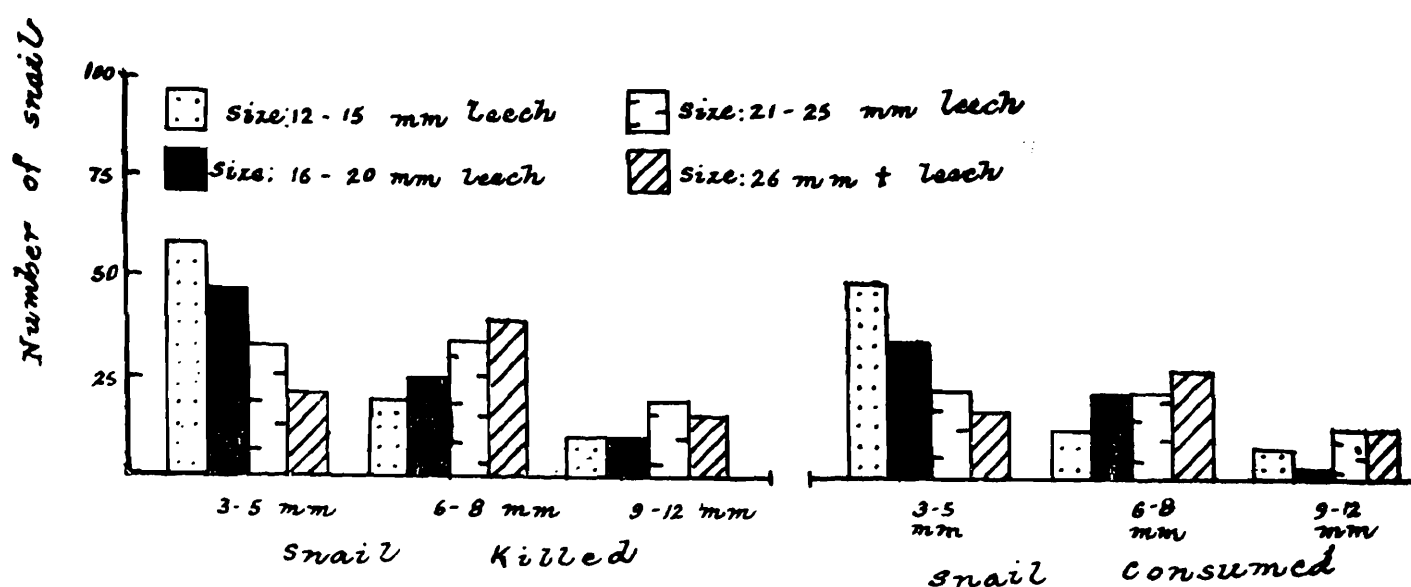


FIG. 2

Fig. 2. Effect and preference of predation (killed/consumed) of 10 leeches of 4 different size groups on prey-snails of 3 size groups in a week.

prey or pest (*vide* Huffaker, 1971a, b). Huffaker *et al.* (1976) summarized the desired characteristics for achieving self-sustaining (permanent) economic control of a pest as follows : (1) fitness and adaptability to the various conditions of the host and host's environment, (2) searching capacity, (3) power of increase relative to that of

effective agents for biological control of snail populations of the species *Lymnaea luteola* which has widely been incriminated to act as vectors for various snail-borne diseases.

Attempts have been made to evaluate the predation potential, predation interval, prey preference, predator-prey relationship, consumption capacity and effect of predator-prey

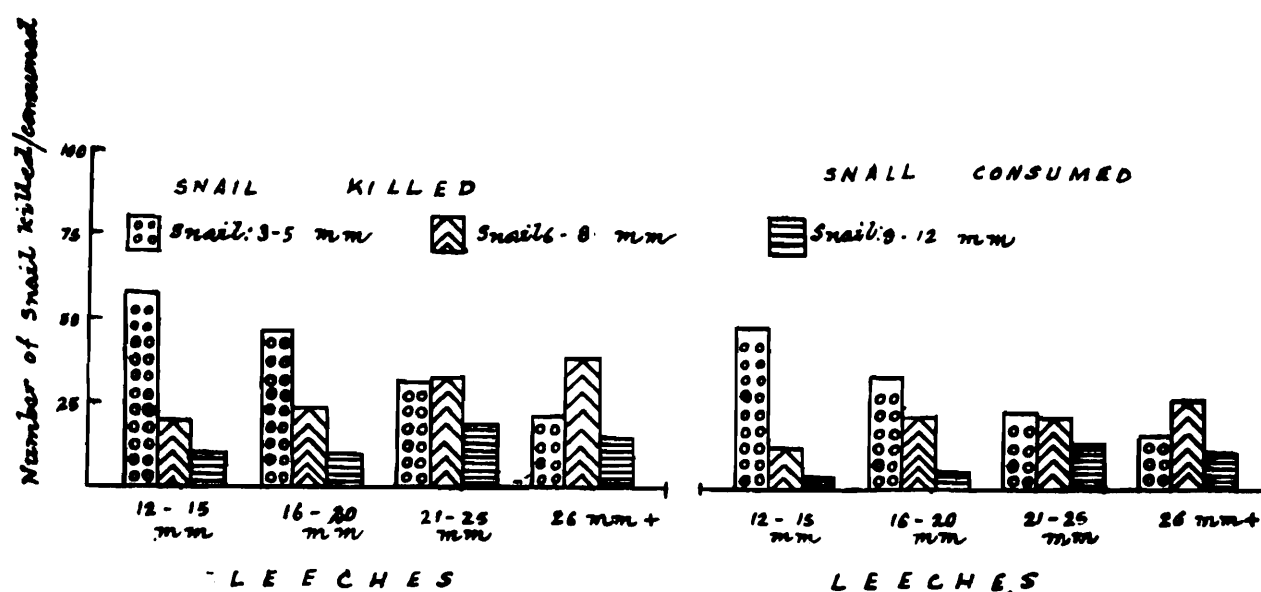


FIG. 3

Fig. 3. Weekly predation and consumption rate of 10 leeches of 4 different size groups on prey-snails of 3 different size groups.

its host or prey, (4) host or prey specificity, or potential for development of host or prey preference, (5) synchronization with the host or prey, and the habitat, (6) density dependent performance relative to either or both the hosts or prey's density (functionally, reproductively, or aggregatively) and its own density (e. g., mutual interference), (7) detection of responsiveness to the condition of the host (stage and whether parasitized or not), and (8) efficient competitiveness with other natural enemies.

Many of the above characteristics of predator-prey systems may be attributable to the leech, *Glossiphonia weberi* to declare them as

densities in the laboratory. In so far as predation potential, interval time, prey preference and consumption are concerned the glossiphonid leech (*G. weberi*) preferred the juvenile snails.

The comparative account of predation and consumption rate of 12-15 mm size leeches of different size groups of snails (Table 6) reveal that they show a higher potential of both predation and consumption by a batch of leeches than by a single leech (Fig. 4). In an average, 7 leeches in a day killed more than that by a single leech in a week from any size group of snails showing a proportion of 10.6 *vs.* 9.0 snails of 3-5 mm size group,

TABLE 6. Predation of single vs. multiple leech (10 leeches) on 3 different snail groups supplied separately in a week.

No. of leech	Size group of snail (mm)	No. of snail supplied	No. of snails killed (consumed) in a week							Total		Daily	
			1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	Killed	Consumed	Killed $\pm$ SE	Consumed $\pm$ SE
I	3-5	10	2 (2)	1 (1)	0 (0)	2 (1)	0 (0)	2 (1)	2 (1)	9	6	1.28 ± 0.21	0.85 ± 0.17
	6-8	10	2 (2)	0 (0)	2 (1)	0 (0)	2 (1)	1 (1)	0 (0)	7	5	1.0 ± 0.20	0.71 ± 0.19
	9-12	10	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1	1	0.14 ± 0.12	0.14 ± 0.12
10	3-5	40	16(10)	16(8)	13(10)	13(9)	13(8)	15(10)	15(10)	106	65	15.14 ± 0.56	9.28 ± 0.40
	6-8	40	17(9)	15(7)	14(7)	14(9)	14(6)	17(6)	15(9)	88	53	12.57 ± 1.00	7.57 ± 0.49
	9-12	40	10 (5)	6 (3)	5 (2)	6 (4)	6 (2)	7 (3)	6 (3)	46	22	6.57 ± 0.52	3.14 ± 0.37

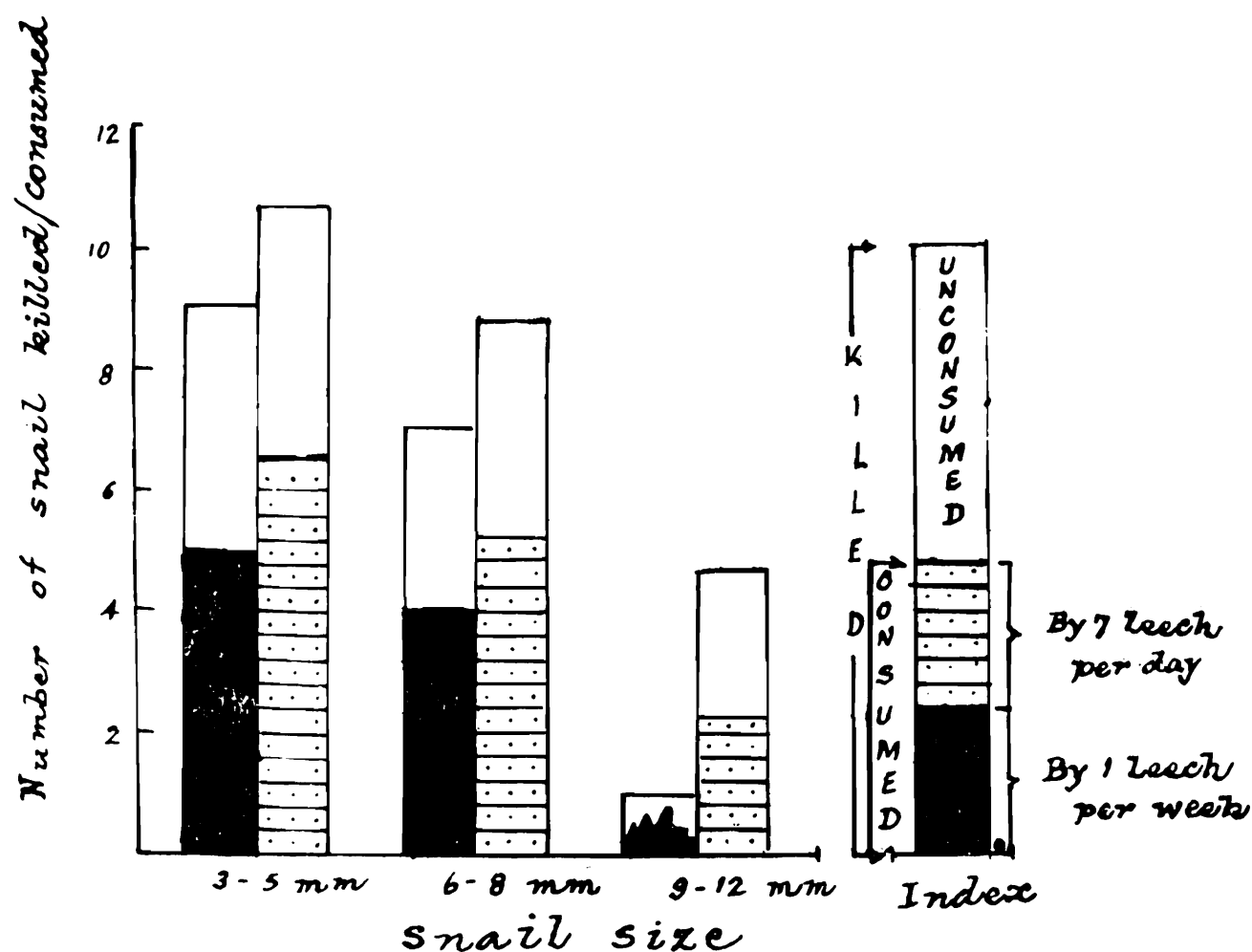


FIG. 4

Fig. 4. Comparative predation and consumption capacity of a single 12-15 mm leech in a week *versus* 7 leeches (12-15 mm) a day on 3 different size groups of snails.

8.8 vs. 7.0 snails of 6-8 mm size group and 4.6 vs. 1.0 snails of 9-12 mm size group. Similarly the estimated consumption rates of 7 leeches per day vs. 1 leech per week are 6.5 vs. 5.0 snails of 3-5 mm size, 5.3 vs. 4.0 snails of 6-8 mm size and 2.2 vs. 1.0 (in partim) of 9-12 mm size. This indicates that predation may be increased with the increase in the number of predators. By applying Wilcoxon Sign test it is seen that the predation of single vs. multiple leech (predator) was not significant for both 3-5 mm and 6-8 mm size groups. But it showed statistically significant result for 9-12 mm size group of snails. It implies that groups of leeches may proportionately kill more prey than single leeches.

From the experiments as conducted above weekly predation and consumption rate of 10 leeches of 12-15 mm size group on prey snails supplied group-wise separately and in

various combination with other groups are shown in Fig. 5. The predation rate, if we consider the total kill in number of snails, is always higher when prey snails are supplied separately than when the number of total kill of the different size groups offered in combination with other group(s). However, the consumption rate slightly oscillates when offered prey snails of different size groups separately (Fig. 5). This oscillation in the consumption rate does not follow any definite pattern and might relate to the satiation of the predator under experiments.

If we consider all the 4 experiments of Group E with 4 different size groups of leeches together, the total kill of leeches in a week would be 326 snails (Table. 7).

Thus, in a stable condition, where all the size groups of leeches and snails are present, one leech, in an average, may kill 1.46 snails a day. But this will require field trial and

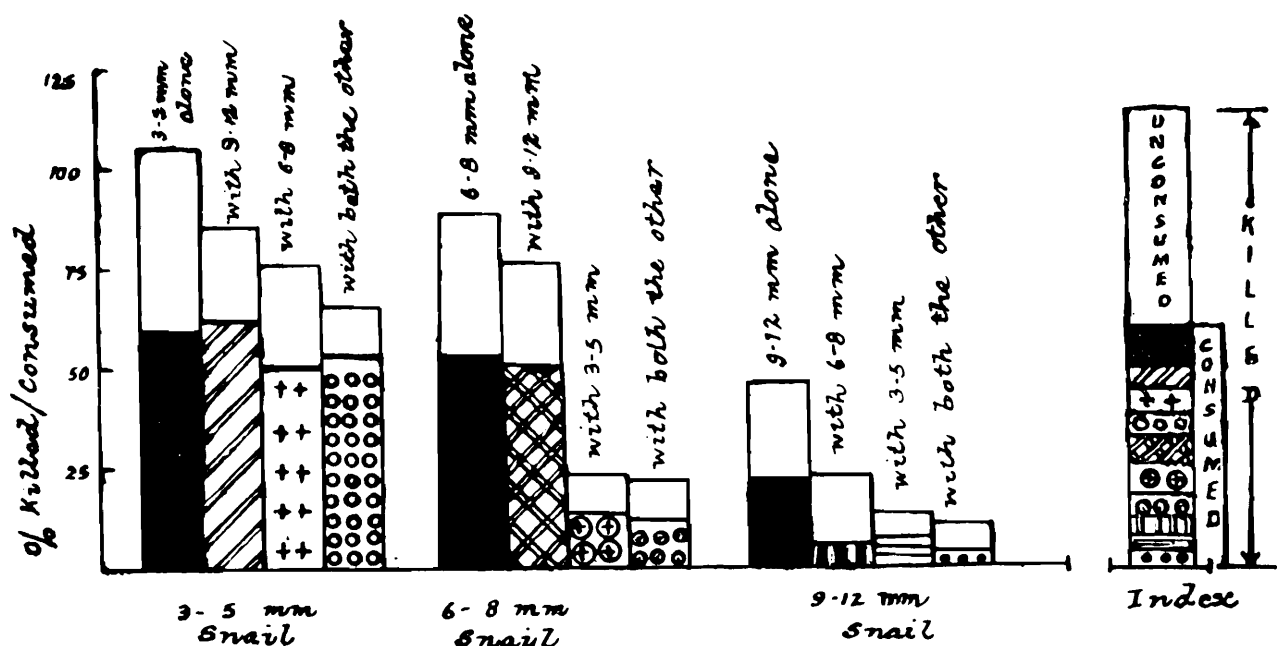


FIG. 5

Fig. 5. Weekly predation and consumption capability of 10 leeches 12-15 mm size groups on prey-snails of 3 different size groups supplied separately or in combination with other size group (s).

assessment of efficiency under field condition as search time, satiation, and various other physical factors of the environment may dampen the process of predation in the field. Still, by considering a potentiality half than that (1.46 snails per leech per day) observed in the laboratory i. e. 0.73 snails per leech per day, a reduction of snail population to a half in a week could be achieved releasing predators at one-tenth the population of snails. For example, more than half of the population of 1000 snails may be killed in a week by 100 (one-tenth of the prey) predators, and they are able to kill $100 \times 0.73 \times 7 = 511$ snails a week. The complete biological control commonly means a density of 1/25 or 1/100 of the pest without the controlling agents.

DISCUSSION

Since the chemical control of medically important snails has not been successful,

attention was given to biological control by a number of workers (Nagano, 1927; Bequaert, 1928; Mozely, 1939, 1951; McMullen, 1952) but little detail is known.

Studies on the predation potential of the leech, *Glossiphonia weberi* suggest that they can be employed effectively in regulating the snail (*L. luteola*) populations though the leeches of 4 different size groups killed a varying number of snails of 3 size groups. Since size selective predation was found and since multiple leeches yield better result of predation than single leeches ANOVA was made to study the influence of the size of the predators and preys, and also the combinations of predator and preys (Table 8). It has been revealed from the Analysis of variance (ANOVA) that there is significant interaction between leeches and snails. From the calculation it is clear that the influence of the size of predator and preys were not significant.

TABLE 7. Total predation of leeches of 4 different size groups in a week.

Predator groups (mm)	Number of Predator	Size group of snail killed per week			Total
		3-5 mm	6-8 mm	9-12 mm	
12-15	10	58	20	10	88
16-20	10	46	24	10	80
21-25	10	32	33	19	84
26 +	10	21	38	15	74
Total =	40 leeches	157	115	54	326

TABLE 8. Analysis of variance (ANOVA) of data on predation of 4 different size groups of leeches on 3 size groups of snails.

Source	D. F.	S. S.	M. S.	F.
L=Leech	3	45.4334	15.1445 (N. S.)	1 (N. S.)
S=Snail	2	2886.9060	1443.4530 (N. S.)	4.84 (N. S.)
L X S	6	1789.3732	298.2288*	13.19*
Error	72	1628.4046	22.6167	—

N. S. Not significant ; Significant at 1% level.

From the experiments stated above, it appears that the juvenile snails (3-5mm) are highly vulnerable to the leeches. This is in agreement with the findings of Chernin *et al.* (1956b) on the predaceous action of the leeches *Helobdella fusca* on the snail *Austro-lorbia glabratus*. Experimental results revealed that the leeches are more effective in killing the snails when they occur in groups, and a few predatory leeches collectively would be able to capture a prey-snail of larger size (9-12mm). Further more, it has also been found that the leeches proportionately killed more prey than what they consumed. It might be due to the preference for a selective portion of flesh of the prey and/or the effect of group predation. This is because of the fact that larger snails are attacked by 2-3 leeches whereas one predator one prey is the rule for smaller ones (Raut and Nandi, 1980). This particular point is especially emphasized for statistical significant result obtained for 9-12mm snails. This phenomenon is of greatest interest from the view point of augmentation of natural enemy action that we have much power to manipulate.

Biological control is recognized as a substantial means of pest control even by those who deny that natural enemy action is truly regulating in nature. Coutinho and Coutinho (1968) have assumed in their model that larvae of helminths, including schistosomes, are important in regulating snail populations because they decrease survival and fertility rates of snails. Lie *et al.* (1971) found that the introduction of echinostome eggs into a small pond was followed by a considerable reduction in snail population due to parasitic castration and high mortality among infected snails. However the selective pressures in such a system would favour the development

of resistance in the snail population and a decrease in parasite pathogenicity.

Ewers and Rose (1966) and Ewers (1967) have also speculated that snail populations might be genetically polymorphic with respect to resistance to attack by parasites and also to other inimical forces in the environment. This hypothesis appears to be supported by their observations on the littoral prosobranch *Velacumantus australis*, as individuals that are resistant to parasites are more susceptible to predation. However, the possibility of controlling snails (*L. luteola*) by leech (*G. weberi*) in their natural habitat may prove to be encouraging. It may be mentioned here that Chernin *et al.* (1956b) were successful in controlling the growth of *A. glabratus* population through the predaceous action of glossiphonid leeches. Since the present species is a potential predator and a member of the family Glossiphonidae, which habitually and almost exclusively feed upon aquatic snails, one would expect a considerable degree of success in the field too. Moore (1901) also suggested the possibility of control of the schistosome intermediate host-snails through these agents. However, we are to know a great deal more from field studies on the ecology of the predators and prey so that we may more reliably use this glossiphonid leeches in vector control programmes, one of the important goals of medical malacology.

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STUDIES ON THE FOOD PREFERENCE AND CONSUMPTION
OF *RATTUS RATTUS* (LINNAEUS) [RODENTIA :
MURIDAE] IN CAPTIVITY

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ABSTRACT

The order of preference and the rate of consumption of five most common food grains of West Bengal were investigated in *Rattus rattus* (Linnaeus) under controlled condition in special type of cage. Two food grains were provided at a time until all the possible combination (a total of ten) had been given. A simple preferential order for rice was observed in all the four dyadic trials. However, from the amount of consumption of other food grains, it is obvious that this species prefers a varied diet, rather than consuming a single food grain to the exclusion of others. No significant difference was observed in the quantity of day and night feeding. Average daily consumption is about 9.85 gm. It has been estimated that 61 individuals of adult *Rattus rattus* can consume food equivalent to that necessary for one Indian.

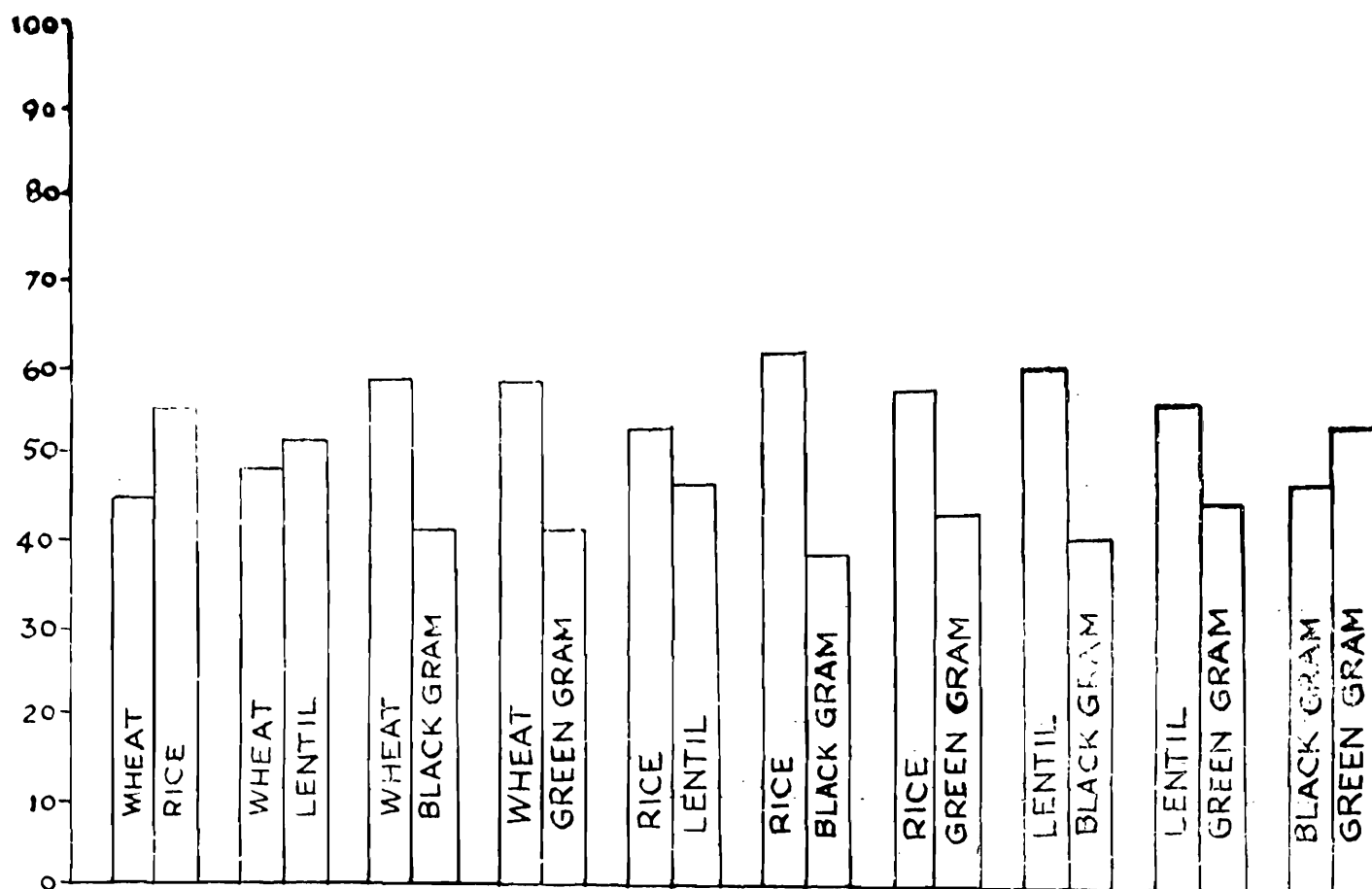
INTRODUCTION

The knowledge about the food preference and rate of consumption of pest species of rodents is a long felt need. Rodents are versatile in feeding behaviour and choice of food, but they are not uniformly so. For the effective control measure and to determine the extent of damage, detailed studies on the feeding of rodents are needed in different parts of the country growing different types of crops and herbs, as the normal food of rodents depend on their immediate environments. Variety, seasonal changes of diet, food preference and rate of consumption in different species of rodents have been studied in different parts of our country, but except for the reports of Spillett (1968), Parrack and Thomas (1970) and Chakraborty (1977), no qualitative and quantitative information have been collected on the food habits of rodents occurring in West Bengal. Spillett

(1968) made detailed study on the food preference, consumption and calorie intake of *Bandicota bengalensis* (Gray) in captivity with five most common food grains of West Bengal, viz., wheat (*Triticum aestivum*), rice (*Oryza sativa*), lentil (*Ervum lens*), black gram (*Phaseolus radiatus*) and green gram (*Phaseolus aureus*). In the present paper similar study was made on the *Rattus rattus* (Linnaeus). It is mainly a house rat and occurs in good number in West Bengal. However, its population is gradually decreasing in the city areas due to highly growing population of *B. bengalensis* (Spillett 1968, Seal and Banerji 1969).

METHOD

For the experiment, rats (*R. rattus*) were regularly collected from groceries near Behala Tram Depot (Calcutta-34) in wonder trap (Trap designed for multiple catch). They were



Food consumption in Rattus rattus

Fig. 1. Graphic representation of percentage of consumption for each of five food grain when presented two at a time to four individually caged *R. rattus* during 5-day study period.

reared in special type of wire cages. Each cage is about 100 cm. × 55 cm. × 50 cm. in size with three equal compartments. Partitions between the compartment are removable (Plate III). There is also a removable metallic tray at the base of the cage for the collection of faeces and spilled food grains. The adults were maintained in the cages for two days with water and all the food grains used for the experiment for acclimatization. Experiment was conducted only with these acclimatized rats. Food grains used by Spillett (1968) are the most common crops of West Bengal, and a good stock of them are maintained in the ration shops, groceries and

houses. Hence the same five food grains, viz., rice (*Oryza sativa*), wheat (*Triticum aestivum*), lentil (*Ervum lens*), black gram (*Phaseolus radiatus*) and green gram (*Phaseolus aureus*) were selected for the present study. Calorie values of these grains were given by Parpia *et al.* (1964). In natural condition rats are rarely restricted to single food type, thus two food grains were provided at a time until all the possible combination (a total of ten) had been given. Only a single rat was kept in each cage and the food and water trays were kept in the first compartment. The rat was forced to move into third compartment of the cage at 07.00 hour and 19.00 hour with

TABLE 1. Consumption rates (gramme and calories), defaecation rates and weights for four individually caged adult *R. rattus* when presented five food grains two at a time during five days study period.

Total rat hours	Food grains	Calories/ gramme	Gramme consumed	Calories consumed	Faeces		Total weight of rats in gramme			Calories consum- ed/X gramme of rat.	
					No.	Weight in gra- mme (air dried)	Start	Finish	Difference		Mean
480	Wheat	3.46	93	321.78	900	35.2	675.3	683.6	+ 8.3	679.45	1.06
	Rice	3.48	114	396.72							
480	Wheat	3.46	102	352.92	879	35	639.4	651.8	+12.4	645.6	1.13
	Lentil	3.43	109	373.87							
480	Wheat	3.46	115	397.9	1021	48.6	708.5	721.3	+12.8	714.9	0.95
	Black gram	3.47	81	281.07							
480	Wheat	3.46	113	390.98	998	37.8	592.8	610.4	+17.6	601.6	1.12
	Green gram	3.51	80	280.8							
480	Rice	3.48	110	382.8	896	38.2	721.2	716.4	- 4.8	718.8	0.99
	Lentil	3.43	96	329.28							
480	Rice	3.48	119	414.12	1005	47.4	635.7	637.8	+ 2.1	636.75	1.05
	Black gram	3.47	74	256.78							
480	Rice	3.48	109	379.2	709	30.8	624.7	621.6	- 3.1	623.15	1.06
	Green gram	3.51	81	284.31							
480	Lentil	3.43	116	397.88	881	31.7	587.6	601.2	+13.6	594.4	1.12
	Black gram	3.47	78	270.66							
480	Lentil	3.43	108	370.44	967	37.5	619.2	647	- 2.2	648.1	1.03
	Green gram	3.51	85	298.35							
480	Black gram	3.47	87	301.89	951	37.3	703.4	689.3	-14.1	696.2	0.93
	Green gram	3.51	99	317.49							
Total 4800		69.40	1969	6829.36	9207	379.5	6537.8	6580.4	42.60	6558.95	10.44
Mean 480		3.47	393.8	1365.87	1841.4	75.9	653.78	658.04	4.26	655.89	1.04

the help of movable partition to collect all the food grains and pellets from the cage as well as from the tray. This permitted both the food consumption and defaecation rates to be recorded on the day versus night basis. Faecal pellets were counted and air dried before weighing them. The rats were weighed to the nearest 0.1 gm. before and at the end of each trial.

RESULT

Of the five food grains presented two at a time to individually caged rat, a simple

preferential order was observed for rice in all four dyadic trials; lentil in three out of four; wheat in two out of four; greengram in one out of four and black gram was not favoured in any trials. The rate of consumption is presented in Table 1, and percentage of consumption for each is graphed in Fig. 1. The average daily consumption of food by individual *R. rattus* comes to about 9.85 gm. which is nearly 1/17th of its body weight. Although there is a marked preference for rice over others, from the amount of consumption of other food grains it is

obvious that this species prefers a varied diet, rather than consuming single food grain to the exclusion of others. No significant difference was observed in the day and night feeding and particular food grain is preferred in the day as well as in the night. However, defaecation rate is little lower during the day time.

Weight losses occurred when the following combinations of foods were provided :— rice-lentil, rice-green gram, lentil-green gram, and black gram green gram. Weight was gained with all other six combinations of foods. It is interesting to note that presence of wheat in the food always increases the weight of the rat. The calorie consumed per mean gm. of rat varied within a very small range of 0.93-1.13 with a mean of 1.04 for the five days of study period. No significant difference of calorie intake was found with any particular combination of foods. Below are some calculations derived from the data given in Table 1.

$$\text{Rat days : } \frac{4800}{24} = 200$$

$$\bar{x} \text{ gm. consumed/rat/day : } \frac{1969}{200} = 9.85$$

$$\bar{x} \text{ calories consumed/rat/day : } \frac{6929.36}{200} = 34.15 \dots (A)$$

$$\bar{x} \text{ number of faeces/rat/day : } \frac{9207}{200} = 46.06$$

$$\bar{x} \text{ weight (gm. air dried) of faeces/rat/day : } \frac{379.5}{200} = 1.9$$

$$\bar{x} \text{ gain (gm.) /rat/day : } \frac{42.6}{200} = 0.21$$

$$\bar{x} \text{ weight (gm.) of rat used : } \frac{6558.95}{40} = 163.97 \dots (B)$$

$$\bar{x} \text{ calories consumed/day/gm. of rat : } \frac{A}{B} = 0.21$$

DISCUSSION

In the present study following preference was obtained : (i) rice, (ii) lentil, (iii) wheat, (iv) green gram, (v) black gram. Harrison and Woodville (1950) also reported marked preference for rice by *R. rattus*. Chitre and Deoras (quoted by Spillett, 196) reported the following preference of food grains for *R. rattus* in captivity : (i) wheat, (ii) barley, (iii) lentil, (iv) maize, (v) millet and (iv) rice. According to Majumdar *et al.* (1969) jower appeared to be the most preferred grain to *R. rattus*. Mukta Bai *et al.* (1978) found that under laboratory condition some rodents including *R. rattus* preferred a snail (*Ariophanta madraspatana*) in preference to whole wheat, ragi, jower, rice or groundnut. This is obvious that *R. rattus* shows different types of preference in different studies, but in all the experiments it consumes other grains or food in good quantities showing ultimate preference for a varied diet. In fact, members of the genus *Rattus* generally accept a wide spectrum of foods (Fall *et al.* 1971) and it appears that niche differences determine the extent of food preference in *R. rattus*. Thus, the suggestion of Fitzwater and Prakash (1966) that for trapping of rodents, a mixed bait or a choice of bait is better than reliance on a single type, holds good for this species.

Spillett (1968) found some differences in the day and night feeding of *B. bengalensis*, but the same was not observed in *R. rattus*. Actually in the shops and godowns, the latter species is found to be almost equally active in the day as well as in the night, while the former species is almost completely nocturnal in habit. The daily consumption of *R. rattus* in the present study comes to about 9.85 gm. which is much less than that found by Majumdar *et al.* (1969) in Mysore. However,

weight of the stomach contents of adult *R. rattus* collected from the shops goes up to 16 gm. This indicates that consumption in captivity is much less than in nature. As Kavanau (1967), Spillett (1968) and others have pointed out, the relatively sterile environment to which the captive animals are submitted, restricted movement, absence of disturbances and social stresses, tend to distort their behaviour and less consumption of food. Food consumption data derived from captive animals probably represent the minimum requirement of them.

From the above study it was derived that an adult *R. rattus* of body weight 163.97 gm. requires 34.15 calories daily. According to Parpia *et al.* (1964), the average Indian subsists upon approximately 2100 calories per day, which means 61 individuals of adult *R. rattus* can consume food equivalent to that necessary for one Indian in a day.

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A NEW *HEMILEA* (DIPTERA : TEPHRITIDAE) FROM MEGHALAYA, INDIA.

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ABSTRACT

A new species under the genus *Hemilea*, *H. setigera* of the dipterous family Tephritidae is described and illustrated from Meghalaya, India.

INTRODUCTION

The genus *Hemilea* is characterised by having the third costal section relatively short, subequal to second costal section, vein R_{4+5} sparsely setose, with the setae not extending to m cross-vein (this does not seem to be a constant generic character since the new species being described below has the setae beyond m cross-vein.) and narrow genae equal to about the width of third antennal segment. Hardy (1974 : 195) prefers to treat those species of Trypetini which have the wings long, narrow, rather parallel sided, approximately 3 X longer than wide, which have the anterior $\frac{3}{4}$ entirely dark brown and only the posterior margin hyaline under *Hemilea*.

Hemilea setigera n. sp. (Figs. 1-7).

This species is readily differentiated by the wing markings, by the presence of a hyaline streak in cell R_1 just after stigma and by having the vein R_{4+5} sparsely setose, beyond the level of m cross-vein.

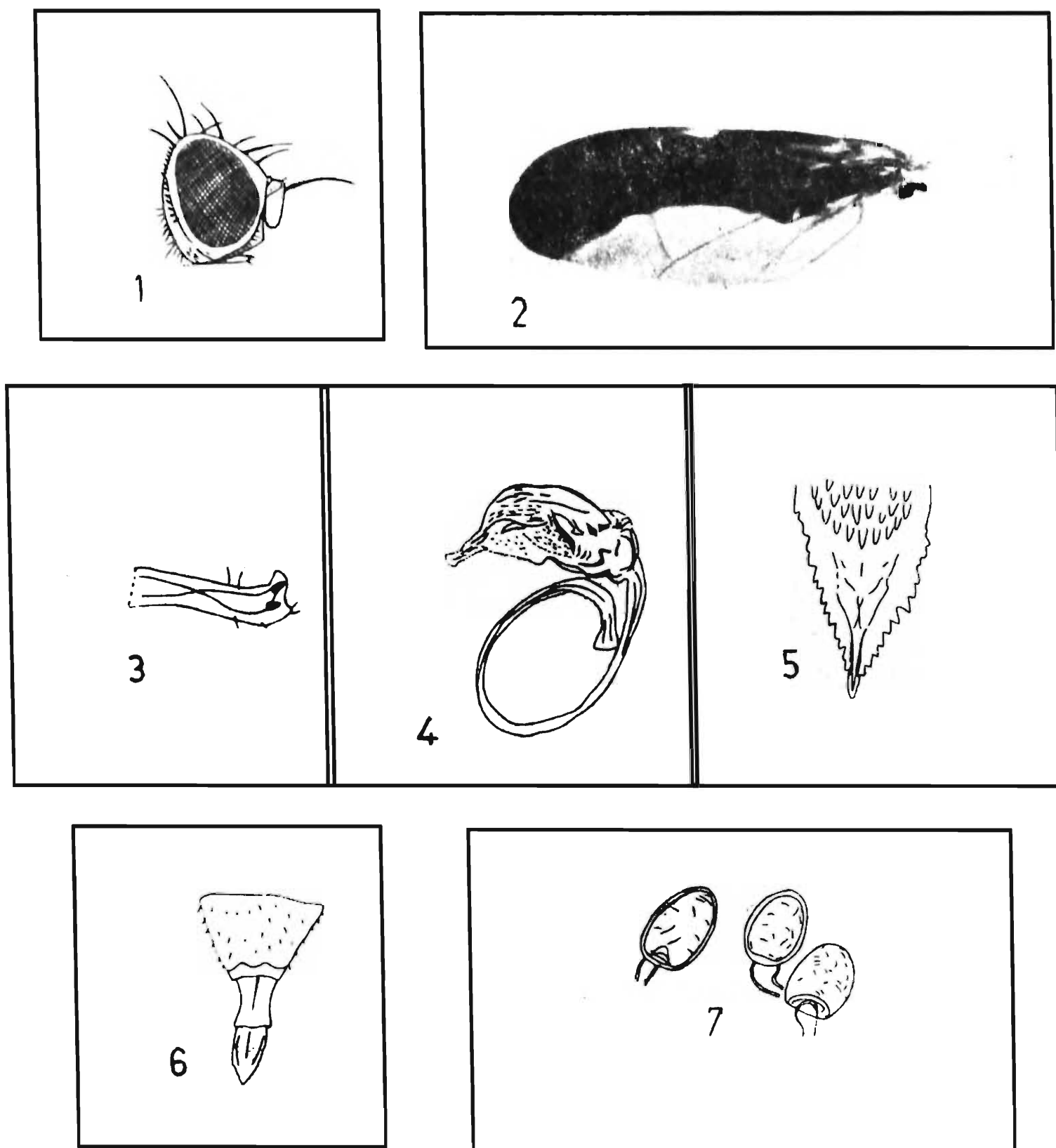
Male : Head : (Fig. 1) Yellow except for the dark reddish brown eyes. Occiput slightly swollen towards the lower portion.

3 pairs of inferior fronto-orbital bristles and 2 pairs of superior fronto-orbitals present. Ocellar bristles slightly shorter than lower superior fronto-orbitals. Antenne yellow, aristae pubescent. Genae narrow, equal to width of third antennal segment.

Thorax : Mesonotum brownish yellow with black setae. Scutellum concolourous with mesonotum, bearing 4 strong bristles. Pleura pale yellow with a slight tinge of brown on the sternopleura. A pale yellow streak runs from humerus along the upper edge of each mesopleuron to the wing base. Dorsocentral bristles situated behind anterior supra alars.

Legs : Entirely yellow.

Wings : Long, narrow, parallel sided about 3 times longer than wide with anterior $\frac{3}{4}$ dark brown, posterior margin hyaline as in fig. 2. third costal section sub-equal to second. A hyaline streak in the fore margin of cell R_1 along the costa just after the stigma extending to some distance is present. r-m cross-vein situated near apex of cell 1st M_2 . Vein R_{4+5} sparsely setose above, beyond the level of m cross-vein. Hyaline posterior border of wing extending through cell 2nd M_2 .



Figs. 1-7. 1. Head 2. Wing 3. Male surstylus 4. Aedeagus 5. Apex of piercer
6. Extended ovipositor 7. Spermathecae.

Abdomen : Brownish yellow, with black marks on the lateral edges of the last two abdominal terga. Surstylus and aedeagus as in figs. 3 & 4.

Length : Body about 5 mm., wings about 5.8 mm.

Female : Fitting the description of male in most respects. Lateral edges of abdominal

terga 4-6 with black marks. Oviscape black except for the yellow apex and black setae. Oviscape viewed from dorsal surface measures about 0.6 mm. Piercer (Fig. 5) is short, the apical portion toothed on sides and measures about 0.4 mm. Extended ovipositor (Fig. 6) measures approximately 1.4 mm. Spermathecae as in fig. 7.

Holotype ♂, India : Meghalaya, Shillong, Risa colony, 29-iv-1980, Coll : *C. Radhakrishnan* ; Allotype ♀, same locality, 29-iv-1980, Coll : Same ; Paratypes 3 ♂♂, 28 & 29-iv-1980 ; 1 ♀, 28-iv-1980, same locality, Coll : Same.

Holotype for the present retained in the collections of the Eastern Regional Station, Zoological Survey of India, Shillong and will be deposited in the National collection of the Zoological survey of India, Calcutta.

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TWO NEW SPECIES OF *PSEUDENDESTES* LAWRENCE
(COLEOPTERA : COLYDIIDAE) FROM INDIA

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ABSTRACT

P. lawrencei sp. nov., and *P. namdaphacensis* sp. nov. are described. A key to the species of *Pseudendestes* is appended.

Lawrence (1980) erected the genus *Pseudendestes* under Gempylodini : Colydiinae for two Australian species viz., *australis* Lawrence, *robertsi* Lawrence, and transferred *Endestes andrewesi* described by Grouvelle (1908) from South India to this genus. *Pseudendestes* belongs to the subfamily Colydiinae in having antennal insertions hidden under projection of frons ; and belongs to the tribe Gempylodini in having the subcylindrical shape, mandibular bases concealed from above, antennal insertions separated from mandibular articulation by carina, prosternal process narrower than front coxal cavities, pronotum with a median longitudinal depression.

So far only three species are included in this genus of which only *P. andrewesi* (Grouvelle) is recorded from South India. In the present study two species are described from North-East India and Southern India (Karnataka). A key to the species is also given.

Genus *Pseudendestes* Lawrence

Pseudendestes Lawrence, 1980, *J. Aust. ent. Soc.* 19 : 298.

Type-species : *Pseudendestes australis* Lawrence, by original designation.

Diagnosis : Elongated, parallel-sided somewhat cylindrical, coarsely and densely punctured, reddish brown to blackish brown. Head devoid of fronto-clypeal suture, with a pair of supra-antennal ridges separated from supraorbital ridges, with a pair of small depressions on the inner border supra-antennal ridges, eyes in transverse axis. Antenna 11-segmented, with a 2- to 5- segmented club. Prothorax usually elongated, rarely about as broad as long, pronotum with 2 pairs of longitudinal carinae, procoxae closely situated and coxal cavities closed, prosternal process broadly rounded at apex, mesocoxae and metacoxae more widely separated. Each elytron with 3 and rarely 4 carinae in addition to sutural carina.

Key to the Species of *PSEUDENDESTES*

1. Prothorax about as long as broad and widest near middle, pronotum with large, rugose punctures ; dense pile on dorsal surface of elytra. ... *robertsi* Lawrence
- Prothorax elongate and widest near apex, pronotum devoid of rugose punctures ; dense pile on dorsal surface of elytra absent, at least on anterior two-third. 2

2. Antennal club 2-segmented. ... 3
 Antennal club 3-segmented. ... 4

3. Apex of clypeus emarginate and densely pubescent, labrum visible from above, supra-antennal and supraorbital ridges moderately strongly developed and furrow in between them well marked, vertex and frons devoid of any rugose-ocellate punctures. ...

australis
Lawrence

Apex of clypeus not emarginate and sparsely pubescent, labrum not visible from above, supra-antennal and supraorbital ridges weakly developed and furrow in between them less marked, rugose-ocellate punctures on vertex and frons. ...

lawrencei sp.
nov.

4. Supra-antennal and supraorbital ridges weakly developed, lateral margin of prothorax serrated, each elytron with 3 carinae and carinae complete upto apex. ...

andrewesi
(Grouvelle)

Supra-antennal and supraorbital ridges strongly developed, lateral margin of prothorax smooth, each elytron with 4 carinae and carinae 2 and 3 not extending upto apical margin.

... *namdaphaensis*
sp. nov.

***Pseudendestes lawrencei* sp. nov.**

(Fig. 1)

This species is closely related to *P. australis* Lawrence but can be separated by its apex of clypeus not emarginate and sparsely pubescent, labrum not visible from above, supra-antennal and supraorbital ridges weakly developed and the furrow between them less marked, rugose-ocellate punctures on vertex

and frons, pronotal and elytral carinae weakly developed; median longitudinal furrow of pronotum confined within the anterior one-third and the pit on the posterior half larger, puncturation coarser and denser.

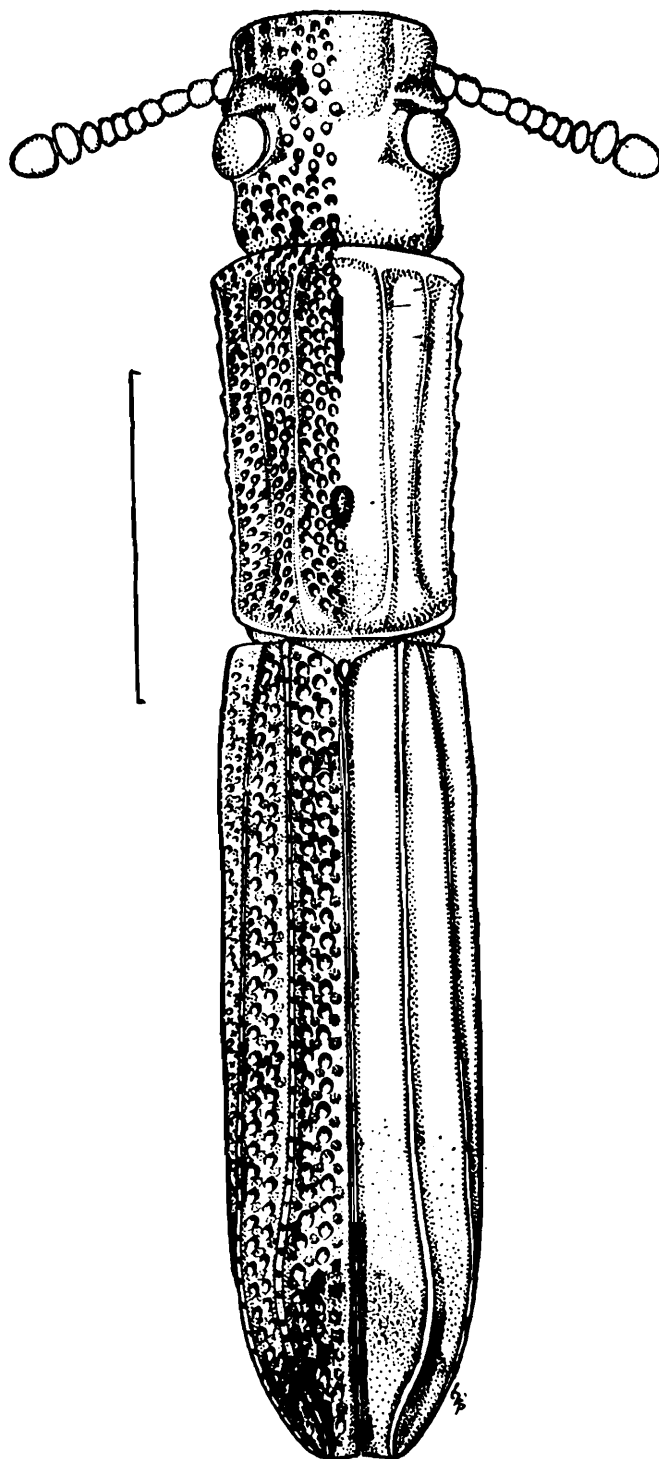


Fig. 1. *Pseudendestes lawrencei* sp. nov., dorsal view (scale=1.0 mm.).

General appearance (Fig. 1) elongated, sub-cylindrical, slightly shiny, reddish-brown ; with short, semierect golden pubescence.

Head about as broad as long, clypeus broad and not emarginate ; eyes about one-fourth as long as head and coarsely faceted, anterior margin emarginate ; temples longer than eyes, supra-antennal and supraorbital ridges weakly developed, depressions on inner border of supra-antennal ridges small and oblique, puncturation on vertex coarse and dense, rugose-ocellate punctures on anterior half of vertex and frons, front margin of clypeus moderately setose. Antenna moderately long and slender, scape short and broad, segments 2 and 3 hardly elongated, segments 4-9 slightly transverse, club 2-segmented, segment 10 transverse and segment 11 about as broad as long.

Prothorax 1.6 times as long as broad, widest anteriorly and narrowed posteriorly, front margin rounded, anterior angles not produced ; lateral margin almost straight, serrated and with about 15 denticles. Pronotum convex, carinae moderately prominent, inner carinae slightly diverging anteriorly and unite with anterior rim ; outer carinae sinuated, distinctly diverging anteriorly and not unite with anterior rim ; puncturation coarse and dense, a small oval median pit in posterior half and a narrow elongated furrow in anterior one-third.

Scutellum Small, elongate-ovoid.

Elytra 3.2 times as long as broad and 2.1 times as long as prothorax, subparallel and slightly wider posteriorly, apical margin emarginate, slightly declivous at apex between inner carinae, each elytron with 3 longitudinal carinae except sutural one, carinae more elevated in posterior third, inner carinae comparatively more elevated, carinae unite

posteriorly, punctures in rows deep and moderately large, intervals tuberculated, setae projected posteriorly. Metasternum 1.1 times as long as broad, median impressed line 0.7 time as long as median length of sternum, densely and coarsely punctate laterally and sparsely on either side of median line. Abdomen 3.3 times as long as broad ; with rugose punctures and pubescent.

Measurements of holotype : Total length 4.46 mm., width of head across eyes 0.71 mm., length of antenna 0.85 mm., length and width of prothorax 1.14 and 0.72 mm., length and width of elytra 2.92 and 0.78 mm.

Holotype, INDIA : KARNATAKA, South Kanara Division, Sunksal, 9. xi. 1929, B. M. Bhatia (Forest Research Institute, Dehra Dun).

Remark : This species is named after Dr. J. F. Lawrence, well known Coleopterist.

Pseudendestes namdaphaensis, sp. nov.

This species shows some resemblances to *P. andrewesi* (Grouvelle) but can be differentiated by its antennal club not abruptly developed, supra-antennal and supraorbital ridges strongly developed, prothorax parallel-sided in first third and then narrowed posteriorly, lateral margin of prothorax smooth, each elytron with four carinae and carinae 2 and 3 not complete upto apex.

General appearance (Fig. 2) elongate, sub-cylindrical, not shiny, deep blackish brown, pubescence scanty.

Head about as broad as long, clypeus broad and not emarginate ; eyes shorter than one-third as long as head and coarsely faceted, anterior margin emarginate, exposed part of temple much shorter than eyes, supra-antennal and supraorbital ridges strongly

developed and markedly elevated; depressions on inner border of supra-antennal ridges small, deep and globular; puncturation on vertex coarse and moderately dense, dorsal surface almost devoid of setae. Antenna moderately long and slender, scape broadly

elongated, pedicel short, segment 3 elongated; segments 4-8 short, subequal and slightly transverse; club 3-segmented, gradually wider towards apex, segments 9 and 10 transverse and segment 11 about as broad as long.

Prothorax 1.8 times as long as broad, widest anteriorly and narrowed posteriorly, front margin rounded, anterior angles slightly produced; lateral margin slightly undulated, smooth and bordered. Pronotum convex, carinae well developed and undulated, intervals between carinae grooved, especially median one; puncturation coarse and moderately dense, punctures along median line larger, a small and elongated pit near middle which is not easily distinguishable from large punctures.

Scutellum Small, elongate-ovoid, punctate.

Elytra 4.7 times as long as broad and 2.2 times as long as prothorax, subparallel, apical margin deeply emarginate, not declivous at apex, each elytron with four longitudinal carinae except sutural one, carinae slightly more elevated in anterior one-sixth and posterior one-fourth, outer and inner carinae unite posteriorly, carinae 2 and 3 not extending upto apex and not unite with other carinae, punctures in rows moderately large, intervals not tuberculated, few short setae only near apex. Metasternum 1.3 times as long as broad, median impressed line 0.7 time as long as median length of sternum, moderately coarsely and sparsely punctate. Abdomen 3.4 times as long as broad, puncturation coarse and dense, pubescence fine and sparse.

Measurements of holotype: Total length 8.80 mm., width of head across eyes 1.2 mm., length of antenna 1.6+ mm., length and width of prothorax 2.48 and 1.36 mm., length and width elytra 5.76 and 1.2 mm.

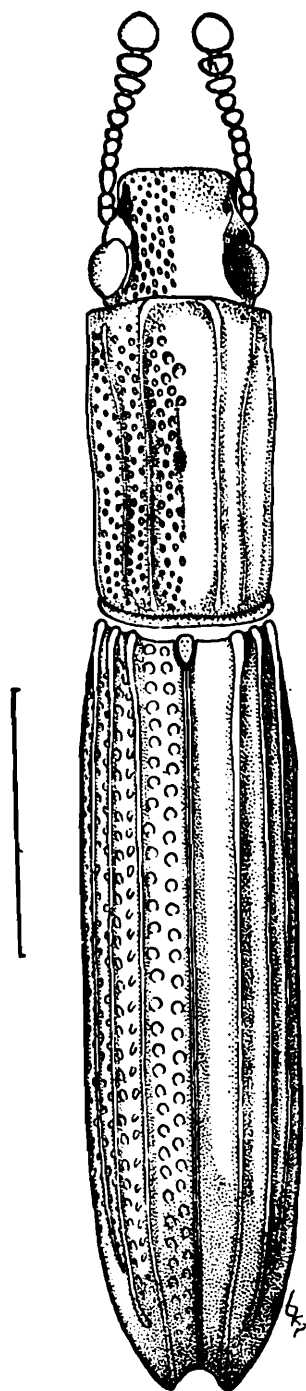


Fig. 2. *Pseudendestes namdaphaensis* sp. nov., dorsal view (scale=2.0 mm.).

Holotype : INDIA : ARUNACHAL PRADESH, Namdapha Survey, Hornbill, 14. iv. 1981, S. Biswas and party, under bark (Zoological Survey of India, Calcutta).

ACKNOWLEDGEMENTS

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A NOTE ON THE ODONATA (INSECTA) FROM KHASI HILLS, MEGHALAYA, WITH DESCRIPTION OF A NEW SPECIES

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Zoological Survey of India, Calcutta.

ABSTRACT

This paper is based on a small collection of Odonata collected from Khasi Hills, Meghalaya. A total of 18 species and sub-species are reported, of which one, *Anisopleura lieftincki* is described as new and three others reported for the first time from the area.

INTRODUCTION

Most of the work on the Odonata fauna of Khasi Hills (Meghalaya) are done by Laidlaw (1915, 1917a and 1917b); Fraser (1933, 1934, and 1936); Kennedy (1936); Varshney (1971); Lieftinck (1977) and Lahiri (1975, 1976, 1977a, 1977b and 1979). Consequent to these studies so far only 58 species and subspecies are reported, along with some interesting informations. During the course of present study on a small collection of Odonata collected by one of us (S. K. Ghosh), altogether 18 species and subspecies are recognised, of which one is new to science, and other three species and subspecies are reported for the first time from the area, thus bringing number of known species to 62. Most of the species agree fairly well with the available descriptions and differences are recorded under each species.

Suborder : ZYGOPTERA

Superfamily : COENAGRIOIDEA

Family : PLATYCNEMIDIDAE

1. *Calicnemia pulverulans* Selys (Fig. 1, A)

Calicnemia pulverulans Selys, 1886. *Mem. Ccur.*,
38 : 133.

Material examined : 1 ♂, 1 ♀, Khasi Hills, along the road from Mawsamai to Shella, 26.5.1979, coll. S. K. Ghosh and G. K. Srivastava and 1 ♀, Khasi Hills, around Dawki Road from Pynursla to Pamshutia, 27.5.1979, coll. S. K. Ghosh and G. K. Srivastava.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	31.00 mm	23.00 mm	22.00 mm
<i>Female</i> :	29.50 mm	24.00 mm	23.00 mm

Distribution : North Bengal, Sikkim and Western Himalaya ; first time recorded from the Khasi Hills.

Remarks : Pterostigma in the male reddish brown, covers $1\frac{1}{2}$ cells ; 19 to 20 postnodal nervures in forewings and 17 in hindwings. Anal appendages entirely black, a small black spine (Fig. 1, A) present nearer to base on the superior anal appendages. In female labium pale yellow, its outer margin black ; labrum yellow with a small black spot in the centre ; ante and postclypeus yellow, a "T" shaped black marking present at the outer margins of postclypeus ; 16 to 18 postnodal nervures in forewings and 15 to 16 in hindwings. A small paired yellowish marking

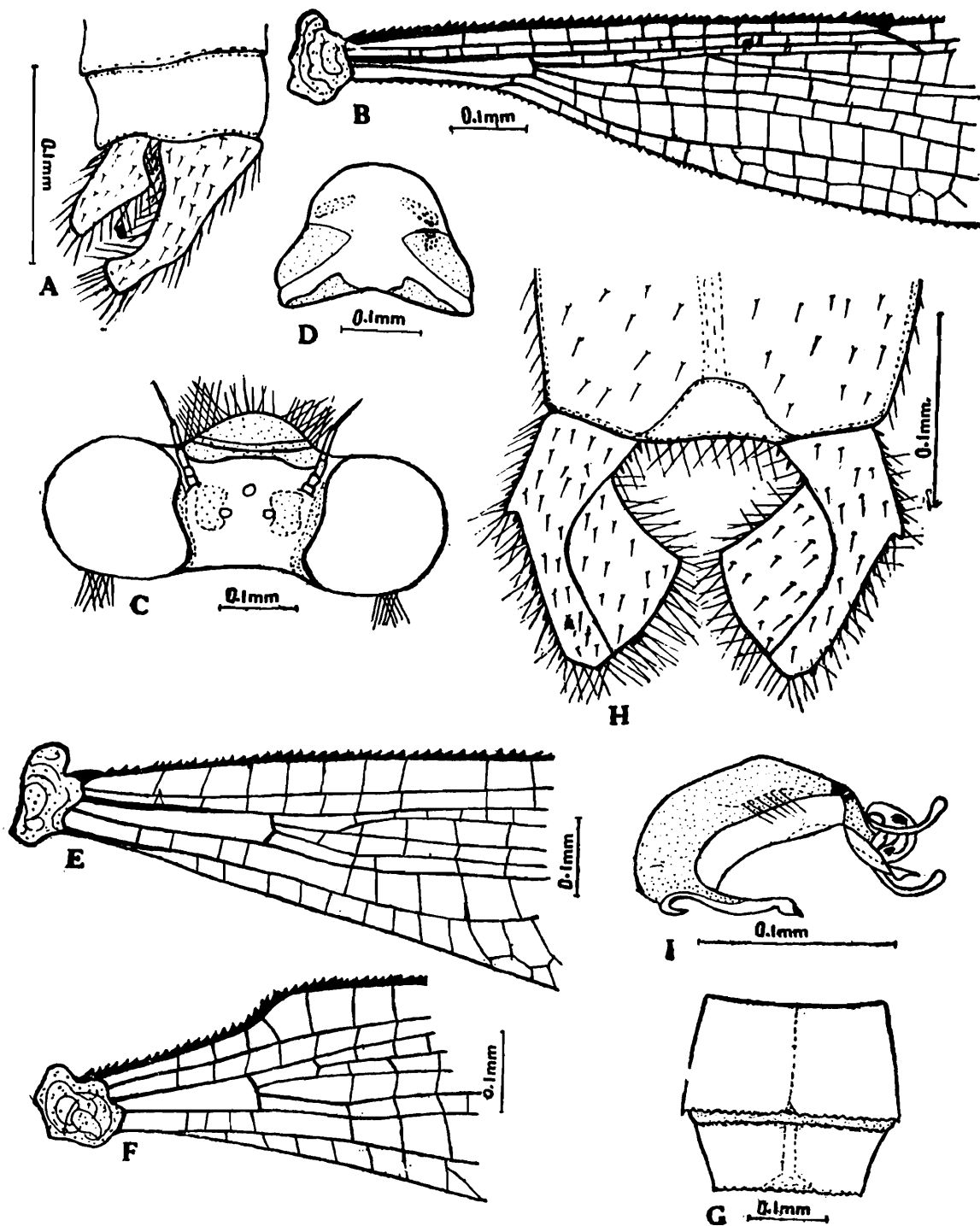


Fig. 1. A-H. A—Lateral view of anal appendages of *Calicnemia pulverulans* Selys.
 B—Basal portion of hindwing of *Philoganga montana* (Selys).
 C—I—*Anisopleura lieftincki* sp. nov. C—dorsal view of head ; D—dorsal view of prothorax ;
 E—basal portion of forewing ; F—basal portion of hindwing ; G—dorsal side of 10th
 abdominal segment ; H—Anal appendages dorsal view and I—Prophallus (Penis).

present at the basi-dorsal sides of the 1st to 6th abdominal segments in the female.

Specimens of this species are common and found resting on the ferns and other mixed forest vegetation on the hill slopes, adjacent to the water falls inbetween Pynursla to Pamshutia.

2. *Coeliccia bimaculata* Laidlaw

Coeliccia bimaculata Laidlaw, 1914, *Rec. Indian Mus.*, 8 : 341.

Material examined : 1 ♂, Shillong, Botanical Garden, 20.5.1979, coll. S. K. Ghosh and G. K. Srivastava and 1 ♀, Khasi Hills around Dawki Road from Pynursla to Pamshutia, 27.5.1979, coll. S. K. Ghosh and G. K. Srivastava.

Measurements :

Abdomen Forewing Hindwing

Male :

(teneral

specimen) 38.00 mm 24.00 mm 23.00 mm

Female :

(incomplete) — 25.00 mm 24.00 mm

Distribution : India : Tura and Garo Hills ; first time recorded from the Khasi Hills.

Remarks : In the male pterostigma light brown in colour, covers $1\frac{1}{2}$ cells and its distal end very oblique, nervure RIV+V arising proximal to subnode while 1Rlll arising at the subnode ; 18 postnodal nervures in forewings and 15-16 in hindwings.

Superfamily : AGRIOIDEA

Family : CHLOROCYPHIDAE

3. *Rhinocypha spuria* Selys

Rhinocypha spuria Selys, 1879. *Bull. Acad. Belg.*, (2) 42 : 388.

Material examined : 1 ♂, Forest around Mawsamai Cave, Cherrapunji, 25.5.1979, coll. S. K. Ghosh and G. K. Srivastava.

Distribution : India : Meghalaya (Shillong), Nagaland (Naga Hills) ; Burma : Kalaw, Southern Shan States and Chin Hills.

4. *Rhinocypha quadrimaculata hemihyalina* Fraser

Rhinocypha quadrimaculata hemihyalina Fraser, 1921. *Mem. Dept. Agric. Inda (Ent.)*, 7 : 64.

Material examined : 1 ♂, Khasi Hills along the road from Mawsamai to Shella, 26.5.1979, coll. S. K. Ghosh and G. K. Srivastava.

Distribution : Meghalaya (Shillong) and Nagaland (Naga Hills).

Family : AMPHIPTERYGIDAE

5. *Philoganga montana* (Selys)

(Fig. 1, B)

Anisoneura montana Selys, 1859. *Bull. Acad. Belg.*, (2) 7 : 445.

Philoganga montana Kirby, 1890. *Cat. Odon.*, : 111.

Material examined : 1 ♂, Khasi Hills, Pynursla, 27.5.1979, coll. S. K. Ghosh and G. K. Srivastava.

Measurements :

Abdomen Forewing Hindwing

Male : 47.00. mm 47.00 mm 45.00 mm

Distribution : West Bengal (Darjeeling), Assam (Nowgong) and Meghalaya (Shillong).

Remarks : Agress with the description of the species except the following : Labrum greenish yeliow ; occiput black ; sides of the ocelli brownish yellow. The specimen was collected from the side of a hill stream nearby the hill slope, covered with mixed forest. However, this is the second record of the species since the publication of *Fauna of India* (1934).

Family : EUPHAEIDAE

6. *Allophaea ochracea* (Selys)

Euphaea ochracea Selys, 1859. *Bull. Acad. Belg.*,
(2) 7 : 443.

Allophaea ochracea Fraser, 1929. *J. Bombay nat. Hist.*
Soc. 33 : 288-289.

Material examined : 2 ♂♂, Khasi Hills
along the road from Mawsamai to Shella,
26.5.1979, coll. S. K. Ghosh and G. K. Sri-
vastava.

Distribution ; Assam (Cachar), Meghalaya
(Shillong), Burma, Malacca and Thailand.

Genus : *Anisopleura* Selys 1853

Genus *Anisopleura* Selys, 1853 includes
montane and submontane stream breeding
species, and rest on the branches of tree
and bushes bordering the streams with rapid
currents, clear water and stony beds. Its
distribution is confined to Western Himalaya,
West Bengal, Sikkim, Assam and Upper
Burma (Fraser, 1934 ; St. Quentin, 1937 ;
Sahni, 1965 and Kumar and Prasad 1981). So
far a total of 6 species are known from the
Indian subcontinent. Of those *Anisopleura*
lestoides Selys and *A. comes* Selys, most
commonly occur in these areas, while *A.*
subplatystyla Fraser is known from Shillong,
Meghalaya and *A. vallei* from Cherapunji,
Khasi Hills. The 5th Indian species *A. kusumi*
Sahni, is reported from Bhowali (Nainital)
and the last one *A. furcata* Selys is recorded
from Upper Burma.

In the present paper a male specimen of
this genus was collected from Khasi Hills,
along the road from Mawsamai to Shella is
described here as a new species. It is an
incomplete specimen, its 6th to 9th abdomi-
nal segments are missing. The remaining
portions of the specimen shows all the

distinguishing taxonomic characters and on
the basis of these characters it has been
described as a new species. A key from the
known Indian species of the genus *Aniso-
pleura* Selys is given below.

**Key to the Indian Species of the genus
Anisopleura Selys**

1. Usually only one cubital nerv- ure in all the wings. ...	2
Several cubital nervures in all the wings. ...	3
2. Superior anal appendages with short spine at the middle ...	<i>lestoides</i> Selys
Superior anal appendages with a stout spine present near the base ...	<i>kusumi</i> Sahni
Superior anal appendages sim- ple, cone-shaped, spine absent. ...	<i>A. vallei</i> st. Quentin
3. Extreme apices of forewings of male dark brown ...	4
Extreme apices of forewings of male not marked with dark brown ...	<i>lieftincki</i> sp. nov.
4. Superior anal appendages with- out spine ...	<i>comes</i> Selys
Superior anal appendages with short spine near the base ...	<i>subplatystyla</i> Fraser

7. *Anisopleura lieftincki* sp. nov.

(Fig. 1, C-I)

Labium black, fringed with long black
hairs ; labrum brownish yellow, its middle
portion reddish yellow ; anteclypeus black ;
postclypeus reddish yellow ; face, frons and
occiput black ; a somewhat kidney shaped
bright yellow marking present on each side
inbetween ocelli and eye (Fig. 1, C). Both
ante and postclypeus and face fringed with
long black hairs ; eye black, posteriorly also

fringed with a bunch of long black hairs ; Prothorax black, anterior lobe with a small creamy yellow spot on the sides ; a broad approximately rounded bright yellow markings present on the sides of middle lobe (Fig. 1, D). Posterior lobe with a triangular light yellow markings on its sides. Thorax black, marked with a narrow antehumeral stripes on the sides ; mesopimeron and metapimeron with a long and broad greenish yellow stripes which covers first lateral suture ; a triangular pale yellow spot present on the ante-alar sinus. Legs medium sized, robust and black ; spines black and long ; first two pairs of femora marked with cream yellow stripe on its outer sides.

Wings hyaline (Fig. 1, E & F), narrow and equal in breadth ; bases of both fore and hindwings marked with pale saffron, extending upto node in costal and subcostal nervures in the forewings while in hindwings extends beyond two cells of the abrupt angulation. Dark brown marking at the apices of forewings absent. An abrupt outwards angulation in between 4th to 6th antenodal nervures present on the costal border of hindwings. 1A not clearly forked ; 4 cubital nervures in forewings and 4 to 5 in hindwings ; arc markedly angulated, separated at the origin and present between 3rd to 4th nervures in both the wings. Pterostigma long, narrow, yellow and covers 3 cells in forewings and $3\frac{1}{2}$ to 4 cells in hind wings, 17 to 20 postnodal nervures in the forewings and 17 to 18 in hindwings.

Abdomen (lacking 6th to 9th abdominal segments) black, marked with greenish yellow as follows : Segment 1st broadly at the lateral sides ; a fine mid-dorsal carinal stripe present on 2nd to 5th segments ; broad basal markings present dorsally on 2nd to 5th segment. A

fine stripe present on the lateral side of the segments 2nd to 5th.

Genitalia ; Prophallus medium sized, tubular and curved ; glans of prophallus long, dilated basally and become narrower posteriorly (Fig. 1, I). Flagella one pair, long, tubular with clubshaped apex.

Anal appendages black, some small robust spines present on the lateral margins ; several black long fine spines are also present throughout the anal appendages. Superior anal appendages very broad and overlap each other. In the middle portion of superior anal appendages a short pointed spine present which is slightly nearer to the base than the apex (Fig. 1, H). Inferior anal appendages rudimentary.

Holotype : 1 ♂, Khasi Hills, along the road from Mawsamai to Shella, 26.5.1979, Registration No. 3628/H13 coll. *S. K. Ghosh and G. K. Srivastava*. Holotype will be deposited to the National Collection of Zoological Survey of India, Calcutta.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male (lacking abdominal segment 6th to 9th)	—	32.50 mm	30.00 mm

Comparison : *Anisopleura leifstincki* sp. nov. is closely related to *A. comes* and *A. subplatystyla* and can be easily separated from these two species by the complete absence of dark brown marking on the apices of forewing in the male. From *A. lestoides* and *A. kusumi* it can be distinguished by the presence of 4 to 5 cubital nervures in both the wings and clubshaped flagella (Male genitalia), while in *A. lestoides* and *A. kusumi* only one cubital nervure is present in both the wings and in

A. lestoides flagella are rounded at the apex, not clubshaped.

Family : CALOPTERYGIDAE

8. *Neurobasis chinensis chinensis* (Linn.)

Libellula chinensis Linnaeus, 1758, *Syst. nat.*, 1 : 545.

Neurobasis chinensis Kirby, 1890, *Cat. Odon.*, : 102.

Neurobasis chinensis chinensis Fraser, 1936, *Fauna Brit. India Odonata*, 2 : 121-124.

Material examined : 1 ♂, Forest around Mawsamai cave, Cherrapunji, 25.5.1979 coll. S. K. Ghosh and G. K. Srivastava.

Distribution : India : South Kanara, Coorg, Malabar, Nilgiri, Wynad, Palni Hills, Western Himalaya, Bihar, West Bengal, Assam, Manipur, Meghalaya, Mizoram ; Sri Lanka ; Nepal ; Burma ; Thailand ; Indochina ; Malaysia and Sumatra.

Suborder : ANISOPTERA

Superfamily : LIBELLULOIDEA

Family : LIBELLULIDAE

9. *Orthetrum sabina sabina* (Drury)

Libellula sabina Drury, 1770. *III. Exotic Ins.*, 1 : 114-115.

Orthetrum sabina sabina Lieftinck, 1954. *Treubia*, 22 (Suppl).

Material examined : 1 ♂, Shillong, Botanical Garden, 20.5.1979, coll. S. K. Ghosh and G. K. Srivastava.

Distribution : From Africa across Tropical Asia and Australia to Pacific Islands.

10. *Orthetrum glaucum* (Brauer)

Libellula glauca Brauer, 1865. *Verh. Zool. bot. Ges. Wien*, 15 : 1012.

Orthetrum glaucum Kirby, 1890. *Cat. Odon.*, 39.

Material examined : 2 ♂♂, Khasi Hills around Dawki road from Pynursla to

Pamshutia, 27.5.1957, coll. S. K. Ghosh and G. K. Srivastava.

Distribution : India : West coast, Western Himalaya, Manipur, Meghalaya, Arunachal Pradesh, Mizoram ; Sri Lanka ; Nepal ; Philippines and Java.

11. *Orthetrum triangulare triangulare* (Selys)

Libellula triangularis Selys, 1878, *Mitth. Mus. Dresden*, : 314.

Orthetrum triangulare triangulare Fraser, 1936. *Fauna Brit. India. Odonata*, 3 : 305-307.

Material examined : 1 ♀, Khasi Hills along road from Mawsamai to Shella 26.5.1979, coll. S. K. Ghosh and G. K. Srivastava and 2 ♂♂, on Dawki road from Pynursla to Pamshutia, 27.5.1979 coll. S. K. Ghosh and G. K. Srivastava.

Distribution : India : South Indian Hills, Western Himalayas, West Bengal, Arunachal Pradesh, Assam, Meghalaya, Mizoram ; Sri Lanka ; Nepal ; Burma and Vietnam.

12. *Palpopleura sexmaculata sexmaculata* (Fabricius)

Libellula sexmaculata Fabricius, 1787, *Mant. Ins.*, 1 : 338.

Palpopleura sexmaculata sexmaculata Fraser, 1936. *Fauna Brit. India Odonata*, 3 : 318-320.

Material examined : 1 ♀, Khasi Hills, on road from Samer to Kyrdem Kulai, 23.5.1979, coll. S. K. Ghosh and G. K. Srivastava.

Distribution : Throughout India ; Sri Lanka ; Nepal ; Tibet ; Malaysia ; Indochina and China.

13. *Crocothemis servilia servilia* (Drury)

Libellula servilia Drury, 1770. *Ill. Ex. Ins.*, 1 : 112-113.

Crocothemis servilia servilia Fraser, 1936. *Fauna Brit. India Odonata*, 3 : 345-347.

Material examined : 2 ♂♂, Shillong (Botanical Garden), 20.5.1979, coll. S. K. Ghosh and G. K. Srivastava ; 1 ♀, Khasi Hills on road from Sumer to Kyrдем Kulai, 23.5.1979, coll. S. K. Ghosh and G. K. Srivastava and 1 ♂, Forest around Mousamai cave, Cherrapunji, 25.5.1979, coll. S. K. Ghosh and G. K. Srivastava.

Distribution : From Mesopotamia to Japan, Philippines, Malaysia and Indonesia.

14. *Diplacodes trivialis* (Rambur)

Libellula trivialis Rambur, 1842. *Ins. Neurop.*, : 115.

Diplacodes trivialis Karsch, 1891. *Ent. Nachr.* 17 : 246.

Material examined : 1 ♂, Forest around Mawsamai cave, Cherrapunji, 25.5.1979, coll. S. K. Ghosh and G. K. Srivastava 1 ♀, Khasi Hills, along the road from Mawsamai to Shella, 26.5.1979, coll. S. K. Ghosh and G. K. Srivastava.

Distribution : From Seychelles across tropical Asia and from Australia to Western Pacific Islands.

15. *Trithemis festiva* (Rambur)

Libellula festiva Rambur, 1842. *Ins. Neurop.* : 92.

Trithemis festiva Brauer, 1868. *Verh. Zool.-bot. Ges. Wien.*, : 736.

Material examined : 1 ♂, Khasi Hills around Dawki road from Pynursla to Pamshutia, 27.5.1979, coll. S. K. Ghosh and G. K. Srivastava.

Distribution : From West Pakistan across Sri Lanka and from India to New Guinea.

16. *Trithemis pallidinervis* (Kirby)

Sympetrum pallidinervis Kirby, 1889. *Trans. zool. Soc. Lond.*, 12 : 327.

Trithemis pallidinervis Morton, 1907. *Trans. ent. Soc. Lond.*, : 804.

Material examined : 2 ♀♀, Khasi Hills on road from Sumer to Kyrдем Kulai, 23.5.1979, coll. S. K. Ghosh and G. K. Srivastava.

Distribution : Throughout India ; Sri Lanka ; Burma ; Formosa and Philippines.

17. *Pantala flavescens* (Fabricius)

Libellula flavescens Fabricius, 1798. *Ent. Syst. Suppl.*, : 185.

Pantala flavescens Hagen, 1861. *Syn. Neur. N. Amer.*, : 142.

Material examined : 1 ♂, 3 ♀♀, Barapani, 21.5.1979, coll. S. K. Ghosh and G. K. Srivastava ; 2 ♂♂, Khasi Hills on road from Sumer to Kyrдем Kulai, 23.5.1979, coll. S. K. Ghosh and G. K. Srivastava ; 1 ♂, 2 ♀♀, Forest around Mawsamai cave, Cherrapunji, 25.5.1979, coll. S. K. Ghosh and G. K. Srivastava and 3 ♂♂, Khasi Hills along the road from Mawsamai to Shella, 26.5.1979 coll. S. K. Ghosh and G. K. Srivastava.

Distribution : Cosmopolitan.

18. *Tramea basilaris burmeisteri* Kirby

Libellula chinensis Burmeister, 1839. *Handb. Ent.*, 2 : 852.

Libellula basilaris Hagen, 1862, *Peters, Reise n. Mossambique zool.*, 5 : 105.

Tramea burmeisteri Kirby, 1839. *Trans. zool. Soc. Lond.*, 12 : 816.

Tramea basilaris burmeisteri Fraser, 1936. *Fauna Brit. India Odonata*, 3 : 461.

Material examined : 1 ♀, Khasi Hills along the road from Mawsamai to Shella, 26.5.1979, coll. S. K. Ghosh and G. K. Srivastava.

Measurements :

	Abdomen	Forewing	Hindwing
Female :	(incomplete) 40.50 mm	39.50 mm	

Distribution : India : Western Himalaya, Tamil Nadu, Karnataka, Madhya Pradesh, Bihar, West Bengal ; Sri Lanka ; Burma and

Malaysia ; first time recorded from the Khasi Hills.

Remarks : Discoidal cells in forewings traversed only once ; discoidal field in left forewing begins with 4 rows of cells while in right forewing and hindwings with 3 rows of cells ; nodal index $\frac{9-11\frac{1}{2}}{10-7} \frac{12\frac{1}{2}-9}{6-11}$

ACKNOWLEDGEMENTS

We express our gratitude to B. K. Tikader, Director and Dr. S. K. Bhattacharya, Deputy Director, Zoological Survey of India, Calcutta for giving us facilities to carry out this work. Thanks are also due to Dr. G. K. Srivastava, Superintending Zoologist, Zoological Survey of India, Calcutta for critically going through the manuscript.

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REMARKS ON TWELVE SPECIES OF NEWLY RECORDED GRASSHOPPERS (Order ORTHOPTERA) FROM WEST BENGAL

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ABSTRACT

Twelve species of grasshoppers of the super-family Acridoidea are recorded here for the first time from the state of West Bengal. Remarks have been given on their distribution and additional morphological features, measurements and illustrations have been provided wherever necessary.

INTRODUCTION

While working on the grasshoppers from West Bengal it is found that 12 spp. of the super-family Acridoidea that remains yet unreported from the state. So the opportunity is utilized for reporting them below for the first time. The present communication also contains in details records of localities from the state ; new data in the form of remarks of systematic value including variability of species and subspecies, additional descriptions with suitable illustrations and measurements are given wherever necessary.

All measurements are given in mm.

Super-family : ACRIDOIDEA

Family : ACRIDIDAE

Genus (1) *Phlaeoba* Stal, 1860

1. *Phlaeoba panteli* Bolivar, 1902

(Figs. 1-2)

Phlaeoba panteli Bolivar, 1902. *Annls. Soc. ent. Fr.*,
70 : 589.

Material : 1 ♂ ; Gurubathan, Darjeeling, W. B. ; 4.3.1974. 1 ♂, 1 ♀ ; Bejoynagar Tea Estate, Darjeeling, W. B. ; 19.6.1978. 3 ♂, 3 ♀ ; Naxalbari, Darjeeling, W. B. ; 17.9.1974. 2 ♂, 4 ♀ ; Chunarbat, Darjeeling, W.

B. ; 8-10.3.1974. 1 ♂, 2 ♀ ; Saurini Lower Basti, Mirik, Darjeeling, W. B. ; 23.6.1979. 2 ♀ ; Sumsing, Darjeeling, W. B. ; 6.3.1974. 1 ♂, 3 ♀ ; Mohar Tea Estate, Sukna, Darjeeling, W. B. ; 16.11.1974. 1 ♀ ; Sukna, Darjeeling, W. B. ; 13.11.1974. 1 ♂ ; Near Mirik Lake, Darjeeling, W. B. 2 ♂ ; Sundarinala, Jamduar, Darjeeling, W. B. ; 2.11.1973. 2 ♂ ; Sevok, Darjeeling, W. B. ; 22-24.11.1974. 1 ♂, 1 ♀ ; Mongpo, Darjeeling, W. B. ; 18.3.1974. 1 ♀ ; Jayanti, Jalpaiguri, W. B. ; 4.9.1975. 1 ♂ ; Rydak, Jalpaiguri, W. B. ; 9.9.1975. 2 ♂, 9 ♀ ; Botanical Garden, Howrah, W. B. (different dates). 3 ♂ ; Andul, Howrah, W. B. ; 12.9.1978. 2 ♂ ; Singur, Hooghly, W. B. ; 30.6.1978. 2 ♀ ; Garia, 24-Parganas, W. B. ; 4.8.1978.

Remarks : So far the species was known to be distributed in Madura (type : Tamil Nadu) and Pusa (Bihar). Though quite abundant in the lower part of Darjeeling district, the species has never been recorded earlier from the region. Cejchan (1969) recorded it from Afganistan.

The species (♂ 19-25, ♀ 25-41) resembles, *P. antennata*, in the colouration of wings (being bluish in both species) but can be easily distinguished by the character of irre-

gular striped callosities of head and pronotum. Besides, sub-genital plate and epiphallus (Figs. 1, 2) are also notable.

Genus (2) *Ceracris* Walker, 1870

2. *Ceracris nigricornis laeta* (Bolivar, 1914)

(Figs. 3-4, 18)

Ceracris nigricornis Walker, 1870. *Cat. Derm. Salt. Br. Mus.*, 4 : 791.

Material : 1 ♀ ; Bamanpokri, Darjeeling, W. B. ; 22.8.1975. 4 ♀ ; Mirik, Darjeeling, W. B. ; 17.9.1974. 1 ♂ ; Adalpur, Sukna, Darjeeling, W. B. ; 15.2.1974. 2 nymphs ; Thorbu Tea Estate, Mirik, Darjeeling, W. B. ; 24.6.1979. 3 ♂, and (1 nymph) ; Saurini Lower Basti, Darjeeling, W. B. ; 22-25.6.1979. 1 ♀ ; Khanikhola, Rangpo, Sikkim ; 6.7.1979.

Remarks : Uvarov (1925) while revising the genus divided the species, *C. nigricornis*, into 2 subspecies, basing on relative size. Following Uvarov (op. cit.) the present series of specimens belong to the subspecies *laeta* (Bolivar, 1914), though Uvarov (op. cit.) stated that it usually occurred in South China and Taiwan. Therefore, this subspecies in the Himalayan West Bengal is a new record.

Additional description : Females (Fig. 18) : The female specimens (25-36) studied show that the antenna may be brownish on basal half and dark at apical half or entirely blackish. Frontal ridge at median ocellus less than half width of interocular distance. Lateral carina of pronotum more or less prominent at prozona and may be perceptible at metazona though obliterated in the posterior end or may be entirely obliterated (though perceptible by pigmentations) ; latter, a little more longer than half of prozona. Mesosternal lobe wider than long, its inner margin rounded ; interspace narrow

(Fig. 3) ; metasternal lobe separated by a very narrow interspace (Fig. 3). Posterior tibia almost subequal to posterior femur ; former, with 10-11 external and 11-12 internal spines. Tibiae of all legs pilose.

Males : Less robust (22-24.5). Antenna uniformly dark ; olive-green colouration of body more prominent. Lateral carina perceptible only by pigments in metazona. Sub-genital plate rounded ; supra-anal-plate tongue shaped with a very wide longitudinal groove ; cercus conical ; epiphallus as figured (Fig. 4).

Nymphs : The collection contains 2 nymphs (♂ 17.2, ♀ 24.0), which are almost identical to adults except for incomplete elytra and genital parts. Lateral carina in metazona clear ; posterior femur olive-greenish without any spot or dot ; posterior knee brownish ; posterior tibia beyond basal ring pale brownish ; antenna brownish, shorter than the normal size. Elytron (6-7) brownish with curved venation. Supra-anal-plate tongue shaped ; cercus conical. Valves of ovipositor not yet formed.

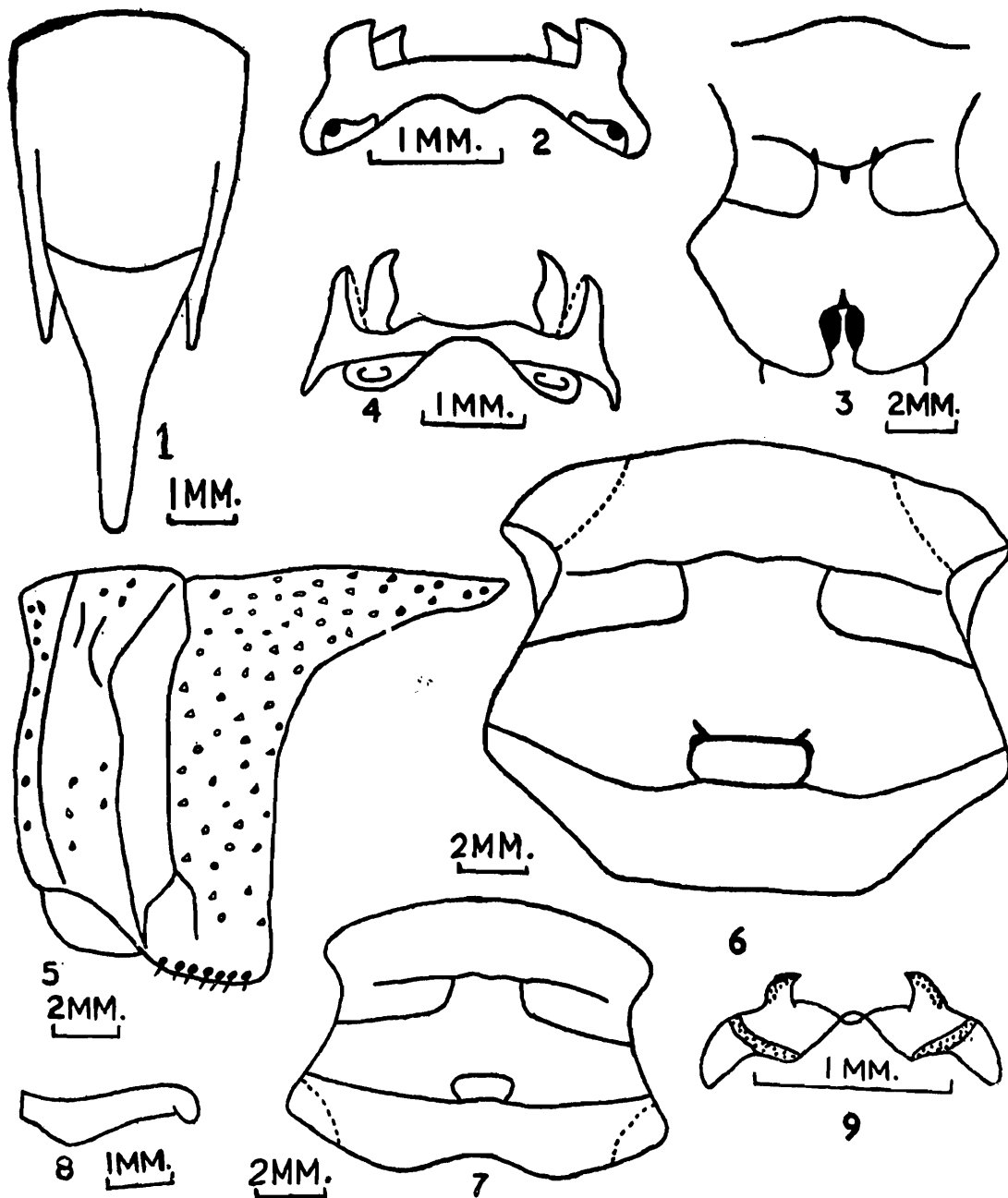
The availability of nymphal stages during May-June will indicate the pre-monsoon generation of the species.

Genus (3) *Dnopherula* Karsch, 1896

3. *Dnopherula (Aulacobothrus) luteipes* (Walker, 1871)

Stenobothrus (?) *luteipes* Walker, 1871. *Cat. Derm. Salt. Br. Mus.*, 5 (suppl.) : 82.

Material : 5 ♀ ; Suklapara, Jalpaiguri, W. B. ; 29.8.1975. 2 ♂ ; Bhutan Ghat ; 6.9.1975. 1 ♀ ; Rydak, Jalpaiguri, W. B. ; 11.9.1975. 1 ♂, 1 ♀ ; Sahapur, Maldah, W. B. ; 17.9.1975. 1 ♂ ; Andherikola, Rangpo, Sikkim ; 5.7.1979.



Figs. 1-9. 1. Subgenital plate, ventral.
Phlaeoba panteli, male.
2. Epiphallus, dorsal.
Ceracris nigricornis laeta, female.
3. Meso- and metasternal lobes and their interspaces.
4. Male, epiphallus, dorsal.
Dittopternis venusta, female.
5. Pronota lateral lobes, lateral.
6. Meso- and metasternal lobes.
Oedaleus abruptus, female.
7. Meso- and metasternal lobes (same scale as 3 and 6).
Eucroptacra praemorsa, male.
8. Cercus, lateral (same scale as 1).
9. Epiphallus, dorsal.
Cyrtacanthacris tatarica, male

Remarks : This species (δ 14-18, η 21-22) is very common in oriental region. Also distributed over China ; Japan ; Europe and North America. It is, however, a new record from the present localities.

Genus (4) *Dittopternis* Saussure, 1884

4. *Dittopternis venusta* (Walker, 1870)

Oedipoda venusta Walker, 1870. *Cat. Derm. Salt. Br. Mus.*, 4 : 740.

Material : 2 δ ; Tukriajhar, Darjeeling, W. B. ; 18.6.1979. 1 η ; Panitanki, Darjeeling, W. B. ; 17.6.1979. 2 δ ; Bamanpokri, Darjeeling, W. B. 1 δ (dry) & 8 η (wet) ; Bhutanghat, Jalpaiguri, W. B. 2 δ , 5 η (dry) & 3 δ (wet) Rydak, Jalpaiguri, W. B. 10-12.9.1975. 1 η ; Jayanti, Jalpaiguri, W. B. ; 4.9.1975.

Remarks : So far known from South India (South of Pollachi ; Anaimalai ; Sheveroy : Mysore) the species is recorded here for the first time from the state of West Bengal.

Additional description : Females : Ventral parts of body and legs pilose. Frontal ridge constricted just beneath truncated apex of fastigium, and again immediately below median ocellus ; punctured. Pronotum densely punctured ; granules dense or spared ; metazona about one and half times longer than prozona ; posterior angles of lateral lobes rounded (Fig. 5). Meso-and metasternal plates punctured ; mesosternal interspace as wide as or slightly wider than one of its plates, its inner posterior angle obliquely rounded (Fig. 6) ; metasternal plates separated by an elliptical furcal suture. Median black band above abdomen extends up to tip. Upper carina of posterior femur ends in a terminal spine.

Males : Identical with females except much smaller in size and the density of

granules lesser on vertex and pronotum. Cerci conical.

Measurements : Length of body δ 18.5-19, η 27-29 ; length of antenna δ 12.5-13, η 13-14, length of head δ 2.8-3, η 3.3-3.5 ; maximum width of face δ 2.1-2.3, η 3.4-3.5 ; minimum width of interocular distance δ 1-1.1 ; η 1.5-1.8 ; width of frontal ridge at median ocellus δ .4-.5, η .9-1 ; length of prozona δ 1.8-1.9, η 2.1-2.3 ; length of metazona δ 2.7-2.9, η 3.2-3.6 ; length of elytron δ 18.3-19, η 24-27 ; length of posterior femur δ 11.3-11.5, η 14.5-16 ; maximum width of post. femur δ 4-4.1, η 4-4.6 ; post. tibia δ 10-10.1, η 11.5-13.

Genus (5) *Oedaleus* Fieber, 1853

5. *Oedaleus abruptus* (Thunberg, 1815)

(Fig. 7)

Gryllus abruptus Thunberg, 1815. *Mem. Acad. Sci. St-Petersb.*, 5 : 233.

Material : 3 δ , 8 η ; Panitanki, Darjeeling, W. B. ; 17.6.1979. 2 δ ; F. R. H. Campus, Naxalbari, Darjeeling, W. B. ; 18.6.1979. 1 δ ; Tukriajhar, Darjeeling, W. B. ; 18.6.1979. 1 δ , 1 η ; Lish forest, Darjeeling, W. B. ; 13.3.1974. 1 δ ; Bhutanghat, Jalpaiguri, W. B. ; 5.9.1975. 1 δ , 1 η ; Suklapara, Jalpaiguri, W. B. ; 30.8.1975. 1 δ ; Falakata, Cooch Behar, W. B. ; 14.9.1975. 2 η ; Sahapur, Maldah, W. B. ; 17-18.9.1975. 1 δ ; Khanikhola, Rangpo, Sikkim ; 6.7.1979.

Remarks : A common grasshopper of India. Also known from Sri Lanka ; China and Eastern Nepal. It is, however, a new record for West Bengal.

Additional description : Females (12.5-17) Fastigium with a slender median carinula continued backwards over vertex ; frontal ridge hardly sulcated, a little divergent towards

clypeus; facial carinae oblique. Antenna longer than head and pronotum taken together, filiform, testaceous; sometimes apex may be dark and apical portion may be depressed and sulcated. Intercalary serration continues along posterior media and cubitus veins up to end of post. cubital vein. Mesosternal lobe very short, much wider than long, less than width of interspace in between, inner posterior margin of plate strongly oblique (Fig. 7). Supar-anal-plate almost tongue-shaped, with a median groove on basal half. Posterior tibia pale (perhaps due to wet preservation) with 13 black tipped spines on each margin.

Males : Identical with that of females.

Genus (6) *Eucoptacra* Bolivar, 1902

6. *Eucoptacra praemorsa* (Stal, 1860)

(Figs. 8-9)

Acridium (*Catantops* ?) *praemorsum* Stal, 1860.
Eugenie's Resa, Orth. : 330.

Material : 1♂ ; Sevok, Darjeeling ; 22.7.1974. 1♀ ; Tukriajhar, Darjeeling, W. B. ; 18.6.1979. 1♀ ; P. W. D. Bunglow, Rangpo, Sikkim ; 2.7.1979. 1♂ ; Khanikhola, Rangpo, Sikkim ; 6.7.1979. 1♀ ; Andberikhola, Rangpo, Sikkim ; 5.7.1979.

Remarks : Known from China ; Burma and in India from Bombay (Maharashtra) and Tamil Nadu. It is a new record for the North India.

Additional description : Male : Antenna decidedly longer than head and pronotum taken together ; segments on distal half gradually widened. Frontal ridge convex, expanded maximally between antennae ; finely punctured. Median carina of pronotum distinctly cut by 3 sulci, 3rd sulcus restricted not only to dorsum but also extends to

lateral lobes as other sulci. Metazona longer than prozona. Lateral field of pronotum almost as long as high. Prosternal tubercle short, cylindrical ; mesosternal interspace a little narrower than width of one of lobes, with rounded inner margins, slightly more approximating in upper region than lower one ; metasternal plates separated. Elytron with a little expanded costal area, opaque up to middle ; cells of radial sector and medial region elongated ; reticulation in basal half very dense. Posterior femur rather robust, with a distinct attenuated apical portion, equalling about one third of entire length of femur ; all carinulae spotted with dark spots. Cerci slightly compressed, incurved (Fig. 8) ; epiphallus as figured (Fig. 9).

Females : Perfectly identical with males.

Measurements : Length of body ♂ 18.5, ♀ 23-25. 1 ; length of head ♂ 1.8, ♀ 2-2.8 ; length of antenna ♂ 8, ♀ 9 ; length of pronotum ♂ 4.2, ♀ 5-5.8 ; length of prozona ♂ 2.2, ♀ 2-2.7 ; length of metazona ♀ 2.3, ♀ 3-3.5 ; length of elytron ♂ 19, ♀ 21.5-23.5 ; post. femur ♂ 12.5, ♀ 13-14.5 ; post. tibia ♂ 10, ♀ 11-12. (measured 1 male and 3 females).

Genus (7) *Cyrtacanthacris* Walker, 1870

7. *Cyrtacanthacris tatarica* (Linn., 1758)

(Fig. 10)

Gryllus Locusta tataricus Linnaeus, 1758. *Syst. Nat.*
(10th. ed.) : 432.

Material : 4♂, 4♀ ; Bijanbari, Naxalbari, Darjeeling ; 12.9.1974. 1♂ 1♀ ; Tukriajhar, Naxalbari, Darjeeling ; 18.6.1978.

Remarks : Distributed over the Oriental and the African continents. In India, it is known from Barkuda I., Chilka I., Calcutta, Nilgiri and recently Tandon and Shishodia (1969) recorded it from Nagarjun Sagar,

Andhra Pradesh. The availability of the species from Naxalbari of Siliguri Sub-division is not only a new record but also very interesting from zoogeographical distribution.

Additional description : Males : Fastigium of vertex rounded, shallowly concave, horizontal and reclinate with frontal ridge ; interocular distance narrow. Pronotum with a distinct median carina, slightly tectiform on prozonal portion, flat on metazona ; latter, widened laterally and broadly angular at posterior margin ; prozona and metazona subequal in length ; punctured throughout specially on lateral lobes and with a few insignificant, scattered yellowish granules on pronotal disc. Elytron 5 times longer than its maximum width and characterized by not having precostal veins, their place being occupied by coarse and strongly irregular reticulations. Epiphallus typical for the genus ; ancora slightly indicated, lophus tooth-like (Fig. 10).

Females : Identical with males (44-46) except for their bigger size (58-60).

Field notes : Naxalbari is situated in the 'Duars' in an area (lat. 26°N to 27°N and long. 88°E to 89°E), elevation 75 metre which is associated with heavy annual rainfall (300 cm. to 400 cm.) and hot (above 27°C in summer), moist climate with tropical evergreen forest. The chief cultivation of the area is tea plantation and recently in reclaimed plots of lands rice and vegetables like Lady's finger (*Hibiscus esculentus*) and chillie (*Capscium frutescens*) are grown. Due to constant encroachment for ever growing demand for agriculture, the area of virgin forest is decreasing. The species is abundant in the locality and it is seen that the members of the species enter the chillie and Lady's finger plantations. it is reported by local

farmers that the species is fond of leaves and twings of chillie, causing serious devastation. The junior author also noticed them during July frequenting in the Lady's finger garden, eating on leaves and tender fruits and busy-ing themselves obviously in the act of ovipositing in the soft ground. While this observation needs further checking it is certain that these insects are definitely pests on the crops in the area.

Genus (8) *Eupreponotus* Uvarov, 1921

8. *Eupreponotus inflatus* Uvarov, 1921

(Figs. 11-12)

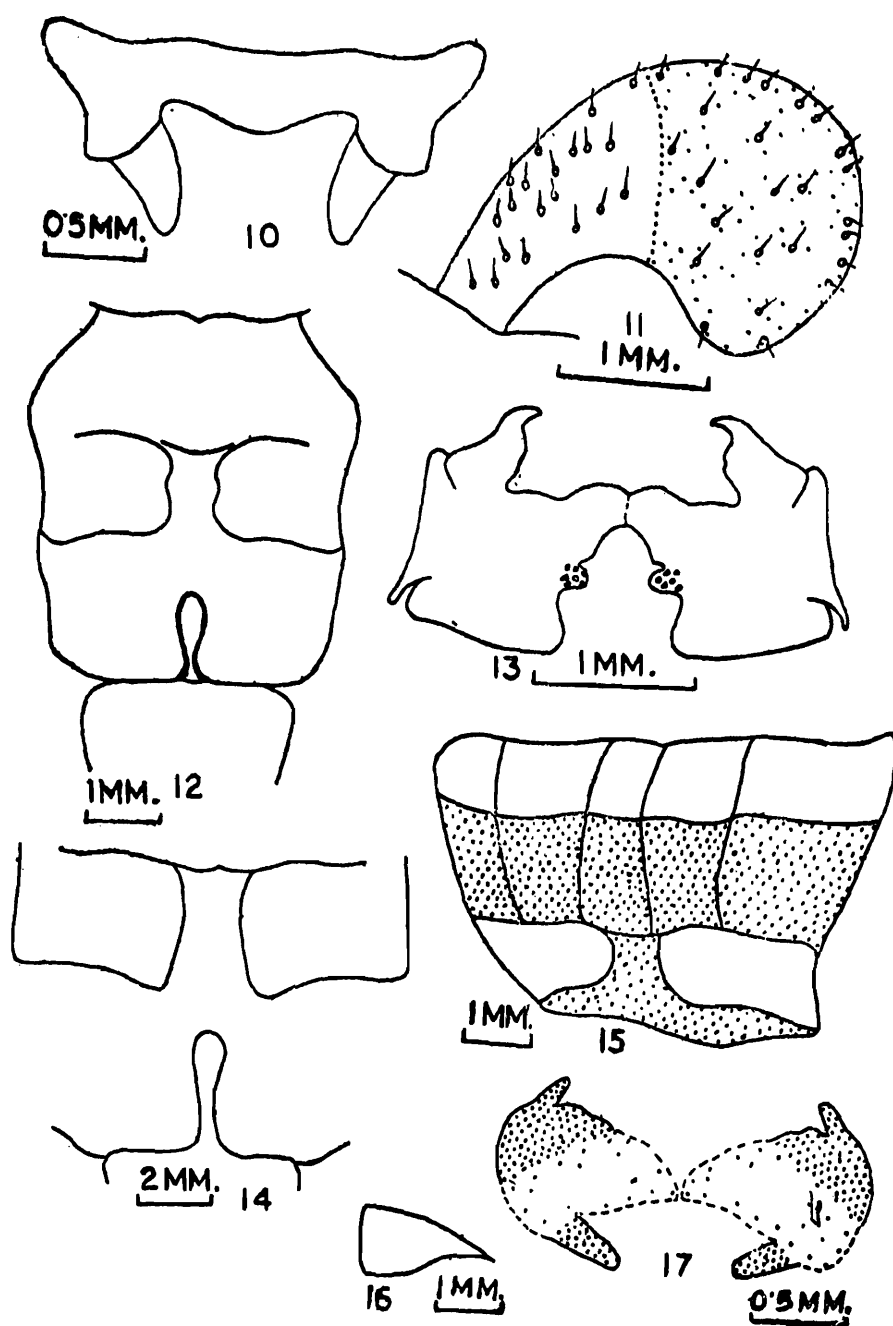
Eupreponotus inflatus Uvarov, 1921. *Ann. Mag. nat. Hist.*, 7 (9) : 508.

Material : 1 ♂, 1 ♀ ; Bamanpokri, Darjeeling, W. B ; 22.8.1975 ; H. K. Bhowmik coll. 1 ♂ (and 1 ♂, 2 ♀ nymphs) ; Sankrail, Howrah ; 8.7.1980 ; P. Halder coll.

Remarks : Uvarov (1921) erected the genus *Eupreponotus* with the single species, *E. inflatus*, from an unknown Indian locality. Later he (1927A) fixed the type locality as Cuttack and also examined one male and one female specimens from Calcutta, both these 2 examples being present in the National Collection of Zoological Survey of India. The present material (♂ 26, ♀ 38) from the ever green, thick forest of foothills of Darjeeling ('Duars') as well as from Howrah not only extends its zoogeography but also indicates its ability to adapt itself to Himalayan biotope as also to the cultivated area in the plains.

Presence of nymphs in the collection from Howrah during July will show that the species completes its life-cycle in the hot, rainy season.

Lately Singh (1978) has described the second species of the genus from Dehra Dun



Figs. 10-17. 10. Epiphallus, dorsal.
Eupreponotus inflatus, male.
 11. Cercus, lateral
 12. Meso- and metasternal lobes.
Heteracris pulchra, male.
 13. Epiphallus, dorsal.
Tylotropidius varicornis, male.
 14. Meso- and metasternal lobes.
Mesambria dubia, male.
 15. Pronotal lobes, lateral.
 16. Cercus, lateral (same scale as 15).
 17. Epiphallus dorsal (same scale as 10).
Ceracris nigricornis laeta, female.

apparently not being aware of Uvarov's type locality etc. Singh's species, *E. punctatus*, closely resembles Uvarov's species.

Figures of male cercus, mesosternal lobe are added here for the first time (Figs. 11, 12).

Genus (9) *Heteracris* Walker, 1870

9. *Heteracris pulchra* (Bolivar, 1902)

(Figs. 13, 19-21)

Euprepocnemis pulchra Bolivar, 1902. *Annls. Soc. ent. Fr.*, 70 : 630.

Material : 3♂, 2♀ ; Naxalbari (alt. c. 150 m), Siliguri, (Darjeeling) ; 13.9.1975 ; P. Halder coll. 2♂, 1♀ ; Gaur, Maldah, W. B. 19.9.1975 ; P. Halder coll. 1♂, 1♀ ; Falacata, Cooch Behar Dist., 14.9.1975 ; H. K. Bhowmik coll.

Remarks : So far was known from Tamil Nadu and Sri Lanka. The availability of the specimens from Naxalbari (borders of W. B., Bihar and Nepal), Cooch Behar and Maldah indicates that the species must be distributed throughout the plain terrain of sub-Himalayan region.

Additional description : Males (Fig. 19) : Antenna filiform (15-16), longer than head and pronotum taken together, brown, but from below segments appear dark giving it a different colouration ; middle segments elongated, about twice as long as their width. Prozona longer than metazona, posterior margin of latter being almost round. Mesosternal lobe wider than interspace, rounded on inner margin ; metasternum almost closed. Cercus compressed, laterally incurved, apex subacute and directed downwards. Subgenital plate rounded, curved upwards, apical margin straight. Epiphallus as figured (Fig. 13). Elytra about 4 times longer than their maximum width and without spot or with ill-defined

brownish spot ; rounded at apices ; costal vein with a few branches on precostal side ; medial vein giving off 4 branches of elongated cells and occupies more space than radial veinlets ; space usually occupied by intercalary vein filled with some irregular cells ; cubital veins run in dependently to be united with post-cubital apically, space between two again filled with irregular cells (Fig. 20). Wing shorter than elytron, basally with bluish tinge (decoloured in wet specimens). Posterior tibia pilose with 10 to 11 white but black tipped spines.

Females : Much larger. Frontal ridge sparsely punctated. Antenna more dark even on dorsum. Elytron slightly extends beyond posterior tibia ; clearly with brownish spots and areas, separated by hyaline areas (Fig. 21). Cercus small and gradually tapers. Superior valves of ovipositor comparatively larger than inferior ones, curved upwards and with pointed apices.

Measurements : Length of body ♂ 27.5-28, ♀ 54-56 ; length of head ♂ 3.5-4, ♀ 5-5.2 ; interocular distance ♂ 1-1.25, ♀ 2-2.15 ; length of antenna ♂ 15-16, ♀ 20-22 ; length of prozona ♂ 3-3.13, ♀ 6-6.16 ; length of metazona ♂ 2-3, ♀ 5-5.25 ; length of elytron ♂ 23-24.15, ♀ 45-46 ; posterior femur ♂ 19.5-20, ♀ 32-33 ; post. tibia ♂ 17-18.25, ♀ 29.5-30.

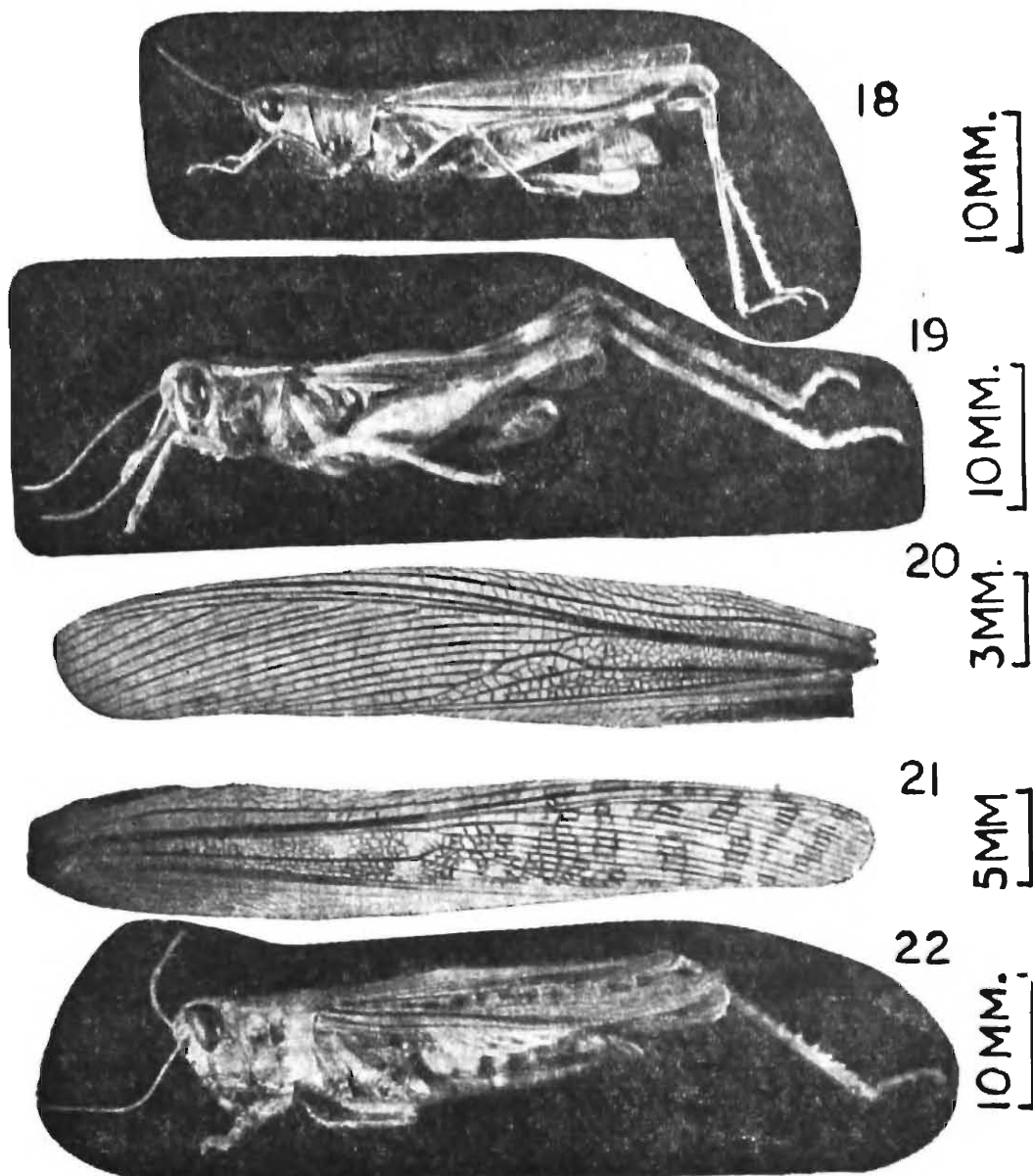
Genus (10) *Eyprepocnemis* Fieber, 1853

10. *Eyprepocnemis alacris alacris* (Serville, 1839)

(Figs. 22)

Acridium alacre Serville, 1839. *Ins. Orth.* : 682.

Material : 1♂, 1♀ ; Sukna, Mohar tea estate, W. B. ; 16.2.1974. 1♂ (nymph) ; Adalpur, Sukna ; 15.2.1974. 1♀ (damaged)



Figs. 18-22. 18. Profile.
Hetracris pulchra, male.
 19. Profile.
 20. Elytron.
 21. Female, elytron.
Eyprepocnemis alacris alacris, female.
 22. Profile.

Sevok, Darjeeling, W. B. ; 22.2.1974. 1 ♀ ;
 Mirik, Darjeeling, W. B. ; (alt. ca. 1688m).
 1 ♂ ; Andheri Khola, Darjeeling, W. B. ;
 5.7.1978. 1 ♂ ; Nilpara, Jalpaiguri ; 30-31.8.
 1975.

Remarks : Known from all over Afganistan ; East Persia : Pakistan ; Sri Lanka ;
 Burma and India. In India, it is distributed in
 Tamil Nadu (Madura : Nilgiri) and Chota

Nagpur. It is recorded here for the first time from West Bengal.

The subspecies (δ 22-24, η 35-36) is the commonest in the genus and tallies nicely with the revised characters given by Dirsh (1958).

Genus (11) *Tylotropidius* Stal, 1873

11. *Tylotropidius varicornis* (Walker, 1870)

(Figs. 14)

Heteracris varicornis Walker, 1870. *Cat. Derm. Salt. Br. Mus.*, 4 : 667.

Material : 2 δ ; Sevok, Darjeeling, W. B. ; 22.2.1974. *H. K. Bhowmik* coll. 1 δ ; Kangumaduga, Eastern Ghats, Seshacharams, Cuddapah dist. (alt. ca. 960m.) ; 20-21.7.29 ; *P. S. Pruthi* coll. 1 δ ; Rajpur. M. P. ; Dec. 1939 ; *H. S. Rao* coll. 1 δ ; Baghkor, Shillong ; 13.5.1960 ; *S. N. Prasad* coll.

Remarks : Previously known from South India ; Sri Lanka ; Burma and also from the Eastern Nepal, the species is recorded here for the first time from the North Bengal.

The specimens at hand are easily recognizable by having fastigium of vertex with two depressions at the base ; compressed, truncated and somewhat bituberculated apex of prosternal tubercle, in the castaneous tagmina having "a row of triangular whitish spots upon the radial nervure" and also with distinctly attenuated apical halves of posterior femora. Meso-and metasternal plates (Fig. 14) are added here for the first time.

Genus (12) *Mesambria* Stal, 1878

12. *Mesambria dubia* (Walker, 1870)

(Figs. 15-17)

Acridium dubium Walker, 1870. *Cat. Derm. Salt. Br. Mus.*, 4 : 632.

Material : 5 δ , 1 η ; Mirik, Darjeeling, W. B. ; 17.9.1974 ; *H. K. Bhowmik* and *P. Halder* coll.

Remarks : This species was described on female from Sri Lanka. Uvarov (1927B) mentioned its male counterpart in a few words. The availability of the specimens at the high altitude of Darjeeling district is a new and interesting record of its zoogeography.

Additional description : Males : Small, slender ; testaceous brown. Head short ; fastigium of vertex produced beyond eyes, triangular and transverse on profile, rounded at apex, lateral carinae prominent and extend between eyes, separated from front by distinct edges ; frontal ridge distinctly sulcate, narrowed just after separating edge of fastigial border, gradually widened up to middle ocellus, below ocellus constricted, then parallel ; carinae raised and clear. Pronotum almost flat, though a low and weak median carina detectable ; metazona less than half length of prozona, its posterior margin truncated ; lateral lobe of pronotum brownish on lower margin which is in continuation with upper one giving it a design (Fig. 15). Mesosternal lobe with rounded inner margin ; interspace narrower than width of one of its lobes. Metasternal lobes separated. Supra-analplate wider than long, broadly angular at apex, and with a median longitudinal suture. Cercus thin, basally wide, apically tapers to a spine-like structure, a little directed downwards (Fig. 16). Knee of posterior femur and base of posterior tibia dark. Epiphallus as figured (Fig. 17).

Females : Tally fully with original description.

Measurements : Length of body δ 13.5-14-15, η 18 ; length of head δ 1.8-2.2, η

2.4 ; length of antennae ♂ 6-7.5, ♀ (broken) ; length of pronotum ♂ 3.5-4, ♀ 4.8 ; length of prozona ♂ 2.3-2.9, ♀ 3.3 ; length of metazona ♂ .9-1-2, ♀ 1.5 ; length of elytron ♂ 2-3, ♀ 3.5 ; post. femur ♂ 9-10, ♀ 11.5 ; post tibia ♂ 8-9, ♀ 10.5.

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* Denotes references not seen in original.

NOTE ON A SMALL COLLECTION OF FLEAS (INSECTA :
SIPHONAPTERA) FROM MEGHALAYA

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ABSTRACT

Three flea species, e. g., *Ctenocephalides canis* (Curtis), *Xenopsylla cheopsis* (Rothschild) (family Pulicidae) and *Stivalius ferinus* (Rothschild) (family Pygiopsyllidae) have been recorded for the first time from Meghalaya along with some notes on injurious and parasitic effect inflicted upon human beings by the first mentioned species.

INTRODUCTION

Flea fauna of certain North East Indian states have in recent times been dealt with by Iyenger (1973), Kulkarni *et. al.* (1974) and Singh *et. al.* (in press). However, no species of flea has till date been reported in literature from the hill state of Meghalaya. Present contribution brings into record the existence of three flea species in the state, all collected by the writer from capital city Shillong. Occurrence of *Ctenocephalides canis* (Curtis) in human enclosures is also reported for the first time in India along with some details of the nature of resultant parasitic injury inflicted upon human beings.

MATERIAL STUDIED AND OBSERVATION

1. *Ctenocephalides canis* (Curtis)

Pulex canis, Curtis, 1826, *British Entomology*, 3 : 114.

Material : 4 ♂♂, 6 ♀♀, 23. viii. 1978, ex "bed sheet, blanket cover and pillow cover" of a residential house ; 1 ♂, 1 ♀, 25. viii. 1978, ex "*Mus musculus*" captured from the same residential house.

This species is recorded here for the first time in Eastern India and its occurrence in

human enclosures is also reported here for the first time in India, such occurrence having earlier been reported from countries like Africa, Iraq, America and Australia [Hubard (1947), Hopkins and Rothschild (1953)]. Collection of the fleas from bed sheets etc., mentioned above, was made when irritation due to flea bites experienced by the writer and other inhabitants of the house was predominant, but observation was continued throughout the occurrence of the incidence i. e., the months of August and September. Painful red sores causing scratching sensation and lasting for 2-3 days resulted from flea bites, the irritation caused appeared somewhat comparable to that caused by bed bugs. With the ability of jumping and penetrating cloth in the most swift manner, the fleas easily escaped notice when searched. Yet, pressing against any object for about a minute or so made the specimens momentarily less active and blood stain resulted when a freshly fed specimen was crushed to death.

Man, with hairs rather thinly covering the body, do not seem to be a suitable sheltering host of fleas, their occasional refuge in human enclosures might be, besides other

possibilities caused by some climatic factors as has been suggested by Hubard (1947).

This is a cosmopolitan species.

2. *Xenopsylla cheopsis* (Rothschild)

Pulex cheopsis Rothschild, 1903, *Ent. mon. Mag.*, 39 : 85.

Material : 1 ♂, 1 ♀, 10. viii. 1978, ex "*Rattus rattus*"; 1 ♂, 1 ♀, 17. viii. 1978, ex "*Rattus sp.*"; 1 ♂, 17. viii. 1978, ex "*Mus musculus*".

This species, known from different parts of Southern Asia, Africa and South America was so far reported only from Sikkim in Eastern India.

3. *Stivalius ferinus* (Rothschild)

Pygiopsylla ferinus Rothschild, 1908, *Proc. zool. Soc. London*, : 622.

Material : 4 ♂♂, 2 ♀♀, 24.viii.1978, ex "*Suncus murinus*".

This species, known from Sri Lanka, Nepal and other parts of India, was earlier reported only from Sikkim in Eastern India.

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IXODID TICK (ACARINA : METASTIGMATA) FAUNA OF ANDAMAN AND NICOBAR ISLANDS

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ABSTRACT

Ten species of ixodid ticks belonging to six genera collected from Andaman and Nicobar Islands are reported here. Three genera and three species reported here are the first record from A & N Islands.

INTRODUCTION

The ixodid ticks are very important as disease carriers in man and domesticated animals. Though the ixodid tick fauna is well represented in India by 86 species distributed over 9 genera, but the same is very poorly known from Andaman and Nicobar Islands. So far seven species belonging to four genera are reported through works of Nuttall and Warburton (1915), Sharif (1928) and Hoogstraal (1970).

The present work is based on the collections made by the survey parties from Zoological Survey of India. A total of ten species belonging to six genera are treated in this communication, of these three genera and three species are reported for the first time from Andaman and Nicobar Islands. Additional data on the measurements of different forms are given. All the measurements in the text are in millimetres. All the collections are deposited in the National Collections of Zoological Survey of India, Calcutta.

Key to the genera from Andaman & Nicobar Islands

1. Eyes present	...	...	2
— Eyes absent	...	...	5

2. Capitulum long with long narrow palps ; male without ventral shields ; scutum usually ornate ; eyes generally flat ...	<i>Amblyomma</i> Koch	
— Capitulum short with short broad palps ; male with or without ventral shields ; scutum ornate or inornate ; eyes flat or spherical ...	...	3
3. Basis—capituli dorsally rectangular, no lateral saliences ; scutum generally ornate ; male without ventral shields, coxae IV longer than others ...	<i>Dermacentor</i> Koch	
— Basis—capituli dorsally hexagonal, lateral saliences present ; scutum generally inornate ; male with four ventral shields...	...	4
4. Spiracle oval ; festoons and anal groove faint or obsolete ; no setiferous ventral plate on palpal article I ...	<i>Boophilus</i> Curtice	
— Spiracle sub-triangular or comma-shaped ; festoons and anal groove well developed ; setiferous ventral plate on palpal article I ..	<i>Rhipicephalus</i> Koch	

5. Capitulum long, no lateral salience on palpal article II; dorsal retroverted spur absent on trochanter I; coxa I usually bifid ...

Aponomma
Neumann

Capitulum short, with lateral salience on palpal article II; blade-like dorsal retroverted spur on trochanter I; coxa I never bifid ...

Haemaphysalis
Koch

Key to the species of the genus

AMBLYOMMA Male and Female

Scutum ornamented; coxa I with two unequal spurs; hypostome 3/3 ...

helvolum

Scutum not ornamented; coxa I with two sub-equal spurs; hypostome 4/4 ...

nitidum

Amblyomma helvolum Koch

Amblyomma helvolum Koch, 1844, *Arch. Naturgesch* 10 : 230.

Amblyomma helvolum, Robinson, 1926, Cambridge Univ. Press, 216-219.

Amblyomma helvolum, Sharif, 1928, *Rec. Indian Mus.*, 30 : 325-326.

Measurements : Male— $3.2 \times 2.6 - 2.5 \times 2.2$,

Capitulum— $0.7 - 0.8$; female— $5.4 \times 3.4 - 3.9 \times 2.9$. Capitulum— $0.8 - 0.7$; nymph— 1.8×0.7 ; nymph— $1.8 \times 1.5 - 1.6 \times 1.4$, Capitulum— $0.4 - 0.3$.

Material examined : 7 ♂♂, 2 ♀♀, Little Andaman Isl., Ingite Kudda forest, from unknown host, 28.II.1961, coll. A. Daniel; 12 ♂♂, 2 ♀♀, 6 NN, Great Nicobar Isl., Campbell bay, from unknown host, 13.III.1966, coll. A. Daniel.

Hosts : *Python reticulatus*, *Zamensis mucosus*, *Zamensis korros*, *Varanus salvator*, *Varanus*

nebulosus, *Coluber onicephalus*, *Coluber radiatus*, *Geomyda grandis*, *Triglyphedon dendrophylum*, Iguana.

Distribution in India : Andaman and Nicobar Islands.

Remarks : This species is mostly parasitic on large snakes and lizards and causing discomforts to the hosts.

Amblyomma nitidum Hirst and Hirst

Amblyomma nitidum Hirst and Hirst, 1910, *Ann. Mag. nat. Hist.*, 8 (vi) : 304-305.

Amblyomma nitidum, Sharif, 1928, *Rec. Indian Mus.*, 30 : 326-328.

Measurements : Male— $5.7 \times 4.1 - 5.0 \times 3.5$.

Capitulum— 0.9 ; female— $6.9 \times 4.9 - 6.0 \times 4.2$, Capitulum— 1.0 ; nymph— $3.2 \times 2.2 - 3.0 \times 2.0$, Capitulum— 0.3 ; larva— $0.6 - 0.4$.

Material examined : 2 ♂♂, 4 ♀♀, 5 NN, 1 L, Andaman Isl., Port Blair, from *Laticauda laticaudatus*, 31.V.1926, coll. Baley de Castro (Z. S. I. Reg. No. 65/18).

Hosts : Sea snakes (*Laticauda colubrina*, *Laticauda laticaudatus*, *Laticauda semifasciatus*).

Distribution in India : Andaman Island.

Remarks : The sea snakes under the genus *Laticauda* are parasitized by this species of tick while resting in mangroove tree holes or in rock crevices out of water at day time.

Aponomma lucasi Warburton

Aponomma gervaisi var. *lucasi* Warburton, 1910, *Parasitology*, 3 : 406-407.

Aponomma gervaisi var. *lucasi*, Sharif, 1928, *Rec. Indian Mus.*, 30 : 337-340.

Aponomma lucasi, Hoogstraal et al., 1968, *Ann. ent. Soc. Am.*, 61 (3) : 722-729.

Measurements : Male— $3.4 \times 2.8 - 2.8 \times 2.4$, Capitulum— 1.0 ; female— 2.9×2.4 , Capitulum— 0.4 .

Material examined : 4♂♂, Nicobar Isl., Nancowry, from *Varanus bengalensis*, November, 1921, coll. R. B. S. Sewell (Z. S. I. Reg. No. 20/18); 6♂♂, 1♀, Andaman Isl., Narcondam, from *Varanus salvator*, coll. T. R. Mallet (Z. S. I. Reg. No. 933/17).

Hosts : *Bangarus fasciatus*, *Gongilophis conicus*, *Naia bungards*, *Naia tripudians*, *Python molurus*, *Python reticulatus*, *Varanus*, *nebulosus*, *Varanus salvator*, *Vipera russellii*, *Bos frontalis*, *Ovis nahura*.

Distribution in India : Andaman and Nicobar Islands, Assam, Bihar, Madhya Pradesh, Orissa, Uttar Pradesh, West Bengal.

Remarks : The species is recorded for the first time from Andaman Island. The materials from Nicobar Island studied here were recorded by Sharif (1928). But he did not mention the name of the collector and Registration number which are given in the present communication.

Boophilus microplus (Canestrini)

Haemaphysalis micropla Canestrini, 1887, *Atti Soc. veneto. trent. Sci. Nat.*, **11** : 104.

Rhipicephalus micropla Canestrini, 1890, *Padova*, **4** : 493.

Boophilus australis Sharif, 1928, *Rec. Indian Mus.*, **30** : 284-289.

Boophilus microplus (Canestrini), Fairchild, 1949, *Am. J. trop. Med.*, **23** (6) : 586.

Boophilus microplus, Hoogstraal, 1956, *African Ixodoidea*, **1** : 295-296, 317-324.

Boophilus microplus, Arthur, 1960, *Ticks*, **V** : 207-214.

Measurements : Female—7.5×5.2—5.0×3.3, Capitulum—0.3—0.4; larva—0.6×0.4—0.5×0.4.

Material examined : 75 LL, Car Nicobar Isl., from vegetation, 25.XII.1972, coll. S. K. Gupta; 45 LL, Andaman Isl., Rangat Isl.,

Yerrata, from grass, 8.I.1973, coll. S. K. Gupta; 13 ♀♀, North Andaman Isl., Mayabunder, from cow, 11.V. 1971, coll. B. K. Tikader.

Hosts : Chicken Pheasant, cattle, horse, sheep, camel, deer, nilgai, buffalo, dog, vegetation.

Distribution in India : Andaman and Nicobar Islands, Assam, Bihar, Gujarat, Maharashtra, Madhya Pradesh, Meghalaya, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Remarks : *B. microplus* is reported here for the first time from Nicobar Island. This species is widely distributed throughout the country and most important pest of cattle. It has got considerable veterinary importance causing red water fever, anaplasmosis or gall sickness to cattle, Babesiosis to cattle and sheep and biliary fever to horses.

Dermacentor auratus Supino

Dermacentor auratus Supino, 1897, *Atti. Soc. veneto-trent. Sci. Nat.*, **3** (2) : 235.

Dermacentor auratus, Sharif, 1928, *Rec. Indian Mus.*, **30** : 292-297.

Measurements : Male—6.5×4.4—3.2×2.2,

Capitulum—1.0; female—5.5×4.1—3.5×2.5, Capitulum—0.8; nymph—2.6×1.1—1.8×0.9, Capitulum—0.3.

Material examined : 2 NN, South Andaman Isl., Wrafter's Creak, Baratang, from chital, 16.III.1964, coll. B. S. Lamba; 11♂♂, 5♀♀, 3 NN, Baratang, from wild pig, 18.III. 1964, coll. B. S. Lamba; 2 NN, Mt. Harriet range, from man, 1.IV.1964, coll. B. S. Lamba; 1 N, Chiriatapu, from civet cat, 11.IV.1964, coll. B. S. Lamba; 1♂, 1♀, Havloc Isl., from wild pig, 18.IV.1971, coll. B. K. Tikader; 1♀, Smith Isl. (near forest

dept.), from unknown host, 27.IV.1971, coll. B. K. Tikader.

Hosts : Bear, chital, civet cat, deer, *Felis pardus*, man, *Melursus ursinus*, nias pig, wild boar, wild pig.

Distribution in India : Andaman Island, Assam, Arunachal Pradesh, Bihar, Karnataka, Orissa, Uttar Pradesh, West Bengal.

Remarks : This species is widely distributed throughout India, but it is recorded here for the first time from Andaman and Nicobar Islands. A single virus strain of KFD has been isolated from the species of *Derma-centor* in India (Rao, 1964).

Key to the species of the genus HAEMAPHYSALIS Male and Female

1. Coxae I and IV each with a long spur ...	<i>spinigera</i>
— Coxae I and IV with normal and inconspicuous spur ...	...
2. Scutum elongate oval with inconspicuous punctations ; palpal article 3 with long dorsal spur ...	<i>bispinosa</i>
— Scutum oval or wider than long with medium sized or large punctations ; palpal article 3 with short dorsal spur ...	... 3
3. Palpi compact ; palpal article 2 with internodorsal protuberance ...	<i>papuana kinneari</i>
— palpi more or less salient ; palpal article 2 without any protuberance ...	<i>wellingtoni</i>

Haemaphysalis bispinosa Neumann

Haemaphysalis bispinosa Neumann, 1897, *Mem. Soc. Zool. Fr.*, 10 : 341-342.

Haemaphysalis bispinosa, Sharif, 1928, *Rec. Indian Mus.*, 30 : 255-258.

Haemaphysalis bispinosa, Hoogstraal and Trapido, 1966, *J. Parasit.*, 52 : 1188-1192.

Measurements : Male—2.1×1.8–1.8×1.1,

Capitulum—0.4–0.2 ; female—3.5×2.1–2.4×1.3, Capitulum—0.5–0.4 ; nymph—1.8–1.1, Capitulum—0.2.

Material examined : 1 ♀, Andaman Isl., Port Blair, Chabagicha, from rotten wood, 23.V.1971, coll. B. S. Lamba ; 31 ♂♂, 3 ♀♀, 11 NN, Andaman Isl., Baratang, from spotted deer and chital, 14.III.1964, coll. B. S. Lamba ; 4 ♀♀, Nicobar Isl., Kamorta, from pig, 19.III.1971, coll. B. K. Tikader ; 7 ♂♂, 2 NN, North Andaman Isl., Diglipur, from deer, 25.IV.1971, coll. B. K. Tikader ; 4 ♂♂, 1 ♀, Andaman Isl., Port Blair, from deer, 23.V.1971, coll. B. K. Tikader ; 6 ♂♂, 7 ♀♀, Andaman Isl., Rangat ; Yerrata, from cow, 8.I.1973, coll. S. K. Gupta ; 1 ♂, 4 ♀♀, Andaman Isl., Mayabunder, from buffalo, 8.I.1973, coll. S. K. Gupta.

Hosts : Buffalo, cat, cattle, dog, goat, horse, monkey, pony, sheep, tiger.

Distribution in India : Andaman and Nicobar Islands, Arunachal Pradesh, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal.

Remarks : This species is widely distributed in India and is of considerable economic importance. They are responsible for transmitting the virus causing KFD in domestic animals.

Haemaphysalis papuana kinneari Warburton

Haemaphysalis kinneari Warburton, 1913, *Parasitology*, 6 : 127-128.

Haemaphysalis papuana kinneari Trapido et al., 1964, *J. Parasit.*, 50 : 179-188.

Measurements : Male—3.2×2.1, Capitulum—0.5 ; female—3.1×1.9, Capitulum—0.5.

Material examined : 1 ♂, 1 ♀, Great Nicobar Isl., on way to Galathea bay, from vegetation, 4. IV. 1966, coll. H. K. Bhowmick and party.

Hosts : Bonnet monkey, langur, Indian wild boar (*Sus scrofa cristatus*), tiger, wild vegetation.

Distribution in India : Andaman and Nicobar Islands, Karnataka.

Remarks : This species is reported here for the first time from Andaman and Nicobar Islands. The KFD virus has been isolated from this species (Trapido *et al.*, 1959).

***Haemaphysalis spinigera* Neumann**

Haemaphysalis spinigera Neumann, 1897, *Mem. Soc. Zool. Fr.*, 10 : 352-354.

Haemaphysalis spinigera, Nuttall and Warburton, 1915, *Ticks* pt. 3 : 447-449.

Haemaphysalis spinigera, Sharif, 1928, *Rec. Indian Mus.*, 30 : 262-263.

Haemaphysalis (Kaiseriana) spinigera, Ghalsasi and Dhanda, 1974, *Oriental Ins.*, 8 (4) : 505-520.

Measurements : Nymph— $2.7 \times 1.9 - 1.5 \times 0.7$; larva— $0.6 - 0.4$.

Material examined : 5 NN, 3 LL, Andaman Isl., Mt. Harriet range, from man, 2. IV. 1964, coll. B. S. Lamba; 4 LL, Andaman Isl., Ferrurgunj from vegetation, 15. I. 1973, coll. S. K. Gupta.

Hosts : Panther, bear, tiger, leopard, buffalo, sheep, man, langur, gaur or Indian bison, jungle cat, small Indian civet, black-naped hare, sombar, mouse deer, wild dog, rat, porcupine, squirrel, schrew, mongoose, jungle fowl, crow, pheasant, jungle myna, jungle babbler, peacock, red vented bulbul and white throated ground thrush.

Distribution in India : Andaman and Nicobar Islands, Andhra Pradesh, Assam,

Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu, West Bengal.

Remarks : This species is generally occurred in forested areas where the rainfall is heavy to moderate. *H. spinigera* is of great economic importance as the species is mostly parasitic on different birds and mammals. This species is also recognised as the chief vector of KFD virus for man and monkey.

***Haemaphysalis wellingtoni* Nuttall and Warburton**

Haemaphysalis wellingtoni Nuttall and Warburton, 1907, *Proc. Camb. phil. Soc. biol. Sci.*, 14 : 392-398.

Haemaphysalis wellingtoni, Sharif, 1928, *Rec. Indian Mus.*, 30 : 267-268.

Measurements : Male— 1.9×1.4 , Capitulum— 0.4 ; female— $5.1 \times 3.1 - 3.4 \times 2.1$, Capitulum— 0.5 .

Material examined : 1 ♂, 2 ♀♀, Andaman Isl., from unknown host, coll. G. H. F. Nuttall.

Hosts : Langur, bonnet monkey, dog, buffalo, domestic fowl, wild fowl, turkey, goose, few migratory birds.

Distribution in India : Andaman Island, Assam, Karnataka, Orissa.

Remarks : Rajagopalan *et al.* (1970) isolated the ganjam virus identical to Nairobi sheep disease virus from this species.

***Rhipicephalus sanguineus* (Latreille)**

Ixodes sanguineus Latreille, 1806, *Genera Crustaceorum et Insectorum*, 1 : 157.

Rhipicephalus sanguineus (Latreille), Koch, 1844, *Arch. Naturgesch.*, 1 : 217-239.

Rhipicephalus breviceps, Warburton, 1910, *Parasitology*, 3 : 398-399.

Rhipicephalus sanguineus, Sharif, 1928, *Rec. Indian Mus.*, **30** : 275-279.

Rhipicephalus sanguineus, Fairchild, 1949, *Am. J. trop. Med.*, **23** : 593.

Measurements : Male— 2.4×1.3 , Capitulum—0.3.

Material examined : 1 ♂, Andaman Isl., Ross Isl., from dog, 23.III.1911, coll. C. Paiva.

Hosts : Dog, cattle, horse, donkey, wild boar, bear, fox, *Felis marmorata*, *Felis viverrina*, *Canis aureus*.

Distribution in India : A & N Isls., Andhra Pradesh, Bihar, Gujarat, Haryana, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu, West Bengal.

Remarks : This species is recorded here for the first time from Andaman and Nicobar Islands. It is known to transmit boutonneuse fever, Indian tick typhus and Rocky Mountain spotted fever in areas where these diseases occur. This species acts as a vector of Canine piroplasmiasis and rickettsiosis. The relapsing fever spirochaete caused by *Borrelia theileri* is transmitted to domestic ruminants by this species. This species is widely known as a vector of *Babesia canis* causing malignant jundice of dogs.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. B. K. Tikader, Director, Zoological Survey of India, for providing laboratory facilities and to Dr. S. K. Bhattacharyya, Deputy Director and Dr. S. K. Gupta, Superintending Zoologist, for

valuable suggestions and encouragements in the preparation of the paper.

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ZOOGEOGRAPHY OF LOACHES OF THE SUPERFAMILY COBITOIDEA (COBITIDAE AND HOMALOPTERIDAE)

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INTRODUCTION

Hora (1932) divided his Homalopteridae into two subfamilies, Gastromyzoninae and Homalopterinae and considered the former as a derivative of the family Cobitidae and the latter the Cyprinidae. Subsequently in 1950 he raised the subfamilies to the rank of families. Sawada (1982) on the basis of comparative osteological studies of the Homalopteridae, Gastromyzonidae and Cobitidae combined the families Homalopteridae and Gastromyzonidae relegating them to the rank of a subfamily : Homalopterinae. He further considered the Noemacheiline loaches phylogenetically closer to Homalopteridae than to Cobitidae and accordingly transferred the Noemacheilinae to the family Homalopteridae. The Cobitidae traditionally considered as an independent family of the suborder Cyprinoidei has been placed along with the Homalopteridae under the superfamily Cobitoidea bringing about the following major changes in the phylogenetic classification of the Suborder Cyprinoidei.

Superfamily	COBITOIDEA
Family	COBITIDAE
Subfamily	BOTIINAE
Subfamily	COBITINAE
Family	HOMALOPTERIDAE
Subfamily	NOEMACHEILINAE
Subfamily	HOMALOPTERINAE

The important findings of Sawada (*Op. cit.*) based on osteological studies on the inter-familial and intrafamilial relationship of the Cobitidae, Homalopteridae and Gastromyzonidae have raised certain points of great zoogeographical interest. To elucidate these points the distribution of the Cobitoid fishes, both in time and space, has been carefully investigated which led me to certain important considerations which form the subject matter of this short communication.

DISTRIBUTION IN TIME

The first fossil record of the Cobitoid fish is by Laube (1901) who described *Noemacheilus tener* from the Bohemian Oligocene. However it has not been established with certainty that the species belongs to the genus *Noemacheilus* (Nalbant, 1963). Laube (*Op. cit.*) in the same work recorded four species belonging to the Cobitidae from the Upper Miocene of Ohningen, near lake Konstanz, West Germany. However, it is hard to decide whether they belong to *Noemacheilus* or *Cobitis* (Nalbant, *Op. cit.*). The next record of a *Cobitis*, *C. senogalliensis* Erasmo, is from the Neogene of Senogallia, Italy (Nalbant, *Op. cit.*). Next is that of Lebedev (1959) who described numerous specimens of a *Cobitis*, closely related to *C. taenia* from the Mid-Miocene beds of Saisson Nor Lake, near the source of the Irtysh river, W. Siberia. The latest record is that of Gau-

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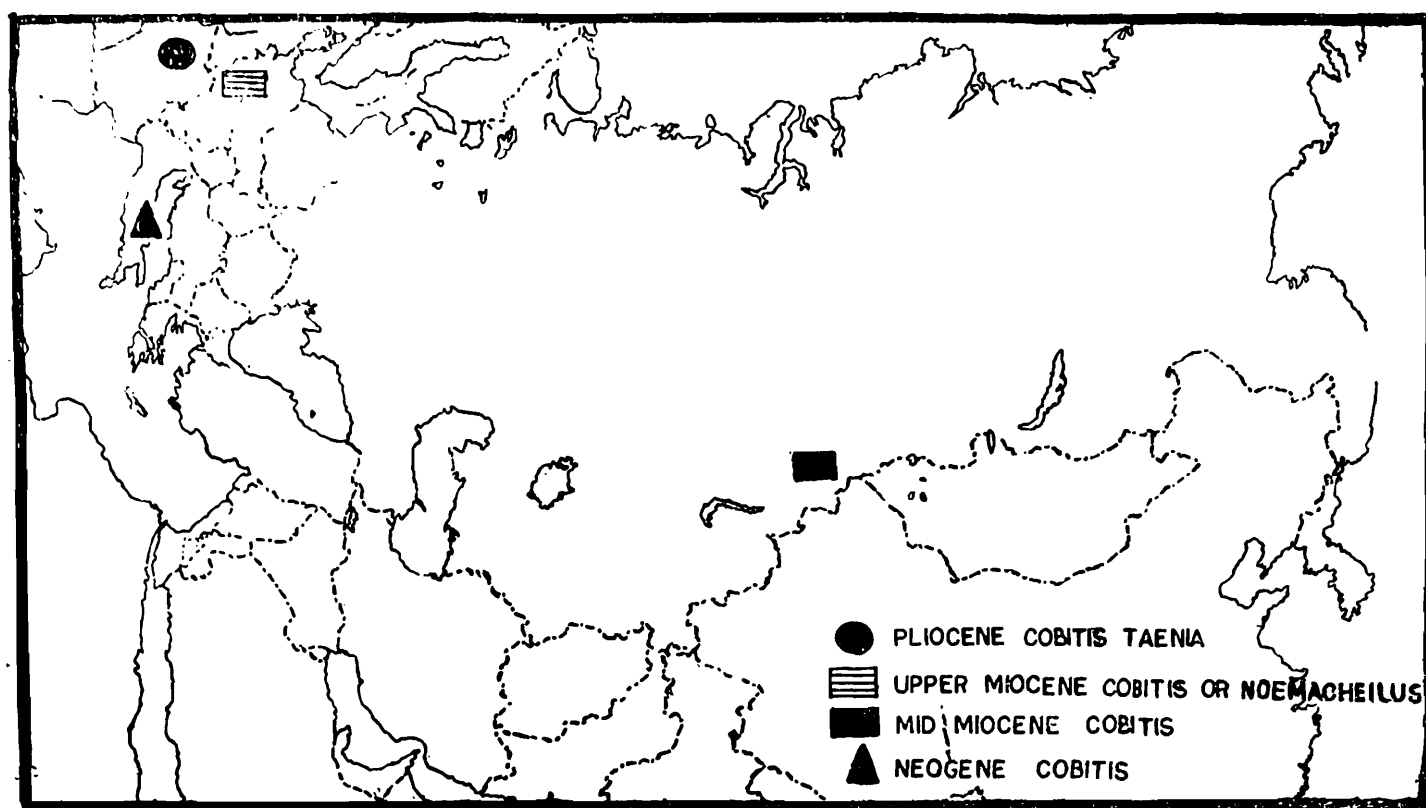


Fig. 1. Map of Eurasia showing the distribution of fossil Cobitoidea

dant (1976) who reported a single incomplete fossil *Cobitis* related to the recent species *Cobitis taenia* from the lignitic shales of Pliocene of Puy-de-Dome, France.

The above mentioned fossil records lead one to the following conclusions :

1. The Cobitidae (*Cobitis*) and the Homalopteridae (*Noemacheilus*) had differentiated from their Cyprinoid ancestors at almost the same time, probably in the early Miocene.

2. Their dispersal to Europe took place through Siberia during the Mid-Miocene—Pliocene period when favourable climatological conditions prevailed in Northern Europe and Siberia.

The above conclusions can however, be assessed only after a careful consideration of the present-day distribution and the phylogenetical routes of dispersal of the superfamily.

PRESENT-DAY DISTRIBUTION

Distribution of the Cobitidae : The family Cobitidae comprising of two subfamilies Botiinae and Cobitinae is found to-day in Eurasia and the adjacent islands and the northern part of Africa.

Distribution of the Botiinae : The subfamily comprises of two genera *Leptobotia* Bleeker and *Botia* Gray (Sawada, *loc. cit.*, p. 184). The *Leptobotia* is confined to the Amur drainage from Blagoveschensk to Liman, Ussuri, Sungari and Liao drainages in North-East Asia, Central Japan and Fukien in S. E. China. The genus *Botia* is found today from South China to Sumatra and Borneo on the one hand and through Mekong and Menam drainages to Burma and on the other to Ganges-Brahmaputra and the Indus drainages.

Distribution of the Cobitinae : The Cobitinae is the largest of all the four subfamilies of

the superfamily and has 13 genera : (1) *Misgurnus* Lacépède (2) *Cobitis* Linnaeus, (3) *Sabanejewia* Vladykov (4) *Niwaella* Nalbant (5) *Somileptes* Swainson, (6) *Enobarichthys* Whitley (7) *Acanthopsis* Van Hasselt (8) *Acanthopsoides* Fowler (9) *Lepidocephalus* Bleeker (*Lepidocephalichthys* Bleeker) (10) *Paralepidocephalus* Tchang (11) *Acanthophthalmus* Van Hasselt (= *Cobitops* Myers), (12) *Neocucirrhichthys* Banareescu and Nalbant and (13) *Eucirrhichthys* Perugia. The distribution of the subfamily covers more or less the same area as that of the family Cobitidae.

Distribution of the Homalopteridae : The family consisting of two subfamilies is distributed in Eurasia and its adjacent islands and the north-eastern part of Africa.

Distribution of the Noemacheilinae : The subfamily is composed of Five genera : *Noemacheilus* Van Hasselt, *Oreonectes* (= *Lefua*) Gunther, *Aborichthys* Chaudhuri, *Turcinoemacheilus* Banareescu and Nalbant and *Vaillantella* Fowler. The genus *Noemacheilus* comprising of over 100 nominal species has the widest distribution of all Cobitoid genera. It is known from Eurasia to Sakhalin Islands, Hokkaido, Hainan, Borneo, Sumatra, Java, Sri Lanka and the Blue Nile of East Africa. *Turcinoemacheilus* is restricted to Turkey, *Lefua* to N. E. Asia and *Vaillantella* to Malay Archipelago while the distribution of *Oreonectes* is discontinuous having found in Japan, Amur drainage, Korea and North China on the one hand and South China and Indonesia on the other (Banareescu and Nalbant, 1968).

Distribution of the Homalopterinae : The subfamily is restricted to South and South-East Asia.

CENTRE OF ORIGIN AND DISPERSAL

It is a well-known fact that the centre of origin and dispersal of the Cyprinoid fishes is in South-East Asia, most probably in South China (Hora, 1949). The Cobitoid fishes were most probably differentiated from a Cyprinid ancestor (Greenwood *et al*, 1966) in the South-West Chinese region during the early Miocene period and had spread to Europe and thence to Northern Africa during Mid-Miocene or early Pliocene through a Siberian route when the climatological conditions there were favourable (Banareescu, 1973). Their dispersal westwards to Central Asiatic Highlands seems to have been along an eastern Tibetan route during the late Miocene or early Pliocene period (*Vide*, Hora, 1937) and to India and thence to West Asia along the southern face of the Himalayas during the late Pliocene or early Pleistocene. The migration southwestwards to the Indian Peninsula and southwards to the Malay Archipelago had most probably taken place only during the Pluvial periods of the Pleistocene.

THE GEOLOGICAL HISTORY OF THE HIMALAYAN AND THE SOUTH-WEST CHINESE MOUNTAIN SYSTEMS

In considering the time of origin and evolution of any group of animals of which the fossil evidences are meagre, two main facts are taken into consideration—firstly, the present-day ecological requirements of the animal and secondly, the geological history of the countries it inhabits. In the case of Cobitoid fishes the evolution of adaptive characters for torrential life seems to be closely related to the evolution of mountain systems in South-East Asia. In order to understand therefore the causes of evolution and dispersal, it is necessary to consider the

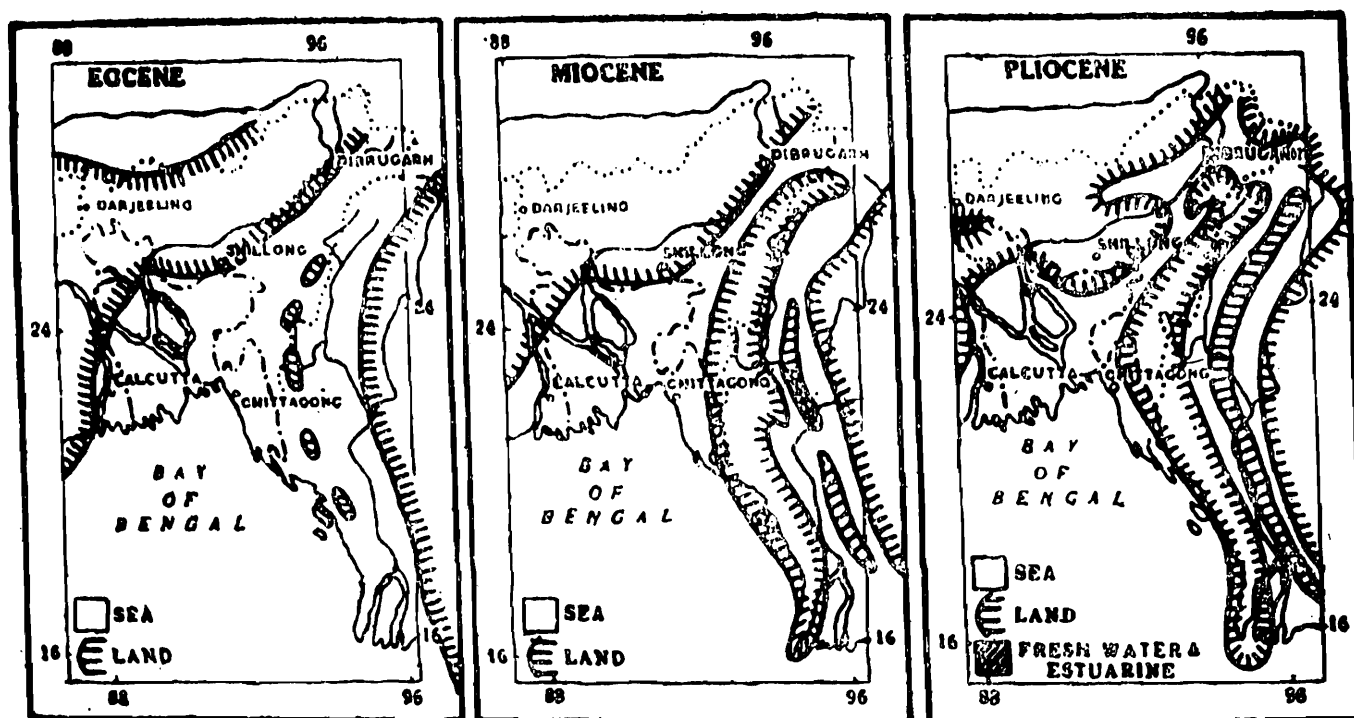


Fig. 2. Map of north-eastern India showing the northward transgression of the Bay of Bengal during the Eocene, Miocene and Pliocene periods. After Krishnan (*Bull. nat. Inst. Sci. India*, 1, 26-28, 1952.)

geological facts regarding the evolutionary history of the mountain systems of the South-East Asia.

THE HIMALAYAS

There is no evidence to show that the Himalayas as a great mountain range are older than the latter part of the Eocene period (Burrad and Hayden, 1933). Before that the Himalayan area formed the northern coast of Gondwanaland and a number of rivers flowed northward into the Tethys Sea of that time. The orogenic movement which was strongly pronounced during the Oligocene, probably began in late Cretaceous times and continued through the Eocene and Middle Tertiary periods. There is considerable evidence to show that it was still active during the Pliocene and later periods. The ossiferous beds of Ngari Khorsum and of the

Karewas of Kashmir, however, indicate that during the Pleistocene period the Himalayas had already acquired the general features of their present day form. The nature of the Siwalik deposits shows that the main drainage lines of the south face of the Himalayas date as far back as the Pliocene epoch and that the rivers which brought down sands and boulders from the mountains to build up the Siwaliks of the Duns and Hundes were the direct ancestors of the modern Sutlej and Ganges.

THE MOUNTAIN SYSTEMS OF CHINA AND THE MALAY ARCHIPELAGO

The eastwards extension of the Alpine-Himalayan systems has long been a subject of great controversy. According to one view it passed north-eastward across China to Bering straits; according to another it was

bent round against the mass of Chinese Tibet and passed through western Burma to Sumatra and thence along the southern Islands to the eastern Archipelago. The interpretation of the mountain structure of Chinese Tibet is however, complicated by being due to movements at two different periods. The Himalayan movements as has been pointed out are not older than the latter part of the eocene period while the other group is much older, this movement being culminated in South-East Asia in the middle Permian. The older system is represented in Europe by the Hercynian mountains, and in Asia by the Altaids, the members of which cross China Tibet on lines approximately north and south, and continue southwards as the Indo-Malayan mountains. This older system is supposed to have stemmed the eastward extension of the direct Himalayan uplift. In this region of the Chinese Tibet where the Himalayan and the Altai mountains meet, crustal movements have produced complex topographical features. As a result of the resistance offered by the Altai mountains, the Himalayan movements became resolved into two factors one resulting in a chain of intense folding across southern China known as Nan Shan and the other in the uplift of the Burmese-Malayan arc.

MIocene—PLIOCENE GEOLOGY AND DISTRIBUTION OF COBITOID FISHES

The spread of Cobitoid fishes westwards to Central Asiatic Highlands was facilitated along Chinese Tibet during the late Miocene or early Pliocene period. The drainage of Central and south-eastern Asia before the major Pliocene upheaval of the Himalayas was probably mainly through broad east to west trending valleys due to the gentle

buckling of the earth's crust. The Himalayan movements confirmed this system, but during the subsequent settling down of the country the eastward outlet of the Tibetan rivers was reduced and Tibet became a land of lakes (Gregory 1925).

Geologists have shown that a transgression of the Bay of Bengal during the Mid-Eocene cut off the land route between India and Burma and it lasted the whole of the Miocene. During this period no freshwater fish seems to have migrated into India from South China (Hora and Menon, 1953). It is known (Menon, 1951) that during the Pliocene wet tropical conditions prevailed along the southern face of the Himalayas extending to China in the east and beyond Baluchistan towards the west facilitating the spread of marsh-loving fishes from south-west China to as far as Africa. The clear water hill-stream fishes like *Noemacheilus* had most probably dispersed along the southern face of Himalayan during the early Pleistocene period. During the end of Pliocene or early Pleistocene, the major final upheaval of the Himalayas had occurred which raised the Siwalik sediments into dry land and the Siwalik fore-deep (Krishnan, 1943) gradually disappeared leaving a shallowed depression—the Pleistocene fore-deep—which with the formation of the Assam Plateau by then began draining northern India from Assam to the Arabia Sea (Hora, 1953). The Pleistocene river was probably not pouring into the sea exactly at the place where the Indus to-day joins the Arabian Sea for the floor of the north Western part of the Indian Ocean as we know it to-day assumed its present form as a result of compression in Tertiary times, probably contemporaneously with upheaval of Alpine-Himalayan Mountain

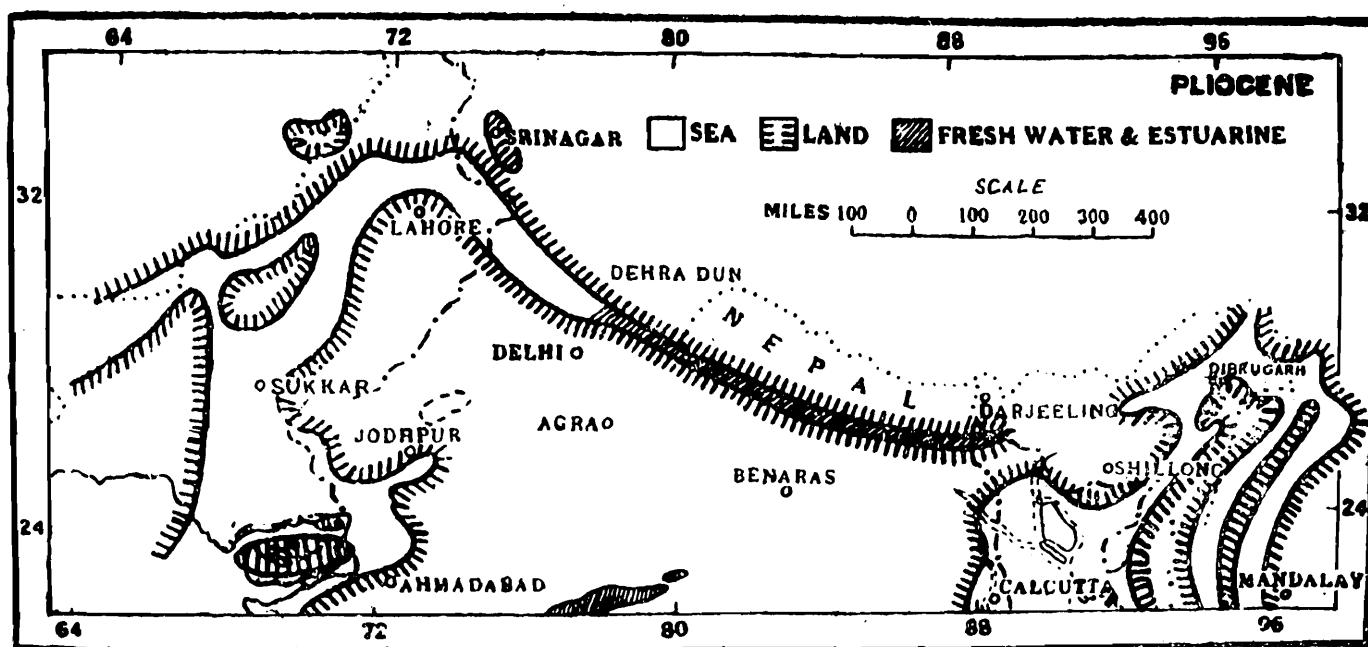


Fig. 3. The Siwalik fore-deep of the Pliocene period. After Krishnan (*Ibid.*, p. 28).

system and the Arcs of the Malay Archipelago and the formation of the rift valley. Consequently, in Pliocene or Post-Pliocene times the area of land that once filled the triangle now bounded by the northern part of the East African coast and its continuation, the south-east coast of Arabia, the Baluchistan coast and the west-coast of India, became separated off by a series of faults and was submerged to its present depth (Wiseman and Sewell, 1937).

From the present-day distribution of *Noemacheilus* (*N. abyssinicus*) it would appear that the land mass between East African coast and the west-coast of India had submerged only quite recently, probably simultaneously with the birth of Ganges and the Indus. Till then the present-day Persian Gulf must have probably been a river valley in continuation with Euphrates-Tigris basin and the Pleistocene fore-deep of the Himalayas may have had connections with it during the Pluvial periods of the Glacial epochs. Thus from the Yunnan Plateau in the east up to

the head-waters of Euphrates-Tigris rivers there must have been a continuous route along which the *Noemacheilus* seems to have been got distributed as far west as Anatolia (*Vide*, Cosswig, 1955).

The Garo Rajmahal gap was under the sea during the whole of the Pliocene period and therefore practically no migration of Cobitoid fishes from the north to the Indian Peninsula was possible. During the Pleistocene, however, the Garo-Rajmahal gap became a dry land facilitating the migration of hill stream fishes (Hora 1951). During the Glacial periods of this epoch, aeustatic drop in the sea level of 600 feet had actually bridged up the Garo-Rajmahal gap topographically and climatically enabling the Cobitid fishes like *Lepidocephalus* and Homalopterids like *Noemacheilus*, *Balitora* and *Homaloptera* to cross over from the north to the Peninsula. There was also greater runoff of water in the streams and rivers especially in the big rivers like the Narmada-Tapti along the Satpura-Vindhya during the Ice-ages of the Pleistocene enabling the quick spread of

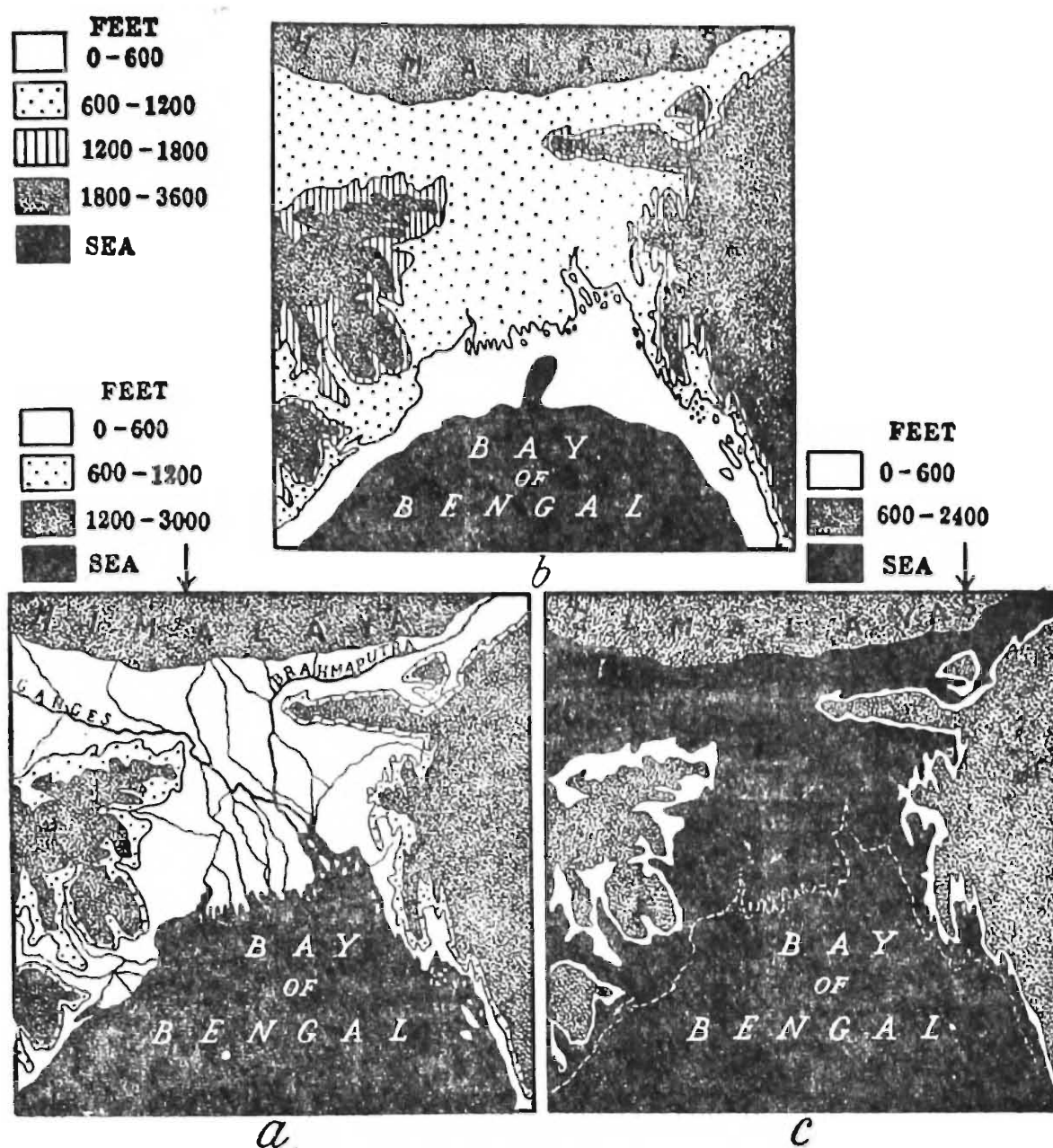


Fig. 4. Orographic features of Garo-Rajmahal gap. a. Present-day conditions, b. Conditions during a glacial period, c. Conditions during an interglacial period. After Hora (*Proc. nat. Inst. Sci.*, 17, p. 439, 1951).

these fishes to the Peninsula, and *Noemacheilus* and *Leptocephalus* even to Sri Lanka, the final separation of Sri Lanka from the Peninsula being about 10,000 years ago (Jacob, 1949).

The spread of the Homalopterinae and the Noemacheilinae from South-China to the

Malay Archipelago occurred during the Pluvial periods of the Pleistocene (Silas, 1952).

CONCLUSION

The superfamily seems to have evolved from a Cyprinoid ancestor which had adapted

to a bottom-living habitat. Bottom-living Cyprinid fishes are known to have developed the pipette-like system of suction feeding method with the ability to protrude the mouth (Alexander, 1966). The Cyprinid feeding method with such a protrusion mechanism is useful in taking food from the bottom with the long axis of the body remaining as nearly horizontal as possible in fast flowing hill-streams where to maintain an oblique position of the body against the force of current is impossible. From such a Cyprinid ancestor the ancestors of the Cobitidae and the Homalopteridae were differentiated. The ancestors of the Cobitidae gave rise to two subfamilies, the Botiinae and the Cobitinae. The Botiinae retained the original Cobitoid habitat while the Cobitinae through reduction of fins and elongation of the body adapted to a complete bottom habitat and movement at the bottom by undulation. The gradual reduction of pelvic fin and the elongation of the body of *Misgurnus*, *Niwaella*, *Acanthopsoides* and *Acanthopthalmus* are closely associated with the adaptation to moving at the bottom by undulation (Sawada, *loc. cit.*, p. 155).

The ancestors of the Homalopteridae gave rise to the Noemacheilinae and the Homalopterinae, the former with the gradual modification of the body to a subcylindrical shape and with considerably reduced and compact paired fins having adapted for life in shallow, fast-flowing waters amongst pebbles and boulders at the foot-hills and the latter for torrential habitats through the development of a perfect suckorial disc (Hora, *op. cit.*).

Evolutionary changes in Cobitoid fishes had thus taken place towards achieving definite objectives and to fit them to the needs of different environments. In the case of the

hill stream fishes of south-east Asia the production of new families, subfamilies, genera and species can be correlated with the orogenic movements due to the birth of the Himalayas which had produced complex topographical features in the south-west Chinese region. So long as the environment remains static, the organisms do not change much. Plaeogeographical changes have often converted a static environment into a dynamic one and it is during such periods of the earth's history that vast evolutionary changes have occurred.

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NEMATODES FROM WEST BENGAL (INDIA) XIV. ON THE OCCURRENCE
OF ECTOPARASITIC NEMATODES OF LONGIDOROIDEA AND
TRICHODOROIDEA (DORYLAIMIDA), WITH REMARKS
ON THE VALIDITY OF GENUS *SIDDIQIA*
(LONGIDORIDAE)

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ABSTRACT

The male of *Paralongidorus citri* (Siddiqi, 1959) Siddiqi, Hooper and Khan, 1963 is reported for the first time. *Longidoroides droseri* (Sukul, 1971) Khan, Chawla and Saha, 1978 is being synonymised with *P. citri*. The genus *Siddiqia* Khan, Chawla and Saha, 1978 is considered a synonym of *Paralongidorus* Siddiqi, Hooper and Khan, 1963. *Paratrichodorus (Atlantodorus) porosus* (Allen, 1957) Siddiqi, 1974 and *P. (Nanidorus) renifer* Siddiqi, 1974 are reported from soil around roots of tea at Darjeeling.

INTRODUCTION

Our knowledge about the occurrence of longidorid and trichodorid nematodes in West Bengal is very meagre despite their economic importance as ectoparasites of plants and most of them as vectors of viruses. Sukul (1971) described *Paralongidorus droseri* from Birbhum district. Chaturvedi and Khera (1979) have reported *Xiphinema americanum* Cobb, 1913 and *X. insigne* Loos, 1949 from Howrah and Hooghly districts respectively.

Jana and Baqri (1977) have already reported the following species from Darjeeling and Jalpaiguri districts of West Bengal: *Xiphinema radiculicola* Goodey, 1936; *X. brasiliense* Lordello, 1951; *X. insigne* Loos, 1949; *X. reversi* Dalmasso, 1969; and *Paralongidorus citri* (Siddiqi, 1959) Siddiqi, Hooper and Khan, 1963. Further investigations have yielded a male of *Paralongidorus citri* for the first time which is described and illustrated herein. Besides, a soil sample collected from

around roots of tea at Darjeeling contained the following two species of the genus *Paratrichodorus* Siddiqi, 1974: *P. (Atlantodorus) porosus* (Allen, 1957) Siddiqi 1974 and *P. (Nanidorus) renifer* Siddiqi, 1974. This is the first record of the genus *Paratrichodorus* from West Bengal.

The study of the topotype females of *Paralongidorus droseri* Sukul, 1971 (=now *Longidoroides droseri*) has revealed that it is a synonym of *P. citri*. The present paper also concludes that the genus *Siddiqia* is a synonym of *Paralongidorus*.

***Paralongidorus citri* (Siddiqi, 1959)**
Siddiqi, Hooper and Khan, 1963
(Fig. 1, A-G)

Syn. *Xiphinema citri* Siddiqi, 1959, *Proc. helminth. Soc. Wash.*, 26 : 160-162.

Siddiqia citri (Siddiqi, 1959) Khan, Chawla and Saha, 1978, *Indian J. Nematol.*, 6 : 57.

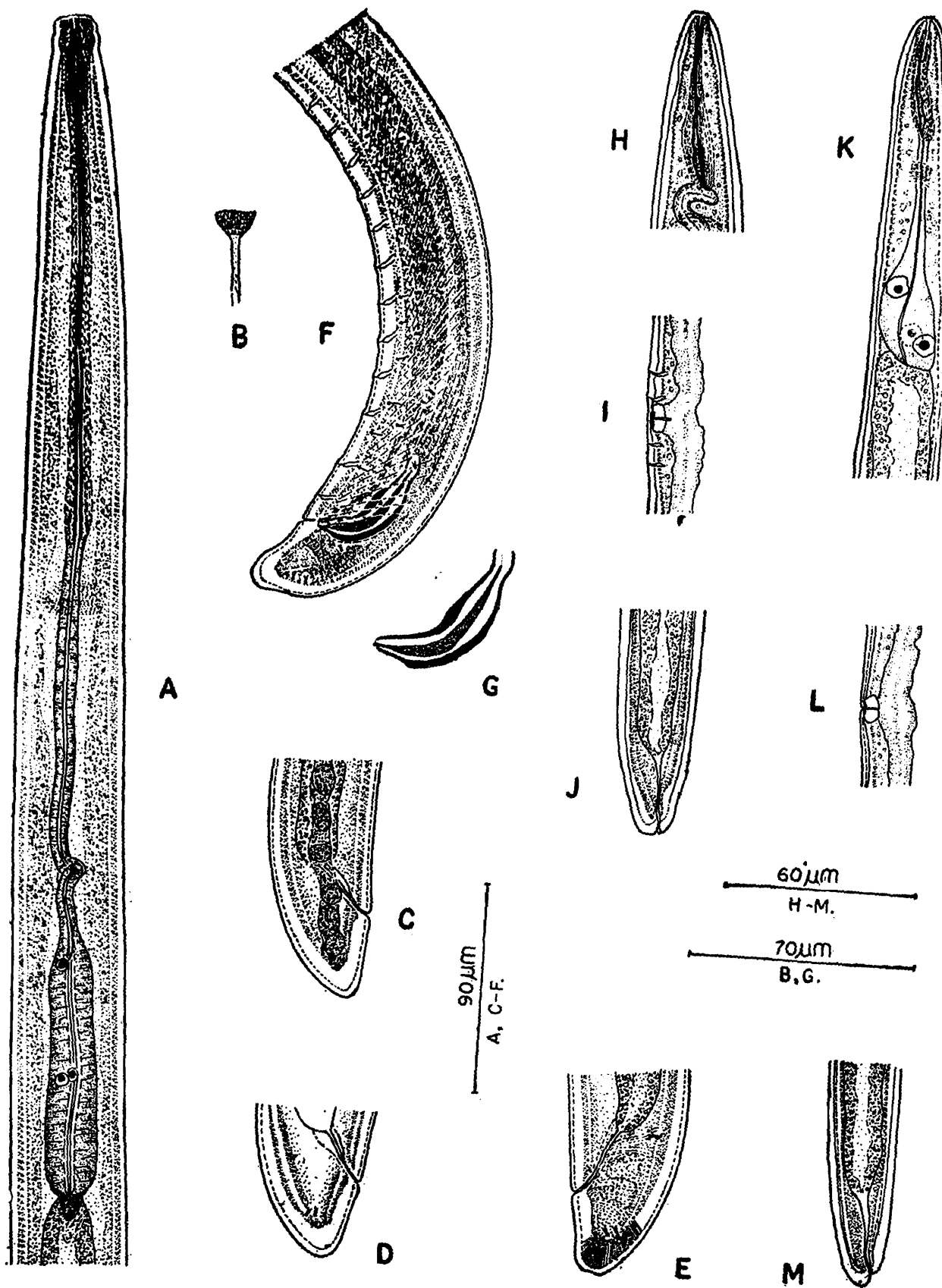


Fig. 1. A-G. *Paralongidorus citri*, A-Oesophageal region, B-Amphid, C-E, Female tails showing variation, F-Posterior region of male, G-Spicule. H-J. *Paratrichodorus* (*Atlantodorus*) *porosus*, H-Anterior end, I-Vulva region, J-Female tail. K-M. *Paratrichodorus* (*Nanidorus*) *renifer*, K-Anterior region, L-Vulva region, M-Female tail.

Paralongidorus droseri Sukul, 1971, *Bull. Ent.*, 12 : 85-88.

Longidoroides droseri (Sukul, 1971) Khan, Chawla and Saha, 1978, *Indian J. Nematol.*, 6 : 52, new synonymy.

Measurements :

Females (10) : $L=6.30-8.66$ mm ; $a=99-152$; $b=10.3-15.8$; $c=184-238$; $v=4^{+5}42-46^{+6}$; odontostyle= $126-141$ μ m ; odontophore= $74-90$ μ m.

Male (1) : $L=6.71$ mm ; $a=129$; $b=13.2$; $c=197$; $T=42$; odontostyle= 139 μ m ; odontophore= 79 μ m.

Description :

Female : Body ventrally arcuate upon fixation. Cuticle finely striated transversely, 3-13 μ m thick (thickest on tail). Lateral chords 1/6th-1/4th of the body-width near middle. Lip region broadly rounded demarcated by a constriction. Amphids stirrup-shaped with a wide slit-like apertures, occupying 75% of the corresponding body-width ; amphidial basal lining not lobed. Odontostyle 7.6-8.2 lip region-width long. Guiding ring 1.8-2.1 lip region-width from anterior end. Odontophore 0.6-0.7 times the odontostyle length. Basal expanded part of oesophagus occupies 21-26% of the neck region. Vulva transverse ; vagina extending inward about half of the corresponding bodywidth. Female reproductive system amphidelphic. Prerectum 15-18 times the anal body-width. Tail convex-conoid with obtusely rounded or rounded terminus, 34-39 μ m or 0.8-1.1 anal body-width long, with two caudal pores on each side.

Male : Similar to female in general shape and morphology except the male reproductive

system and more ventrally curved posterior region. Supplements consist of an adanal pair and 11 ventromedians, spaced nearly at regular intervals, the first ventromedian supplement at about 0.8 anal body-width from cloacal opening. Six irregularly spaced subventral papillae visible up to fifth ventromedian supplement. Spicules 60 μ m or 1.7 anal body-width long when measured along the curved median line. Lateral guiding pieces rod-shaped, 14 μ m long. Prerectum 662 μ m or about 19 anal body-width long. Tail almost similar to female, 34 μ m or about one anal body-width long, with three caudal pores on each side.

Habitat and locality : Soil around roots of mango, *Mangifera indica* and Banana, *Musa* sp. at New Jalpaiguri, district Jalpaiguri.

DISCUSSION

Sukul (1971) described a new species *Paralongidorus droseri* and distinguished it from the *P. citri* on the following differences : Shorter and differently shaped tail and longer body length. Khan *et al.*, (1978) proposed a genus *Longidoroides* under Longidoridae to accommodate the species of *Longidorus* and *Paralongidorus* having large amphids, pouch-like, slit-like apertures, with unlobed or bilobed basal lining. They also transferred *Paralongidorus droseri* under their newly proposed genus. The study of the topotype specimens of *P. droseri* obtained through the courtesy of Dr. N. C. Sukul has confirmed that he (1971) has correctly illustrated the structure of the amphids as stirrup-shaped and it is not pouch-like. The study finally reveals that these specimens belong to *Paralongidorus* and all the differentiating characters of *P. droseri* from *P. citri*, mentioned by Sukul (l. c.), are overlapping with the original description and measurements of the latter

THE APPLICATION OF VARIANCE ANALYSIS FOR THE COMPARISON OF SPATIOTEMPORAL VARIATION IN FRESHWATER ZOOPLANKTON

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ABSTRACT

The spatial and temporal variations of zooplankton community of an artificial lake of Calcutta have been analysed by integrating the two factors. Component of variances associated with station, date, station-date interaction and error were worked out using 2-way analysis of variance. The station component yielded information on fixed horizontal spatial variation, the date component measured the variations in abundance through time, the interaction components were associated with ephemeral spatial patchiness which changed character through time. There were marked differences in relative importance of spatial and temporal variations of cladocera and copepoda. The ephemeral spatial variations were greater than fixed spatial variation in all species and their stages. However it was more important to cladocera than copepoda. In cladocera the spatial component of variance (fixed+ephemeral) also exceeded the temporal component of variance but it was reverse in case of copepoda.

INTRODUCTION

While there are a large number of published works dealing with variations in zooplankton populations in space and time, including some of those involving highly advanced and sophisticated sampling and analysis techniques, very few workers have attempted to integrate the two factors in order to obtain a composite and interdependent picture. With the result, the vast amount of available literature could not provide any definite understanding of the relationship between the two, particularly their relative magnitude. Margalef (1958, 1967) made first attempt to integrate the two variations and recently Lewis (1978) suggested the use of variance components for the analysis of spatio-temporal variation in zooplankton. The objectives of this paper are to integrate and compare the two factors in the crustacean

zooplankton community of an artificial lake, Rabindra Sarovar (Dhakuria lake) of Calcutta by variance analysis as suggested by Lewis (1978) and to check the efficiency of the method.

MATERIALS AND METHOD

The present report is based on the data collected during detailed studies on the population and production ecology zooplankton in Ravindra Sarovar, where samples have been collected regularly since 1975 to date. Rabindra Sarovar is an artificial lake constructed by Calcutta Improvement Trust mainly for recreational purpose. The main lake, which is elongated in shape, covers an approximate area of 72 acres. The maximum length is 1770 meters, while the width at the broadest point is 282 meters. Mean depth varies from

9.3 meters to 10.5 meters. It is mainly fed by rain water.

Since spatial variation studies require the sampling of the entire limnetic zone throughout the lake and sampling stations should not be strongly correlated with their biological similarity; 5 different stations, situated at suitable distances spread over the entire lake, were selected (Fig. 1). The prerequisite for temporal studies as reported by Lewis (1978), is that the samples should be far enough apart in time that they are not autocorrelated. For this samples of 7 different dates, covering the entire year, were taken into consideration. These sampling dates are January 15, March 20, May 5, June 16, August 25, October 15 and November 30 of 1977.

fixed in 4% formalin and brought to the laboratory where identification, classification and enumeration were done simultaneously under a binocular of varying magnification. Only crustacean zooplankton have been taken into consideration. Copepods were divided into 4 classes, nauplii, copepodites, adults and eggs and cladocerans were divided into 3 classes, juveniles, adults and eggs-neonats. The details of classification have already been described (Khan 1981).

STATISTICAL ANALYSIS

An ordinary 2-way analysis of variance has been carried out taking station and date factors, for each class, following Mather (1964) and Sum of Squares and Mean Squares



Fig. 1. Outline of Rabindra Sarovar showing the position of sampling station.

Duplicate samples were collected at each station on each date with the help of water sampler from different depth covering the entire column. One litre of water was collected from 5 to 6m depths at each station starting from the bottom to the surface and filtered through a No. 25 bolting nylon plankton net. Since the samples of all depth at any station were pooled, the term spatial variation represents the spatial variation in abundance beneath an unit of lake surface and comprised only horizontal distribution, not the vertical. Zooplankton samples were

for total, station, date, station-date interaction and error were worked out. From the Mean Squares, the components of variance were computed as follows, following Lewis (1978).

$$S_e^2 = MSe$$

$$S_s^2 = (MS_s - MS_i) / Nd. Nr$$

$$S_d^2 = (MS_d - MS_i) / Ns. Nr$$

$$S_i^2 = (MS_i - MSe) / Nr$$

Where S^2 = variance, MS = mean square, N = number of samples, e = error, S = station, d = dates, i = interaction and r = replicates. Each

TABLE 1. Components of Variance and Variance ratios for Different species of Zooplankton

Code Nos.	Species stages	Station (Ss ²)	Percent of variance			Ratio		
			Date (Sd ²)	Station date interaction (Si ²)	error (Se ²)	Ss ² . Sd ²	Si ² .Sd ²	$\frac{Ss^2 + Si^2}{Sd^2}$
<i>Halodiaptomus</i>								
<i>contortus</i>								
1	Nauplii	10	75	11	4	0.130	0.146	0.280
2	Copepodite	8	60	20	12	0.130	0.133	0.466
3	Adult	10	72	12	6	0.140	0.166	0.305
4	Egg	13	50	22	15	0.260	0.440	0.700
<i>Themacyclops</i>								
<i>hyalinus</i>								
5	Nauplii	13	62	19	6	0.216	0.306	0.516
6	Copepodite	6	80	10	4	0.075	0.125	0.200
7	Adult	20	55	21	3	0.363	0.400	0.763
8	Egg	28	36	30	6	0.777	0.833	1.611
<i>Mesocyclops</i>								
<i>leuckarti</i>								
9	Nauplii	6	55	22	17	0.109	0.400	0.509
10	Copepodite	8	62	25	5	0.126	0.403	0.532
11	Adult	8	48	30	14	0.166	0.625	0.792
12	Egg	10	56	22	12	0.178	0.398	0.571
<i>Microcyclops</i>								
<i>varicans</i>								
13	Nauplii	10	50	28	12	0.200	0.560	0.760
14	Copepodite	20	50	13	7	0.400	0.260	0.660
15	Adult	15	40	30	15	0.375	0.750	1.125
16	Egg	10	50	28	12	0.200	0.560	0.760
<i>Ceriodaphnia</i>								
<i>cornuta</i>								
17	Juvenile	20	35	38	7	0.571	1.085	1.657
18	Adult	31	30	33	6	1.033	1.100	2.133
19	Egg/Neonate	28	20	35	17	1.400	1.750	3.150
<i>Daphnia carinata</i>								
20	Juvenile	30	20	42	8	1.500	2.100	3.600
21	Adult	30	25	35	10	1.200	1.400	2.600
22	Egg/Neonate	25	35	38	2	0.714	1.080	1.800
<i>Moina micrura</i>								
23	juvenile	35	20	40	5	1.750	1.000	3.750
24	Adult	25	20	52	3	1.200	2.080	3.250
25	Egg/Neonate	35	20	35	10	1.150	1.750	3.500
<i>Bosmina longirostris</i>								
26	juvenile	30	26	35	9	1.153	1.340	2.500
27	Adult	29	20	36	15	1.400	1.800	3.250
28	Egg/Neonate	32	29	35	4	1.103	1.200	2.310

component was expressed as percentage of total variance. The ratios between station components and date components (Ss^2 , Sd^2), between interaction component (Si^2 , Sd^2) and composite ratio $(Ss^2 + Si^2)/Sd^2$ were worked out.

The station component (Ss^2) is associated with variations between stations independent of date and represents fixed spatial patchiness. The date component (Sd^2) is a measure of variations in abundance through time. The interaction component (Si^2) is related to zooplankton patchiness which changes its formation everytime and has been termed as ephemeral spatial patchiness. The ratio Ss^2 , Sd^2 measures fixed spatial patchiness against time variation while the ratio Si^2 , Sd^2 measures ephemeral spatial variance against time variations. The composite ratio $(Ss^2 + Si^2)/Sd^2$ compares the sum of both types of horizontal spatial variations with temporal variations.

RESULTS AND DISCUSSION

The crustacean zooplankton of Rabindra Sarovar were mainly composed of one calanoid, *Haliodyptomus contortus* (Gurney), 3 cyclopoid, *Thermocyclops hyalinus* (Rehberg), *Mesocyclops leuckarti* (Claus) and *Micrcyclops varicans* (Sars) and 4 cladocerans, *Ceriodaphnia cornuta* Sars, *Daphia carinata* King, *Moina micrura* Kurz and *Bosmina longirostris* (O. F. Muller). The components of variance expressed in terms of percentage alongwith the ratios for each group are given in Table 1. It is apparent that while station component in all stages of calanoids and cyclopoid was never large enough showing low contribution of variance related to fixed horizontal spatial patchiness, in all cladocerans this component formed sizeable percentage and was mostly

higher than date component revealing somewhat higher variances in fixed spatial patchiness. However, in no case the station component overtook the interaction component revealing the greater importance of ephemeral spatial variation. The ratios Si^2 , Sd^2 were always less than 1 in copepods but more than 1 in cladocerans (except in juveniles of *Ceriodaphnia cornuta*), showing that fixed spatial variation exceeded temporal variations in cladocerans. The ratio Si^2/Sd^2 also revealed almost similar results, where ephemeral spatial variations exceeded the size of temporal variations in cladocerans. The relative importance of total spatial and total temporal variations is exhibited by the composite ratio $(Ss^2 + Si^2)/Sd^2$, which was again high in case of cladoceran and always exceeded 1.5. Among copepods only eggs of *Thermocyclops hyalinus* exhibited a ratio more than 1. For all other copepod stages, temporal variation and total horizontal variation were of almost equal importance. These phenomena have become more clear when the ratio Si^2/Sd^2 was plotted against the ratio Ss^2/Sd^2 (Fig. 2). It shows the low relative magnitude of fixed spatial variance, where none of the species fell in the category of fixed Ephemeral. Lewis (1978) pointed out that fixed spatial variance is greater in lakes with point source of heterogeneity such as effluents or tidal input or situations where both limnetic and littoral habitats have been sampled. Since samples from Ravindra Sarovar were collected quite away from littoral region and there was no intake way near any of the stations, the low importance of fixed spatial variance is quite expected. This also reveals that the limnetic zone of the lake is almost homogeneous.

The two groups of crustacean zooplankton, the copepoda and cladocera differ considera-

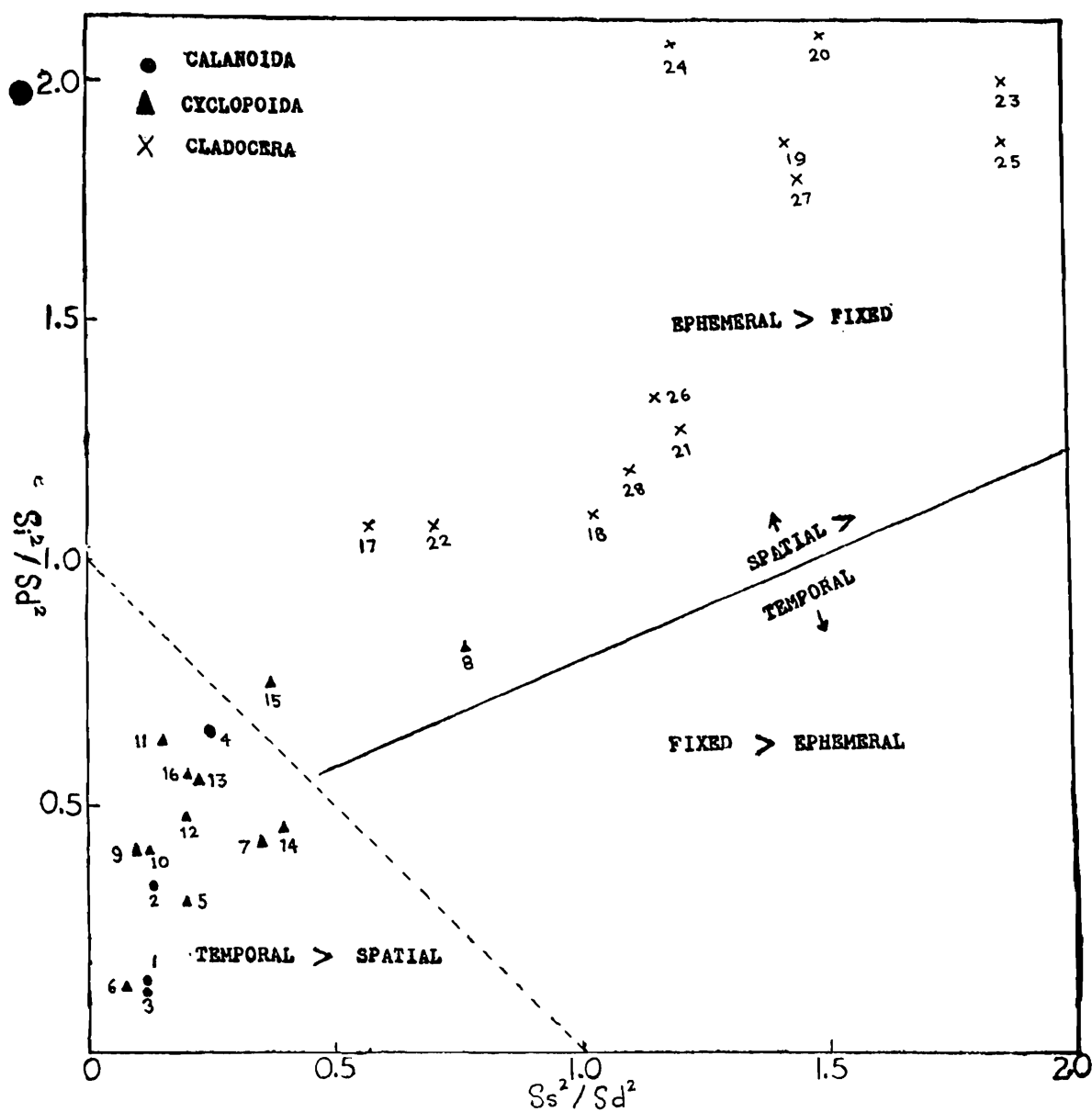


Fig. 2. Ratios of variance components plotted against each other to show relative importance of spatial and temporal variations in zooplankton (Codes are from Table 1.)

bly with regards to relative importance of temporal or spatial differences. Both groups of copepods showed almost very stable relationship where temporal variance always dominated spatial variance. This indicates that these species have well established themselves in the lake. In cladocera, high ephemeral patchiness is a definite characteristic of all the three species. It is suggested by Lewis (1978) that ephemeral patchiness may

be extremely important to the survival of these species in limnetic habitats.

The striking similarity between the result of Lewis and that of present study reveals that the variance component method can be successfully used for the comparison of spatio-temporal variations in freshwater crustacean zooplankton. However more studies involving extensive comparison of

lakes and reservoirs are required to establish the utility of the method.

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ECOLOGICAL STUDIES ON THE AMPHIBIANS OF GUJARAT

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ABSTRACT

The brief systematic account, details of material collected, geographical distribution, observations on the field ecology, food and association with other animals of nine species of amphibians (256 ex.) from Gujarat are discussed in the present paper.

INTRODUCTION

The amphibians of Gujarat are very little known in the Indian fauna. Even the fundamental work of Boulenger (1890 and 1920) contains no information on the amphibians of Gujarat. Mc Cann (1938), Soman (1960) and Daniel and Shull (1963) have published short accounts on the amphibians from Kutch area and Surat Dangs (Southern Gujarat) of the State. So, this will be first detailed account on the amphibians of the area. Collections have mostly been made by Dr. R. C. Sharma, Superintending Zoologist, Zoological Survey of India.

SYSTEMATIC ACCOUNT

Class : AMPHIBIA

Order : ANURA

Family : RANIDAE

1. *Rana hexadactyla* Lesson

(Pond Frog)

Material : 3 ex., Halwad and Jamnagar. Collected in February and March.

Measurements : Snout to vent length 30 mm. in all the examples.

Distribution : Gujarat : As above (first record). Elsewhere ; Punjab, Rajasthan, Maha-

rashttra, Goa, West Bengal, South India and Sri Lanka.

Ecology : The frogs prefer to live in shallow muddy rain water tanks with muddy bottom and embankments. The vicinity of the above collection spots exhibited perfect xeric environment and *Prosopis* and *Acacia* bushes were in abundance. As evidenced by the stomach contents the food of *Rana hexadactyla* in the said localities during February and March consists of large black ants *Camponotus* sp. and various species of beetles.

Remarks : Porous warts on neck, under the thighs and along each side of belly are most prominent. The dorsal region of head and body is quite smooth and light olive-green in colour.

2. *Rana cyanophlyctis* Schneider

(Skittering Frog)

Material : 127 ex., Palanpur, Deesa, Bhuj, Anjar, Patna, Himmatnagar, Viramgam, Dhrangadhra, Rajkot, Bhavnagar, Jamnagar, Godhra, Dwarka, Dantiwada, Ahwa, Melegaon and Veraval. Collected between January and December.

Measurements : Snout to vent length 22-65 mm.

Distribution : *Gujarat :* As above (new locality records), Bhuj, Ahwa and Waghai. *Elsewhere :* Widely distributed in India, Sri Lanka, Thailand, Malaya Peninsula, Nepal, Iran, South Arabia and Pakistan (Swat and Kalat Districts).

Ecology : Frogs are equally comfortable in running as well as stationary water. In various localities the frogs were found to be living in stagnant pools of water.

According to Minton (1966) this species in Pakistan feeds on aquatic invertebrates, diving beetles, odonata larvae, crustaceans, snails, terrestrial insects, muscid flies etc.

The species is found to be a predator on a smaller species of the same genus i. e. *Rana limnocharis* Wiegmann (Plate 4) and also devours its own tadpoles. As evidenced by the study of gut contents the food of this species in Gujarat consists of various species of aquatic and terrestrial beetles and their larvae, mainly of families Carabidae, Scarabaeidae, Curculionidae and Hydrophilidae ; large black ants (*Camponotus* sp.) ; Crickets, grasshoppers and various other orthopterous insects ; dipterous nymphs ; cockroaches ; earthworms ; spiders ; various hymenopterous insects ; earwigs ; large number of arthropod eggs ; many small to large red and black species of ants ; moths ; dragon flies and their nymphs ; bugs ; numerous pupae and adults of mosquitoes ; gastropod molluscs ; centipedes ; lepidopterous caterpillars ; numerous white ants ; seeds, grass and fibres of certain wild plants and *Acacia* leaves.

Remarks : In most of the examples ventrum is spotted with dark brown in adults whereas in young this ventral colour pattern is confined to the throat and chin only. The dorsum in most examples is dark-

olive to brown with dark-brown round spots, scattered irregularly. Some of the examples possess reddish-olive tinge in dorsal coloration.

3. *Rana tigerina* Daudin

(Indian Bull Frog)

Material : 7 ex., Bhuj, Anjar, Mehsana, Veraval and Rajkot. Collected between September and October.

Measurements : Snout to vent length 69-97 mm.

Distribution : *Gujarat :* As above (new locality records), Bhuj, Surat Dangs in Southern Gujarat and Baroda. *Elsewhere :* Rajasthan, Base of Himalayas through Punjab, Uttar Pradesh to South India, Orissa, Bihar, West Bengal, Assam and Tripura. Sri Lanka, Burma, Thailand, South China, Nepal, Taiwan and Pakistan.

Ecology : In Gujarat the Bull frogs prefer to live in tanks with muddy bottom and in shallow wells. The frogs were observed feeding near the banks of ponds. Wadekar (1963) states that the diet of these frogs at Baroda comprises cockroaches, termites, silverfish, mole crickets, earwigs, bugs, beetles, moths, house flies and various dipterous larvae, ants, spiders, snails, earthworms, millipedes, centipedes, juveniles of its own kind, house lizards, small birds, mouse, paddy grains and leaves of onion. According to Minton (1966) its food in Pakistan consists of belestomids, dytiscids, snails, small frogs, including its own kind.

On the examination of the stomach contents of the material included here it was found that the food of this species in Gujarat during September and October consists of beetles of the families Scarabaeidae, Carabidae

SARKAR

PLATE IV



Skittering frog, *Rana cyanophlyciis* Schneider engulfing a cricket frog *Rana limnocharis* Wiegmann.

and Elateridae ; locusts, *Schistocerca gregaria* ; grasshoppers ; large lepidopterous caterpillars various species of small to large ants ; winged termites ; earwigs ; bugs ; dragon flies and their nymphs ; spiders ; Crustacea-Conchostaca ; scales of reptiles ; seeds and fibres of some wild plant ; grass. The present observations add various new items to the known range of its food.

Remarks : In most of the above examples the dorsal longitudinal warts are most prominent and ridge like. In the examples from Anjar the cream coloured line on the thigh and tibia is absent. While in the examples from Bhuj a most prominent cream line on the outer dorsal aspect of thigh is present which is continuous upto the foot joint through the inner aspect of tibia. In the frogs from Mehsana a faint cream line on thigh does not extend on tibia ; in adult the throat is densely spotted with dark-brown, margins of the lower jaws are with a series of brown spots, general dorsal colour is light-brown with a raddish tinge and the complete dorsum and upper surface of thighs are provided with dark brown irregular spots, a dorsolateral white band originates from the level of axilla and reaches upto the groin. The examples from Veraval exhibit a general greenish black colour with longitudinal series of dark-black spots with white or yellow centres, inner aspects of the thighs are with black cross-bars (with yellow or white shades in middle), outer aspects of thighs speckled with darker spots, a narrow cream stripe from snout to vent is present in both the examples but in one of them there are white lines along the outer margins of the thighs, in both the frogs upper lips are with dark spots and streaks whereas the lower lips are spotted with black. In all the Gujarat examples lower parts are dirty white.

4. *Rana limnocharis* Wiegmann

(Cricket Frog)

Material : 37 ex., Bhuj, Mehsana, Himmatnagar, Rajkot, Dwarka, Jasdan, Godhra, Veraval and Jamnagar. Collected between January to November.

Measurements : Snout to vent length 13-22 mm.

Distribution : *Gujarat :* As above (new locality records), Bhuj and Surat Dangs in South Gujarat. *Elsewhere :* Widely distributed in India, Sri Lanka, Southern Japan, Philippines, Indonesia, Malaya Peninsula and Archipelago, Borneo, Lombok, Eastern and Central China, West Nepal and Pakistan.

Ecology : In Gujarat Cricket frogs prefer to live in marshy and shallow water habitats, flooded agriculture fields and shallow pools on river beds. At Veraval numerous such tiny frogs were observed in a grassy damp plot of land where the water waste of the Indian Rayon factory is drained.

As evidenced by the study of the gut contents, the food of these frogs in Gujarat consists of various small orthopterous insects and their nymphs ; odonata larvae ; small beetles of families Scarabaeidae, Carabidae and Hydrophilidae ; mantids ; thysanurans ; muscid flies ; honey bees (family Apidae) ; small red ants ; eggs of arthropods ; spiders and isopod crustaceans.

Remarks : In all the Gujarat examples the dorsal region of head and body possesses dark distinct spots. Throat and ventral aspects of thighs are brick-red. Few examples from Jamnagar possess a faint cream vertebral stripe.

5. *Rana breviceps* Schneider

(Indian Burrowing Frog)

Material : 2 ex., Vijarkhi, Jamnagar. Collected in September.

Measurements : Snout to vent length 23-42 mm., width of head 18 mm.

Distribution : *Gujarat* : As above (new locality records), Bhuj and Surat Dangs in Southern Gujarat. *Elsewhere* : Rajasthan, Uttar Pradesh, Maharashtra, South India. Sri Lanka, North Burma, Eastern Nepal and Pakistan.

Ecology : The above examples at Vijarkhi were found hiding inside the subterranean muddy tunnels under a huge stone. The spot is situated on a hill slope roughly 70 metres high. The nearest pool of water from the spot of collection was about half a kilometre and surroundings on the whole constitute a dry, rocky habitat with plenty of xerophytic vegetation. Even the muddy tunnels from which these burrowing toad-like frogs were dug out, were perfectly dry and hard.

Minton (1966) states that the food of *Rana breviceps* in Pakistan consists of beetles and crickets. Present studies on the basis of gut contents reveal that their food in Gujarat during September consists of medium sized red ants ; beetles and larvae of families Curculionidae and Scarabaeidae ; bugs ; gastropod molluscs (*Gurulus* sp.) and certain wild fruits with flat, hard, oval and thorny seeds.

Remarks : In the above material the juvenile frog possesses a distinct longitudinal fold, along the back, half webbed toes, greenish-black dorsum and a yellow vertebral streak. The another bigger example which is an adult male possesses a robust body,

bulged eyes, tympanum half of the eye, irregular warts on the dorsum, half webbed toes, shoval-shaped inner metatarsal tubercle, warts on the belly, a distinct longitudinal fold along the back, brownish dorsum with darker spots and a prominent cream coloured vertebral stripe.

Family : BUFONIDAE

6. *Bufo melanostictus* Schneider

(Common Indian Toad)

Material : 20 ex., Vijarkhi, Jamnagar ; Ranavav, Porbandar ; Somnath, Veraval ; Girnar Hills, Junagadh and Rajkot. Collected in September.

Measurements : Snout to vent length 17-65 mm.

Distribution : *Gujarat* : As above (new locality records) Ahwa and Waghai. *Elsewhere* : Rajasthan, Karnataka (Dharwar), common in many parts of India. Sri Lanka, Burma, Southern China, Malaya Peninsula and Archipelago, Pakistan (Sind).

Ecology : Plenty of such toads were noticed in the vicinity of hilly areas like Vijarkhi, Ranavav and Girnar Hills (1500 metres). They always like to live in wet surroundings and hardly go far from water bodies.

Rangaswamy and Channabasavanna (1973) examined the gut contents of 362 individuals and found that their food consists of beetles ; ants ; wasps ; syrphids ; aphids ; muscid flies, their eggs, maggots and pupae ; lepidopterous caterpillars ; mantids ; cockroaches ; various orthopterans ; earwigs ; bugs ; spiders ; scorpions ; centipedes ; snails and slugs.

In present studies, as evidenced by the gut contents the food of this toad in Gujarat during September consists of earwigs ;

beetles ; bugs ; numerous small and big red ants ; large black ants, *Camponotus* sp. ; various hymenopterous insects ; lepidopterous larvae ; numerous white ants ; millipedes, and vegetable fibres of some wild plant. The present studies beside confirming the findings of Rangaswamy and Channabasavanna (l. c.) add few more items like termites and vegetable matter to the food list of this species. Many examples were found to be highly infested with nematodes.

Remarks : Dorsum possess spiny warts, well developed parotid glands, dark-brown black spotted colour on dorsum. In many examples throat and chin speckled with jet-black spots.

7. *Bufo stomaticus* Lütken

(Marbled Toad)

Material : 38 ex., Palanpur, Bhuj, Meh-sana, Himmatnagar, Jamnagar and Rajkot. Collected between September to November.

Measurements : Snout to vent length 21-61 mm.

Distribution : *Gujarat* : As above (new locality records) and Bhuj. *Elsewhere* : Rajasthan, Uttar Pradesh, Himachal Pradesh (Simla Hills), Kashmir, West Bengal, Bihar, Andhra Pradesh and Maharastra in India. Arabia, Bangladesh, Nepal, Burma, Sri Lanka and Pakistan (Sind, Baluchistan).

Ecology : In Gujarat these toads were in abundance in or near the human habitations. They were seen hunting on insects under mercury lights in the vicinity of water bodies at Jamnagar. These toads were seen in considerable number even during the day in the moist vegetation near the pools, tanks, lakes and rivers. At Lalparilake area, Rajkot all the 11 examples were collected from the

subterranean zig-zig muddy tunnels under a large stone.

As evidenced by the study of the gut contents of the above material the food of this most common toad in Gujarat during September to November comprises mainly the termites ; beetles ; big black ants ; *Camponotus* sp. ; small red ants (75% of the gut full in many examples) ; bugs ; earwigs ; lepidopterous larvae ; vegetable fibres and seeds of certain wild plants. It is worth recording that during the said period the main food of this toad in Gujarat consists of mainly the termites and ants of all kinds. This toad thus provides a most effective biological control for termites and many other insect pests of agriculture. Daniel (1963) records that in captivity they feed on termites but refuse larger prey.

Remarks : Most of the examples are spotted with black on the chest. General colour in life was dark-brown.

8. *Bufo viridis* Laurenti

(Green Toad)

Material : 18 ex., Dwarka and Bet Dwarka Islands. Collected in September.

Measurements : Snout to vent length 15-30 mm.

Distribution : *Gujarat* : As above (first record from India) *Elsewhere* : According to Minton (1966) the range of this species is from Germany to Mangolia and Central Siberia and South to Tibet, Iran, Israel, Egypt, Morocco and Pakistan (Baluchistan).

Ecology : These small flat toads in Gujarat choose to live in swampy grassy areas quite close to the sea coasts. Most of the examples were collected from the muddy tunnels under the large stones.

The study of the gut contents reveal that the diet of these small toads in Gujarat during September comprises mainly the black and red ants ; beetles of the families Curculionidae, Scarabaeidae and Hydrophilidae ; termites ; lepidopterous caterpillars ; aphids and isopod crustaceans.

Remarks : Dorsum, upper surface of legs, head and lateral aspects of body are greenish and possess numerous irregular black orange-centred spots. A spinose tubercle exactly in the centre of such spots is one of the marked features. In living examples the upper lip and ventrum was greenish and chest was spotted with black.

Snout is moderately acute ; parotid-glands elongated and kidney-shaped (the length is between 3-8 mm.) ; tympanum $\frac{1}{3}$ of the eye ; basal and posterolateral margins of tympanum in all the examples are devoid of warts, tubercles and nodular glands ; and the portion as noticed is smooth (*Vs.* warts, tubercles or nodular glands are always present in this region in *Bufo stomaticus* and *Bufo melanostictus*).

Family : MICROHYLIDAE

9. *Microhyla ornata* (Dumeril & Bibron)

Material : 4 ex., Palanpur and Bhuj. Collected in October.

Measurements : Snout to vent length 13-15 mm.

Distribution : Gujarat : As above (new locality records for Palanpur) and Surat Dangs in Southern Gujarat. Soman (1960) recorded it from Bhuj (in a small pool of water calling at night). *Elsewhere* : Rajasthan, most of the Indian sub-continent, Kashmir. Bangladesh, Burma, Sri Lanka, Malaya Peninsula, Taiwan, Thailand and Southern China.

Ecology : All the above examples were collected from the flooded agriculture fields. The study of gut contents reveals that during September these tiny frogs devour nothing except small red ants.

Remarks : Dorsum reddish-brown ; tarsals and carpels with brown bands or annuli above ; thighs, tibio-tarsus and forelimbs are with dark brown bars or spots above ; lower parts uniform light brown. Toes are minutely webbed.

ACKNOWLEDGEMENTS

I am extremely indebted to Dr. B. K. Tikader, Director, Zoological Survey of India for rendering encouragement and facilities. I am thankful to Dr. R. C. Sharma, Superintending Zoologist, for providing with the field notes and critical scrutiny of the paper.

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A NOTE ON THE MARINE BORERS OF MANGROVES OF LITTLE ANDAMAN, INDIA

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ABSTRACT

Four species of teredinid borers, namely, *Bactronophorus thoracites* (Gould), *Lyrodus pedicellatus* (Quatrefages), *Nausitora dunlopei* Wright and *Nausitora hedleyi* Schepman and one species of isopod borer, *Sphaeroma terebrans* Bate, collected from the mangrove zone of Little Andaman are dealt with in this paper. All these borers constitute new records for the island. In addition to this, one species of amphipod, *Melita zeylanica* Stebbing and three species of isopods, namely, *Sphaeroma triste* Heller, *Cirolana parva* Hanson and *C. elongata* H. M. Edward have been collected from the same habitat as that of the said isopod borer. These crustaceans are also recorded for the first time in Andaman and Nicobar islands.

INTRODUCTION

A number of papers have been published on marine bores of Andaman and Nicobar islands particularly in recent years (see Ganapati and Rao, 1960 ; Rajagopal and Danial, 1972 ; Kalyansundram and Granti, 1975 ; Karande, 1978 ; Das and Dev Roy, 1980, 1981 and in press and Tiwari *et al*, 1980). But, upto now, no information is available on this group from Little Andaman which is topographically unique in the sense that it is the southernmost island of the Andaman group and is separated from the Great Andamans (collective name for main stretch of Andaman group consisting of North, Middle and South Andaman) by the Duncan passage and from Nicobar group by the Ten Degree Channel.

In order to fill up this lacunae a survey was undertaken in the mangrove zone of of Little Andaman during February-March,

1982 giving emphasis on the collections and study of the marine borers of the mangrove ecosystem. As a result, four species of teredinid borers (Mollusca : Bivalvia), namely, *Bactronophorus thoracites* (Gould), *Lyrodus pedicellatus* (Quatrefages), *Nausitora hedleyi* Schepman and *Nausitora dunlopei* Wright and one species of isopod borer (Crustacea), namely, *Sphaeroma terebrans* Bate have been collected. Incidentally all these borers constitute new records for the island.

No teredinid borer was found in the living mangroves. These were collected from the logs and dead stumps of the following mangrove trees.

Local name	Scientific name	Family
Goran	<i>Rhizophora</i> <i>stylosa</i>	Rhizophoraceae
Goran	<i>Rhizophora</i> <i>mucronata</i>	-do-

*Present Address : Zoological Survey of India, Calcutta.

Local name	Scientific name	Family
Kankara	<i>Bruguiera gymnorrhiza</i>	Rhizophoraceae
Passur	<i>Xylocarpus granatum</i>	Meliaceae
Sundri	<i>Heritiera littoralis</i>	Sterculiaceae

Sphaeroma terebrans was found to inhabit the logs of *Rhizophora* sp. in large numbers. Moreover, one species of amphipod, *Melita zeylanica* Stebbing (Family Gammaridae) and three species of isopod, namely, *Sphaeroma triste* Heller (Family Sphaeromidae), *Cirolana parva* Hanson and *C. elongata* H. M. Edward (Family Cirolanidae) have also been collected from the logs of *Rhizophora* spp. These species are recorded for the first time in Andaman and Nicobar islands. But these are not dealt with in the present communication as wood borers (Pillai, 1967).

SYSTEMATIC ACCOUNT

A. Teredinid borers

Family TEREDINIDAE

Bactronophorus thoracites (Gould)

Material examined : 10 exs., South Bay, Little Andaman, 4.iii.1982, coll. *M. K. Dev Roy*.

Distribution : India : Sundarbans, Mahanadi estuary, Visakhapatnam, Vellar-Cole-room estuary (Poto Novo), Bombay, South Andaman, Ritchie's Archipelago, Little Andaman (present record) and Camota Is. (Nicobar).

Outside India : Indian oceanic Islands, Burma, Malaya, Indonesia, Australia and New Zealand.

Remarks : This is a common mangrove borer of South Andaman and Ritchie's

Archipelago. In Little Andaman this was extracted from the logs of Kankara tree where salinity was 16‰ at the time of collection.

Lyrodus pedicellatus (Quatrefages)

Material examined : 4 exs., Hut Bay, Little Andaman, 24. ii. 1932, *M. K. Dev Roy* ; 16 exs., South Little Andaman, 4.iii.1982, coll. *M. K. Dev Roy*.

Distribution : India : Mahanadi estuary, Visakhapatnam, Madras, Pamban, Tondi and Adirampatnam, Tuticorin, Kayamkulam, Cochin, Magalore, Karwar, Panaji, Ratnagiri, Bombay, Daman, Veraval, Okha, Kandla, South Andaman, Ritchie's Archipelago, Little Andaman (present record) and Camorta Is. (Nicobar). Outside India : Widely distributed in tropical and temperate seas.

Remarks : This species was collected from logs and dead stumps of Goran and Passur trees lying in salinity ranging from 16.7‰ to 32‰.

Nausitora dunlopei Wright

Material examined : 12 exs., 22 km from Hut Bay, Little Andaman, 20.ii.1982, coll. *M. K. Dev Roy*.

Distribution : India : Sundarbans, Mahanadi estuary, Madras, Cochin Harbour, Great Nicobar, Car Nicobar and Little Andaman (present record).

Outside India : Bangladesh, Siam, Bismark Archipelago, Madagascar, Australia.

Remarks : This species is reported for the first time in Andaman waters. This borer was extracted from the dead stumps of Kankara tree lying in salinity of 5.15‰.

Nausitors hedleyi Shepmann

Material examined : 1 ex., Hut Bay, Little Andaman, 24.ii.1982, coll. M. K. Dev Roy ; 1 ex., South Bay, Little Andaman, 4.iii.1982, coll. M. K. Dev Roy.

Distribution : India : Mahanadi estuary, Madras harbour, Cochin, Middle Andaman, Ritchie's Archipelago, South Andaman and Little Andaman (present record).

Remarks : This borer was collected from the same locality and habitat as in the case of *Lyrodus pedicellatus*.

B. Isopod borers**Family SPHAEROMIDAE*****Sphaeroma terebrans* Bate**

Material examined : 3 exs., 22 km from Hut Bay, Little Andaman, 20.ii.1982, coll. M. K. Dev Roy ; 25 exs., Hut Bay, Little Andaman, 23.ii.1982 and 26.ii.1982, coll. M. K. Dev Roy ; 10 exs., 13 km from Hut Bay, Little Andaman, 1.iii.1982, coll. M. K. Dev Roy.

Distribution : India : Kerala, Karnataka, South Andaman, Ritchie's Archipelago, Little Andaman (present record).

Outside India : California, Florida, Brazil, Congo, South Africa, Mozambique, Zanzibar, Mediterranean, Shri Lanka, Australia, New Zealand.

Remarks : *S. terebrans* which is known as the most destructive borers of all the species of *Sphaeroma* recorded so far from India, was found to inhabit the logs of *Rhizophora* sp in large numbers in the mangrove areas of Little Andaman. Diameter and depth of the holes of these borers were found to vary from 5 to 5.5 mm and 2.5 to 8.5 mm respectively. Within the log of 5 mm sq area selected at random 37 holes and 400 nymphs

and adults on average were found. This species of borer was found in the logs lying in different salinity varying from 5.15‰ to 32‰. This is very noteworthy because *S. terebrans* usually occurs in brackish water.

GENERAL REMARKS

In the course of present investigation it is revealed that members of the family Rhizophoraceae are more susceptible to the attack of teredinid borers than the mangroves belonging to the other families. This may be due to the fact that these mangroves, more particularly *Rhizophora* spp, occupy most outer seaward fringe in this island.

As mentioned earlier, out of five species of crustacea collected from the logs of *Rhizophora* spp, only one species, *Sphaeroma terebrans*, is known as true wood borer (Pillai, 1967). Of course, in one occasion *Melita zeylanica* was observed to scrape the surface of the submerged timber in the Kerala back water (see Pillai, op. cit.). In the present case *M. zeylanica*, *Cirolana parva* and *C. elongata* were collected from the logs lying in the brackish water having salinity 5.15‰, whereas *Sphaeroma triste* was found in the logs placed in salinity 32‰. Unfortunately, the present authors were not able to study the habit of these organisms.

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A NEW FLY NIGRITOMYIA ANDAMANENSIS (DIPTERA : STRATIOMYIDAE)
FROM THE ANDAMANS

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AND

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ABSTRACT

A new fly *Nigritomyia andamanensis* sp. nov. is described here.

INTRODUCTION

These flies were collected recently from the Andamans during a collection trip. After a careful examination it was found to be a new species.

Nigritomyia andamanensis sp. nov.

(Figs. 1. A, B, C)

♂ ♀. Black ; males larger than females ; head usually as large as thorax, with short whitish pubescence ; eyes confluent in

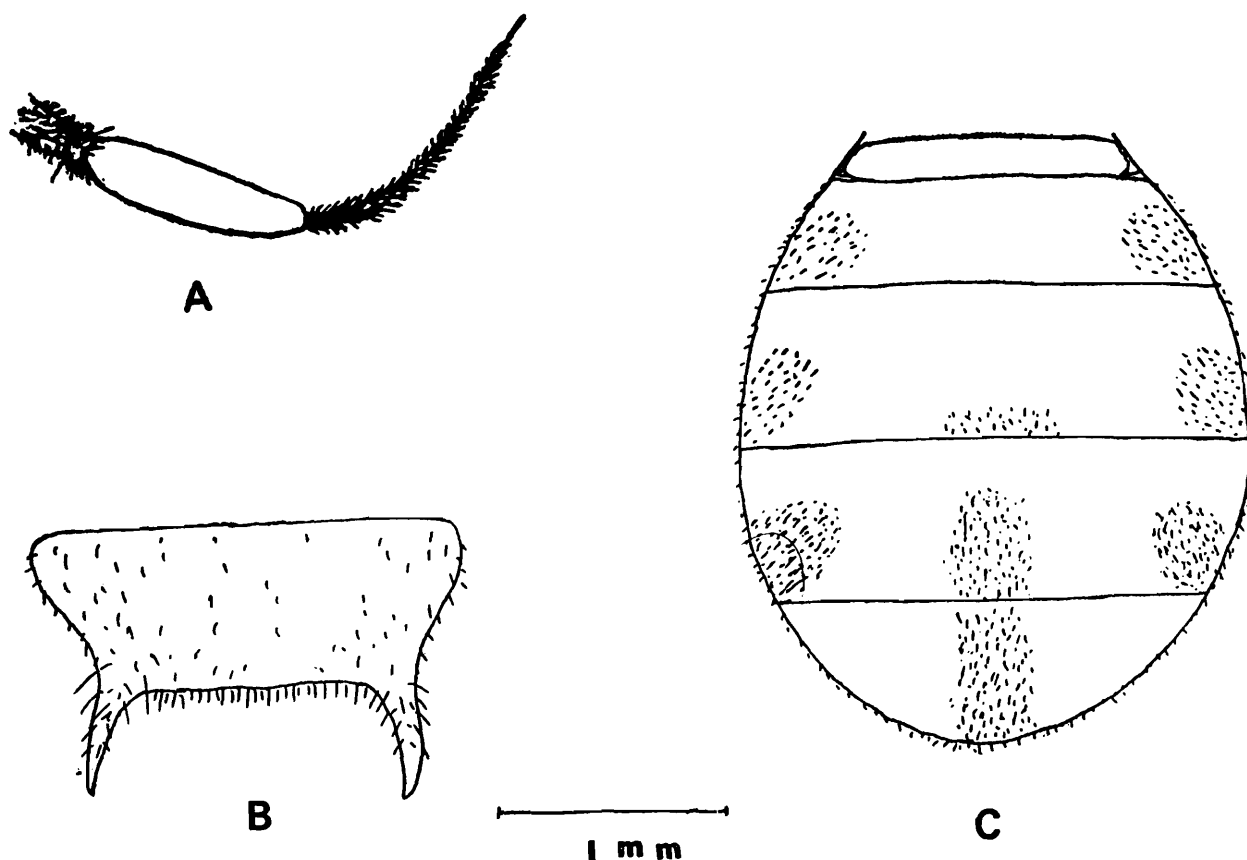


Fig. 1. *Nigritomyia andamanensis* sp. nov. A. Antenna, B. Scutellum with spines, C. Abdomen.

male but separate in female ; facets equal, posterior orbit with narrow silvery-white pubescence in females but in male it is not so prominent ; ocular setae proclinate ; palpi black. Antenna black, 3-jointed, 3rd joint annulated, arista apical, pubescent, arista shorter in females but longer in males.

Thorax black, shining, covered with short white pubescence, forming two median longitudinal white lines, the sides black with white pubescence, dorsal hairs on thorax short and sparse, in males these are longer than in females, side spines black, strong and long, present at the base of the wing dorsally, scutellum black with short black hairs and white pubescence, two broadly separated strong long black spines on hind margin bearing minute hairs, these spines are longer in males than in females.

Abdomen black, shining with white pubescence, forming a spot on 4th and 5th segment laterally and a dorsomedian line on last two segments. Legs black, with minute whitish pubescence, coxae black, trochanter pale yellow ; femur yellowish at base, tibia pale yellow at base, tarsi pale yellow at base gradually being darker towards apex. Wing

subhyaline, stigma dark brown, wing tip is more darker in females than in males ; halter's stem and club white.

Material : *Holotype* 1 ♂, Sippighat, S. Andaman, 16.x.1982, Coll. R. M. Sharma ; *Allotype* 3 ♀ ♀, Sippighat, S. Andaman, 20.xi.81 ; 25.i.82, Coll. R. M. Sharma ; *Paratype* 1 ♂, Sippighat, S. Andaman, 21.iii.81, Coll. R. M. Sharma.

Z. S. I. Regd. No. 6843/H6-6847/H6

Remarks : This species comes close to *Nigritomyia maculipennis* Macq., but differs as follows : Palpi with whitish pubescence ; trochanter yellowish ; thorax with two parallel whitish lines ; shape of the abdomen roundish ; arista densely hairy.

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The authors are thankful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta for encouragement and facilities given to work.

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STUDIES ON INDIAN CALANOIDS I. DESCRIPTION OF A NEW CALANOID
COPEPOD, *NEODIAPTOMUS TIWARI* SP. NOV. (CALANOIDA : DIAPTOMIDAE)
FROM THE NILGIRI DISTRICT WITH ECOLOGICAL OBSERVATIONS.

TUSHARENDU ROY

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ABSTRACT

A new species of the genus *Neodiaptomus* Kiefer was described and figured from the Nilgiri District in South India. Affinities with previously described species of the genus, discussed. Brief ecological observations of various water bodies in relation to the species described, have been incorporated.

INTRODUCTION

So far, the following nine species of the genus *Neodiaptomus* Kiefer have been described: *N. schmackeri* (Pope & Richard, 1892) (= *D. strigilipes* Gurney, 1907; = *D. handeli* Brehm, 1921); *N. meggitti* Kiefer, 1932; *N. lymphatus* Brehm, 1933; *N. mephistopheles* Brehm, 1933; *N. physalipus* Kiefer, 1935; *N. diaphorus* Kiefer, 1935; *N. lindbergi* Brehm, 1953; *N. satanas* Brehm, 1953 and *N. kamakhiae* Reddiah, 1964.

Kiefer (1939) reported six species out of which four of them *N. schmackeri*, *N. meggitti*, *N. lymphatus* & *N. mephistopheles* were recorded from China, Burma, Celebes and Java respectively. The remaining two species *N. physalipus* and *N. diaphorus* along with the three more species, *N. lindbergi*, *N. satanas* and *N. kamakhiae* were recorded from eastern and southern India.

A careful examination of the material of the Calanoid Copepods collected during

Nilgiri District Faunistic Survey by the Zoological Survey of India in January-February, 1971, from 18 localities of which 8 localities, revealed the presence of a tenth and new species of *Neodiaptomus* Kiefer.

MATERIAL AND METHODS

The field work and laboratory study for preliminary identification was carried out while the author was holding a fellowship of the Zoological Survey of India, Calcutta.

The collections were made by the author with the help of 29 cm diameter conical (0.5 mm to 1.0 mm mesh size) plankton tow-net for about fifteen minutes in each haul and the pH measurement was made by the Litmas paper. The specimens of all localities were preserved in 85% Ethyl alcohol (C₂H₅OH) including 2/3 drops of Glycerine. Detail of the material examined has been given under the systematic account of the species described.

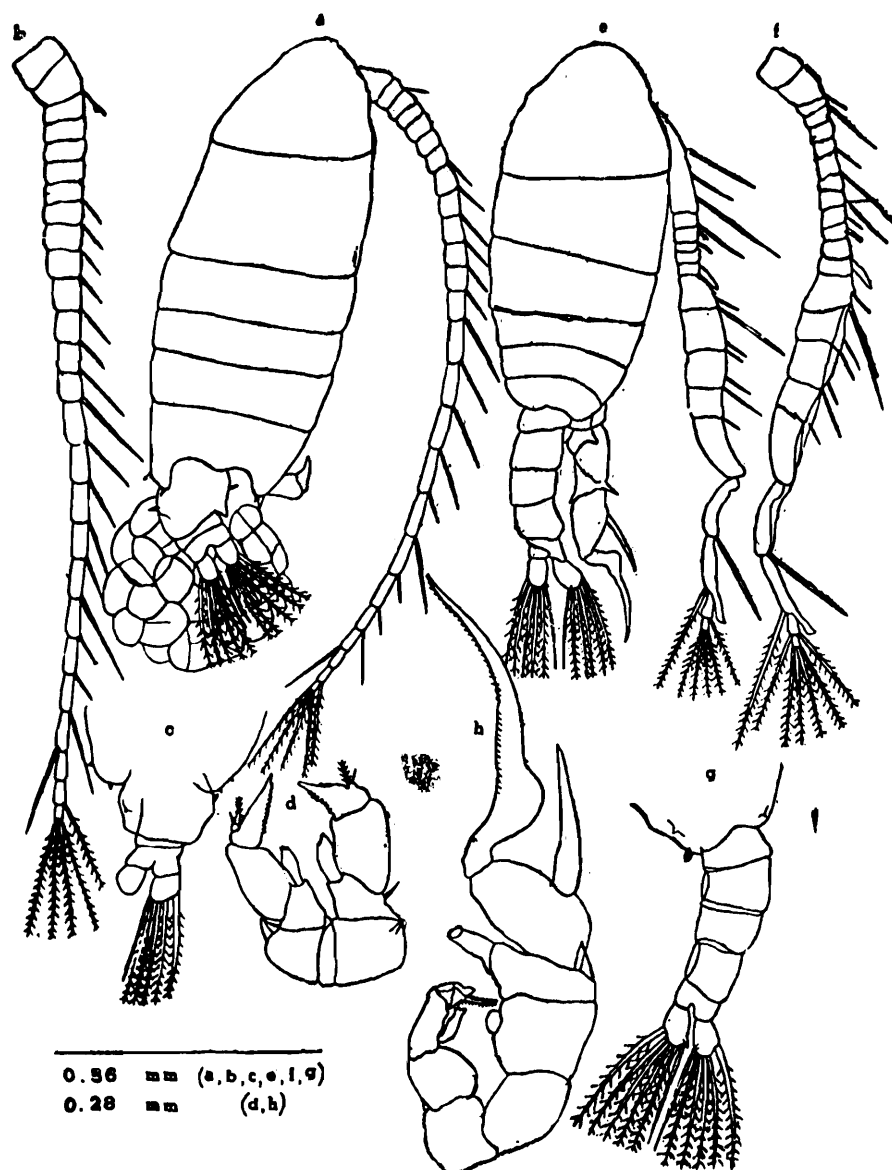
*Neodiaptomus tiwarii* sp. nov.

Fig. 1. (a—h), a—d, adult female ; e—h, adult male

a.	Adult female	dorsal view
b.	" "	antennule
c.	" "	urosome with last thoracic segment
d.	" "	fifth pair of legs
e.	" male	dorsal view
f.	" "	right antennule
g.	" *	urosome with last thoracic segment
h.	" "	fifth pair of legs

The specific name of the new species *tiwarii* is dedicated in honour of Dr. K. K. Tiwari, a renowned carcinologist of India,

as a tribute to his untiring efforts towards the development of the carcinological research in the Zoological Survey of India, Calcutta.

***Neodiaptomus tiwarii* sp. nov.**

(Fig. 1 a-d, adult female ; e-h,
adult male)

Material : Holotype : Adult female, Nullah (below culvert) near Wellington Military Barracks, 5 kms, up from Coonoor town on way to Ootacamund, Tamilnadu, India, 27.1. 1971 (T. Roy Coll.), Regd. No. C 2546/2. Allotype : Adult male, with same data as the holotype, Regd. No. C. 2547/2. Paratypes : 119 females and 84 males with the same data as the holotype, Regd. Nos., C 2548-49/2. All the specimens including non types have been deposited in the National Collections of the Zoological Survey of India, Calcutta.

Description of the adult female :

The total length of the body (Fig. a) excluding the caudal setae is 1.16 mm. The average length of the species is 1.10 mm range : 1.06 mm to 1.20 mm based on the measurement of five specimens. The body is more cylindrical with six divisions of the prosome and three divisions of the urosome (Fig. c). The wings of the last thoracic segment are asymmetrical and has two lobes. Each lobe is possessing two small spines. The spines of the right lobe are more closer than the left lobe. The proportional length of the prosome and the urosome are as follows :

$$78 : 22 = 100$$

The genital segment (Fig. c) is the largest segment and the second segment is the smallest. The middle of the both inner and outer margin of the genital segment is little swollen and each bears a small spine pointing laterally. The proportionate length of the urosomal segments are as follows :

$$\text{Segments } \frac{-1 \quad -2 \quad -3 \text{ caudal rami}}{50 \quad 9 \quad 18 \quad 23} = 100$$

Caudal rami (Fig. c) are symmetrical. Each ramus bears six caudal setae. The innermost naked caudal seta is thin and short and has a small sclerotised knee a short distance from the base. The other five setae are equal in length and are crowded with fine setules in plumose fashion.

The first antennule :

When it (Fig. b) folds back to the body, the tip of the antennal setae reaching a little beyond the tip of the caudal setae. It consists of 26 segments. The setal arrangement in the antennule are as shown in the figure. The proportionate length of segments are given below :

$$\begin{array}{cccccccc} \text{Segments} & 1 & : & 2 & : & 3 & : & 4 & : & 5 & : & 6 & : & 7 & : \\ & 48 & & 54 & & 25 & & 25 & & 25 & & 25 & & 25 \\ & 8 & : & 9 & : & 10 & : & 11 & : & 12 & : & 13 & : & 14 \\ & 28 & & 31 & & 34 & & 41 & & 41 & & 38 & & 38 \\ & 15 & : & 16 & : & 17 & : & 18 & : & 19 & : & 20 & : & \\ & 56 & : & 47 & : & 50 & : & 47 & : & 53 & : & 33 \\ & 21 & : & 22 & : & 23 & : & 24 & : & 25 & : & 26 \\ & 49 & : & 49 & : & 50 & : & 38 & : & 31 & : & 19 \end{array} = 1000$$

Fifth leg :

Fifth leg (Fig. d) is symmetrical. It consists of two pairs of basipod, two pairs of exopod and one pair of endopod segments.

The right fifth leg :

It consists of two basipod two exopod and one endopod segments. The first basipod segment is large and nearly circular and it possesses a strong spine on its dorsolateral region of the outer margin. The second basipod segment is smaller than the first basipod segment and is ornamented with a small seta on its outer margin. The first exopod segment is large, cylindrical and

unornamented. The second exopod segment forms claw and is knobbed at its base. It has a notch on its outside from which two unequal setae arise. The inner margin of the claw is set with seven to eight highly chitinated and conical teeth out of which three are larger and four to five are smaller. The outer margin of the claw is set with five to six small highly chitinated and thick denticles. The endopod arises from the dorsolateral corner of the inner margin of the second basipod segment and is fringed with fine hairs at its tip.

The left fifth leg :

The left fifth leg (Fig. d) is similar to the right in many respects except in the sizes of the second basipod, first and second exopod segments (Claw) and the nature of denticulation of the claw. The size of the endopod of the left leg is little smaller than that of the right.

Description of the adult male :

The total length of the body (Fig. e) excluding the caudal setae is 1.12 mm. The average length is 1.11 mm (range : 1.10 mm to 1.13 mm based on the measurement of five specimens). The body is more cylindrical and with six divisions of the prosome and five divisions of the urosome. The head fused with the first thoracic segment. The anterior region of the body is little compressed. The wings of the last thoracic segment are asymmetrical. Each wing bears two small spines. The proportionate length of the cephalothorax and the urosomal segment are as follows :

$$67 : 33 = 100$$

The urosome (Fig. g) consists of five segments. The second segment is the largest and the anal segment is the smallest. The caudal rami

are symmetrical. Each ramus bears six caudal setae. The innermost caudal seta is short and thin and has a sclerotised knee a short distance from the base. The remaining five caudal setae are equal in length and fringed with fine setules in plumose fashion.

Right anterior antennule :

When the prehensile right anterior antennule (Fig. f) folds back to the body, the tip of the antennal setae reaching almost the tip of the caudal setae. It consists of 22 segments. The proportionate length of the segments are as follows :

Segments	1	:	2	:	3	:	4	:	5	:	6	:	7
	44	:	51	:	18	:	22	:	29	:	26	:	37
	8	:	9	:	10	:	11	:	12	:	13	:	14
	22	:	26	:	29	:	18	:	29	:	29	:	55
	15	:	16	:	17	:	18	:	19	:	20	:	21
	51	:	66	:	51	:	118	:	118	:	102	:	37
	22												
	22	:=1000											

Segments 10 and 11 bear small spines while the segment 13 possesses the longest, stoutest and highly chitinated spine. The terminal process of the antepenultimate segment is straight and slightly broad at its tip with little recurved distally. The setae of the ultimate and penultimate segments are fringed with fine setules.

Fifth leg :

Fifth leg (Fig. h) is well built and asymmetrical. The tip of the left leg reaching almost the distal end of the first exopod segment of the right leg. It consists of right and left fifth leg.

The right fifth leg :

It consists of two basipod, three exopod and one endopod segments. The first basipod

TABLE 1. Frequency distribution of the catch composition of *Neodiaptomus tiwarii* sp. nov., indicating the sex ratio within the species and occurrence of other Cyclops.

	Nullah (below culvert) near Wellington Military Barrack, Coonoor.	Reservoir near Ralliah Dam, Coonoor.	Nursery pond (A) in the Wilson Fish Farm, Ootacamund.	Nursery pond (B) in the Wilson Fish Farm, Ootacamund.	Nursery pond (C) in the Wilson Fish Farm, Ootacamund.	Reservoir near pykara Dam, Ootacamund. * * *	Kamraj Sagar Reservoir, Ootacam- und.	Ootacamm- und Lake, Ootacamm- und. * * *	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Date	27.1.1971	27.1.1971	2.2.1971	2.2.1971	5.2.1971	3.2.1971	3.2.1971	5.2.1971	
No. of females	122 ; 3D*	226 ; 5D*	94 ; 1D*	80 ; 1D*	4 ; 1D*	56 ; 4D*	6 ; 1D*	8 ; 2D*	
(i) ** Range (mm) based on 5 spe- cimens	1.12-1.18	1.14-1.16	1.13-1.17	1.14-1.16	1.13-1.16	1.15-1.18	1.13-1.16	1.14-1.17	
(ii) Mean (mm)	1.15	1.16	1.15	1.16	1.15	1.17	1.14	1.16	
No. of males	88 ; 3D*	209 ; 5D*	27 ; 2D*	38 ; 1D*	1D*	48 ; 2D*	2 ; 1D*	1D*	
(i) **Range : (mm) based on 5 spsci- mens	1.10-1.14	1.10-1.15	1.09-1.12	1.10-1.12	—	1.10-1.14	1.08-1.10	—	
(ii) Mean (mm)	1.12	1.13	1.10	1.10	1.11	1.13	1.09	1.10	
No. of immatures	1	3	—	—	—	3	—	—	
Other Cyclops	—	—	13	7	39	10	9	12	

*D=Dissected ; **Range=Total length of the body excluding caudal setae ; ***=From the water bodies, author collected the new species and no other diaptomids except Cyclops.

segments. is nearly circular and unornamented. The second basipod segment is larger than the first and has a prominent hyaline tubercle near the middle of the inner margin. The first exopod segment possesses a strong spine on its dorso-lateral region of the outer margin and a small protuberance on its inner margin. The second exopod segment is cylindrical and a strong spine which is almost the equal in length of the second exopod segment, originating from the middle of the outer margin of the segment. The third exopod segment forms claw and its bends and tapers to a blunt end. The inner margin of the claw is striated. The base of the claw which is a little distance from the proximal region is knobbed posteriorly. The endopod is small and cylindrical originating from the dorsolateral region of the inner margin of the first exopod segment and is fringed with fine hairs at its tip.

The left fifth leg :

It consists of two basipod, two exopod and one endopod segments. The first basipod segment is almost equal in size of the basipod of the right fifth leg. The second basipod segment is smaller than its counter part of the right leg. The first exopod is longer than the wide and cylindrical and the inner margin of segment is smaller than the first. The third exopod segment is represented by a strong and short spine and long serrated seta. The endopod is small and narrow and is little wider at its base and is fringed with fine hairs between the two spinnules at its tip.

REMARKS

New species differs from *N. schmackeri* in the size and shape of the genital segment of the female and in the shape and structure

of the claw and the endopod of the male right fifth leg. It also differs from *N. meggitti* in the shape and structure of the female genital segment. New species differs from *N. lymphatus* and *N. mephistopheles* in the absence of serrations on the process of the antepenultimate segment of the right antennule of the male. New species differs from *N. physalipus* and *N. diaphorus* in wider than long in the genital segment and in the shape and denticulation of the claws of the fifth leg of female. In the male, though similar in shape of the claw but it differs in size of the claw and the endopod of the male right fifth leg. New species differs from *N. lindbergi* in the size of the females and in the ornamentation at the tip of the endopods of the female fifth leg. It also differs in the position and length of the lateral spine of the second exopod segment and in the shape of the endopod of the male right fifth leg. *N. satanas* differs from the new species in having the extremely thin nature of the claw of the male right fifth leg. It also differs in having a small lateral process at the outer distal corner in addition to the small and curved lateral spine of the second exopod segment of the male right fifth leg. Further, is also differs in having the serrated process of the antepenultimate segment of the right antennule of the male. New species differs from *N. kamakhiae* in the size and structure of the genital segment and in the structure and denticulation of the claws of the female fifth leg. In the male, it differs in the shape of the claw and in the size and position of the lateral spine of the second exopod segment of right fifth leg.

N. tiwarii differs from all species in the size and shape of the genital segment of the female and in the structure and degree of denticulation of the claw of the female fifth

leg. In the male, it differs in the size of the endopod and in the size and position of the lateral spine of the second exopod segment of the right fifth leg.

ECOLOGICAL OBSERVATIONS

Ecological observations were made from the following localities where the new species was encountered :

- i) Nullah (below culvert) near Wellington Military Barracks (formerly known as Jakatalla Barracks), 5 kms. up from Coonoor town on way to Ootacamund on 27.1.1971 ; Adult abundant, many females ovigerous and with attached spermatophores ; single immature ; some vegetation ; cool and unclean water ; temperate (9°C)* ; pH-neutral ; 3 males and 3 females dissected.
- ii) Large reservoir near Ralliah Dam, 11 kms. from Coonoor town on 27.1.1971 ; Adult abundant, many females ovigerous and with attached spermatophores ; very few immature ; no vegetation ; Cool and clean water, temperate (9°C)* ; pH-neutral ; 5 males and 5 females dissected.
- iii) Nursery ponds (A, B & C) in the Wilson Fish Farm in Ootacamund on 2.2.1971 and 5.2.1971 Adult abundant, associated with other Cyclops ; some vegetation ; cool and unclean water, temperate (1°-2°C)* ; pH-neutral ; 4 males and 3 females dissected.
- iv) Large reservoir near Pykara Dam in Ootacamund on 3.2.1971 ; Adult abundant, many females ovigerous and with attached spermatophores ; few

immature associated with other Cyclops ; no vegetation ; cool and clean water ; temperate (1°C)* ; pH-neutral ; 2 males and 4 females dissected.

- v) Kamraj Sagar reservoir in Ootacamund on 3.2.1971 ; very low population probably due to the effect of effluents of nearby the Hindustan Photo Films Factory and other small factories ; no vegetation ; cool and unclean water, temperate (1°C)* ; pH-acidic ; 1 male and 1 female dissected.
- vi) Ootacamund Lake near P. W. D. Bunglow 0.8 km. from Ootacamund Railway Station on 5.2.1971 ; Adult very few associated with other Cyclops ; phytoplankton blooms with leaves and branches of trees ; cool and unclean water, temperate (2°C)* ; pH-acidic ; 1 male and 2 females dissected.

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*The figure in the parenthesis indicates the atmospheric temperature at the time of collections.

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REPORT ON A COLLECTION OF ORTHOPTERA (INSECTA) FROM THE DISTRICTS OF PURULIA AND BANKURA, WEST BENGAL, INDIA

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ABSTRACT

17 species and subspecies of grasshoppers and crickets (Orthoptera) have been recorded and reported for the first time from the districts of Purulia and Bankura, West Bengal, India. Zoogeographical data of all species are provided ; additional taxonomical characters and measurements have been given whenever needed.

INTRODUCTION

For no apparent reason, the Orthopteran fauna of Purulia and Bankura districts of West Bengal is meagrely known. The present communication fills up the lacunae of our knowledge about the faunal composition of the districts.

The districts of Purulia and Bankura are the easternmost limit of the Chottanagpur plateau of Bihar. Both the districts are the hottest and driest regions of W. B. In winter, the average annual rainfall is less than 5 cm and temperature lows down up to 10°C. In summer, the average annual rainfall is 110 cm to 130 cm and average temperature rises up to 46°C. The vegetation of the districts is of monsoon forest or moist deciduous forest, as December to May is the dry period. But most of the area is now denuded or deforested for agriculture (mostly paddy).

All the 17 species and subspecies dealt here with are new records from the districts and definitely extend their biogeography. Further, data have been furnished in respect of the zoogeographical distribution of all species and subspecies ; additional characters

of taxonomical importance and measurements have been provided, wherever necessary.

All collections were, unless stated otherwise, done by the author. All the measurements are given in millimetre.

W. B. stands for West Bengal.

SYSTEMATIC ACCOUNT

Order : ORTHOPTERA

Family : ACRIDIDAE

1. Subfamily : ACRIDINAE

Genus (1) *Acrida* Linnaeus, 1758

1. *Acrida exaltata* (Walker, 1859)

Truxalis exaltata Walker, 1859. *Ann. Mag. nat. Hist.* 4 (3) : 222.

Material : W. B. : 1 ♂ ; Raghunathpur Mulberry moth seed farm, Purulia ; 18.9.81. Other localities : Himachal Pradesh : 1 ♂ ; Paota ; 10.6.1970 ; M. M. Chandra coll. 2 ♂ ; Rajgarh Road ; 5.7.1971 ; H. P. Agrawal coll. Sikkim ; 1 ♂ , (1 nymph) ; Khanikhola, Rangpo ; 6.7.1979 ; P. Halder coll.

Remarks : The species (♂ 26-35, ♀ 44-54) is predominantly distributed in India, Pakistan, Bangladesh, Sri Lanka, Afghanistan, S. E.

Tibet, S. E. Persia and Arabia (Yemen). It is available both in open grasslands including agricultural fields (paddy) as well as in moist, deep tropical woods.

II. Subfamily GOMPHOCERINAE

Genus (2) *Dnopherula* Karsch, 1896

2. *Dnopherula (Aulacobothrus) luteipes* (Walker, 1871)

Stenobothrus (?) *luteipes* Walker, 1871. *Cat. Derm. Salt Br. Mus.* 5 : 82.

Material : W. B. : 1 ♂, 1 ♀ ; Mukutmanipur, Bankura ; 22.9.81.

Remarks : The species (♂ 14.5, ♀ 21) is very common in oriental region.

Genus (3) *Leva* Bolivar, 1909

3. *Leva apicalis* (Walker, 1871)

Stenobothrus apicalis Walker, 1871. *Cat. Derm. Salt Br. Mus.* 5 (suppl.) : 81.

Material W. B. : 1 ♂, 2 ♀ ; Baram, Purulia ; 12.9.81. 1 ♀ ; Sirkabad, Purulia ; 14.9.81. 1 ♂ ; Ajadhya Hill, Purulia ; 15.9.81. 1 ♂ ; Mukutmanipur, Bankura ; 23.9.81.

Remarks : This species (♂ 12, ♀ 14-17) was described from Bombay. It is recorded here for the first time from a place other than its type locality. The specimens were collected from growing paddy fields and its surrounding places.

III. Subfamily OEDIPODINAE

Genus (4) *Aiolopus* Fieber, 1853

4. *Aiolopus thalassinus tamulus* (Fabricius, 1798)

Gryllus tamulus Fabricius, 1798. *Ent. Syst. Suppl.* : 195.

Material : W. B. : 1 ♂, 1 ♀ ; Sirkabad, (Paddy field) Purulia ; 14.9.81.

Remarks : This subspecies is common in Oriental region, Far east Asian Islands, China, Japan, Philippine isle and Australian regions. It is a serious pest of agricultural fields specially of paddy fields.

Genus (5) *Acrotylus* Fieber, 1853

5. *Acrotylus humbertianus* Saussure, 1884

Acrotylus humbertianus Saussure, 1884. *Mem. Soc. Phys. Hist. nat. Geneve*, 28 (9) : 189.

Material : W. B. : 2 ♂ ; Ajadhya Hill foothill, Purulia ; 15.9.81. 1 ♀ ; Sevok, Darjeeling ; 22.11.74. 2 ♂, 1 ♀ ; Mongpong, Darjeeling ; 15.11.74. Assam : 1 ♀ ; Raimona Forest, Goalpara ; 27.1.73.

Remarks : The species is distributed over India, Sri Lanka, Afganistan and Pakistan. In India, it was so far known from Pusa, Chapra, Keitni (M. P.) Shevaroy (Tamil Nadu) and Bulsar (Bombay). It is recorded here for the first time from the state of W. B.

Measurements : Length of body 17-18 ; length of tegmeng 18-19.5 ; posterior femur 10.5-11 ; posterior tibia 8.5-9 (measured 3 ♀).

Genus (6) *Oedaleus* Fieber, 1853

6. *Oedaleus abruptus* (Thunberg, 1815)

Gryllus abruptus Thunberg, 1815. *Mem. Acad. Sci. St-Petersb.* 5 : 238.

Material : W.B. : 1 ♂, 3 ♀ ; Baram, Purulia ; 12.9.81. 2 ♂, 1 ♀ ; Arsha, Purulia ; 11.9.81. 1 ♂ ; Raghunathpur Mulberry moth seed farm, Purulia ; 18.9.81.

Remarks : The species is distributed over Afganistan, Burma, China, India, Nepal, Sri Lanka and Thailand. It is very common in India and is a pest on our agricultural crops.

Genus (7) *Pternoscirta* Saussure, 18847. *Pternoscirta bimaculata* (Thunberg, 1815)

Gryllus bimaculatus Thunberg, 1815. *Mem. Acad. Sci. St-Petersb.* 5 : 239.

Material : W. B. : 1 ♂ (and 2 nymphs) ; Mukumanipur, Bankura ; 22.9.81. 1 ♂ ; Ajadhya Hill, Purulia ; 15.9.81.

Remarks : Additional description : Antennae much longer than head and pronotum taken together, mostly with elongated segments, roughly 3 times longer than width, first six segments smaller than rest and almost of equal length and breadth. Metazona longer than prozona. Mesosternal plates wider than long (about half) ; their interspace a little wider than width of one of its plate. Metasternal plates contiguous. Male anal cerci conical, shorter than subgenital plate, and slightly up turned.

Nymphs (9.5-16.5) more reddish and possess more granules on body parts. Tegmina etc. not yet grown up.

Measurements : Length of body 16.5-16.75 ; length of prozona 1.5-1.75 ; length of metazona 3-3.25 ; tegmen 18.5-19 ; wing 17-17.5 ; posterior femur 11.5-12 ; posterior tibia 9.25-9.5 (measured 2 ♂).

Genus (8) *Trilophidia* Stal, 18738. *Trilophidea annulata* (Thunberg, 1815)

Gryllus annulatus Thunberg, 1815. *Mem. Acad. Sci. St-Petersb.* 5 : 234.

Material : W. B. : 1 ♂ ; Arsha, Purulia ; 11.9.81. 1 ♀ ; Baram ; Purulia ; 12.9.81. 1 ♂, 1 ♀ ; Mukutmanipur, Bankura ; 23.9.81.

Remarks : This is a widespread and variable species (♂ 12.5-15.5, ♀ 16-22) of the Oriental region.

IV. Subfamily COPTACRIDINAE

Genus (9) *Eucoptacra* Bolivar, 19029. *Eucoptacra praemorsa* (Stal, 1860)

Acridium catantops (?) *praemorsum* Stal, 1860. *Eugenie's Resa, Orth.* 3 : 330.

Material : W. B. : 2 ♂ (and 2 ♀ advanced nymphs) ; Mukutmanipur, Bankura ; 22.9.81.

Remarks : It is one of the little known grasshoppers in India.

Genus (10) *Epistaurus* Bolivar, 188910. *Epistaurus sinetyi* Bolivar, 1902

Epistaurus sinetyi Bolivar, 1902. *Annls Soc. ent. Fr.* 70 : 623.

Material : W. B. : 2 ♂, 3 ♀ ; Mukutmanipur, Bankura, 22-23.9.81.

Remarks : The species was so far known from South India (Trichinopoly) ; Howrah (Botanical Garden) and Sri Lanka.

V. Subfamily CATANTOPINAE

Genus (10) *Catantops* Schaum, 185310. *Catantops pinguis innotabilis* (Walker, 1870)

Acridium innotabile Walker, 1870. *Cat. Derm. Salt. Br. Mus.* 4 : 629.

Material : W. B. : 1 ♂ ; Mukutmanipur, Bankura ; 23.9.81.

Remarks : This subspecies is rather less common in India.

VI. Subfamily OXYINAE

Genus (11) *Oxya* Serville, 183111. *Oxya velox* (Fabricius, 1787)

Gryllus velox Fabricius, 1787. *Mant. Ins.* 2 : 239.

Material : W. B. : 1 ♀ ; Mukutmanipur, Bankura ; 24.9.81. Other localities : West

Bengal, Sikkim and H. P. : Numerous examples from different localities.

Remarks : The species is very common in our agricultural fields during rainy season.

VII. Subfamily HEMIACRIDINAE

Genus (12) *Spathosternum* Karsch, 1877

12. *Spathosternum prasiniferum prasiniferum* (Walker, 1871)

Heteracris (?) *prasiniferum* Walker, 1871. *Cat. Derm. Salt. Br. Mus.* 5 (suppl.) : 65.

Material : W. B. : 1 ♂, 3 ♀ ; Mukutmanipur, Bankura ; 21.9.81.

Remarks : This subspecies is one of the commonest grasshoppers (♂ 14-16.5, ♀ 19-22) of India, to be met with in open grass fields.

VIII. Subfamily CYRTACANTHACRIDINAE

Genus (13) *Cyrtacanthacris* Walker, 1870

13. *Cyrtacanthacris tatarica* (Linne, 1758)

Gryllus locusta tataricus Linnaeus, 1758. *Syst. Nat.* (10th ed) : 492.

Material : W. B. : 1 ♂, 2 ♀ ; Mukutmanipur, Bankura ; 23.9.81.

Remarks : The species (♂ 44-46, ♀ 58-60) is distributed over Africa and Oriental region. In India it was so far known from Andhra Pradesh (Nagarjun Sagar), Tamil Nadu (Nilgiri), Orissa (Chilka and Barkuda) and W. B. (Calcutta).

Family PYRGOMORPHIDAE

Genus (14) *Chrotogonus* Serville, 1838

14. *Chrotogonus trachypterus trachypterus* (Blanchard, 1836)

Ommexycha trachypterus Blanchard, 1836. *Annls Soc. ent. Fr.* 5 : 618, pl. 22, fig. 6.

Material : W. B. : 2 ♂ ; Baram, Purulia ; 12.9.81. 1 ♀ ; Sirkabad, Purulia ; 14.9.81. 6

nymphs (of different stages) ; Mukutmanipur, Bankura ; 20-21. 9. 81. 1 ♂ ; Bamanpockri, Darjeeling (Tarai) ; 22.8.75. Orissa : 1 ♀ (and 1 nymph (♀) ; Barkuda Is., Chilka Lake, Ganjam dist., IX-1920 ; N. A. coll. Sikkim : 3 ♂, 4 ♀, (and 4 nymphs) ; Rangpo ; 2-7.7.-1979 ; P. Haldar and party coll.

Remarks : The subspecies (♂ 12-16, ♀ 20-23) has a rather restricted distribution to North eastern India (Kevan, 1968 p. 153).

The sub-species is, however, here reported for the first time from the state of W. B. The availability of nymphs in September indicates that the generation starts after monsoon.

Measurements : Length of body ♂ 12-16, ♀ 20-23 ; antennal length ♂ 5-6.5, ♀ 6-8 ; head length ♂ 2.2-2.8, ♀ 3-3.6 ; maximum width of head ♂ 1.1-1.6, ♀ 1.6-2.2 ; maximum width of face ♂ 2.4-2.7, ♀ 3.8-4.2 ; minimum width of interocular distance ♂ .7-.9, ♀ 1-1.1 ; width of frontal ridge at median ocellus ♂ .3-.5, ♀ .4-.5 ; pronotal length ♂ 2.9-3.9, ♀ 4.2-5.2 ; length of prozona ♂ 1.4-1.7, ♀ 2-2.3 ; length of metazona ♂ 1.5-2.2, ♀ 2.2-2.5 ; maximum width of pronotum ♂ 4.2-5.2, ♀ 6.3-7 ; minimum width of pronotum ♂ 2-3.1, ♀ 3.2-4.5 ; length of tegmen ♂ 9-15, ♀ 14-19 ; maximum width of tegmen ♂ 1.6-2.5, ♀ 3.3-3.7 ; length of post. femur ♀ 7-9, ♀ 9.5-10.5 ; maximum width of post. femur ♂ 2.1-2.7, ♀ 3-3.3 ; length of post. tibia ♂ 6-7, ♀ 8-8.5.

Genus (15) *Atractomorpha* Saussure, 1861

15. *Atractomorpha crenulata* (Fabricius, 1793)

T. (ruxalis) crenulata Fabricius, 1793. *Ent. Syst.* 2 : 28.

Material : W. B. : 1 ♂, 2 ♀ ; Raghunathpur, Purulia ; 18. 9. 81. 1 ♀ ; Panitanki, Darjeeling ; 12.9.1974. 1 ♀ ; Sukha, Adalpur, Darjeeling ; 15.7.1974. 1 ♂ ; Raimona forest,

Darjeeling ; 27.1.1973. 1 ♂, 1 ♀ ; Mirik, Darjeeling ; 17.9.1974. 2 ♂ ; Saurini lower Basti area, Darjeeling ; 22-25.6. 1979. 1 ♂ ; Mirik Lake area, Darjeeling ; 22.6.1979. 1 ♂, 1 ♀ ; Sevok, Darjeeling ; 22-24. 11. 1974. 1 ♂ ; Sundarinala, Jamduar, Darjeeling ; 2.11.1973. 1 ♀ ; Murti Rivulet, Samsing, Darjeeling ; 6.3.1974. 1 ♂, 3 ♀ (and 1 nymph) ; Garia, 24-Parganas, 13.7.1974. 1 ♂, 2 ♀ ; Raghunathpur, 24-Parganas ; 17.7.1974. 2 ♂, (and 1 nymph) ; Singur, Hooghly ; 30.3.1978. 2 ♂, 1 ♀ ; Chandannagar, Hooghly ; 8.9.1979. 1 ♂, 1 ♀ (and 1 nymph) ; Andul, Howrah ; 12.9.-1978. 1 ♂, 1 ♀ (and 1 nymph) ; Botanical Garden, Howrah ; 17.3.1978 and 16.5.1978. Himachal Pradesh : 2 ♂ ; Renuka Lake, Sirmipur ; 11. 4. 1974 ; Orissa : 2 ♀ ; Barkuda, Chilka ; 9.11.1920 ; N. A. coll. 1 ♂ ; Saproon ; 9. 10. 1975. Assam : 1 ♂, 1 ♀ ; Kachugram forest ; 22.1.1973. Sikkim : 3 ♂, 1 ♀ ; Rangpo ; 2, 3, 5.7.1979 ; *P. Haldar & party* coll.

Remarks : The species is generally distributed over Laccadive and Maldiva Isle, Sri Lanka, India (except far north), Bangladesh and South-eastwards to South Vietnam.

The collection contains a female nymph (19). Antennae, tegmina (5.5) and genital parts of the specimen not complete but its median carina of pronotal disc more prominent and tectiform, with lateral carinae well impressed. The membranous area of pronotal lobe not yet detectable. Fastigium of vertex more concave and marginated than in adults.

This species is commonly found on two plants viz. *Tephrosia* sp. and *Crotalaria* sp.

Measurements : Length of body ♂ 17-20, ♀ 26-31 ; antennal length ♂ 5.5-6, ♀ 5.5-6.5 ; head length ♂ 3.1-4.1, ♀ 4.6-4.7 ; maximum width of head ♂ 1-1.2, ♀ 1.4-1.7 ; maximum width of face ♂ 1.5-2, ♀ 2.8-3 ; minimum width of interocular distance ♂

5-7, ♀ 8-1 ; width of frontal ridge at median ocellus ♂ 2-3, ♀ 3-4 ; pronotal length ♂ 3.4-4.4, ♀ 5.9-6.9 ; length of prozona ♂ 1.8-2.4, ♀ 3.1-3.6 ; length of metazona ♂ 1.6-2, ♀ 2.8-3.4 ; maximum width of pronotum ♂ 1.8-2.3, ♀ 3-3.4 ; minimum width of pronotum ♂ 1.2-1.4, ♀ 1.9-2.2 ; length of tegmen ♂ 14.5-18, ♀ 20-23 ; maximum width of tegmen ♂ 1.9-2, ♀ 3.3-3.5 ; length of post femur ♂ 7-9.5, ♀ 12-13 ; maximum width of post. femur ♂ 1.4-1.7, ♀ 1.8-2 ; length of post. tibia ♂ 6.5-8, ♀ 10-11.

Family GRILLIDAE

Genus (16) *Paranemobius* Saussure, 1877

16. *Paranemobius pictus* (Saussure, 1877)

Pseudonemobius pictus Saussure, 1877. *Mem. Soc. Phys. Hist. nat. Geneve*, 25 : 235-236.

Material : W. B. : 1 ♀ ; Baram, Purulia ; 12.9.81.

Remarks : The species was described from Kashmir and now known from Bombay, Nagpur, Chotanagpur, Karnataka, Kerala and Sri Lanka. The availability of the species in Purulia indicates its easternmost limit and is a new record from W. B.

Genus (17) *Acanthoplistus* Saussure, 1877

17. *Acanthoplistus birmanus* Saussure, 1877

Acanthoplistus birmanus Saussure, 1877. *Mem. Soc. Phys. Hist. nat. Geneve*. 25 : 490, pt. 15, fig. 2.

Material : W. B. : 1 ♂ ; Arsha, (on embarkment of paddy field) Purulia ; 11.9.81.

Remarks : The species was so far known from Himachal Pradesh, Uttar Pradesh, Karnataka and Tamil Nadu. Its availability in Purulia district indicates its discontinuous distribution in India. The specimen (7 mm.) studied is a little smaller in size.

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ON THE OCCURRENCE OF HAEMOGREGARINA NUCLEOBISECANS SHORTT, 1917 IN TOADS OF WEST BENGAL

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ABSTRACT

Haemogregarina nucleobisecans was found to infect two species of toad viz., *Bufo melanostictus* (13.4%) and *B. andersoni* (28%) from Bankura and Purulia districts, West Bengal, India. Intra-erythrocytic development and tissue schizogony of the parasite in the liver parenchyma from both the bufonid hosts were described and illustrated. *H. nucleobisecans* has been recorded from a new geographical locale of Eastern India and from a new host *Bufo andersoni*.

INTRODUCTION

Shortt (1917) described *Haemogregarina nucleobisecans* for the first time from *Bufo melanostictus* collected from Cawnpore, Delhi and Ambala (Punjab), India. Subsequently, Wenyon (1926) reported the occurrence of this parasite from the same host in India. Since then there was no information on amphibian haemogregarines till the reports of Ray (1977, 1979). Sinha (1979) reported one *Haemogregarina* sp. from *Bufo himalayanus* of Darjeeling, West Bengal.

The present paper deals with the detailed description of *Haemogregarina nucleobisecans* in two species of Toad viz., *Bufo melanostictus* and *B. andersoni* along with the schizogony in the liver of both the hosts. *Bufo andersoni* has been recorded as a new host for this haemogregarine parasite.

MATERIAL AND METHODS

Both the hosts were collected from Bankura and Purulia districts of West Bengal and some of them were kept alive in the laboratory for examination. Peripheral blood was obtained from finger tips on alternate

days and at autopsy. Impression and spread preparations were made from liver, lungs, kidney etc. Air-dried blood films and organ imprints were fixed in 100% methanol and stained with Ramanowsky type of stains. For microtome section the tissue of lung, liver, kidney and spleen were fixed in alcoholic Bouin's fixative, followed by general histological technique (Pearse, 1960) and stained with iron-haematoxylin and eosin.

Measurements were obtained from the camera-lucida drawings drawn on a graph paper (mm division) as it facilitated the area measurements by counting the squares covered. The photomicrographs were taken with the help of 'Ergavel C. Z. microscope using PM6 attachment camera.

OBSERVATION

47 13.4% out of 343 examples of *Bufo melanostictus* and 7 (28%) out of 25 *B. andersoni* examined were found positive for the parasite. A minimum of 5% to a maximum of 15% of the total R. B. C. counted were found to be infected with *H. nucleobisecans*. The description of the parasite is as follows :

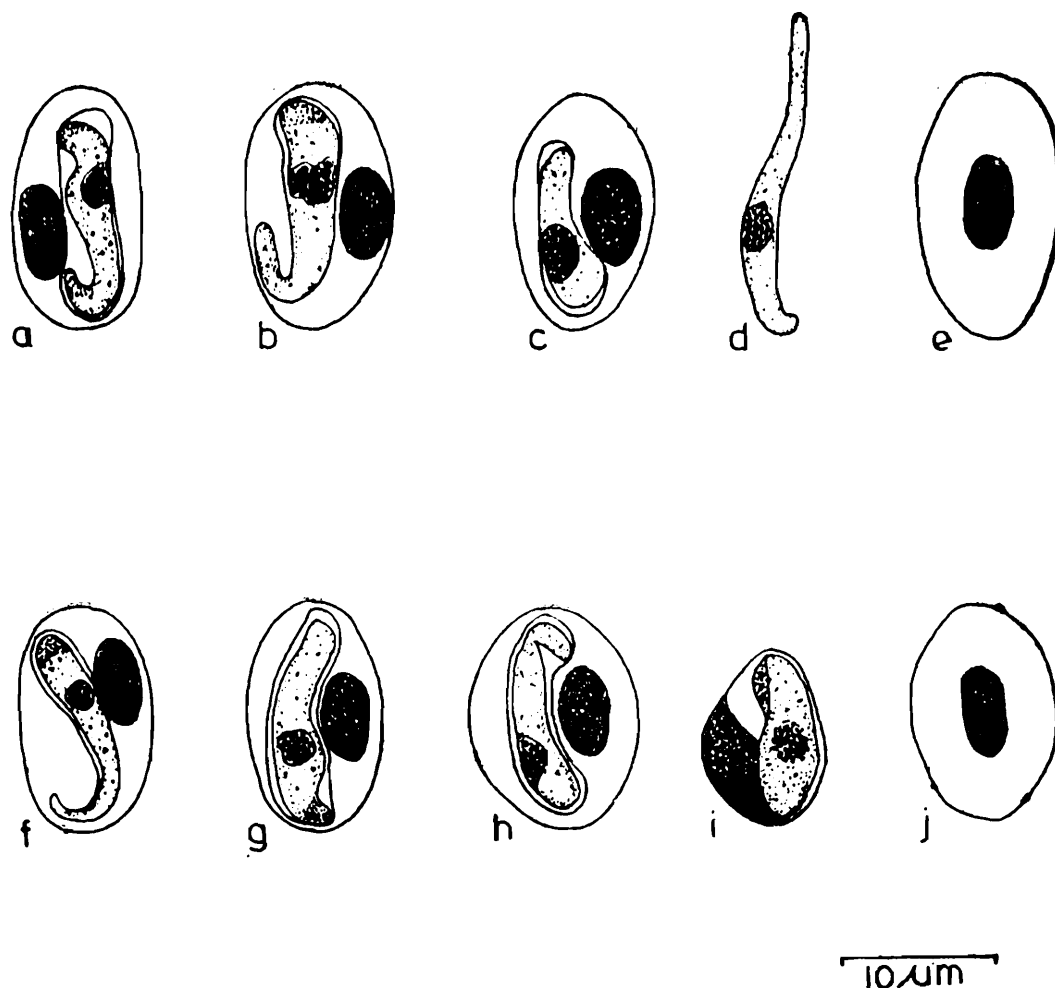


Fig. 1. Camera-lucida drawings of the erythrocytic stages of *Haemogregarina nucleobisecans* from two anuran hosts.

a-d, the gametocyte stages of *H. nucleobisecans* in *Bufo melanostictus*. a & b, the elongate mature forms ; c, the young forms ; d, the free gametocyte ; e, the uninfected erythrocyte ;

f-i, the elongate mature gametocyte stages of *H. nucleobisecans* in *Bufo andersoni* ; j, the uninfected erythrocyte.

Gametocytes :

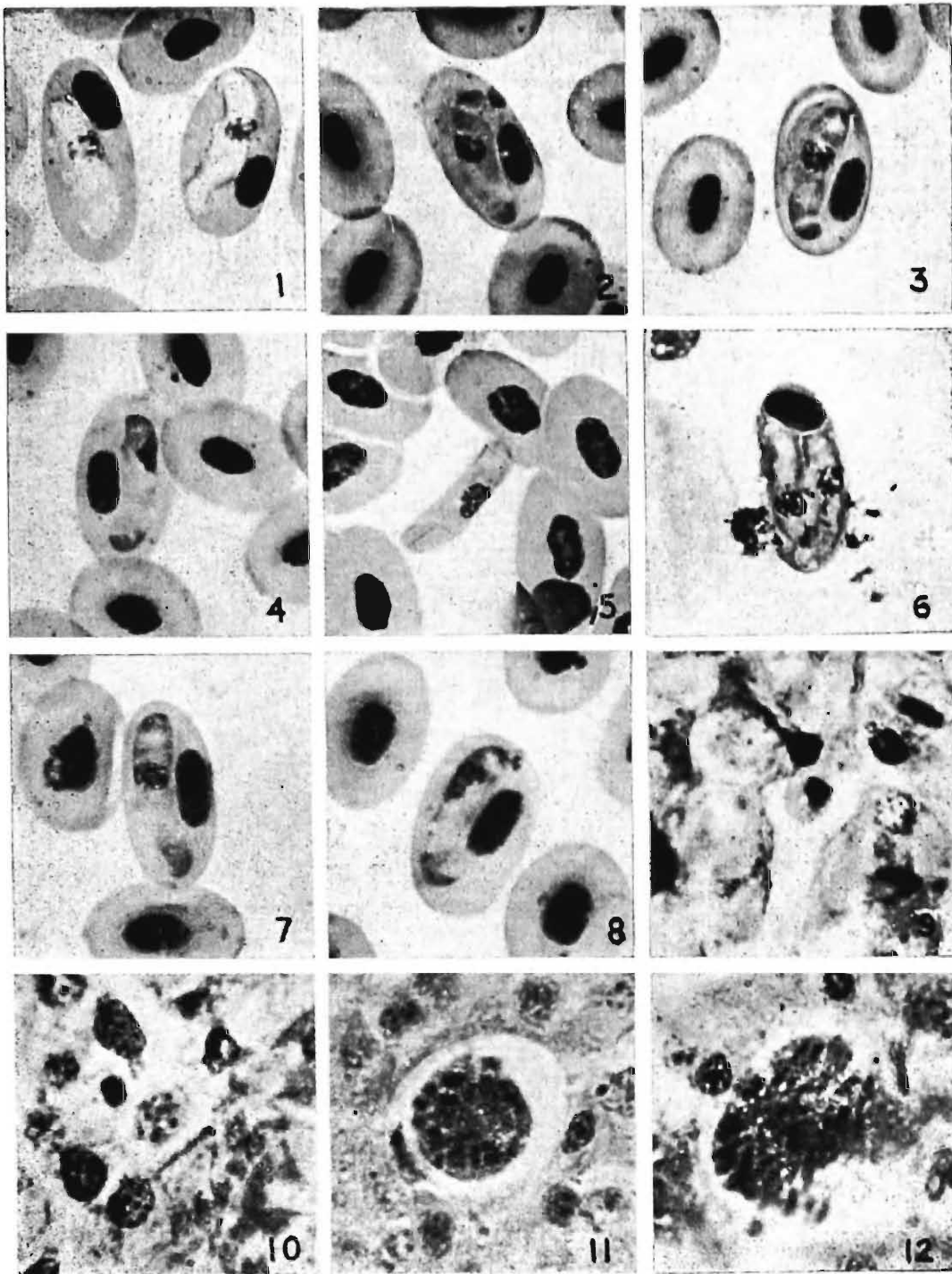
Elongate mature (Figs. 1a-c & Pl. V Figs. 1-4) :

N=15. These are sausage shaped endoparasites of erythrocytes, slightly curved and lying with its concave border applied to the convexity of the host cell nucleus or *vice-versa*. The anterior end is regular, rounded and broad while the posterior end is usually slightly bent (Fig. 1 a) or hook-like (Fig. 1 b). In some cases both the extremities may be

recurved and afflicted or the parasite may show a constriction about its centre. These elongate forms measure $14.4 \mu\text{m} \times 2.95 \mu\text{m}$ with an average area of $28.95 \mu\text{m}^2$ occupying about 25.97% of the total host cell-parasite complex. Granulated cytoplasm stains azure blue or faint pink with Giemsa stain. The nucleus, approximately central in position, almost fills up the entire width of the parasite. It may be rounded (Fig. 1 f), oval (Fig. 1a) or band-shaped or irregular in outline, measuring $3.25 \mu\text{m} \times 1.95 \mu\text{m}$ and $5.18 \mu\text{m}^2$ in area ; stains pink with Giemsa. The

RAY

PLATE V



Figs. 1-12. Photomicrographs of the erythrocytic and tissue stages of *Haemogregarina nucleobisecans* from *Bufo melanostictus* and *Bufo andersoni*.

1-4. Elongate mature gametocytes in the peripheral blood of <i>B. melanostictus</i> .	X 1665
5. An extra-corporal free gametocyte	X 1800
6. An erythrocyte with double infection	X 1665
7-8. Elongate mature gametocytes in <i>Bufo andersoni</i> .	X 1800
9. A mononucleated schizont within the liver tissue.	X 1110
10. An immature schizont	X 1400
11. A multinucleated mature schizont within the liver parenchyma.	X 1140
12. A mature schizont with developing merozoites.	X 1665

gametocytes are always enveloped in a pink coloured thick capsule.

Intermediate and young forms (Fig. 1 c) :

Intermediate forms measure $10.5\ \mu\text{m} \times 3.0\ \mu\text{m}$ and are comparatively rare in the peripheral circulation. Cytoplasm stains light blue and contains a few metachromatic granules. The nucleus is the aggregation of chromatin materials at the centre of the parasite. Young forms measure $5.2\ \mu\text{m} \times 2.5\ \mu\text{m}$; both the ends rounded, capsule-like; band-shaped nucleus at the centre. Cytoplasm stains deep blue, with very few metachromatic granules.

Extracorporeal free forms (Fig. 1 d & Pl. V, Fig. 5) :

These are elongated with one end rounded and the opposite end being attenuated; measuring $21.72\ \mu\text{m} \times 2.84\ \mu\text{m}$ with $24.8\ \mu\text{m}^2$ in area. The cytoplasm is bluish with metachromatic granules evenly distributed. The compact rounded nucleus measures $3.2\ \mu\text{m} \times 2.28\ \mu\text{m}$ with an area of $4.9\ \mu\text{m}^2$.

Effect of the parasite on the host cell :

Elongate forms caused a marked hypertrophy of the infected red blood corpuscles and their nuclei. As a result of which the host cell became enlarged and the host cell nucleus was placed peripherally or sometimes pushed to apical position in case of double infection (Fig. 6). Nuclear Displacement Ratio=0.17. Host cell hypertrophied in length (7.3%) and area (11.3%). Host cell nucleus also hypertrophied in area (17%).

Uninfected erythrocyte :

N=15. Cell $15.47\ \mu\text{m} \times 8.55\ \mu\text{m}$ and $100.10\ \mu\text{m}^2$ in area. Cell nucleus $5.85\ \mu\text{m} \times 2.72\ \mu\text{m}$ and $13.28\ \mu\text{m}^2$ in area. N. D. R.=0.97.

Schizogony (Pl. V, Figs. 9-12) :

A thorough examination revealed some schizogonic stages in the liver parenchymatic cells. Erythrocytic schizogony was not detected. The early developmental stage of a schizont is an oblong or spherical uninucleate body measuring $4.5 \times 4.2\ \mu\text{m}$; occupying a cavity (Parasitophorous vacuole) (Fig. 9) within the liver cell. The spherical nucleus is $2.5\ \mu\text{m}$ in diameter, surrounded by an areola. The multinucleate schizonts (Fig. 11) measure $15.00\ \mu\text{m} \times 14.00\ \mu\text{m}$. The larger mature schizonts measure $20\ \mu\text{m} \times 13\ \mu\text{m}$ and contain many slender curved merozoites ($4.5\ \mu\text{m} \times 1.5\ \mu\text{m}$).

A more or less spherical nucleus is situated at the centre of each merozoite which stains deep black with Iron alum haematoxylin stain.

DISCUSSION

Haemogregarina nucleobisecans along with its hepatic schizogony was first reported by Shortt (1917) from North India. Wenyon (1926) reported the same parasite as *Haemogregarina bisecans* from the same anuran host of India.

The present study of *H. nucleobisecans* well agrees with that of Shortt's description in all general respects. The bisecting nature of the host-cell nucleus, however, has not been observed by the present author. Shortt (1917) did not observe any movement of this parasite but the present author noted a characteristic slow movement of extracorporeal gametocytes in the citrated saline preparation of fresh blood.

H. nucleobisecans has also been recorded during the present investigation from *Bufo andersoni* which is little smaller than that described from the type host. Moreover, in *B. andersoni* some leucocytes were also found

to be infected with the parasites measuring $11.5 \mu\text{m} \times 2.5 \mu\text{m}$.

Tissue Schizogony of the parasite has been observed in both the hosts *Bufo melanostictus* and *B. andersoni*. One type of schizogony with only one type of merozoite was noted.

Haemogregarina nucleobisecans has been recorded from a new geographical locale of Eastern India and from a new host *Bufo andersoni* along with *B. melanostictus*.

ACKNOWLEDGEMENT

The author is grateful to Dr. B. K. Tikader, Director, Zoological Survey of India for providing laboratory facilities. He is also indebted to Prof. A. Choudhury, Calcutta University and Dr. A. K. Mandal, Superintending Zoologist, Zoological Survey of India for their interest in the study.

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DESCRIPTION OF SIX NEW SPECIES OF SPIDERS OF THE FAMILIES CLUBIONIDAE, GNAPHOSIDAE AND SALTICIDAE FROM INDIA

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Zoological Survey of India, Calcutta

ABSTRACT

The six new species of spiders, described in this paper, were collected from Calcutta. The new species belong to the genera *Clubiona* Latreille, *Castianeira* Keyserling, *Herpyllus* Hentz, *Phidippus* Koch, *Marpissa* Koch and *Myrmarachne* Mac Leay.

INTRODUCTION

During the tenure of my one year research work I have covered the two areas within Calcutta, The Agri-Horticultural Society of India-garden, Calcutta and Zoological garden, Calcutta and have under taken twelve trips for collection. While examining the collected spider specimens I came across six species which are new to science under the six genera belonging to three families (Clubionidae, Gnaphosidae and Salticidae) described in this paper.

All the type specimens are deposited in the National Zoological Collection of the Zoological Survey of India, Calcutta.

Family CLUBIONIDAE

1. *Clubiona bengalensis* sp. nov. (Figs. 1-3)

General : Cephalothorax and abdomen greyish to cream colour, legs light brown. Total length 6.70 mm. Carapace 2.50 mm. long, 1.80 mm. wide ; abdomen 4.20 mm. long, 2.80 mm. wide.

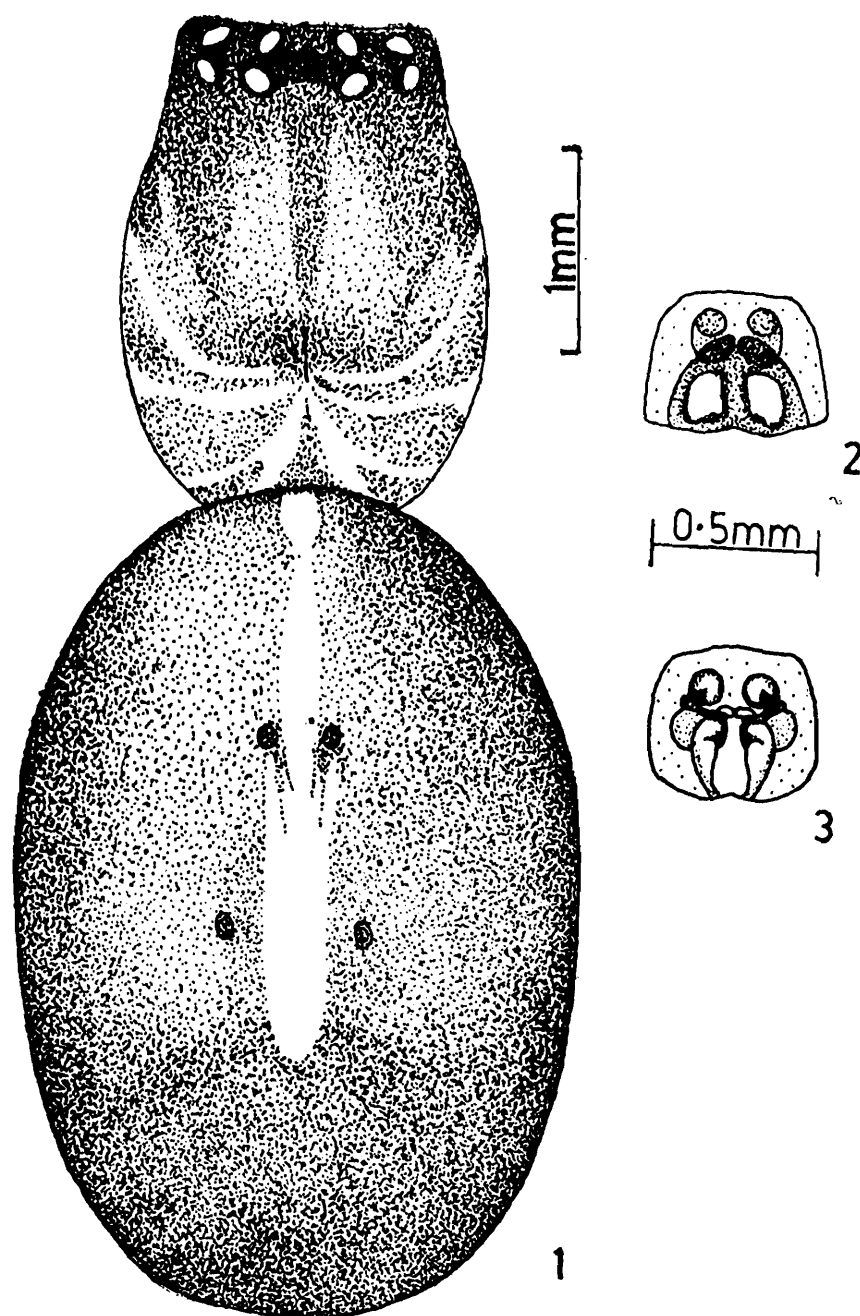
Cephalothorax : Longer than wide, wider in front, clothed with fine hair and some spine-like hair ; convex cephalic region slightly higher than posterior region. Eyes pearly

white, posterior row slightly longer and pro-curved, anterior row nearly straight. Ocular quad wider than long and wider in behind, all eyes nearly of same size. Middle of cephalothorax provided with prominent fovea. Chelicerae strong, vertical and dark brown in colour, inner margin provided with two teeth and outer margin with one. Maxillae and labium provided with deep brown colour, anterior margin with conspicuous scopulae. Sternum nearly heart-shaped, longer than wide clothed with fine hair. Legs strong, stout, clothed with hair. Posterior legs longer than anterior legs. Tibiae I and II provided with two pairs of ventral spines and metatarsi and tarsi also provided with ventral scopulae.

Abdomen : Longer than wide, oval in shape, clothed with pubescence. Two pairs of sigilla present on the dorsum. Ventral side uniform pale colour. Epigyne and internal genitalia as in figs. 2-3.

Holotype : Female in spirit, deposited at Z.S.I., Calcutta, Regd. Nos. 5113-14/18.

Paratype : Five females, from paddy field, Assam, India, August, 1983, Coll. *N. Krishnasamy*.



Figs. 1-3. 1. Dorsal view of female, legs omitted. 2. Epigyne. 3. Internal genitalia.

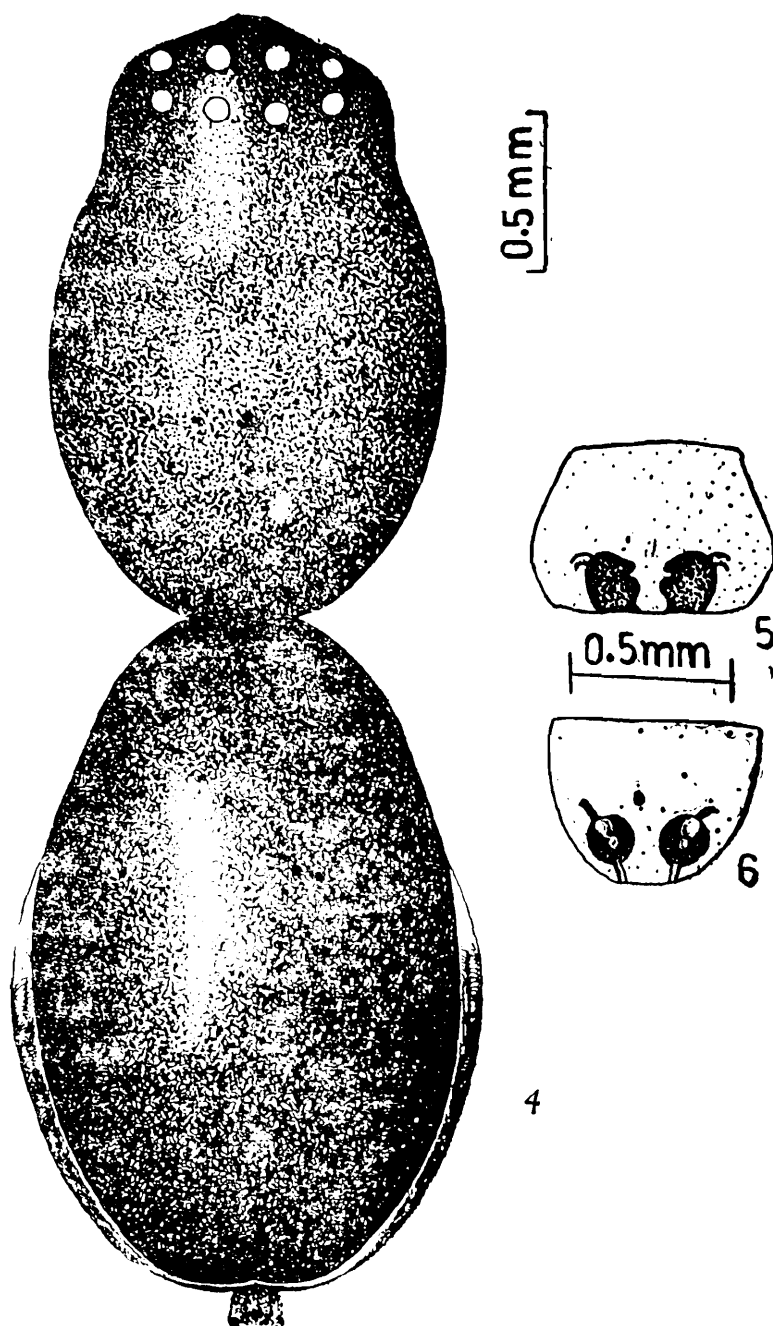
Type-locality : The Agri-Horticultural Society of India-garden, 1, Alipore Road, Calcutta, India, 15-9-1981, Coll. *Bijan Biswas*.

This species in general resembles *Clubiona ludhianaensis* Tikader, but it is separated as follows : (i) Inner margin of chelicerae provided with two teeth and outer margin with one but in *C. ludhianaensis* inner margin of chelicerae provided with two and outer

margin with three. (ii) Presence of two pairs of sigilla but in *C. ludhianaensis* no such sigilla. (iii) Epigyne and internal genitalia also structurally different.

2. *Castianeira bengalensis* sp. nov.
(Figs 4-6)

General : Cephalothorax and abdomen with shiny deep brown to chocolate colour,

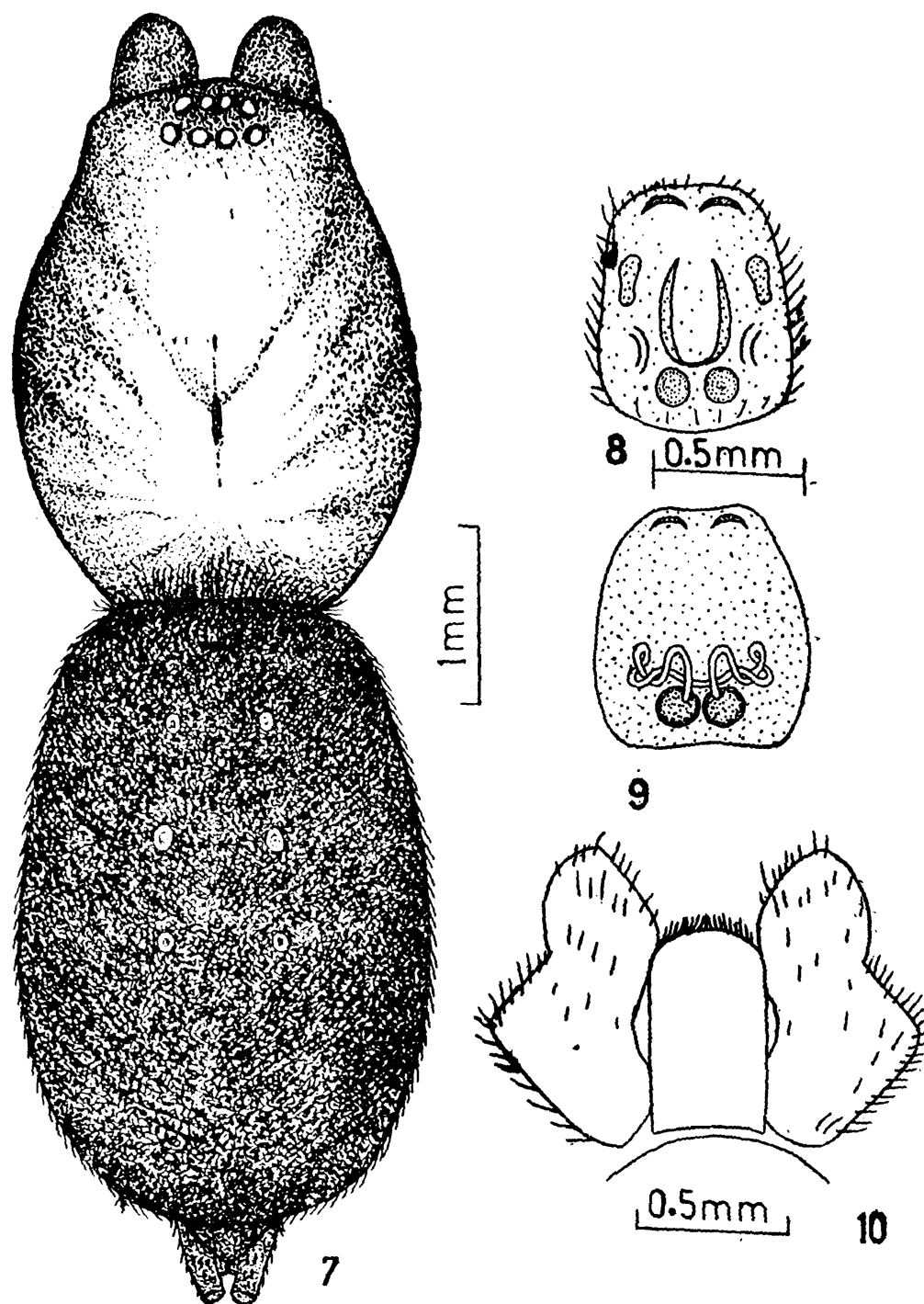


Figs. 4-6. 4. Dorsal view of female, legs omitted. 5. Epigyne. 6. Internal genitalia.

legs are brown. Total length 3.90 mm. Carapace 1.80 mm. long, 1.30 mm. wide; abdomen 2.10 mm. long, 1.50 mm. wide.

Cephalothorax: Nearly oval, longer than wide and wider in front, cephalic region slightly high, clothed with fine pubescence. Posterior of cephalo thorax provided with a fovea. Eyes round and silvery white. Anterior

row slightly recurved and medians larger than laterals and pearly white. Posterior row procurved and all eyes nearly same size. Ocular quad slightly longer than wide and wider behind. Chelicerae strong, inner margin with five teeth and outer margin with three. Maxillae and labium longer than wide, anterior end of maxillae provided with



Figs. 7-10. 7. Dorsal view of female, legs omitted. 8. Epigyna.
9. Internal genitalia. 10. Labium and maxillae.

scopulae. Sternum heart-shaped, pointed behind deep brown and clothed with hair. Legs long and slender, clothed with hair and spines. Tibiae and metatarsi of I and II provided with seven and five pairs of ventral spines respectively.

Abdomen: Longer than wide, narrowing in front, clothed with pubescence. Nearly total area of the dorsal side provided with large sclerotized scutum as in fig. 4. Ventral side, light brown to whitish, white and brown lines extending from epigastric fold

to near the base of spinnerets. Epigyne and internal genitalia as in figs. 5-6.

Holotype : Female in spirit, deposited at Z. S. I., Calcutta, Regd. Nos. 5115/18 and 5142/18.

Paratype : Two females, from Zoological garden, Alipore, Calcutta, India, 12.3.1984, Coll. Bijan Biswas.

Type-locality : Zoological garden, Alipore, Calcutta, India, 1-9-1982, Coll. Bijan Biswas.

This species in general resembles *Castianeira indica* Tikader, but it is separated as follows : (i) Chelicerae strong, outer margin provided with three and inner margin with five teeth but in *C. indica* outer three and inner margin with six. (ii) Nearly whole area of the dorsum covered with sclerotized scutum but in *C. indica* dorsum sclerotize scutum covered with small area. (iii) Epigyne and internal genitalia also structurally different.

Family GNAPHOSIDAE

3. *Herpyllus calcuttaensis* sp. nov.

(Figs. 7-10)

General : Cephalothorax and legs reddish brown, abdomen black-velvate in colour covered with mousy hair. Total length 4.20mm. Carapace 1.40 mm. long, 1.50mm. wide ; abdomen 2.60 mm. long, 1.65 mm. wide.

Cephalothorax : Longer than wide, oval, slightly narrowing in front, slightly convex, clothed with pubescence and some long hair, posterior middle provided with a conspicuous short fovea. Eyes pearly white, separated, posterior row slightly longer than the anterior row. Anterior row of eyes nearly straight, laterals larger than the medians and close to adjacent medians than to each other. Posterior row of eyes nearly straight, medians

nearly rounded, smaller than the laterals and slightly closer to each other to the adjacent laterals. Median ocular quadrangle longer than wide and wider behind than in front. Chelicerae moderate, vertical inner margin provided with one small tooth and outer margin with three teeth. Maxillae and labium longer than wide, provided with long hair, and anterior end provided with scopulae, shape as in text fig. 10. Sternum deep brown, nearly elliptical, clothed with fine and long hair. Legs relatively long and strong, clothed with hair and spines. Legs formula 4123.

Abdomen : Longer than wide, widest behind the middle clothed with black-velvately mousy hair. Presence of three pairs of sigilla on the dorsum. Ventral side lighter than the dorsal. Epigyne and internal genitalia as in figs. 8-9.

Holotype ; Female in spirit, deposited at the Z. S. I., Calcutta, Regd. No. 5116/18.

Type-locality : Zoological garden, Alipore, Calcutta, India, 1-9-1982 Coll. Bijan Biswas.

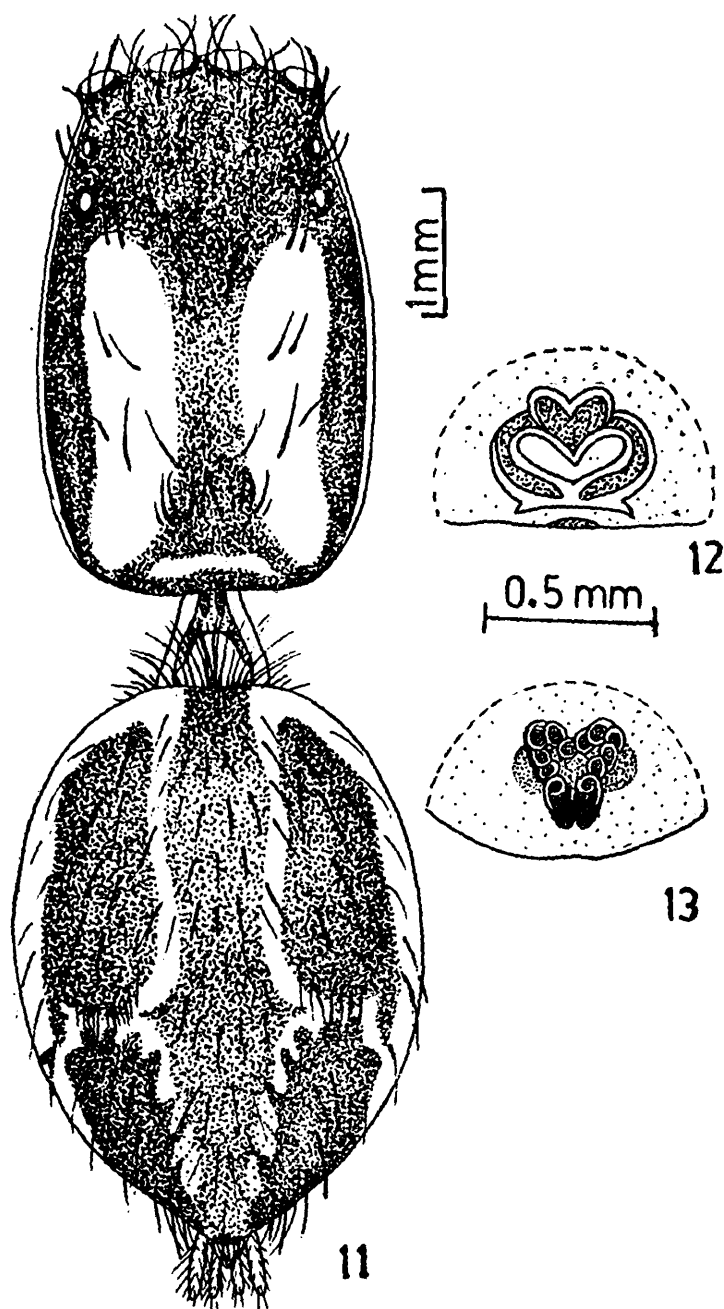
This species resembles *Herpyllus goaensis* Tikader, but differs from it as follows : (i) Abdomen black-velvate, covered with mousy hair but in *H. goaensis* grey and no such mousy hair. (ii) Presence of three pairs of sigilla but in *H. goaensis* no such sigilla. (iii) Epigyne and internal genitalia also structurally different.

Family SALTICIDAE

4. *Phidippus calcuttaensis* sp. nov.

(Figs. 11-13)

General : Cephalothorax and legs brownish red in colour. Total length 7.75 mm. Carapace 3.75 mm. long, 2.75 mm. wide ; abdomen 4.00 mm. long, 2.70 mm. wide.



Figs. 11-13. 11. Dorsal view of female, legs omitted. 12. Epigyne. 13. Internal genitalia.

Cephalothorax : Longer than wide, high in front, posterior and lateral sides sloping. Cephalic region flat, clothed with fine white hair. Anterior medians are milky white and laterals are pearly white. Anterior row of eyes recurved. Bases of all eyes encircled by blackish rim. Anterior and posterior lateral eyes nearly same size. Second pair of eyes

very small and situated near the anterior lateral eyes. Middle of cephalothorax provided with a small deep fovea. Chelicerae with one moderate tooth on inner margin and two small teeth on outer margin. Sternum nearly oval, longer than wide, narrowing in front. Legs clothed with hair and spines, I and II more robust than III and IV.

Tibiae and metatarsi I and II provided with three and two pairs of ventral spines respectively.

Abdomen : Longer than wide and pointed behind, clothed with spine-like hair. White and brownish black decorated patches on the dorsum. Anteriorly presence of two pairs of sigilla. Ventral side creamy-white. Epigyne and internal genitalia as in figs. 12-13.

Holotype : Female in spirit, deposited at Z.S.I., Calcutta, Regd. No. 5117/18.

Type-locality : Zoological garden, Alipore, Calcutta, 4-1-1982. Coll. *Bijan Biswas*.

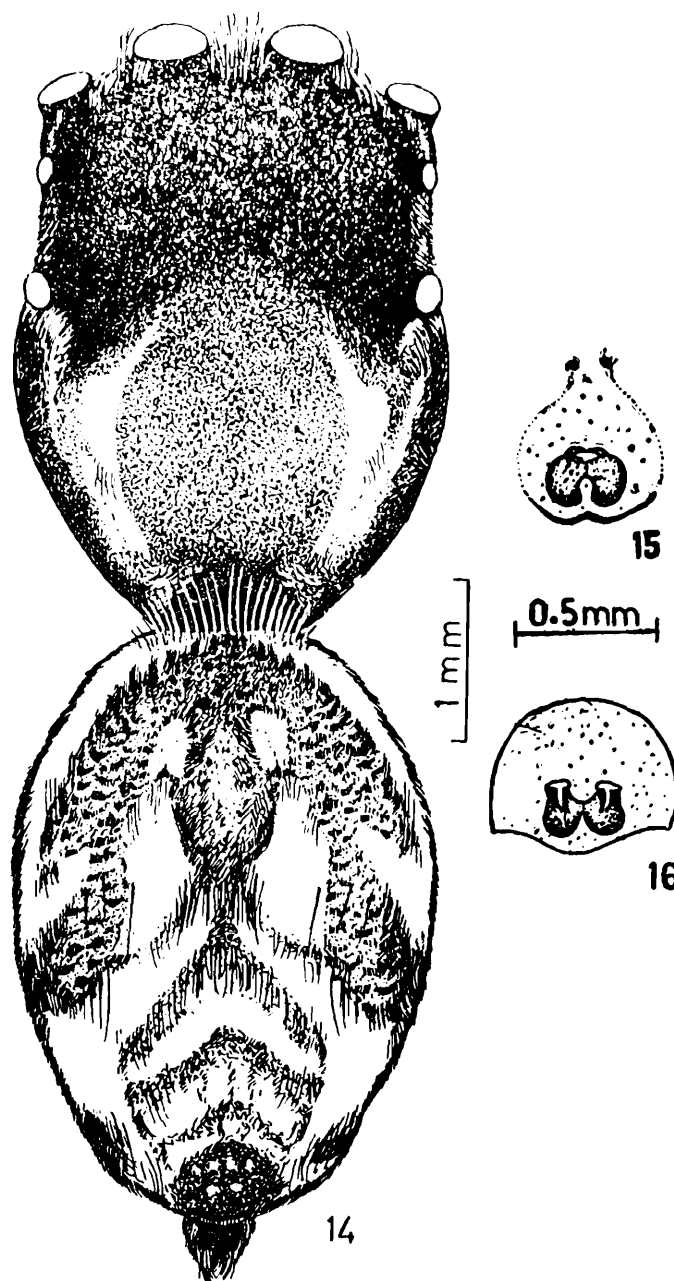
This species resembles *Phidippus bengalensis* Tikader but can be separated as follows : (i) Colour pattern of abdomen different. (ii) Presence of two pairs of sigilla but in *P. bengalensis* with one pair of sigilla. (iii) Epigyne and internal genitalia also structurally different.

5. *Marpissa tikaderi* sp. nov. (Figs. 14-16)

General : Cephalothorax, legs and abdomen are deep brown to light brown in colour. Total length 10.30 mm. Carapace 4.40 mm. long, 2.90 mm. wide ; abdomen 5.00 mm. long, 3.40 mm. wide.

Cephalothorax : Longer than wide, deep brown. clothed with black and spine-like hair. Cephalic region flat with a conspicuous pale, nearly two longitudinal bars extending from posterior row of eyes to end of the cephalothorax and with a small fovea. Eyes of anterior row recurved and anterior median eyes nearly four times longer than the lateral eyes. Middle row of eyes small and situated nearly equidistant from anterior and posterior laterals. Base of the eyes encircled by white mousy hair. Posterior lateral eyes slightly smaller than the anterior lateral eyes. Cheli-

cerae moderately strong and with one tooth on outer margin. Labium longer than wide, maxillae broad in front and provided with scopulae. Sternum elliptical, clothed with fine hair and spines. Legs formula 4312. Tibiae and metatarsi of I and II provided with three and two pairs of ventral spines respectively.



Figs. 14-16. 14. Dorsal view of female, legs omitted.
15. Epigyne.
16. Internal genitalia.

Abdomen : Longer than wide, narrowing behind, clothed with fine and few coarse hair. Dorsum provided with two longitudinal conspicuous deep brown bands extending from base to the end of abdomen and middle of it divided transversely by white band. Presence of two pairs of sigilla on the

dorsum. Ventral side pale colour. Epigyne and internal genitalia as in figs. 15-16.

Holotype : Female in spirit, deposited at Z.S.I., Calcutta, Regd. No. 5118/18.

Type-locality : Zoological garden, Alipore, Calcutta, 4-1-1982. Coll. *Bijan Biswas*.

This species resembles *Marpissa anusuae* Tikader & Biswas but differs from it as follows : (i) Presence of two longitudinal bars extending from posterior row of eyes to end of the cephalothorax but in *M. anusuae* there is a square-shaped conspicuous pale patch on the middle of thorax. (ii) Tibiae and metatarsi of I and II provided with three and two pairs of ventral spines but in *M. anusuae* with four and two pairs of ventral spines. (iii) Epigyne and internal genitalia also structurally different.

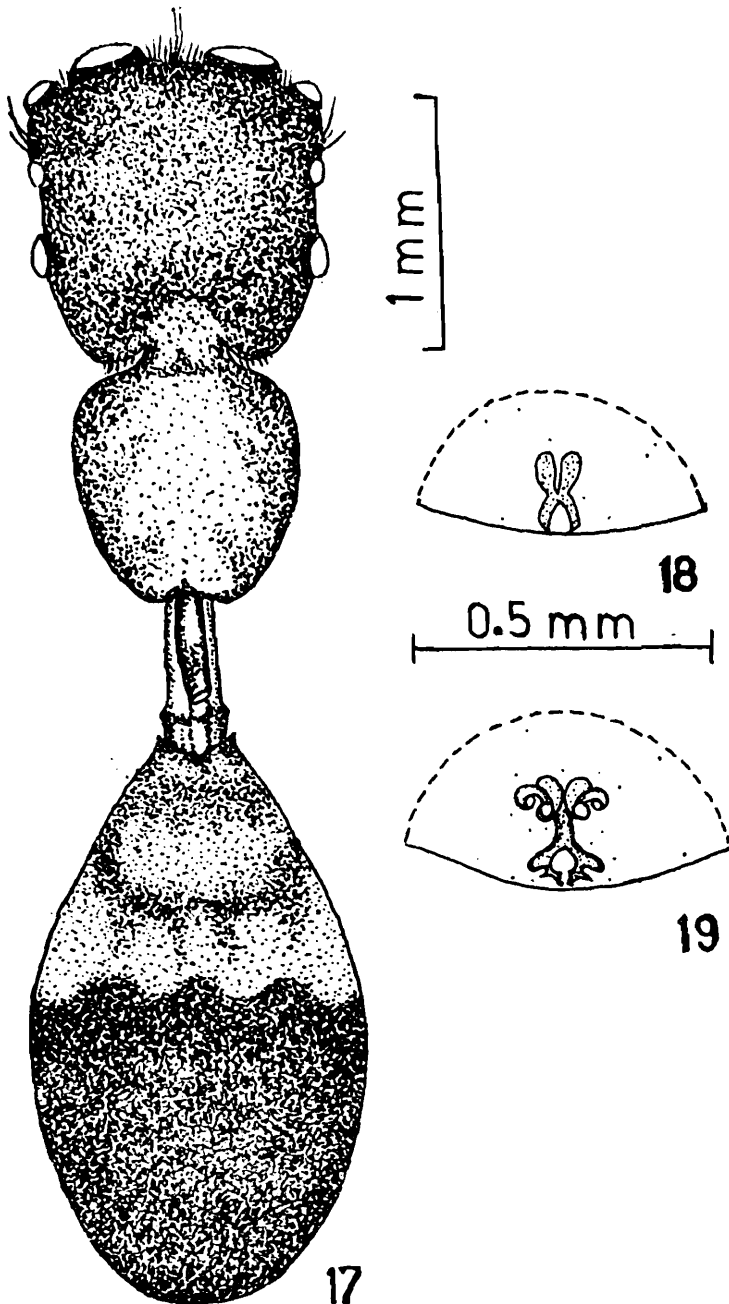
6. *Myrmarachne calcuttaensis* sp. nov.

(Figs. 17-19)

General : Cephalothorax deep brown to light brown in colour, legs and abdomen blackish grey. Total length 5.10 mm. Carapace 2.20 mm. long, 1.10 mm. wide ; abdomen 2.30 mm. long, 1.30 mm. wide.

Cephalothorax : Longer than wide clothed with fine grey hair. Cephalic region high and flat. Cephalic and thoracic junction very much constricted and thoracic region sloping behind as in Fig. (17). Anterior row of eyes slightly procurved. Ocular trapezium wider than long. Sternum long and narrow. Legs thin and long clothed with fine hair. I and II pairs of legs pale in colour and provided with conspicuous blackish markings, III and IV pairs of legs blackish brown colour, legs formula 4312.

Abdomen : Longer than wide and posterior end wider than anterior end and clothed



Figs. 17-19. 17. Dorsal view of female, legs omitted.
18. Epigyne.
19. Internal genitalia.

with fine pubescence. Ventral side slightly pale colour than the dorsal side. Pedicel not very long. Epigyne and internal genitalia as in figs. 18-19.

Holotype : Female in spirit, deposited at Z. S. I., Calcutta, Regd. No. 5119/18.

Type-locality : Zoological garden, Alipore, Calcutta, 4-1-1982. Coll. *Bijan Biswas*.

This species resembles *Myrmarachne bengalensis* Tikader but separated as follows : (i) Body colour is different. (ii) Markings and colour pattern of the legs are different from *M. bengalensis* (iii) Epigyne and internal genitalia also structurally different.

ACKNOWLEDGEMENT

My thanks are due to Dr. B. K. Tikader, Director, Zoological Survey of India, for encouragement and offering useful suggestions during the preparation of this paper. Thanks are also due to Dr. S. K. Bhattacharya, Deputy Director and Dr. S. K. Gupta, Superintending Zoologist for suggestions.

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DESCRIPTION OF TWO NEW SPECIES OF JUMPING SPIDERS OF THE GENUS *MARPISSA* (FAMILY : *SALTICIDAE*) FROM INDIA.

BIJAN BISWAS AND KAJAL BISWAS
Zoological Survey of India, Calcutta

ABSTRACT

The two new species of spiders, described in this paper, were collected from Calcutta. The new species belong to the genus *Marpissa* Koch.

INTRODUCTION

Spiders of the family Salticidae in India have not received much attention in the past. The *Fauna of British India, Arachnida* by Poccock (1900) contains no reference of this family. But Narayan (1915) and Dyal (1935) had taken some interest on the Salticid spiders. Recently Tikader (1965-1974, 1977 and Tikader & Biswas 1981) described twenty five species of Salticids from India.

While examining the spider collection made by one of us (KB) from Calcutta, West Bengal, we came across two new species of spiders of the genus *Marpissa*, which are described in this paper.

All the type specimens will, in due course, be deposited in the collection of the Zoological Survey of India, Calcutta.

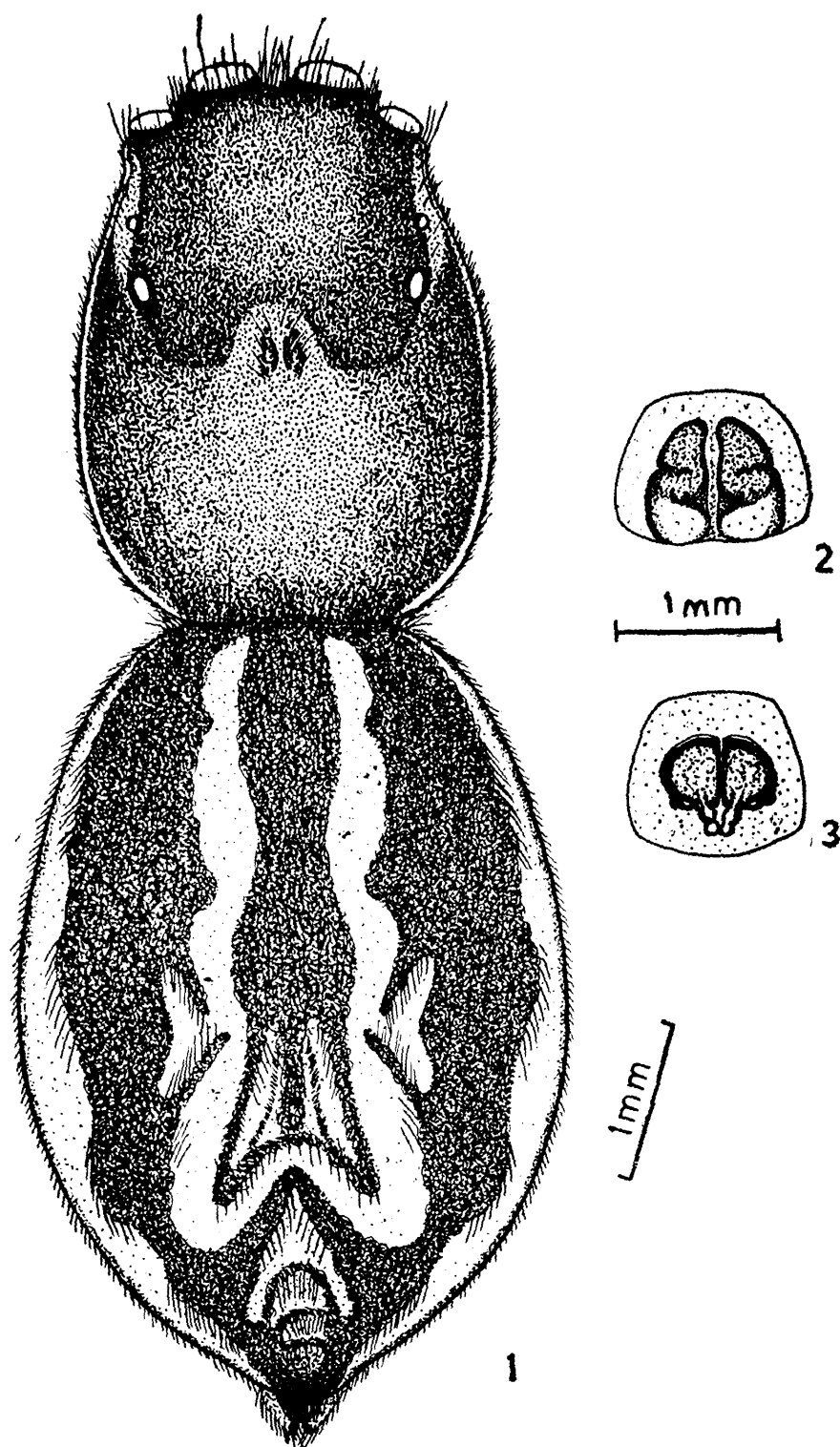
1. *Marpissa prathamae* sp. nov.

(Figs. 1-3)

General : Cephalothorax deep brown, abdomen and legs greenish pale in colour. Total length 8.40 mm. Carapace 3.30 mm. long, 2.50 mm. wide ; abdomen 5.10 mm. long, 3.40 mm. wide.

Cephalothorax : Longer than wide, deep brown, clothed with white and few pale hair. Cephalic region flat, and with a small fovea. Eyes of anterior row recurved and anterior median eyes nearly four times larger than the lateral eyes. Middle row of eyes small and situated nearly equidistant from anterior and posterior laterals. Base of eyes encircled by brown patch. Posterior lateral eyes slightly smaller than the anterior lateral eyes. Chelicerae moderately strong and with one tooth on the inner margin and two small teeth on the outer margin. Labium longer than wide, maxillae broad in front and provided with scopulae. Sternum elliptical, clothed with long grey hair. Legs moderate, strong, clothed with hair and spines. Legs formula 4132. Tibiae and metatarsi of I and II provided with three and two pairs of ventral spines respectively.

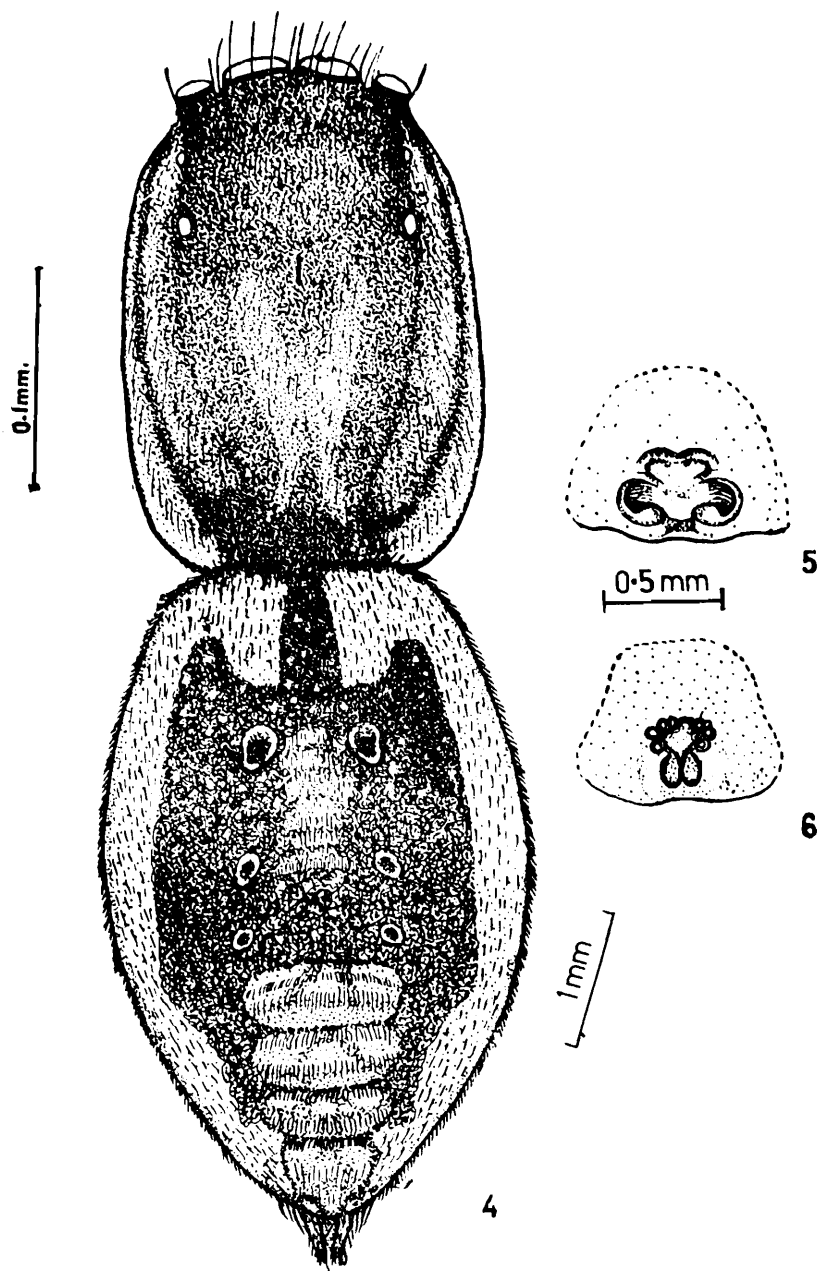
Abdomen : Longer than wide, narrowing behind, clothed with 'spine-like blackish and grey hair. Dorsum provided with three longitudinal conspicuous deep brown-blackish bands extending to base to the end of abdomen. Ventral side with light-grey and blackish in colour. Epigyne and internal genitalia as in figs. 3-4.



Figs. 1—3. 1. Dorsal view of female, legs omitted.
2. Epigyne.
3. Internal genitalia.

Holotype: Femal in spirit deposited at Z. S. I., Calcutta, Regd. Nos. 5121/18 and 5143/18.

Paratype: One female, from Gangasagar, Dist. 24-Parganas, West Bengal, 20.3.1984, Coll. Bijan Biswas,



Figs. 4—6. 4. Dorsal view of female, legs omitted.
5. Epigyne. 6. Internal genitalia.

Type-locality : Kalupara, near Ballygunge Rly. Station, Calcutta, 7-9-1982. Coll. *Kajal Biswas*.

This species resembles *Marpissa anusuae* Tikader & Biswas but can be separated as follows: (i) Dorsum provided with three longitudinal conspicuous deep brown-blackish bands but *M. anusuae* with two bands. (ii) Chelicerae provided with one tooth on

the inner margin and two small teeth on the outer margin. (iii) Epigyne and internal genitalia also structurally different.

2. *Marpissa nutanae* sp. nov.

(Figs. 4-6)

General : Cephalothorax, abdomen and legs light brown in colour. Total length 8.50 mm. Carapace 3.50 mm. long, 2.60 mm.

wide ; abdomen 5.00 mm. long, 3.00 mm. wide.

Cephalothorax : Longer than wide, cephalic region flat, middle of cephalothorax provided with a small deep fovea, one-third of the posterior portion of cephalothorax abruptly slope behind. Eyes are transperent and anterior median eyes nearly four times larger than the lateral eyes. Anterior row of eyes recurved. Middle row of eyes small and situated nearly equidistant from anterior-lateral eyes. Anterior lateral eyes slightly larger than posterior lateral eyes. Cephalothorax clothed with thick white and few spine-like hair. Chelicerae with one tooth on the outer margin. Sternum oval, narrow in front, clothed with spine-like hair. Legs strong and stout, clothed with hair and spines. Legs formula 4312. Tibiae and metatarsi of I and II provided with three and two pairs of ventral spines respectively.

Abdomen : Longer than wide, narrowing in behind, clothed with brown and black hair. Dorsum provided with three pairs of sigilla. Anterior part of the dorsum there is some white dots. Ventral side pale in colour clothed with fine hair. Epigyne and internal genitalia as in figs. 5-6.

Holotype : Female in spirit deposited at Z. S. I., Calcutta, Regd. No. 5122/18.

Type-locality : Kalupara, near Ballygunge Rly. Station, Calcutta, 7-9-1982. Coll. *Kajal Biswas*.

This species resembles *Marpissa calcuttaensis* Tikader but it is separated as follows : (i) Whole body is covered with thick hair but in *M. calcuttaensis* there is no thick hair covered the body. (ii) Chelicerae with one

tooth on the outer margin but in *M. calcuttaensis* with two similar smaller teeth on the outer margin. (iii) Epigyne and internal genitalia also structurally different.

ACKNOWLEDGEMENT

Our thanks are due to Dr. B. K. Tikader, Director, Zoological Survey of India, for encouragement and offering useful suggestions during the preparation of this paper. Thanks are also due to Dr. S. K. Bhattacharya, Deputy Director, Dr. S. K. Gupta, Superintending Zoologist for suggestions.

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DESCRIPTION OF A NEW SPECIES OF SPIDER
(ARANEIDAE : LARINIA) FROM INDIA

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ABSTRACT

A new species under the genus *Larinia* Simon has been described and illustrated. This new species dealt with in this paper is the third species under this genus described from the Indian Sub-continent.

INTRODUCTION

The spider of the family Araneidae have received attention very recently by Tikader (1960-1982). The *Fauna of India* (Family : Araneidae) has been published by Tikader (1982) after the *Fauna of British India, Arachnida*, by Pocock (1900). Though the Araneidae spiders are abundant in our country. While examining the retained specimen which was received from Dr. N. P. Jaysankar, C.P.C.R.I., Kerala, and our old collection lying in the Arachnida Section, I came across a new species of spider of the genus *Larinia* which is described in this paper and this is the third species described from the Indian Sub-continent.

All the type specimens are deposited in the National Zoological collection of the Zoological Survey of India, Calcutta.

Larinia Simon

1874. *Larinia* Simon, *Ar. Fr.*, 1 : 115.
1871. *Epeira* : Koch, *Ar. Austr.*, : 130.
1970. *Larinia* : Grasshoff, *Senckenberg, biol.*, 51 (3-4) : 220-225.

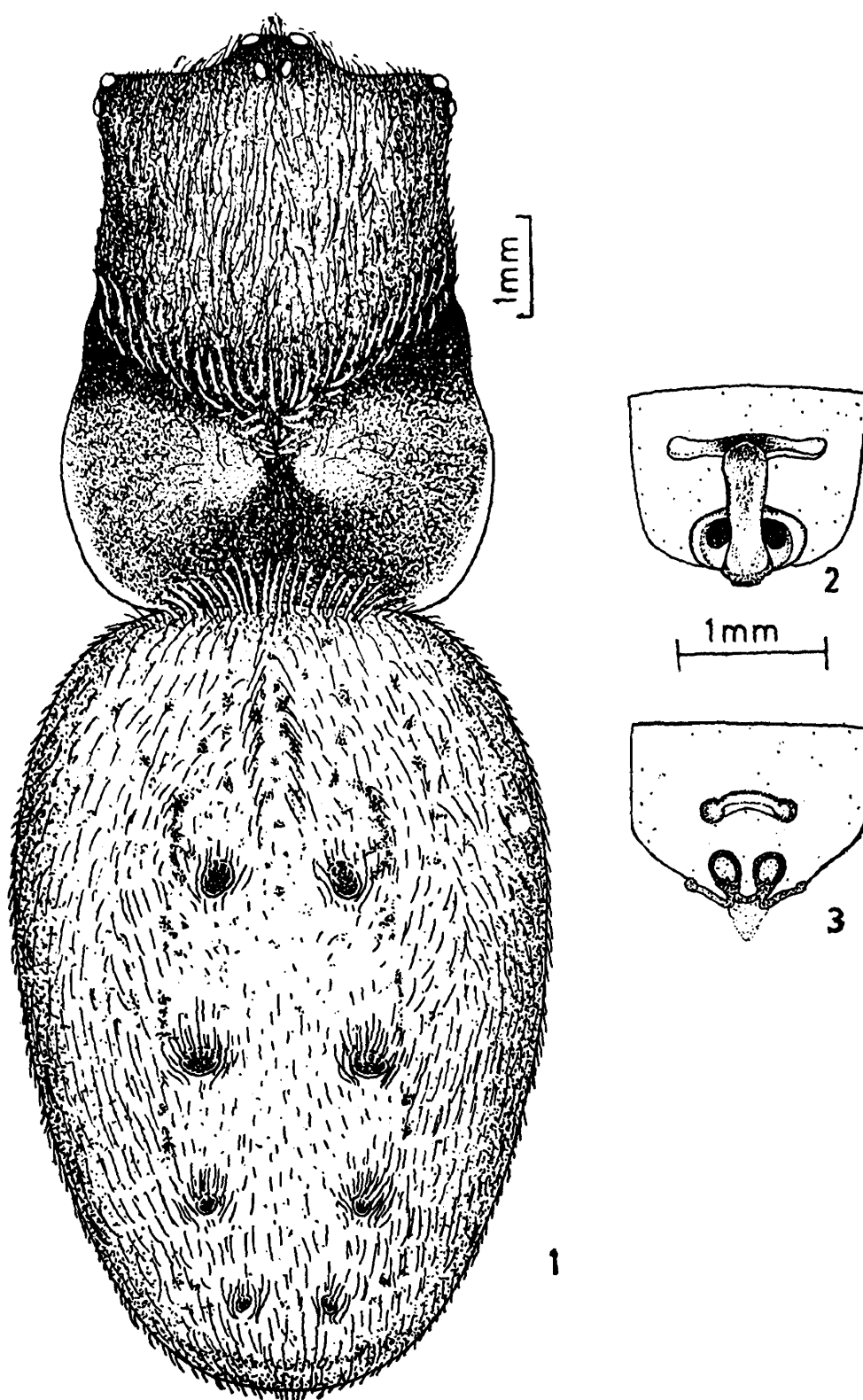
1972. *Drexelia* : Kaston, *How to know the spiders* : 153.
1975. *Larinia* : Patel, *Oriental Ins.*, 9 (1) : 111-116.
1975. *Larinia* : Levi, *Bull. Mus. comp. Zool. Harv.*, 147 (3) : 102.
1981. *Larinia* : Tikader & Biswas, *Rec. zool. Surv. India, Occ.*, pp. 30 (1) : 43-44.
1982. *Larinia* : Tikader, *Fauna of India, Spiders* (Family : Araneidae : Araneae) II (1) : 205.

Characters : Carapace rather long, scarcely convex posteriorly. Ocular quad forming a trapezium, nearly twice as wide in front than behind ; lateral eyes subequal in size and very close. Maxillae longer than wide. Legs long and slender. Abdomen elongated with a single median blunt point in front and no caudal process, ventral side with a longitudinal white band guarded laterally by black patches between epigastric furrow and spinnerets. Males with palpal patella bearing two heavy curved spines at the apex.

Larinia jaysankari sp. nov. (Figs. 1-3)*

General : Cephalothorax redish brown, abdomen yellow ochre and legs yellowish.

*It is with much pleasure that I name this species after Dr. N. P. Jaysankar, Joint Director, C. P. C. R. I., Kerala, who kindly collected this spider and disposed it for my study.



Figs. 1-3. 1. Dorsal view of female, legs omitted.
 2. Epigyne.
 3. Internal genitalia.

Total length 14.00 mm. Carapace 5.80 mm. long, 4.50 mm. wide ; abdomen 8.20. mm. long, 5.40 mm. wide.

Cephalothorax : One and half times longer than wide, narrowing in front, clothed with white hair anteriorly cephalic region high

and sharply distinct from thoracic region, behind the posterior median eyes a double line running and ends before the deep longitudinal thoracic furrow. Ocular quad forming a trapezium, wider in front than behind; medians much larger than posterior medians; posterior medians closely situated; laterals subequal, closed and situated on distinct tubercles; both rows of eyes recurved but posterior row very narrowly recurved than anterior row. Sternum rather elongated heart-shaped, pointed behind, clothed with white hair; labium as long as wide, brownish with proximal white border. Maxillae as long as wide, redish brownish, provided with distinct scopulae. Chelicerae strong and stout blackish brown, inner margin with three and outer margin with five teeth. Legs long and slender, clothed with hair and spines. Male not reported.

Abdomen : Elongated, slightly more than two times longer than wide, clothed with white pubescence and hair. Dorsum of abdomen yellowish ochre with four pairs of sigilla. Ventral side provided with segmented area which covered the spinnerets to epigastic furrow and guarded by two white longitudinal bars. Epigyne having a large scape with concave tip. Internal genitalia as in text fig. 3.

Holotype : Female (left chelicerae broken); paratype two females, one from Durgapur, Calcutta and another from Gmatia, Birbhum, West Bengal, in spirit, deposited at Z. S. I., Calcutta, Regd. Nos. 5139-41/18.

Type locality : Holotype from Central Plantation Crops Research Institute, Krishnapuram, Kerala, India, September, 1981 Coll. Dr. N. P. Jaysankar.

Paratype from Durgapur, Calcutta, India, 23-5-1914, Coll. F. H. Gravely.

Paratype from Gmatia, Birbhum Dist., West Bengal, India, Coll. *Indian Museum*.

This species in general resembles *Larinia phtisica* (L. Koch), but it is separated as follows: (i) Cephalic region high and distinct from the thoracic region but no such differentiation in *L. phtisica*. (ii) Inner margin of chelicerae provided with three teeth and outer with five but in *L. phtisica* with four teeth. (iii) Epigyne and internal genitalia also structurally different.

ACKNOWLEDGEMENT

My thanks are due to Dr. B. K. Tikader, Director, Zoological Survey of India, for encouragement and offering useful suggestions during the preparation of this paper. Thanks are also due to Dr. S. K. Bhattacharya, Deputy Director, Dr. S. K. Gupta, Superintending Zoologist for suggestions and to Dr. N. P. Jaysankar for supplying the material.

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NEW RECORDS OF HOST-PLANTS AND DISTRIBUTION OF SOME COCCIDS FROM INDIA (HOMOPTERA : COCCOIDEA)

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ABSTRACT

Seven new host-plants and 14 new localities of occurrence have been reported for 12 species of coccids from India. Notes on known distribution and hostplants of these species have been added.

INTRODUCTION

The Coccid fauna of the Indian region is inadequately known. Our present knowledge is based on species reported from Sri Lanka (Green, 1896-1922), South India (Ayyar, 1930), West Bengal (Ghose, 1961), Bihar (Ali, 1968) and many other scattered papers which have been compiled in an Oriental catalogue (Ali, 1969-1971). As these insects, commonly known as scale insects and mealybugs, affect a large number of plants, many of which are of considerable economic importance, it is necessary to keep records of all the host-plants of various species, as well as the records of their distributional range.

While studying the coccid collections received in the Zoological Survey of India, Calcutta, during the last few years, the author has come across certain lots, which have been collected either from certain new host-plants or from new localities. Since most of the coccid species dealt with here are of pest status, their new record on plants like jute, sugarcane, tea and rose etc. attracts attention. Some species are being recorded for the first time from certain states of India.

Family MONOPHLEBIDAE

Drosicha stebbingi (Green)

Monophlebus stebbingii Green in Stebbing, 1902, *Dep. Notes Ins. Forestry* : 135.

Drosicha stebbingi : Ali, 1968, *J. Bombay nat. Hist. Soc.*, 65 (1) : 120.

Material examined : (i) 7 exs. in wet colln., mango tree, Karnal, Haryana, May 1980 (Coll. Dr. O. B. Chhotani); (ii) several exs. in wet colln., *Ficus bengalensis*, Indian Botanic Gardens, Shibpur, Howrah, 21.6.1979 (Coll. R. K. Varshney & B. N. Das).

New records : *Ficus bengalensis* as a host-plant. Besides, it is first record of this species from Haryana and West Bengal States.

Remarks : It is a polyphagous species occurring on mango, *Pyrus*, *Prunus*, *Butea monosperma* etc. in N. India and Pakistan. Earlier '*Ficus* spp.' have been recorded as host of it from Madhya Pradesh.

Some authors have considered *D. stebbingi* and *D. mangiferae* (Green) synonymous, whereas separation of *D. mangiferae* and *D. dalbergiae* (Green) has been questionable (*vide* Ali, 1968).

* Present address : Z. S. I., Desert Regional Station, Jodhpur-342 006,

Icerya formicarum Newst.

Icerya formicarum Newstead, 1897, *Entomologist's mon. Mag.*, **33** : 169.

Icerya formicarum : Rao, 1950, *Indian J. Ent.*, **12** : 54.

Material examined : (i) 4 exs. on 3 slides (badly mounted exs.), host : rose, Sabour (Distt. Bhagalpur, Bihar), 21.1.1976 (Coll. R. P. Sinha) (ZSI Regd. No. 357-359/H 15) ; (ii) several exs. in dry colln. (material misplaced), sugarcane leaf, Insectory, Shahjahanpur (U. P.), 12.10.1956 (Coll. Z. A. Siddiqui) (ZSI Regd. No. 6838/H 7).

New records : Sugarcane as a host-plant. Besides, this species is recorded for the first time from Bihar State (Bhagalpur) and U. P. State (Shahjahanpur).

Remarks : Although not as common as *I. aegyptiaca* (Douglas), it occurs on *Anona*, *Psidium*, crotons etc., in some states of India (Assam, A. P., Karnataka, M. P., Maharashtra, W. Bengal) and Sri Lanka. *Rosa* sp. has been mentioned as its host by Rao (1950). However, it has not been included in sugarcane insects by Box (1953).

Family ORTHEZIIDAE

Orthezia insignis Browne

Orthezia insignis Browne, 1887, *Quekett Micros. Club J.*, (2) **3** : 169.

Orthezia insignis Douglas, 1887, *Entomologist's mon. Mag.*, **24** : 169.

Orthezia insignis : Ghose, 1961, *Indian Agric.*, **5** (1) : 58.

Material examineds : 5 exs. on 2 slides and several exs. in dry & wet colln., *Clerodendron* sp., Samsing (500 m.), N. Bengal, March 1981 (Coll. Dr. R. K. Varshney).

New records : This species is recorded from Samsing forest, near Siliguri (Distt. Darjeeling), for the first time.

Remarks : This species is the only representative of its family found within the Indian region. It has been recorded on large number of host-plants including Lantana, *Hibiscus*, *Ixora*, citrus etc. It has been reported on *Clerodendron* from India and Singapore. Ghose (1961) collected it in W. Bengal from Kalimpong on Lantana, *Gardenia* and compositae plants. The present author also collected it from Kalimpong and Rangpo (Sikkim) on various plants, the details of which will be published in a later contribution on the coccids collected from N. Bengal and Sikkim.

Family CEROCOCCIDAE

Cerococcus indicus (Maskell)

Eriococcus paradoxus Var. *indicus* Maskell, 1897, *Trans. Proc. N. Z. Inst.*, **29** (1896) : 318.

Cerococcus hibisci Green, 1908, *Mem. Dep. Agric. India, ent. Ser.*, **2** (2) : 19,

Cerococcus hibisci : Ali, 1967, *Oriental Ins.*, **1** (1-2) : 29.

Material examined : (i) 4 exs. on a slide, host-Jute (Mesta), Barrackpur, Distt. 24-Parganas, 1972, (Coll. R. L. Tripathi) (ZSI Regd. No. 9373/H 7) ; (ii) Several exs. in wet colln., host : *Hibiscus* spp (2 species), Forest Deptt. garden, near Rly. Stn., Kalyani, 30.8.1979 (Coll. Dr. R. K. Varshney & B. N. Das).

New records : This species is reported here for the first time on the jute plant. This is also its first record from Kalyani (Distt. Nadia), W. Bengal.

Remarks : Ghose (1961) has earlier noticed *C. hibisci* in the districts of 24-Parganas and Burdwan in West Bengal. Besides, it has been reported from Bihar, Maharashtra and South India, and Sri Lanka and Burma,

on *Hibiscus*, *Gossypium* (including cotton), *Tephrosia* etc.

C. hibisci has been synonymized with *C. indicus* (Maskell) by Lambdin & Kosztarab (1977).

Family ASTEROLECANIIDAE

Asterolecanium sp.

Asterolecanium Targioni-Tozzetti, 1868, *Soc. Ital. di Sci. Nat. Atti.*, 11 : 41.

Asterolecanium : Ferris, 1955, *Atlas scale ins. N. Amer.*, 7 : 15.

Material examined : One ex. on a slide and several exs. in wet colln., Host : Tea, Darjeeling (W. Bengal), Aug. 1981 (Coll. Dr. S. M. Mukherjee) (ZSI Regd. No. 884/H 15).

New records : This is the first record of an *Asterolecanium* on the tea plant. This is also first record of this genus from North Bengal hills (Darjeeling).

Remarks : A close species, *Cerococcus ficoides* (Green), has been reported earlier on tea in 1903 by Watt & Mann, but it was not found by Das & Ganguli (1961) in their exhaustive studies from N. E. India.

This genus is represented in all zoo-geographical regions of the world, but out of a total of 19 species recorded from the Indian subcontinent, only 4 species have so far been collected from India proper (*vide* Ali, 1971). Material of the present lot requires further study for the specific identification. However, for generic determination, I considered the presence of 8-shaped geminate pores on the margin reliable.

Family PSEUDOCOCCIDAE

Ferrisia virgata (Ckll.)

Dactylopius virgatus Cockerell, 1893, *Entomologist*, 26 : 178.

Ferrisia virgata : Ali, 1970, *Indian Mus. Bull.*, 5 (2) : 108.

Ferrisia virgata : Williams, 1970, *Bull. ent. Res.*, 60 : 189.

Material examined : (i) 6 exs. on 3 slides, *Rosa indica*, Baruipur (24-Parganas, W. Bengal), 27.11.1977 (coll. B. N. Das) (ZSI Regd. No. 702-704/H 15) ; (ii) 39 exs. on 12 slides, *Croton* sp., Dum Dum airport runway, Calcutta (W. B.), 3.12.1977 (coll. B. N. Das) (ZSI Regd. No. 705-716/H 15) ; (iii) 49 exs. on 12 slides, *Nerium odorum*, Park Street, near St. Xavier's College, Calcutta, 12.3.1979 (coll. B. N. Das) (ZSI Regd. No. 717-728/H 15).

New records : *Nerium odorum* and *Rosa indica* are new host-plants for this species.

Remarks : This is a highly polyphagous species which is world-wide in distribution. Ali (1970) states that it may be expected on almost any flowering plant in the tropics. In our country it has been already recorded from Assam, Bihar, W. Bengal, U. P., Maharashtra, and S. India, and also recorded from Maldives Is., Sri Lanka and Bangladesh (Green, 1922 ; Ayyar, 1930 ; Ghose, 1961 ; Ali, 1968, 1970).

Maconellicoccus hirsutus (Green)

Phenacoccus hirsutus Green, 1908, *Mem. Dept. Agric. India, ent. Ser.*, 2 (2) : 25.

Phenacoccus hirsutus : Ali, 1968, *J. Bombay nat. Hist. Soc.*, 65 (1) : 127.

Maconellicoccus hirsutus : Williams, 1970, *Bull. ent. Res.*, 60 : 149.

Material examined : One ex. (immature), cotton plant, Ludhiana, 20.11.1976 (coll. R. K. Dhawan) (ZSI Regd. No. 352/H 15).

New records : This species is recorded here for the first time from Punjab State.

Remarks : Commonly found on *Hibiscus* plants, this mealybug has also been reported

on *Tectona*, *Morus*, *Ficus* etc. In our country it is so far recorded from Bihar and Calcutta (Ali, 1970). Its record on Sugarcane from India was reported doubtful by Williams (*loc. cit.*). It was recorded on cotton from Pusa, Bihar by Misra (1924).

***Planococcus lilacinus* (Ckll.)**

Pseudococcus lilacinus Cockerell, 1905, *Proc. Davenport Acad. Sci.*, 10 : 128.

Planococcus lilacinus : Ali, 1970, *Indian Mus. Bull.*, 5 (2) : 90.

Material examined : 5 exs. on 3 slides (all exs. damaged and badly mounted), Trichur, Kerala (coll. Dr. C. C. Abraham) (ZSI Regd. No. 349-351/H 15).

New records : This is first record of this species from Kerala State.

Remarks : There is no indication of host-plant with the material reported here. However, it is a well known mealybug pest of many plants including pomegranate, sapota, *Mallotus*, *Gardenia* etc. In S. India this species is already reported from Coimbatore (Tamil Nadu) and Alamanda, Vizagapatnam District (Andhra Pradesh) (Ayyar, 1930). Present record extends its range to Kerala. Outside S. India, it has been reported from Calcutta in our country.

Incidentally it may be reported that in the Index of Oriental catalogue, this species has been shown belonging to '*Planococcus*' (Ali, 1971 : 70), which is unintentional error for *Planococcus*.

Family COCCIDAE

***Chloropulvinaria polygonata* (Ckll.)**

Pulvinaria polygonata Cockerell, 1905, *Proc. Davenport Acad. Sci.*, 10 : 131.

Pulvinaria cellulosa Green : Ghose, 1961, *Indian Agric.*, 5 (1) : 65.

Chloropulvinaria polygonata : Ali, 1971, *Indian Mus. Bull.*, 6 (2) : 47.

Material examined : 11 exs. on 4 slides, Mango tree, Visva Bharati, Santiniketan (Distt. Birbhum), 5.4.1971 (Coll. A. Chatterjee) (ZSI Regd. No. 10171-10174/H 7).

New records : This species is reported new from Distt. Birbhum in West Bengal.

Remarks : Cockerell described this species in 1905, and not in 1907 as shown in Ali (1971). Originally described from Philippine Islands, this species has been collected in our region from Sri Lanka, Pakistan and India (Bihar, U. P., Orissa, West Bengal). Its well known host-plants are citrus and mango, on which it occurs frequently.

This species and *Pulvinaria cellulosa* Green have been considered identical by various workers. Ghose (*loc. cit.*) noted the latter on mango at Maldah in West Bengal.

***Coccus hesperidum* Linn.**

Coccus hesperidum Linnaeus, 1758, *Syst. Nat.*, 10th ed., 1 : 455.

Coccus hesperidum : Ali, 1971, *Indian Mus. Bull.*, 6 (2) : 24.

Coccus hesperidum : Gill et al., 1977, *Occ. Papers Ent., Calif.*, 24 : 18.

Material examined : 7 exs. on 4 slides, *Lonicera* sp., Srinagar (J. & K.), 8 Aug. 1981, (Coll. R. C. Bhagat).

New records : This species is newly reported on *Lonicera* sp. Besides, it is first record of this pest from Jammu & Kashmir State.

Remarks : This is type-species of the genus *Coccus*, over which Family Coccidae, and later Superfamily Coccoidea, have been erected.

A cosmopolitan species, it is already known to occur in our region from Burma, Sri Lanka, Pakistan and India. Its host-plants run in a long list including important crops like citrus, tea, mango, cashew nut, coconut, red gram etc. In India it has been previously recorded from West Bengal, Bihar, Tripura, Andhra Pradesh, Kerala, Karnataka, Gujarat and Goa.

***Pulvinaria maxima* Green**

Pulvinaria maxima Green, 1904, *Entomologist's mon. Mag.*, **40** : 206.

Pulvinaria maxima : Ayyar, 1930, *Bull. agric. Res. Inst. Pusa*, **197** : 36.

Pulvinaria maxima : Ali, 1971, *Indian Mus. Bull.*, **6** (2) : 50.

Material examined : 19 exs. on 8 slides, *Jatropha pendurifolia*, Subhash Sarovar, Belia-ghata, Calcutta (W. B.), 30.6.1978 (Coll. R. K. Varshney & B. N. Das) (ZSI Regd. No. 694-701/H 15).

New records : This species has not been reported from West Bengal by Ali (1971). Its host-plant species *Jatropha pendurifolia* is also a new record.

Remarks : It has been reported by Ayyar (1930) on '*Jatropha*' from Krishna District (Andhra Pradesh). Other known host-plants include nim (*Melia*) on which it is very common, and mulberry, grape-vine, cotton, kadam etc. The species is distributed in our region over Sri Lanka and South India, with a stray record from Aligarh (U. P.).

Two species *P. thespesiae* Green and *P. burkilli* Green have been suspected as more or less identical with this species, by Ali (*loc. cit.*).

Family DIASPIDIDAE

***Aonidiella aurantii* (Mask.)**

Aspidiotus aurantii Maskell, 1879, *Trans. N. Z. Inst.*, **11** : 199.

Aonidiella aurantii : Takagi, 1969, *Insecta matsum.*, **32** (1) : 82.

Aonidiella aurantii : Ali, 1970, *Indian Mus. Bull.*, **5** (1) : 39.

Material examined : (i) 4 exs. on 4 slides, citrus leaf, Sarol (Chamba Distt., Himachal Pradesh), Jan. 1961 (Coll. A. N. Chowdhuri) ; (ii) 3 exs. on 3 slides, Salem Tabri, Ludhiana, 21.2.1976 (Coll. B. S. Chahal) (ZSI Regd. No. 171-173/H 15).

New records : The species is recorded here for the first time from Himachal Pradesh and Punjab States.

Remarks : Originally described on orange and lemons from Australia and New Zealand, this well known species has been collected on rose bushes, *Citrus* spp. (including pomelo), guava, jasmine, tea, mulberry etc. in our region from Nepal, Burma, Sri Lanka, Pakistan and many parts of India. It has been reported from Punjab region of present Pakistan by Pruthi & Mani (1945).

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I am grateful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta, for providing facilities and encouragement. Sincere thanks are also recorded to Dr. D. J. Williams of the Commonwealth Institute of Entomology, London, and Shri S. M. Ali of our department, for determination of some material.

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ADDITIONS TO TWO SPECIES OF GRASSHOPPERS
(ACRIDIDAE : ORTHOPTERA)

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AND

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(With 19 Figures)

ABSTRACT

Description of the previously undescribed male of *Choroedocus robustus* (Ser., 1839) (Eyprepocnemidinae) and redescription of the species, *Epistaurus sinetyi* Bol., 1902 (Coptacridinae) are given. The differential diagnosis of the species are also given.

INTRODUCTION

While preparing the consolidated faunal information of grasshoppers (43 species and subspecies) from West Bengal it is found that one species of them, *Choroedocus robustus*, described previously only on females contains male specimens which are yet unpublished. Similarly the species, *Epistaurus sinetyi*, though described on both the sexes, is inadequately known. So the opportunity is utilized for describing the former and redescribing the latter. Their differential diagnosis with related species are also pointed out.

W. B. stands for West Bengal.

All the collections were made by the authors.

DESCRIPTION

1. *Choroedocus robustus* (Serville, 1839)
(Figs. 1-10)

Acridium robustum Serville, 1839. *Ins. Orth.*, 647.
no. 7.

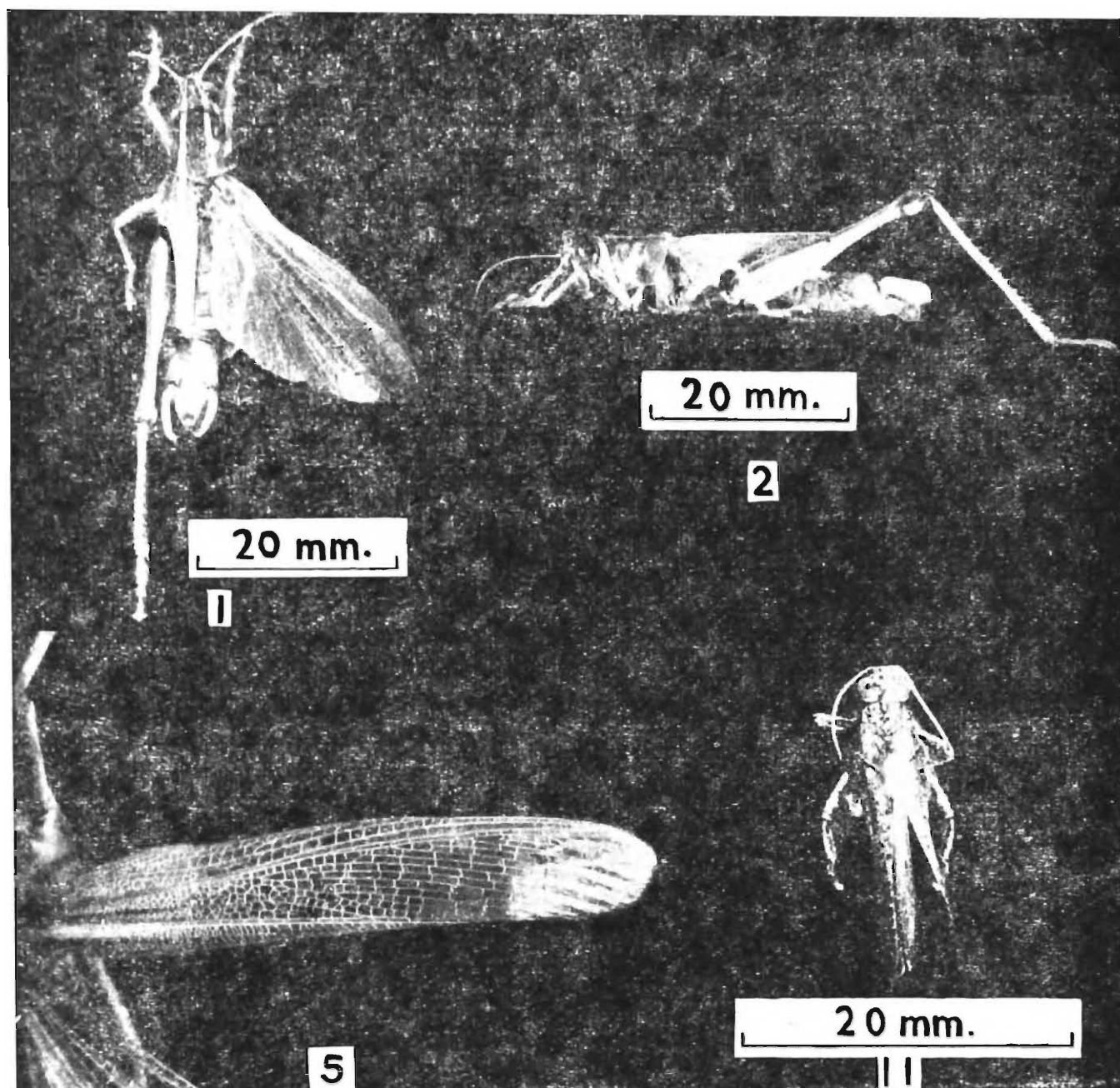
Heteracris ducalis Walker, 1870. *Cat. Derm. Salt. Br. Mus.*, 4 : 663, 665.

Heteracris robusta : Kirby, 1914. *Fauna British India, Orth.*, 1 : 262.

Choroedocus (?) *robustus* : Uvarov, 1921. *Trans. R. ent. Soc. Lond.*, 69 (1 & 2) : 109.

Material : W. B. : 4♂, 3♀ ; Naxalbari, Darjeeling ; 11-12.9.74. 1♀ ; Suklapara, Jalpaiguri ; 29.8.1975. 1♂ ; Bhutan Ghat, Jalpaiguri ; 6.9.1975. 1♂, 3♀ ; Calcutta, (old collection).

Remarks : The species seems to be a very rare one because since its description from Sylhet : Assam (now Bangladesh), though its systematic position has been changed repeatedly, no additional material information has been added. Serville (1839) described the species, on female, basing mainly on colouration. Uvarov (1921) put the species doubtfully in the present genus because he had no male specimen before him. However, he placed it rightly in the present genus. Recently good number of specimens were



Chorodocus robustus, male.

Figs. 1 & 2. Profile, dorsal and lateral respectively.

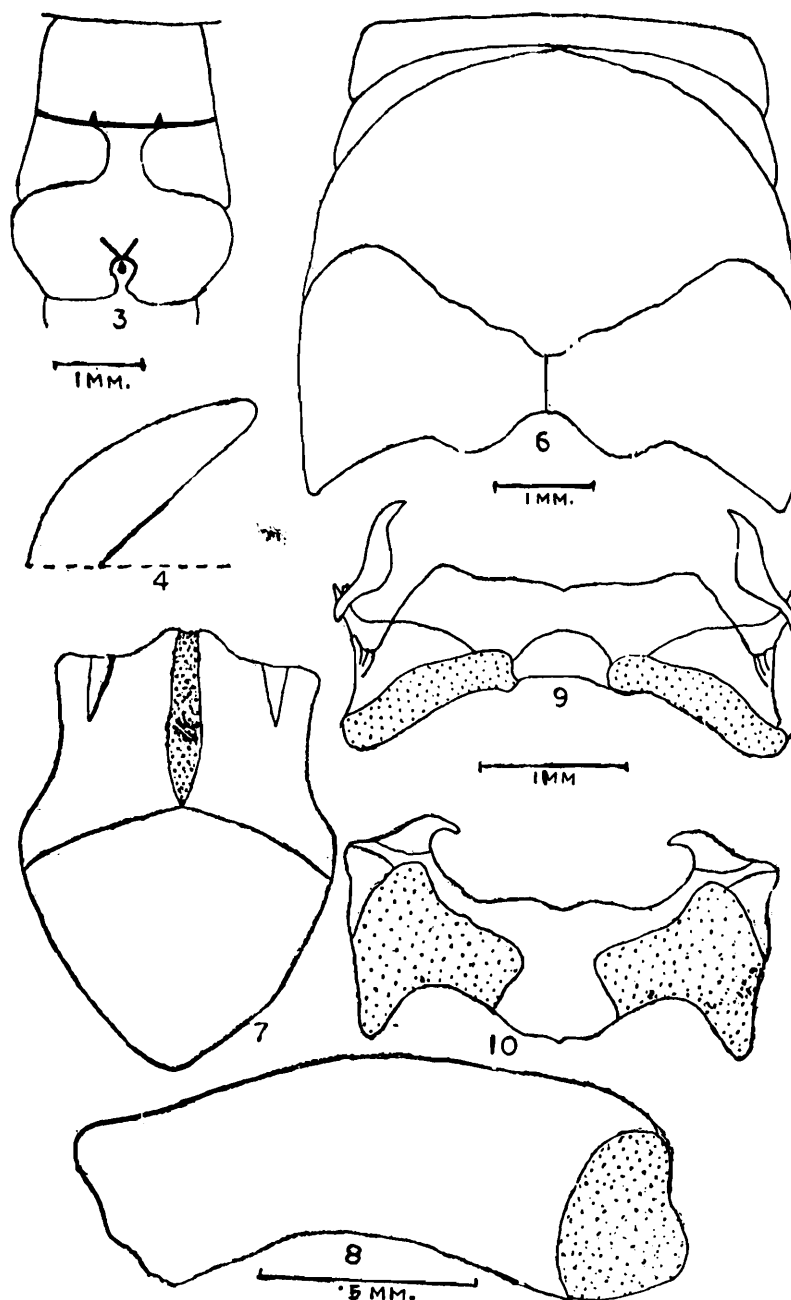
Fig. 5. Elytron.

Epistaurus sinetyi, male.

Fig. 11. Profile, dorsal.

collected comprising of both sexes, from the Eastern Himalaya. Moreover, previously collected material whose locality is mentioned as Calcutta have been examined. Hence the opportunity of describing the male on modern taxonomical trend is utilised here.

Description of male : Body moderately large, shape slender (Figs. 1, 2). Antennae longer than head and pronotum together ; filiform, median segments almost twice as long as wide. Head short, slightly obtuse, occiput short : fastigium of vertex short,



- Fig. 3. Meso- and metasternal plates.
 Fig. 4. Prosternal tubercle, lateral (same scale as Fig. 3).
 Fig. 6. Last abdominal tergite.
 Fig. 7. Supra-anal plate (same scale as fig. 6).
 Fig. 8. Anal cercus.
 Figs. 9 & 10. Epiphallus, dorsal and ventral respectively (same scale).

about as long as wide, shallowly concave, obtusely rounded in front, with a median carinula reaching occiput and in profile sloping down into frontal ridge; frontal ridge flat, surface with punctation, narrowest

between antennae and gradually widening towards clypeus, convex in profile; facial carina strong and straight; interocular distance slightly wider base of fastigium of vertex; eyes prominent, lateral, strongly

elongate. Pronotum weakly tectiform with prominent median carina intersected by all three transverse sulci and with less prominent and slightly divergent lateral carinae which are obliterated in metazona due to coarse punctation; prozona slightly less than twice as long as metazona; lateral pronotal lobes with transverse sulci as usual, surface punctured. Prosternal tubercle (Fig. 4) cylindrical, gradually tapering apically, weakly incurved and pubescent; mesosternal interspace about one third width of a mesosternal lobe, innermargin of latter arcuate; metasternal furcal suture distinct (Fig. 3). Tegmen (Fig. 5) extending well beyond hind knees, almost $4\frac{1}{2}$ times as long as wide, venation as usual. Abdomen with tympanum closed and last two tergites fused and hind margin of last tergite with a pair of small rounded projections medially (Fig. 6). Supraanal plate large, tongue-shaped, in basal half sulcated medially and shallowly depressed laterally, apex broadly rounded (Fig. 7). Subgenital plate gradually tapering apically, distinctly upcurved, hairy, with truncate apex. Cerci very remarkable (Fig. 8): laterally compressed, incurved strongly expanded and widening distally with leaf-like obtuse angular tip. Epiphallus as figured (Figs. 9, 10). Posterior

femora rather slender. Posterior tibiae slightly shorter than posterior femora, with 10-11 internal and 12-13 external spines. Arolium well developed, longer than claws.

Colouration: General colouration agrees fairly well with the description of the female as give by Serville (1839), Walker (1870) (as *Heteracris ducalis*) and Kirby (1914) (as *Heteracris robusta*) with the following exceptions: antennae yellowish; prosternal tubercle greenish yellow; elytron with veins and veinlets in yellow, membrane semitransparent, postcubital area and vannal vein 1 green; hand wing bluish basally; posterior tibia coral red with yellowish white-black tipped tibial spines.

Measurements (in mm): Length of body 43-45; head length 4.25-5.1; maximum width of head 4-5.1; interocular distance 1.95-2; antennal length 18-19; pronotal length 8-8.55; maximum width of pronotum 5-6; minimum width of pronotum 3.1-4; length of prozona 4.65-5; length of metazona 3.15-3.75; length of tegmen 35-37; maximum width of tegmen 6.25-7.1; length of post femur 26-27; length of post tibia 23-24.1.

Differential diagnosis: 1. Resembles those of other two Indian species, *C. illustris*

Measurements (in mm) :

Body parts	♂	♀	Type
Length of body	13.0-13.5	15.0-17.5	12.0-15.0
Length of head	1.0-1.5	2.0-2.2	—
Antenna	7.0-7.5	6.5-7.0	—
Pronotum (a) L. of prozona	2.0-2.2	2.5-2.7	3.0-4.0
(b) L. of metazona	1.5-1.7	1.75-1.9	
Tegmen	11.0-11.2	13.0-13.2	9.0-12.0
Posterior femur	9.0-9.2	10.0-10.2	7.5-10.0
Posterior tibia	8.0-8.5	9.25-9.5	—

(Walker, 1870) and *C. capensis* (Thunberg, 1815) in having body rather compressed laterally; frontal ridge flat, slightly widened towards clypeus and narrowed near fastigium of vertex; pronotum with somewhat tectiform median carina, lateral ones being obsolete in metazona; tegmen and wing long and narrow; anal segment of male abdomen posteriorly inflated; and, male cercus with broadened, compressed and rounded apex.

2. Unspotted tegmina different from those of *C. illustris* and *C. capensis* (both of them with small or large, black or brown spots and points in tegmina).

3. Strongly infumated (except inner margin) wings somehow resemble that of *illustris* (where it is slightly infumated towards foremargin and apex) and different from greyish hyaline wing of *capensis*.

4. Male subgenital plate resembles *capensis* with truncate apex. In *illustris* it is conical.

5. Coral—red colouration of hind tibiae different from those of *capensis* (yellowish) and *illustris* (purplish blue).

6. Unique in form of male cercus (white leaf-like obtuse angular tip).

7. Epiphallus differs from that of other species.

Discussion : An endemic species of the eastern India. The difference of colouration noted in this communication (which is identical for both the sexes) is due perhaps the present study is based on fresh specimens whereas previous workers examined the dried up material.

2. *Epistaurus sinetyi* Bolivar, 1902

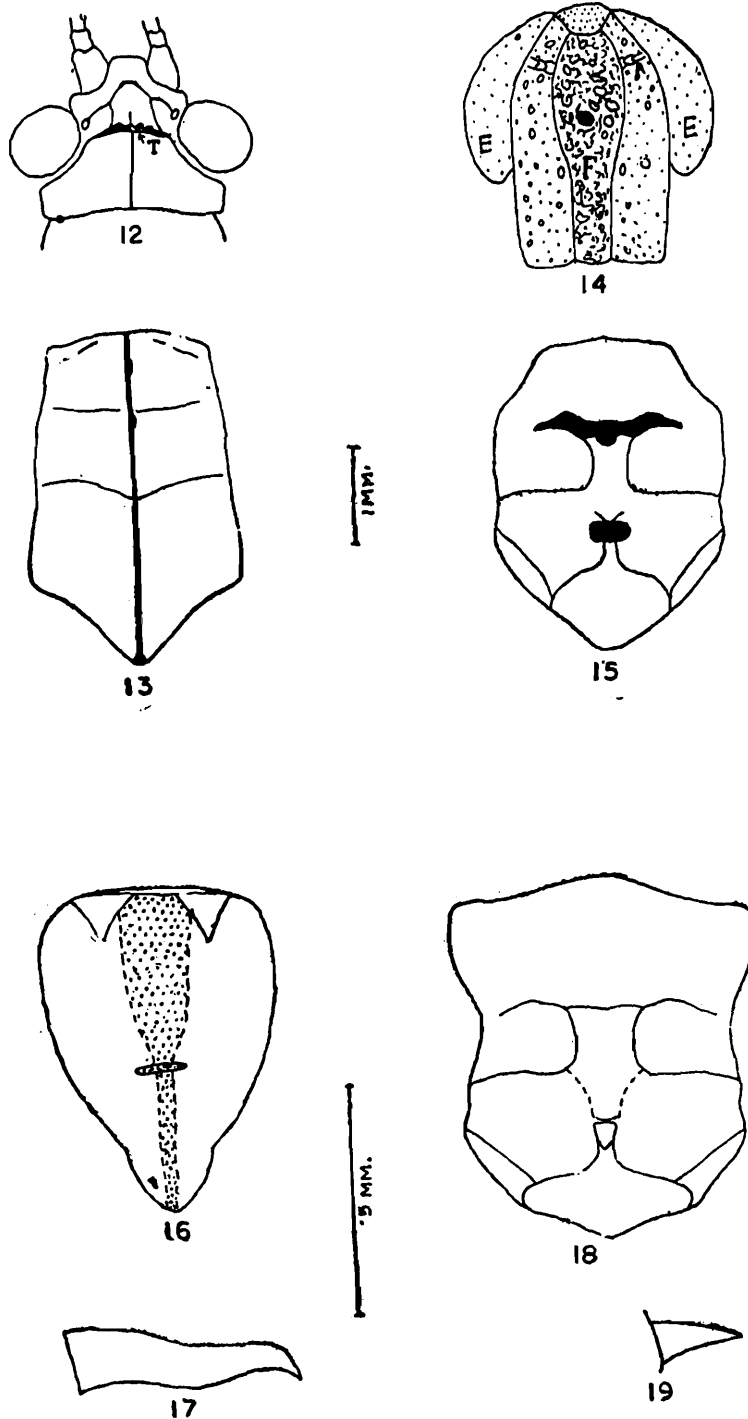
(Figs. 11-19)

Epistaurus sinetyi Bolivar, 1902. *Annls Soc. ent. Fr.*,
70 : 623.

Material : W. B. : 1 ♂ ; Andul, Howrah ; 12.9.78. 1 ♀ ; Botanical Garden, Howrah ; 14.3.80. 2 ♂, 3 ♀ ; Mukutmanipur, Bankura ; 22-23. 9. 81.

Remarks : The species was described from South India (Trichinopoly). Later Uvarov (1927) recorded it from Sri Lanka. So it is a new record for W. B.

Redescription : Males : Size small (Fig. 11). Body pilose. Head very small, less than half length of pronotum; occiput very small; fastigium of vertex extended before eyes, longitudinally tricarinated with truncate apex, median carinula continued behind to occiput and pronotal median carina; fastigium limited posteriorly by transverse carina between eyes (Fig. 12), latter, lateral, projected, approximating in middle and raised more than level of head and pronotum. Frontal ridge narrowest beyond fastigial end, widest in between antennae, more than double width of fastigial width and then gradually converged towards clypeus; finely but closely punctured, in profile, not so convex as in spp. of *Eucoptacra*, shallowly sulcated, carinae being somewhat prominent (Fig. 14). Antennae filiform, 20 to 21 segmented, longer than head and pronotum taken together; scape largest, 2nd to 7th segments narrowest, then gradually thickened. Pronotum tectiform due to well marked median carina, interrupted by posterior transverse sulcus only, punctured; prozona longer than metazona, latter with posterior margin angular (Fig. 13). Prosternal tubercle short, pyramidal (apex spine-like); mesosternal lobes with rounded inner margin; metasternal lobes separated (Fig. 15). Tegmen a little longer than abdomen, opaque throughout, more so in basal half with thick reticulation. Wing as long as tegmen. Posterior femur stout with filiform apical portion. Posterior tibia with 10 to 11



- Fig. 12. Head, dorsal, showing transverse carina. (T.) in between eyes.
 Fig. 13. Pronotal disc, dorsal.
 Fig. 14. Face, frontal view (E—eye ; F—frontal ridge ; A—antenna).
 Fig. 15. Meso- and metasternal plates.
 Fig. 16. Supra-anal plate.
 Fig. 17. Anal cercus, lateral (same scale as fig. 16).
Epistaurus sinetyi, female.
 Fig. 18. Meso- and metasternal plates.
 Fig. 19. Anal cercus, lateral (Figs. 12, 13, 14, 15, 18 and 19 same scale)

internal and 9 to 10 external spines. Tympanum closed. Abdomen carinated medially. Supra-anal plate (Fig. 16) more or less tongue-shaped, with apex broadly angulate, shallowly sulcated in basal half; subgenital plate navicular, with rounded apex; cercus longer than supraanal plate, conical, incurved and acuta at apex (Fig. 17).

Females : Identical with males except differing in the following minor features :— Size a little longer. Posterior tibia with 10 internal and 9 external spines. Meso- and metasternal plates somewhat different (fig. 18). Valves of ovipositor coarsely impress-punctate; anal cercus short, compressed basad and acute apically (Fig. 19).

Trifasciate colouration of posterior femur undetectable.

Colouration : General colouration dark-brown. Antennae brownish, apical segments darkened. Tegmen dark-brownish with spots which are hardly detectable. Wing vermillion-red basad with margins infuscated. Posterior femur yellowish, in males trifasciated. Posterior tibia brownish basad, followed by a pale ill defined yellowish ring, thereafter reddish; spines black tipped. Posterior metatarsus dark-brown. Abdomen brown to dark-brownish; only a few scattered spots visible in females, in males not noticeable.

The colouration of the specimens at hand differ in two points from that of the description of types which are stated to be "Pale reddish and wings yellowish hyaline".

Differential diagnosis : 1. Resembles that of other oriental species, *E. aberrans* Brunner, 1893, known so far from Burma, in having vertex longitudinally carinated, with a very unique transverse carina between eyes; frontal ridge round, arched basad, widest between

antennae, shallowly sulcated; tectiform median carina of pronotum traversed by posterior sulcus only and fully developed tegmen with truncated apex.

2. Unique in form of red abdomen with spots on either side of median line, trifasciated posterior femora, male with tongue-shaped supra-anal plate with apex broadly angulate and with conical and incurved anal cerci. In *aberrans* abdomen brown, post femora indistinctly bifasciated, male supra-anal plate quadrate and cerci curved, deflexed and pointed at apices.

3. Colouration of wing (red) different from that of *aberrans* (yellowish).

Discussion : It is yet a little known species and reported so far to occur in isolated areas such as Tamil Nadu, Sri Lanka and West Bengal.

ACKNOWLEDGEMENTS

Our sincere thanks are due to Dr. B. K. Tikader, Director, Zoological Survey of India, for facilities provided to carry out the work, to late Prof. D. N. Raychaudhuri of Calcutta University for critically going through the manuscript, to Dr. N. D. Jago, PSO i/c Acridid taxonomy, London, for confirming the identification of *E. sinetyi*, to Shri A. K. Chanda, Artist, for inking the drawings and to Miss Kujur for typing the mss.

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A NEW SPECIES OF TRYPANOSOME FROM AN INDIAN MICROHYLID
FROG, *KALOULA PULCHRA TAPROBANICA* PARKER

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ABSTRACT

A new trypanosome, *Trypanosoma taprobanica* sp. nov. is described from an Indian microhylid frog, *Kaloula pulchra taprobanica* Parker. It is monomorphic and attenuated at both the ends, measuring 24.9 μ m in total length. Its affinities with related species have been discussed.

INTRODUCTION

During the last 5 years (1976-1980) 204 microhylid frogs, *Kaloula pulchra taprobanica* Parker were collected from different districts of West Bengal, India. Blood examination of the frogs revealed the presence of a trypanosome in only 14 of them (6.8%) which seemed to be different from any of the described species from the Anura.

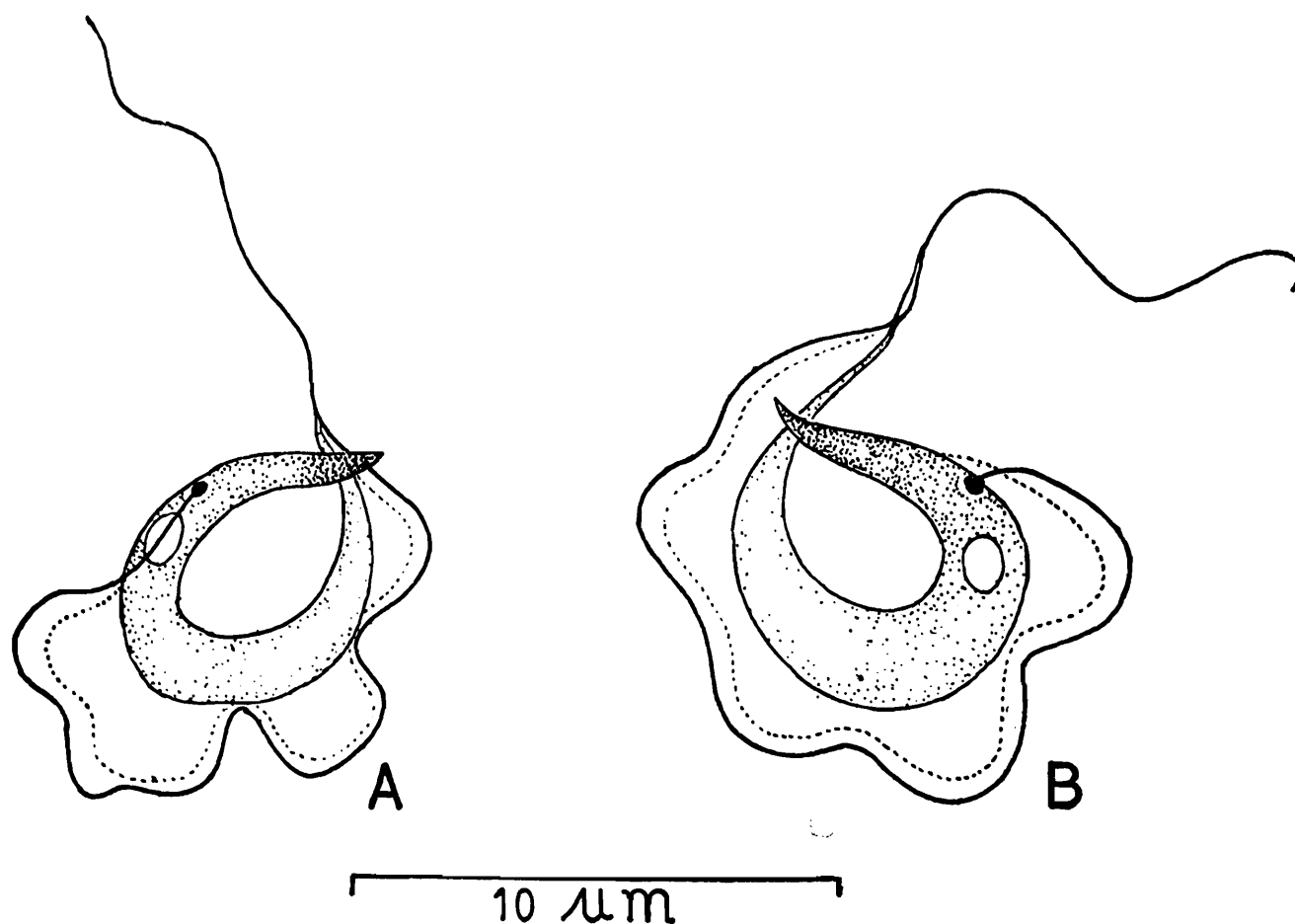
In India, relatively few trypanosomes have been described from the anuran amphibians. It was Dr. N. Berestneff (1903) who initiated the study by reporting a *Trypanosoma* from *Rana tigrina* and *Rana limnocharis*. Patton (1908) also recorded a new species of trypanosome in *Rana tigrina* from India and named it as *T. hendersoni*. Scott (1926, 1927) reported the occurrence of *Trypanosoma* in the blood of the same frogs which were brought from India to the Zoological Gardens, London. Afterwards, Pujati (1953), Ray (1979, 1980) and Ray and Choudhury (1981) studied the anuran trypanosomes in details from India.

The present communication deals with a new species of trypanosome from *Kaloula pulchra taprobanica*, a small frog belonging to the family Microhylidae.

MATERIAL AND METHODS

A total of 204 microhylid frogs, *Kaloula pulchra taprobanica* Parker were collected from different districts of West Bengal, India. Of which 14 (6.8%) were found to be infected with trypanosomes. Five frogs were sacrificed and two blood films were drawn from each frog. Blood was obtained directly from the heart and blood films were prepared on clean grease-free slides. Imprint smears of different organs viz., liver, lungs, heart, kidney etc. were also made. All the smears were fixed in 100% methanol and stained with Romanowsky type of stains.

Camera-lucida drawings of 20 trypanosomes (N=20), 4 from each frog, were drawn on drawing paper at a magnification of 1000 $\times$. *T. loricatum* and *T. rotatorium* were also obtained from *Rana limnocharis* and *Rana*



Figs. A and B. Camera-lucida drawings of *Trypanosoma taprobanica* sp. nov. in *Kaloula pulchra taprobanica*.

tigrina respectively from the same localities of West Bengal. Ten ($N=10$) trypanosomes were drawn and measurements were taken after Hoare (1972) for both the species to establish their specific identity. Trypanosomes were measured from the camera-lucida drawings by means of a fine divider, the points of which were separated at a small unit measurements. Standard deviation (SD) was calculated for each parameter and all the data were compared statistically for significance test by using 'Student test' method. Photomicrographs were taken with the help of an 'Ergavel Carlzeis' microscope using PM6 'Olympus' attachment camera.

OBSERVATION

***Trypanosoma taprobanica* sp. nov.**

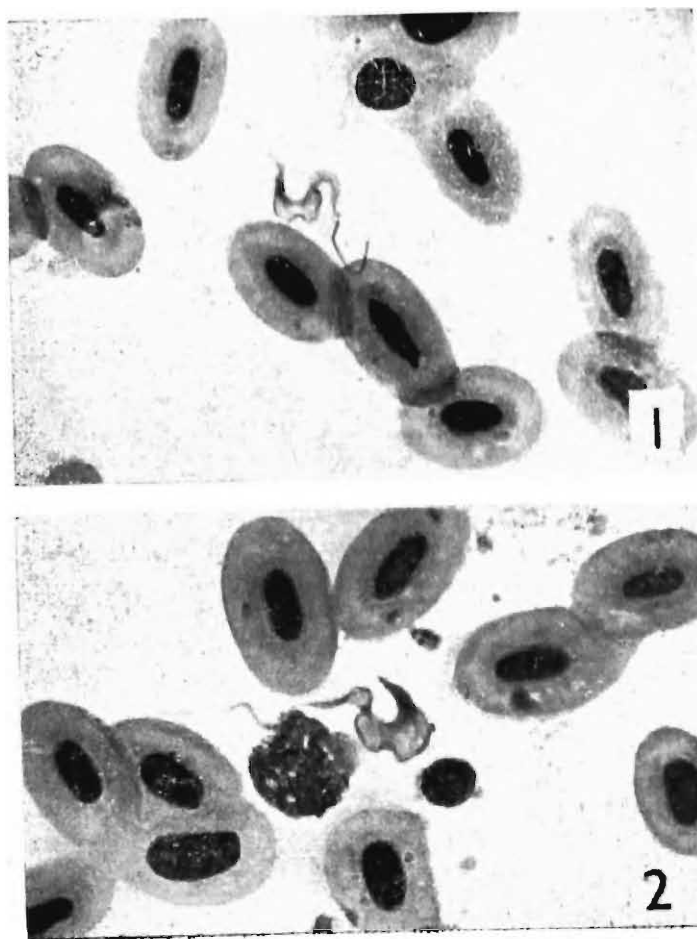
(Plate VI, figs. 1, 2 & Figs. A, B)

Description : The trypanosomes are monomorphic (Table-1), very small, 'C' or 'S' shaped in configuration. Body curved, elongated with both ends attenuated and pointed. The trypanosome measures $16.62 \mu\text{m}$ (1.54) in length (excluding free flagellum) and $1.82 \mu\text{m}$ (0.20) in width.

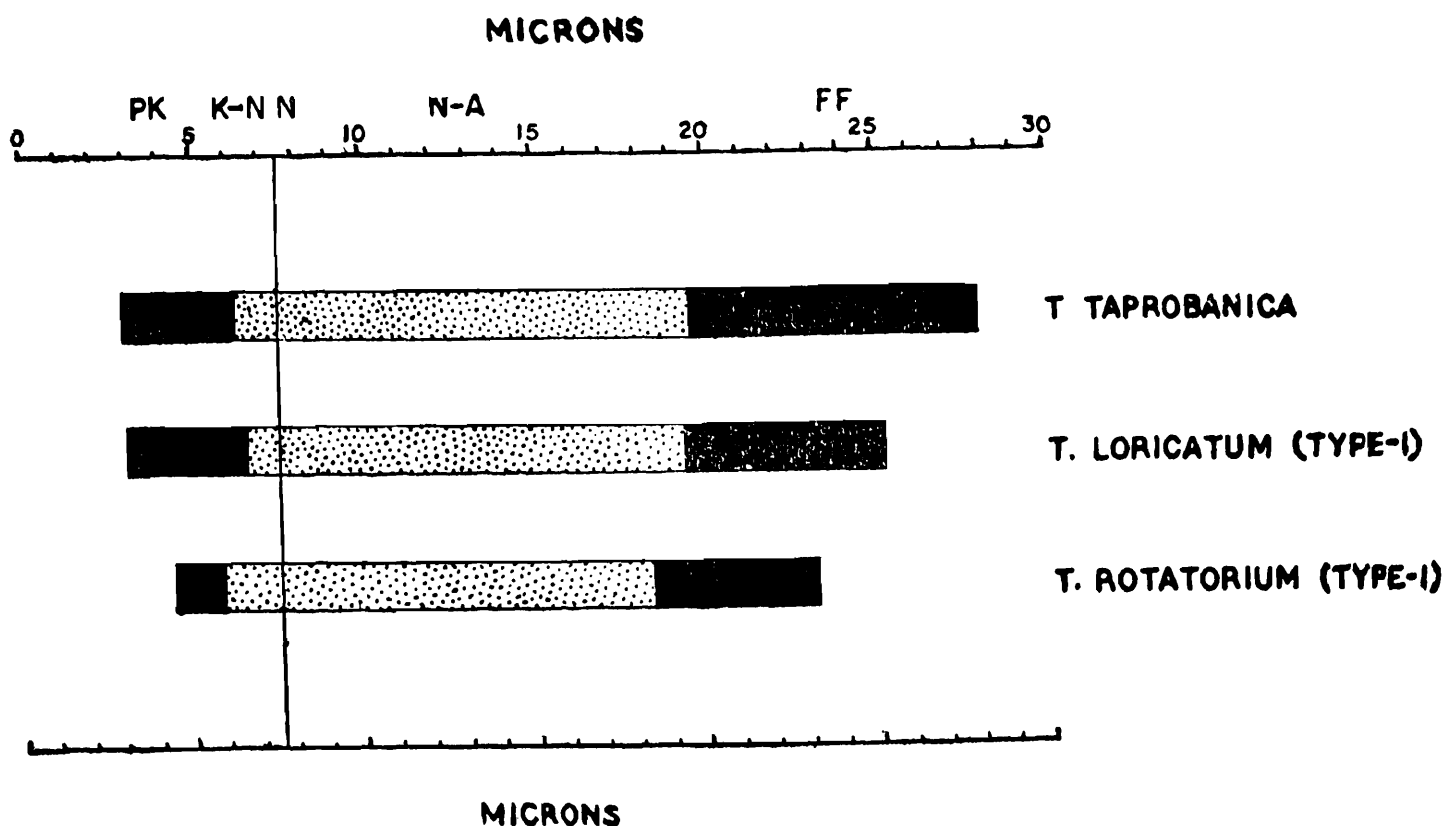
Cytoplasm : The cytoplasm is finely granular, homogeneous, stained light blue in Leishman. Body costae or striations were not found.

RAY & CHOUDHURY

PLATE VI



Figs. 1 and 2. Photomicrographs of *Trypanosoma taprobanica* sp. nov.
in *Kaloula pulchra taprobanica*. X 1235, 1500.



GRAPH-I

Graph 1. Comparison of overall morphometric measurements of 3 species of trypanosomes viz., *Trypanosoma taprobanica* sp. nov., *T. loricatum* (Type I) and *T. rotatorium* (Type I).

PK—Posterior end to the kinetoplast ;

K-N—Kinetoplast to the centre of the nucleus ;

N —Centre of the nucleus ;

NA—Centre of the nucleus to the anterior end ;

FF—Free flagellum.

Nucleus : The nucleus is small, rounded to oval, measuring $1.0 \times 0.57 \mu\text{m}$; stained red with Leishman and always situated on the posterior part of the body parallel to the body axis and close to the kinetoplast (Nuclear Index (NI)=0.36).

Kinetoplast : The kinetoplast is a dot-like structure measuring $0.45 \times 0.45 \mu\text{m}$; stained blue-black with Leishman and situated on the posterior part of the body very close to the nucleus (kinetoplasmic index (KI)=3.65).

Flagellum and undulating membrane : The flagellum emerges from the posterior end of the kinetoplast and traverses the whole body producing 4-6 prominent folds of the undulating membrane and finally leaves the body as a long free flagellum. The free flagellum is $8.3 \mu\text{m}$ in length and is about half the length of the body (FF/PA=0.49).

The method and site of reproduction in the vertebrate host has not been encountered in numerous samples of peripheral and heart

blood and stained impression smears of heart, lungs, liver and kidney examined.

Type-host : *Kaloula pulchra taprobanica* Parker.

Site of infection : Blood.

Locality : Santaldi, Purulia District, West Bengal, India.

Vector and life-cycle : Unknown.

Registration Nos. : Holotype—Z. S. I. Pt. 1971.

Paratype—on the same slide.

Diagnosis of *Trypanosoma taprobanica* sp. nov.

The trypanosome is monomorphic, measuring 24.9 μ m in total length. Cytoplasm is finely granular and homogeneous. Nucleus is small, rounded or oval situated on the posterior part of the body. Kinetoplast is dot-like and situated on the posterior part of the body very close to the nucleus. Undulating membrane is very prominent with 4-6 folds. The free flagellum is about half the length of the body.

DISCUSSION

Numerous workers (Woodcock, 1914, Bennett, 1961) indicated that the relation of the kinetoplast to the nucleus and to the posterior end may be used as a specific criteria for the determination of trypanosome species, as they stained well in Romanowsky type of stains and were subjected to little distortion. Mackerras and Mackerras (1961) separated on this basis three species of reptilian trypanosomes of about the same size and form from closely related hosts,

The anuran trypanosomes (except *T. rotatorium*) exhibit a restriction in occurrence at their host family level as shown by most of the blood parasites of avian families. A perusal of literature on anuran trypanosomes revealed that there is no trypanosome reported so far from the family Microhylidae to which the frog *Kaloula pulchra taprobanica* belongs.

However, the species under discussion is monomorphic (Table-I) and did not correspond to any known anuran trypanosomes described so far. It has some resemblances to the slender form of *T. loricatum* (Mayer, 1843) and the Juvenile form of *T. rotatorium* (Mayer, 1843) but differs from them by being monomorphic. Moreover, the cytoplasm of the present species is less granular and non-striated in contrast to the coarsely granular and thickly striated cytoplasm of *T. loricatum* and *T. rotatorium*. A comparison of the statistical analysis of the morphometric parameters of the present species with that of *T. loricatum* and *T. rotatorium* is presented in Table-2 and Graph-I. There are significant differences (at 5% level) in some of the important morphological features viz., the length of free flagellum (FF), the body width (BW), the distance between kinetoplast and nucleus (KN) and the kinetoplastic index (KI).

The proposed new species can also be separated from *T. gaumontis* and *T. lavalia* (Fantham *et al.*, 1942) of *Bufo americanus* by having a long free flagellum which is absent in the latter forms.

Therefore, a new name *Trypanosoma taprobanica* sp. nov. is proposed after its host's name to mark its specific identity.

TABLE 1. Morphological measurements of *Trypanosoma taprobanica* sp. nov. from *Kaloula pulchra taprobanica*. Measurements in micrometers taking four from each of the 5 host specimens (SAN 5, PUR 10, SAN 11, PUR 25 & SAN 40) have been represented to show the monomorphic species.

	SAN 5				PUR 10				SAN 11				PUR 25				SAN 40			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
PK	3.0	3.2	3.5	3.1	3.0	3.5	3.5	3.1	3.0	3.5	3.5	3.0	3.5	3.2	3.1	3.0	3.2	3.4	3.0	3.5
KN	1.0	2.0	1.0	1.0	1.5	1.2	1.4	2.0	2.0	1.0	1.0	1.2	1.0	1.5	1.2	2.0	1.0	1.6	1.5	2.0
PN	4.0	5.5	4.5	4.0	4.0	4.5	5.0	4.5	5.5	4.0	4.5	4.0	4.0	4.5	5.0	4.5	4.5	5.0	4.5	4.0
NA	12.5	13.0	10.5	10.5	13.0	12.5	13.5	10.5	12.0	13.5	13.5	13.5	13.5	10.5	13.5	12.0	13.5	13.0	12.5	10.5
PA	15.0	12.5	18.0	15.0	15.0	18.0	18.5	15.5	15.0	18.5	18.0	15.0	15.5	18.5	18.0	15.0	18.5	15.5	15.0	16.4
FF	8.5	8.0	8.2	8.5	8.2	8.0	8.5	8.5	8.0	8.2	8.5	8.5	8.5	8.0	8.5	8.2	8.5	8.0	8.2	8.5
BW	1.5	2.0	2.0	1.8	1.8	2.0	2.0	1.5	2.0	2.0	1.8	1.5	1.8	1.5	2.0	2.0	1.5	2.0	2.0	1.8
Kinetoplast																				
L	0.4	0.5	0.5	0.4	0.5	0.4	0.5	0.4	0.5	0.4	0.5	0.4	0.5	0.4	0.5	0.4	0.5	0.5	0.5	0.4
W	0.4	0.5	0.5	0.4	0.5	0.4	0.5	0.4	0.5	0.4	0.5	0.4	0.5	0.4	0.5	0.4	0.5	0.5	0.5	0.4
KI	2.7	4.0	4.0	3.9	4.0	2.7	3.9	4.0	4.0	3.9	2.7	4.0	2.7	4.0	4.0	3.9	3.9	4.0	4.0	2.7
Nucleus																				
L	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
W	0.5	0.8	0.5	0.5	0.5	0.5	0.5	0.5	0.8	0.5	0.8	0.5	0.5	0.8	0.5	0.8	0.5	0.5	0.5	0.5
NI	0.32	0.42	0.35	0.35	0.42	0.32	0.35	0.35	0.42	0.35	0.32	0.35	0.42	0.32	0.35	0.35	0.42	0.32	0.35	0.35
No. of undulations	4	4	5	6	4	6	5	4	5	6	4	4	4	5	4	6	4	4	5	6

Abbreviations : PK, posterior end to the kinetoplast ; KN, Kinetoplast to the centre of the nucleus ; PN, Posterior end to the centre of the nucleus ; NA, Centre of the nucleus to the anterior end ; PA, posterior end to the anterior end ; FF, length of free flagellum ; BW, Body width, KI, Kinetoplastic index ; NI, Nuclear index.

TABLE 2. Comparative morphological measurements of *T. taprobanica* sp. nov. with slender form of *T. loricatorum* and juvenile form of *T. rotatorium*. All measurements in micrometers. Standard deviations in parentheses.

	<i>T. taprobanica</i> (N=20)		<i>T. loricatorum</i> (N=10)		<i>T. rotatorium</i> (N=10)	
	Range	Mean	Range	Mean	Range	Mean
PK	3-3.5	3.2 (0.22)	2.5-4.5	3.5 (0.65)	1-2	1.33 (0.47)
*KN	1-2	1.3 (0.40)	0.5-1	0.9 (0.17)	1.5-2	1.66 (0.23)
PN	4-5.5	4.5 (0.47)	3-5.5	4.4 (0.77)	2.5-4	3.0 (0.70)
NA	10.5-13.5	12.3 (1.18)	10-14	11.85 (1.21)	9-14	10.83 (1.69)
PA	15-18.5	16.6 (1.54)	15.3-17	16.25 (0.62)	11.5-18.0	13.83 (2.19)
*FF	8-8.5	8.3 (0.21)	3-10	5.85 (2.51)	3-7	4.91 (1.30)
*BW	1.5-2	1.82 (0.20)	1.6-2.8	2.34 (0.35)	2-2.5	2.26 (0.23)
Kinetoplast						
Length	0.4-0.5	0.45 (0.07)	0.4-0.5	0.41 (0.03)	0.50-0.75	0.66 (0.11)
Width	0.4-0.5	0.45 (0.07)	0.4-0.5	0.42 (0.03)	0.5-0.6	0.53 (0.04)
*KI	2.75-4	3.65 (0.55)	4-6	4.97 (0.69)	1.66-2.0	1.77 (0.16)
Nucleus						
Length	—	1.0 —	0.9-1.5	1.01 (0.02)	1.8-2.0	1.90 (0.10)
Width	0.5-0.8	0.56 (0.15)	—	5.0 —	1-1.2	1.03 (0.07)
NI	0.32-0.42	0.36 (0.03)	0.21-0.55	0.37 (0.10)	0.20-0.38	0.27 (0.05)

*Significant at 5% level.

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TAXONOMIC STATUS OF THE INDIAN SUBSPECIES OF THE KELAART'S
PIPISTRELLE, *PIPISTRELLUS CEYLONICUS* KELAART
[CHIROPTERA : VESPERTILIONIDAE]

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ABSTRACT

Detailed taxonomic studies on the different subspecies of *Pipistrellus ceylonicus* occurring in India has been made. Of the three recognized forms, *P. c. indicus*, *P. c. chrysothrix* and *P. c. subcanus* only *indicus* has been maintained, and the other two forms are synonymized with it.

INTRODUCTION

Kelaart (1853) described the species *Scotophilus ceylonicus* from Sri Lanka. Dobson (1878), while describing *Vesperugo indicus*, mentioned that since the type specimen of *Scotophilus ceylonicus* Kelaart was lost, it was not possible to recognize the species with certainty. However, he opined that it might be identical with *indicus*. Blanford (1888) after studying the description given by Kelaart of the upper incisors of *ceylonicus*, accepted *ceylonicus* as a valid species, and later (1891) treated *indicus* as its synonym. Wroughton (1899) followed Blanford and described another species *Pipistrellus chrysothrix*. Thomas (1915) suggested that *P. chrysothrix* was founded on a specimen of *P. ceylonicus* with abnormal incisors and recognized four subspecies of it. *P. ceylonicus*, viz., the nominate subspecies from Sri Lanka, a larger and dark subspecies (*indicus*) from south-western India, a small-sized subspecies of intermediate colour (*chrysothrix*) from the neighbourhood of Bombay, and a greyish subspecies (*subcanus*) from Kathiawar and Kutch. Wroughton (1916a, 1916b, 1918), Tate (1942), Ellerman and Morrison-Scott (1951), Siddiqi

(1961) and Hill (1963) accepted this arrangement for the subspecies of *P. ceylonicus*. Hill (1963) described another subspecies *P. borneanus* from North Borneo.

While studying the collection of *P. ceylonicus* from different localities in India present at the Zoological Survey of India, I encountered difficulties in identifying the specimens upto subspecies on the basis of the key provided by Thomas (1915) and Wroughton (1918). Hence, it was felt desirable to study the taxonomic status of the Indian subspecies of *P. ceylonicus* afresh.

Material examined : 2 ♀ : Tamil Nadu ; 8 ♂, 7 ♀ : Andhra Pradesh ; 1 ♂, 2 ♀ : Karnatak ; 4 ♂, 6 ♀ : Orissa ; 2 ♂ : Maharashtra ; 4 ♂, 7 ♀ : Gujarat ; 2 ♂, 2 ♀ : West Bengal.

Pipistrellus ceylonicus indicus Dobson, 1878.

1878. *Vesperugo indicus* Dobson, *Cat. chiroptera. Brit. Mus.* 222. Mangalore, Malabar coast, India.
1899. *Pipistrellus chrysothrix* Wroughton, *J. Bombay nat. Hist. Soc.* 12 : 720. Mheskatri, Surat Dangs, India.

1915. *Pipistrellus ceylonicus subcanus* Thomas, J.
Bombay nat. Hist. Soc. 24 : 30. Yalala,
Junagarh, Kathiawar, India.

A detailed comparative study of colouration among the three Indian subspecies of *P. ceylonicus* reveals that there is no marked difference amongst them on this character. Further comparative study of various characters including external and skull measurements (Table) also do not show any significant difference among the previously recognized Indian subspecies. Hence, I would treat *P. ceylonicus indicus* as the only valid

subspecies occurring in India, the other two Indian forms being synonym of it.

The measurements and colour of the nominate subspecies occurring in Sri Lanka seems to be very much similar to the Indian form but since I have not examined any specimen of this subspecies, I hesitate to say anything about its present taxonomic status.

Distribution : Tamil Nadu, Kerala, Karnataka, Andhra Pradesh, Orissa, Gujarat, Maharashtra, Uttar Pradesh, Bihar, West Bengal, Bangladesh, and Pakistan.

TABLE 1.

Comparative measurements of *Pipistrellus c. indicus*, *Pipistrellus c. chrysothrix* and *Pipistrellus c. subcanus*.

Ex	<i>P. c. indicus</i>	<i>P. c. chrysothrix</i>	<i>P. c. subcanus</i>
External	10♂, 14♀	4♂, 6♀	4♂, 7♀
Fa	35.3-39.4 (37.9)	34.5-39.2 (37.8)	34.3-38.3 (37.1)
E	8.7-13.5 (11.6)	11.8-13.8 (12)	9-13.6 (11)
Tb	12.2-15.5 (14.3)	12-14.8 (14.6)	12.7-15 (14.4)
F & cl	7.7-10.6 (8.1)	7-9.6 (7.8)	7-9.6 (7.6)
Skull	2♂, 3♀	2♂, 3♀	3♂, 7♀
l	14.5-15.1 (14.8)	13.7-14.9 (14.4)	14.4-14.9 (14.7)
cb	13.1-14.5 (13.9)	13.2-14.4 (13.8)	13.2-14.7 (14.1)
pl	5.5-6.4 (6.2)	6-7.1 (6.6)	5.6-6.4 (6.2)
c ¹ -m ³	5.1-5.7 (5.5)	5.3-5.6 (5.4)	5.4-5.6 (5.5)
c ¹ -c ¹	5-5.1 (5.1)	4.8-5.1 (5)	5-5.4 (5.2)
zw	9.2-10 (9.8)	9.7-10.4 (10.1)	9-10 (9.7)
cw	7.4-7.8 (7.5)	7.2-7.6 (7.4)	7-7.5 (7.3)
ml	10-11.1 (10.8)	10.5-11.1 (10.9)	10-2-11.4 (11.1)

Abbreviations used :

Fa=Length of forearm

E=Length of ear

Tb=Length of tibia

F & cl=Length of foot and claw

l=Maximum length of skull

cb=Condylbasal length

pl=Palatal length

c¹-m³=Length of upper tooth row

c¹-c¹=Maximum distance between canines

zw=zygomatic width

cw=cranial width

ml=Mandibular length

Figures given in parentheses show the average measurements.

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A NEW FRESHWATER FISH OF THE GENUS *Danio* HAMILTON (PISCES : CYPRINIDAE) FROM ASSAM, INDIA, WITH THE KEY TO THE IDENTIFICATION OF THE INDIAN SPECIES OF THE SUBGENUS *Danio*

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ABSTRACT

A new species of the genus *Danio* Hamilton collected from Assam, India is described under the name *Danio* (*Danio*) *assamensis*. It is distantly related to *Danio* (*Danio*) *regina* Fowler and *Danio* (*Danio*) *aequipinnatus* (McClelland) from which it differs in the lateral line scale count, head length and body depth. The new species is described here in detail with two photographs.

INTRODUCTION

The Cyprinid genus *Danio* Hamilton under subgenus *Danio* is distributed throughout India, Pakistan, Nepal, Bangladesh, Sri Lanka, Burma, Thailand, Malaya, and China. Jayaram (1981) recorded 9 species under this subgenus from the Indian regions. Three examples of freshwater fish collected from Assam, were examined and compared with the known species and were found to be a hitherto undescribed species. The species is being described here and named after its locality, Assam, *Danio* (*Danio*) *assamensis*.

Material : *Holotype* (Plate VII) : 69mm. in standard length. Reg. No. Zoological Survey of India, Calcutta. FF 1861. Locality : Streamlets round about Tangla, Darrang dist., Assam. Date of Collection. 14.11.1939. Collector : Dr. S. L. Hora.

Paratypes : 2 exs., 62 mm-78 mm. in standard length. Reg. No. Zoological Survey of India, Calcutta, FF 1862. Locality, collector and date of collection same as in holotype.

DIAGNOSIS

Body depth 2.99 (2.87-3.10) and head length 4.17 (4.05-4.33) in standard length. Eye diameter 3.58 (3.40-3.75) in head length. Eye with a small backward projecting spinous process on anterior orbital rim. Lateral line scales 40-41. Height of caudal peduncle 1.31 (1.22-1.42) in its own length.

DESCRIPTION

***Danio* (*Danio*) *assamensis* sp. nov.**

D. 2/12, A. 2/16-17, P. 12, V. 8. C. 21, L. I. 40-41, L. tr. $7\frac{1}{2}/2\frac{1}{2}$.

Dorsal profile more or less convex and ventral profile bow-shaped. Head triangular, directed upward. Body depth 2.99 (2.87-3.10) and head length 4.17 (4.05-4.33) in standard length. Width of head 1.85 (1.80-1.88) and snout length 3.86 (3.60-4.25) in length of head. Eye anterior, with a small backward projecting spinous process at the anterior rim of orbit (Fig. 1), diameter 3.58 (3.40-3.75) in length of head and 1.58 (1.40-1.75) in interorbital width. Interorbital width flat or slightly convex.

Mouth, small directed upward. Barbels 2 pairs, rostral pair half the eye diameter and maxillary pair smaller at the junction of upper and lower jaw. Height of caudal peduncle 1.31 (1.22-1.42) in its own length.

Scales : Lateral line complete, covering 40-41 scales, $7\frac{1}{2}$ scales above lateral line and $2\frac{1}{2}$ scales between lateral line and origin of pelvic fin, predorsal scales 16 and scales surrounding caudal peduncle 14.

Fins : Dorsal fin with 2 spines and 12 branched rays, height 5.56 (4.92-6.20) in

longitudinal bands extending from opercular end to base of caudal fin on each side. A black spot at the superior margin of the gill opening present. Fins are without any colour markings.

RELATIONSHIPS

In the possession of the preorbital spinous process the new species, *Danio (Danio) assamensis* is related to *Danio (Danio) regina* Fowler and *Danio (Danio) aequipinnatus* (McClelland). Of the two *D. regina* described by Fowler (1934) from Nakon Sritamarat,

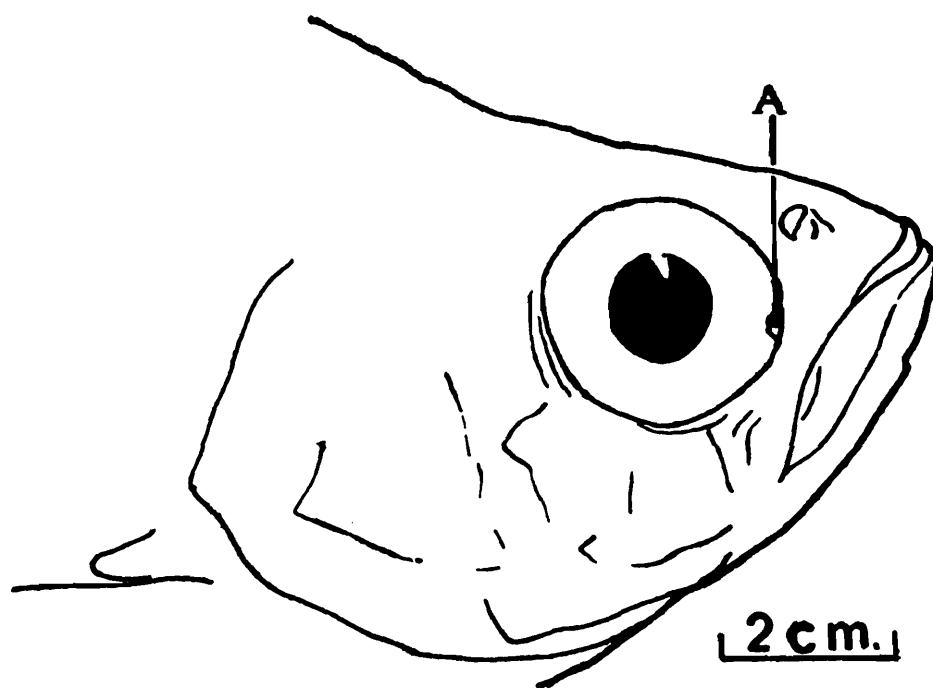


Fig. 1. Head region of *Danio (Danio) assamensis* Barman showing the preorbital spinous process (A) on the anterior rim of orbit.

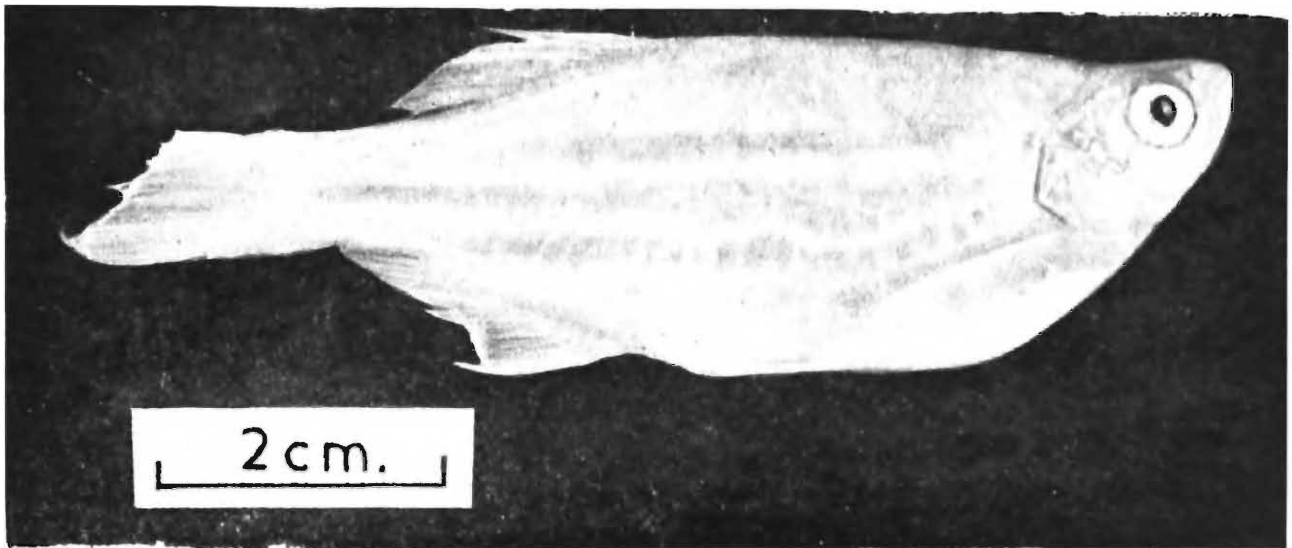
standard length. Anal fin with 2 spines and 16-17 branched rays, height 6.21 (5.75-6.88) in standard length. Pectoral fins with 12 rays, length 4.87 (4.60-5.16) in standard length. Pelvic fin with 8 rays, length 6.84 (6.27-7.75) in standard length. Pectoral fin & pelvic fin provided with scaly appendages at their superior margins. Caudal fin emarginate with 21 rays.

Colour in alcohol : Two pale (silvery)

peninsular Siam, is more closely related to the new species in having an upturned head and also in general morphological similarities in both the species. The new species can be easily separated from *D. regina* in having a smaller head length 4.05-4.33 vs. 3.66-3.75 in standard length, $2\frac{1}{2}$ scales between the lateral line and base of pelvic fin vs. 1 scale between the lateral line and base of pelvic fin, lateral line scales 40-41 vs. 34-35

BARMAN

PLATE VII



Lateral view of holotype of *Danio (Danio) assamensis* Barman.

scales and 2 longitudinal bands vs. 5 longitudinal bands from the opercular end to the base pelvic fin.

The new species can be also distinguished from *D. aequipinnatus* in having greater number of lateral line scales 40-41 vs. 34-36, much deeper body depth 2.87-3.10 vs. 3.75-4.00 in standard length, greater number of anal fin rays 18-19 vs. 14-16, least depth of caudal peduncle 1.22-1.42 vs. 1.75-2.00 and 2 longitudinal bands vs. 3 longitudinal bands from head to base of caudal fin on either lateral sides of the body.

Key to the identification of the Indian species of the subgenus Danio

1. A small backward projecting spinous process on anterior rim of the orbit. ... 2
No backward projecting spinous process on anterior rim of the orbit ... 6
2. One or two supraorbital forwardly directed spine in addition to the preorbital spinous process on anterior orbital rim ... *D. spinosus* Day
No supraorbital spine present... 3
3. Lateral line scales 54-56 ; lateral transverse scales 15 ... *D. annandalei* Chaudhuri
Lateral line scales not more than 53 ... 4
4. Lateral line scales 40-41 ; lateral transverse scales 10 ... *D. assamensis* sp. nov.
Lateral line scales 32-36 ... 5
5. Lateral line scales 32 ; dorsal fin rays (total) 10 ; one pair of maxillary barbels ... *D. kakhienensis* Anderson
Lateral line scales 34-36 ; dorsal fin rays (total) 12-13 ; two pairs of barbels ... *D. aequipinnatus* (McClelland)

6. One pair of maxillary barbels ; lateral line scales 45-52 ... *D. devario* (Hamilton)
Two pairs of barbels ... 7
7. Barbels well developed ; both pairs of barbels much longer than eye diameter ; lateral line scales 36-42 ; lateral colour bands breaking up anteriorly to form a mottled pattern ... *D. dangila* (Hamilton)
Barbels not well developed ; maxillary barbels rudimentary and rostral barbels short ... 8
8. Lower lip hypertrophied forming a loose flap along the lower jaw ; lateral line scales 40-41 ; anal fin rays (total) 17-19 ... *D. fraseri* Hora
Lower lip not hypertrophied, simple anal fin rays (total) 10-14. ... 9
9. Lateral line scales 40-42 ; dorsal fin rays (total) 10 ... *D. naganensis* Chaudhuri
Lateral line scales 37-38 ; dorsal fin rays (total) 12-14. ... *D. neilgherriensis* (Day)

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ACROSSOCHEILUS MANIPURENSIS sp. nov. (PISCES : CYPRINIDAE)
FROM MANIPUR, INDIA

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ABSTRACT

A new species *Acrossocheilus manipurensis* under the family Cyprinidae from Eastern Manipur has been described.

INTRODUCTION

During the course of our taxonomic studies on the fishes of Taret hill stream, Saibol, Tengnoupal district, Manipur, collected by Mr. I. S. Laishram, we came across an interesting example of fish belonging to the genus *Acrossocheilus*, 130 mm. in total length. This example represent hitherto an unknown species. Genus *Acrossocheilus* is represented in India by the only species, *Acrossocheilus hexagonolepis* (Mc Clelland). Species under the genus *Acrossocheilus* are mainly distributed in mountain stream of Burma, Thailand, Indo-China, China, Malaya and Sumatra.

SYSTEMATIC POSITION

Order : CYPRINIFORMES

Suborder : CYPRINOIDEI

Family : CYPRINIDAE

Genus : *Acrossocheilus* Oshima

Acrossocheilus manipurensis sp. nov. (Fig. 1 and 2)

MATERIAL

Holotype : 130 mm. in total length, Reg. No. Z. S. I. FF. 1698.

Locality : Taret hill stream, Saibol, 20 kms. east of Tengnoupal, Manipur, Coll. I. S. Laishram, Date-15. V. 1981.

DESCRIPTION

D. 3/8, P. 16, V. 9, A. 2/5, C. 19 L. I. 40-41
L. tr. 5.5/5.5.

Body laterally compressed, dorsal profile arched. Depth of body 4.19 in total length and 3.26 in standard length. Length of head 5.42 in total length and 4.21 in standard length. Width of head 1.50, height of head 1.20 in head length. Height of head 1.55 in depth of body. Eye diameter 3.00 in length of head. Snout arched, its length 2.82 in length of head, beset with pores and tubercles. 8 spinous gill rakers on the upper arm of the first gill arch ; on lower arm 2 spinous and 2 short and blunter gill rackers finally reduced

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to mere ridges. Upper lip separated from upper jaw with a groove, lower labial fold interrupted in the middle. Interorbital space 1.12 in diameter of eye.

Barbel two pairs, rostral and maxillary. Rostral barbel 3.00 and maxillary barbel 3.20 in head length. Rostral as long as and maxillary 1.07 in eye diameter. Height of dorsal fin 5.42 in total length, 4.21 in standard length. Base of dorsal fin 8.12 in total length, 6.31 in standard length. Dorsal fin insertion

length. Caudal deeply forked, lobes are almost equal. Length of caudal 4.48 in total length, 3.48 in standard length.

Lateral line complete with 40-41 scales, predorsal scales 13, lateral traverse scales 5.5/5.5, 3.5 scales between lateral line and base of ventral fin. Depth of caudal peduncle 1.36 in its length, circumpeduncular scales 12. Back and top of head dark slate coloured, scales with black marking, underside pale yellow, a black mark covering the caudal base.

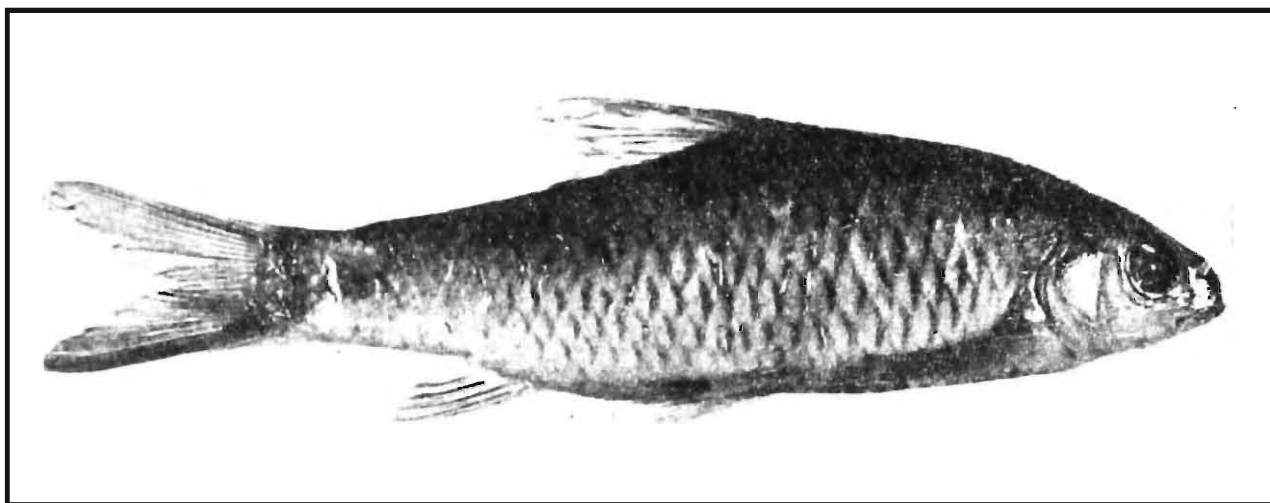


Fig. 1. Lateral view of *Acrossocheilus manipurensis* sp. nov. (Reg. No. Z. S. I. FF. 1698, 180 mm. in total length).

opposite to ventral fin insertion, lies slightly nearer to tip of snout than caudal base. Last undivided ray of dorsal fin strong, bony and denticulated. Pectoral fin 6.05 in total length, 4.70 in standard length, 1.12 in head length and 0.72 in head length excluding snout. Pectoral does not reach base of ventral. Ventral 6.84 in total length, 5.32 in standard length.

Eye diameter 3.12 in that of distance between ventral and anal fin insertions. Length of anal 6.50 in total length, 5.05 in standard

Relationship

Genus *Acrossocheilus* is distinguished by its conspicuously separated lower lip from lower jaw, having horny sheath; snout and cheeks bearing horny tubercles; barbels two rostral and two maxillary. *Acrossocheilus manipurensis* is distinctly separated from *A. hexagonolepis* (Mc Clelland) in having 40-41 lateral line scales versus 28-31; lateral tranverse scales 5.5/5.5 versus 4.5/2.5; predorsal scales 13 versus 8; number of circumpeduncular scales 12 versus 9 and with a denticulated

bony dorsal spine versus a nondenticulated spine. It also varies from *A. hexagonolepis* in the following body measurements : length of head, caudal length and length of largest ray of dorsal in total length ; depth of body in

29-33 ; circumpeduncular scales 12 versus 14 ; origin of dorsal fin over 12th scale of lateral line versus over 10th scale of lateral line.

A. manipurensis comes closer to *A. bantamensis*, however, it differs *A. bantamensis* in

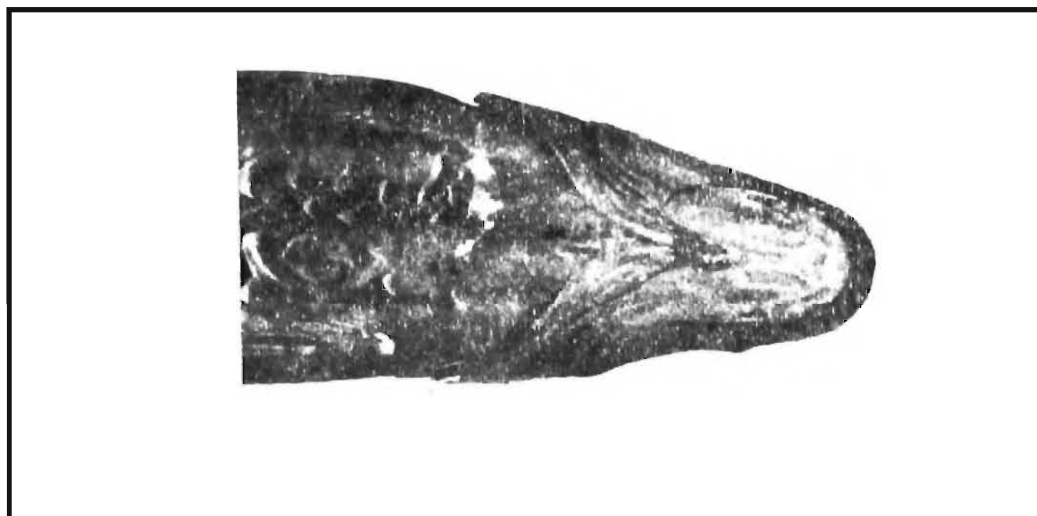


Fig. 2. Ventral view of the head of *Acrossocheilus manipurensis* sp. nov.

height of body ; eye diameter in that of distance between ventral and anal fin insertions.

having 3 unbranched dorsal spine versus 4 ; 40-41 lateral line scales versus 34-38 ; circumpeduncular scales 12 versus 14 ; depth of

TABLE 1. Comparison of *A. manipurensis* sp. nov. with related species

Sl. No.	Characters	<i>A. hexagonolepis</i>	<i>A. deauratus</i>	<i>A. bantamensis</i>	<i>A. manipurensis</i>
1.	Dorsal fin	with 9 branched rays	with 8 branched rays	with 8 branched rays	with 8 branched rays
2.	Last simple dorsal ray	Osseous and smooth	Osseous and denticulated	Osseous and denticulated	Osseous and denticulated
3.	Lateral line scales	28-31	29-33	34-38	40-41
4.	Pte-dorsal scales	8	11-12	12-14	13
5.	Circumpeduncular scales	9	14	14	12
6.	Depth of caudal peduncle in its length	1.5	1.5	2.0	1.36
7.	Lateral line transverse	4½-2½	4½ to 6-1-2½ to 3	5½-1-2½ to 3	5½-5½
8.	Origin of dorsal fin	Over 11th scale on lateral line	Over 10th scale on lateral line	Over 13th scale of lateral line	Over 12th scale of lateral line

A. manipurensis also differs from *A. deauratus* in having 40-41 lateral line scales versus

caudal peduncle in its length 1.36 versus 2.0 ; origin of dorsal fin over 12th scale versus

over 13th scale. The points of differences detailed above are shown in the table 1.

Key to the Indian and allied Indo Malay species of Acrossocheilus osima

- 1 (a) Dorsal spine osseous and smooth, branched dorsal rays 9.
- 2 (a) Lateral line scales 28-31; predorsal scales 8; circumpeduncular scales 9. ... *A. hexagonolepis* (McClelland)
- 2 (b) Lateral line scales 23-25; predorsal scales 7-8; circumpeduncular scales 12. ... *A. sumatranus* (Weber & Beaufort)
- 1 (b) Dorsal spine osseous and denticulated; branched dorsal rays 8.
- 2 (c) Lateral line scales 24; predorsal scales 9; circumpeduncular scales 12. ... *A. vittatus* Smith
- 2 (d) Lateral line scales 26, predorsal scales 8; circumpeduncular scales 14. ... *A. malcolmi* Smith
- 2 (e) Lateral line scales 29-33; predorsal scales 11-14; circumpeduncular scales 14. ... *A. deauratus* (Cuv. & Val.)
- 2 (f) Lateral line scales 34-38; predorsal scales 11-14; circumpeduncular scales 14. ... *A. bantamensis* (Rendahl)
- 2 (g) Lateral line scales 40-41; predorsal scales 13; circumpeduncular scales 12. ... *A. manipurensis* sp. nov.

- 1 (c) Dorsal spine osseous and denticulated; branched dorsal rays 9.
- 2 (h) Lateral line scales 34; predorsal scales 11; circumpeduncular scales 6. ... *A. schroederi* Smith

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Shri I. S. Laishram obliged to Dr. N. C. Datta, Reader in Zoology, University of Calcutta for his encouragement and to the U. G. C. and Deptt. of Education, Govt. of Manipur for granting him teacher fellowship and study leave.

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A NEW SPECIES OF *TREATIA* KRANTZ AND KHOT (ACARI : OTOPHE
IDOMENIDAE) WITH A NEW RECORD OF *AMBLYSEIUS*
BERLESE (ACARI : PHYTOSEIIDAE) FROM INDIA

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AND

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ABSTRACT

Treatia indicus sp. nov. is described and illustrated. *Amblyseius* (*Neoseiulus*) *paspalivorus* (DeLeon) is recorded for the first time from India.

INTRODUCTION

Treatia Krantz and Khot is so far known only from two species from the world, viz., *Treatia phytoseoides* (Baker and Johnston, 1959) known from Florida and collected on hemipteran bug and *Treatia dieuches* Ramsey, 1973 from East Africa and collected on a lygaeid bug. The senior author collected a species of this genus which is new to science and the same is described here. It is interesting to note that both the species of this genus so far known were collected from hemipterous bugs but this species was collected on malformed mango inflorescence and was collected through Berlese's funnel. In addition, a species of Phytoseiidae viz., *Amblyseius* (*Neoseiulus*) *paspalivorus* (De Leon) is recorded for the first time from India and is redescribed here. The measurements given in text are in microns.

***Treatia indicus* sp. nov.**

(Fig. 1)

Female : Dorsum covered with 2 shields, podonotal and opisthonotal. The former 331 long, 454 wide, lateral and posterior margin reticulate, with 11 pairs of setae; latter shield 309 long, 450 wide, reticulate, anterior margin grooved with 4 pairs of setae J5 extends beyond the base of S5; S5 71 long. Dorsocentral setae on podonotal shield measure 22-24; those dorsolateral series measure 35-49; r3 on dorsal shield 44 long, R1 on lateral integument 47 long. Sternal shield very poorly sclerotized, with 3 pairs of sternal setae, metasternal setae on membranous plates. Genital shield much longer than wide, narrowed anteriorly, truncated posteriorly, anterior portion with fimbriate pattern, reticulate posteriorly, genital setae 1 pair lie outside shield margin. Ventrianal shield

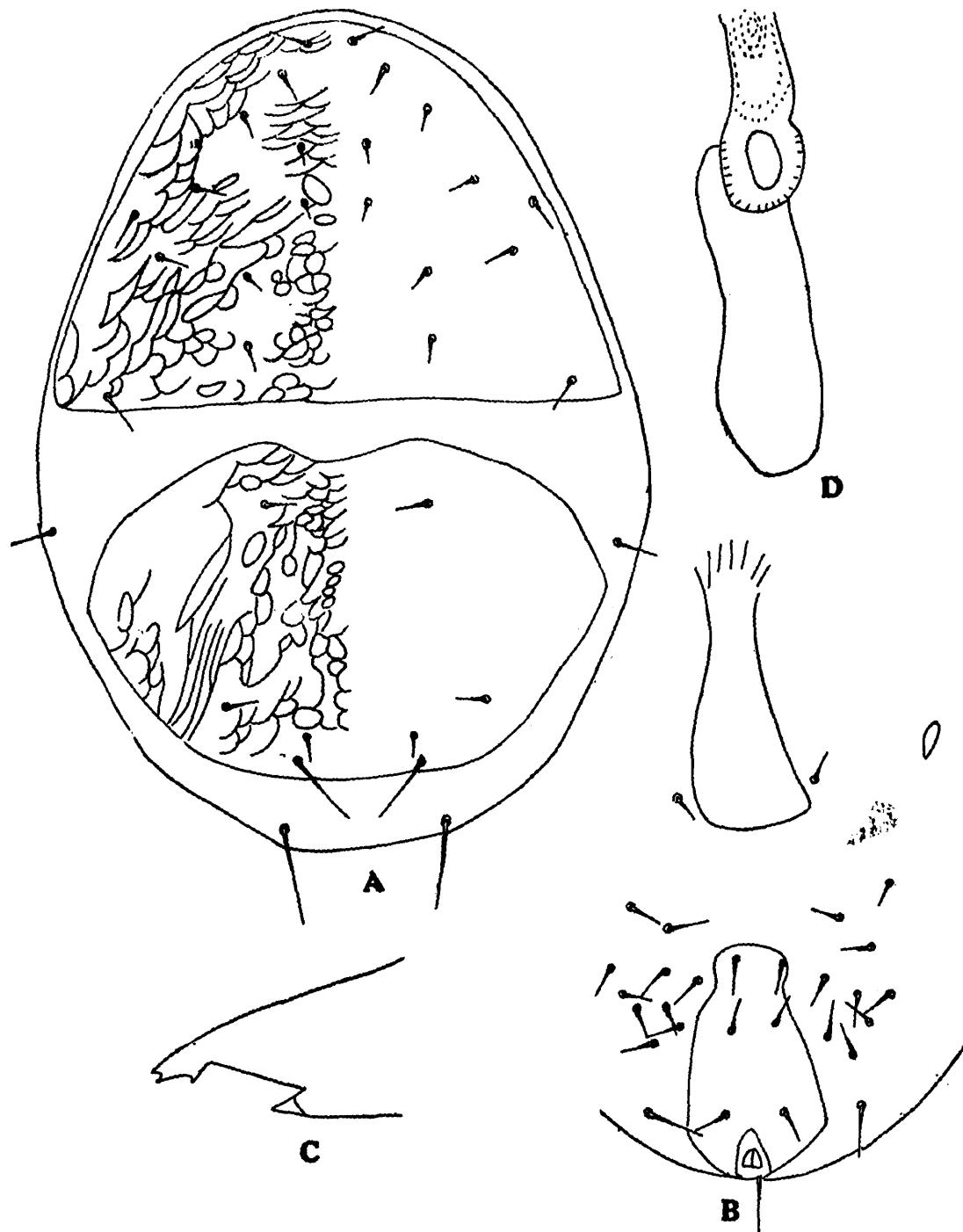


Fig. 1 (A-D). *Treatia indicus* sp. nov. : A—Dorsal shield, B—Posteroventral surface, C—Chelicera, D—Peritreme

shaped as figured, 204 long, 127 wide, with 2 pairs of preanal setae and a strong postanal seta, 70 long. At least 10 pairs of setae present on the membrane around ventrianal shield; a pair of metapodal plates present, 35 long. Fixed digit of chelicera small, peg

like, movable digit large with sharp teeth. Peritreme short, extending anteriorly upto middle of coxae II, shield fuses anteriorly with podonotal shield. Spermatheca not discernible. All femora and tarsi II-IV appear to be subdivided. Leg chaetotaxy

	I	II	III	IV
Coxa	2	2	2	1
Trochanter	5	5	5	4
Femur	10	8	5	5
Genu	10	6	6	6
Tibia	10	6	5	5
Tarsus	27	11	12	12

(Approx.)

Macrosetae on femur	I	2 (70 each)
	II	2 (56 each)
	III	1 (67)
	IV	1 (56)
Length of leg :	I	423
	II	408
	III	408
	IV	485

Palpal femora with strong macroseta, longer than the segment.

Male : Unknown.

Material : *Holotype* ♀, INDIA : Delhi, ex malformed mango inflorescence (Coll. S. Ghai).

Paratypes : 6 ♀ ♀, data same as holotype. All types are deposited in National Pusa Collection, Division of Entomology, I. A. R. I., New Delhi.

Remarks : Only two species of this genus are so far known. From *Treatia phytoseoides* (Baker & Johnston, 1959), this species differs in the presence of genital setae, fixed digit of chelicera (though may be very much reduced), in shape of ventrianal shield and in difference of leg chaetotaxy. From *T. dieuches* Ramsey, 1973, it differs in presence of genital setae outside genital shield, in having palpfemur macroseta being longer than

the length of the segment, in shape of ventrianal shield and in leg chaetotaxic character.

***Amblyseius* (*Neoseiulus*) *paspalivorus* (De Leon)
(Fig. 2)**

Typhlodromus paspalivorus De Leon, 1957, *Florida Ent.*, 40 : 140.

Typhlodromus (*Amblyseius*) *paspalivorus*, Ohant, 1959, *Can. Ent.*, 19 (Suppl.-12) : 79.

Cydnodromus paspalivorus, Muma, *Bull. Fla. Sta. Mus.*, 5 (7) : 290.

Amblyseius paspalivorus, Corpuz & Rimando, 1966, *Philip. Agr.* 50 : 128-129.

Female : Dorsal shield elongated, narrow, distinctly reticulate, 350 long, 155 wide, with 17 pairs of setae. $j1=j3=z2=z4$; $s4>j3$, $S4=S6$, $S2>Z1$. Measurements of setae : $j1-11$, $j4-j6-11-13$, $J2-J5-11-13$, $j3-12$, $z2-10$, $z4-10$, $S4-15$, $Z1-13$, $S2-16$, $S4-25$, $S5-25$, $Z5-89$, $z5-11$, $Z4-25$, $r3$ and $R1$ both on lateral integument measuring 9-10 each. Sternal shield 106 long, 68 wide, with postlateral angulation and 3 pairs of setae ; 4th pair lie on metasternal plates. Genital shield adjacent to ventrianal shield with a pair of genital setae. Ventrianal shield shaped as figured, imbricate, with 3 pairs of preanal setae and a pair of rounded preanal pores below the level of 3rd pair of preanal setae ; 4 pairs of setae present around ventrianal shield, $JV5-29$ long ; 2 pairs of metapodal plates present, primary one-33 long. Peritreme extends anteriorly upto $j1$. Fixed digit of chelicera with 3 teeth anterior to *pilus dentilis* and 1 tooth posterior to it ; movable digit with a sharp tooth. Spermatheca as figured. Macroseta present on basitarsus IV-44 long. Leg chaetotaxic formula : genu II $2 \frac{2}{3} \frac{2}{3} 1$, tibia II $1 \frac{1}{2} \frac{2}{3}$, genu III $1 \frac{2}{3} \frac{2}{3} 1$, tibia III $1 \frac{1}{2} \frac{2}{3} 1$.

Material examined : 12 ♀ ♀, Rajasthan, Udaipur, ex malformed mango inflorescence, 10.ii.1962 (Coll. S. Ghai), deposited in NRC,

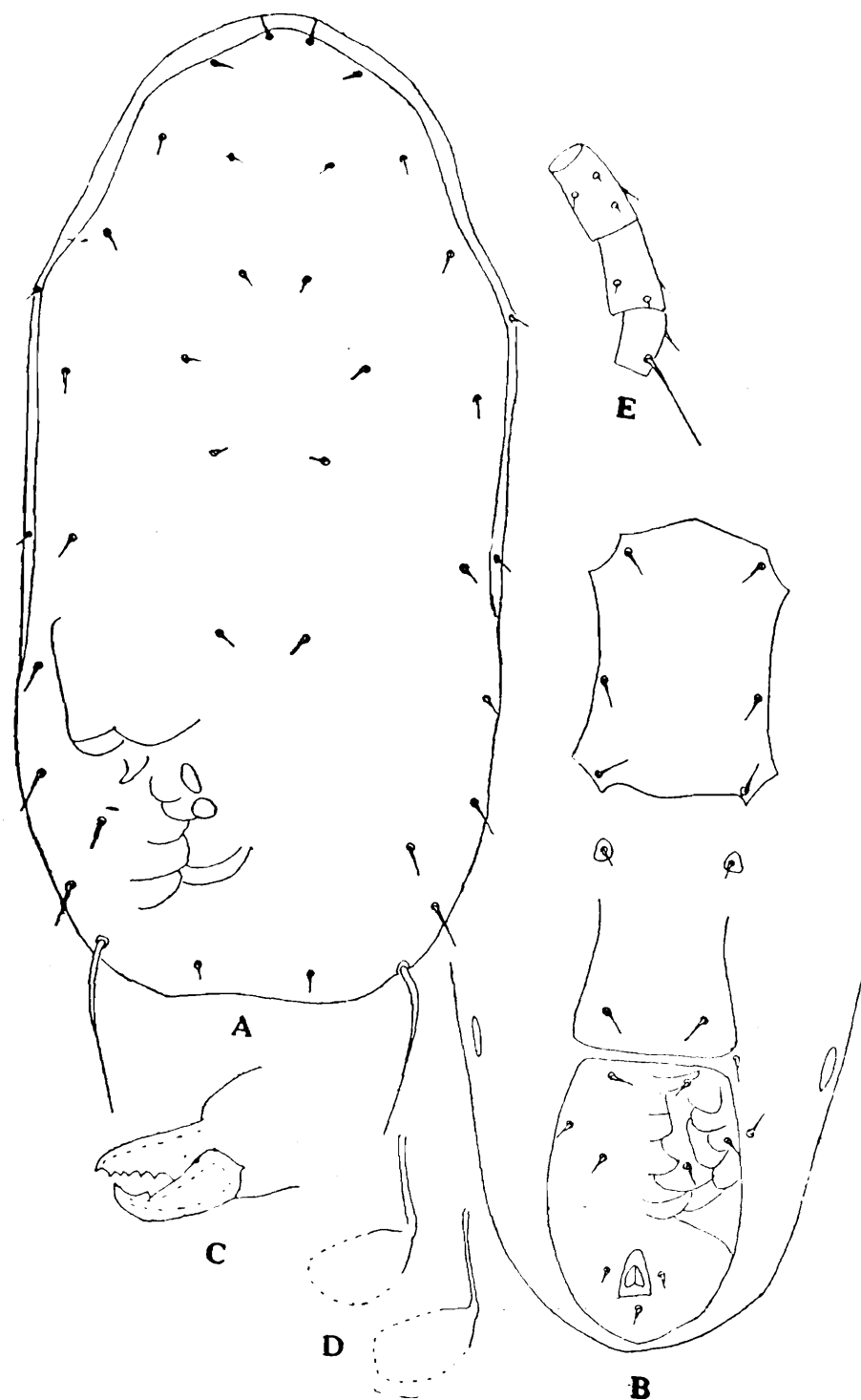


Fig. 2 (A-E). *Amblyseius (Neoseiulus) paspalivorus* (De Leon) A—Dorsal shield, B—Ventral surface, C—Chelicera, D—Spermatheca, E—Genu, tibia and basitarsus of leg IV.

I. A. R. I., New Delhi-110012 ; 1 ♀, Andhra Pradesh, Anakapalli, ex. paddy, 2.xii.1980, (Coll. A. Venusopal Rao), ZSI, Reg. No. 3433/17.

Remarks : This species was earlier known from Florida and latter was recorded from Philippines. This is the first record of the species from India.

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The authors are thankful to Dr. (Mrs.) E. Shaul, University of Toronto, Canada and Mr. D. Macfarlane, Commonwealth Institute of Entomology, London, for confirmation of the species. The Junior author is grateful to Dr. B. K. Tikader, Director, Zoological Survey of India, for the facilities.

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ON VARIATIONS OF *HELEOPERA SYLVATICA* PENARD (PROTOZOA : HYALOSPHEINIIDAE) IN INDIA AND ITS CAUSATIVE FACTORS

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ABSTRACT

The extent of morphological variations observed in populations of *Heleopera sylvatica* Penard collected from mosses growing on boles of trees at Calcutta (West Bengal) and Calicut (Kerala) during different seasons are noted. The tests of the species show considerable variations in its structure and texture due to the collective effect of the substratum and environmental factors, both biotic and abiotic, during different seasons. The factors which seem to cause the variations are also noted in the paper.

INTRODUCTION

Detailed ecological observations for describing the testacean rhizopods are found necessary by earlier workers like Wallich (1864), Penard (1902) and Deflandre (1937). Stepanek (1952) noted that in *Diffugia* and *Lesquereusia*, the structure of the test depended largely on the substratum. Bonnet (1961) stated that the soil dwelling testaceans are not only smaller in size than those from aquatic habitats but also differ in shape. Chardez (1963) depicted the structure and number of the nucleus of some species of testacean rhizopods. Heal (1963) stressed the importance of applying culture techniques to determine the exact taxonomic status of doubtful species. Based on the water content of the habitat Bartos (1940, 1946) grouped the species as Hydrophiles, Hygrophiles and Xerophiles.

Testacean rhizopods offer interesting material for microecological studies. *Heleopera sylvatica* Penard described in 1902 as a form inhabiting the mosses growing on hedge banks in Switzerland is reported from other

parts of the world since then. Nair & Mukherjee (1969) reported its occurrence in Calcutta, India. Several (total 345 approximately) specimens of this species examined in 1969, 1970 from the mosses growing on the tree trunks at Calcutta and in 1982 at Calicut from mosses on wall tops displayed considerable variations in the texture of their tests. The extent of these variations of the species and the co-relation of environmental factors are elucidated in this paper.

MATERIALS

The moss growth from the boles of trees of Calcutta and wall tops at Calicut were collected and examined at different seasons. The individuals were isolated, examined and their diagrams were drawn from each lot of material taken during active monsoon, just after the cessation of monsoon and in the dry period extending upto summer. Some tests from each lot were examined often crushing under the coverslips by gentle pressure in distilled water, and also in dry state on slides. Measurements were taken with the aid of a calibrated micrometer.

DESCRIPTION

The specimens isolated from the first lot are elegantly shaped with a transparent chitinous test having oval scales on its surface (Fig. 1), plasma being visible through the test. Individuals were very active, often putting forth eight to ten lobose pseudopodia. Test measurements are as follows: length 59-70 μm , width of broad side 30-39 μm , that of narrow side 18-25 μm , and aperture size $16 \times 12 \times 6 \mu\text{m}$.

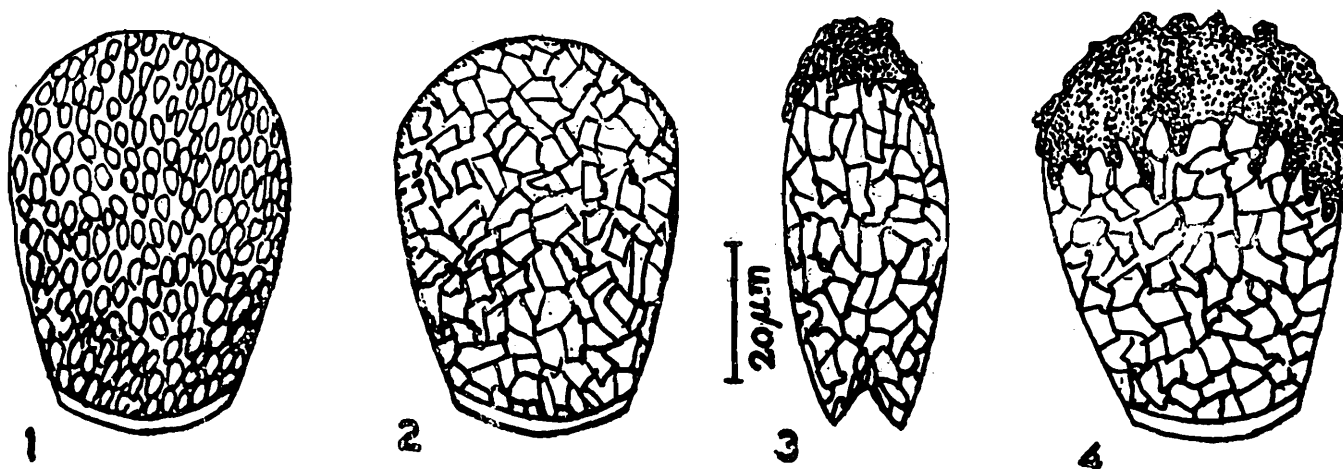
The tests of specimens isolated from the second lot i.e. post-monsoon are partly covered by oval scales and also partly or wholly covered by amorphous scales (Fig. 2). Test size; length 62-72 μm , broad side with 33-39 μm ; narrow side width 23-28 μm , aperture size $22 \times 15 \times 8 \mu\text{m}$.

& 4). Test size: length 63-74 μm , broad side width 33-39 μm , narrow side width 23-30 μm , aperture size $22 \times 15 \times 8 \mu\text{m}$. Individuals are less active, putting forth only two or three pseudopodia occasionally. The observation of plasma is rendered difficult due to the opaque nature of test. Several individuals were seen in encysted condition.

The tests of specimens inhabiting the mosses on tree boles are with little rosy tinge unlike the colourless of those isolated from mosses growing on wall surface.

DISCUSSION

Heleopera sylvatica Penard existing in a habitat subject to the seasonal conditions referred above shows the collective effect of the substratum as well as the environmental



Figs. 1-4. *Heleopera sylvatica* Penard (Pseudopodia Omitted).

1. Broad side view of test with oval scales.
2. Broad side view of test with amorphous scales.
3. Narrow side view of test with little encrustation on fundus.
4. Broad side view of test with thick encrustation on fundus.

The third lot from-dry season contained specimens having their tests covered entirely with amorphous scales and also with encrustation of materials of indeterminate nature on the fundus. The volume of encrustation on the fundus also varied considerably (Figs. 3

factors acting on the morphology in a remarkable manner. Specimens observed during the monsoon period are elegant and active since they are bathed in enough rain water falling on the habitat. The cessation of the monsoon rainfall and the consequent gradual drying

up of the habitat make the specimens less active. Fine flakes from the ground blown up by the wind get deposited on the moist regions in between the moss plants. These amorphous flakes in turn get adhered on the test of individuals and gradually obliterate the oval scales. During locomotion the individuals adopt a vertical position to the substratum and this habit further facilitates the deposition of extraneous matter on the fundus. The amount of deposition depends on the volume of matter falling on the habitat and also on the time taken to get cemented on the fundus. The black lump removed from the fundus and crushed by gentle pressure exhibits a fine granular structure.

This colour is perhaps due to the fine carbon particles (soot), suspended in the atmosphere settling and getting incorporated on the fundus. In the monsoon season the possibility of deposition of fine flakes and other extraneous matter on the habitat is considerably less since the habitat as well as the specimens are bathed in rain water.

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ON SOME COLLECTIONS OF CICADELLIDS (HOMOPTERA : CICADELLIDAE)

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ABSTRACT

The present communication deals with the systematic investigation of 23 cicadellid species in 20 genera under 7 subfamilies of Cicadellidae. The specimens examined are reposit in the National Collections of Zoological Survey of India. The material is represented by 14 Oriental and 9 Nearctic species. The study of the fauna under consideration is principally concentrated upon the structural significance of genitalia over and above the colouration, distribution and vectorial status of a few species. Quite a few of the hitherto-existing taxonomical problems of congeneric species could be well resolved by using the distinctive characteristics of so important genital armature, as illustrated in the text.

SYSTEMATIC ACCOUNT

Subfamily CICADELLINAE

1. *Kolla ganeshia* Distant, 1918

Distant, 1918, *Fauna Brit. India*. 7 : 8.

(Figs. 1-3)

Material : Palni Hills, South India, 13-15-IX-1923 (Ind. Mus. Coll.).

Length : 6mm. (male)

Vertex with a black, rectangulate spot at apex, subanterior margin with a dark band extending to antennal bases, centrally with three linear bands ; clypeus reddish-brown, anteriorly with a black Y-shaped band ; pronotum dark brown, anterolaterally with a dark triangular patch ; scutellar angles spotted otherwise shiny reddish brown ; tegmina at costal margin black, veins dark grey, claval cells darker, abdominal segments black ; hind tibiae with black spines.

Genitalia : Connective Y-shaped, aedeagus bulbous at base (figs. 1, 2) ; style very short (Fig. 1), mesal apical extension conico-acuminate apically, margin infolded giving disc

a sulcate appearance, outer lobe differentiated ; male plate (Fig. 1) converging distad, multi-seriate setae on lateral margin ; pygofer (Fig. 3) densely spinulate, pygofer hook geniculate subapically, apex sharp.

Morphology : Median length of crown half the length of interocular width ; trans-clypeal suture indistinct ; pronotal width same as transocular width ; pronotal surface finely granulate ; scutellar surface rugosissimus ; hind femoral setal formula : 2 : 1 : 1.

Distribution : Madras

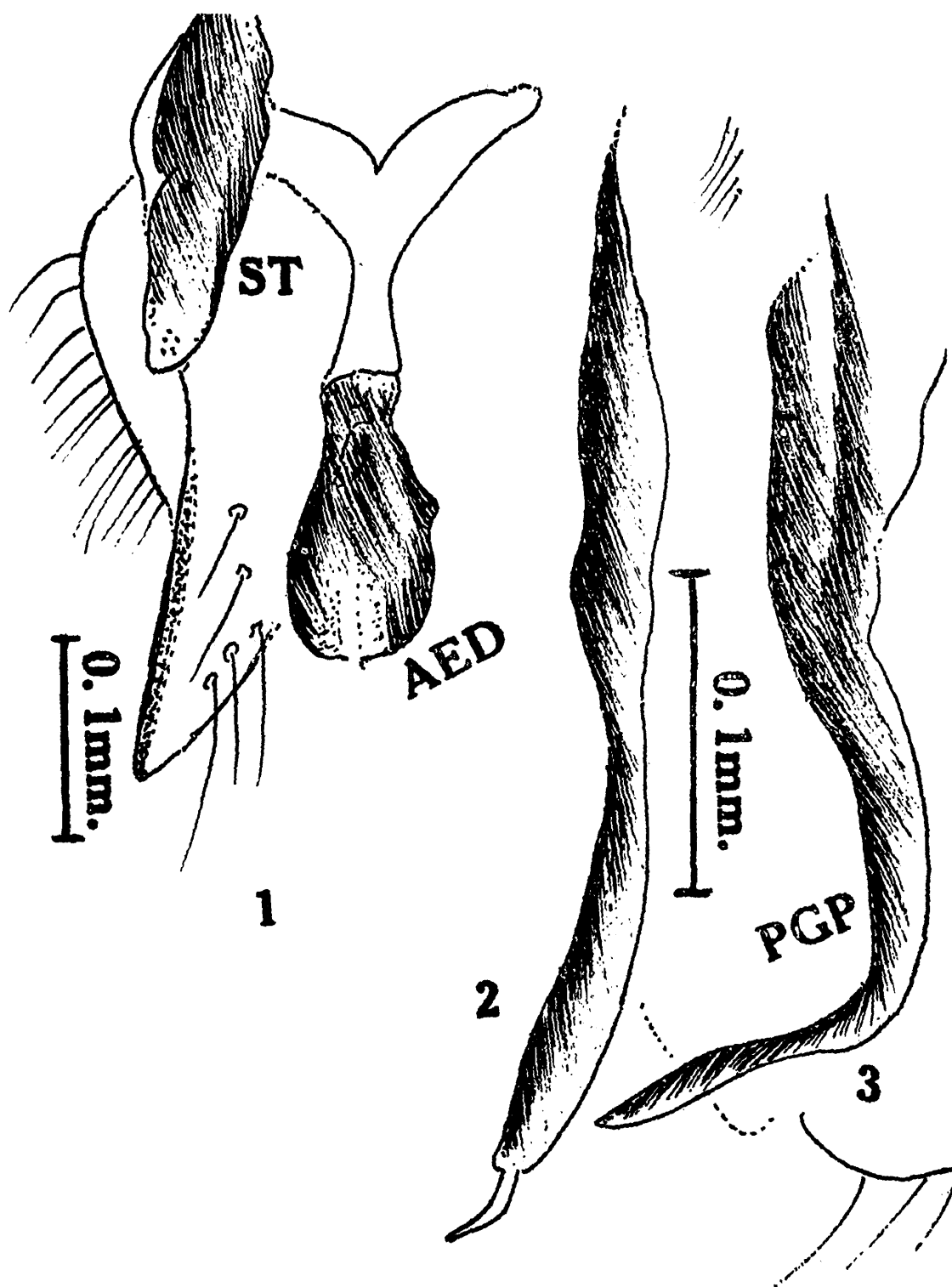
2. *Mileewa margheritae* Distant, 1908

(Figs. 4-5)

Distant, 1908, *Fauna Brit. India*. 4 : 238.

Material : Mussoore Hills, U. P., VI-1933 (H.S. Pruthi). Vertex, pronotum, anterior half of scutellum and tegmina dark brown ; tegmina centrally with an elliptical transparent patch, apical cells with more than two transparent patches, apical margin truncate.

Length : 4.5 mm. (male).



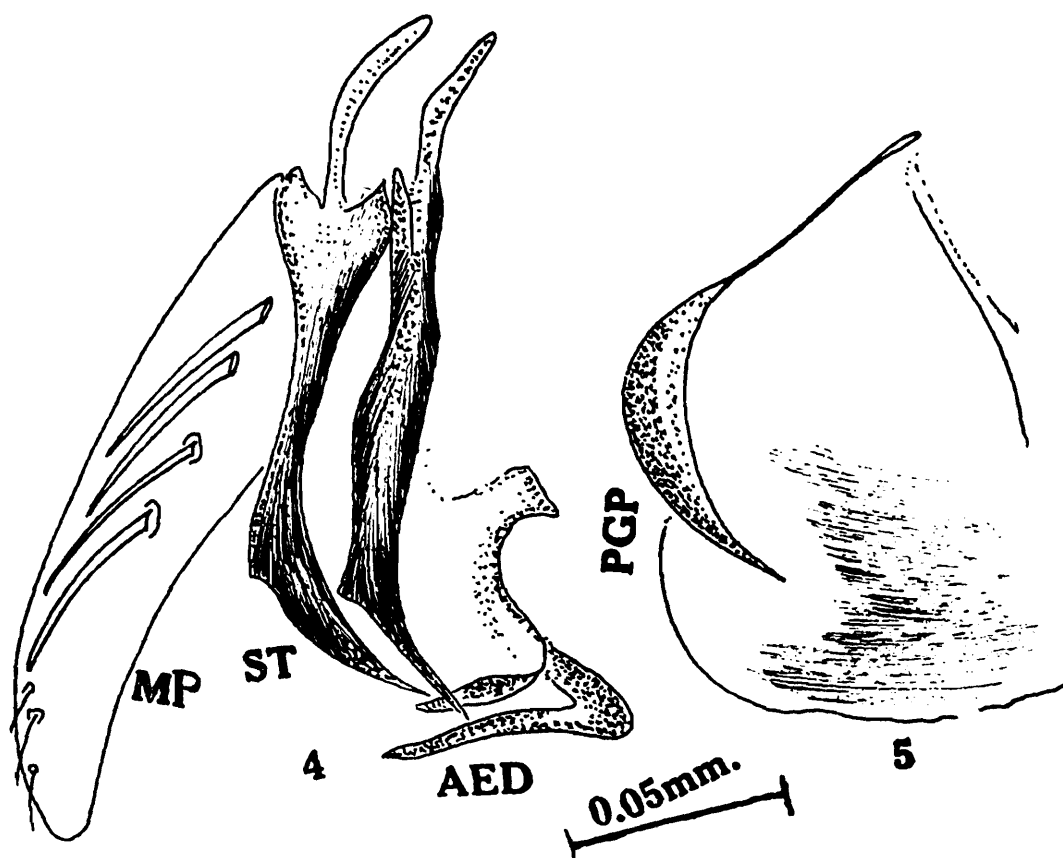
Figs. 1-3. *Kolla ganesha* Dist.

Aedeagus (Fig. 1), (Fig. 2)

Style (Fig. 1)

Male plate (Fig. 1)

Pygofer (Fig. 3)



Figs. 4-5. *Mileewa margheritae* Dist.

Aedeagus (Fig. 4), Style (Fig. 4), Male plate (Fig. 4), Pygofer (Fig. 5).

Genitalia : Connective rectangulate, aedeagus (Fig. 4) 3/4th flat, with a pair of sharp, foot-like apical processes ; style (Fig. 4) with mesal apical extension elongate, slender, with sharp apex ; male plate (Fig. 4) gradually converging, uniseriate setal arrangement along median margin ; pygofer (Fig. 5) sub-quadrate, robust, pygofer hook arising on postero-mesal margin, strongly arcuate, directed cephalad.

Distribution : Assam, Upper Burma.

3. *Soibanga bella* Walker, 1851

(Figs. 6-7)

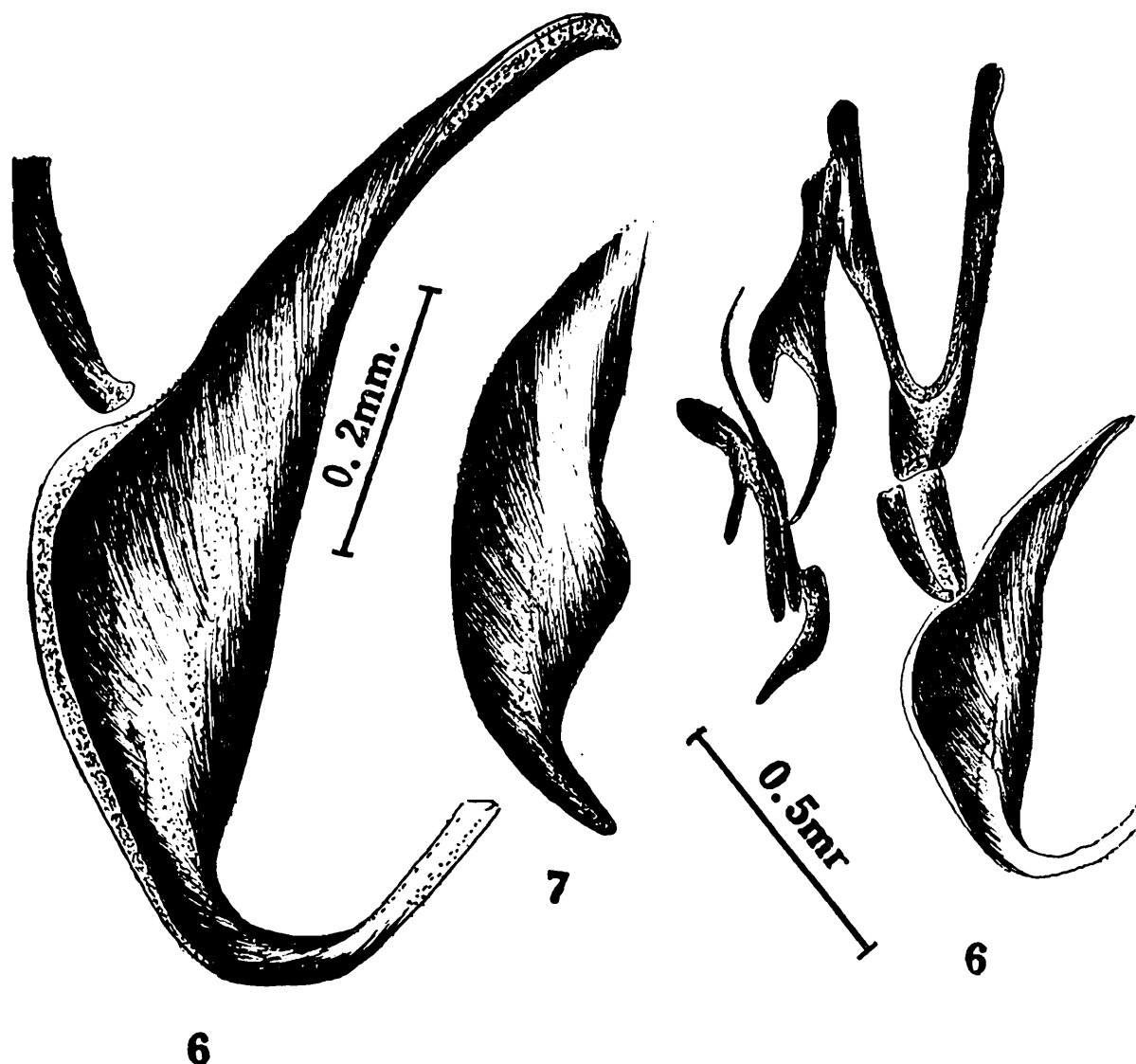
Walker, 1851, *List. Brit. Mus.* 3 : 778.

Material : Nainital, U. P., 9-XII-18 (Ind.

Mus. Coll.). Vertex centrally with a series of creamy-white spots ; face with an oblong creamy-white spot at posterior margin, transverse impression laterally distinct ; pronotum finely rugose, laterally a pair of creamy-white patches ; creamy-white patches on tegmina extending to middle of costal and claval areas ; abdomen ventrally creamy-white ; meta-tibiae densely spinulate, creamy colored.

Length : 5.5 mm. (male).

Genitalia : Connective Y-shaped, arm arcuate at point of union with aedeagal base, aedeagus (Fig. 6) robust, laminate, postero-laterally sinuate ; style (Fig. 6) with mesal apical extension very short, apex beak-shaped ; male plate (Fig. 7) converging distad ; pygofer hook arising latero-basally,

Figs. 6-7. *Soibanga bella* Walk.

Aedeagus (Fig. 6), Style (Fig. 6), Male plate (Fig. 7).

geniculate medially, apex sharply pointed, deeply emarginate.

Distribution : Assam, Sylhet.

Subfamily PENTHIMIINAE

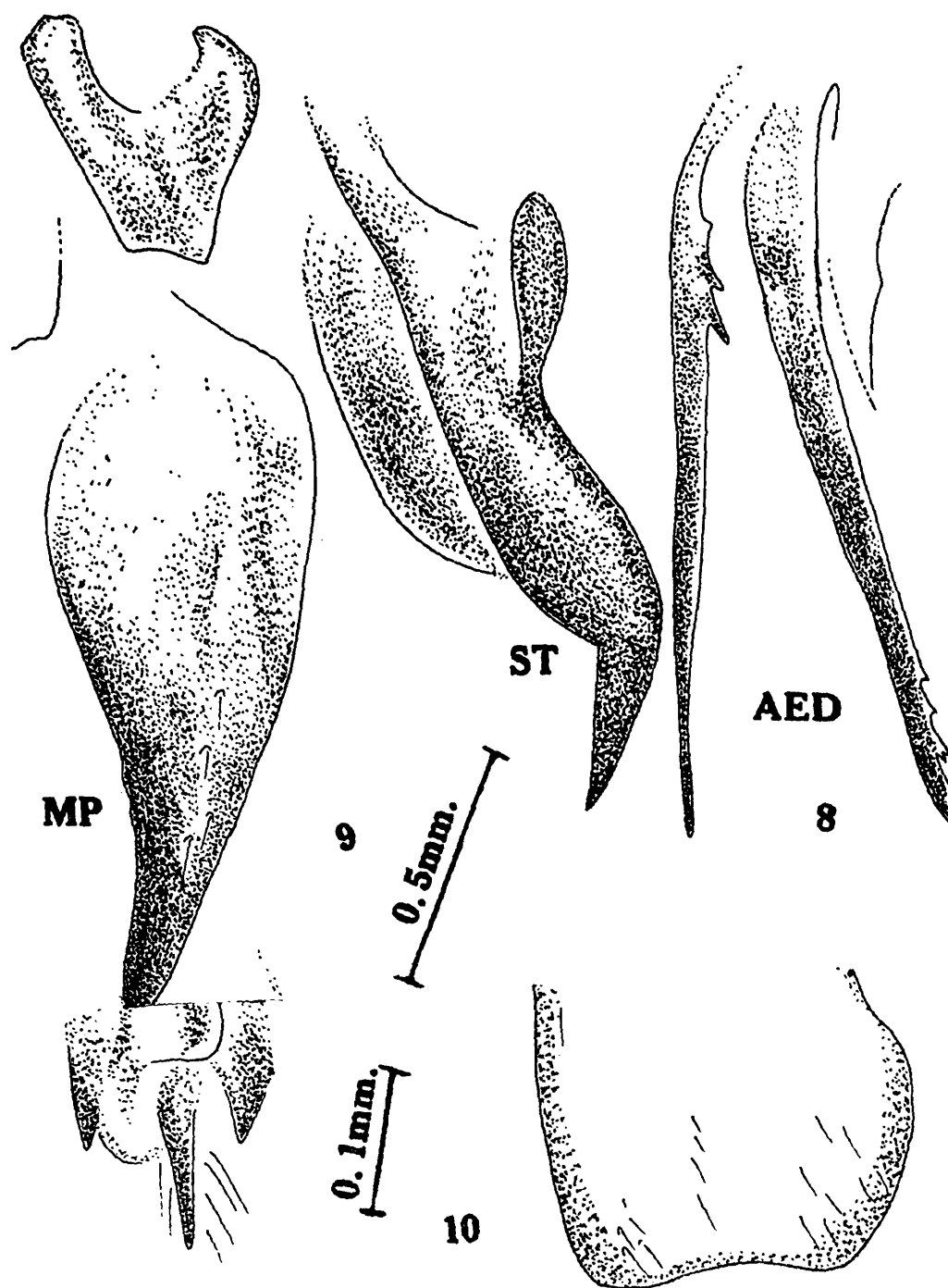
4. *Haranga scutellaris* Distant, 1908

(Figs. 8-10)

Distant, 1908, *Fauna Brit. India*. 4 : 249.

Material : Arunachal Pradesh, 11-III-69 (Ind. Mus. Coll.). Pronotum, scutellum and tegmina piceous ; abdominal segments and

spines on legs reddish-brown, shiny ; tegmina beyond middle semi-transparent, veins dark brown, claval suture dark reddish at apex. Length : 6 mm (male), 8 mm. (female) Morphology : Median length of crown one and a half times lesser than interocular width, surface of crown pubescent, rugose at anterior half ; transclypeal suture indistinctly demarcated ; pronotal surface transversely rugous, posterolateral angle angulated ; scutellum transversely impressed ; tegmina coriaceous, extending beyond abdominal tip ;

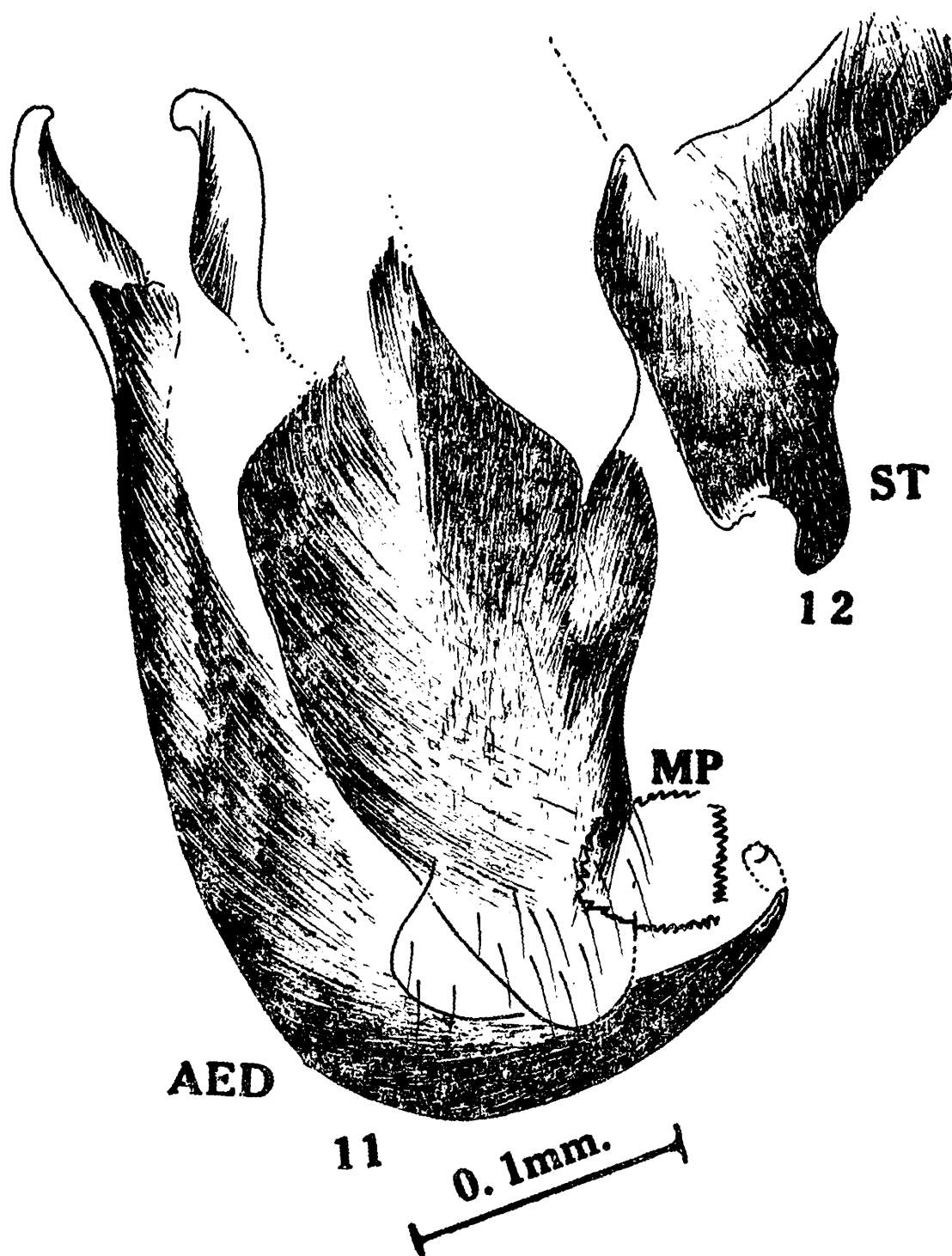


Figs. 8-10. *Haranga scutellaris* Dist.

Aedeagus (Fig. 8), Style (Fig. 9), Male plate (Fig. 9), Pygofer (Fig. 10).

hind femoral setal formula : 2 : 1 : 1 : 1 ;
VIIIth sternite (female) carinate medially,
postero-medially semicircularly notched, later-
ally feebly concavus.

Genitalia : Connective Y-shaped, arm
very short, aedeagus (Fig. 8) broader basad,
gradually re-curved, subapically twisted, apex
pointed, carinate along median axis ; style



Figs. 11-12. *Penthimia scapularis* Dist.
Aedeagus (Fig. 11), Style (Fig. 12), Male plate
(Fig. 11).

(Fig. 9.) with short preapical lobe, aedeagal shaft $\frac{3}{4}$ th broader, disc set with sparse microsetae, postero-lateral margin distinctly rugulose, apex conico-acuminate, placed at right angle to basal part ; male plate (Fig. 9) concavus laterally, uniseriate setal arrangement, slightly undulated on outer margin ; pygofer (Fig. 10) rectangulate, pygofer hook extending along mesal margin.

Distribution : Assam, Shillong.

5. *Penthimia scapularis* Distant, 1908

(Figs. 11-12)

Distant, 1908, *Fauna Brit. Inia.* 4 : 244.

Material : Haringhata, West Bengal, 14-XII-1962 (G. K. Manna). Vertex rugose ; ocellus close to each eye ; anterior margin of pronotum to facial area pitchy black ; pronotum reddish brown ; scutellum black, rugose ; tegmina beyond middle reddish brown ; apical cells spotted, claval suture black ; thorax ventrally black, femora and metatibiae with blackish tinge.

Length : 6 mm. (male)

Genitalia : Connective Y-shaped, with elongate arm ; aedeagus (Fig. 11) broader basad, strongly re-curved, apex blunt with a cup-shaped structure as figured ; style (Fig. 12) $\frac{3}{4}$ th laminate, mesal apical extension spanner-shaped ; male plate (Fig. 11) robust, setae multiseriate ; pygofer sub-rectangulate, infolded laterad.

Distribution : Bombay, Assam, Tenasserim, Sikkim.

Subfamily LEDRINAE

6. *Ledra quadricarina* Walker, 1858

(Figs. 13-14)

Walker, 1858, *List. Brit. Mus. Suppl.* p. 249.

Material : Simla Hills, Himachal Pradesh, VIII-IX-1925 (B. Chopra). Robust, body den-

sely rugulose ; vertex, pronotum, wing veins thickly nodulate ; vertex tricarinate, a pair of nodulate structures at base ; tegminal venation reticulate ; abdomen reddish-brown, tibiae densely pubescent.

Length : 13 mm. (male)

Genitalia : Connective U-shaped, aedeagus (Fig. 13) robust, scaphiform, apical $\frac{1}{5}$ th abruptly tapered, a pair of long, sub-apical processes directed caudad ; style (Fig. 13) robust, mesal apical extension cylindrical, foot-shaped, strongly chitinised ; male plate robust, elongate, postero-laterally infolded ; pygofer (Fig. 14) constricted medially, pygofer hook arising from inner margin.

Distribution : Coorg, Mysore

Economic importance : This species was trapped on a sticky paper during investigation on the cause of spike disease of *Santalum album* (Dover, 1932 : 36, Pruthi, 1934 : 6, Chatterjee, 1939 : 21).

Subfamily APHRODINAE

7. *Anoterostemma ivanhofi* (Lethierry), 1876

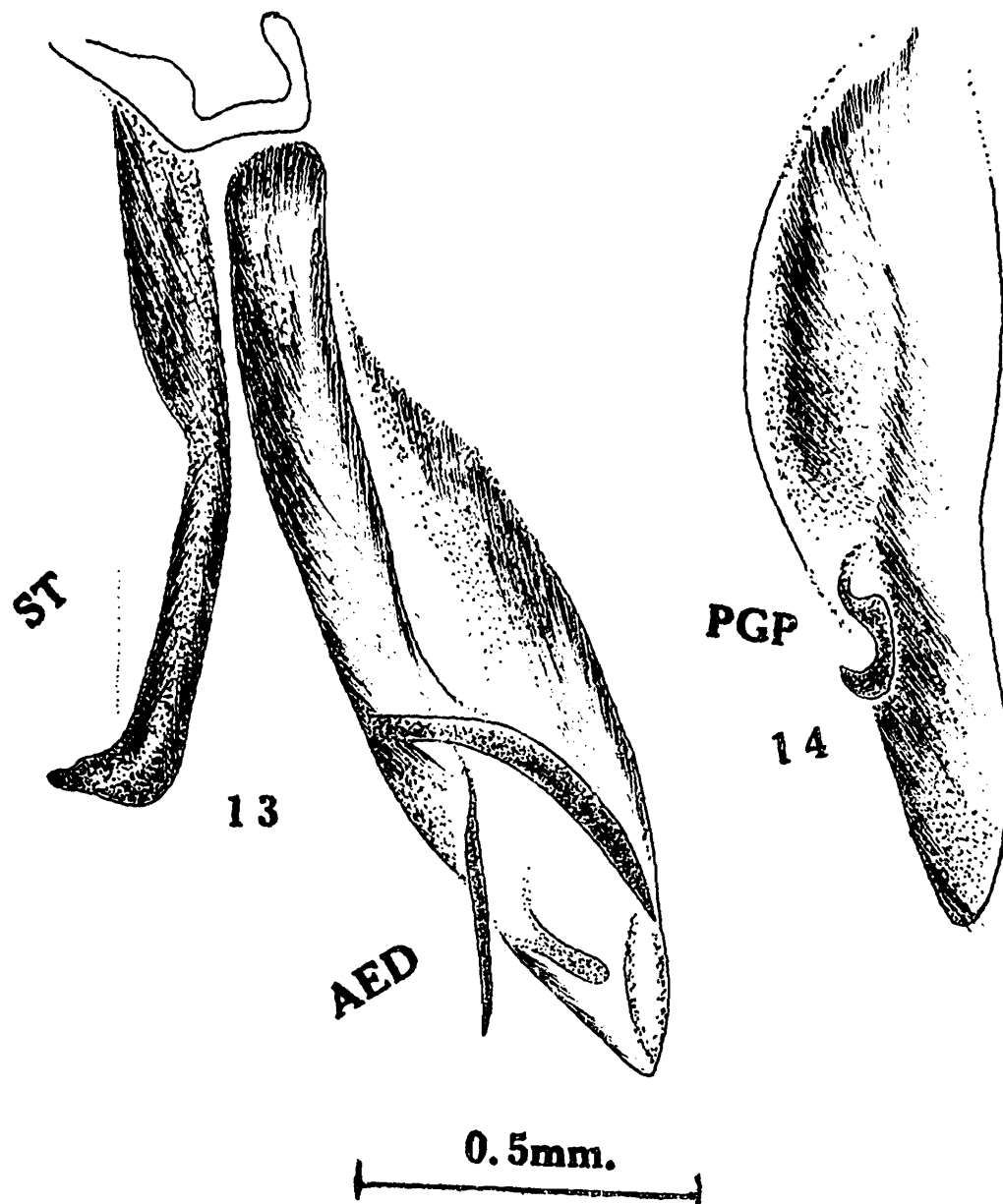
(Fig. 15)

Lethierry, 1876, *Pet. Nouv. Ent.* 2 : 26.

Material : Russia (A. N. K.), exchange material (Ind. Mus. Coll. 2-VI-31). Anterior margin of crown including clypeus dark shiny brown, excluding central and antero-lateral margin, median suture of crown on each side with dark brown patch ; pronotum creamy, disc with dark brown patches ; scutellum with dark brown patches ; scutellum dark brown, shiny.

Length : 4 mm. (male)

Genitalia : Connective Y-shaped, aedeagus (fig. 15) at base funnel-shaped, cylindrical, drawn to a filamentous process ; style (fig. 15) with mesal apical extension distinctly serrate



Figs. 13-14. *Ledra quadricarina* Walk.

Aedeagus (Fig. 13), Style (Fig. 13), Pygofer (Fig. 14).

at posterior part ; male plate sulcate at sagittal half ; pygofer conico-acuminate, a strongly bent hook along mesal margin.

Morphology : Median length of crown, half length of interocular width, posterior half densely granulate, foveate on each side of median suture ; ocelli in line with anterior

eye-angles, equidistant from each eye ; clypeal surface densely granulate ; pronotal width greater than transocular width, angulate laterad, disc rugulose ; tegmina shiny, granulate.

Distribution : Ukran, Crimea, Italy

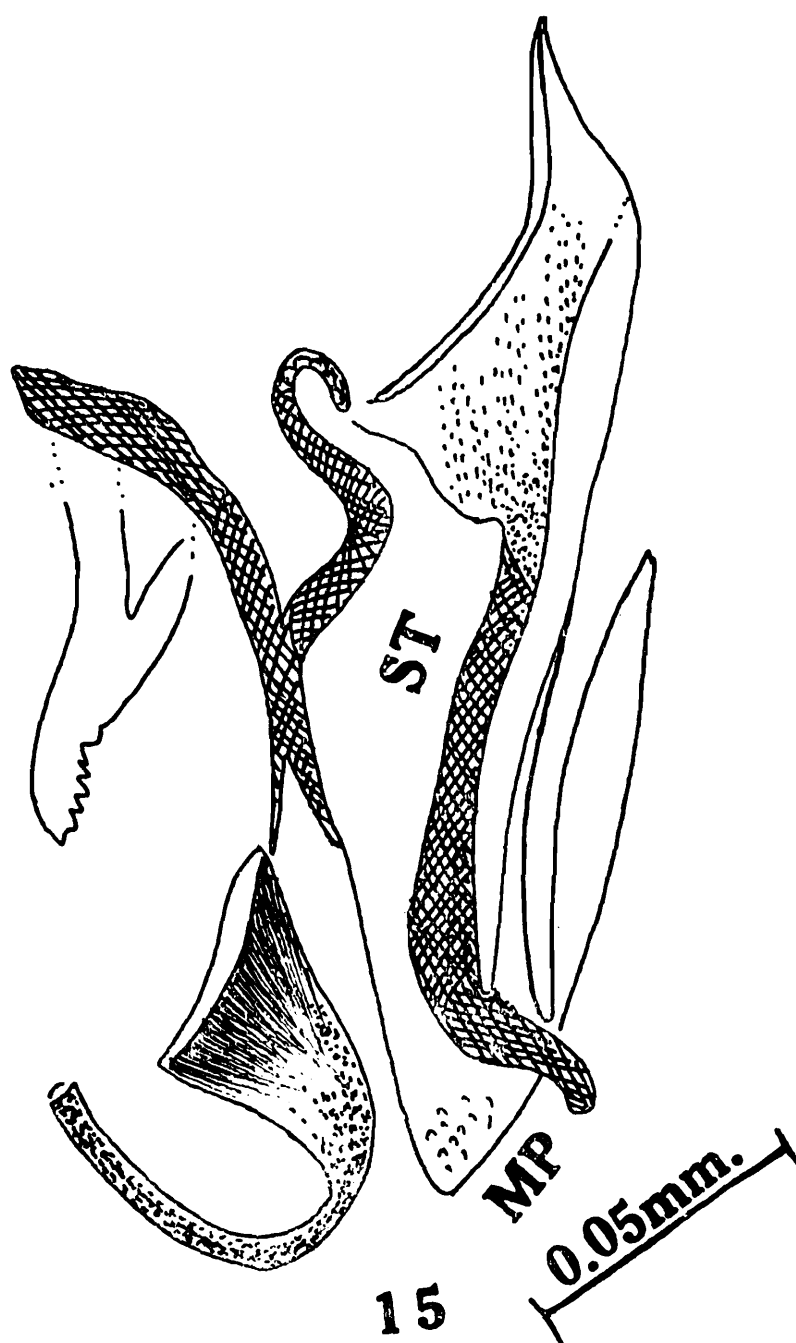


Fig. 15. *Anoterostemma ivanhofi* (Leth)
Aedeagus, Style (Fig. 15).

8. **Gurawa vexillum** Distant, 1908
(Fig. 16)

Distant, 1908, *Fauna Brit. India*. 4 : 263.

Material : Sikkim, 29-III-1975 (Ind. Mus. Coll.).

Vertex subtriangulate, a black band (female) extending from middle of facial area to anterior margin of pronotum, some times absent in male, lateral margin with a pair of black spots on each side, pronotal surface coriaceous ; scutellum with three minute

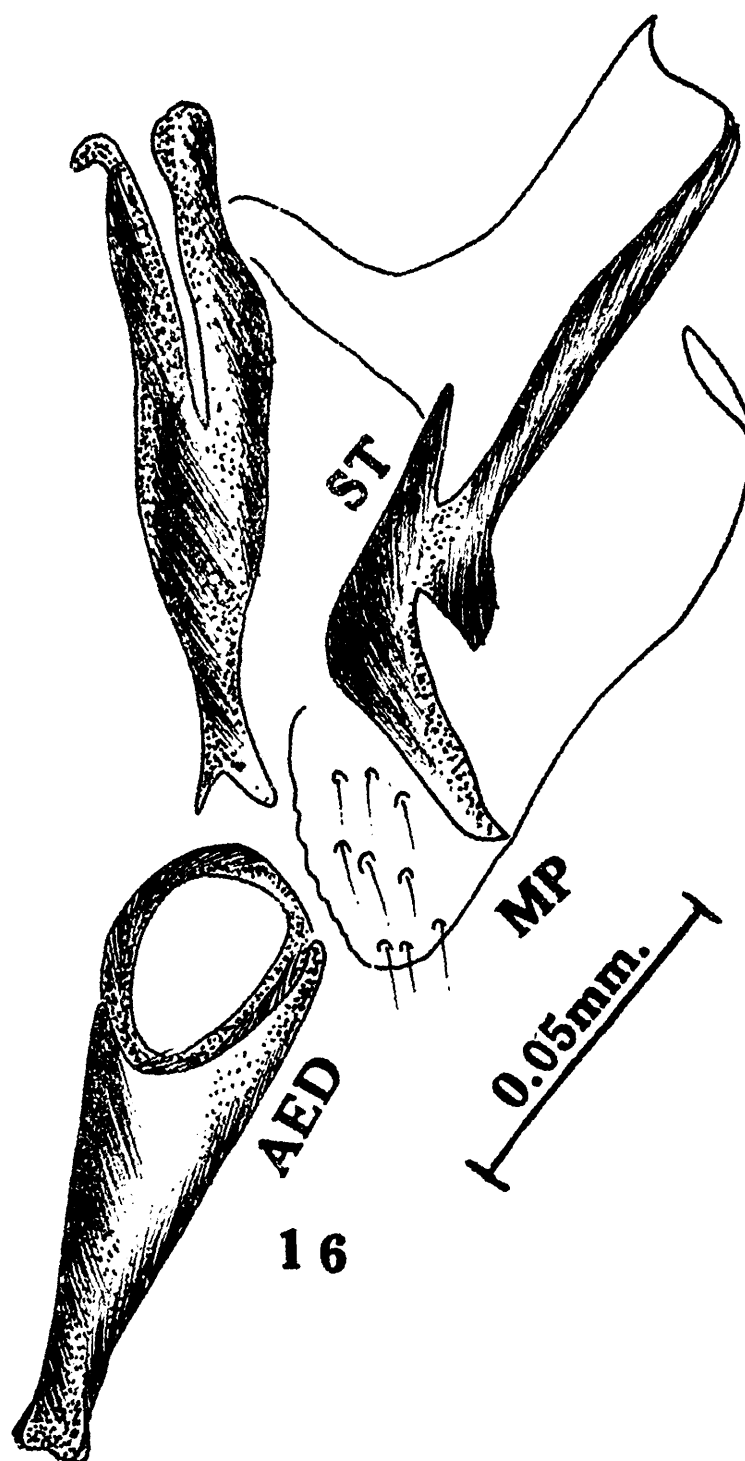


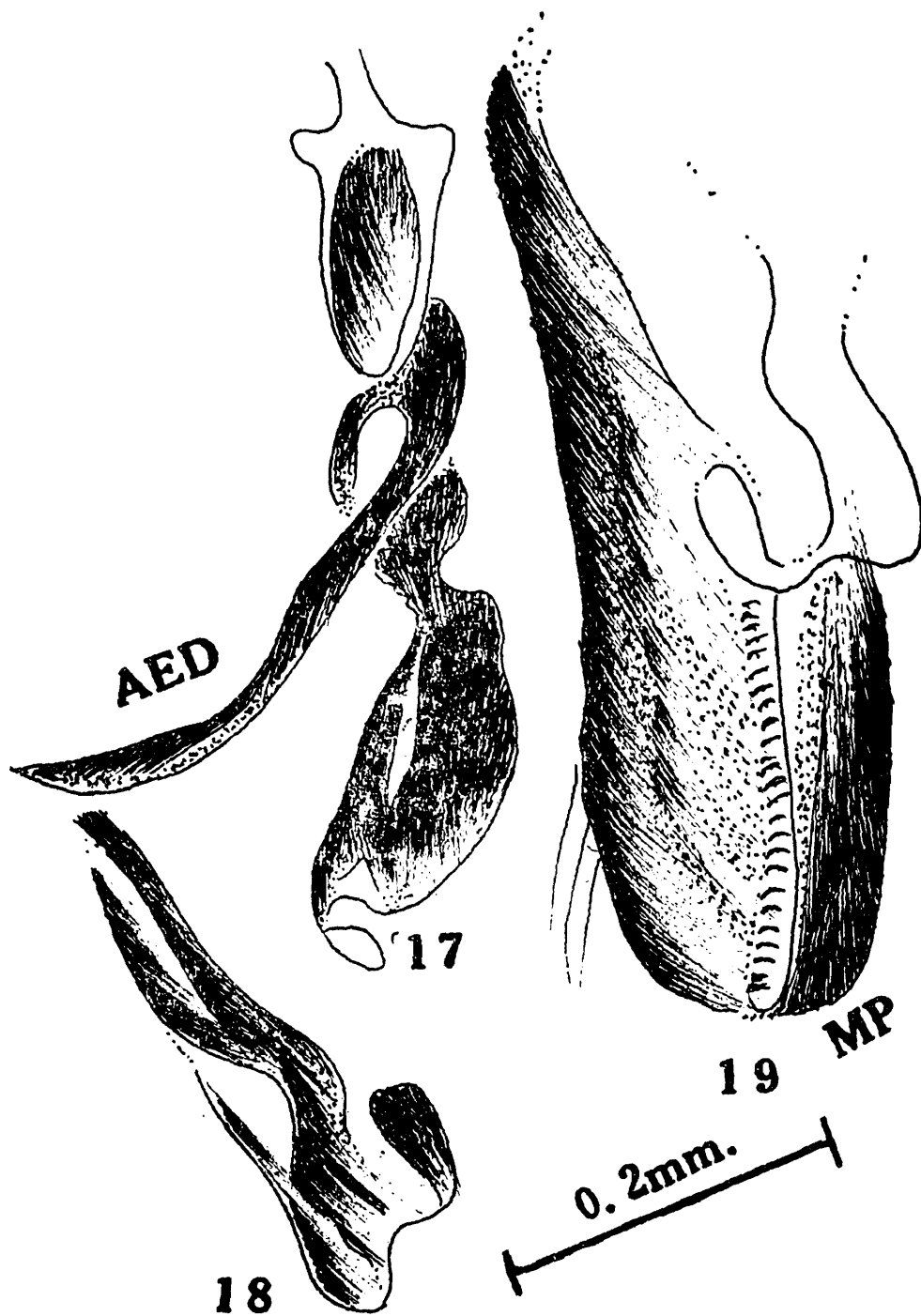
Fig. 16. *Gurawa vexillum* Dist.
Aedeagus, Style, Pygofer (Fig. 16).

black spots ; tegmina semi-transparent, apical cells short ; anterior femora with dark brown bands.

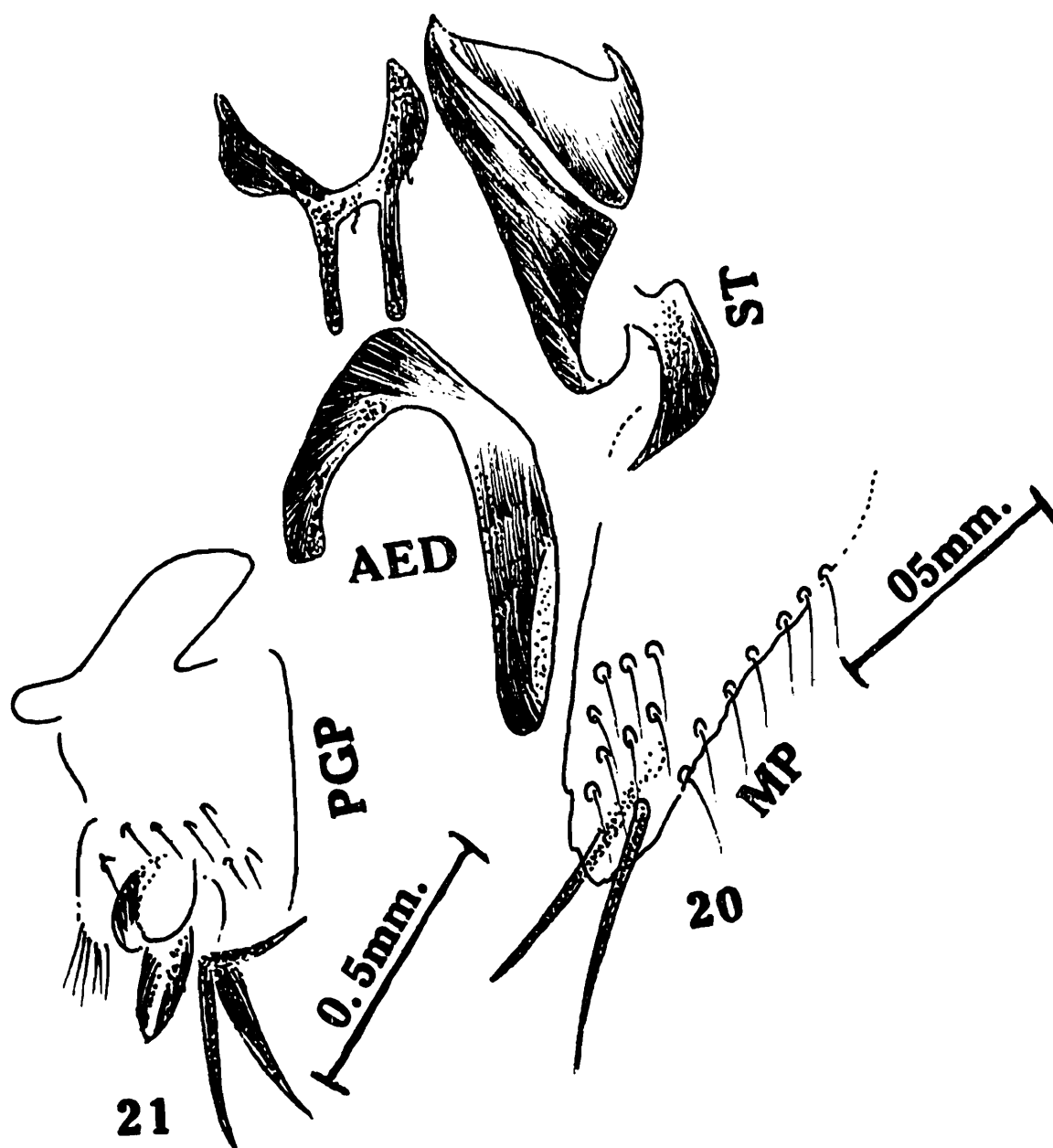
Length : 4 mm. (male), 4.5 mm (female).

Genitalia : Connective Y-shaped, aedeagus

funnel-shaped, attenuate gradually ; style with mesal apical extension deeply emarginate, apex conico-acuminate, medially with a strip of nodulate structures extending upto apex ; male plate short, triangulate, setose ;



Figs. 17-19. *Leofa unicolor* Dist.
Aedeagus (Fig. 17), Style (Fig. 18), Male plate (Fig. 19).

Figs. 20-21. *Banus oblatu* Dist.

Aedeagus, Style, Male plate (Fig. 20), Pygofer (Fig. 21).

pygofer densely spinulose; anal lobe with a pair of hooks directed cephalad.

Distribution : Sikkim, Madras.

9. *Leofa unicolor* Distant, 1918

(Figs. 17-19)

Distant, 1918, *Fauna Brit. India*. 7 : 88.

Material : Harrai, Rewa State, M. P., 17-II-27 (H. S. Pruthi). Vertex subtriangulate,

face with dark brown stripes; pronotum, scutellum dark reddish brown, sometimes with patches; tegmina with a series of transverse reddish spots; legs reddish brown.

Length : 4 mm. (female), 3 mm. (male).

Genitalia : Connective U-shaped, aedeagus (fig. 17) short, apical margin truncate, shaft elongate, twisted; style (fig. 18) with mesal apical extension emarginate at apical margin,

densely rugulose ; male plate (fig. 19) setose on lateral margin, thickly dentate ; pygofer quadrate, a short, re-curved hook arising posteromesally, directed cephalad ; seventh sternite (female) projected at posteromesal margin, apex truncate, surface, densely spinulate.

Distribution : South India

Subfamily EUSCELINAE

10. **Banus oblatulus** Distant, 1908

(Figs. 20-21)

Distant, 1908, *Fauna Brit. India*. 4 : 353.

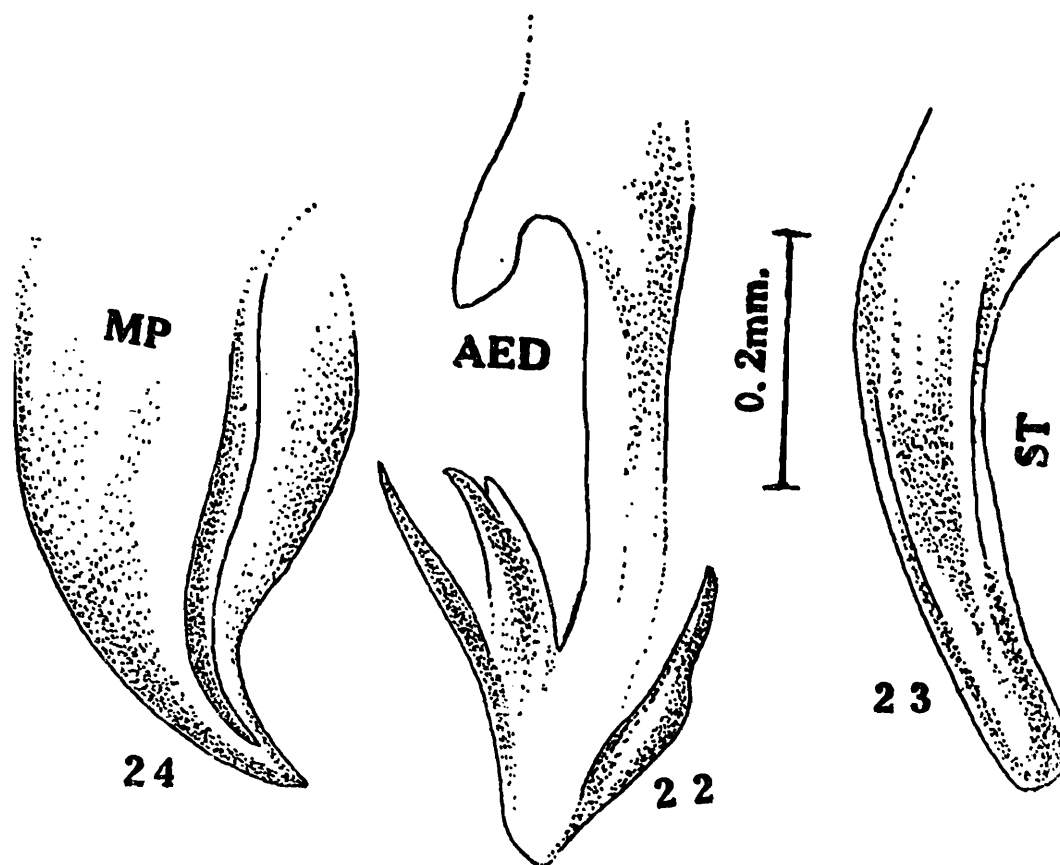
Material : Paradeniya, Ceylon, XI-1910
(Ind. Mus. Coll.)

Vertex subtriangulate, posterior margin deeply emarginate, disc with black spots ; tegmina reddish brown, apical cells with dark brown patches (male) ; legs reddish brown.

Length : 4.5 mm (male)

Genitalia : Connective Y-shaped, aedeagus (fig. 20) with a pair of subapical processes, directed cephalad ; style (fig. 20) with mesal apical extension attenuate gradually ; male plate (fig. 20) subtriangulate, setae multi-seriate laterad ; pygofer (fig. 21) sub-quadrate disc with macrosetae.

Distribution : Tennasserim, Burma



Figs. 22-24. *Calonia signata* (Ball)

Aedeagus (Fig. 22), Style (Fig. 23), Male plate (Fig. 24).

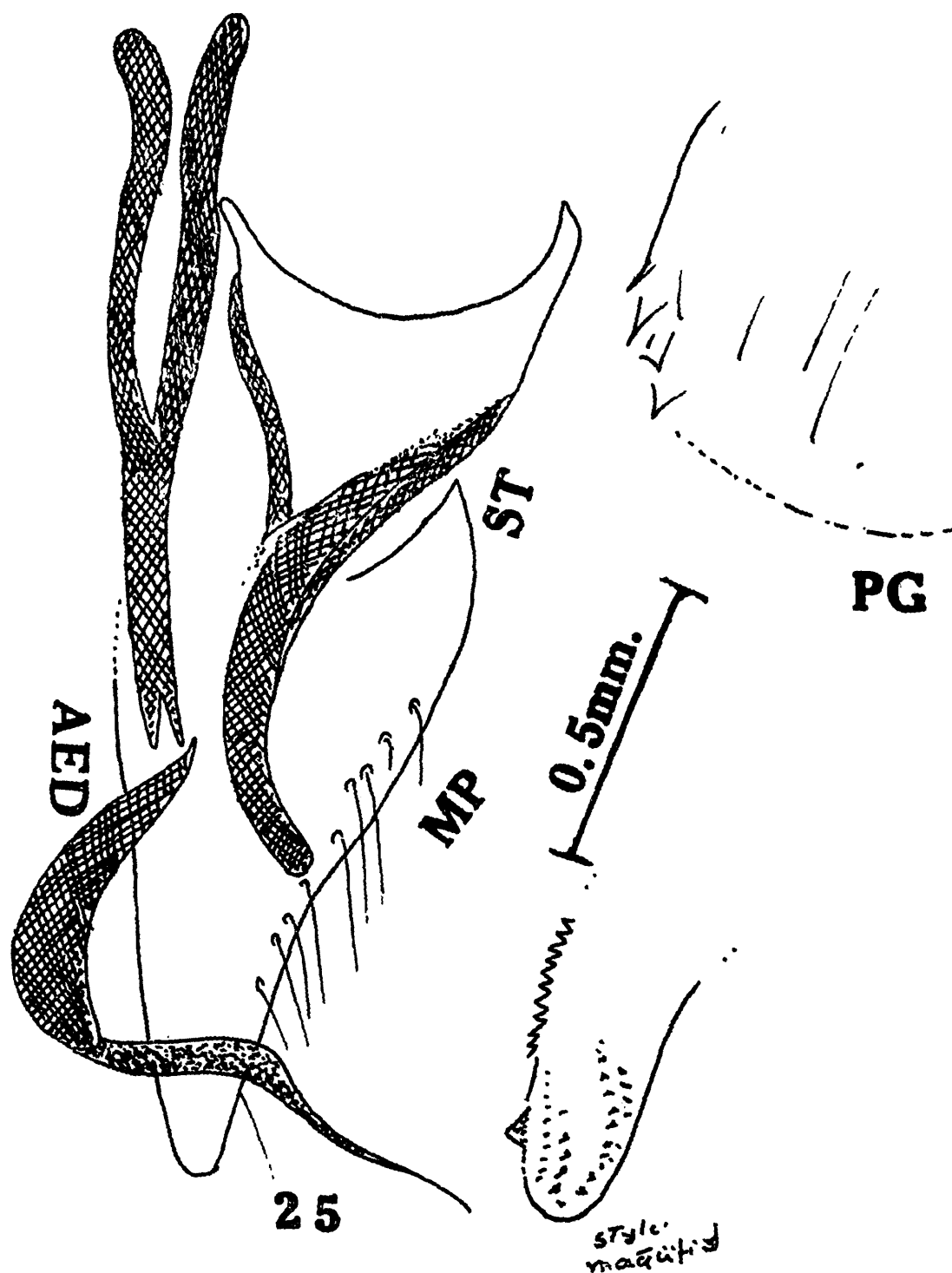


Fig. 25. *Chlorotettix unicolor* (Fitch)
Aedeagus, Style, Male plate (Fig. 25).

11. *Calonia signata* (Ball), 1902

(Figs. 22-24)

Ball, 1902, *Canad. Ent.* 34 : 56

Material : Los Angeles, California, (C. F. Baker), no date.

Vertex angulate, with arched bonds at anterior margin ; pronotum rugulose, with a pair of bands ; scutellar angles spotted with a pair of median bands ; legs dark brown.

Length ; 5 mm (male).

Morphology : Median length of crown half the length of interocular width ; pronotal width equal to transocular width of head, lateral margin smoothly curved ; scutellum medially sulcate.

Genitalia : Connective Y-shaped, aedeagus (Fig. 22) with a short apodeme, two pairs of terminal processes, directed cephalad ; style (Fig. 23) with mesal apical extension strongly curved along median axis, apex truncate ; male plate (Fig. 24) triangulate, setae uniseriate laterally ; pygofer hook robust, beak-shaped.

Distribution : California.

12. *Chlorotettix unicolor* (Fitch), 1851

(Fig. 25)

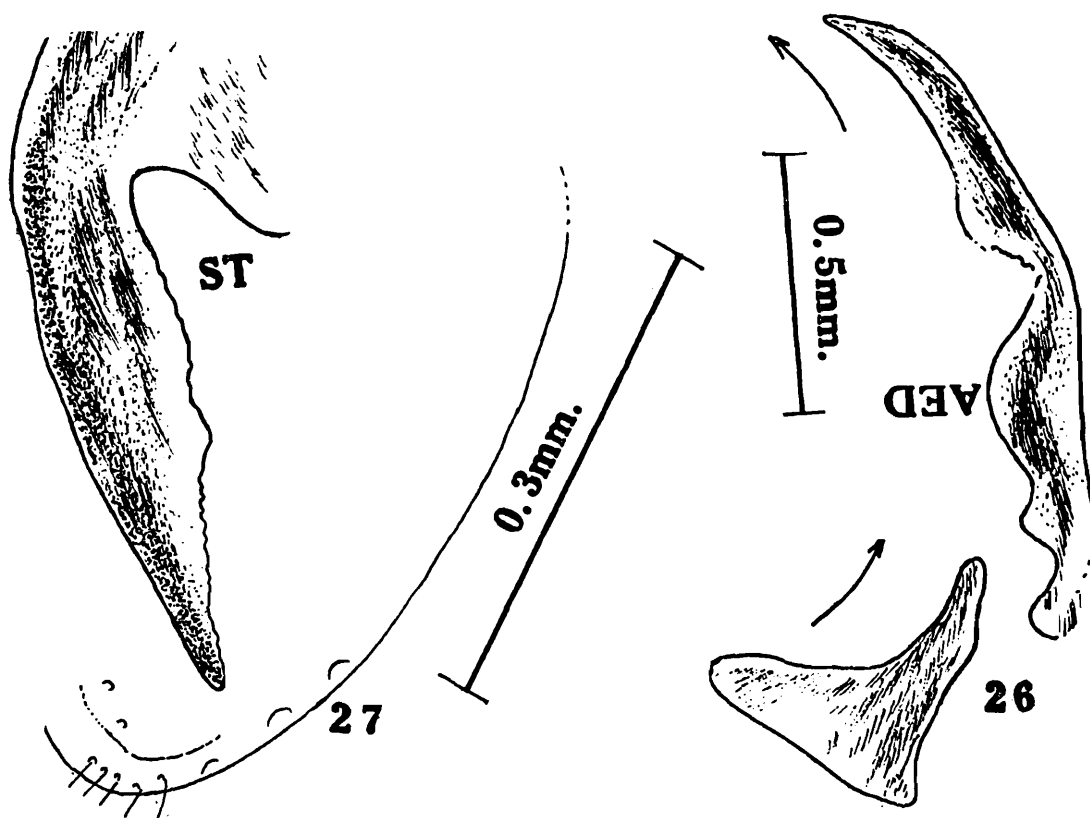
Fitch, 1851, *State Cabinet. Nat. Hist. Ann. Rept.* 4 : 58.

Material : Montreal, Canada, VII-1926 (P. W. Oman). Vertex subtriangulate ; pronotum indistinctly rugulose ; facial area with blackish tinge ; legs pale brown.

Length : 7 mm. (male)

Genitalia : Connective Y-shaped, oval at base, with a pair of terminal filamentous processes ; style with mesal apical extension laterally serrate, subapically tumid, densely spinulate ; male plate with uniseriate setal arrangement laterally, connivent distad ; pygofer latero-medially with short spurs, disc with macrosetae.

Distribution : Manitoba, Staten Island, Columbia.



Figs. 26-27. *Togacephalus distinctus* Mots.

Aedeagus (Fig. 26), Style, Male plate (Fig. 27).

13. **Togacephalus distinctus** (Motschulsky), 1859
(Figs. 26-27)

Motschulsky, 1859, *Etud. Ent.* 8 : 112.

Material : Imphal Valley, Manipure, 10-13-IX-1945 (Ind. Mus. Coll.). Vertex subtriangulate, anterior margin piceous, intercepted by a series of creamy-brown spots ; pronotum, scutellum reddish-brown ; wing semi-transparent ; tibiae with dark spots.

Length : 3 mm. (male), 3.5 mm. (female)

Genitalia : Aedeagus (Fig. 26) elongate, shaft slender, subapically notched, pointed apex ; style (Fig. 27) broader basad, geniculate, mesal apical extension serrate on outer margin, densely rugulose, apex pointed ; male plate (Fig. 27) sub-quadrate, setae uniseriate on lateral margin.

Distribution : Formosa, Korea.

14. **Deltocephalus gopii** Pruthi, 1936
(Figs. 28-29)

Pruthi, 1936, *Mem. Ind. Mus.* II : 127.

Material : Holotype. No. 5419/H7, allotype. No. 5420/H7 (Ind. Mus.) Calcutta, Murree Hills, Punjab, 1936 (Pruthi).

Vertex with a dark brown band extending upto inner margin of eyes ; face including clypeus piceous with yellowish striations (male), facial area with alternate yellowish and dark brown lateral bands intercepted by creamy white longitudinal lines (female) ; sometimes outer margin of each eye with a black spot ; tegmina with oblong dark brown patches ; abdomen black ; prothoracic femur banded dark brown (male).

Length : 4 mm. (male) incl. tegmina.

Genitalia : Connective U-shaped, aedeagus (fig. 28) linear, baculiform, uniform along

length ; style (fig. 28) short, apex foot-shaped ; male plate triangulate, setal arrangement uniseriate on lateral margin ; pygofer (fig. 29) sub-quadrate, disc densely spinulate ; apex bifid, anal hook distinct, stouter one dentate.

Distribution : Punjab.

15. **Deltocephalus pulicaris** (Fallen), 1806
(Figs. 30-31)

Fallen, 1806, *Svenska Vetensk. Akad. Nya Handl.* 27 : 21.

Material : Butler Collection (purchased), no date and locality.

Vertex with fine central suture, pronotum castaneous, shiny ; facial area piceous ; inner margin of each eye bordered dark brown ; pronotum spotted at anterior margin.

Length : 4 mm, (male).

Genitalia : Connective U-shaped, aedeagus (fig. 30) with beak-shaped apex, subapically serrate along central line ; style (fig. 31) laminate, mesal apical extension baculiform, strongly chitinised ; male plate (fig. 31) rugulose transversely, setae uniseriate on lateral margin, a tuft of setae at apex ; pygofer with spinulate apex.

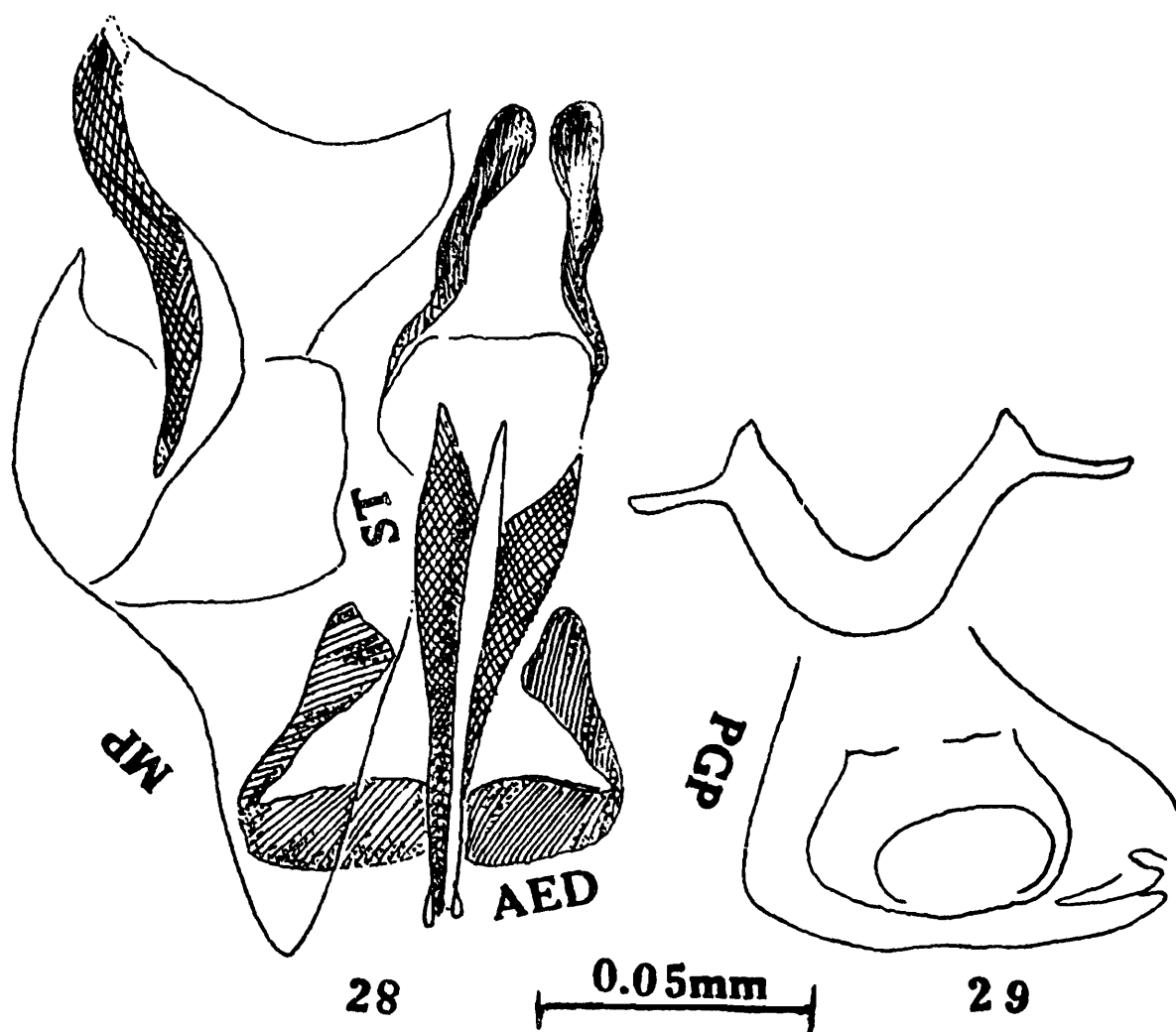
Distribution : Algeria, Moravia, Kiev, Siberia.

16. **Penhularia acuticephala** Beamer, 1934
(Figs. 32-33)

Beamer, 1934, *Pan-Pacific. Ent.* 10 : 43.

Material : Montana, U. S. A. (P. W. Oman). Vertex snout-shaped, ventrolateral margin bordered piceous ; pronotum rugulose, with three creamy bands ; tegmina dark brown.

Length : 9 mm. (male).



Figs. 28-29. *Deltocephalus gopii* Singh-Pruthi
Aedeagus, Style (Fig. 28), Pygofer (Fig. 29).

Morphology : Median length twice interocular width, central carina extending upto anterior pronotal margin ; ocelli placed in a shallow depression ; clypeus granulate, pronotal disc rugulose.

Genitalia : Connective Y-shaped, aedeagus (fig. 32) with a distinct basal apodeme, a pair of subterminal processes directed cephalad ; style (fig. 33) at apex with irregular denticulations ; male plate (fig. 33) with uniseriate setae laterad, mesal margin spinulate ; pygofer (fig. 32) densely spinulose at caudal margin.

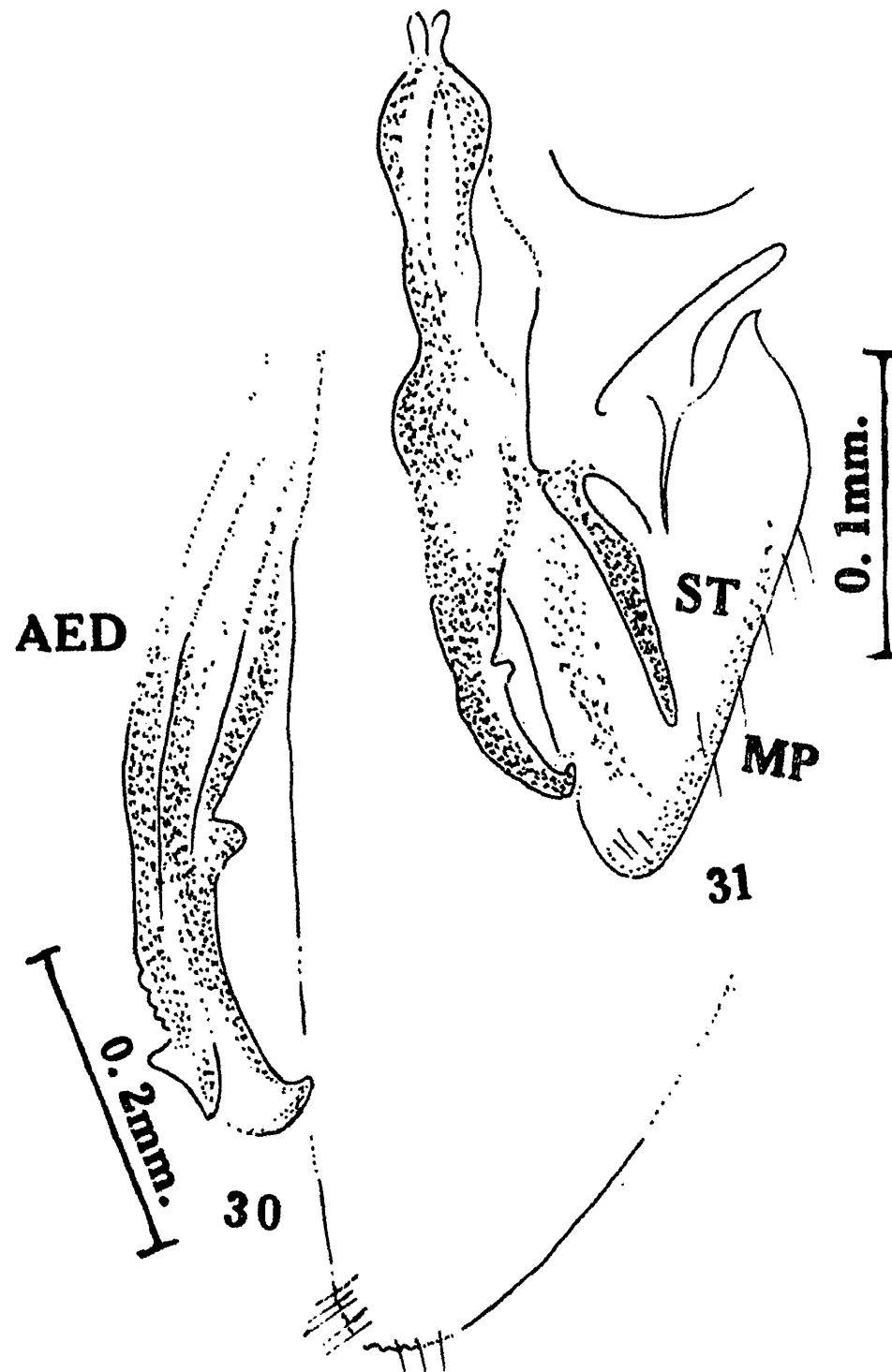
Distribution : California.

17. *Stirellus obtutus* (Van Duzee), 1892 (Figs. 34-35)

Van Duzee, 1892, *Canad. Ent.* 24 : 115.

Material : Mississippi, U.S.A., Nov. 1894 (C. F. Baker).

Vertex with a pair of sub-rectangulate dark brown spots, facial area ivory-creamy colour, laterally striped, a black patch at posterior margin ; pronotum with a pair of spots, anterior margin granulated (female), posterior margin banded brown, rugulose (male) ; scutellum at base spotted ; tegmina with a linear dark brown marking, apical cells dark



Figs. 30-31. *Deltocephalus pulicaris* Fallen
Aedeagus (Fig. 30), Style, Pygofer (Fig. 31).

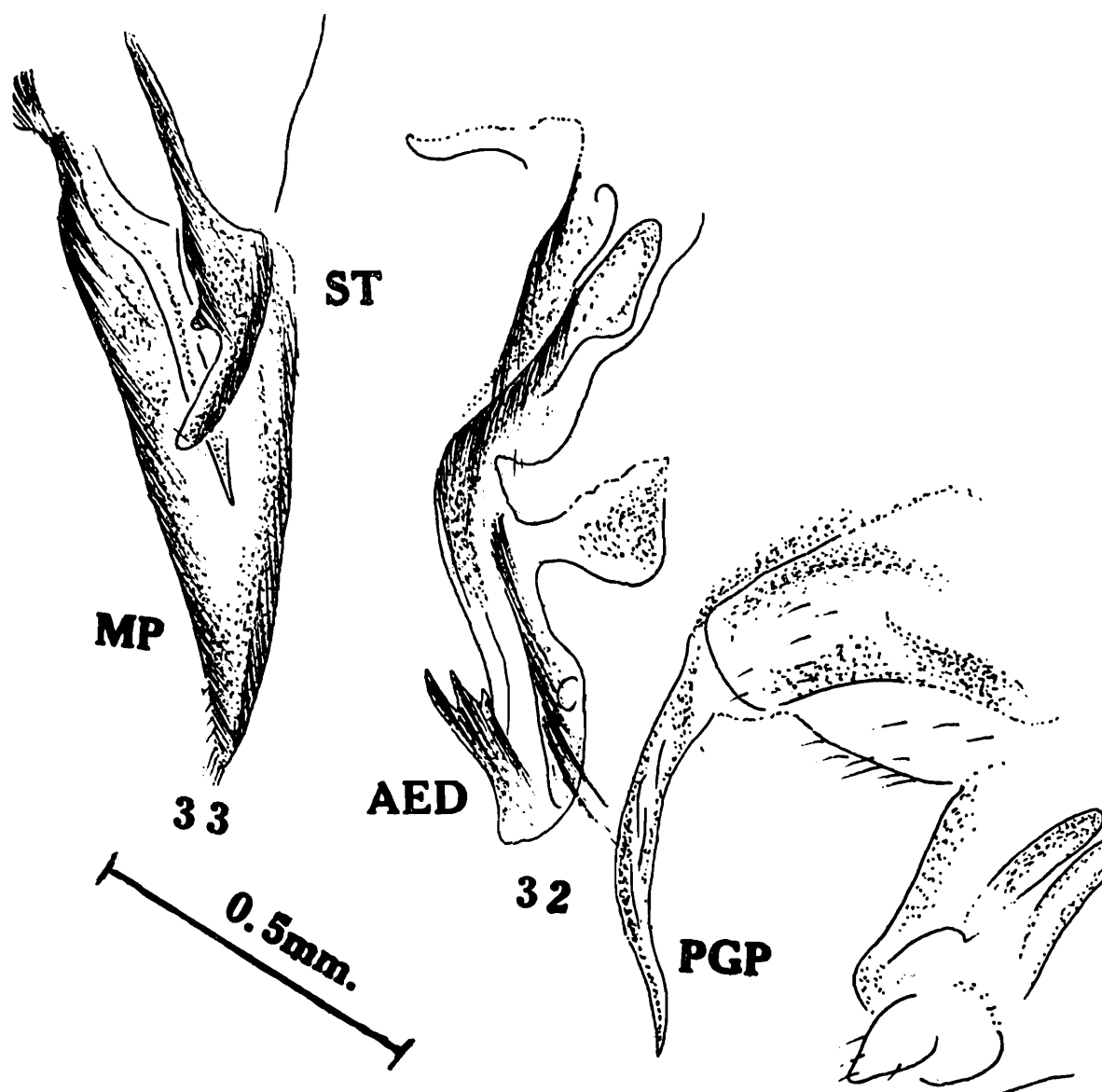
brown; abdominal segments with alternate brown and sanguineous bands.

Length : 3 mm. (male), 3.7 mm (female).

Morphology : Median length of crown equal to interocular width, surface granulate, anterior margin subconical; clypeal area flat;

pronotal width equal to transocular width, laterally angulate, posterior margin concavus, surface wrinkled; scutellum with a transverse median-sulcus; posterior tibiae densely spinulate.

Economic importance : The species is



Figs. 32-33. *Penohularia acuticephala* Beamer
Aedeagus, Pygofer (Fig. 32), Style, Male plate
(Fig. 33).

recorded as spreading Mosaic and streak virus diseases to rose plants (Brierley, 1940 : 648).

Distribution : Mississippi, Minnesota, Missouri, Cuba, Arizona, Texas, Illinois, Florida, Maryland.

18. *Texananus superbus* (Van Duzee), 1892
(Figs. 36-37)

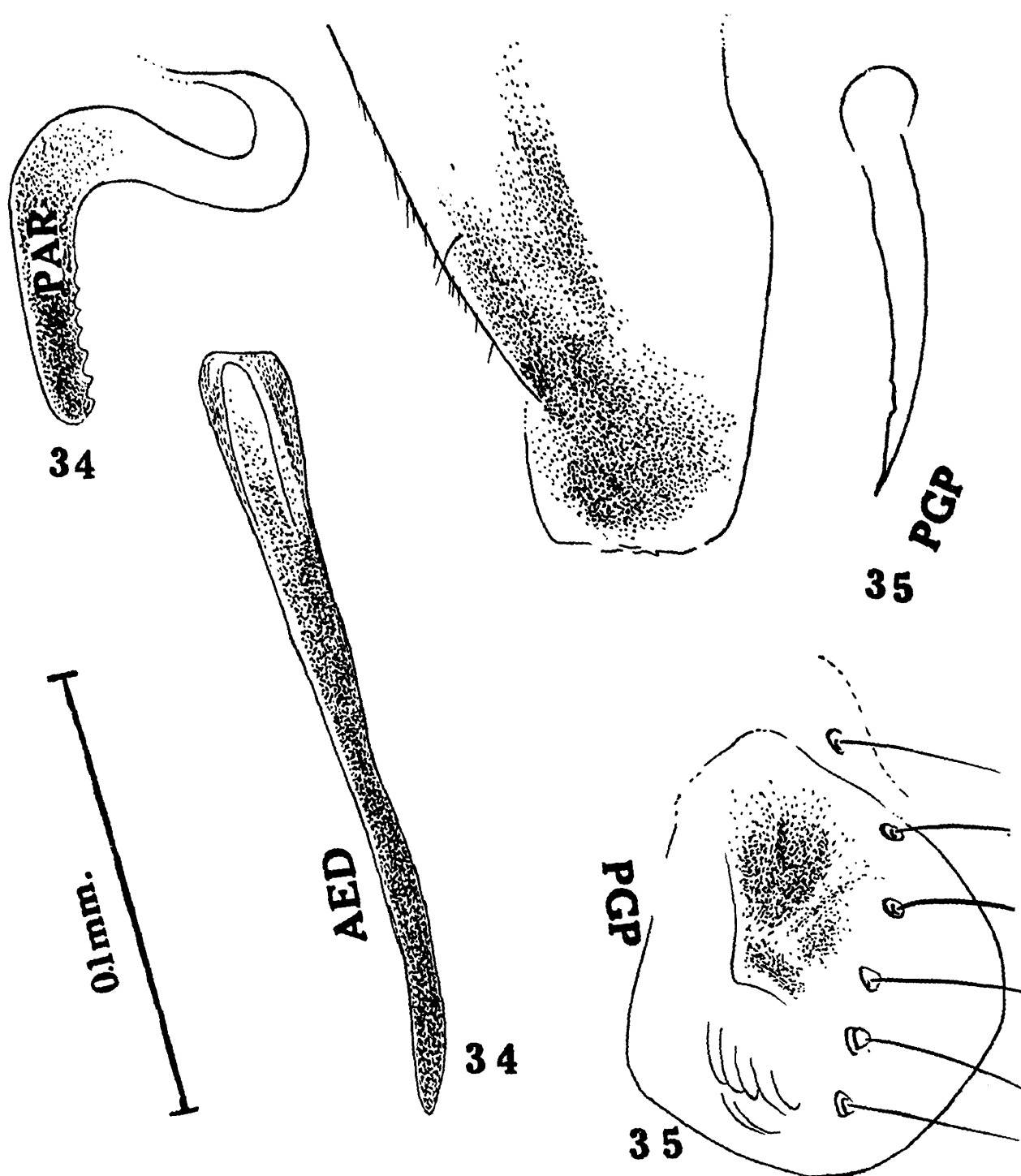
Van Duzee, 1892, *Trans. Amer. Ent. Soc.* **19** : 81.

Material : California, Hot Spring, 2-V-1927 (E. R. L.).

Vertex including facial area mottled with black pigments and creamy-white spots ; pronotum and scutellum creamy-white with blackish tinge ; scutellum with a pair of linear bands on transverse furrow ; tegmina ornamented with dark brown markings, series of ivory-colored spots along commissure ; first femora banded.

Length : 6 mm (male).

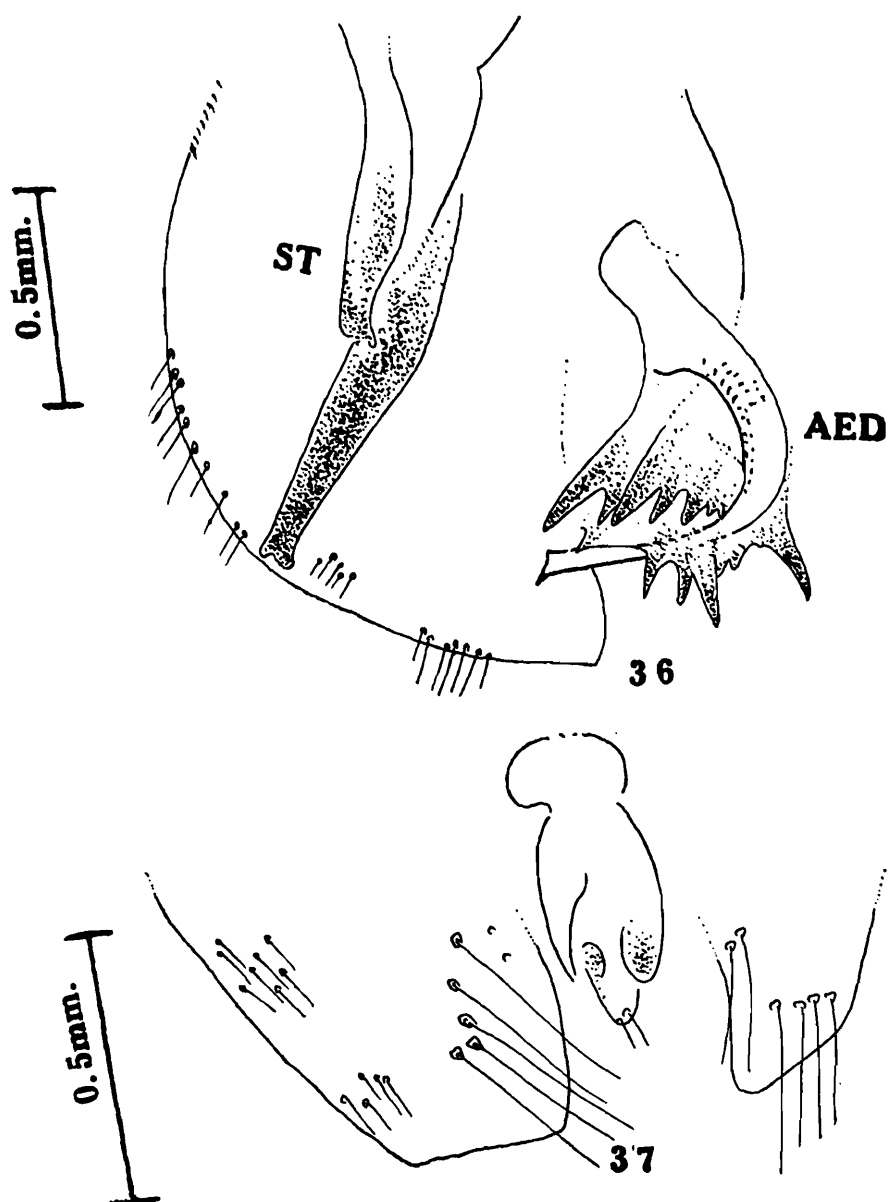
Genitalia : Connective with broader arms ; aedeagus (figs. 36) broader basad, finely

Figs. 34-35. *Stirellus obtutus* (Van Duz)

Aedeagus, Style, Male plate (Fig. 34), Pygofer (Fig. 35).

serrate, nodulate, apex with a short pointed process; style (fig. 36) densely nodulate, postero-apical margin serrate, apical margin notched; male plate (fig. 36) marginally with multiseriate setal arrangement; pygofer (fig. 37) disc with long setae beyond middle.

Morphology: Crown half the length of interocular width, foveate at posterior margin, finely granulate; pronotal width equal to transocular width; scutellum indistinctly carinate, granulate; hind femoral setal formula: 2 : 1 : 0.



Figs. 36-37. *Texananus superbis* Van Duz
Aedeagus, Style, Male plate (Fig. 36), Pygofer
(Fig. 37).

Distribution : Arizona, Colorado, Florida, Alabama.

Subfamily TARTESSINAE

19. *Tartessus ferrugineus* (Walker), 1851
(Fig. 38)

Walker, 1851, *List. Brit. Mus.* 3 : 865.

Material : Baratang, South Andaman,
17-III-1964 (B. S. Lamba)

Vertex angularly-rounded, apex narrower, sulfur-yellow, extreme anterior margin black ; pronotum, scutellum, abdomen golden-yellow ; sternal plates laterally black, tegmina bronzy-yellow, veins dark brown, costa beyond middle blue-black, abdomen black.

Length : 8 mm. (male), 10.5mm. (female).

Genitalia : Aedeagus with an well-deve-

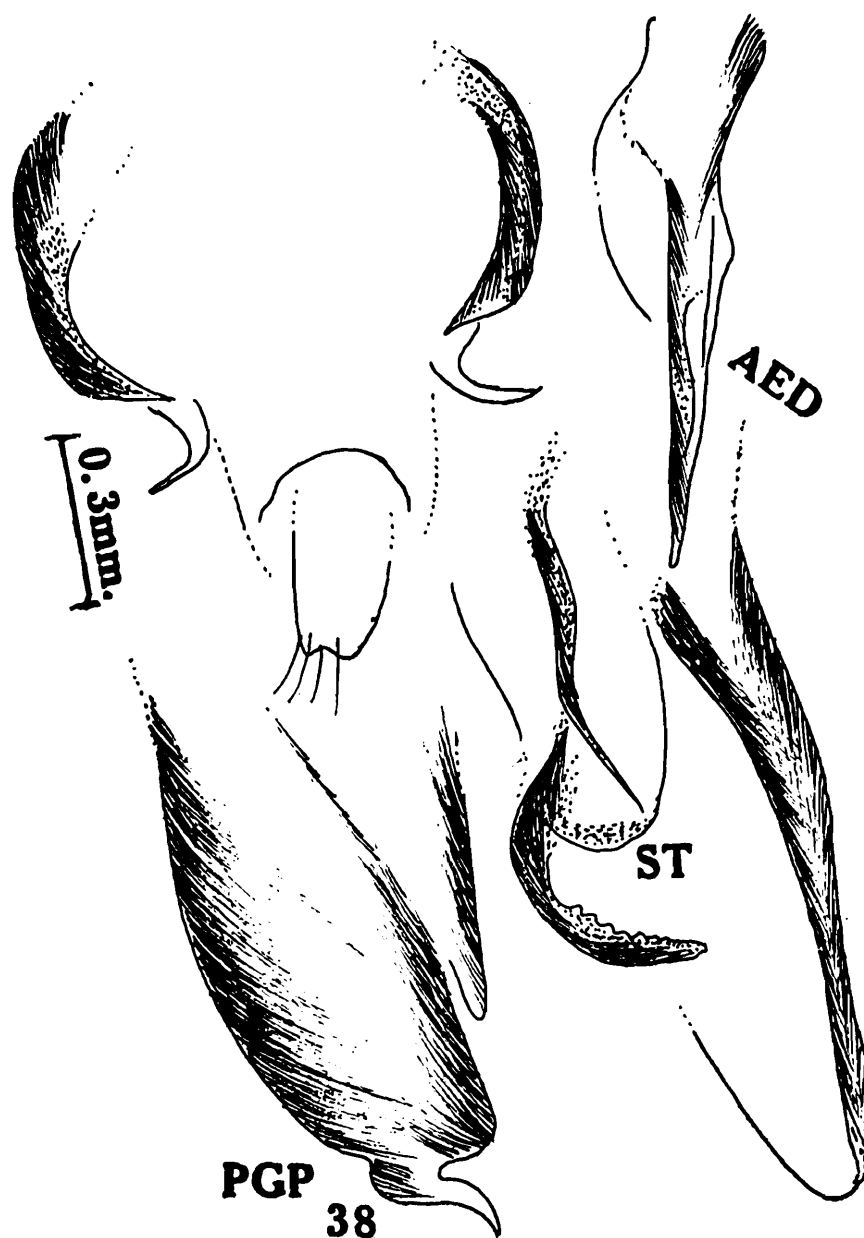


Fig. 38. *Tartessus ferrugineus* (Walk)
Aedeagus, Style, Male plate, Pygofer (Fig. 38).

loped basal apodeme, linear, latero-basally serrate, attenuate gradually; style $\frac{3}{4}$ th broader, mesal apical extension arched, margin nodulate; male plate with a tuft of microsetae at subapical area; pygofer rectangulate, a short, stout hook arising posteromesally, directed laterad; anal hooks bifid, outer one elongate, inner one slenderer, arcuate, pointed,

Economic importance: The species is recorded as pest on citrus and on subtropical fruits.

Distribution: Java, Borneo, Philippine Islands.

20. *Tartessus ferrugineus* Walk. var. a
(Fig. 39)

Material: Kiaano, Formosa (no data)

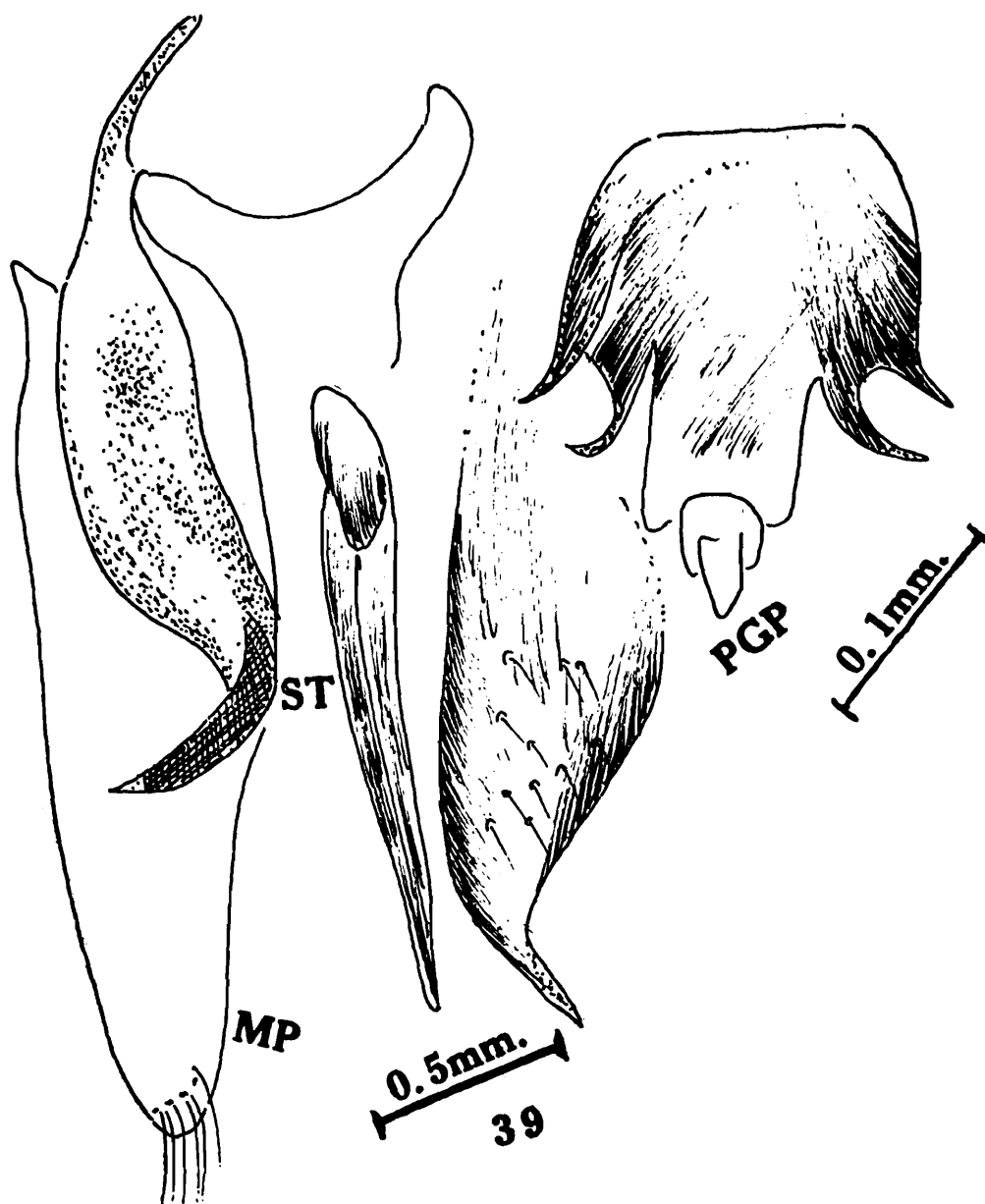


Fig. 39. *Tartessus ferrugineus* var. a.
Aedeagus, Style, Male plate (Fig. 39).

(Ind. Mus. Coll.). Clypeus with a pair of spots, costal margin without any linear dark blue patches.

Length : 7 mm. (male).

Genitalia : Connective Y-shaped, aedeagus linear, pointed apically ; style 2/3rd broader, mesal apical extension pointed at apex ; a series of nodules along subapical margin ; male plate subtriangulate, apex with

a tuft of setae ; pygofer beak-shaped apically, a short hook arising close to apex ; anal hooks stout, inner one spanner-shaped.

Remarks : The species is considered as variety owing to having spots on clypeal area, and without any patches on costal margin.

21. *Tartessus ferrugineus* Walk. var. b
(Fig. 40)

Material : Kusaru, Formosa (Ind. Mus. Coll.)

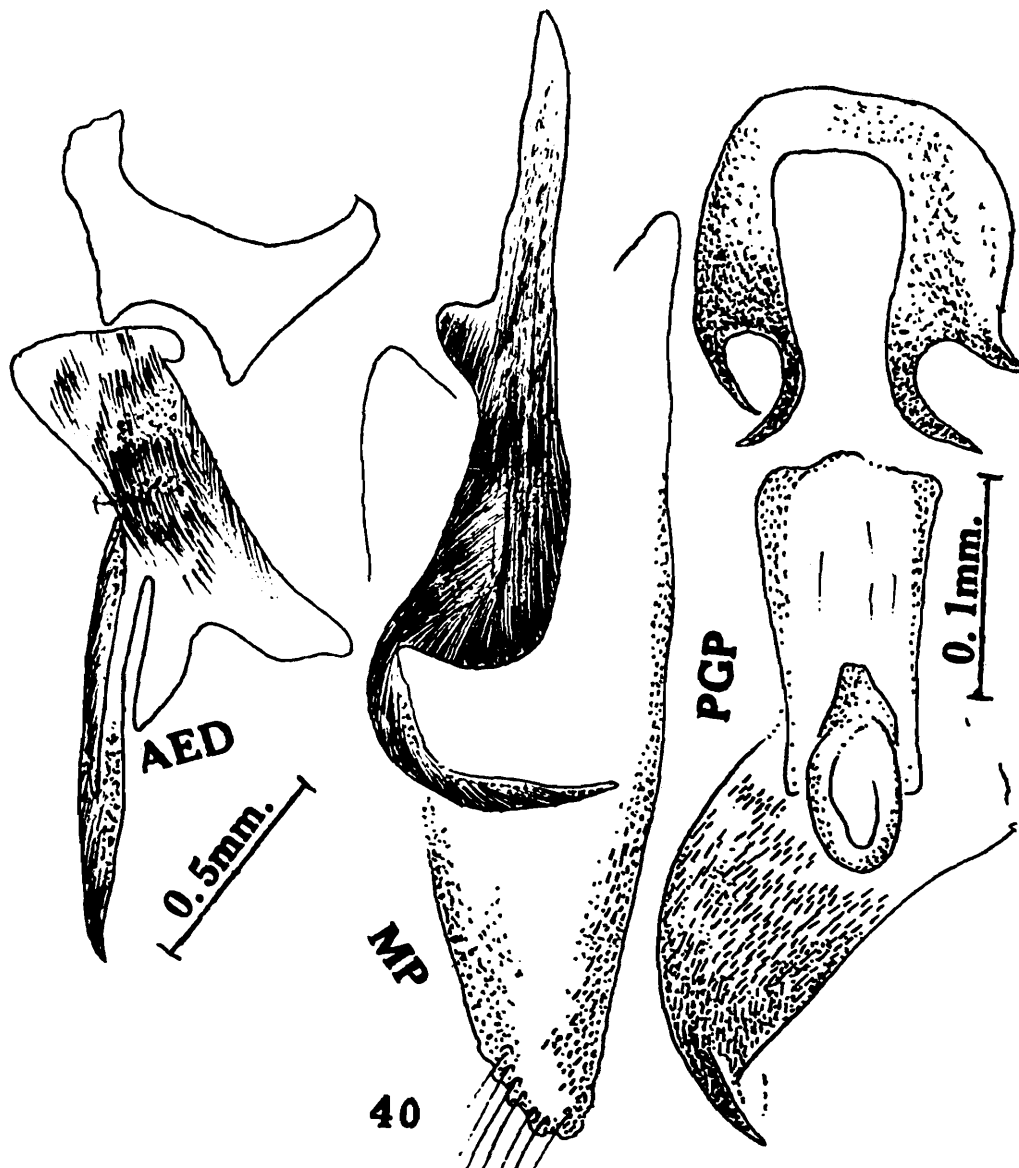


Fig. 40. *Tartessus ferrugineus* var. b.
Aedeagus, Style, Pygofer (Fig. 40).

The species is being recorded as var. b. because of two dark bands on anterior margin of vertex and spotted clypeus.

Length : 8 mm. (male), 9mm. (female).

Genitalia : Connective Y-shaped, apical margin emarginate ; aedeagus with developed apodeme, cylindrical, apex drawn out to a pointed structure ; style with strongly geniculate mesal apical extension, gradually sharply attenuate ; male plate subtriangulate ;

pygofer hook arising posterolaterally ; anal hook spanner-shaped.

Subfamily NIONINAE

22. *Nionia palmeri* Van Duzee, 1891

(Fig. 41)

Material : Washington, 26-V-31 (P. W. Omam).

Body dark black including facial area ;

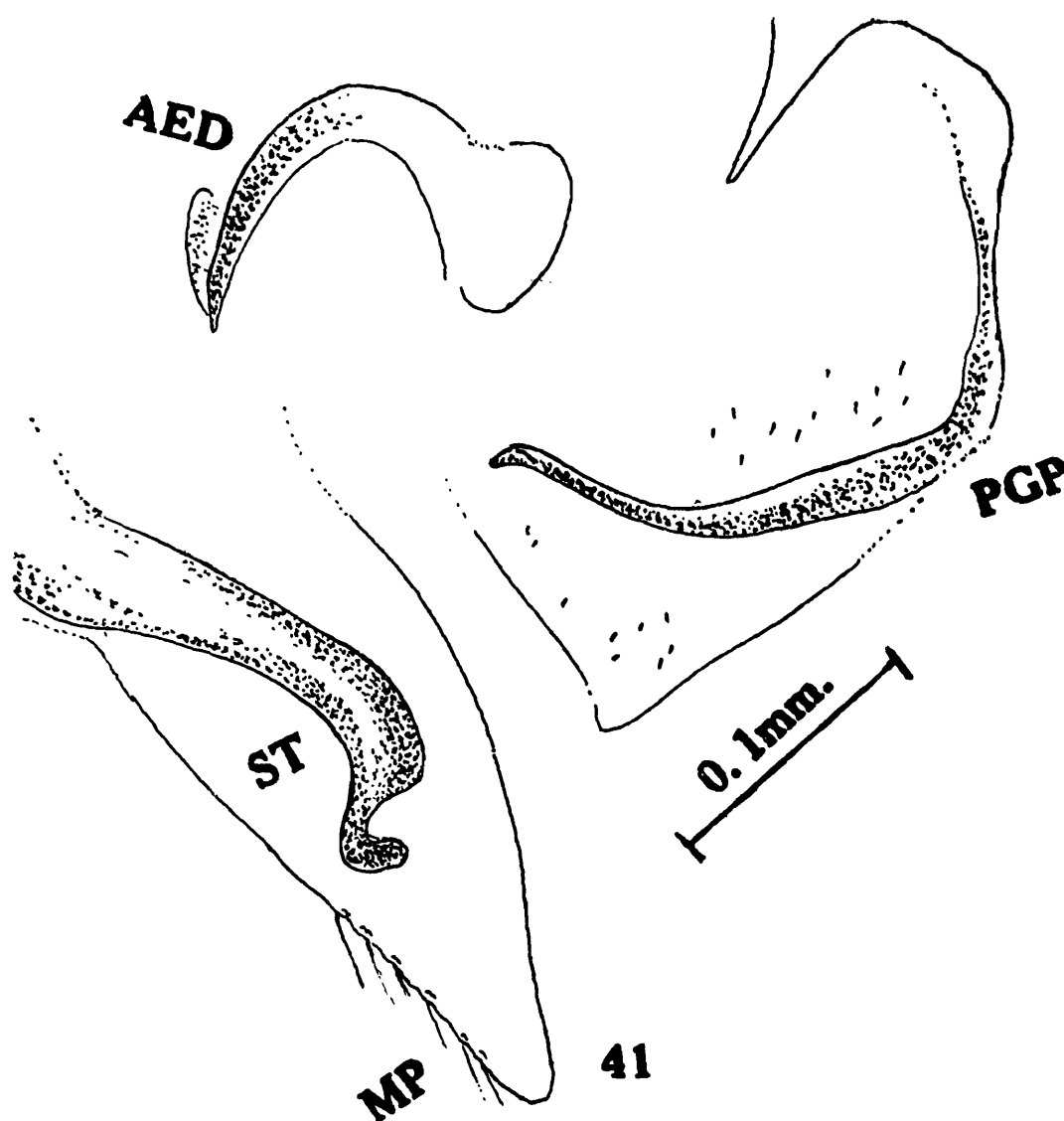


Fig. 41. *Nionia palmeri* Van Duz
Aedeagus, Style, Male plate, Pygofer (Fig. 41).

tegmina piceous, punctate, apical cells dark brown.

Length : 3.5 mm. (male).

Genitalia : Connective Y-shaped, proximally with 2 pairs of short, pointed spurs ; aedeagus arcuate lengthwise, linear, apex acuminate, beak-shaped, subapically bulging ; style with beak-shaped mesal apical extension ; male plate marginally with a row of filamentous setae ; pygofer subquadrate, pygofer hook arising laterobasally, disc with a set of microsetae.

Morphology : Median length of crown $\frac{1}{5}$ th of interocular width, crown, clypeal surface pitted ; ocelli closer to eyes ; pronotal and scutellar surface punctate ; hind femoral setal formula : 2 : 1 : 0 ; tegminal veins with linear punctations.

Distribution : Staten Island, New York, Kansas.

Subfamily AGALLINAE

23. *Aceratagallia* (Sub. gen. *Ionia*) *triunata*
(Ball), 1933

(Fig. 42)

Ball, 1933, *Brooklyn Ent. Soc. Bul.* 28 : 226.

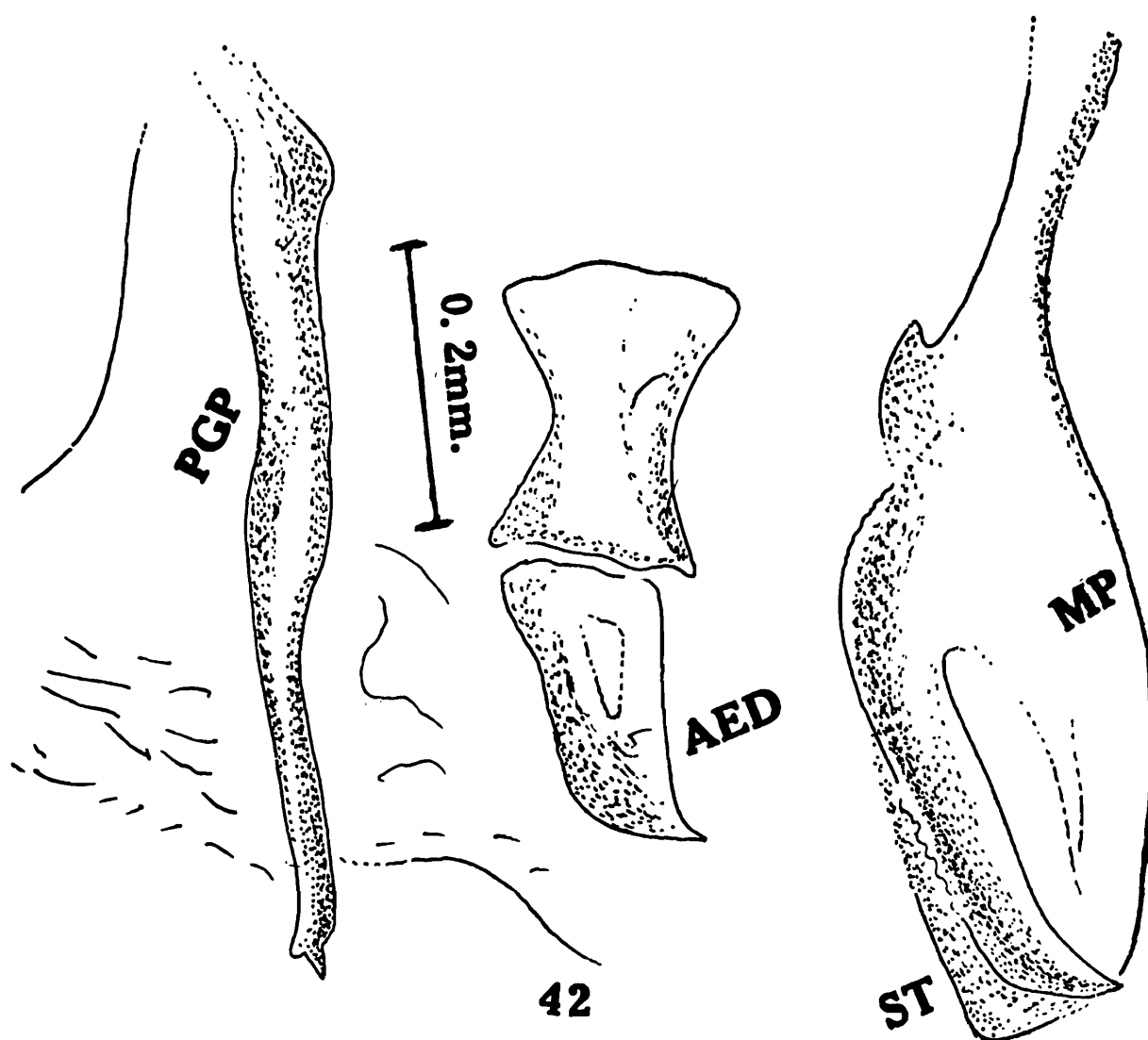


Fig. 42. *Aceratagallia triunata* (Ball)
Aedeagus, Style, Male plate, Pygofer (Fig. 42).

Material : Sabino, Can, AR/2, 22-VI-33 (P. W. Oman).

Vertex, pronotum, tegmina and legs castaneous.

Length : 2 mm. (male).

Morphology : Median length of crown half interocular width, surface pitted, clypeal surface granulate ; pronotal surface rugulose, sparsely punctate ; scutellar granulate at anterior half, posterior half rugulose ; tegmina granulated, hind femoral setal formula : 2 : 1 : 0.

Genitalia : Connective rectangulate, aedeagus as figured : style robust, mesal apical extension geniculate basad, mesal margin dentate ; male plate laterally infolded ; pygofer medially with a long linear hook, a short spur at apex.

Distribution : Arizona, North America.

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ON THE STATUS OF SOME DIGENETIC TREMATODES OF MARINE FISHES OF INDIA

By

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Zoological Survey of India, Calcutta.

ABSTRACT

This study was prompted after detecting certain inaccuracies in the literature developed recently, and overlappings of accounts of some species of digenetic trematodes of marine fishes of India from almost the same areas along the coasts of India. The study is well supported by collections of relevant material. As a result of the study of this material, *Lasiotocus hasti* Madhavi, 1974 and *Retractomonorchis* Madhavi, 1977 fall synonyms of *Genolopa trifolifer* Nicoll, 1915 and *Opisthomonorchoides* Parukhin, 1966 respectively. Further, *Opisthomonorchoides indicus* Karyakarte and Yadav, 1976, *O. indicus* Ahmad, 1977, *O. indicus* Gupta, S. P. and Gupta, R. C., 1978, *O. nigeri* Gupta, N. K. and Puri, 1981, and *Retractomonorchis delicatus* Madhavi, 1977 are considered synonyms of *Opisthomonorchoides karwarensis* Karyakarte and Yadav, 1976 in the family Monorchidae. In view of *Opisthomonorchis carangis* Yamaguti, 1952 and *O. thapari* Varma and Singh, 1979, the genus *Pseudopisthomonorchis* Madhavi, 1974 is considered synonymous with *Opisthomonorchis* Yamaguti, 1952, and thus, Varma and Singh's species becomes identical to *O. carangi* (Madhavi, 1974) n. comb. In the family Deropristiidae Skrjabin, 1958, *Opisthodiplotomorchis* Madhavi, 1974 and three species, viz., *Opisthodiplotomorchis elongatus* Madhavi, 1974, *Skrjabinopsolus indicus* Gupta, V. and Ahmad, 1976 and *S. kurotchkini* Parukhin, 1976 are considered synonyms of *Skrjabinopsolus* Ivanov in Ivanov and Murygin, 1937 and *S. elongatus* (Madhavi, 1974) n. comb. respectively. Similarly, *Karachitrema* Bilgees, 1973 and three species, viz., *K. trilobata* Bilgees, 1973, *Monascus chauhani* Vasantha Kumari, 1975 and *M. elongatus* Karyakarte and Yadav, 1976 are concluded to be synonyms of *Monascus* Looss, 1907 and *Monascus filiformis* (Rud., 1819) Looss, 1907 respectively. Travassos *et al.* (1965) raised the status of the subfamily Monascina Dollfus, 1947 to the rank of family Monascidae which is proposed to be suppressed in favour of Fellodistomidae (Nicoll, 1913) in the light of the important result of the SEM study of *Monascus filiformis* (Rud., 1819) by K  ie (1979) that the oesophagus in its cercariae and adults does bifurcate into two caeca.

INTRODUCTION

During the last decade or so, collections of digenetic trematodes of marine fishes of India were made by various workers from same or adjoining areas along the Indian coasts. The published accounts of these collections resulted in some overlappings of the descriptions of identical materials, one worker remaining unaware of the work of the other. Moreover, certain erroneous

observations have crept in the literature on the groups published during the recent days. These overlappings and erroneous records are required to be corrected, more so, when Zoological Survey of India has taken up the project of writing Fauna of India on various groups. Through this communication, an attempt is made to set right the records of literature on certain genera and species. This attempt is well supported by a good collec-

tion of relevant material, which is deposited with the Zoological Survey of India, Calcutta.

The scientific and English names of the host fishes have been taken from the FAO Species Identification Sheets (1974).

SYSTEMATIC ACCOUNT

Family MONORCHIIDAE Odhner, 1911

Subfamily LASIOTOCINAE Yamaguti, 1958

Genolopa trifolifer Nicoll, 1915

Host : *Pomadysis hasta* (Bloch), lined silver grunt, (Pisces : Pomadysidae).

Location : Intestine

Locality : Bombay (Arabian Sea)

Number of specimens : 8, on 4 slides, collected by Prof. Ather H. Siddiqi on 16.5. 1963

Specimens deposited : Z. S. I. Reg. Nos. W 7442/1 to 7445/1.

Hafeezullah (1971) recorded *Genolopa trifolifer* Nicoll, 1915 from the marine fish host, *Pomadysis hasta*, from Bombay. He only illustrated it just for the sake of completeness of the Indian Fauna of Digenetic Trematodes, and did not feel the necessity to provide detailed description of a known species. Madhavi (1974), while describing *Lasiotocus hasti* as a new species from the same fish host from Waltair, contended that in Nicoll's species "Body shape is oval, oral sucker is circular in outline and prepharynx is absent", and therefore Hafeezullah's specimens could not be *Genolopa trifolifer* Nicoll, 1915. She further observed that, "In the absence of knowledge of the structure of terminal genitalia it is difficult to relegate Hafeezullah's specimens to any particular species", in spite of the fact that it was identified to be a known species. The confusion arose because Nicoll (1915) in his

original account did not describe spines on the terminal parts of the male and female ducts as well as in the atrium but he considered them present by analogy with the result that workers, even like Manter and Pritchard (1961), were unable to give it a definite status. Yamaguti (1971), however, treated it under the genus *Lasiotocus*.

Originally, Hafeezullah had assigned his specimens to a new species of the genus *Lasiotocus* (viz. *Lasiotocus pomadasi*) as Madhavi has done. The description and the same illustration which appeared in Hafeezullah's (1971) paper were communicated to Late Prof. H. W. Manter of Nebraska University, U. S. A., who was a world authority on trematodology, for his opinion and comments through Prof. Ather H. Siddiqi of Aligarh Muslim University, Aligarh, India. He wrote back in a personal communication to Prof. Ather H. Siddiqi observing "*Lasiotocus pomadasi* is *Genolopa trifolifer* Nicoll, 1915 from the same host in Australia. Nicoll does not show spines in the cirrus and metraterm but assumed their presence. I saw his type specimens when I was in Australia and can confirm such spines and also spines in the atrium. Thus, the genus is indeed *Genolopa*." But Hafeezullah insisted to maintain it as *Lasiotocus pomadasi* n. sp. In another communication, Dr. Manter further observed that "*Lasiotocus pomadasi* is without doubt, I believe, *Genolopa trifolifer* Nicoll, 1915. This makes it more interesting", and he suggested to make necessary correction while sending the manuscript for publication, and Hafeezullah did accordingly. One should accept Late Prof. Manter's observations and suggestion particularly because he had himself studied and re-examined the type specimen of *Genolopa trifolifer* while he was in Australia on a study tour. If one accepts Late Prof.

Manter's confirmation of identification of Nicoll's specimens, and every worker should, *Lasiotocus hasti* Madhavi, 1974 becomes a synonym of *Genolopa trifolifer* Nicoll, 1915.

It seems that some of Nicoll's specimens (including the one which has been illustrated) were contracted giving them oval body shape and making the short prepharynx indiscernible. In Nicoll's own words "Not infrequently the body is of fairly uniform breadth." and "the pharynx is *almost* absent". The oral sucker has been shown to be conical or funnel-shaped (definitely not circular as Madhavi has stated). These facts only indicate correctness of confirmation of the identification of *Genolopa trifolifer* Nicoll, 1915.

This note becomes necessary and important in order to set right the literature on *Genolopa trifolifer*, and to bring on record the presence of fine spines in the terminal genitalia of the male and female ducts as well as in the atrium of Nicoll's species as checked by Late Prof. H. W. Manter in its type specimen.

Subfamily OPISTHOMONORCHEIDINAE

Yamaguti, 1971

Genus *Opisthomonorchis* Parukhin, 1966

Syn. *Retractomonorchis* Madhavi, 1977 n. syn.

Opisthomonorchis karwarensis Karyakarte and Yadav, 1976

Syn. *O. indicus* of Karyakarte and Yadav, 1977 n. syn.

O. indicus of Ahmad, 1977 n. syn.

O. indicus of Gupta, S. P. and Gupta, R. C. 1978 n. syn.

O. indicus of Gupta, N. K. and Puri, 1981 n. syn.

Retractomonorchis delicatus Madhavi, 1977 n. syn.

Host : *Fomio niger* (Bloch), black pomfret, (Pisces : Formionidae)

Location : Intestine

Locality : Gopalpur (Bay of Bengal) and Mangalore (Arabian Sea). Specimens from Mangalore were collected by Dr. T. D. Soota & Party in January, 1976.

No. of Specimens : 25 from Gopalpur on 10 slides and 17 from Mangalore on 3 slides, total 42 on 13 slides.

Specimens deposited : Z. S. I. Reg. Nos. W 7446 to W 7458/1.

Parukhin (1966) proposed the genus *Opisthomonorchis* with *O. decapтери* as type species for the specimens he collected from the fish hosts *Decapтери* sp. and *Selar mate* (Carangidae) from the Gulf of Tokin. Since then, Karyakarte and Yadav (1976a and 1977) described two species, *O. karwarensis* and *O. indicus* respectively from the fish host *Stromateus niger* from the Arabian Sea. Ahmad (1977) described the fourth species, *O. indicus* from the fish host *Apogonichthys ellioti* from the Bay of Bengal. Gupta, S. P. and Gupta, R. C. (1978) described the fifth species, *O. indicus*, from the fish host *Caranx malabaricus* from the Arabian Sea. Gupta, N. K. and Puri (1981) described still another species, *O. nigeri*, from the fish *Stromateus niger* from Calicut. Madhavi (1977) proposed a new genus *Retractomonorchis*, with *R. delicatus* as type species resembling *Opisthomonorchis*, from the fish hosts *Pampus chinensis* and *Pampus argenteus* from the Bay of Bengal, but in the differential diagnosis she qualified the proposal that her genus would only be valid "pending verification of the presence or absence of a genital atrium and the position of genital pore in *Opisthomonorchis*", because in some of her specimens of *Retractomonorchis delicatus* "it was difficult to detect the genital pore and such specimens look like *Opisthomonorchis*".

The study of 42 specimens collected from black pomfret from the Bay of Bengal and Arabian Sea reveals the following facts :

1. In some specimens the genital pore is apparently postacetabular where male and female ducts come close to each other ;

2. In some others the ova are seen lying in a linear fashion between the anterior margin of acetabulum and the point where the male and female ducts come close to each other in the postacetabular region ; and

3. Still in some other specimens one or two ova are seen immediately before the acetabulum.

These conditions can very well be explained by correctly interpreting that the genital atrium is tubular and opens immediately in front of the acetabulum as Madhavi (*loc. cit.*) described in *R. delicatus*, and that its wall is so thin that it becomes difficult to detect and therefore the point where spined male and female terminal genitalia open into the thin-walled tubular genital atrium behind the acetabulum is easily mistaken as the position of the genital pore. The same situation, it is presumed, was also probably confronted by Parukhin (*loc. cit.*) who proposed the genus *Opisthomonorchoides* with postacetabular genital pore. Under the circumstances mentioned above on the basis of two big populations from the Bay of Bengal and Arabian Sea, it should be taken for granted that the position of the genital pore in *Opisthomonorchoids* Parukhin, 1966 is immediately preacetabular. Consequently, the author is inclined to believe that *Retractomonorchis* Madhavi, 1977 is congeneric with *Opisthomonorchoides* Parukhin, 1966.

Six species, as listed above, have been described from India from the three species of pomfret, a carangid and an apogonid fish

from the Bay of Bengal and the Arabian Sea under two genera *Opisthomonorchoides* and *Retractomonorchis*. There are overlappings among them because probably the various papers having their descriptions were simultaneously in press. Only one of them, *Opisthomonorchoides karwarensis* Karyakarte and Yadav, 1976 is valid, and other five species, viz., *O. indicus* of Karyakarte and Yadav, 1977, *O. indicus* of Ahmad, 1977, *O. indicus* of Gupta, S. P. and Gupta, R. C., 1978, *O. nigeri* Gupta, N. K. and Puri, 1981, and *R. delicatus* Madhavi, 1977 have been found to be identical to it and therefore conspecific with the former. Thus, so far there are only two species in the genus *Opisthomonorchoides*, viz. *O. decapтери* Parukhin, 1966 from the Gulf of Tonkin, and *O. karwarensis* Karyakarte and Yadav, 1976 from Arabian Sea, the latter mainly differing from the former in having lobed ovary.

Subfamily OPISTHOMONORCHINAE Yamaguti, 1952

Genus *Opisthomonorchis* Yamaguti, 1952

Opisthomonorchis carangi (Madhavi, 1974) n. comb.

Syn. *Pseudopisthomonorchis carangi* Madhavi, 1974 n. syn.

Opisthomonorchis thapari Varma and Singh, 1979 n. syn.

Host : *Carangoides malabaricus* (Bloch), (Pisces : Carangidae)

Location : Intestine

Locality : Bombay (Arabian Sea)

No. of specimens : Several, on 6 slides, collected by Prof. Ather H. Siddiqi in May, 1963.

Specimens deposited : Z. S. I. reg. Nos. W 7459/1 to 7464/1

Madhavi (1974) proposed the genus *Pseudopisthomonorchis* to accommodate her species

P. carangi in the intestine of the fish *Carangoides malabaricus* (Bloch) from Waltair coast, Bay of Bengal. She distinguished her genus *Pseudopisthomonorchis* from *Opisthomonorchis* Yamaguti, 1952 in having a globular cirrus sac, short unarmed cirrus, spacious genital atrium with spines, and preacetabular vitellaria. Varma and Singh (1979) described *Opisthomonorchis thapari* in the intestine of the fish *Caranx armatus* (Cu. & Val.) at Quilon, Arabian Sea with minut spines on the cirrus. Apparently, they were unaware of Madhavi's (1974) work on monorchiid trematodes from marine fishes of Waltair, Bay of Bengal, and therefore, compared their species only with the type species *O. carangis* Yamaguti, 1952. Now, a comparison of *O. thapari* Varma and Singh, 1979 with *P. carangi* Madhavi, 1974 shows that the two species (from the same group of fish hosts) are identical, differing only in the spined genital atrium. It may be observed that Madhavi (*loc. cit.*) might have escaped observation of the minute spines on the cirrus, or the minute spines of the cirrus might have been mixed up with those of the genital atrium, leading to erroneous conclusion. The identity and sameness of the species is beyond doubt.

Ultimately, the distinctness of *Pseudopisthomonorchis* Madhavi, 1974 from *Opisthomonorchis* Yamaguti, 1952 narrows down to acetabular and preacetabular vitellaria in the former and postacetabular in the latter. Varma and Singh (*op. cit.*) considered the difference of the position of vitellaria with respect to acetabulum as specific only. In the absence of any other important supporting character to this character, Varma and Singh's treatment to consider their specimens to belong to the genus *Opisthomonorchis* sounds more logical than Madhavi's. Therefore, *Pseudopisthomonorchis* should be considered

as congeneric with *Opisthomonorchis* Yamaguti, 1952, *O. thapari* becoming synonymous with *P. carangi* Madhavi, 1974.

Family DEROPRISTIIDAE Skrjabin, 1958

Subfamily DEROPRISTIINAE Cable and

Hunninen, 1942

Genus *Skrjabinopsolus* Ivanov in Ivanov
& Murygin, 1937

Syn. *Fristotrema* Cable, 1952

Skrjabinopsolus elongatus (Madhavi, 1974) n.
comb.

Syn. *Opisthodioplomonorchis elongatus* Madhavi, 1974
n. syn.

Skrjabinopsolus indicus Gupta, V. & Ahmad, 1976 n.
syn.

S. kurotchkini Parukhin, 1976 n. syn.

Hosts : *Polynemus sextarius*, black-spot threadfin, (Pisces : Polynemidae) ; *P. xanthonemus*, silver thread tassel fish, (Pisces : Polynemidae) ; and *P. heptadactylus*, seven finger threadfin, (Pisces : Polynemidae)

Location : Intestine

Localities : Porto- Novo (Vellar Estuary) ; Digha (Bay of Bengal), and Veraval (Arabian Sea) respectively.

No. of specimens : 4+1+1, 4 in good condition, 2 not good for study, on 4 slides ; specimens from Porto-Novo were collected by Dr. T. D. Soota & Party in March, 1975

Specimens deposited : Z. S. I. Reg. Nos. W 7465/1 to W 7468/1

Opisthodioplomonorchis elongatus Madhavi, 1974 has been described from the fishes *Polynemus sextarius* and *Psettodes erumei* collected at Waltair coast under the family Monorchiidae. Describing the female terminal duct, Madhavi (1974) mentions the presence of terminal organ and calls it "small, simple, oval, undivided, armed with spines similar to those of cirrus". According to her, the

terminal part of the uterus opens into the distal end of the 'terminal organ'.

The specimenes in the author's collection are from the type host and other fishes of the same genus. Moreover, they have also been collected from the coast of the Bay of Bengal. They show no differences from that which has been illustrated by Madhavi (*loc. cit.*). What she calls a simple and undivided 'terminal organ' is nothing but well differentiated metraterm armed with spines as is found in the genera *Skrjabinopsolus* Ivanov in Ivanov & Murygin, 1937, *Deropristis* Odhner, 1902, and *Pristicola* Cable, 1952 (subfamily Deropristiinae Cable and Hunninen, 1942). By all probabilities *Opisthodiplomonorchis* Madhavi, 1974 fits well within the concept of the genus *Skrjabinopsolus*. Therefore, *Opisthodiplomonorchis* is considered as congeneric with *Skrjabinopsolus*. Thus, *Opisthodiplomonorchis elongatus* Madhavi, 1974 becomes *Skrjabinopsolus elongatus* (Madhavi, 1974) n. comb.

Opisthodiplomonorchis had been described to possess no seminal receptacle. Of the four specimens collected from the fish genus *Polynemus*, in one (collected at Digba) the seminal receptacle is very small and lies anterior to the lobed ovary while in the other one (collected at Veraval), it is quite big and lies dorsolateral to the female gonad. In the remaining two (from Porto-Novo), this structure is undistinguishable from the lobes of the ovary, probably it got pressed with the latter. It is quite likely that Madhavi might have missed the receptacle in her specimens too as did Bychowsky and Dubinina (1954) in the specimens of the type species *Skrjabinopsolus acipenseris*, which fact has been emphatically pointed out by Cable (1955). He also pointed out the correct

designation of *Skrjabinopsolus* which has been followed in this paper.

Gupta, V. and Ahmed (1976) described their specimens from a marine fish *Glyphiodon bengalensis* (Günther), from Chilka Lake adjoining to Waltair from where Madhavi (*loc. cit.*) described *O. elongatus*, as *S. indicus* with seminal receptacle. There seems to be no morphological difference between the two except in the egg size and hence they are considered as identical species, Madhavi's having priority over that of Gupta, V. and Ahmad. Parukhin (1976) described *Skrjabinopsolus Kurotchkini* from the fish *Polydactylus sextarius* (= *Polynemus sextarius*) from Indian Ocean. Its morphological details indicate that it is also synonymous with Madhavi's species. This is the first species of *Skrjabinopsolus* which has been reported from a teleostei. All other species have been reported from Chondrostei.

Skrjabin (1958) erected the family Deropristiidae to accommodate the genera *Deropristis*, *Pristicola* and *Skrjabinopsolus*. Peters (1961) feels that *Cestrahelminis* Fischthal, 1957 should also be included in this family but under a separate subfamily Cestrahelminae Peters, 1961 and consequently emended the diagnosis of the family. Yamaguti (1971), however, treated *Cestrahelminis* as a monorchiid under the subfamily Lasciotocinae.

Family FELLODISTOMIDAE (Nicoll, 1913)

Subfamily MONASCINAE Dollfus, 1947

Genus *Monascus* Looss, 1907

Syn. *Haplocladus* Odhner, 1911

Karachitrema Bilgees, 1973 n. syn.

Monascus filiformis (Rud., 1819) Looss, 1907

Syn. *Distoma filiformis* Rudolphi, 1819

Haplocladus filiformis (Rud., 1819) Odhner,

Monascus typicus (Odhner, 1911) Looss, 1912

M. monenteron Looss, 1907 (*nom. nud.*)

M. netci Travassos et al., 1965

M. trilobatus (Bilqees, 1973) n. syn.,

M. elongatus Karyakarte and Yadav, 1976

- Hosts :**
1. *Formio niger*, black pomfret, (Pisces : Formionidae)
 2. *Stromateus sinensis*, Chinese, pomfret, (Pisces Stromateidae) ;
 3. *Caranx* sp., (Pisces : Carangidae)

Location : Intestine

Localities : Gopalpur (Bay of Bengal), collected on 03.05.1972 ; Madras (Bay of Bengal), collected on 03.12.1964 ; Junput (Bay of Bengal), collected on 07.01.1977.

No. of specimens : 1+2+5 respectively, on 3 slides

Specimens deposited ; Z. S. I. Reg. Nos. N 7469/1 to W 7471/1.

Bilqees (1973) proposed a new genus *Karachitrema* with type species *K. trilobata*, on the basis of five specimens she recovered from the marine fish *Caranx affinis* from Karachi coast (Arabian Sea). She assigned this genus to the family Allocreadiidae. From the morphology and figures of the species, there remains little doubt that her five specimens should actually belong to a known genus *Monascus* Looss, 1907 in the family Fellodistomidae. She does mention that the oesophagus bifurcates anterior to acetabulum and the caeca reach posterior end of body, but she does not show the bifurcation of the oesophagus in the figure. Actually, the genus *Monascus* had been known to possess a single caecum (right one) since its inception, but the Scanning Electron Micro-

scopic studies of the life-history of the type species, *M. filiformis*, by Kϕie (1979) have revealed that its cercariae and adults do not have a single unbranched caecum as previously described, but have a long right caecum and a short, reduced left caecum, the bifurcation of the pseudo-oesophagus taking place much behind the acetabulum in front of the ovary. Kϕie (*op. cit.*) observes that "the bifurcation of the intestine has been overlooked in all the previous descriptions of both *M. typicus* and *M. filiformis*". As a matter of fact, this has happened in the descriptions of all the subsequent species in the genus *Monascus*. The unbranched nature of intestine was taken for granted. The SEM studies of life-cycle of *M. filiformis* are revealing and set right for ever all the discrepancies in the various species of the genus *Monascus*, which have been puzzling and misleading the workers. The long standing hesitation to merge *M. typicus* with *M. filiformis* has been removed by working out the life-history of the latter species by Kϕie (1979). It has now been proved beyond doubt that *M. typicus* is not valid, and is a synonym of *M. filiformis*. Bray and Gibson (1980), unaware of Kϕie's work, have also done so.

Vasanth Kumari and Srivastava (1976) recorded *M. orientalis* (= *Haplocladus orientalis* Srivastava, 1941) from two unrelated host fishes viz. a sole (*Synaptura orientalis*) and a cat-fish (*Arius jella*) from Digba (Bay of Bengal near Sunderbans). This is the second record of the species from India. It has not been reported from the rest of the world. Its record from a cat-fish is interesting. I personally examined the specimens of *M. orientalis*. It was found that its characters overlap those of *M. filiformis* (Syn. *M. typicus*). It is felt that *M. orientalis* is not valid, and is a synonym of *M. filiformis*. Bray and Gibson

(*op. cit.*) have already suggested this synonymy.

M. filiformis (syn. *M. typicus*) is known to have an entire ovary without any sign of indentation or lobation of its contour. But Dollfus' (1947) redescription of *M. filiformis* is based on a collection of specimens from the type host—a collection which was mixed with specimens having trilobed ovary also. Lamothe-Argumendo's *M. typicus* from Puerto Escondido and Salina, Oaxaca, from Carangid fishes *Trachurops crumenophthalmus* and *Caranx hippos* respectively, also had trilobed ovary. Even some of the specimens of *M. filiformis* from dab (Kie's, 1979 SEM study) have trilobed ovary. In my own collection identified as *M. filiformis*, two of the three specimens recovered from *Formio niger* from Gopalpur have trilobed ovary. On these evidences, there seems to be strong justification in suspecting that *M. netoi* Travassos, *et al.* described on the basis of a single specimen, may be a synonym of *M. filiformis* as pointed out by Kϕie. The cylindrical pharynx longer than the length of the oral sucker is considered by him as changeable relative character. However, all the five specimens recovered from *Caranx* sp. from Junput, W. Bengal, have unlobed ovary. By the same reasoning, *M. trilobata* (syn. *Karachitrema trilobata*), *M. chauhani* Vasantha Kumari, 1975 and *M. elongatus* Karyakarte and Yadav, 1976 having lobed ovary also fall synonyms of the type species *M. filiformis*. Bray and Gibson (1980) have already listed species having lobed ovary as synonyms of *M. filiformis*.

Travassos *et al.* (1965) described *M. netoi* and raised the subfamily Monascine Dollfus, 1947 to the family rank-Monascidae because members of *Monascus* have a single caecum which opens into the excretory vesicle near

posterior end of body. To our mind, the family Monascidae on the basis of the genus *Monascus* cannot be recognised because a single caecum is not considered a family character in several other cases of Digenea. Moreover, the lifehistory studies of the type species by Kϕie (*loc. cit.*) show that the intestine apparently does not establish relationship with the excretory bladder at the posterior end of body. Further, it has been proved beyond doubt that in the type species *M. filiformis*, the pseudoesophagus does bifurcate into right and left caeca although it happens between the acetabulum and ovary near the dorsal surface, and the left one is very short and reduced. Therefore, Monascidae should be suppressed in favour of Fello-distomidae (Nicoll, 1913).

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NOTES ON THE STUDY OF THREE SPECIES OF RIVER TURTLES IN ORISSA

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ABSTRACT

The authors have discussed the distribution of three species of freshwater chelonians from rivers of Orissa, *Trionyx gangeticus* Cuvier and *Kachuga tectum tentoria* (Gray) from river Mahanadi and *T. leithi* Gray from Sileru river. They have also made observations on the egg laying of one species and about growth of another in captivity.

INTRODUCTION

In connection with the study of ecology and biology of freshwater turtles in Orissa, three species were collected from rivers of Orissa and some live specimens of those species have been studied in the Nandankanan Biological Park under captive condition.

The work of Annandale (1912) on the aquatic Chelonia of river Mahanadi and its tributaries is so far the only important work on freshwater turtles in Orissa. He described one new subspecies, *Trionyx gangeticus mahanaddicus* Annandale and recorded *T. leithi* Gray, *Emyda punctata granosa* (Schoeff) and *Kachuga tectum intermedia* Blanford from Mahanadi. Smith (1931) synonymised the new subspecies under *Trionyx gangeticus* Cuvier and other two subspecies in *Lissemys punctata granosa* (Schoeff) and *Kachuga tectum tentoria* (Gray).

The subspecies *L. p. granosa* after Annandale was not again collected from Mahanadi

but authors (Biswas & Acharjyo, 1977) found them occurring in lakes and ponds of Orissa. This species is an important item of supply from Orissa for the consumption of Calcutta market. Lastly the authors feel that a thorough turtle survey in the rivers of Orissa is needed to fill up the gap of our knowledge of distribution and status of freshwater Chelonians.

Order : TESTUDINES

Family : TRONYCHIDAE

***Trionyx gangeticus* Cuvier**

(Oriya name : Bada Pani Kaincha)

1931. *Trionyx gangeticus*, Smith, *Fauna of British India*, Vol. I : 167 & 168.

Material : One female collected from Mahanadi river near the Village Banragoda, Cuttack Dist., on 8.10.1981.

Measurement and weight : Carapace : 51 × 40 cm ; Plastron—41 × 36 cm ; Weight—14.600 kg.

Distribution : The range of distribution for this species is the Indus, Ganges, and Mahanadi. Recently Zoological Survey of India received a specimen from Bhopal, Madhya Pradesh but the distribution of the species from M. P. and Western part of Orissa is poorly known.

Observation : The colour pattern of the specimen closely conforms to the description given by Smith (loc. cit). The carapace is deep olive with faintly spotted yellow marks. There are three pairs of oblique longitudinal markings on the head.

The specimen was collected by a local fisherman on 8.1.82 and received in Biological Park on the next day. On the same day night 5 white, round eggs like Ping Pong balls were laid inside the water. The diameter of five eggs are 3.0 to 3.3 cm. and weight 22,100 to 23,800 gms. It again laid 3 eggs each time on 17.1.82 & 18.1.82 and died on 31.1.82. On post mortem examination more fully developed eggs were recovered from the oviduct.

Remarks : It is presumed that the specimen was collected by the fisherman when it came out off water of laying eggs but did not lay due to disturbance. Sometimes the turtles are caught in fishing nets. It could only lay eggs when it was released in the water of the turtle enclosure. Thus this egg laying incidents in, January is only a month or broadly winter is the laying season of this species. There are many records of death in turtle and tortoises due to disturbances in their laying activity (Ewert 1979). Minton (1966) mentioned about a female weighing 13.2 kgs. collected from Indus river in October which contained in its oviduct three full grown eggs (diameter 33 mm.) and many immature eggs.

Trionyx leithi Gray

(Pl. VIII, fig. A & B)

Material : Two female specimens where collected from Balimela reservoir, Koraput Dist. and received on 3.9.78 and 30.1.78 respectively at the Nandankanan Biological Park from Shri P. C. Sarangi, D. F. O., Afforestation Division.

Distribution : The range of distribution is the Ganges and rivers of peninsular India as far south as Madras. Balimela reservoirs are on the Sileru river at Chitrakonda in Koraput Dist. of Orissa adjoining Madhya Pradesh. The river originates in the hilly plateau of south eastern M. P.

Observation : The identification of the specimens belonging to the species appeared confusing as the usual colour pattern is usually lacking in grown up specimens. The heads and carapaces are uniformly dark olive and their probosises are less pointed comparatively to specimens belonging to *T. gangeticus*. We are referring the two specimens in the above mentioned species based on the patch of warty skin on the anterior flap of the disc and the prominent anterior boss on the carapace.

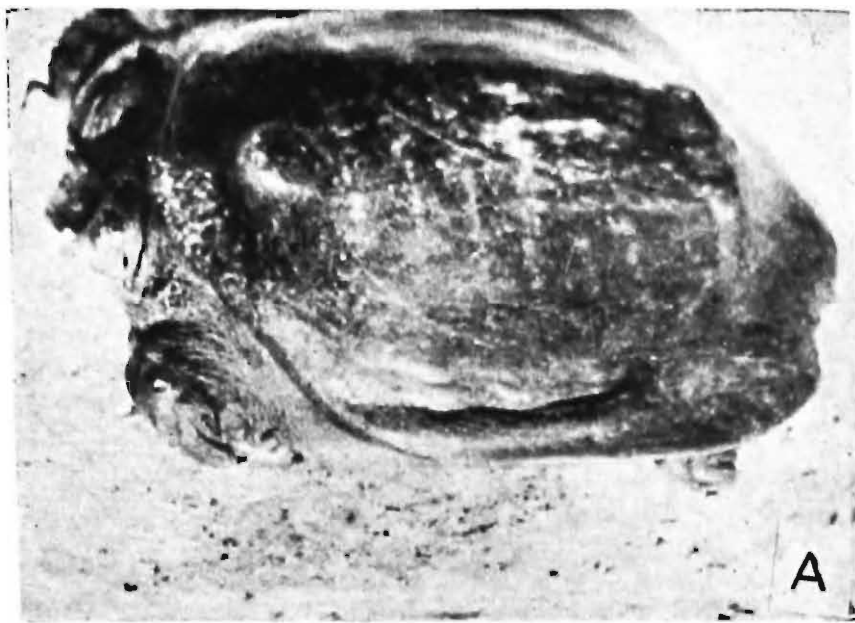
Observation in captivity : One of the two turtles of Balimela is being maintained successfully for more than two years in a small cemented pool of approximately 5×5 mts. in size with a depth of .45 cm. They thrived well on the fishes that were regularly being supplied to the aquatic birds.

Measurements and weight during their captivity period are mentioned below :

Remarks : The weight gained by the first turtle in captivity in 2 years and 10 months on the fish diet is an encouraging point to undertake further investigation on its develop-

BISWAS & ACHARJYO

PLATE VIII



Trionyx leithi Gray, Photo No. A. Dorsal view of one of the female specimen. B. Ventral view of the same specimen.

Measurements and weight during their captivity period are mentioned below :

Date of Measurement	Wt. Kgs.	Carapace length (cm)	Carapace width (cm)	Plastron length	Turtle No.
30.1.78	11.200	49	40	37	I
3.7.78	11.800	49	40	38	
30.1.80	12.000	51.5	40.5	39	Presently
24.11.80	12.800	52	42	40	alive
30.9.78	12.000	46.5	39	38	II
30.1.80	12.000	48	39	39.5	Died on 8.2.80

ment and growth in captivity as well as in natural condition. The growth of the second turtle was less, gaining no weight within 16 months of its captivity. Whereas the first specimen gained 600 gms within seven months of its captivity. Perhaps it could not adapt to its new habitat due to some internal infection and therefore died suddenly.

Family : EMYDIDAE

Kachuga tectum tentoria (Gray)

(Oriya name : Pani Kaincha)

1931. *Kachuga tectum tentoria*, Smith, *Fauna British India*, Vol. I : 128-129.

Material : 1 ♂ ; Naraj, Cuttack Dist, Mahanadi river. 2 ♀ ♀ ; Tikarpara, Dhenkanal Dist., Mahanadi, Coll. E. O. Moll & S. Biswas ; 20.2.83.

Measurements (in mm) : 1 ♂, Carapace length 77, breadth 67, depth 50, plastron length 73 ; 2 ♀ ♀, Carapace length 183, 178, breadth 137, 135, depth 90, 91, Plastron length 189, 183.

Distribution : According to Smith (loc. cit) the species occurs in the Mahanadi and Godavari and probably in Krishna. It has been earlier recorded from Hasdo river, a tributary of Mahanadi, Madhya Pradesh, Blanford (1870).

Observation : This subspecies differs from the typical *K. t. tectum* in having a second vertebral shield shorter than third and the colouration of their head being dull olive with a conspicuous red patch behind the tympanum. This olivaceous and the yellow streaks, if present, are fewer and less distinct than the typical one.

Remarks : It is the common turtle of Mahanadi. They are often found basking in the winter season on stones and floating logs of the rivers. The habitat of this species is rocky or stony sides of the river.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. B. K. Tikader, Director, Zoological Survey of India and the Chief Conservator of forest, Orissa for allowing them facilities to work on the problem. They are also thankful to Dr. E. O. Moll, Chairman, FCSG, IUCN/SSC for his helpful suggestions and scientific advice.

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TWO NEW SPECIES OF ORIBATID MITES (ACARI) FROM DARJEELING, INDIA

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ABSTRACT

The present paper deals with the description of two new species of oribatid mites, viz., *Heterobelba rostrata* and *Basilobelba barbata*, from forest and tea soils in the district of Darjeeling, India.

INTRODUCTION

The genus *Heterobelba* was erected by Berlese (1913) with *Heterobelba galerulata* as the type from Java. The genus was recorded for the first time from India by Chakrabarti and Mondal (1981). Balogh (1958) instituted the genus *Basilobelba* with *Damaeus retarius* Warburton, 1912 as the type-species. The genus *Basilobelba* was first reported by Bhaduri, Chakrabarti and Raychaudhuri (1974) from India. Mishra, Bhaduri and Raychaudhuri (1980) reported the genus for the first time from Orissa (India). The genus is reported here for the first time from Darjeeling. All measurements are in microns.

Heterobelba rostrata sp. nov.

(Figs. 1-2)

Female : Colour yellowish brown ; length of the body : 472-504 ; width of the body : 306-333.

Prodorsum with granulated cerotegument, slightly broader than long ; rostrum broadly rounded ; rostral setae stout, thicker than lamellar or interlamellar setae, densely barbed at the proximal 2/3rd, distal 1/3rd being smooth and gradually tapering, buldge in the

middle and convergent apically, 45-49 long, inserted close dorsally on rostrum, their follicles touching each other ; lamellar setae barbed, stout, 76-81 long, with distinct round follicles, twice as long as their mutual distance, inserted a little beyond a faint transversely arched ridge ; interlamellar setae of the same nature as lamellar setae, 76-81 long, as long as their mutual distance, closely associated with the postero-lateral border of bothridium ; exobothridial setae 1 pair, minute, 17-18 long, intimately associated with the anterior rim of the bothridium ; bothridium longer than broad, directed postero-laterad ; sensillus stout, flagelliform, distinctly barbed throughout, 166-198 long, about twice as long as their mutual distance, directed postero-laterad.

Notogaster globose with 3 pairs of minute, smooth, nearly equal setae at the posterior margin, 11-16 long ; distance $p_1 - p_2 > p_2 - p_3$; tritonymphal scalp or exuvia with polygonal, reticulated microsculptures, affixed with the notogaster by 2 tubercles anteriorly ; setae on the tritonymphal scalp, long, stout, barbed and of similar nature as lamellar or interlamellar setae.

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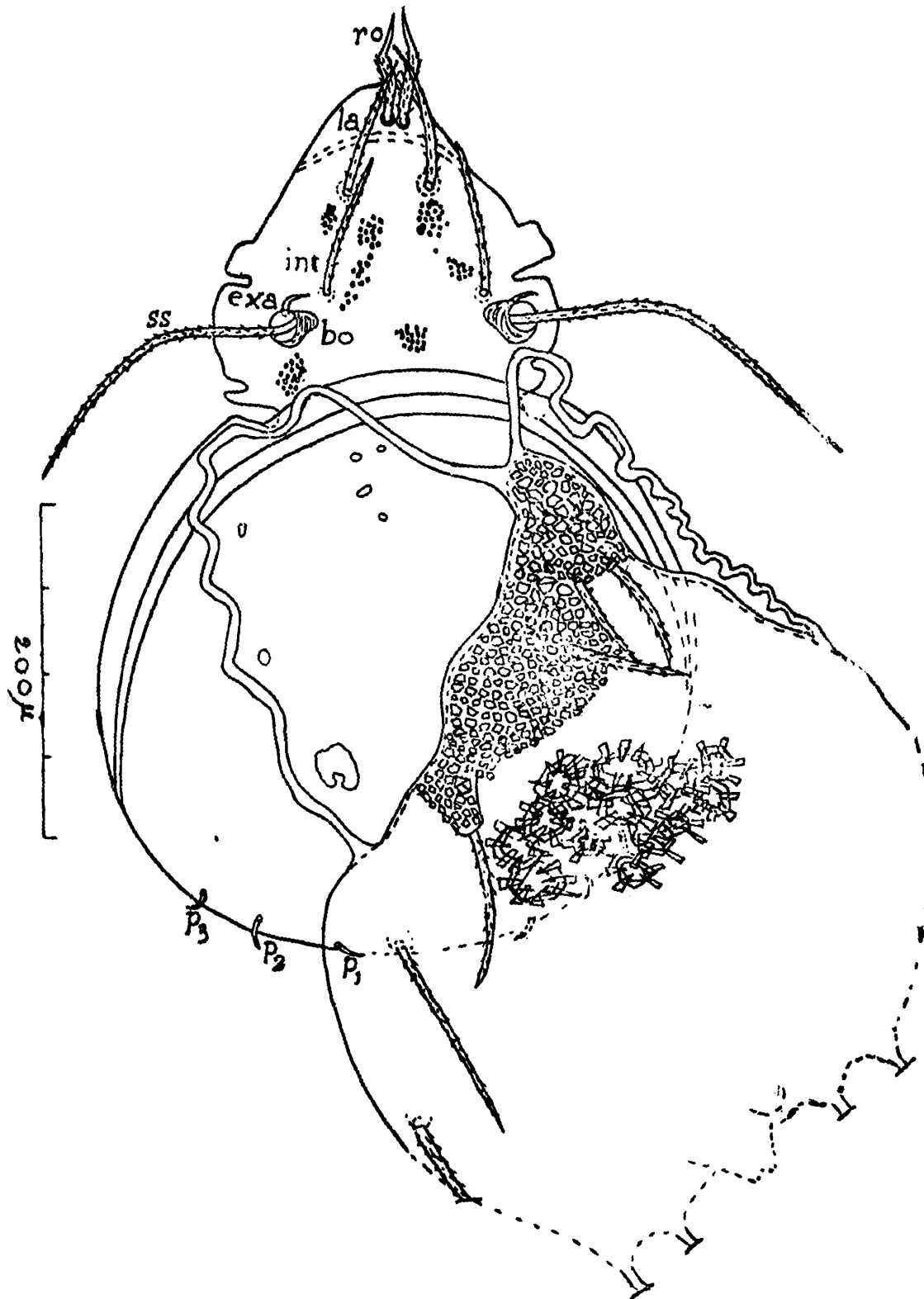


Fig. 1. *Heterobelba rostrata* sp. nov. (Dorsal view), ro=rostral seta, la=lamellar seta, int=interlamellar seta, exa=anterior exobothridial seta, ss=sensillus, bo=bothridium, p₁, p₂, p₃=notogastral setae.

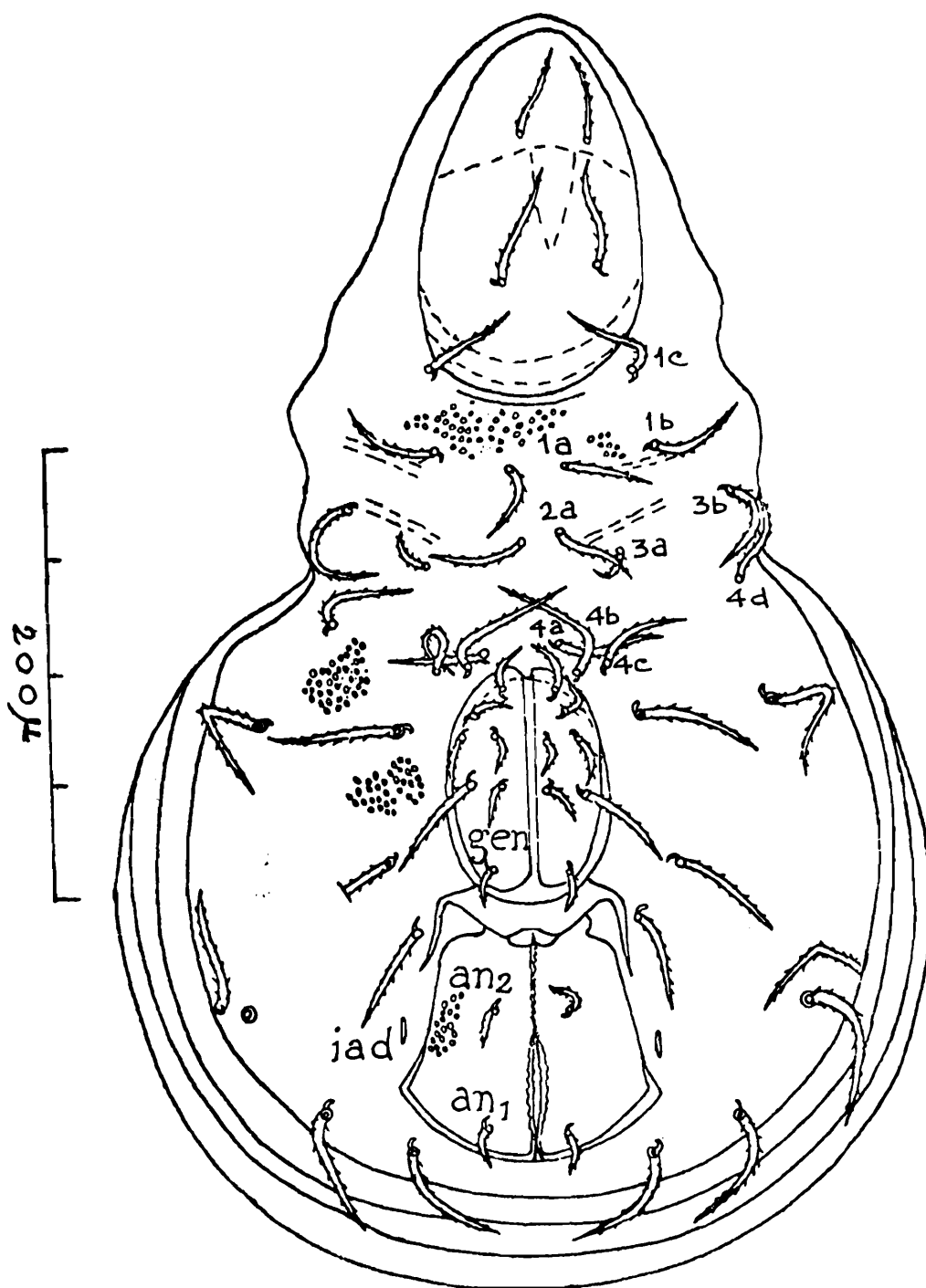


Fig. 2. *Heterobelba rostrata* sp. nov. (Ventral view), an_1 , an_2 =anal setae, iad =adanal fissure, gen =genital plate, 1a, 1b, 1c, 2a, 3a, 3b, 4a, 4b, 4c, 4d=epimeral setae.

Ventral plate with cerotegumental granules, with 8 pairs of moderately barbed setae, 40-76 long; anal plates shield-shaped; anal setae 2 pairs, minute, finely barbed, nearly equal, 18-22 long; an_1 located at the posterior and inner and an_2 at the inner and anterior

1/3rd of the anal plates; iad parallel to the lateral border of anal field, situated medially; genital plates close to the anal plates, 3 times as long as broad; genital setae 7 pairs, finely barbed, 18-45 long, 4 pairs paraxial, 3 pairs antiaxial, posterior one of the antiaxial row

longest ; genital plates separated from gnathosoma by a distance which is quite longer than the length of the genital plates.

Epimeral region with cerotegumental granules ; epimera I, II, III and IV fused ; epimeral setae barbed, 25-60 long ; epimeral setal formula 3-1-2-4.

Legs I, II, III monodactylous, leg IV tri-dactylous, claws slightly curved, middle claw of leg IV twice thicker than the lateral ones.

Holotype : Adult ♀, INDIA : W. Bengal ; Darjeeling, Darjeeling forest Div., Tonglu forest range, Palmajua forest bungalow area (from rotten leaves of *Cryptomeria japonica*), 2300 m., 16.viii.1977 (B. K. Mondal Coll.) ; paratypes : 3 adult ♀ ♀, same data as for holotype ; paratype : adult ♀, INDIA : W. Bengal ; Darjeeling, Darjeeling forest Div., Ghum-Simana forest range, Manibhanjang forest block (from decomposed leaves of *Machilus edulis*), 2200 m., 15.viii.1977 (B. K. Mondal Coll.) ; deposited in the laboratory of the Department of Zoology, Presidency College, Calcutta.

This species bears close resemblance with *Heterobelba galerulata* Berlese, 1913, which is figured and redescribed by Hammer, 1979 from Java. It is, however, distinguishable from *galerulata* in the greater length of the body and interlamellar setae, in the nature of rostral setae, lesser number of epimeral setae, besides a few other characters. Hence, it is considered new to science.

***Basilobelba barbata* sp. nov.**

(Figs. 3-5)

Female : Colour brownish yellow ; length of the body : 421-485 ; width of the body : 253-300.

Prodorsum with finely granulated cerotegument, crown-shaped, longer than broad ;

rostrum with blunt tip ; rostral setae smooth, incurved, apically touching each other, 55-59 long, shorter than their mutual distance, inserted laterally on rostrum ; lamellar setae with long, outward barbs at the proximal 1/3rd, distal 2/3rd smooth, 59-66 long, nearly $1\frac{1}{2}$ times as long as their mutual distance, inserted on the apophyses of a prominent, longitudinal lamella-like lateral prodorsal ridge ; interlamellar setae with small unilateral barbs, 38-39 long, nearly half as long as their mutual distance, inserted close to postero-dorsal part of the bothridium ; bothridium cup-shaped, longer than broad, directed laterad, sensillus long, flagelliform, with a smooth proximal half and distal half beset with moderately long, dense bristles, 160-164 long, directed postero-laterad ; anterior exobothridial setae smooth, fine, 30-32 long.

Anterior margin of notogaster rather straight, lateral and posterior margin convex ; notogaster covered with tritonymphal scalp or exuvia consisting of polygonal, reticulated microsculptures ; tritonymphal exuvia affixed with the notogaster by the round tubercle ; the thong or 'laniere' short, v-shaped and arms of the buckle long and broad ; tritonymphal scalp with 7 pairs of bushy setae postero-marginally ; after removing the tritonymphal scalp 6 pairs of smooth and simple setae discernable ; setae lm , lp dorso-lateral, h_2 , h_3 postero-lateral, h_1 , ps_3 postero-marginal, all nearly equal, 8-11 long.

Each anal plate nearly twice as long as broad, with 2 long, smooth setae, inserted on the outer margin of anal plate medially, 31-35 long ; $an_1 > an_2$; iad parallel to the antero-lateral border of anal plate ; each genital plate more than twice as long as broad, with 6 simple setae, 20-43 long, of these the 4 posterior ones nearly equal, the

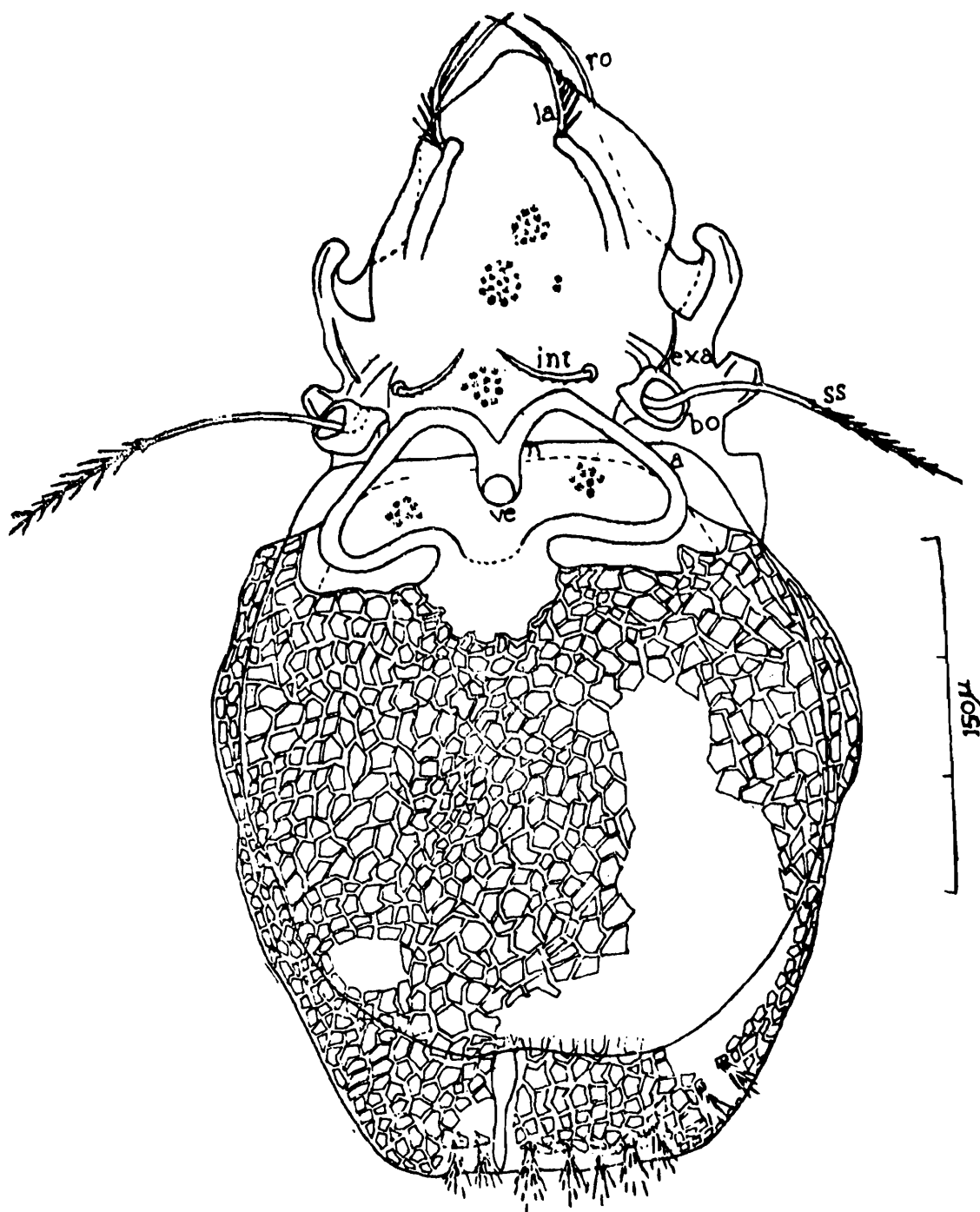


Fig. 3. *Basilobelba barbata* sp. nov. (Dorsal view), ro=rostral seta, la=lamellar seta, int=interlamellar seta, exa=anterior exobothridial seta, ss=sensillus, bo=bothridium, ve=notogastral tubercle, n=thong of buckle attachment, a=arm of buckle attachment.

5th longer than any of these and the anterior most more than $2\frac{1}{2}$ times as long as the posterior 4 setae; ventral plate with granulated cerotegument and 10 pairs of long, smooth setae; genital plates separated from the anal plates by a distance shorter than the maxi-

mum width of any of its component plates; genital plates separated from gnathosoma by a distance which is longer than the length of the genital plates.

Epimeral region with granulated ceroteguments; all apodemata indistinct, all epimeral

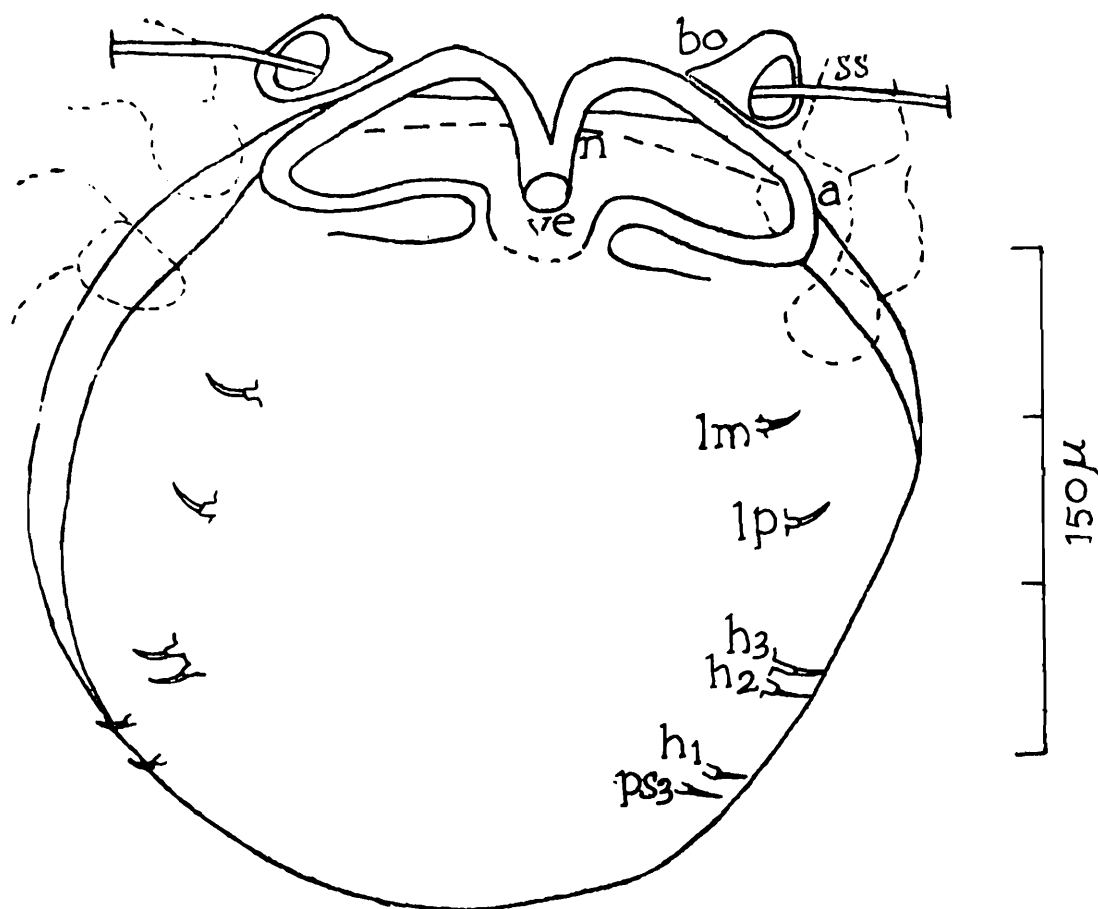


Fig. 4. *Basilobelba barbata* sp. nov. (Dorsal view of notogaster after the removal of tritonymphal scalp), ss=sensillus, bo=bothridium, ve=notogastral tubercle, n=thong of buckle attachment, a=arm of buckle attachment, lm, lp, h₁, h₂, h₃, ps₃=notogastral setae.

setae simple except 2a which is unilaterally faintly barbed 22-31 long; epimeral setal formula 3-2-3-3.

Legs are stout, with dense cerotegumental granules, with 2 types of setae, simple and bushy; tarsi monodactylous; claws sickle-shaped.

Holotype: Adult ♀, INDIA: W. Bengal: Darjeeling, Kurseong forest Div., Sukna forest range, Sukna forest block (from rotten leaves of *Shorea robusta*), 170 m., 24. x. 1978 (B. K. Mondal Coll.); paratypes: 4 adult ♀♀, same data as holotype; paratypes: 3 adult ♀♀, INDIA: W. Bengal: Darjeeling, Mohurgong Tea Estate (from loose soil under a tea plant,

Thea sinensis), 117 m., 4. x. 1978 (B. K. Mondal Coll.); paratypes: 2 adult ♀♀, INDIA: W. Bengal: Darjeeling, Kurseong forest Div., Sevoke forest range, Berrik forest block (from soil under a *Albizia* sp.), 250 m., 16. x. 1977 (B. K. Mondal Coll.); deposited in the laboratory of the Department of Zoology, Presidency College, Calcutta.

This species is closely related to *Basilobelba pacifica* Hammer, 1971 in the nature of rostral tip, rostral setae, general shape of the notogaster, structure of notogastral setae and in the shape of the buckle with long and broad arm, v-shaped thong and round tubercle and the nature and arrange-

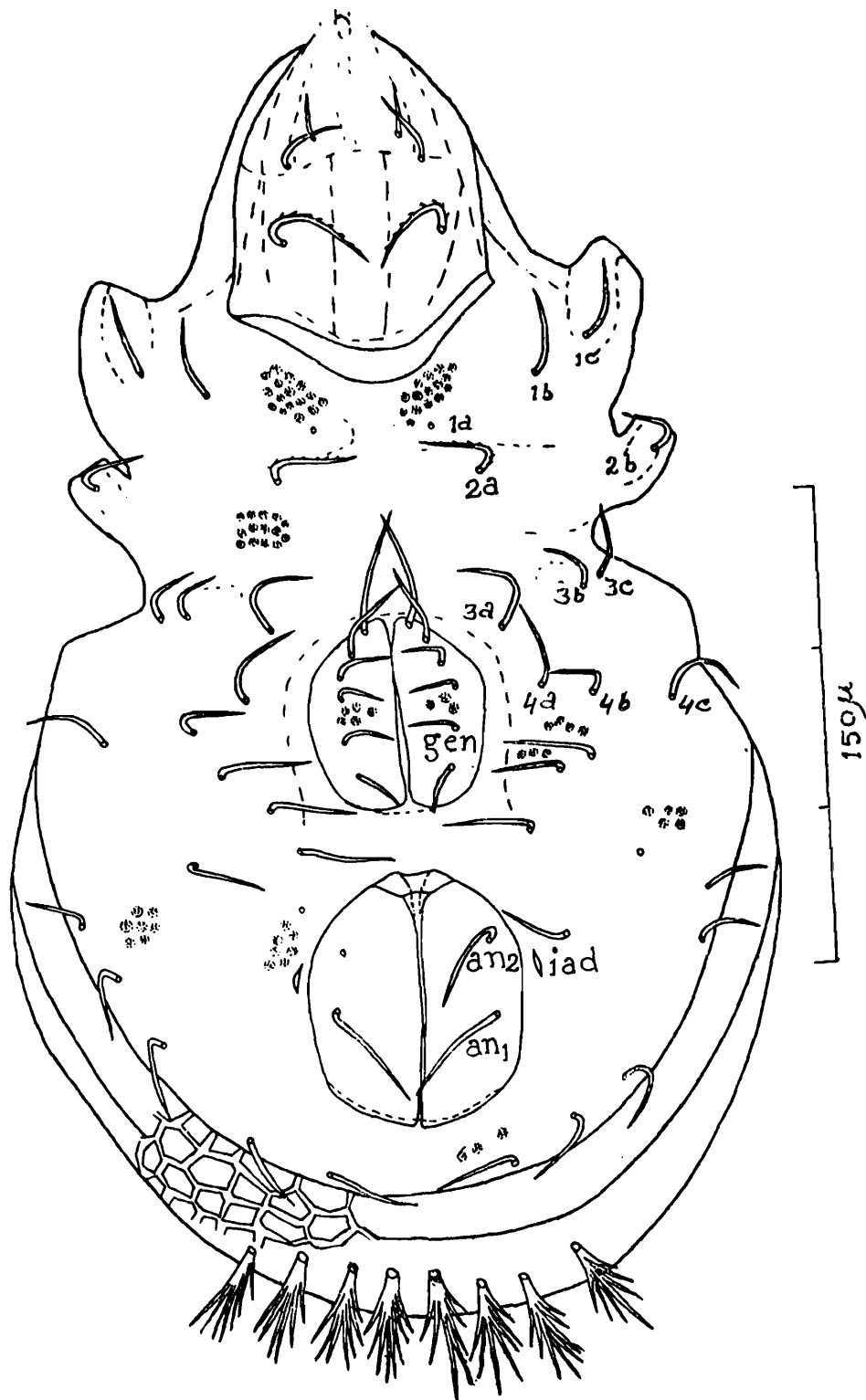


Fig. 5. *Basilobelba barbata* sp. nov. (Ventral view), an_1 , an_2 =anal setae, *iad*=adanal fissure, *gen*=genital plate, 1a, 1b, 1c, 2a, 2b, 3a, 3b, 3c, 4a, 4b, 4c=epimeral seta.

ment of the genital setae. But, it can be easily distinguished from *pacifica* by the absence of transverse ridge anteriorly on

prodorsum, the transverse bridge between the pseudostigmata, in having the lamellar setae with long barbs at proximal $\frac{1}{3}$ rd, a

prominent longitudinal lamella-like lateral prodorsal ridge, distal half of sensillus beset with moderately long bristles, less number of setae on the ventral plate and length and position of anal setae.

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We owe a deep debt of gratitude to Prof. S. K. Dasgupta, Head of the Department of Zoology, Presidency College, Calcutta for providing laboratory facilities and to Dr. D.K. Chakrabarti, Asstt. Prof. of Zoology, Presidency College, Calcutta for offering valuable suggestions. We are also thankful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta for providing necessary facilities to work.

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A NEW SPECIES OF THE GENUS *EREMOBELBA* (ACARI : ORIBATEI)
FROM DARJEELING, WEST BENGAL, INDIA

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ABSTRACT

A new species of the genus *Eremobelba* Berlese (Acari : Oribatei : Eremobelbidae), viz., *E. himalayensis* is described from the soil of tea garden in the district of Darjeeling, West Bengal, India.

INTRODUCTION

The genus *Eremobelba* was instituted by Berlese (1908) with *Eremaeus leprosus* Haller, 1884 as the type-species. The genus was first reported by Haq (1976) from South India. Later Ghosh and Bhaduri (1978) described a new species under the genus from Nagaland, India. Another new species under the genus is described here for the first time from West Bengal, India. All measurements are in microns.

Eremobelba himalayensis sp. nov.

(Figs. 1-2)

Female : Colour light brown ; length of the body : 530-535 ; width of the body : 289-312.

Prodorsum crown-shaped, with granular cerotegument ; tip of the rostrum slightly protruded ; rostral setae barbed unilaterally on the outer side, curved inwards, inserted laterally far behind and extends beyond the tip of the rostrum, 50-52 long, nearly as long as their mutual distance ; lamellar setae smooth, nearly as thick as the rostral setae,

arise on a prominent knob-like lamellar apophyses, slightly beyond the level of insertion of rostral setae, 51-55 long, more than half as long as their mutual distance ; interlamellar setae sparsely barbed bilaterally, situated far behind a strap-like big transverse ridge, on a faint indistinct converging ridge off the bothridium, 98-102 long, twice as long as lamellar setae, more than 3 times as long as their mutual distance ; exobothridial setae 1 pair, smooth, 55-67 long, a little longer than the lamellar setae, situated antero-lateral to the bothridium ; bothridium depressed, cup-like, anterior rim covered by an inverted coma-like bothridial ridge ; sensillus long, filiform, barbed sparsely and unilaterally, directed postero-laterad, 148-156 long, slightly longer than the interlamellar setae ; 2 semilunar structures enclosed in 2 rounded bodies present in the interpseudostigmatic region ; dorsosejugal suture straight ; a thick, broad, slightly curved, lateral lamellar ridge, occupied the middle of prodorsum on either side.

Notogaster oval, slightly less wider anteriorly, with 2 minor projections laterally at

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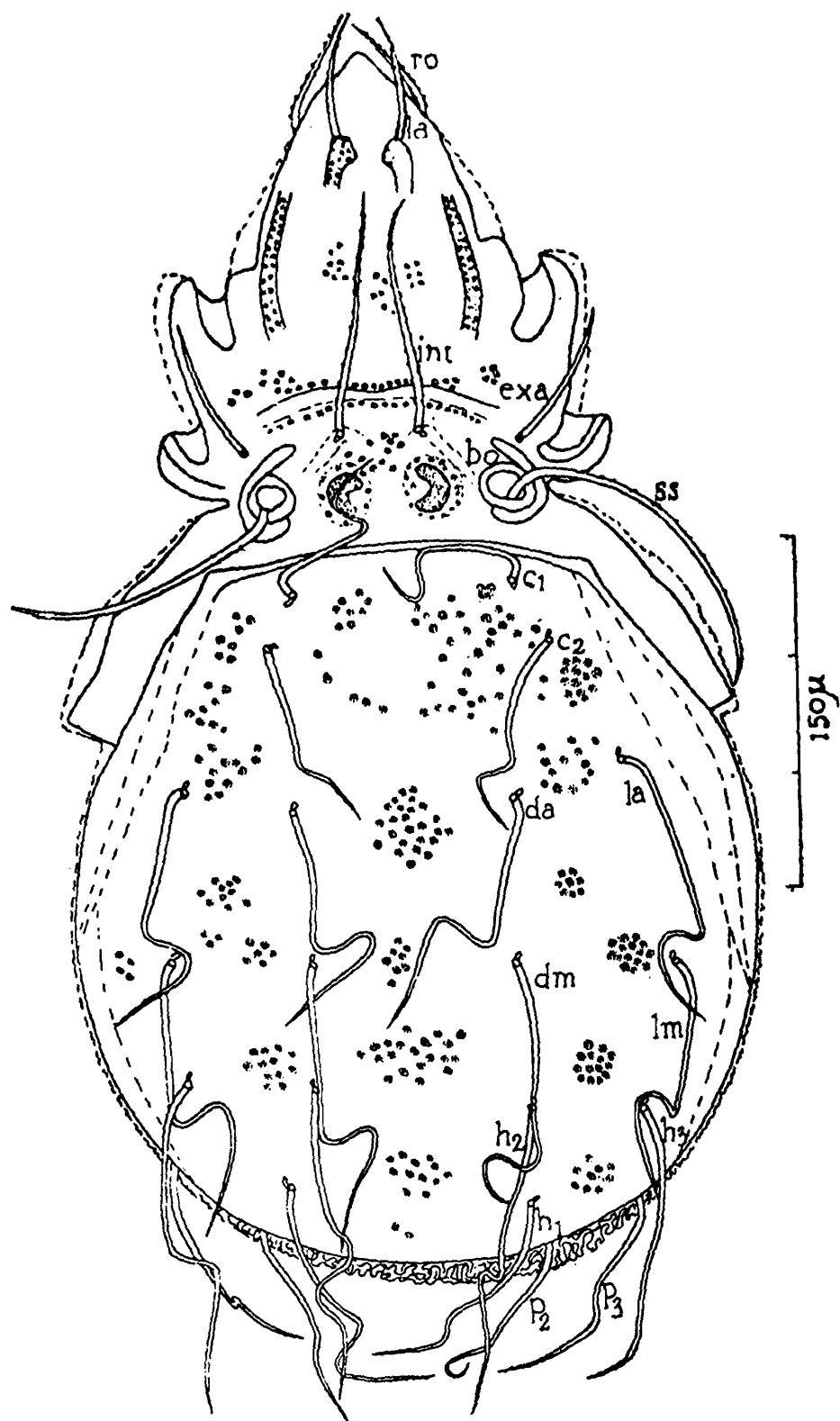


Fig. 1. *Eremobelba himalayensis* sp. nov. (Dorsal View), ro=rostral seta, la=lamellar seta, int=interlamellar seta, exa=anterior exobothridial seta, ss=sensillus, bo=bothridium, c₁, c₂, da, dm, la, lm, h₁, h₂, h₃, p₂, p₃=notogastral setae.

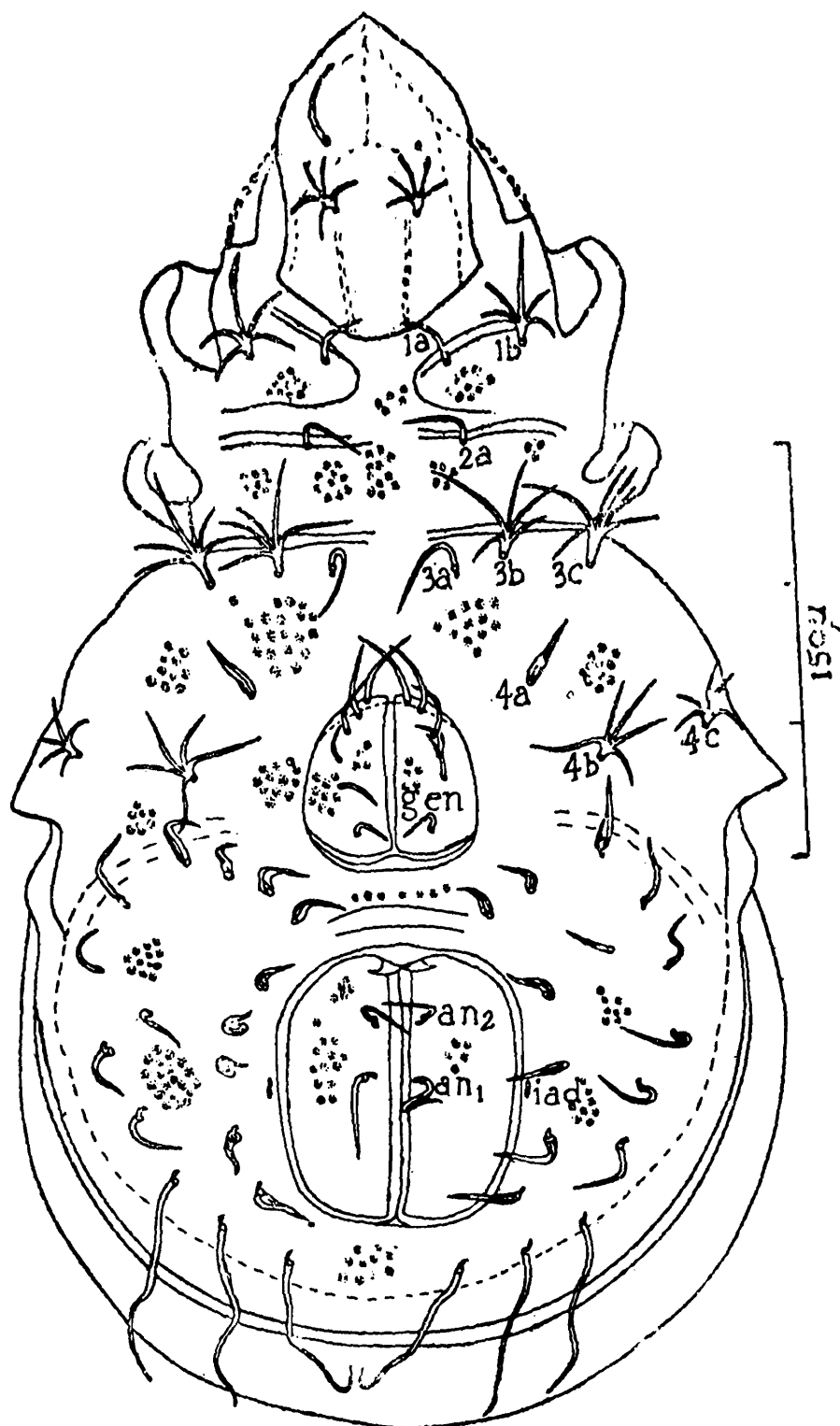


Fig. 2. *Eremobelba himalayensis* sp. nov. (Ventral View), an_1 , an_2 =anal setae, iad =adanal fissure, gen =genital plate, $1a$, $1b$, $2a$, $3a$, $3b$, $3c$, $4a$, $4b$, $4c$ =epimeral setae.

the end of the dorsosejugal suture, covered with dense slimy granular cerotegument; notogastral setae 11 pairs, elongated, 86-160 long, flagelliform, invariably curved at the distal half, inserted on rounded follicles with minute peg-like projections; setae c^1 , c_3 , da ,

dm and h_2 centro-dorsal, la , lm and h_3 lateral, h_1 , p_2 and p_3 postero-lateral; mutual distance $c_2-c_3 > c_1-c_1$; distance $c_1-c_1 = da-da = h_2-h_2 = dm-dm$; distance c_1-c_2 more than thrice the distance c_2-da ; distance $c_2-da = c_2$ $la = da-dm = la-lm$.

Ventral plate with cerotegumental granulations, with asymmetrical distribution of the setae, i. e., right half with 19 setae and left half with 16 setae in majority of the cases; all setae being simple and short except the last 3 pairs which are very long with flagelliform tips; setae on the adanal and aggenital region are shorter and thicker in comparison to its surrounding counterparts; each anal plate more than twice as long as broad, with 2 simple, curved setae, 27-31 long, inserted in the inner margin at the anterior half of each plate, setae $an_1 > an_2$; adanal fissure, iad minute, slit-like, closely lateral to the outer margin of each plate medially; each genital plate twice as long as broad, with 6 simple, slightly curved setae, 18-35 long, placed at the middle of each plate, their mutual distances gradually diminishing anteriorly and length gradually increasing anteriorly; genital and anal plates closely approximated, the intervening distance being equal to the maximum width of a genital plate and interrupted by a strap-like, slightly arched, transverse, preanal tectum much closer to the anal than to the genital plates.

Epimera I and II separate, III and IV fused, all with granular ceroteguments; epimeral setal formula 2-1-3-3; epimeral setae $1a$, $2a$ and $3a$ simple, thin, $4a$ simple twice as thick as the former three; setae $1b$, $3b$, $4b$ and $4c$ pentaradiate where as setae $3c$ hexaradiate, although setae $3b$ is hexaradiate and $3c$ is pentaradiate as observed in two paratypes.

Tarsi of legs monodactylous, claws are slightly curved.

Holotype: Adult ♀, INDIA: W. Bengal: Darjeeling, Singtom Tea Estate (from decomposed leaves of *Thea sinensis*), 1500m., 20.ix. 1978 (B. K. Mondal Coll.); paratypes: 3 adult ♀♀, same data as for holotype; paratypes: 7 adults ♀♀, INDIA: W. Bengal: Darjeeling, Mohurgong Tea Estate (from humus), 117 m., 4. x. 1978 (B. K. Mondal Coll.); paratypes: 7 adult ♀♀, INDIA: W. Bengal: Darjeeling, Sukna Tea Estate (from loose humus), 135 m., 24. x. 1978 (B. K. Mondal Coll.); deposited in the laboratory of the Department of Zoology, Presidency College, Calcutta.

Of all the *Eremobelba* species and of the 9 Oriental species in particular, the present new species bears the greatest similarities with *E. flexuosa* Hammer, 1979 described from Java specially in the nature of lamellar, exobothridial and notogastral setae and semilunar structures behind the interlamellar setae. It can, however, be distinguished from the above mentioned species by the presence of lateral prodorsal lamellar ridge, lesser number of epimeral setae, star-shaped epimeral setae $4c$, increased number of aggenital-adanal setae, besides a few other characters. It, therefore, seems reasonable to consider as a new species.

ACKNOWLEDGEMENTS

We express our deep sense of gratitude to Prof. S. K. Dasgupta, Head of the Department of Zoology, Presidency College, Calcutta for providing laboratory facilities and to Dr. D. K. Chakrabarti, Asstt. Prof. of Zoology, Presidency College, Calcutta for providing necessary facilities to work. Thanks

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*Not seen in original.

ON A COLLECTION OF TETRANYCHOID MITES FROM TAMIL NADU
WITH DESCRIPTION OF A NEW SPECIES OF *APONYCHUS*
(ACARI : TETRANYCHIDAE)

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ABSTRACT

Eighteen species of tetranychoid mites belonging to ten genera and two families are reported here from Tamil Nadu which includes one new species of *Aponychus* Rimando is described here.

INTRODUCTION

The tetranychidae or spider mites and Tenuipalpidae or false-spider mites are plant feeders and, hence are of economic importance. So far only ten species of tetranychoid mite are known from Tamil Nadu (Prasad, 1974). Recently, the author had an opportunity to examine a small collection of tetranychoid mites from Tamil Nadu and the present paper is based on that.

Altogether, sixteen species of Tetranychidae in eight genera including a new species of *Aponychus* and two species of Tenuipalpidae in two genera are treated here. Of these, fourteen species are new records for Tamil Nadu.

1. *Bryobia praetiosa* Koch

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

Bryobia praetiosa, Prasad, 1975. *Intl. J. Acar.*, 1 (1) : 13.

Material examined : 1 ♀, Tamil Nadu : Kodaikanal, St. Marry Road, on pine tree, 24.ii.1983, (Coll. S. K. Bhattacharyya and Y. N. Gupta).

Distribution in India : Assam, Delhi, Himachal Pradesh, Jammu and Kashmir, Punjab, Tamil Nadu (New record), Uttar Pradesh, West Bengal.

Remarks : No male of this mite has been recorded so far. These mites occur on both the surface of the host leaves.

2. *Eutetranychus orientalis* (Klein)

Eutetranychus orientalis (Zacher) Klein, 1936. *Bull. agric. Res. Stn. Rehovoth*. 21 : 3.

Eutetranychus orientalis, Manson, 1963. *Acarologia*, 5 : 851.

Material examined : Sev. exs., Tamil Nadu : Madras, Christian College, On cocount, 2.xii.1975 ; 2 ♀ ♀, Cape comorin, therakalputhoo, on coconut, 12.xii.1975, (Coll. S. K. Gupta) ; 1 ♀, Top Slip, Karion Shola, on an undetermined plant, 20.ii.1982, (Coll. S. K. Bhattacharyya and Y. N. Gupta).

Distribution in India : Andaman and Nicobar Islands, Assam, Delhi, Gujarat, Kerala, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu (new record), Uttar Pradesh, West Bengal.

Remarks : It was observed that the shape and size of dorsal idiosomal setae, some times varied with the host on which the mites fed.

3. *Aponychus corpuzae* (Rimando)

Aponychus corpuzae Rimando, 1966. *Philip. J. Agric.*, 50 : 107.

Aponychus corpuzae, Gupta, 1976. *Oriental. Ins.*, 10 (3) 332-333.

Material examined : 2 ♀ ♀, Tamil Nadu : Kodai Kanal, Bear Shola, On Strawberry, 20.ii.1982, (Coll. S. K. Bhattacharyya & Y. N. Gupta).

Distribution in India : Andaman and Nicobar Islands, Meghalaya, Tamil Nadu (New record), Uttar Pradesh, West Bengal.

Remarks : *Aponychus corpuzae* was described from Philippines and was included in subfamily Aponychinae erected to accommodate this genus (Rimando, 1966), but Tuttle and Baker (1968) did not agree to it.

4. *Aponychus kodaikanalensis* n. sp.

(Fig. 1, 1-5.)

Female : Body oblong, including rostrum 400 μ long, 250 μ wide. Idiosoma with dorsal integument wrinkled as figured. Dorsal idiosomal setae lanceolate and hairy. II and III propodosomals, humeral, 1st and IInd dorsolateral and inner sacrals large. 1st to IIIrd dorsocentral, third dorsolateral medium sized while 1st propodosomals, and cluanals same in length. Outer sacrals absent. peritreme at distal end anastomosing. Genital flap with transverse striae. Stylophore deeply cleft mediodistally, Medioventral setae of moderate size. Palpus with terminal sensillum slender and twice long as broad. Tibia I with 5 tactile and one sensory setae ; tarsus I with 8 tactile and one sensory setae. Tibia II with

two tactile and one sensory setae ; tarsus II with 6 tactile and one sensory setae.

Male : Not known.

Holotype : ♀, (Reg. No. 3725/17), India : Tamil Nadu : Kodaikanal, on way to Golf club., on bamboo, 24.ii.1982, (Coll. S. K. Bhattacharyya and Y. N. Gupta).

Paratype : 1 ♀, (Reg. No. 3726/17), Data same as for Holotype.

Remarks : *Aponychus kodaikanalensis* n. sp. similar to *A. nakaoi* Ehara, in the absence of the outer sacral setae but the former is easily distinguished from the latter by having the idiosomal and caudal setae much longer and serrate.

5. *Panonychus citri* (McGregor)

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

Metatetranychus citri, Pritchard and Baker, 1955, *Mem. Pac. Coast. Entomol. Soc.*, 2 : 97.

Panonychus citri, Meyer and Ryke, 1959. *J. ent. Soc. sth. Afr.*, 22 (2) : 350-351.

Panonychus citri, Prasad, 1975. *Intl. J. Acar.*, 1 (2) : 22.

Material examined : 15 ♀ ♀, Tamil Nadu : Kodai Kanal, Melpellam, on cucumber, 22.ii.1982, (Coll. S. K. Bhattacharyya and Y. N. Gupta).

Distribution in India : Himachal Pradesh, Jammu and Kashmir, Manipur, Tamil Nadu (New record), Tripura, Uttar Pradesh, West Bengal.

Remarks : *Panonychus citri*, the citrus red mite is well known as an important pest of citrus in many parts of the world.

6. *Eotetranychus sexmaculatus* (Riley)

Tetranychus 6 maculatus Riley, 1890. *Insect life*, 2 : 225-226.



1

Figs. 1-5. *Aponychus kodaikanalensis* n. sp.

1. Dorsum of female

Eotetranychus sexmaculatus, Pritchard and Baker, 1955. *Mem. Pac. Coast. Entomol. Soc.*, 2 : 202-203.

Eotetranychus sexmaculatus, Gupta and Gupta, 1977. *News. zool. Surv. India*, 2 (1) : 27-29.

Material examined : 1 ♂, 6 ♀ ♀, Tamil Nadu : Kodaikanal, Bear shola, on strawberry, 20.ii.1982, (Coll. S.K. Bhattacharyya and Y.N. Gupta).

Distribution in India : Assam, Rajasthan, Tamil Nadu, (New record), Uttar Pradesh.

Remarks : This species is a serious pest of citrus in Florida and Southern California. These mites form restricted colonies under the host leaves.

7. *Eotetranychus kankitus* Ehara

Eotetranychus kankitus Ehara, 1955. *Annotoes zool. Jap.*, 28 : 178.

Eotetranychus kankitus, Manson, 1968. *Acarologia*, 5 : 353.

Material examined : 1 ♂, 2 ♀♀, Tamil Nadu : Velve Junction, Naduvattam. On an undertermined plant, 13.ii.1982 ; 1 ♂, 25 ♀♀, Kodaikanal, Forest Rest House, on Rose, 21. ii. 1982, (Coll. S. K. Bhattacharyya and Y. N. Gupta).

Distribution in India : Assam, Tamil Nadu (New record), Uttar Pradesh.

Remarks : This is an Indian species.

8. *Eotetranychus pamela* Manson

Eotetranychus pamela Manson, 1968. *Acarologia*, 5 : 353-356.

Material examined : 2 ♂♂, 20 ♀♀, Tamil Nadu, Kodai Kanal, Perumalmalai, on an unidentified plant, 25.ii.1982, (Coll. S. K. Bhattacharyya and Y. N. Gupta).

Distribution in India : Assam, Himachal Pradesh, Tamil Nadu (New record).

Remarks : This is an Indian species. The present species bear some resembles to *Eotetranychus kankitus* Ehara but can be distinguished from it by the shape of aedeagus manson (1963).

9. *Schizotetranychus andropogoni* (Hirst)

Tetranychus (*Schizotetranychus*) *andropogoni* Hirst, 1926. *Proc. Zool. Soc. Lond.*, 2 : 829.

Schizotetranychus andropogoni, Narsimha, 1952, *Curr. Sci.*, 21 : 163-164.

Schizotetranychus andropogoni, Ghai, 1964. *Entomology in India* : 392.

Material examined : 1 ♂, 8 ♀♀, Tamil Nadu : Coimbatore, Tamil Nadu Agriculture univ., on *Zinia* sp., 17.xii.1975, (Coll. S. K. Gupta).

Distribution in India : Bihar, Delhi, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal.

Remarks : It has been observed that tenent hairs split very often two or more fine hairs.

10. *Oligonychus biharensis* (Hirst)

Paratetranychus biharensis Hirst, 1924. *Proc. Zool. Soc. Lond.*, 69.

Oligonychus biharensis, pritchard and Baker, 1955, *Mem. Pac. Coast. Entomol. Soc.* 12 : 364-365.

Material examined : 2 ♂♂, 5 ♀♀, Tamil Nadu : Coimbatore, Tamil Nadu Agric. university, on an unidentified plant, 18. xii. 1975 ; 3 ♂♂, 12 ♀♀, Coimbatore, Tamil Nadu. Horticultural Garden, on potato, 3.xii.1975, (Coll. S. K. Gupta) ; 2 ♂♂, 15 ♀♀, Nilgiri, Mudumalai, on wood apple, 12.ii.1982, (Coll. S. K. Bhattacharyya and Y. N. Gupta).

Distribution in India : Andaman and Nicobar Islands, Bihar, Gujarat, Karnataka, Kerala, Tamil Nadu, (New record), West Bengal.

Remarks : This species has also been recorded from Thailand feeding on citrus. (Manson, 1963).

11. *Oligonychus mangiferus* (Rahman and Sapra)

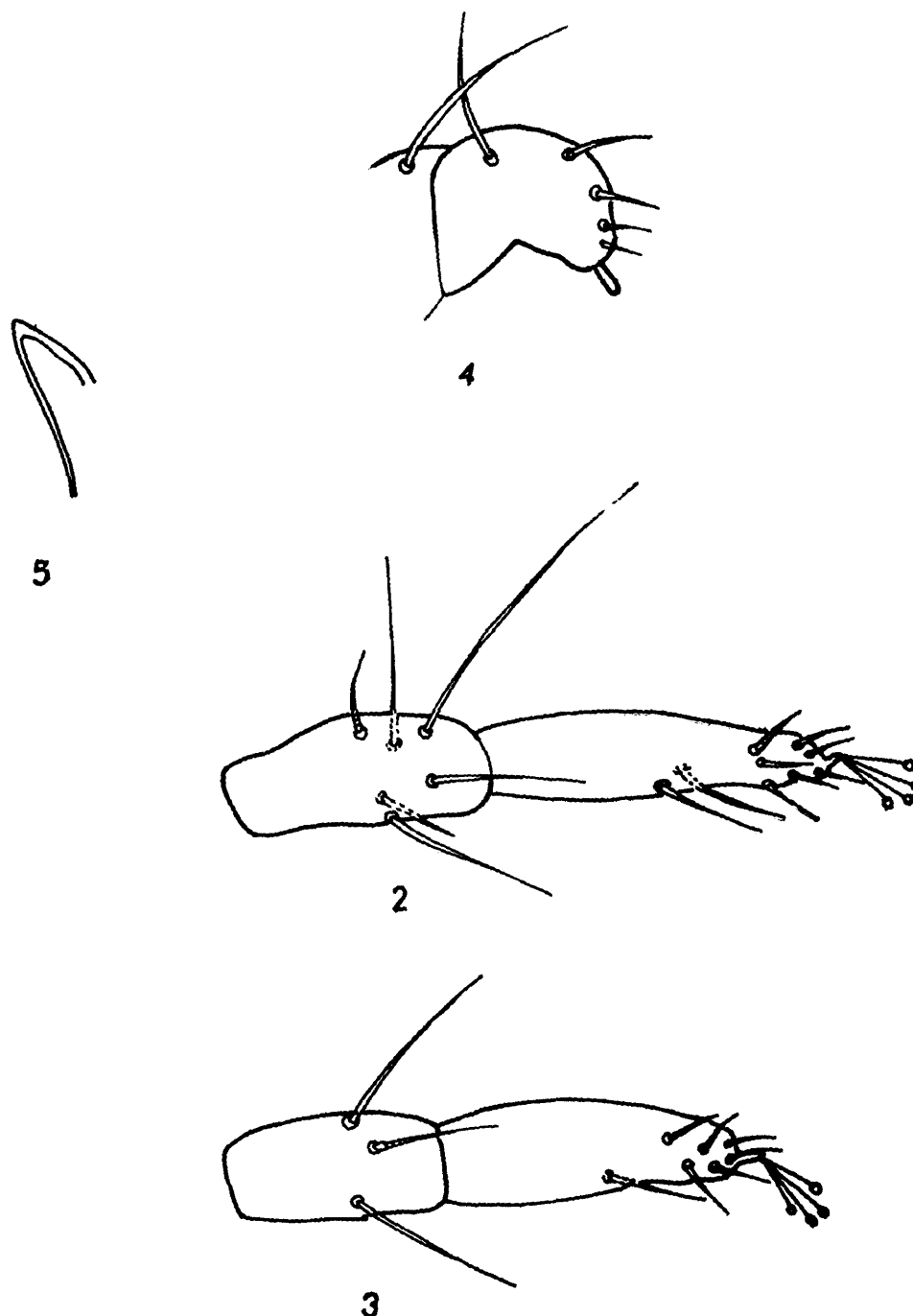
Paratetranychus mangiferus Rahman and Sapra, 1940. *Proc. Indian Acad. Sci.*, 11 (B) : 192.

Oligonychus mangiferus, Pritchard and Baker, 1955. *Mem. Pac. Coast. Entomol. Soc.*, 2 : 33.

Material examined : 1 ♂, 7 ♀♀, Tamil Nadu ; Topslip, On Mango, 17.ii.1982, (Coll. S. K. Bhattacharyya and Y. N. Gupta).

Distribution in India : Haryana, Himachal Pradesh, Punjab, Rajasthan, Tamil Nadu (N. record), West Bengal.

Remarks : This species has been reported feeding on mango, grape, *Eugenia jambolana*, *Anona* sp., rose.



Figs. 1-5. *Aponychus kodaikanalensis* n. sp.

2. Tibia and Tarsus I of female 3. Tibia and Tarsus II of female
4. Distal segment of palpus of female 5. Peritreme of female.

12. *Oligonychus iseilemae* (Hirst)

Paratetranychus iseilemae (Hirst), 1924. *Ann. Mag. nat. Hist. London*, 9 (14) : 524.

Oligonychus iseilemae, Pritchard and Baker, 1955. *Mem. Pac. Coast. Entomol. Soc.*, 2 : 358.

Material examined : Sev. ♂♂, ♀♀, Tamil Nadu ; Madras, Christian College, On Coconut, 2.xii.1975, (Coll. S. K. Gupta).

Distribution in India : Andhra Pradesh, Andaman and Nicobar Islands, Timal Nadu.

Remarks : This is a grass infesting mite. This species is known only from South India.

13. *Tetranychus cinnabarinus* (Boisduval)

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

Tetranychus telarius, Rahman and Sapra, 1940. *Proc. Indian. Acad. Sci.*, 11 B : 182-185.

Tetranychus cinnabarinus, Tuttle and Baker, 1977. *Tuscon Ariz. univ. Ariz. Press* : 129.

Material examined : Sev. ♂♂, ♀♀, Tamil Nadu : Kodaikanal, Chettiar Park, On Castor, 22.ii.1982 ; Sev. ♂♂, ♀♀, Kodaikanal, Chettiar Park, on Rose, 26.ii.1982, (Coll. S. K. Bhattacharyya and Y. N. Gupta).

Distribution in India : Andhra Pradesh, Assam, Bihar, Gujarat, Himachal Pradesh, Jammu and Kashmir, Madhya Pradesh, Meghalaya, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh., West Bengal.

Remarks : This species has a world wide distribution and is a serious pest of many cultivated plants.

14. *Tetranychus ludeni* Zacher

Tetranychus ludeni Zacher, 1913. *Mitt. Kais. Bio. Anst. Lond. Forst.*, 14 : 40.

Tetranychus ludeni, Prasad, 1974. *A Catalogue of mites of India*. Indira Acarology publishing House, Ludhiana : 125.

Material examined : 1 ♂, 16 ♀♀, Tamil Nadu : Coimbatore, Tamil Nadu Agri. univ., On Cotton, 9.xii.1975, (Coll. S. K. Gupta).

Distribution in India : Andhra Pradesh, Karnataka, Kerala, Tamil Nadu (N. record).

Remarks : *Tetranychus ludeni* Zacher has a world wide distribution and occurs on cultivated and as well as on wild plants,

15. *Tetranychus macfarlanei*

Baker and Pritchard

Tetranychus macfarlanei Baker and Pritchard, 1960. *Hilgardia*, 29 : 537.

Material examined : 1 ♂, ♀♀, Tamil Nadu : Topslip, Kayhikamuthi, on banana, 18.ii.1982, (Coll. S. K. Bhattacharyya and Y. N. Gupta).

Distribution in India : Andaman and Nicobar Islands, Madhya Pradesh, Rajasthan, Tamil Nadu (New record), West Bengal.

Remarks : This mite attacks on a large variety of vegetable crops.

16. *Tetranychus neocaledonicus* Andre'

Tetranychus neocaledonicus Andre', 1933. *Bull. Mus. natn. Hist. nat., Paris*, 5 (2) : 302.

Tetranychus cucurbitae, Ghai, 1974. *Entomology in India* : 392.

Tetranychus neocaledonicus, Prasad, 1974. *A catalogue of mites of India*, Indira Acarology publishing House, Ludhiana : 125-126.

Material examined : 1 ♂, 8 ♀♀, Tamil Nadu : Madras, Loyalla college compound, on *Bauhinia purpurea*, 30.xi.1975 ; sev, ♂♂, ♀♀, Pondicherry, on *Bauhinia purpuria*, 4.xii.1975. (Coll. S. K. Gupta), 4 ♂♂, 6 ♀♀, Coimbatore, univ. Botanical Garden, on rose, 10.ii.1982 ; 2 ♂♂, 12 ♀♀, Mudumalai, on wild plant, 12.ii.1982 ; 1 ♂, 12 ♀♀, Kodaikanal, perumalmalai, on Castor, 25.ii.1983 ; 1 ♂, 20 ♀♀, Topslip, on papaya, 17.ii.1982 ; sev. ♂♂, ♀♀, Kodaikanal, Kurinja Adav-antemple compound, on banana, 26.ii.1982 ; 1 ♂, 25 ♀♀, Mudumalai, on wild grass, 12.ii.1982 ; 2 ♂♂, 26 ♀♀, Kodaikanal. Melpallam. on banana 22.ii.1982 (Coll. S. K. Bhattacharyya and Y. N. Gupta).

Distribution in India : Assam, Delhi, Gujarat, Jammu and Kashmir, Karnataka,

Kerala, Orissa, Punjab, Rajasthan, Tamil Nadu (N. record), Uttar Pradesh, West Bengal.

Remarks : This is a serious pest of a large variety of vegetables and fruits.

Family TENUIPALPIDAE

17. *Brevipalpus phoenicis* (Geijskes)

Tenuipalpus phoenicis Geijskes, 1939, *Meded. Land bouw wageningen*, 42 (4) : 230.

Brevipalpus phoenicis, Sayed, 1946. *Bull. Soc. Fouad. Ler. Ent.*, 30 : 99.

Brevipalpus phoenicis (Geij), 1961. Two and a Bud, *Cinnamara*, 8 : 3-4.

Material examined : 20 ♀ ♀, Tamil Nadu : Ooty, Ooty lake, On an unidentified plant, 9.ii.1982 ; 25 ♀ ♀, Kodai kanal, Forest Rest House compound, on an unidentified plant, 11.ii.1982, (Coll. S. K. Ehattacharyya and Y. N. Gupta).

Distribution in India : Assam, Bihar, Delhi, Himachal Pradesh, Karnataka, Madhya Pradesh, Meghalaya, Punjab, Maharashtra, Orissa, Rajasthan, Tamil Nadu (new record).

Remarks : This mite is known to have a world wide distribution infesting a wide range of plants.

18. *Raoiella indica* Hirst

Raoiella indica Hirst, 1924. *Ann. Mag. Nat. Hist.*, 14 (9) : 5-22.

Material examined : Sev. ♂ ♂, ♀ ♀, Tamil Nadu : Coimbatore, univ. Botanical Garden, On beans, 10.ii.1982. (Coll. S. K. Bhattacharyya and Y. N. Gupta).

Distribution in India : Gujarat, Karnataka, Madhya Pradesh, Punjab, Tamil Nadu.

Remarks : This is South Indian species. So far only two species of this genus has been reported from India.

KEY TO THE FAMILIES, GENERA AND SPECIES OF TETRANYCHOID MITES TREATED IN THIS PAPER

1. Palpus Simple, without a claw on the fourth palpal segment... Family Tenuipalpidae ... 2
- Palpus with a claw like appendage on fourth palpal segment. ... Family Tetranychidae ... 3
2. Tarsus I and II with a single sensory rod, Hysterosoma with 4 pairs of dorsosublaterals. ... *Raoiella indica* Hirst
- Tarsus II with two sensory rods Hysterosoma without dorsosublaterals. ... *Brevipalpus phoenicis* (Geijskes)
3. With three pairs of propodosomal setae. Propodosomal and hysterosomal setae not subspatulate ... 4
- With four pairs of propodosomal setae. Propodosomal and hysterosomal setae subspatulate. ... *Bryobia praetiosa* (Koch)
4. Tarsus I with a single set or duplex setae absent. ... 5
- Tarsus I with two pairs of duplex setae, empodium claw like or split distally. ... 7
5. Empodial claw absent, female with two pairs of para-anal setae, male with four pairs of genitoanal setae, dorsal striae of the propodosoma more or less parallel. ... *Eutetranychus orientalis* (Klein)
- Empodial claw absent, female with one pair of para-anal setae, male with three pairs of genito-anal setae. Dorsal striae of the propodosoma not parallel. ... *Aponychus* ... 6

6. Outer sacral setae present. ... *Aponychus corpuzae* Rimando
- Outer sacral setae absent. ... *Aponychus kodaikanalensis* n. sp.
7. Empodium claw like with two pairs of para anal setae. ... 8
- Empodium ending a tuft of hairs with one pair of para-anal setae. ... 12
8. Empodium claw like. ... 9
- Empodium ending in a tuft of hairs. ... *Eotetranychus* 10
9. Empodium a single claw like structure, Dorsal setae borne on strong tubercles and about $1\frac{1}{2}$ longer than interval between their bases. ... *Panonychus citri* (McGregor)
- Empodium split into two claw like structure, usually with appendant hairs. Dorsal setae not ; borne on strong tubercles and about as long as intervals between their bases. ... *Schizotetranychus andropogoni* (Hirst)
10. Dorsal idiosomal setae serrate... *hankitus* Ehara
- Dorsal idiosomal setae not serrate. ... 11
11. Genital flap with longitudinal striae. ... *sexmaculatus* (Riley)
- Genital flap with transverse striae. ... *pamelae* Manson
12. Empodium claw like, with proximoventral hairs, duplex setae of tarsus I distal and approximate. ... *Oligonychus* 13
- Empodium split distally, usually into three pairs of hairs, duplex setae of tarsus I well developed. ... *Tetranychus* 15
13. Aedeagus bent dorsal. ... *mangiferus* (Rahman and Sapra)
- Aedeagus bent ventrad. ... 14
14. Tarsus I with proximoventral empodial appendages forming a pair of empodial spurs, on monocot mostly grasses. ... *iseilemae* (Hirst)
- Tarsus I with three pairs of proximoventral hairs on empodium, on other hosts. ... *biharensis* (Hirst)
15. Tarsus I with proximal pair of duplex setae in line with most other proximal setae. ... 16
- Tarsus I with proximal pair of duplex setae distad of other proximal tactile setae. ... 17
16. Aedeagus knob with anterior and posterior angulation. ... *macfarlanei* Baker and Pritchard
- Aedeagus without posterior angulation. ... *ludeni* Zacher
17. Knob of aedeagus berry like round, anterior posterior more strongly developed than the posterior convexity. ... *neocaledonicus* Andre'
- Knob of aedeagus not globular the caudal projection angulate... *cinnabarinus* (Boisd.)

ACKNOWLEDGEMENT

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THREE SMALL, LITTLE-KNOWN GENERA OF ASILIDAE (DIPTERA) FROM INDIA

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ABSTRACT

One new species each of *Apoclea* Macquart, *A. rajasthanensis* n. sp., *Stichopogon* Loew, *S. indicus* n. sp., and *Lobus* Martin, *L. jairami* n. sp. are described from India and keys to the species are also given.

Apoclea Macquart, *Stichopogon* Loew and *Lobus* Martin are three small genera of Asilidae, represented in India by one species, four species and two species respectively (Oldroyd, 1975); one more new species of the last mentioned genus was recently (1989) described by us. In this paper, one new species each, of these genera, is described.

Genus *Apoclea* Macquart

Apoclea Macquart, 1838, *Dipt. exot.* 1 (2) : 119. Type-species *Asilus algirus* Linnaeus, by monotypy.

Medium to large-sized flies with dense pollen and characteristically appressed, short, hairs; wings with subcosta narrow, marginal cell relatively wide, and anterior branch of third vein generally with a short basal extension; male terminalia large, superior forceps closely apposed and laterally wholly dominate the terminalia.

KEY TO THE INDIAN SPECIES OF *Apoclea* Macquart

1. Femora black, tibiae and tarsi reddish, antennae dark brown, superior forceps of male terminalia rather long. ... *indica* Bromley
Legs and antennae uniformly yellowish-brown, superior forceps of male terminalia comparatively short. ... *rajasthanensis* n. sp.

Apoclea rajasthanensis n. sp.

(Fig. 1)

Medium sized yellowish-brown to dark brown species with yellowish-brown legs

covered with white hairs, and hyaline wings. Male: length 17 mm, wing 11 mm; female: length 18 mm, wing 12 mm.

Male: Head broader than thorax, dark brown, greyish-yellow tomentose; mystax white to pale, frons below as well as above antennae with dense pale hairs, the hairs being longer below, ocellar bristles white, hairs of occiput pale, some of which medio-laterally form bristles. Antennae yellowish-brown, bristles on segments 1 and 2 white, segment 2 longer than half of 1, segment 3 longer than 2 but shorter than 1. Palpi yellowish-brown and proboscis black, their hairs white and also with some pale ones.

Thorax dark brown to black, sparsely greyish-yellow tomentose; pronotal hairs white and pale, dense on sides; mesonotum with the mediolongitudinal stripe indistinctly marked, humeri yellowish-brown, covering hairs and bristles pale; scutellum with the disc bearing white hairs and hind border a pair of white bristles; pleura densely grey or greyish-yellow tomentose with the hairs white. Halteres yellowish-brown.

Legs yellowish-brown, covering hairs and bristles white but for a few black ones on tarsal segments.

Wings hyaline, anterior branch of third vein with a small basal extension, first posterior cell, fourth posterior cell and anal cell closed and stalked.

Abdomen yellowish-brown to dark brown, sides of tergites 1-3 with a few pale bristles, clothing hairs white. Male terminalia (Fig. 1) concolourous with the rest of abdomen, hairs white, dense.

Female: Similar, but comparatively darker coloured. Apex of ninth tergite bearing

Paratype ♀, Reg. No. 6970/H6, India : Rajasthan : Gudba, 17.v.1958, coll. T. G. Vazirani.

Genus *Stichopogon* Loew

Stichopogon Loew, 1847, *Linn. Ent.* 2 : 499. Type-species, *Dasypogon elegantulus* Wiedemann, by original designation.

Minute flies of dark colour characterised by the single transverse row of mystax above the mouth margin, frons and vertex very widely divergent, style quite short; male terminalia hood-like and turned downwards, not distinctive.

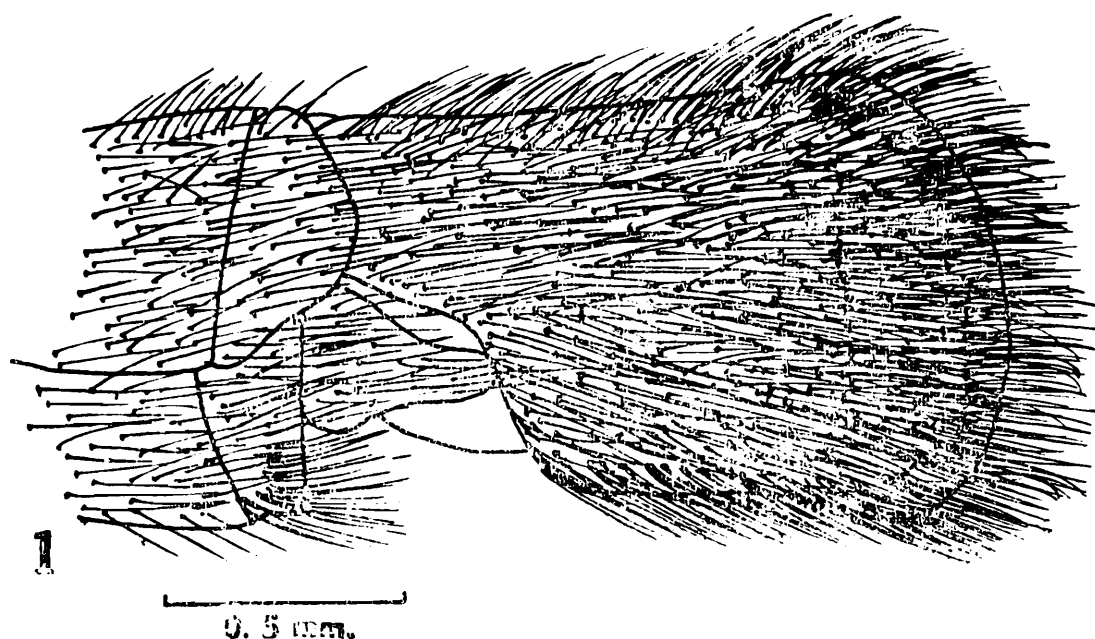


Fig. 1. *Apoclea rajasthanensis* n. sp., lateral view of male terminalia.

about eight spines of unequal size arranged in two rows on either side.

The only other species recorded under *Apoclea* from India is *A. indica* Bromley from which *A. rajasthanensis* n. sp. differs in the yellowish-brown antennae, uniformly yellowish-brown legs and comparatively short superior forceps of male terminalia.

Holotype ♂, ZSI Reg. No. 6969/H6, India : Rajasthan : Narana, 27.v.1958, coll. T. G. Vazirani.

KEY TO THE INDIAN SPECIES OF *Stichopogon* Loew (After Oldroyd 1948)

1. Fore femora partly or wholly orange or yellow. ...	...	2
Fore femora black contrasting with orange base of tibia. ...	...	3
2. Lamellae of female rather bare, with pointed tuft of golden hairs. ...	...	<i>meridionalis</i> Oldroyd
Lamellae tomentose, without tuft of hairs. ...	...	<i>tomentosus</i> Oldroyd

3. Lamellae of female with a broad tuft of hairs fringing all upper margin. Mystax and face white in both sexes. ... *inaequalis* Loew

Lamellae of female without tuft of hairs. ... 4

4. Mystax white in female and bright golden-yellow in male, antennae orange with blackish style, eighth tergite with 5-6 stout bristles. ... *gymnurus* Oldroyd

Mystax straw coloured in both sexes, basal segments of antennae black, apical segment brown with upper side black, eighth tergite without bristles. ... *indicus* n. sp.

Stichopogon indicus n. sp.

(Figs. 2, 3)

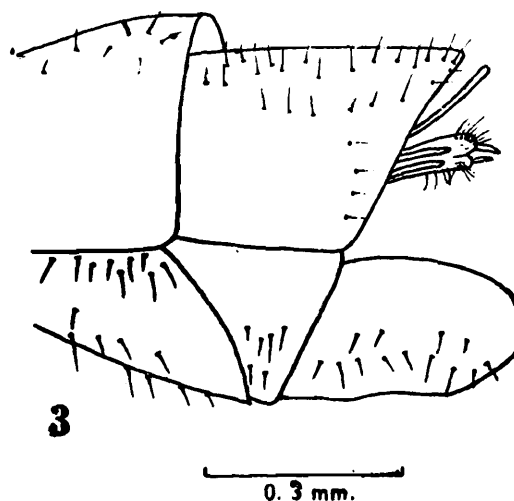
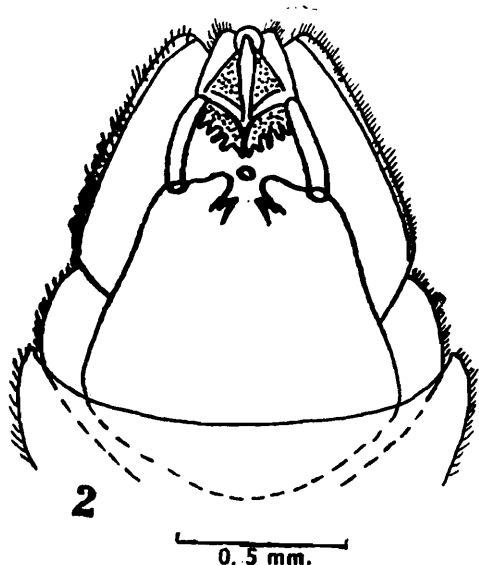
A tiny black species with black and yellowish-brown legs and lightly infuscated wings. Female : length 6-7 mm, wing 4-5 mm ; male : length 5-6 mm, wing 4-5 mm.

Female : *Head* broader than thorax, black with sparse yellowish tomentum above antennae and grey to greyish-yellow tomentum

below them ; mystax straw coloured and forming a transverse row above mouth margin, frons along sides above antennae bearing white hairs, ocellar bristles pale, upper occiput sparsely white haired and also with four pale bristles, postocular occiput white haired. Antennal segments 1 and 2 black, the latter grey tomentose with concolourous bristles, 3 brown with its upper side black, 3 much longer than the combined length of two basal segments. Palpi and proboscis black, the former bearing sparse pale hairs.

Thorax black, sparsely grey tomentose ; pronotum concolourous with the rest and bearing pale hairs anteriorly ; mesonotum with sparse, pale, clothing hairs, bristles brown ; scutellum grey tomentose, disc bare, hind border bearing pale hairs ; pleura sparsely grey tomentose. Halteres brownish tinged, stalks still lighter coloured.

Legs black and yellowish-brown ; coxa to femur black, tibia yellowish-brown with black apex, tarsal segments black with yellowish-brown basal marking on basal 2-3 segments, clothing hairs as well as bristles pale.



Figs. 2-3. *Stichopogon indicus* n. sp. ; 2, ventral view of male terminalia ; 3, lateral view of female terminalia.

Wings lightly infuscated.

Abdomen black, sides of tergites grey which occupy lesser area in posterior segments, tergite 1 on side with long pale hairs, covering hairs pale; tip of abdomen (Fig. 3) illustrated, lamellae without apical tuft of hairs.

Male: Similar but grey tomentum not so distinct; terminalia (Fig. 2) concolourous with rest of abdomen.

Stichopogon indicus n. sp. is generally similar to *S. gymnurus* Oldroyd but differing in the black basal segments of antennae, in female lamellae devoid of apical tuft of hairs, and in male eighth abdominal tergite without bristles.

Holotype: ♀, ZSI Reg. No. 6920/H6, India: Maharashtra: Ratnagiri District: Ratnagiri, 7.vii.1981, coll. P. Parui and P. H. Roy.

Paratypes: 1 ♀, 4 ♂♂, 6921/H6 to 6925/H6, rest of details as in holotype.

Genus *Lobus* Martin

Lobus Martin, 1972, *J. Kansas ent. Soc.* **45** (1): 8.
Type-species, *Leptogaster pallipes* Janssens 1953, by original designation.

Members belonging to *Lobus* Martin are slender, black flies which are readily recognised from the remaining genera of Leptogastrinae by the long, horizontal, pod-like ventral organ of male terminalia called lobos and the almost wholly fused aedeagal sheath with the lobos.

KEY TO THE INDIAN SPECIES OF *Lobus* Martin

1. Anterior legs uniformly yellowish.	...	...	2
Anterior legs pale yellow, apex dark brown.	...	...	3

2. Hind femur with dark spot medially and basally, hind tibia without band; scutellum bears 8 short dark bristles on posterior margin. ... *keralae* Martin

Hind femur reddish-brown at tip, hind tibia with a brown band at apex; scutellum bears pale hairs on posterior margin. ... *himalayae* Martin

3. Posterior border of scutellum with 2 or 3 rows of short bristles; proctiger of male terminalia conical. ... *martini* Joseph & Parui

Posterior border of scutellum without bristles; proctiger of male terminalia ovoid. ... *jairami* n. sp.

Lobus jairami n. sp.

(Fig. 4)

A slender black fly with dark brown and yellowish-brown legs, brownish tinged wings and dark brown abdomen. Male: 8 mm, wing 4 mm; female: length 9 mm, wing 7 mm.

Male: Head black; gibbosity indistinct, mystax a transverse row of white bristles on mouth border with sparse grey tomentum, occipital hairs short and pale coloured, which become gray on sides. Antenna dark brown, segments 1 and 2 nearly equal, 3 elongate, style about two thirds of 3. Palpi and proboscis dark brown.

Thorax black, sparsely grey tomentose; pronotum devoid of hairs; mesonotum without mediolongitudinal stripe, sides, especially posteriorly, grey tomentose and the rest black, covering hairs dark brown or pale, posterior side bearing somewhat dense, brown hairs; scutellum thickly grey tomentose, covered with hairs but without bristles; pleura to a greater extent covered with gray

tomentum, mesopleuron and sternopleuron anteriorly bearing dense, long, pale hairs. Halteres brownish.

Legs dark brown and yellowish-brown, coxa and trachanter dark brown; forefemur for more than three-fourths yellowish-brown and apically dark brown, midfemur dark brown except at extreme base, hindfemur with the basal half yellowish-brown and distal half dark brown, tibiae basally for more than half yellowish-brown while the rest dark brown, tarsus with the basitarsus yellowish-brown; bristles and clothing hairs predominantly pale with some black ones also.

Wings brownish tinged, basally comparatively darker coloured.

Abdomen dark brown with tergites somewhat lighter on anterior and posterior borders, the lighter colouration gradually decreases in hind tergites. Male terminalia (Fig. 4) with the lobes yellowish-brown and the rest dark brown, hairs pale.

Female : Similar but comparatively darker coloured: in forelegs femur and tibia uniformly yellowish-brown, in mid and hind legs femur and tibia yellowish-brown and

black; abdomen black with grey markings at the anterior and posterior sides of tergites.

Genus *Lobus* Martin is represented by *L. martini* Joseph and Parui, *L. keralae* Martin and *L. himalayae* Martin from India. Of these *L. jairami* n. sp. is somewhat similar to *L. martini* Joseph and Parui, but otherwise quite distinct in structural details of male terminalia and colouration of hind legs. This species is named in honour of Sri Jairam Singh, Insect Setter, who has collected many valuable flies.

Holotype ♂, ZSI Reg. No. 6971/H6, India: Kerala: Kottayam, Edapaliyam 5.i.1971, coll. A. N. T. Joseph.

Paratype ♀, Reg. No. 6972/H6, rest of details as in holotype.

ACKNOWLEDGMENTS

We express our deep gratitude to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta, for the necessary permission accorded to us for studying the material and to Dr. S. K. Bhattacharyya, Deputy Director of the same department, for encouragements.

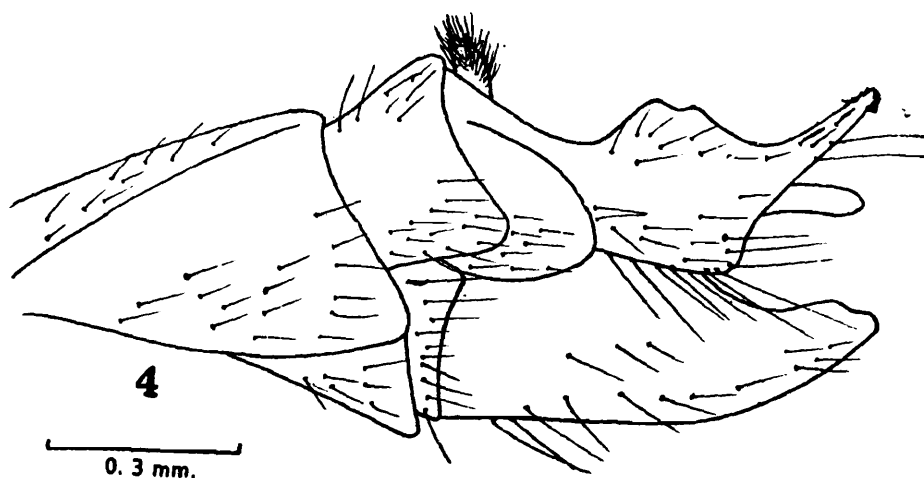


Fig. 4. *Lobus jairami* n. sp., lateral view of male terminalia.

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DISCOVERY OF THE GENUS *TENTYRINA* REITTER (COLEOPTERA :
TENEBRIONIDAE) FROM INDIA WITH DESCRIPTION
OF A NEW SPECIES

G. N. SAHA

Zoological Survey of India, Calcutta.

ABSTRACT

The genus *Tentyrina* Reitter (1900) of the subfamily Tentyriinae Solier (1937) is recorded for the first time from India and a new species, *Tentyrina rajasthanica* is described from Rajasthan.

INTRODUCTION

The insects belonging to the subfamily Tentyriinae, usually apterous considered as an archaic group of the family Tenebrionidae is characterised by the very large mentum, concealing both the ligula and the maxilla, frons usually trilobed, the mesocoxae enclosed by the meso- and metasternum without exposing the mesotrochantin, and the abdomen without intersegmental membranes between distal sternites. Doyen (1972) elevated it to a family rank as Tentyriidae. All Tentyriinae are eremophilous, exhibiting in their extreme desertic forms the highest of adaptation in overcoming the difficulties of existence in the wastes of the barren desert. The most specialised of these forms are to be found in the South African Namib desert (Koch, 1955).

While I was studying the collection of the family collected from desert and semi-desert parts of Rajasthan, I came across this interesting new species of *Tentyrina* which is a small genus of restricted distribution in Egypt and Palestine and this forms the first record of this genus from India.

Genus *Tentyrina* Reitter

Tentyrina Reitter, 1900, Best-Tab. XLII, p. 92, 166.

Body hard, shiny black, finely punctate; head convex posteriorly and gradually flat in front; pronotum and elytra fairly convex; apterous; eyes small and finely granular; antennae 11-segmented, slender, somewhat clavate; mandibles strong, pointed apically; mentum very large; maxillary palpi moderately elongate; pro- and mesocoxal semi-rounded; abdomen narrowed and pointed apically; legs elongate, with sharp tibial spines, tarsi spinous, claws simple.

Tentyrina rajasthanica sp. n.

(Fig. 1)

Female: Body convex, oblong, shiny black, glabrous, length 15-17 mm.

Head: Smooth, semi-rounded, very finely punctate, smaller than pronotum, convex posteriorly and gradually flat in front; labrum small, distinct, brownish, rounded apically and with small setae; mandibles strong, usually bidentate, upper one small, lower one fairly elongate, curved inwardly and acute apically; clypeus roundly protruded

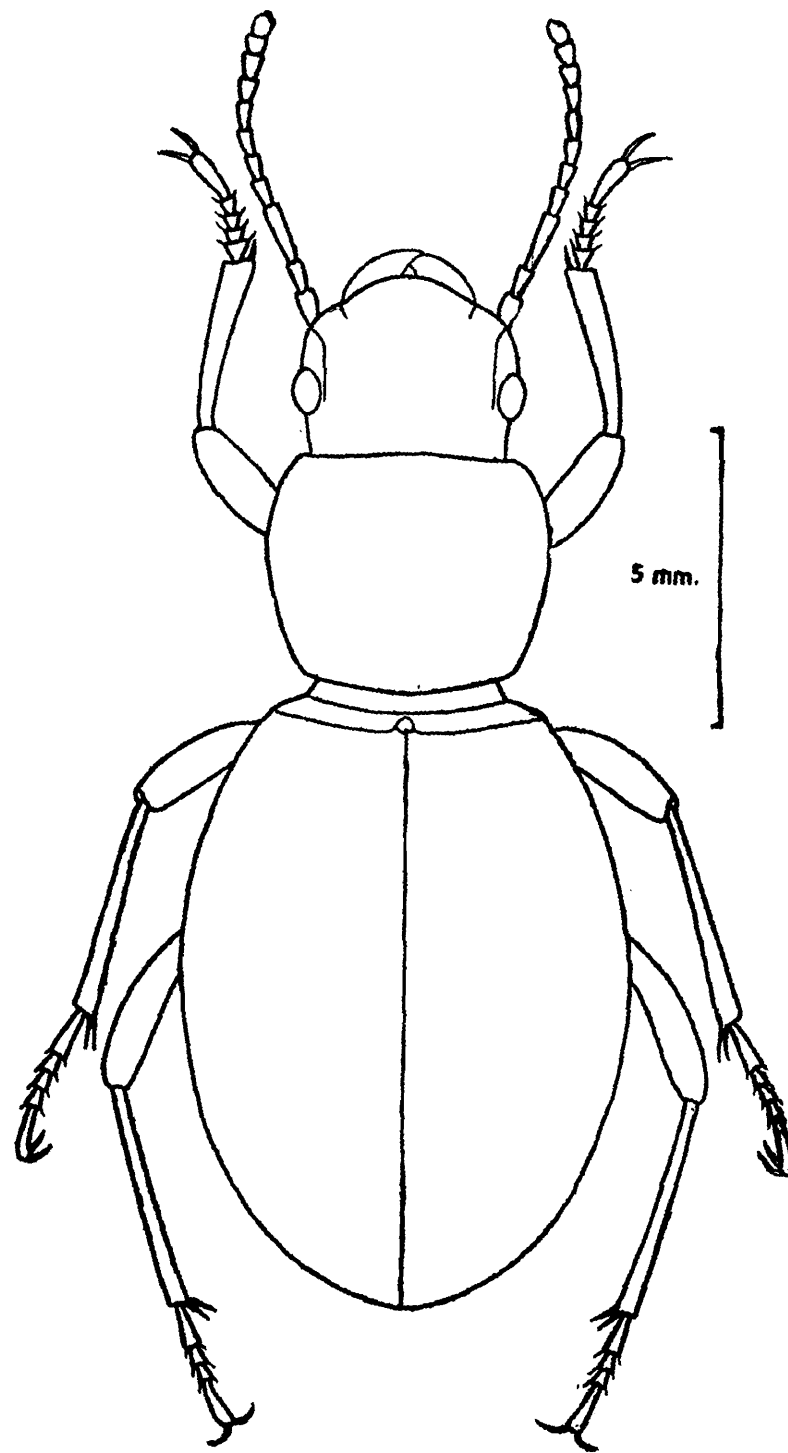


Fig. 1. *Tentyrina rajasthanica* sp. n., Holotype ♀ Dorsal view

in front ; frons produced and slightly elevated over the antennal sockets and extends slightly into the emargination of the eyes ; vertex and occiput moderately convex : eyes small, transverse, moderately convex, granular and slightly incised in front ; antennae

slender, somewhat clavate apically, segment I slightly longer and more swollen anteriorly than II, segment III longest, cylindrical and slightly longer than the total length of the segments IV and V, segments VI, & VII equal in length and slightly longer than VIII

& IX which are wider apically, segments X & XI wider and shorter in length than the preceding ones; mentum large, notched in front, moderately convex, bilobed; ligula not visible; apical segments of maxillary and labial palpi enlarged; sub-mentum triangular; enlarged gena region very sparsely hairy.

Pronotum : Fairly convex, broader than head, vary finely punctate, wider and truncate apically, all sides surrounded with a carina, moderately explanate laterally, faintly narrowed at base.

Scutellum : Small, finely elevated, semi-rounded posteriorly.

Elytra : Finely punctate, except posterior parts which finely tuberculate, carinate at base, with a fine sutural margin and distinct epipleura, apically rounded, embracing the sides.

Mesosternum anteriorly rugose; metasternum small; fore tibia gradually broad towards apex and ventrally slightly concave, rugose, with spines; mid and hind; tibiae cylindrical, fairly elongate and the mid and hind tibial spines more closely situated and more acute than those of fore tibiae; tarsi spinous; segments 1-4 of fore tarsi nearly transverse and equal in length; segments 2-4 of mid tarsi nearly equal in length and segment 5 of mid tarsi nearly equal of the total length of the segment 1 and 2; hind tarsal segment 2 slightly longer than segment 3, segment 4 slightly longer than segment 1.

Holotype ♀, INDIA : RAJSTHAN : Gandra Road, 2.II.1958, (K. K. T. & S. B.). Paratypes 2, ♀♀, 11 ♀, 1 ♀ RAJASTHAN, Pachfatra, Saltdift, 14.II.1957; RAJASTHAN : Jaisalmer

1 ♀, 24.XII.1957 (K. K. T. & S. B.); RAJASTHAN : Sardarshahr 1 ♀, 31. I. 1957.

Remarks : This species can be easily separated from other species of the genus by the protruded epistome, 3rd longest antennal segment and by the large, convex and bilobed mentum.

ACKNOWLEDGEMENTS

I am thankful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta, for necessary facilities and Dr. Z. Kaszab, Director General, Hungarian Natural History Museum, Budapest, for confirmation of the new taxa of the present paper and providing kind help to me when I was working in the aforesaid museum on the deputation through Govt. of India.

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OCCURRENCE OF FOSSIL *PANTHERA PARDUS* LINN.
FROM THE PLEISTOCENE DEPOSITS OF SUSUNIA,
BANKURA, WEST BENGAL.

By

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Zoological Survey of India, Calcutta.

ABSTRACT

A fossil fragment of mandible with last molar tooth collected from Jhikoria, Susunia, Bankura, West Bengal is described in this paper as *Panthera pardus* Linn. This is the first definite record of this species from the Pleistocene deposits of India.

INTRODUCTION

Among the fossil remains collected during the recent survey in the year 1982 by the Palaeozoology Division of the Zoological Survey of India at Susunia hill Bankura, West Bengal, we came across a fragment of mandible with an intact last molar tooth. On examining the material it appeared to be the last molar of *Panthera pardus* Linn. As far as we could ascertain from the literature (Lydekker, 1886 and Pilgrim, 1932) that there is a doubtful reference of a phalangeal figured by Lydekker, 1886 (G. S. I. No. F 225) and a metacarpal (G. S. I. No. F 225a) of *Panthera pardus* Linn. from Billa Surgam cave deposits in Karnul district of Andhra Pradesh.

Our discovery of a fragment of mandible with a last molar tooth, constitute the first definite record of fossil *Panthera pardus* Linn. from the Indian Pleistocene alluvial deposits from Susunia, Bankura, West Bengal.

SYSTEMATIC ACCOUNT

Phylum : CHORDATA
Class : MAMMALIA
Order : CARNIVORA
Family : FELIDAE
Species : *Panthera pardus* Linnaeus

Material : Fragment of left mandible with last molar tooth.

Locality : Jhikoria village about 13 km. North West of Susunia hill (23°2 3'30" 86°58'), Bankura, West Bengal.

Date of Collection : 20th February, 1982.

Horizon : Oldest alluvial deposits, Pleistocene.

Collector : Shri K. D. Saha and party, deposited the material in the National Zoological Collection of the Zoological Survey of India, Calcutta, Reg. No. V. P. 17.

DESCRIPTION

The molar of the mandible is the sectorial tooth, the crown of this molar consists exclusively of the blades. It is divided into two equally compressed lobes, with straight margins, very sharp except the anterior one of the first lobe. The margins of the lobes meet at right angle from where a vertical fissure extends nearly half way down the crown. The outer surface of the crown presents an equally convexity from before backwards, in the inner side there is a deep groove in the lobes.

The fragment of the mandible is fossilised and organic material has been replaced by inorganic substances.

DISCUSSION

The structure of the last molar amongst the genus *Panthera* has some similiarity, but there are some differences in the specific level. The height of the two lobes in the molar of *Panthera pardus* are almost equal. In other two species *P. leo* and *P. tigris* there is a sizeable difference in height. The grooves between the lobes is deeper and wider in

P. leo than *P. tigris* and the lower border of crown of molar on the buccal side is rather irregular in *P. leo* (Datta, 1976). In *P. pardus* the groove is less wider than *P. tigris* and lower border of the crown of molar on the buccal side is more smooth, (Plates IX & X).

In measurements the length of the last molar of Susunia specimen of *P. pardus* is in between the recent species of *P. leo* and *P. pardus*. The width and the height from the base of mandible of the molar is almost equal in Susunia specimen and recent *P. pardus* and much larger in *P. leo* and *P. tigris* which can be seen from (Table 1.).

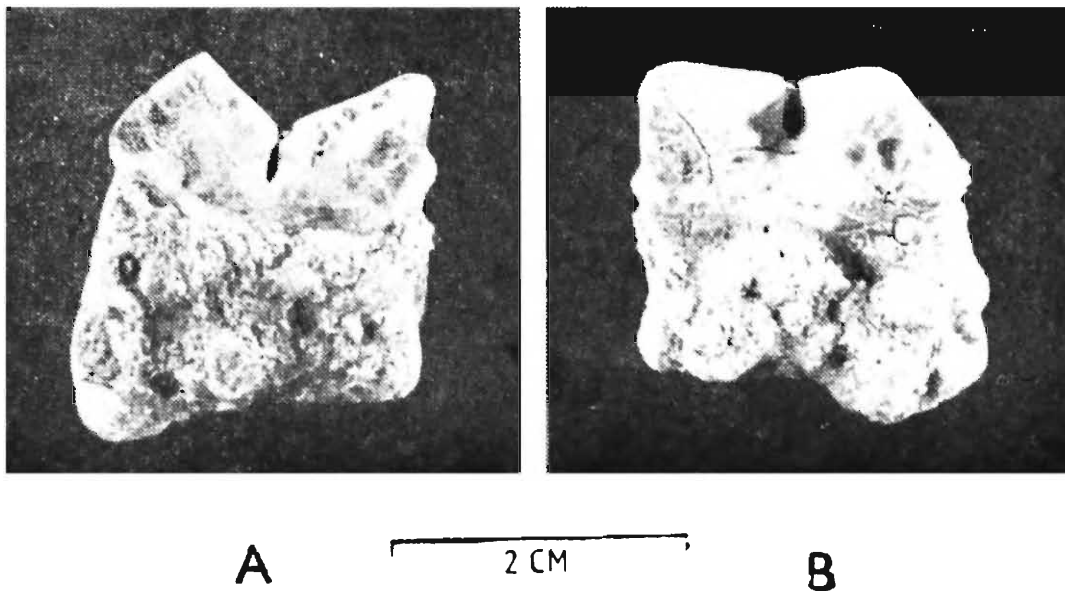
There is no fossil record of last molar of *Panthera pardus* from Siwalik or any other fossil bearing beds in India. Dutta (1976) described a mandible with a molar and fourth premolar of *Panthera cf. leo* from Susunia. Presently this species is distributed in whole of India from Kashmir and apparently the foot hills of the Himalayas in the North to Cape Comorin in South (Pocock, 1939). So, we can safely conclude that the last molar tooth from Susunia is the first definite record of fossil *Panthera pardus* Linn. from India.

TABLE 1. Comparative measurements (in mm.) of last molar tooth of Susunia specimen with the recent *Panthera pardus*, *Panthera leo* and *P. tigris*.

	Length	Width	Height from the base of mandible.
<i>Panthera pardus</i> (Z. S. I. V. P. 17) from Susunia.	20	8	9
<i>Panthera pardus</i> (Z. S. I. Reg. No. 17597.)	17.5	7.5	8.5
<i>Panthera leo</i> (Z. S. I. Reg. No. 9065.).	23	12	11
<i>Panthera tigris</i> (Z. S. I. Reg. No. 19024).	28	13	13

SAHA, BANERJEE & TALUKDAR

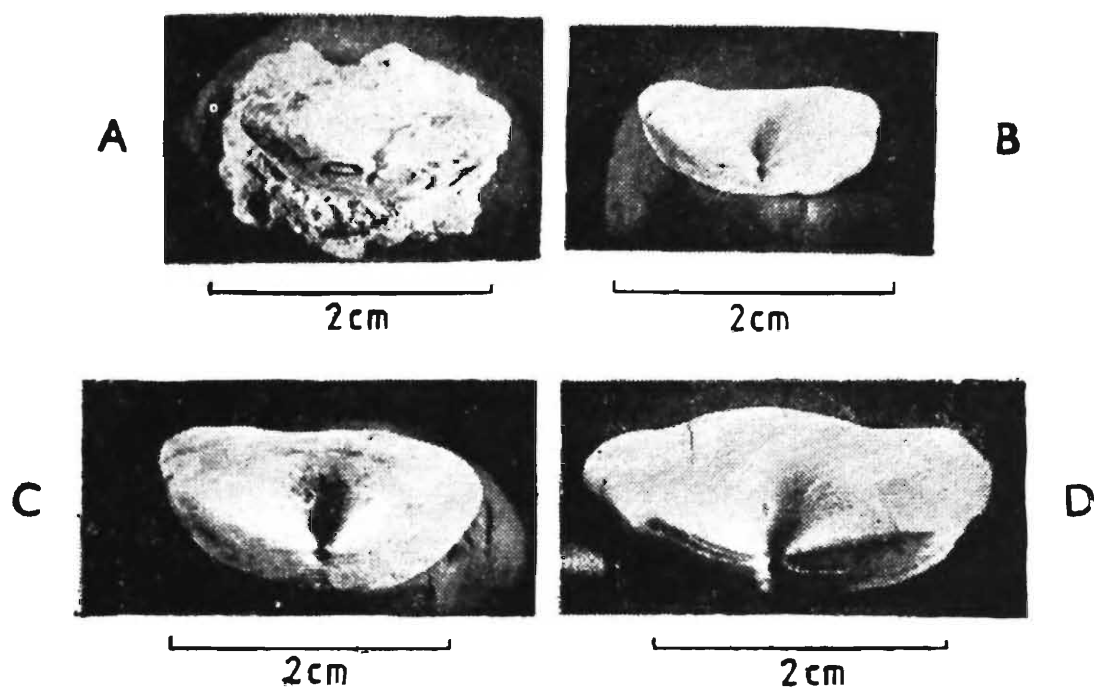
PLATE IX



Figs. A-B. A. Lingual view of the left mandible with last molar tooth of *Panthera pardus* Linn. from Susunia hill, Bankura, West Bengal.
B. Buccal view of the above.

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PLATE X



Figs. A-D. A. Occlusal view of *Panthera pardus* Linn. from Susunia hill, Bankura, West Bengal.
B. Occlusal view of *Panthera pardus* Linn. present in the Z. S. I. collection.
C. Occlusal view of *Panthera leo* (Linn.) present in the Z. S. I. collection.
D. Occlusal view of the *Panthera tigris* (Linn.) present in the Z. S. I. collection.

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ON A SMALL COLLECTION OF STOMATOPODA (CRUSTACEA) FROM GOA

H. C. GHOSH

Zoological Survey of India, Calcutta

ABSTRACT

Four species pertaining to 3 genera and 2 families are reported for the first time from Goan waters. Of these *Acanthosquilla humesi* Manning is new to Indian waters.

INTRODUCTION

The present study is based on a small collection of stomatopods made by the author during a general faunistic survey in 1975 and a few specimens lying unnamed in the Zoological Survey of India. On close examination the material was found to belong to 4 species pertaining to 3 genera and 2 families. The finding of *Acanthosquilla humesi* Manning, 1968 is of special significance as it is being reported here for the first time since its discovery off Madagascar. The specimens were collected from coastal inshore waters mainly on board a fishing trawler provided by the National Institute of Oceanography, Panaji as well as from dragnets operated by fishermen. A perusal of literature reveals occurrence of 21 species along the west coast of India, but none from Goa. In view of this the author deems it worthwhile to give an account of the Stomatopod fauna of this region. Descriptions for all the species together with restricted synonymy, geographical distribution and key to the species have been provided.

SYSTEMATIC ACCOUNT

Key to species of Stomatopoda of Goa

1. Telson with sharp median carina, 4 or more intermediate denticles on telson (Squillidae) ... 2
— Telson lacking sharp median Carina (Lysiosquillidae) ...
Telson with 2 or four pairs of fixed marginal teeth, uropodal exopod with strong proximal fold on outer margin (*Acanthosquilla*). ...
Rostral plate with sharp median spine, anterolaterally angled; dactylus of claw with 7 teeth; sub-median denticles in transverse row. ... *Acanthosquilla humesi* Manning, 1968
2. Eyes large, T-shaped, Cornea bilobed, upper margin of propodus of claw with alternate long and short spines (*Harpiosquilla*). ...
Lateral process of 5th thoracic somite rounded, propodus of claw with more than one short spine between larger ones. ... *Harpiosquilla harpax* (de Haan, 1849)

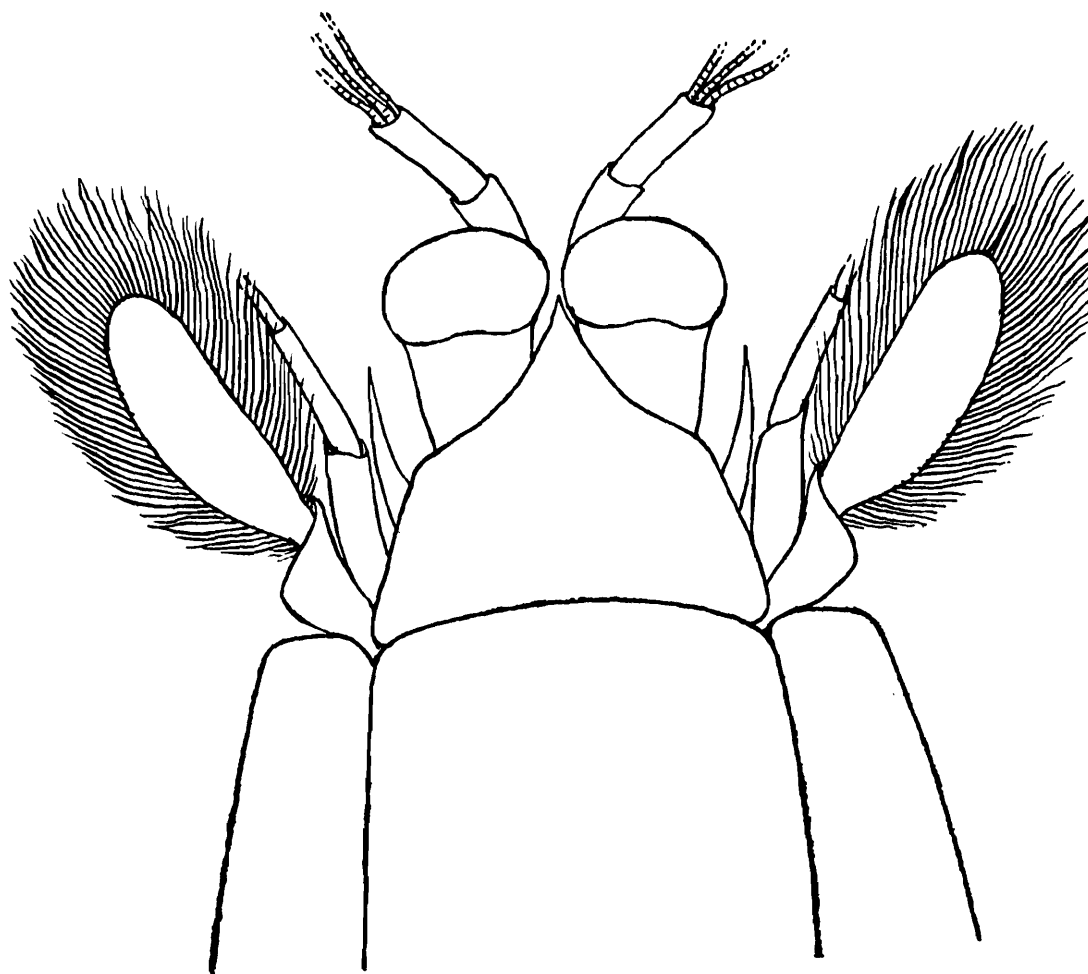


Fig. 1. *Acanthosquilla humesi* Manning, male, TL. 40.0 mm ; Marmagao Bay, Goa.

Anterior portion of body.

- Eyes small, not T-shaped, Cornea bilobed, upper margin of propodus pectinate (*Oratosquilla*). ... 3

- 3. Median carina of carapace distinct and uninterrupted, bifurcation open posterior to dorsal pit. ... *Oratosquillanepa* (Latreille, 1825)

- Median carina of carapace interrupted at base of bifurcation, bifurcation open anterior to dorsal pit. ... *Oratosquilla interrupta* (Kemp, 1913)

Order STOMATOPODA

Family LYSIOSQUILLIDAE Giesbrecht, 1910

Acanthosquilla humesi Manning

(Figs. 1-3)

1968. *Acanthosquilla humesi* Manning, *Proc. U. S. natn. Mus.*, 124 (no. 3641) : 33.

Material : 1 ♀, mm ; Marmagao Bay ; F. G. Megitt ; Reg. No. C 1609/2.

Description : Eyes small, cornea subglo-bular, set obliquely on stalk. Rostral plate with slender median spine, anterolaterally angled. Carapace smooth, narrowed ante-

riorly, rounded anterolaterally and posterolaterally. Mandibular palp and 5 epipods present. Exposed thoracic somites smooth, lateral margins rounded. Abdominal somites broad, smooth, depressed, unarmed except for the slender posterolateral spines on sixth. Telson broader than long, with dorsal fan of 5 teeth, marginal armature on either side of mid-line : 1 movable submedian tooth ; 4 fixed teeth ; 6-7 submedian denticles in transverse row ; 1 denticle between each of the marginal teeth. Uropodal exopod with 7 movable spines on outer margin of proximal segment, last extending to midlength of distal segment ; endopod with prominent fold on inner proximal margin, inner spine of basal prolongation longer than outer.

Colour : Due to long preservation the specimen has become completely faded.

Manning (1968) has dealt with its colour pattern in detail.

Remarks : Manning (1968) in his original description of *Acanthosquilla humesi* has noted 7 teeth on the dactylus of claw. The present specimen lacks both the dactyli. However, the characters of anterior part of body, telson and uropod provided sufficient clues to identify this specimen with *A. humesi*. *A. humesi* can easily be distinguished from *Acanthosquilla acanthocarpus* (Miers, 1880) and *A. multifasciata* (Wood-Mason, 1895) reported from west coast of India, by the presence of 4 pairs of fixed marginal teeth on telson instead of 2 in the latter two species. The present record is first from Indian waters and extends the distribution eastwards into the Arabian sea.

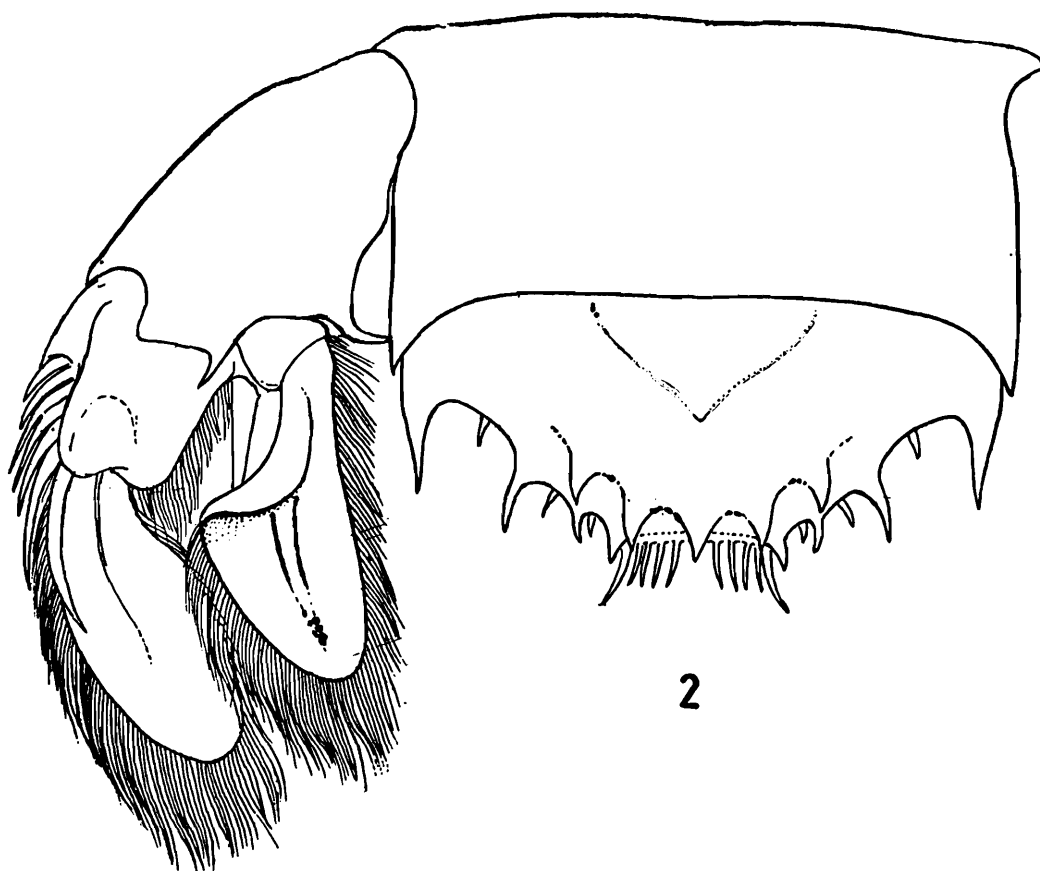


Fig. 2. *Acanthosquilla humesi* Manning, male, TL. 40.0 mm ; Marmagao Bay, Goa.
Sixth abdominal somite, uropod and telson.

Distribution : Nosy Be ; Madagascar (Type-locality) and Goa.

Family SQUILLIDAE Latreille, 1803

Harpiosquilla harpax (de Haan)

1849. *Squilla harpax* de Haan, *Faun. Jap. Crust.* : 222.

1952. *Squilla harpax* : Tiwari and Biswas, *Rec. Indian Mus.*, 49 : 358.

1964. *Harpiosquilla harpax* : Holthuis, *Crustaceana*, 7 (2) : 140.

1969. *Harpiosquilla harpax* : Manning *Smithson, Contr. Zool.* No. 36 : 25.

Material : 2 ♂♂, 145 & 148 mm ; Off Dona Paula beach, Panaji ; H. C. Ghosh ; 25.2.1975 ; Reg. No. C 1607/2.

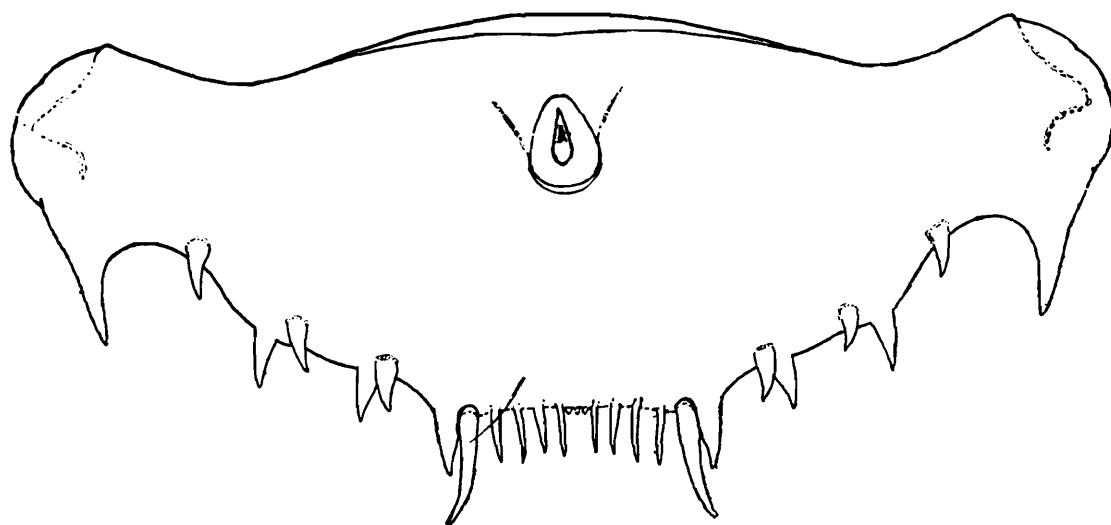
Description : Eyes large, T-shaped. Rostral plate longer than broad, with slender apical projection. Carapace with median carina. Dactylus of claw with 8 teeth, outer margin with prominent angular projection in adult males. Propodus of claw with alternating large and small spines. Fifth thoracic somite rounded laterally. Submedian and

intermediate carinae of last three thoracic somites not armed posteriorly. Spines on abdominal carinae : submedian 6 ; intermediate 2-6 ; lateral 1-6 ; marginal 1-5. Denticles on telson : submedian 4-6 ; intermediate 10-12 ; lateral 1. Outer margin of basal segment of uropodal exopod with 9-10 spines.

Colour : Distal segment of uropodal exopod with inner half black. Telson with a pair of dark spots on the dorsal surface nearer to the anterior margin.

Remarks : The specimens agree well with the description and figures provided by Manning (1969).

Distribution : A widely distributed Indo-West Pacific from extending from S. Africa to Japan. Previous records from the Indian seas : Bombay (Chhapgar & Sane, 1968 ; Tiwari & Biswas, 1952), mouth of river Hooghly including sandheads (Kemp, 1913 ; Tiwari & Biswas, 1952), off Madras coast (Kmp, 1913 ; Tiwari and Biswas, 1952), Andamans (Tiwari & Biswas, 1952).



3

Fig. 3. *Acanthosquilla humesi* Manning male, TL. 40.0 ; Marmagao Bay, Goa, Telson, ventral view.

***Oratosquilla nepa* (Latreille)**

1815. *Squilla nepa* Latreille, *Encycl. Method.* : 471.
 1913. *Squilla nepa* : Kemp, *Mem. Indian Mus.*, 4 : 60.
 1968. *Oratosquilla nepa* : Manning, *Bull. mar. Sci., Gulf Caribb.*, 8 (1) : 134.

Material : 4 ♂♂, 61-70 mm ; 2 ♀♀, 66 & 75 mm ; Off Calangute Beach ; K. S. Pradhan ; 27.2.1967 ; Reg. No. C 2606/2.9 ♂♂, 91-118 mm ; 7 ♀♀, 91-113 mm ; off Dona Paula beach ; H. C. Ghosh ; 22.2.1975 ; Reg. No. C. 1608/2. 2 ♂♂, 60 & 110 mm ; 13 ♀♀, 80-112 mm ; Marmagao Harbour, H. C. Ghosh ; 22.2.1975 ; Reg. No. C 2605/2. 9 ♂♂, 70-117 mm ; 7 ♀♀, 80-117 mm ; Colva beach ; H. C. Ghosh, 1.3.1975 ; Reg. No. C 2604/2.

Description : Eyes moderate in size, cornea bilobed, sat transversely on stalk. Rostral plate tapering distally, apex truncate, lateral margins upturned. Median carina of carapace distinct, uninterrupted, bifurcation opening posterior to dorsal pit. Intermediate carinae of carapace not extending to posterior margin, converging anteriorly with the lateral. Anterolateral spines of carapace strong. Dactylus of claw with 6 teeth, outer margin sinuous. Dorsal ridge of carpus with three tubercles. Anterior lobe of lateral process of 5th thoracic somite with an anteriorly directed slender spine ; posterior lobe much shorter, apex rounded. Anterior lobe of 6th somite large, apex obliquely truncate ; posterior lobe larger, triangular, apex blunt. Spines on abdominal carinae : submedian 3-4 ; intermediate 3-6 ; lateral 2-6, marginal 1-5. Dorsal surface of telson with lines of pits on either side of median carina. Uropod with 8-9 movable spines on outer margin of proximal segment. Lobe on outer margin of

inner spine of basal prolongation of uropod low, rounded, margin concave.

Remarks : All the variations in the anterior bifurcation of the median carina of carapace figured by Tirmizi and Manning (1968), were noticed in the present specimens.

Distribution : *Oratosquilla nepa* is the most commonly distributed Indo-West Pacific form extending from S. Africa to Hongkong. Previous records from the Indian seas : Bombay (Chhapgar & Sane, 1968), W. Bengal (Kemp, 1913), Andhra Pradesh (Kemp, 1913), Kerala (Kemp, 1913 ; Kurian, 1954).

***Oratosquilla interrupta* (Kemp)**

1913. *Squilla interrupta* Kemp, *Mem. Indian Mus.*, 4 : 72.
 1968. *Oratosquilla interrupta* : Manning, *Bull. mar. Sci. Gulf Caribb.*, 18 (1) : 135.

Material : 1 ♂, 101 mm ; 3 ♀♀, 75-107 mm ; Marmago Harbour ; H. C. Ghosh, 22.2.1975 ; Reg. No. C. 2608/2. 3 ♂♂, 107-109 mm ; 3 ♀♀, 100-126 mm ; Colva Beach ; H. C. Ghosh ; 1.3.1975 ; Reg. No. C 2607/2.

Description : Eyes small, cornea bilobed, set obliquely on stalk. Rostral plate subquadrate, apex truncate. Anterior bifurcation of median carina of carapace interrupted at base of bifurcation. Bifurcation opening anterior to dorsal pit. Intermediate carapace not extending to anterior margin. Dactylus of claw with 6 teeth. Dorsal ridge of claw with two tubercles. Submedian and intermediate carinae on last three thoracic somites unarmed. Anterior lobe of lateral process of fifth thoracic somite slender, anteriorly directed ; posterior lobe acute, directed laterally. Anterior lobes of 6th and 7th thoracic somites smaller than the triangular posterior lobes. Spines on abdominal carinae :

submedian 5-6; intermediate 4-6; lateral 3-6; marginal 1-5. Telson broad with 3 pairs of marginal teeth, prelateral lobe present. Denticles on telson: submedian 2-3; intermediate 7-9; lateral 1. Telson with lines of pits on either side of median carina. Uropodal exopod with 8-9 movable spines on outer margin of proximal segment. Lobe on outer margin of inner spine of basal prolongation of uropod rounded, margin convex.

Remarks: These specimens agree well with Kemp's (1913) and Tirmizi and Manning's (1968) accounts of the species.

Distribution: Widely distributed in the Indo-West Pacific region extending from Persian Gulf to Hongkong. Previous records from the Indian seas: Bombay (Kemp 1913; Chhapgar & Sane, 1968), Madras (Kemp, 1913), Orissa (Kemp, 1913), W. Bengal (Kemp, 1913; Chopra, 1934).

ACKNOWLEDGEMENTS

The author wishes to record his gratitude to Dr. B. K. Tikader, Director, Zoological Survey of India, for encouragements and facilities and to the Director, National Institute of Oceanography, Goa for facilities to collect the material.

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CHROMOSOMES OF SEVEN SPECIES OF APHIDS (HOMOPTERA : APHIDIDAE)

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ABSTRACT

Somatic chromosomes from the embryos of apterous viviparous females of seven species of aphids were studied viz. *Sinomegoura citricola* V. d. Goot $2n=12$; *Macrosiphum yamagopholiae* (Shinji) $2n=12$; *M. rosae* (L) $2n=12$; *Eriosoma lanigerum* Hausmann $2n=12$; *Brevicoryne brassicae* (L) $2n=14$; *Geoicea lucifaga* Zehn. $2n=14$ and *Tetraneura nigriabdominalis* Sasaki $2n=14$. Morphometric analysis of their individual chromosome pairs was carried out and karyotypes for these species were constructed.

Studies on the chromosomes of Indian species of aphids have been taken up in recent years. As a result, information on the chromosomes of nearly seventy species of aphids is available (Kulkarni 1982). However, detailed studies on chromosome morphology and karyotypes are available in twentyfive species of aphids. In rest of the species only the diploid chromosome numbers and probable sex-determining mechanisms are discussed.

The present paper deals with the chromosomes of seven species of aphids viz. *Sinomegoura citricola* v. d. Goot; *Macrosiphum yamagopholiae* (Shinji); *M. rosae* (L); *Eriosoma lanigerum* Hausmann; *Brevicoryne brassicae* (L); *Geoicea lucifaga* Zehn. and *Tetraneura nigriabdominalis* Sasaki.

MATERIALS 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 1. The technique employed in the

cytological preparations was similar to that described earlier (Kulkarni and Kacker 1981). Several metaphase plates were scanned under the microscope and the karyotype was prepared based on the measurements of a minimum of ten well spread metaphase plates.

1. *Sinomegoura citricola* V. d. Goot. : The diploid chromosome number in this species was observed to be 12 (Plate XI.6). Studies on the relative percentage lengths of individual chromosome pairs of this species have shown that there is a gradual reduction in their size. One pair appeared to be heteromorphic and was placed fourth within the complement (Plate XII. D). Its individual chromosomes measured 10.42% and 15.70% of the total complement. Occurrence of heteromorphic chromosome pairs has also been reported earlier in some other species of aphids (Kulkarni and Kacker 1980, Blackman 1980).

2. *Macrosiphum yamagopholiae* (Shinji) : $2n$ number in this species was observed to be 12 (Plate XI.1). The morphometric ana-

lysis of the individual chromosome pairs has shown that the first pair measured 26.02% and the second pair to be 23.00% of the total complement. The third and the fourth pairs had a little difference, while the last two pairs were found almost equal in their percentage lengths (Table 2).

3. *Macrosiphum rosae* (L) : Diploid chromosome number in this species was found to be 12 (Plate XI.3) which is in agreement with that reported by Khuda Bukhsh 1980. The longest pair within the complement measured 31.37% of the total length. Second, third and fourth pairs revealed considerable gaps in their relative percentage lengths, while the last two pairs had a narrow difference.

4. *Eriosoma lanigerum* Hausmann : The diploid chromosome number of this species

was reported earlier (Kulkarni and Kacker 1980) to be 12. It was not possible to work out the morphometry of the chromosomes at that time due to insufficient number of suitable metaphase plates. Further studies on the species have enabled now to work out the morphometry as well as the construction of karyotype for it. The details of the percentage lengths of the individual chromosome pairs within the complement are given in table 2 and a karyotype has been constructed (Plate XII. C.).

5. *Brevicoryne brassicae* (L) : The diploid chromosome number in this species was found to be 14 (Plate XI.5). Studies on the morphometry of the individual chromosome pairs have shown that the first two pairs are considerably large, contributing more than

TABLE 1. Table showing the collection data of the aphid species.

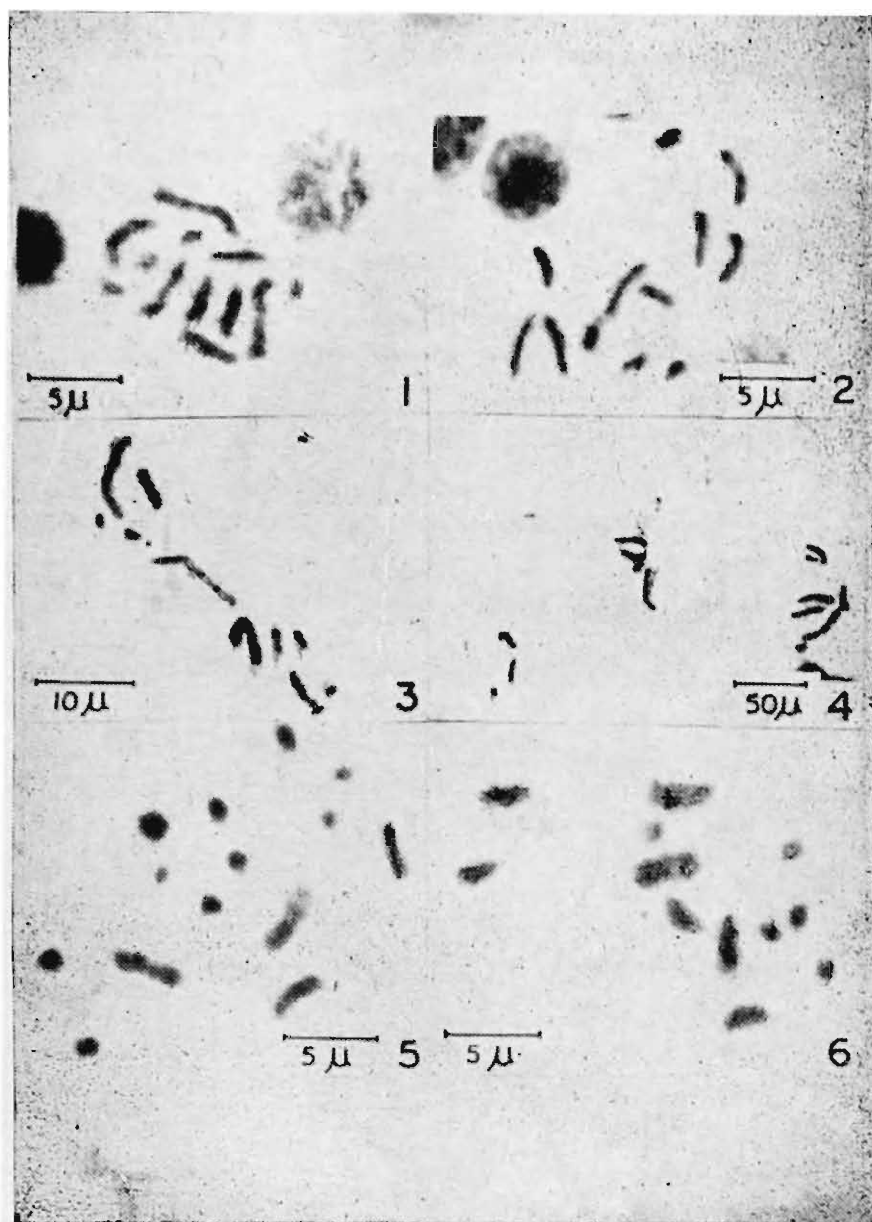
Sr. No.	NAME OF THE SPECIES	HOST	DATE OF COLLECTION	LOCALITY
1.	<i>Sinomegoura citricola</i> (V. d. Goot)	Unidentified	20.2.1981	Darjeeling
2.	<i>Macrosiphum yamagopholiae</i> (Shinji)	Unidentified	1.11.1979	Kursiong, Darjeeling.
3.	<i>Macrosiphum rosae</i> (L)	Rosa ap.	3.11.1979	Tindharia, Darjeeling.
4.	<i>Eriosoma lanigerum</i> Hausmann	Apple roots	12.3.1979	Mashobra, Simla.
5.	<i>Brevicoryne brassicae</i> (L)	Unidentified	23.2.1981	Bijanbari, Darjeeling.
6.	<i>Geoicea lucifaga</i> Zehn.	Grass roots	5.11.1979	Dow Hill, Darjeeling.
7.	<i>Tetraneura nigriabdominalis</i> Sasaki	Grass roots	29.10.1979	Sukna, Darjeeling.

TABLE 2. Table showing the relative percentage lengths of the individual chromosome pairs.

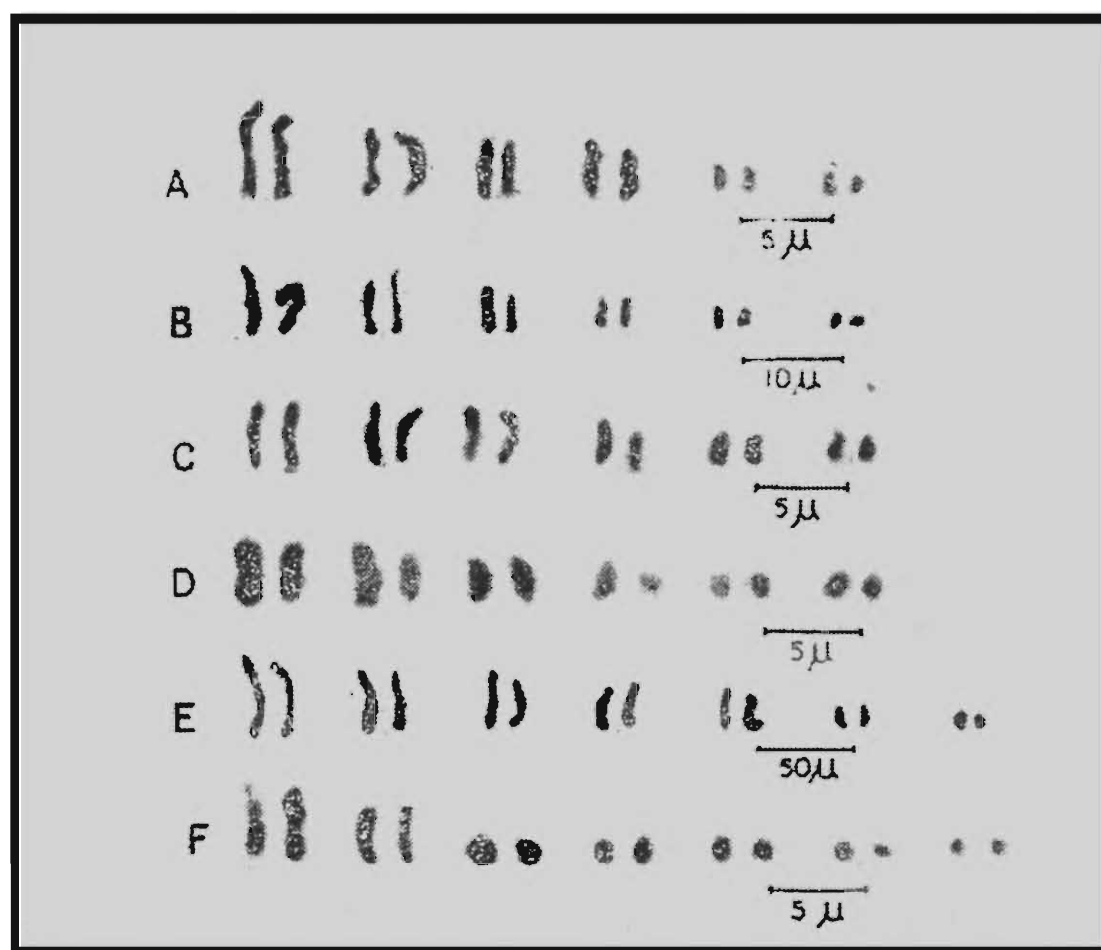
Sr. No.	NAME OF THE SPECIES	CHROMOSOME PAIR Nos.						
		1	2	3	4	5	6	7
1.	<i>Sinomegoura citricola</i> (V. d. Goot)	22.53	17.49	14.18	15.70	10.49	8.62	
					10.42			
2.	<i>Macrosiphum yamagopholiae</i> (Shinji)	26.20	23.00	17.86	16.00	8.53	8.53	
3.	<i>Macrosiphum rosae</i> (L)	31.37	23.79	18.99	11.25	7.70	6.62	
4.	<i>Eriosoma lanigerum</i> Hausmann	27.75	19.77	19.02	13.92	11.48	9.91	
5.	<i>Brevicoryne brassicae</i> (L)	35.32	21.00	13.38	9.41	8.34	6.95	5.57
6.	<i>Geoicea lucifaga</i> Zehn.	25.22	17.97	16.74	14.28	10.26	7.81	6.69

KULKARNI

PLATE XI



Figs. 1-6. 1. *Macroisiphum yamagopholiae* (Shinji) $2n=12$
 2. *Eriosoma lanigerum* Hausmann $2n=12$
 3. *Macroisiphum rosae* (L.) $2n=12$
 4. *Geosiphia lucifuga* Zehn. $2n=14$
 5. *Brevicoryne brassicae* (L.) $2n=14$
 6. *Sinomegoura citricola* (V. d. Goot) $2n=12$



Karyotypes :

- Figs. A-F.** A. *Macrosiphum yamagopholiae* (Shinji)
 B. *Macrosiphum rosae* (L)
 C. *Eriosoma lanigerum* Hausmann
 D. *Sinomegoura citricola* (V. d. Goot)
 E. *Geoicea lucifaga* Zehn.
 F. *Brevicoryne brassicae* (L)

half of the total length of the complement and measured 35.32% and 21.00% respectively. The rest of the pairs showed comparatively narrow difference between their percentage lengths (Table 2). Karyotype of this species is given in Plate XII. F.

6. *Geoicea lucifaga* Zehn. : $2n$ number in this species was observed to be 14 (Plate XI.4). Blackman 1980 has reported chromosome number for four other species of *Geoicea* to be ranging from 16 to 31. This species has shown lesser number of diploid chromosomes. The detailed morphometric analysis of the relative percentage lengths of the individual chromosome pairs of this species is given in Table 2. Karyotype for this species is also constructed (Plate XII. E).

7. *Tetraneura nigriabdominalis* Sasaki : $2n$ number in this species was observed to be 14. Kulkarni and Kacker 1980 have studied chromosomes of a congeneric species *Tetraneura hirsuta* Baker and observed similar diploid number for it. In the present paper, it was not possible to construct the karyotype and calculate the relative percentage lengths of the individual chromosome pairs for the species.

Discussion : Out of the seven species studied here, information on the diploid chromosome numbers was available for two species, *Macrosiphum rosae* (L) (Khuda Bukhsh 1980) and *Eriosoma lanigerum* Hausmann (Kulkarni and Kacker 1979), Sun and Robinson 1966). The present studies have shown no difference so far as the chromosome number is concerned. The detailed morphometric analysis of the individual chromosome pairs was not available earlier, which has been provided here, as well as the karyotypes for these species have been constructed.

In the case of *Geoicea lucifaga* Zehn. and *Tetraneura nigriabdominalis* Sasaki, information on some congeneric species was available (Blackman 1980 and Kulkarni and Kacker 1980).

As far as the studies on the rest of the species viz. *Macrosiphoniella yamagopholiae* (Shinji) ; *Sinomegoura citricola* V. d. Goot and *Brevicoryne brassicae* (L) are concerned, no information on the chromosomes of these species was available earlier. Thus the present studies add these species in the list of chromosomally known aphid species. Although two congeneric species studied here i. e. *Macrosiphum yamagopholiae* (Shinji) and *M. rosae* (L) show similar chromosome number, a considerable difference in the morphometry of their chromosomes was observed.

In all the seven species studied here, observations on the cell division showed no definite 'J' or 'V' shaped configuration and the chromosomal movement was observed as broad sheets side towards the poles, which indicated their possible holocentric nature and thus typically of the Homopteran type.

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ON A GIANT-SIZED CHHIRRUH, *SCHIZOTHORAICHTHYS ESOCINUS*
(HECKEL) FROM KASHMIR VALLEY (SCHIZOTHORACINAE : CYPRINIFORMES)

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ABSTRACT

A record-size specimen of *Schizothoraichthys esocinus* (Heckel), captured from Achhabal stream, Anantnag (J & K), has been described and interesting morphological and taxonomical features have been recorded. The various local names assigned to such specimens are given.

INTRODUCTION

The fishes of the subfamily Schizothoracinae (carps) are palaearctic in origin and they are endemic to Kashmir and the surrounding areas. In this region, they are of great commercial importance and are valued as food. In recent years, the schizothoracids have received a tremendous set-back due to the vast propagation of the Brown Trout (*Salmo trutta fario* Linnaeus) in almost all waters of the region and their population has considerably reduced. It is rather rare to find large-sized specimens of schizothoracids from natural waters during recent years. It was quite interesting to find a giant-sized specimen of a schizothoracid at the Department of Fisheries (Jammu and Kashmir), Harwan (total length 78.4 cms., weighing 9 Kgs.) and collected from Achhabal Stream, district Anantnag (J & K). The fish was electrocuted when a high-tension electric-wire broke and fell into the stream. The large size and the interesting morphometric and meristic characters of the specimen aroused my interest and hence it has been studied in detail and described here. It is important from the taxonomic point of view.

DESCRIPTION

Schizothoraichthys esocinus (Heckel)

(Plate XIII)

B. III, D. II/8, P I/19, V. II/11, A. III/5, C. 17

Lateral line scales : 104

Lateral transverse scales : 30/1/32

The dorsal profile rises from tip of snout upto the occiput and thereafter it suddenly rises upwards upto the base of the dorsal fin. The length of head is 4.48 times in the total length and 3.9 times in the standard length. The eye lies entirely in the front half of the head and its diameter is contained 7.6 times in the head length and 2.4 times in the snout. The nostrils lie much nearer the eye than the tip of the snout. The length of snout is contained 3.2 times in the head length. There are four barbels : the length of the rostral barbel is 1.6 times of the eye diameter. The interorbital space is flat. The mouth is anterior. The lower jaw is longer than the upper. There is a knob at the symphysis of the lower jaw. The lips are thick

and the lower labial fold is interrupted. The labial folds of the two sides extend anteriorly and are separated by a very short interspace. The body is deep and the depth is 4 times in the total length and 3.49 times in the standard length. There is no horny covering on the jaws. The gape of the mouth is 2.2 times in the head length. The isthmus is very narrow and less than 1/5th of the gape of the mouth. The hinder edge of the maxilla reaches below the anterior 1/3rd of the orbit. The width of the operculum is 3.24 times in the head length and 2 times in the postorbital length of the head. The dorsal fin originates behind that of the ventral fin and lies nearer the base of the caudal fin than the tip of the snout. The height of the dorsal fin lies 2.3 times and base of the dorsal fin 2.2 times in the length of head. The dorsal spine is smaller than the postorbital part of the head. The dorsal spine is bony, strong and posteriorly serrated. The height of the dorsal fin is much smaller than the depth of the body below it and is contained 2.6 times in it. The pectoral fin does not reach the ventral fin. The length of the pectoral fin is 1.68 times in the distance between the bases of the pectoral and the ventral fins. The ventral fin reaches only half way to the anal and originates in advance of the dorsal fin. The anal fin, when laid flat, does not reach the base of the caudal fin. The height of the caudal peduncle is 1.5 times in its length. The scales along the lateral line are slightly larger than those of the rest of the body (except the anal sheath). The anal scale is almost equal to the eye diameter. There are 29 scales along the anal sheath of which 13 scales lie along the base of the anal fin and 16 scales anterior to the anal base. The anal sheath extends back upto the base of 4th divided ray of the anal fin.

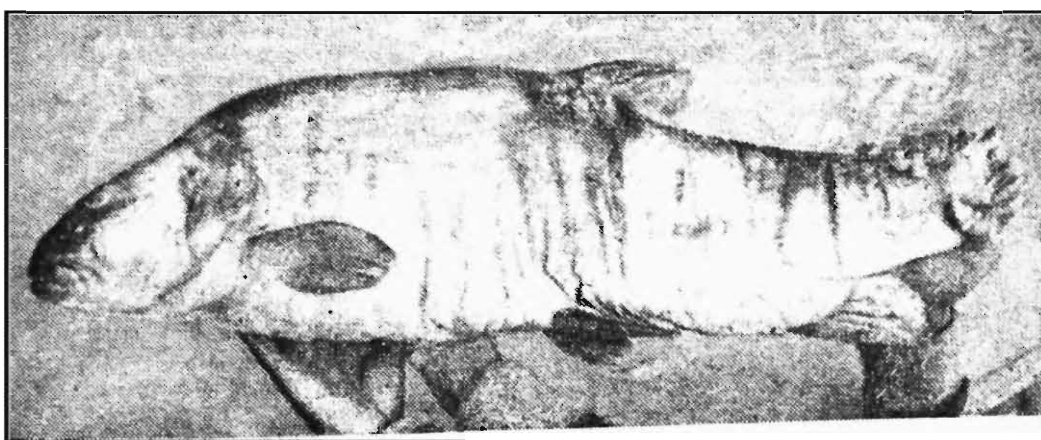
REMARKS

Schizothoracichthys esocinus (Heckel) was described by Heckel (1838) who reported that it grows to a weight of 24 lbs. (10.88 kgs.). Subsequently, Day (1876) described *Schizothorax punctatus* from the Wulur Lake (J & K) but did not mention the maximum size attained by this species. However, the holotype of *S. punctatus* is 19.2 cms. in standard length. Mukerji (1936) recorded 41.0 cms standard length of this species as the largest specimen in his collection. During a study of the material of *Schizothoracinae*, collected by Yale North-India Expedition, Mukerji (1936) discussed the systematic position of *S. punctatus* Day and concluded that this species is an aberrant variation of *S. esocinus* (Heckel). Out of the 20 examples studied by Mukerji (1936), 5 examples showed typical *esocinus* characters, 2 examples indicated typical *punctatus* characters while 13 examples displayed mixed characters of both these species. These data indicate that there could be two possibilities; firstly, *S. punctatus* could be an aberrant variation of *S. esocinus* as suggested by Mukerji (1936). *S. esocinus*, being an earlier name, is valid and *S. punctatus* may be conspecific with it. Secondly, it could be possible that *S. punctatus* and *S. esocinus* are valid species and the specimens showing characters of both species are hybrids between them because *Schizothoracinae*, as a whole are notorious for hybridization. It has been observed that specimens presenting intermediate characters, acquired as a result of hybridization, create a problem in identification. Tilak and Sharma (1982) published only a figure of this specimen without making any comments.

Since the present specimen, apart from showing characters of *S. punctatus*, also

TILAK

PLATE XIII



Photograph of the lateral view of a giant-sized specimen of *Schizothoracichthys esocinus* (Heckel).

possesses a few aberrant characters, a thorough check up of the material of both the species has been carried out and it has been observed that *S. punctatus* is only an aberrant form of *S. esocinus* and hence conspecific with it.

It has been observed that the fish fauna of India in general is getting annihilated and large-sized specimens of fish are rare to find because of a large number of reasons, prominent among which are overfishing, fishing with a variety of illegal methods etc. The existence of such large-sized specimens of schizothoracids in nature is interesting and important from the fisheries point of view; it provides an encouraging ground for propagation of the endemic schizothoracine fishes in Himalaya.

There is a lot of variation of local names of fishes in the Kashmir Valley. *S. esocinus* is called as 'Chirruh or Shiru' by the local fishermen. *S. punctatus* is not a common species in Kashmir and that is why Day (1876) did not mention the local name while describing these species. The Kashmiri fishermen call both these species by the same local name. However, there were some old fishermen who called the present giant-sized specimen by the name of 'Paikut Gaad' which they admit is a sister kind of 'Chhirruh,' The name 'Paikut' or 'Pehri' has also been used by Lawrence (1895) who described these fishes rather loosely from a layman's point of view. Heckel (1838) did not mention any local name as 'Paikut Gaad'. Since the present

specimen is taxonomically similar to *S. esocinus*, the mention of a separate local name for this specimen by some local fishermen does not form a sufficient ground to treat it as a kind different from *S. esocinus*.

ACKNOWLEDGEMENTS

The author feels grateful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta and Officer-in-Charge, Northern Regional Station, Dehra-Dun for encouragement. Thanks are due to Director, Department of Fisheries of Jammu and Kashmir, Srinagar and the members of the research team at Harwan for putting the specimen at my disposal for study.

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ON A NEW SPECIES OF *NOEMACHEILUS* (PISCES : COBITIDAE) FROM
ARUNACHAL PRADESH, INDIA

A. K. DATTA AND R. P. BARMAN
Zoological Survey of India, Calcutta

ABSTRACT

A new species of Cobitid fish, *Noemacheilus arunachalensis* from Namdapha river, Arunachal Pradesh, India is described and illustrated.

INTRODUCTION

The fishes of the cobitid genus *Noemacheilus* van Hasselt are distributed throughout the Indian subcontinent, Thailand, Malaya, Vietnam, China and Afghanistan. While working on the fish fauna of the Namdapha wildlife sanctuary, Tirap district, Arunachal Pradesh (formerly NEFA), we came across three examples of a fish referable to this genus which, when compared with the known species belonging to the genus proved to be a hitherto unknown species. The present species comes closer to the Burmese species, *N. cincticauda* (Blyth) but clearly differs from the latter species in the absence of lateral line, longer eye diameter and in other morphological details. The new species is named *Noemacheilus arunachalensis* after its locality.

Noemacheilus arunachalensis sp. nov.
(Plate XIV)

Holotype : *Material* : 63 mm. in standard length. Reg. No. Z. S. I. FF. 1713.

Locality : Namdapha river, Namdapha Wild Life Sanctuary, Tirap district, Arunachal Pradesh, India. Coll. Dr. S. Biswas and Shri S. Saha. Dated 14.4.81.

Paratypes : 2 examples, 40 mm.-54 mm. in standard length. Reg. No. Z. S. I. FF. 1714 locality, collector and date as in holotype.

DIAGNOSIS

Head length 4.44-4.91 and body depth 5.73-7.71 in standard length. Eye diameter 6.50-9.00 in head length. Body marked by 12-14 lateral black blotches, the insertion of dorsal fin in the posterior half of the body, the origin of ventral fin before the origin of dorsal, the position of eye in the anterior half of the head and lateral line absent.

DESCRIPTION

D. 8, P. 7, V. 6, A. 7

Head pointed, ventral surface cylindrical. Length of head 4.73(4.44-4.91) in standard length ; width of head 2.21(2.17-2.25) in length of head ; height of head 1.83(1.80-1.86) in length of head. Mouth terminal, lower lip interrupted in the middle. Nostril apart, nearer to eye than to tip of snout. Eye nearer to snout than to the gill opening, invisible from below ; interorbital space convex, snout tapering. Eye diameter 7.61(6.50-

9.00) in length of head, 1.61(1.33-2.00) in interorbital width. Barbels three pairs—two pairs rostral and one pair maxillary not extending to the nostril.

Body marked by twelve incomplete blotches—six predorsal, two subdorsal and four postdorsal. Depth of body 6.70 (5.73-7.71) in standard length. Dorsal profile convex, ventral profile somewhat straight. Dorsal fin small, posterior to ventral, nearer to the base of caudal fin than to the tip of snout. Dorsal fin rays 8(II/6). Length of dorsal 7.31 (6.67-7.71) in standard length; 1.50 (1.44-1.57) in length

of head. Predorsal distance 1.55 (1.51-1.60) in standard length. Dorsal fin with irregular black spots. Pectoral fin rays 7, lateral in position; length of pectoral 7.86 (7.71-8.00) in standard length; length of pectoral shorter than head. Pelvic fin rays 6, lateral in position; shorter than pectoral, separated from anal by a considerable distance. Anal fin rays 7, shorter than head; length of anal 9.51 (9.00-10.00) in standard length. Distance between vent to anal fin .31 (.09-.71) in that between anal opening and pelvic base; distance between vent to anal fin .21 (.07-.45) in that between

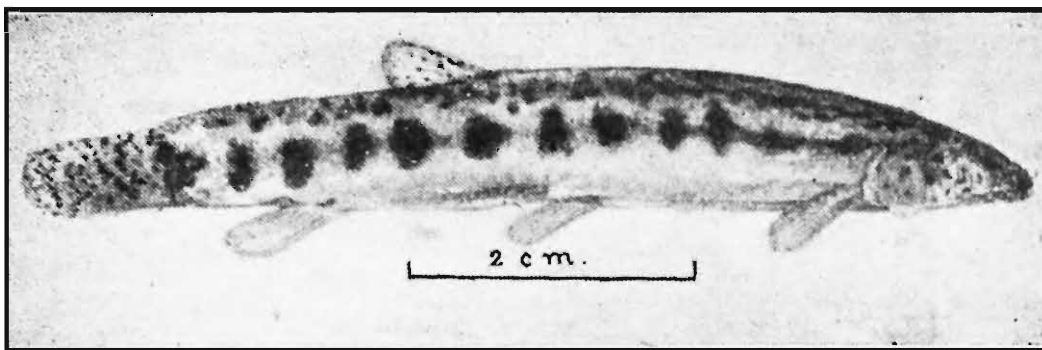
TABLE 1. Measurements (in mm.) and meristic counts of Holotype and two paratypes of *Noemacheilus arunachalensis* sp. nov.

	*I	II	III
Total length	74	63	48
Standard length	63	54	40
Depth of body	11	7	6
Length of head	13	11	9
Depth of head	7	6	5
Width of head	6	5	4
Length of snout	4	4	3
Eye diameter	2	1.5	1.0
Interorbital width	3	2	2
Dorsal fin rays	11/6	11/6	11/6
Predorsal distance	39	35	25
Length of pectoral fin	8	7	5
Distance from anterior origin of pelvic to caudal base	29	25	18
Anal fin rays	7	7	7
Distance from vent to anal fin	2.0	1.0	.5
Pectoral fin rays	7	7	7
Length of caudal peduncle	9	7	6
Depth of caudal peduncle	8	6	5
Distance between origin of Pelvic to origin of anal fin	17	15	11
Length of caudal fin	11	9	8
Distance between origin of ventral to tip of snout/caudal base	32/29	28/25	20/18
Distance between dorsal origin to caudal base	25	20	15
Distance from anal opening to ventral base	14	11	7
Length of dorsal fin	9	7	6
Length of ventral fin	7	6	4
Length of anal fin	7	6	4
Ventral fin rays	6	6	6

*Holotype

DATTA & BARMAN

PLATE XIV



Noemacheilus arunachalensis n. sp.

TABLE 2. Comparision of *Noemacheilus arunachalensis* with its related species.

	<i>N. arunachalensis</i> sp.	<i>N. cincticauda</i>
Depth of body in standard length	6.70(5.73-7.71)	6.54(6.12-7.30)
Length of head in standard length	4.73(4.44-4.91)	4.37(4.18-4.55)
Length of pectoral in standard length	7.86(7.71-8.00)	4.74(4.64-4.89)
Length of dorsal in standard length	7.13(6.67-7.71)	5.88(5.73-5.97)
Length of anal in standard length	9.51(9.00-10.00)	6.80(6.45-7.17)
Diameter of eye in interorbital width	1.61(1.33-2.00)	1.49(1.22-1.75)
Depth of caudal peduncle in length of caudal peduncle	1.17(1.13-1.20)	1.1(.9-1.8)
Diameter of eye in length of head	7.61(6.50-9.00)	5.22(4.59-6.00)
Dorsal fin rays	8	9
Pectoral fin rays	7	9
Ventral fin rays	6	9
Anal fin rays	7	8
Lateral line	absent	Present, terminates above pectoral.

anterior origin of pelvic and anal fin. Lateral line absent.

Caudal fin with five V-shaped bands and irregular black spots. Caudal rounded ; length of caudal 5.58 (5.00-6.00) in standard length. Depth of caudal peduncle 1.17 (1.13-1.20) in its length.

AFFINITIES

The new species, *N. arunachalensis* comes closer to *N. cincticauda* in respect to the position of dorsal fin which is in posterior half of the body, pectoral shorter than head, depth of body and length of head in standard length, diameter of eye in interorbital width, depth of caudal peduncle in length caudal peduncle. It differs from *N. cincticauda* in respect to body colour pattern ; length of anal fin in standard length.

It also disagrees on the following points—paired fins laterally placed in *N. arunachalensis* but paired fins horizontally placed in *N. cincticauda*. Eye diameter 6.50-9.00 in the former species vs. 4.59-6.00 in the latter species in head length. Ventral considerably

apart from anal opening in the former, ventral nearer to anal opening in the latter, 12-14 black ocellus on the body versus 10-11 broad black band on the body ; lateral line absent versus lateral line terminating above pectoral. Morphometric measurements of the other parts are detailed in table no. 2.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. S. Biswas, Zoologist & Shri S. Saha, Asstt. Zoologist, Zoological Survey of India, Calcutta, for collecting the materials. Thanks are also due to Dr. B. K. Tikader, Director and Dr. K. C. Jayaram, Deputy Director, Zoological Survey of India, Calcutta for their encouragement in taking up this project.

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ON THE OCCURRENCE OF *OREICHTHYS COSUATIS* (HAM.)
IN KAZIRANGA NATIONAL PARK,
(PISCES : CYPRINIDAE)

RAJ TILAK* AND J. P. SATI
Zoological Survey of India, Shillong.

ABSTRACT

Oreichthys cosuatis (Hamilton), a hitherto unrecorded species from North-eastern part of India has been found distributed in Kaziranga National Park, Assam. This extends the range of distribution of this species to Eastern India and adds evidence to Satpura Hypothesis of migration of fishes.

INTRODUCTION

Hamilton (1822) described *Cyprinus cosuatis* from Kosi River and Day (1878) reported the occurrence of this species in "Bengal, through North-western Province, the Deccan and Bombay and down the Western Coast as as low as Cottayam in Trivandrum." The material of this species was also studied by Hora (1937a, b, 1942) and Hora and Nair (1941) from Madhya Pradesh and Peninsular India. Hora (1937 a) clarified the systematic position of *Cyprinus cosuatis* and placed it under the genus *Oreichthys* Smith although Day (1878) considered it under *Barbus*. This species was not so far reported from North-eastern part of India. Recently, a specimen of *Oreichthys cosuatis*, from Kaziranga National Park, has been studied and this report extends the distribution of this species to North-eastern region of India. Because of its interesting features and rather rare occurrence of this species, it is important to give a brief-description of material from North-eastern region.

SYSTEMATIC ACCOUNT

Oreichthys cosuatis (Ham.)

(Fig. 1)

1822. *Cyprinus cosuatis* Hamilton, *Fish Ganges*, pp. 338, 392 (Type-locality : Kosi River).
1878. *Barbus cosuatis* : Day, *Fish India*, p. 581, pl. OXLIV, Fig. 1.
1937. *Oreichthys cosuatis* : Hora, *Rec. Indian Mus.*, 39 (4) pp. 321-323.

B III, D. III/8, P 1/13, V 1/8, A II/5, C. 19

Length of head 4.59 in total length (T. L.) and 3.42 in standard length (S. L.), length of snout 3.4 in head length ; length of snout 1.4 in eye diameter ; eye diameter 2.44 in head length ; interorbital width 3.36 in head length ; height of the body 5.2 in T. L. and 3.87 in S. L. ; length of caudal peduncle 6.5 in T. L. and 4.84 in S. L. ; height of caudal peduncle 10.26 in T. L. and 7.63 in S. L. ; height of caudal peduncle 1.58 in length of caudal peduncle ; length of longest dorsal ray 4.59 in T. L. and 3.42 in S. L. ; longest anal ray 6.5 in T. L. and 4.84 in S. L. ; base of

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dorsal 1.7 in longest dorsal ray and base of anal 2.73 in longest anal ray.

The body is somewhat lanceolate. The upper ray is slightly longer than the lower and the mouth is small. The dorsal fin originates slightly nearer the tip of snout than the base of caudal and opposite the posterior half of the pectoral fin. The longest ray of the dorsal fin is a little smaller than the depth of the body below it. The scales along the lateral-line are larger than those of rest of the body. The base of each scale has a dark tinge. There is a black band on the upper half of the first three branched rays. A lighter band along the lower half of the dorsal rays present. A dark band along the anal rays present.

is only one specimen, it is for the time being kept under *Oreichthys cosuatis* which is most close to it.

A study of more material from the same locality and its comparison with that from other parts of India should give a clearer taxonomic position of this specimen.

The distribution of *Oreichthys cosuatis* is quite interesting. It has earlier been recorded from West Bengal, Madhya Pradesh, Maharashtra, Karnataka and Kerala on the one side and Thailand in the far east on the other hand. The present report of this species from Assam indicates that this species is found all along the route of migration of fishes according to Hora's Satpura Hypothe-

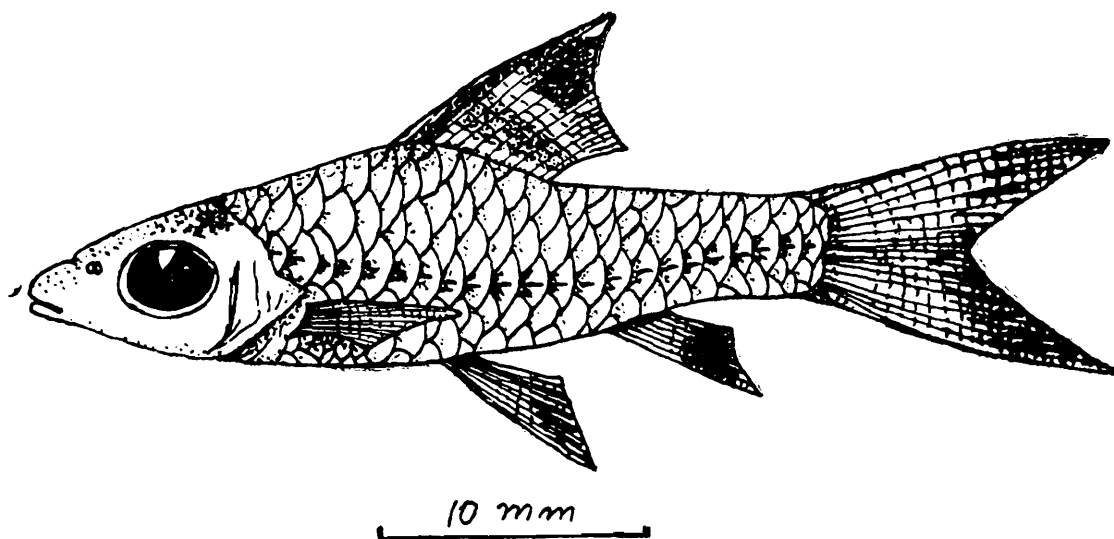


Fig. 1. *Oreichthys cosuatis* (Ham.) from Kaziranga National Park, Assam.

Distribution : Assam, West Bengal, Madhya Pradesh, Maharashtra, Karnataka, Kerala, Pakistan, Bangladesh, Thailand.

Remarks : The present specimen differs from the description of this species given by Day (1878 : 581) in having shorter height of the dorsal, lesser height of the body, origin of the dorsal fin nearer the tip of snout and presence of lower labial fold etc. Since there

sis. The occurrence of this species in Assam is, therefore, very important from zoogeographic point of view and adds another evidence to Satpura Hypothesis of migration of fishes.

ACKNOWLEDGEMENT

The authors feel grateful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta for all facilities and encouragement.

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ON A NEW SPECIES OF THE GENUS *GARRA* HAMILTON (PISCES : CYPRINIDAE)
FROM NAMDAPHA WILD LIFE SANCTUARY, ARUNACHAL PRADESH, INDIA.

A. K. DATTA AND R. P. BARMAN

Zoological Survey of India, Calcutta

ABSTRACT

A new species of fish *Garra tirapensis* belonging to the genus *Garra* Hamilton and the family Cyprinidae from Namdapha river at Namdapha wild life sanctuary, Tirap district, Arunachal Pradesh, India, is described. Range of variations of the characters are compared and discussed with the related species.

INTRODUCTION

During the course of taxonomic studies on the fishes of Namdapha wildlife Sanctuary, Tirap district, Arunachal Pradesh (formerly NEFA), we came across eleven examples of fish belonging to the genus *Garra* measuring 55 to 135 mm in standard length collected by Dr. S. Biswas, Zoologist and Shri S. Saha, Asstt. Zoologist, Zoological Survey of India, Calcutta. These examples represent hitherto unknown species. Systematic characters of this new species is described in the text. This new species is named *Garra tirapensis*.

***Garra tirapensis* sp. nov.**

(Figs. 1 & 2)

Holotype : *Material :* 105 mm in standard length. Reg. No. Z.S.I. FF 1700

Locality : Hornbill Camp., 30 km NE of Miao, Namdapha wildlife Sanctuary, Tirap district, Arunachal Pradesh, India, *coll.* Dr. S. Biswas & S. Saha, Date : 11. 4. 81.

Paratypes : 10 examples, 55 to 135 mm in standard length. Reg. No. Z.S.I. FF. 1701, Locality, collector and date as in holotype.

DIAGNOSIS

Head length 3.93-4.41 and body depth 3.89-5.27 in standard length. Eye diameter 3.50-5.33 in head length. Two pairs of barbels, without dark spot at the base of dorsal fin ray, lateral line scales 34-35. Vent located in advance of base of anal fin. Origin of dorsal fin nearer to tip of snout than to base of caudal fin.

DESCRIPTION

D. 10 P. 13 V. 8 A. 7 LL 34-35

Upper lip coalesce with the skin of rostrum. Paired fins horizontal, lower lip modified into a sucking disc. Mouth inferior.

Head length 4.24 (3.93-4.41) at the distant point on the opercular membrane, body depth 4.90 (3.89-5.27) at the origin of pelvic fin and predorsal distance 2.28 (2.12-2.49) in the standard length. Width of head 1.48 (1.32-1.71) at its widest point and depth of head 1.65 (1.41-1.86) at the occiput in head length. Eye situated in the middle of head. Diameter of eye 4.34 (3.50-5.33) and interorbital width 2.08 (1.85-

2.33) in head length. Snout paraboloid without tubercles. Snout length 2.21 (2.07-2.27) in head length. Interorbital width convex. Length of the disc 2.23 (1.75-2.56) in head length, width of disc 2.28 (1.67-3.00) in

pelvic to anal fin. Length of caudal peduncle 1.78 (1.67-1.97) in head length, width 1.66 (1.50-1.88) its length.

Lateral line scales 34-35, transverse scales 7; scales between lateral line and base of

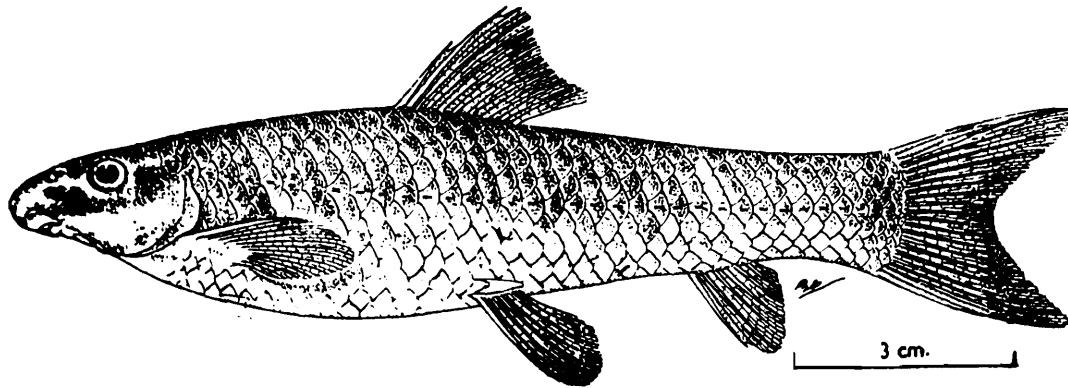


Fig. 1. Holotype of *Garra tirapensis* Datta & Barman

width of head. Barbels 2 pairs, anterior or rostral pairs of barbels and posterior or maxi-

pelvic fin $3\frac{1}{2}$. Predorsal scales 10.

Dorsal fin rays with 2 spines and 8

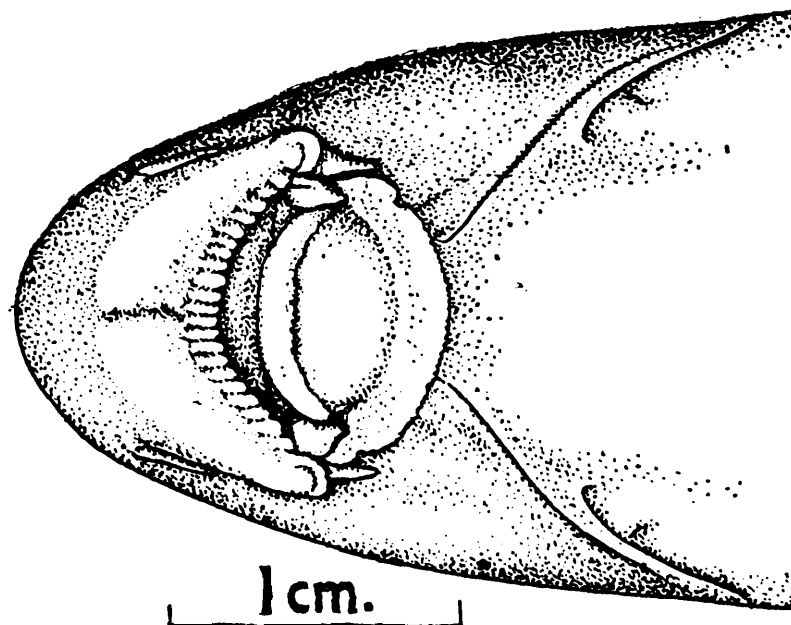


Fig. 2. Ventral view of mouth showing the adhesive disc.

illary pairs of barbels are shorter than eye diameter. Distance between anterior origin of pelvic fin to anal fin 1.97 (1.04-2.22) in that between anterior origin of pelvic fin to base of caudal fin. Distance from vent to anal fin 2.83 (1.88-3.78) in that between anterior origin of

branched rays. Anal fin rays with 2 spines and 5 branched rays. Pectoral length 1.13 (1.04-1.28) in head length.

8 or 9 outer gill rakers in the lower part of anterior arch. Posterior chamber of air bladder 11.70 in the standard length. Chest

and belly scaled.

Colour in alcohol : Dorsal surface gray and ventral surface cream coloured.

Distribution : Namdapha river, Tirap district, Arunachal Pradesh, India.

Measurements and meristic counts of *Garra tirapensis* sp. nov. are given in table 1.

of snout in length of head 2.21 (2.07-2.27) against 1.90 (1.68-2.13), length of disc in length of head 2.23 (1.75-2.56) against 2.12 (1.78-2.58), predorsal distance in standard length 2.28 (2.12-2.49) against 2.07 (1.94-2.21), distance from vent to anal in that between anterior origin of pelvic and anal fin 2.83 (1.88-3.78) against 2.01 (1.83-2.20). Length of

TABLE 1. Measurements (in mm) and meristic counts of *Garra tirapensis* sp. nov.

	1	*2	3	4	5	6	7	8	9	10	11
Standard length	98	105	106	127	103	87	128	55	100	105	135
Depth of body	22	20	21	29	24	22	30	11	25	27	28
Length of head	23	24	25	29	24	21	29	14	24	25	32
Width of head	15	15	18	17	16	14	18	10	18	19	23
Depth of head	15	17	15	20	17	14	19	8	17	15	18
Eye diameter	5	6	6	7	5	5	6	4	6	6	6
Length of snout	10	10	11	13	11	10	14	6	11	12	15
Interorbital width	12	13	12	14	12	9	13	7	11	12	15
Length of disc	7	7	6	8	8	7	10	6	7	7	8
Lateral line scales	34	34	35	35	34	35	34	34	34	35	34
Predorsal scales	10	10	10	10	10	10	10	10	10	10	10
Lateral	3.5/	3.5/	3.5/	3.5/	3.5/	3.5/	3.5/	3.5/	3.5/	3.5/	3.5/
Transverse scales	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Dorsal fin rays	10	10	10	10	10	10	10	10	10	10	10
Predorsal distance	44	45	44	51	46	40	56	26	45	49	50
Length of pectoral fin	21	21	23	26	23	19	27	13	20	21	25
Distance from anterior origin of pelvic to base of caudal fin	51	55	58	64	54	48	68	16	55	59	15
Anal fin rays	7	7	7	7	7	7	7	7	7	7	7
Distance from vent to anal fin	8	10	8	12	10	9	9	8	10	9	14
Length of caudal peduncle	21	23	25	24	22	19	27	13	22	25	32
Depth of caudal peduncle	13	14	13	16	14	12	17	8	13	15	17
Distance between origin of pelvic to origin to anal fin	23	27	28	32	27	23	34	15	27	27	38
Length of caudal fin	20	18	20	25	21	18	26	11	21	22	27

*Holotype

Relationships : This new species fall in between *Garra kempi* and *G. naganensis*, near to *G. kempi*. It differs from the aforesaid species by its width of head in length of head 1.48 (1.32-1.71) against 1.24 (1.08-1.42), length

caudal peduncle in length of head 1.78 (1.67-1.92) against 1.15 (0.96-1.64), depth of caudal peduncle in its length 1.66 (1.50-1.88) against 1.73 (1.22-1.83). Chest scaled against chest naked.

It also differs from *Garra mcClellandi* in respect to the following morphometric characters ; length of snout in length of head 2.21 (2.07-2.27) against 1.74 (1.63-2.04), length of disc in length of head 2.23 (1.75-2.57) against 2.77 (2.53-3.40), width of disc in width of head 2.28 (1.67-3.00) against 1.65 (1.47-1.91), lateral line scales 34-35 against 35-38, length of pectoral in length of head 1.13 (1.04-1.28) against .92 (0.85-1.02). *Garra mcClellandi* is known only from Cauvery drainage, Nilgiri district, Karnataka.

Range of variation of characters between *G. yunnanensis* (Regan), *G. gracilis* (Pellegrin & Chevey), *G. naganensis* Hora, *G. kempi* Hora, *G. mcClellandi* (Jerdon), *G. hughii* Silas are detailed in table II.

Comparing the morphometric measurements of the new species described here against the characters detailed in the table, this new species significantly stands apart from the known species described under

this genus. The new species is named after its locality Tirap district.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. S. Biswas, Zoologist and Mr. S. Saha, Asstt. Zoologist, Zoological Survey of India, Calcutta for collecting the materials and placing them at their disposal for taxonomic assessment. They express their gratitude to Dr. B. K. Tikader, Director, and Dr. K. C. Jayaram, Deputy Director Zoological Survey of India for their encouragement in taking this project. They are also thankful to Mr. P. Biswas, Sr. Artist for making drawing the specimens.

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CONTRIBUTIONS TO THE STUDY OF BAGRID FISHES. 17. THE HISTORY AND USAGE OF 'THE NAME "MYSTUS"

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ABSTRACT

The name *Mystus* applied to a group of Bagrid catfishes in the generic sense has had different usage for a number of years. The proper derivation, the various connotations to which this name has been subjected to and the correct nomenclatural applicability have all been discussed in this paper.

USAGE

The first author to use the word *Mystus* is Belon (1553) who included correctly all fishes having barbels under this name. He used this name polynomially and not as a generic name or taxon. However, subsequent workers did not consider this feature of barbels when using this name.

Linnaeus (1754) used the name in a generic sense to describe *Mystus eusiformis* from China. Osbeck (1757) described the same fish as *Clupea mystus*.

Russell (1756) named one of his species "O" as *Mystus*, which does not belong to Siluriformes. Linnaeus (1758) in his 10th edition of "Systema Naturae" used the name *Mystus* in a specific sense for a species of *Silurus*. This species, *Schilbe mystus* belongs now to the family Schilbeidae; but in the same work in another place Linnaeus used the name *Mystus* again in a specific sense to describe a clupeid fish *Clupea mystus* = *Coilia mystus* (Linn.) belonging to the family Engraulidae. In the 12th edition of "Systema Naturae" also (1766) Linnaeus repeated the

above usage again to indicate a Schilbeid and a Clupeid fish respectively.

Gronow (1763) described seven fishes under the name *Mystus*. He divided the fishes into three divisions depending upon the number of barbels that each possessed as division I—with four barbels, division II—with six barbels and division III—with eight barbels, but included all under the name *Mystus*, as was done by Belon (1553) and Russell (1756). He did not give any binary names to his species under each division, for which reason they have become invalid and unavailable.

Klein (1775) adopted the name in a generic sense and described a fish *Mystus fluviatilis* which is a synonym of *Cyprinus barbatus* of Linnaeus (Cyprinidae).

Scopoli (1777) mentioned "SILURI Species Linn" as belonging to *Mystus*, though it might be contended that he did not specifically include all the Linnaean species of *Silurus*.

Walbaum (1792) while giving a name to the various species in *Artedi Piscium*, used

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the name *Mystus* in a generic sense but for a non-bagrid form, *Aspredo batrachus* Linn. which belongs to the family Aspredinidae.

Meuschen (1778) used in error the word *mystus* in a specific sense to describe a *Aspredo* species which in fact should be *Aspredo mystus* = *Aspredo fluviatilis* belonging to the family Aspredinidae, a Siluroid fish.

Lacépède (1803) utilised the name in a generic sense to describe a Clupeid fish *Clupea mystus* Linnaeus as *Mystus clupeoides*. These species however belong now to the genus *Coilia* Gray (Family Engraulidae) (see Whitehead, 1972).

Cuvier (1817) adopted the name in a specific sense to describe a species of *Thrissa* = *Coilia mystus* which belongs to the family Engraulidae.

Hamilton (1822) used the name *Mystus* in a generic sense for describing three species, *Mystus ramcarati* = *Coilia ramcarati* (Pallas), *Mystus kaporat* = *Notopterus notopterus* (Ham.), *Mystus chitala* = *Notopterus chitala* (Ham.). Of these the first species belongs to the family Engraulidae and the other two to the family Notopteridae.

Valenciennes (1839) correctly described *Schilbe mystus* belonging to the family Schilbeidae, but in the year 1848 he confused the usage by describing an Engraulid fish as *Engraulis mystus*.

Sykes (1841) described *Notopterus bontianus* family Notopteridae under *Mystus*.

Gray (1854) in his catalogue of Fish by Gronovius present in the British Museum gave brief diagnosis of *Mystus* and classified the genus into three categories according to the number of barbels present on the snout. He included *Mystus carolinensis* = *Aelurichthys gronovii* (family Ariidae) with four barbels and *Mystus aceta* = *Pimelodus maculatus*

(Lacépède) belonging to the family Ameiuridae with six barbels and grouped all other *Mystus* under group three with eight barbels.

DISCUSSION

It would thus appear that earlier authors used the name *Mystus* only to describe either a Siluroid or a Clupeoid fish and rarely a Notopterid. The reason seems to be that these fishes also beside some Cyprinids have barbels on their snout. It is evident that the earlier authors did not attach much importance to the presence or absence of scales which is an important character of all Siluroid fishes.

The above discussion can be presented in the form of a synonymy as below :

The following list indicates that the authors have used the name in a generic sense or in a similar conception.

- 1553. *Mystus*, Belon, *De aquatilibus libri* (for all fishes with barbels).
- 1756. *Mystus* (in part), Russell, *Nat. Hist. Aleppo*, (ed. Angl.) 1 : 76, pl. xiii. fig. 2, species "o" (a non-bagrid from).
- 1775. *Mystus*, Klein, *Gesellschaft Schauplatz*, 1 : 595 (non Gronovius ; *Mystus fluviatilis* Klein = *Cyprinus barbatus* Linnaeus).
- 1781. *Mystus* (in part), Meuschen IN : Gronow's *Zoophylacii Gronoviana*, 3.
- 1792. *Mystus*, Walbaum, *Artedi. Ichthyol.*, 3 : 586 (non-Gronovius : for a non-bagrid form).
- 1803. *Mystus*, Lacépède, *Hist. Nat. Poiss.*, 6 : 466 (non-Gronovius).
- 1822. *Mystus*, Hamilton, *Fish. Ganges* 238 (non-Gronovius, for a clupeid fish).
- 1839. *Mystus*, Swainson, *Hist. Nat. Fish.*, 2 (for a non-bagrid fish).
- 1841. *Mystus*, Sykes, *Trans. zool. Soc. Lond.*, 2 : 376 (non-Gronovius : *Notopterus bontianus* Valenciennes—a Clupeid fish).
- 1854. *Mystus*, Gray, *Cat. Fish. Gronow* : 155-156.

The name has been used in a specific sense as listed below :

- 1758. *Silurus mystus*, Linnaeus, *Syst. Nat.* ed. 10 : 805.
- 1758. *Clupea mystus*, Linnaeus, *ibid.* ed. 10 : 819.
- 1766. *Silurus mystus*, Linnaeus, *ibid.* ed. 12 : 502 ;
- 1766. *Clupea mystus*, Linnaeus, *ibid.* ed. 12 : 524.
- 1778. *Aspredo mystus*, Meuschen, *Mus. Gronow* : 34.
- 1817. *Thrissa mystus*, Cuvier, *Regne. Animal*, 2 : 176.
- 1839. *Schilbe mystus*, Valenciennes, *Hist. Nat. Poiss.*, 14 : 327.
- 1848. *Engraulis mystus*, Valenciennes, *ibid.*, 21 : 73.

Nomenclature of the genus *Mystus* :

The genus *Mystus* was proposed by Gronow in 1763. He described seven Siluroid fishes under this name and divided them into three groups based on the number of barbels. He gave brief diagnosis of his species and did not follow the binomial system of nomenclature in designating the species. Gronow's usage of the name *Mystus* has therefore become invalid. However, Scopoli (1777) adopted several of Gronow's genera including *Mystus* in his "Introductio" and gave one line characterization of each. According to the International Commission (opinion 329 in ICZN's *Opinions and Declarations* 9 (23) : 309, 1955) Scopoli's names are valid and are available and hence *Mystus* Scopoli (1777) has come to usage.

Although *Mystus* Scopoli is considered a valid genus, established with a definition, it must be mentioned that no nominal species was referred to it by Scopoli. Under the present Rules the type of a genus should be selected from a species included in the first publication of the genus. Scopoli did not designate any particular species as the type.

Jordan (1917 : 21) selected *Bagrus halepensis* Valenciennes as the type species of *Mystus*

Gronow (1763) = *Mystus* Scopoli (1777). This species is equivalent to No. 388 of Gronow and defined by Gronow as *Mystus cirris octo, capite longioribus : pinna dorsali secunda longissima, a priore ad caudam ferme extensa*.

TYPE SPECIES

The earliest instance in which species were referred definitely to *Mystus* Scopoli is in Fowler's (1928) report of Fishes from the then Bombay State. Three species *vittatus*, *lamarii* (= *seenghala*) and *halepensis* were referred to *Mystus*. Of the three species, *halepensis* alone was referred in clear unambiguous terms not only to *Mystus* Gronow but also to *Mystus* of Scopoli. Thus *Mystus halepensis* becomes the type species of the genus *Mystus*.

However Solander in 1794 gave binomial names to fishes described by Russell in the book *Natural History of Aleppo* (1756). Solander did not designate any type. Fig. 1, pl. vii in Russell's book was named *Silurus pelusius* by Solander which equals as per Günther (1864) *Bagrus halepensis* Valenciennes. Hence the correct valid name of the type species becomes *Mystus pelusius* (Solander).

The synonymy is as below :

Mystus pelusius (Solander)

- 1794. *Silurus pelusius*, Solander In : Russell's *Natural History of Aleppo*, 2 : 210, pl. vii, fig. 1.
- 1840. *Bagrus halepensis* Valenciennes, *Hist. Nat. Poiss.*, 14 : 413.
- 1841. *Bagrus halepensis* Heckel in Russegger's *Reisen Europa, Asien und Africa*, 1 : 1091, pl. viii, fig. 2.
- 1864. *Macrones aleppensis* Günther, *Cat. Fish. Brit. Mus.*, 5 : 431.
- 1928. *Mystus halepensis*, Fowler, *J. Bombay nat. Hist. Soc.*, 33 : 105.

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* Original not seen.

ON AN ABNORMAL CATFISH *MYSTUS VITTATUS* (BLOCH, 1794)
(PISCES : BAGRIDAE) WITH A FORKED MAXILLARY BARBEL

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ABSTRACT

An abnormal specimen of *Mystus vittatus* (Bloch) with a forked left barbel was reported for the first time.

During our investigations on the fishes of Hussain Sagar lake, a polluted lake in Hyderabad, one interesting female specimen of catfish *Mystus vittatus* (Bloch) with a forked left maxillary barbel was recorded on 24th August, 1982. (Pl. XV). The forking of the barbel has its origin at 3.4 cms., from the base of the barbel. Both the dorsal and ventral forked arms are of equal length, measuring 3.4 cms., in length from the base of the fork to the tip. The right unforked maxillary barbel is 7.4 cms., in length from the base to the tip. Except for this abnormality of the left maxillary barbel, all the other characters are agreeing with the description of the species *Mystus vittatus* (Bloch).

The following are the meristic and morphometric characters of the abnormal specimen :

$P=I/7=8$; $V=6$; $D=II/7=9$; $A=II/8$; $C=17$.

Total length : 11.90 cms ; *Standard length* = 9.50 cms ; *Head length* = 2.50 cms ; *Body depth* = 2.15 cms ; *Prepectoral distance* 2.0p cms ; *Preventral distance* : 4.65 cms ; Pre-

Dorsal distance = 3.75 cms ; *Pre-Anal distance* = 6.65 cms ; *Pectoral fin length* = 1.85 cms ; *Ventral fin length* = 1.35 cms ; *Dorsal fin base* = 1.50 cms ; *Anal fin base* = 1.05 cms ; *Eye diameter* = 0.45 cms ; *snout length* = 0.75 cms ; *Depth of peduncle* = 1.05 cms ; *Pre-Adipose fin distance* = 6.05 cms ; *Adipose fin base* = 2.10 cms.

Earlier forked barbels were recorded in *Callichrous macrophthalmus* (Blyth) (Tandon & Sharma, 1971) ; in *Clarias batrachus* (Linnaeus) (Ovais, 1974, Thakur & Singh Kohli, 1976) ; in *Heteropneustes fossilis* (Bloch) (Datta & Ghosh, 1975) ; in *Ompok bimaculatus* (Bloch) (Raghunathan, 1976), and in *Tachysurus maculatus* (Thunberg) (Edwin Chandrasekharan, 1979). However, this is the first record of forked maxillary barbel in *Mystus vittatus* (Bloch).

Jayaram (1978) stated that the catfish barbels are intended for tactile, gustatory, locomotory, aggressive and sexual functions. In the present case during early stages of development, in the course of one of the above activities, the barbel might have been

injured or split, resulting in the growth of forked maxillary barbel in this abnormal specimen.

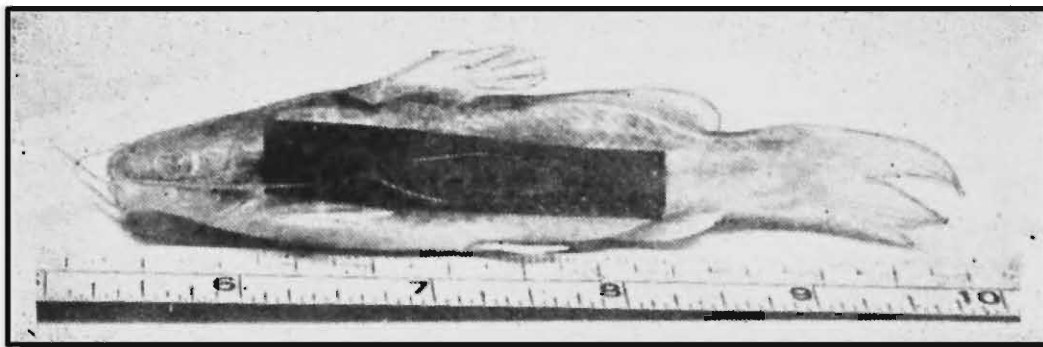
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RAO & REDDY

PLATE XV



Abnormal specimen of *Mystus vittatus* (Bloch), with forked barbel.

ON THE HABITAT AND MORPHOLOGY OF *MACOMA*
(*PSAMMOTRETA*) *ALA* (HANLEY)
(MOLLUSCA : BIVALVIA, TELLINIDAE)

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ABSTRACT

In this paper observations on the ecology and morphology of an Indian Tellinid, *Macoma* (*Psammotreta*) *ala* collected from Beyt island, Gujarat, India, are reported. The bivalve was found to be restricted to the sub-littoral sandy shore, rich in organic debris. Its complete burrowing activity takes only 90 to 120 seconds. In buried condition it remains in unique vertical position. Morphological and anatomical structures were observed to be in line with the general pattern of lamellibranch with certain unique features. The pallial muscles have distinct shape and are useful in the identification of the species. These muscles consist of two compact bundles of transversely running fibres which stretch diagonally between the shell valves running through one another in the middle of their length. The anterior portion of the gill lacks outer demibranch, the inner demibranch extending over the pericardium. Gonads are embedded in foot.

INTRODUCTION

Our knowledge of the habits and habitat of Tellinids is far from satisfactory. Except for a few works like those of Fraser (1932), Stephen (1928, 1932), Yonge (1949), Holme (1950, 1961), and Subrahmanyam *et al* (1949) there have been no attempt to study the ecology of this group particularly in India. This perhaps may due to the difficulty in the collection of the bivalve. In this paper a brief account given of the habits, habitat and morphology of *Macoma* (*Psammotreta*) *ala* Hanley, which was collected from Beyt Island, Gujarat.

MATERIAL AND METHODS

The living specimens brought from the field were kept in an aquarium containing sand and sea water from the same place. The burrowing activity was observed and the time

taken for burrowing was recorded with the help of a stop watch. A few specimens were dissected to study the anatomy.

HABITS AND HABITAT

The animals locally known as *Kadila* are found in sublittoral zone of fine and coarse sand especially where there is organic debris. They are found at a depth of 5 to 15 cms., at an average density of 10 nos/sq. m.

The shells are 17.6 to 26.2 mm. in length and 12.45 to 19.16 mm. in width. When the animal is placed on sand, the foot soon protrudes and extends forward. The anterior end enters the sand, while the posterior end remains directed upwards. Once it is in contact with the sand, the foot is jerked repeatedly. When the animal is completely buried, it lies in vertical position, the siphons are extended, up to 4-5 cms above the sand level. The time

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taken for the entire process from the first extrusion of the foot to its final disappearance under the sand is 90 to 120 seconds. When the animals are placed upside down with the dorsal side downwards they remain inactive for a long time and then they attempt to tilt the body with the help of foot. If they succeed, then the burrowing activity starts, otherwise they remain completely inactive,

GENERAL ANATOMY

The mantle is a thin and transparent structure covering the whole visceral mass., united dorsally and fused posteriorly. Ventrally in the region of cruciform muscles it is thickened at its edge. The foot is large and ventrally compressed, extending from the anterior adductor and posterior adductor muscles to the base of inhalent siphon. The musculature is well developed. The anterior adductor and posterior adductor muscles are large and well developed. The pedal retractors are inserted into the foot. The foot and viscera possess many interesting muscle fibres while posteriorly special siphonal and cruciform muscles are present. The pallial muscles have distinct shape, which are useful in the identification of the species. Besides these cruciform muscles are present which are characteristic of members of Tellinacea. These muscles consists of two compact bundles of transversely running fibres which stretch diagonally between the shell valves running through one another in the middle of their lengths.

The ctenidia and palps are paired structures situated in the mantle cavity. The labial palps are trigonal and larger than the ctenidia. The ctenidium consists of a very large inner and a smaller, upturned outer demibranch. The gill is unique. Its anterior portion lacks the outer demibranch and the

inner demibranch extends dorsally and superficially over the pericardium. Centrally and along most of the ctenidial length the outer demibranch is present and consists of a single dorsally upturned lamella.

The siphons are two, separate, elongated and well developed structures. The tip of the inhalent siphon is bordered by six blunt lobes and that of the exhalent siphon is constricted.

The oesophagus is straight and enters the stomach anteriorly. The stomach is globular anteriorly and extended posteriorly. The style sac is united with the midgut which is long and coiled. The midgut terminates at the beginning of the rectum and passes through the pericardium. The rectum transverses the ventricle, passes through the pericardium continues around the dorsal surface of the posterior adductor muscles and terminates by the anus near opening of the excurrent siphon. The kidney lies between the heart and the posterior adductor muscles. The pericardium is located dorsally between the kidney and digestive diverticula. The heart consists of two large paired, thin walled auricles connected with muscular ventricle which is transversed by the rectum. The nervous system is similar to that in lamellibranches. The gonads are paired branched structures which are embedded in the foot and surround style sac and midgut.

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A NOTE ON THE DISTRIBUTION OF THE LITTLE INDIAN FIELD MOUSE,
MUS BOODUGA (GRAY) [RODENTIA ; MURIDAE],
WITH AN ALTITUDINAL RECORD

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ABSTRACT

The occurrence of the Little Indian Field Mouse, *Mus booduga* (Gray), at a village named Nelang (c. 3695 m), Uttar Kashi District, Uttar Pradesh in India collected during Indian Kalidhang Expedition 1974, is reported. This represents the highest altitudinal record of this species in its range of distribution. Previous records of its distribution have also been discussed.

INTRODUCTION

While examining a small collection of rodents from the Indian Kalidhang (c 6436 m) Expedition 1974, present in the Zoological Survey of India, Calcutta, a small grey-bellied mouse with bicoloured tail was found. On closer examination it turned out to be an example of the Little Indian Field Mouse, *Mus booduga* (Gray). The specimen was collected from a village named Nelang (c 3695 m) in Uttar Kashi District, Uttar Pradesh. The details of the specimen are given below. The external measurements were taken in the field by the collector. All measurements are expressed in mm.

Material : 1 ♀ ; Zoological Survey of India Registration Number 20840 ; in alcohol; 6 July 1974 ; H. C. Ghosh collector.

Measurements : External : Head and body 73.0 ; tail 68.0 ; hindfoot 15.0 ; ear 10.0.

Cranial : Occipitonasal 20.3 ; condylobasal 19.2 ; nasal 6.9 ; palate 10.4 ; bulla 3.2 ; molar tooth row 3.2 ; anterior palatal foramina 4.5 ; diastema 5.3.

According to the extant literature its distributional range is from Pakistan to Burma through India and Nepal. As there

are some contradictory remarks about its distribution in the Indian subregion and also its occurrence in the Himalayas, it becomes necessary to discuss the previous views.

Blanford (1891) said, "it occurred in the Peninsular India and Sri Lanka generally and not recorded from the Indus Valley (except from Karachi) or the Himalayas." It is therefore evident that in Blanford's time there was no record of its occurrence in the Himalayas. However, Wroughton (1914) was the first to report it from the Kumaon (Nainital and Almora) and Rohilkhand (Pilibhit) areas at altitudes varying from 250 m to 2155 m in the Himalayas, followed by Lindsay (1926) from Gopalpur (c 2770 m) (Kangra Valley, Himachal Pradesh), Ellerman & Morrison-Scott (1951) from Kumaon and Ellerman (1963) from Kumaon and Rohilkhand areas on the basis of Wroughton's (1914) report mentioned above. The record of this species within Indian territory as given by Hinton & Lindsay (1926), Lindsay (1926), Roonwal (1950), Kurup (1968), Prakash, Jain and Rana (1971), Sharma and Sharma (1976), Agrawal (1980) and Mandal (1981) are all from altitudes lower than that of not only Nelang (c 3695 m) but also Gopalpur (c 2770 m).

Although Blanford (1891), Ryley (1913), Wroughton (1915) and Phillips (1935) mentioned its occurrence in Sri Lanka, other authors like Ellerman (1963) and Marshall (1977) disagreed by stating that those mice were not *Mus booduga*. As Ellerman is considered to be an authority on rodents of the Indian subregion, his views are given much weightage in this regard. The mouse is common throughout the island up to an altitude of c 1850 m.

Regarding its distribution in Pakistan, Blanford (1891) mentioned its occurrence in Karachi, Siddiqui (1961) and Ellerman (1963) in Rawalpindi (c 220 m), Verma (1968) in Jammu, Sialkot and Lahore sectors (maximum altitude Jammu c 315 m), Sharma and Sharma (1976) at Poonch, Udhampur and Baderwah in Jammu and Kashmir State (maximum altitude Poonch c 978 m). Roberts (1977), however, states that it occurs in Sind and Punjab but "it does not appear to have penetrated the Baluchistan hills or the Himalayas", which in the light of the evidences put forward above, does not seem correct.

David (1970) reported this species for the first time from Nepal in Birganj Forest Division (c 200 m), but unfortunately his specimens were lost during transit. Agrawal and Chakraborty (1971) mentioned its occurrence in Bhojbhawanpur (c 165 m) in Banke District, Nepal. Now, from these reports it appear that this species occurs in Nepal up to an altitude of c 200 m (Birganj Forest Division).

Wroughton (1915), Ellerman and Morrison-Scott (1951), Ellerman (1963) and Marshall (1977) mentioned its occurrence at Mt. Popa (c 1531 m) in Burma.

Although Varma and Mahadevan (1970) have found *Mus booduga* from eastern Hima-

layas (Darjeeling District of West Bengal and Sikkim), yet their records cannot be considered here as they have not mentioned the exact locality from where they got the specimens.

From this discussion it would appear that the present material of *Mus booduga* from Nelang (c 3695 m) in Uttar Kashi District, Uttar Pradesh constitutes its highest altitudinal record in its range of distribution from Pakistan to Burma via India and Nepal.

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Bull. zool. Surv. India, 6 (1-3) : 305, 1984

NEW NAME FOR *LIOTHrips LORANTHI* MURALEEDHARAN & SEN
(THYSANOPTERA : TUBULIFERA : PHLAEOTHIRIPIDAE)

Liothrips loranthi Muraleedharan & Sen, 1981 *Rec. zool. Surv. India*, 79 : 215-217.

The name *Liothrips loranthi* Muraleedharan & Sen is preoccupied by *Liothrips loranthi* Priesner (1968, *Treubia*, 27 (2-3) : 211-212). It is a strange coincidence that both the species are named after the host plant *Loranthus*. *Liothrips loranthi* Muraleedharan & Sen is a distinct species differing from the other species (*Liothrips loranthi* Priesner) by

antennal, wing & setae coloration, anteromarginal setae longer than anteroangulars and number of double fringes of forewings. Therefore a new name *Liothrips bournieri* nom. nov. is proposed for *Liothrips loranthi* Muraleedharan & Sen.

The new name is proposed after Prof. A. Bournier for his valuable contribution on Thysanoptera and also for kindly bringing the homonymy to my notice.

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Bull. zool. Surv. India, 6 (1-3): 307-308, 1984

SOME NEW RECORDS OF ANTS (HYMENOPTERA :
FORMICIDAE) FROM TRIPURA.

While studying a small lot of ants from Tripura, collected by Dr. K. P. Singh, I came across 15 species, of which 9 turned out to be new records to this area.

Family : FORMICIDAE

Sub-family : PONERINAE

1. *Diacamma assamense* Forel

Material : 1 ex, Subalsingh, Agartala, Tripura, 3.8.1979.

Remark : The earlier record of this species in India is only from Assam.

2. *Leptogenys kitteli* (Mayr)

Material : 17 exs, Subalsingh, 3.8.1979.

Remarks : One of the specimens has its colour pattern resembling that of *Pachycondyla amblyops*. This species has been recorded earlier from the foothills of Himalayas from Simla to Sikkim, Assam, Calcutta and Burma.

3. *Pachycondyla leeuwenhoekii* (Forel)

Material : 1 ex, Subalsingh, 3.8.1979.

Remarks : The previous record of this species, in India, is only from Assam and Calicut.

4. *Pachycondyla rufipes* (Jerdon)

Material : 1 ex, Subalsingh, 3.8.1979.

Remarks : Bingham (1903) reports the distribution of this species in the Himalayas

from the Siwaliks to Assam, Bengal, Western India, Southern India and Burma.

5. *Odontoponera transversa* Smith

Material : 1 ex, Subalsingh, Agartala, 3.8.1979.

Remarks : This species is spread throughout Indo-Malayan region.

Sub-family : MYRMICINAE

6. *Crematogaster dohrni* Mayr

Material : 10 exs, Subalsingh, 3.8.1979.

Remarks : This apparently is the first record of this species from India. The previous record is from Ceylon and Burma. (Bingham, 1903 and Chapman & Capco, 1951).

7. *Meranoplus bicolor* Guer

Material : 2 exs, Subalsingh, 3.8.1979.

Remarks : It is a widely distributed species.

8. *Monomorium longi* Forel

Material : 35 exs, Kathal Bazar, Tripura, 11.8.1979.

Remarks : The earlier record of distribution is only from Assam.

9. **Tetraponera rufonigra** (Jerdon)

Material : 1 ex, Kathal Bazar, Tripura, 11.8.1979.

Remarks : A widely distributed species.

Sub-family : FORMICINAE

10. **Camponotus camelinus** (F. Smith)

Material : 1 ex, Subalsingh, 3.8.1979.

Remarks : This species has earlier been recorded from Sikkim and Burma.

11. **Camponotus compressus** (Fabricius)

Material : 18 exs, Bogapha, Agartala, 7.8.1979 ; 11 exs, Vijaynagar, Agartala, 5.8.1979.

Remarks : It is a widely distributed species in India.

12. **Paratrechina longicornis** (Latreille)

Material : 35 exs, Monu, Tripura, 11.8.-1979.

Remarks : It is a widely distributed species in India.

13. **Anoplolepis longipes** (Jerdon)

Material : 15 exs, Subalsingh, Agartala, 3.8.1979.

Remarks : Bingham (1903) gives its distribution as 'Throughout our limits except in the hot dry portions of North-Western Provinces, the Punjab and parts of Central India. Common in Ceylon and Burma'.

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14. **Polyrhachis hippomanes ceylonensis** Emery

Material : 1 ex, Subalsingh, 3.8.1979.

Remarks : The present specimen is much smaller in size than the specimens of this species I have studied from the Khasi Hills of Meghalaya. The previous record of this species is from Sri Lanka.

15. **Polyrhachis illaudata** (Walker)

Material : 1 ex, Subalsingh, 3.8.1979.

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

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Bull. zool. Surv. India, 6 (1-3) : 309, 1984

PARENTAL CARE IN THE KELAART'S PIPISTRELLE, *PIPISTRELLUS*
CEYLONICUS CHRYSOTHRIX (WROUGHTON)

Parental care in bats is relatively little known. Recently an observation on maternal care in *Pipistrellus ceylonicus chrysothrix* (Wroughton) was made which is reported here.

On 3rd September 1981, at about 18.30 hours a bat was seen flying at a low height in the College Square, a medium sized pond in the heart of the city, Calcutta. As the bat was flying in the usual pipistrelline manner we saw something fall from its body. When the spot was visited, a young bat was found lying on the ground. On looking up we saw the adult bat flying in the air around the young. After a few minutes it came down near to the young and tried to lift it with the help of its expanded wings, when it was caught with a view to identifying it. It was found to be a female specimen of *Pipistrellus ceylonicus chrysothrix* (Wroughton). The bat was then released at a distance of about 20 metres from the young to see its response towards the baby, if any. It flew and got stuck under the fence of the park and remained there for about six minutes. Then it started flying again. After five minutes of usual flight, it suddenly came down to the young one and flew away with it.

David (1965) states that the adult of *Pipistrellus mimus* Wroughton could possibly communicate with the young one lying at a distance. Madhavan (1971) found that the females of *Pipistrellus dormeri dormei* (Dobson) and *Pipistrellus coromandra coromandra* (Gray) make special efforts to take back the grounded young ones.

The present observation on *Pipistrellus ceylonicus chrysothrix* Wroughton supports Khajuria's view and indicate that *Pipistrellus ceylonicus chrysothrix* Wroughton behaves like other pipistrelles and takes away the grounded young.

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Bull. zool. Surv. India, 6 (1-3) : 311, 1984

URINATION BY THE LITTLE INDIAN HORSESHOE BAT, *RHINOLOPHUS*
LEPIDUS BLYTH, ON INTRUDERS

Several species of bats are known to urinate on intruders as a means of offence. Harrison (1959) found that flying individuals of an unidentified horseshoe bat in Malaya gave out squirts of urine directed towards the intruder. Khajuria (1975) observed this habit in *Rhinopoma h. hardwickei*, *Taphozous m. melanopogon*, *Megaderma I. lyra*, *Scotophilus h. heathi* and *Scotophilus k. kuhli*, but there is no record of this habit in *Rhinolophus lepidus* Blyth which is reported here.

The observation was made on 22nd November, 1981 in a colony of 22 individuals of *Rhinolophus lepidus* in a ruined temple at Gurup, Burdwan dist., West Bengal at about 14.00 hrs. The bats were hanging very closely to one another forming clusters. On

our entry into the temple, there was no reaction of the bats, but as soon as we focussed the torch on them, they started flying inside the temple discharging drops of urine with a peculiar smell. Although the previous authors have taken it as a means of offence only, but it seems that this act of bats may be a threat display.

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A RECORD OF THE INDIAN FLYING FOX, *PTEROPUS GIGANTEUS*
(BRÜNNICH) IN SIKKIM

Literature available so far on the mammals of Sikkim (Blanford 1888, Wroughton 1916, Finn 1929, Prater 1971) does not record the Indian Flying Fox, *Pteropus giganteus* (Brünnich) there, though Ellerman and Morrison-Scott (1951) 'apparently' included Sikkim in the general distribution of the species. However, in winter this year (1983) while engaged in field work in that State we saw a dead specimen of this Flying Fox, which was hanging from a roadside electric wire at Gangtok (alt. c 1829 m.), close to the Secretariate Building, on 22 January, and is recorded here. This constitutes the first authentic report of this bat from Sikkim.

The Indian Flying Fox do not occur above the base of the Himalaya permanently (Finn 1929, Prater 1971). It appears that the recent increase in the number of orchards of various fruit trees might have enabled this fruit bat of the tropics to extend its distributional range in this hill State recently. Moreover, its occurrence at such an altitude in winter

suggests about its local occurrence there rather than as a migrant.

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Bull. zool. Surv. India, 6 (1-3) : 315-316, 1984

RECENT OCCURRENCE OF THE HISPID HARE, *CAPROLAGUS HISPIDUS*
(PEARSON), IN THE DUARS OF WEST BENGAL

The Hispid Hare, *Caprolagus hispidus* (Pearson), originally described from northern Assam, had been known to occur in the Duars area of northern West Bengal in the earlier part of the present century (Gee 1964). Since then there has been no report of this animal from that area. During a field investigation on the status of some lesser cats in Chilapata forest area in the Jalpaiguri district of West Bengal, we were informed about the occurrence of a dark brown, small-eared hare befitting the description of the Hispid Hare. We, therefore, looked for it, and sighted in four times in Jaldapara-Chilapata area (alt. c 62-92 m) during our field work, which prove its existence there still.

In one instance, in the evening on 3 April 1982, we had two fleeting glimpses of the Hispid in the forest on the north of Chilapata Forest Log Depot, not far from a thatchland. The second observation of this animal was made on 7 April 1982 while we were making field observation on elephant back in the morning hours (c 8.30 or so) on the western bank of the Sil Torsa River along an area with patches of tall grass. The same night while scanning the forest with spot light from the jeep at about 0.30 hrs (8 April 1982) another Hispid was seen in a patchy thatchland in Sissamara area. A Rufous-tailed Hare (*Lepus nigricollis ruficaudatus* Geoffroy) was also noticed following this sighting in an open scrubby area near Sissamara Beat Office.

The last sighting of the Hispid was made on 12 September 1983 at about 22.30 hrs, in the proximity of C. C. Line Camp on the eastern bank of Sil Torsa River, thatchland area.

The sighting areas of the Hispid at Chilapata and the western bank of Sil Torsa River were strewn with the characteristic pellets of the Hispid Hare. The pellets collected from these areas are of two distinct sizes, i. e., 12.5-13.1 mm and 16.1-16.3 mm (*vs* about 10 mm or so in *Lepus nigricollis*) in diameter, as has been recorded in the Rajgarh Forest of Assam (Oliver 1980, Ghose 1981).

The Hispids are primarily dendizens of the grasslands, though at times may also visit open areas for feeding during the night. On the contrary, the sympatric Rufous-tailed Hare (*L. n. ruficaudatus*) which has also been observed by us on several occasions near human habitations around Jaldapara-Chilapata areas during the night prefers comparatively open scrub forests insted of primary thatchlands, as in Assam.

The main components of the thatches or the grasslands in Jaldapara-Chilapata area are Khagra (*Phragmites karaka*) and tall *kasila* grasses (*Saccharum spontaneum*), also *Saccharum procerum*, *Erianthus elephantus*, *Anthistria brasiliensis* etc, and are commonly found on sandy soils, but may also be encountered in clay pockets, which are often silted-up on old stream beds (Spillett 1966).

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Bull. zool. Surv. India, 6 (1-3) : 317, 1984

MYRIAPODS AS THE FOOD OF COMMON GARDEN LIZARD,
CALOTES VERSICOLOR (DAUDIN)

(With Plate XVI)

Various workers like Smith (1935), Minton (1966), Prakash (1973) and Sharma & Vazirani (1977) have established that the food of Common Garden Lizard comprises insects including their larvae grasshoppers, lepidopterans, beetles, dragon flies, hymenopterans and spiders.

Recently the author had an opportunity to examine the stomach contents of about fifty examples of this lizard collected from Bankura and Purulia districts of West Bengal. It was quite interesting to note that 70% of the stomach contents comprised milipedes of the genus *Proterosperphormage*. A centipede of the genus *Rhysida* was also found in the stomach of one of the lizards. The period from November to December is the posthatching time of myriapods, when there are seen in large numbers of them in damp soil, litters and under grass. The author's observations indicate that during this time *Calotes versicolor* devour mainly the milipedes. One animal nematode was found in the stomach of one of the lizards. The above mentioned food items are new additions to the menu of this most common lizard.

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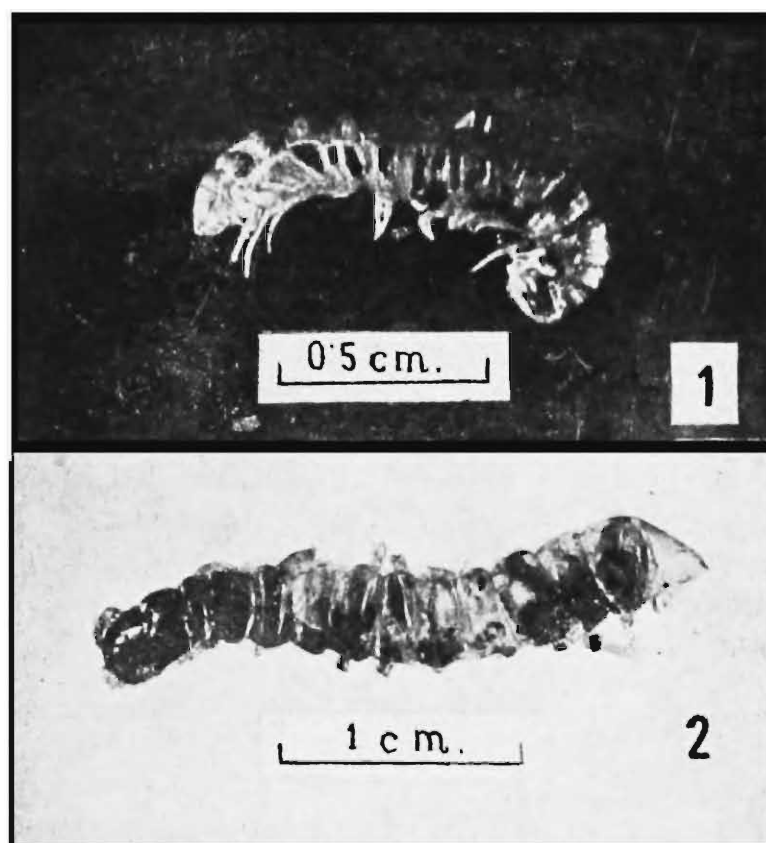
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Text-figs. 1-12, plates 9-36, tables 1-7, maps 1-5.

AHMED

PLATE XVI



Figs. 1-2. 1. The dorsal view of millipede found in the stomach of a Common Garden Lizard, *Calotes versicolor* (Daudin)
2. The centipede (Ventral view) found in the stomach of another specimen of common garden lizard, *Calotes versicolor* (Daudin)

Bull. zool. Surv. India, 6 (1-3) : 319, 1984

RECORD OF *PUSANA LAEVIS* (UVAROV) (INSECTA : ORTHOPTERA :
ACRIDIDAE) FROM THE HIMALAYAS

Uvarov (1921) described *Pusana laevis* from specimens collected partly from Pusa (Bihar) and partly without any precise data under the new generic name *Pusa*. He (1940) transferred the species to the present genus because his original generic name was pre-occupied. Since then no record of this species, subsequent to Uvarov's description, has been made from anywhere else in India or elsewhere.

During a recent survey of the Himachal Pradesh the authors collected one male (Pandoh, Mandi ; 18.9.80) and two males and one female were collected earlier from Sikkim (Rangpo ; 2-3.7.79). All the examples were sent to the Centre for Overseas Pest Research, London, for identification. Dr. J. M. Ritchie who has kindly confirmed the identification notes that he has identified the same species from Bangladesh in 1980 and remarks that the species is rarely collected and probably frequents water places in damp grass, rice, etc. It is thus interesting to note that the species has a wide distributional record ranging from the Himachal Pradesh, right up to Sikkim, Bihar and Bangladesh.

The examples before us agree in most characters with the original description differing in some minor points : Pronotal median carina obliterated in between sulci. Tegmen long, surpassing tip of posterior femora by one-fourth of its length, with rounded apex. Supra-anal-plate with a deep concave medium longitudinal groove. Oviposital valves of female short, slightly curved, lower valves with blunt lateral projection on each side. The specimens (♂ 17-17.5, ♀ 21.5) almost agree with the measurements given for the types. Regd. nos. 9004-9006/H5.

We are grateful to Dr. B. K. Tikader, Director, Zoological Survey of India, for facilities provided.

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Bull. zool. Surv. India, 6 (1-3) : 321-322, 1984

A CASE OF ALBINISM IN THE FIVE-STRIPED PALM SQUIRREL
FUNAMBULUS PENNANTI WROUGHTON

(With Plate XVII)

Instances of albinism in mammals have drawn the attention of many workers since early this century (Milne, 1905 ; Harrison, 1905 ; Rajagopalan, 1967 and Khajuria, 1973). This phenomenon is yet unknown in the Five-striped squirrel, *Funambulus pennanti* Wroughton, a species widely distributed in northern India. Recently, however, we have come across an albinistic individual of this species through the courtesy of Mr. C. Sharfuddin of Patna, and it is described here.

All the measurements are in millimetres.

Material : One female, Chandigarh, India ; collected and owned by Mr. C. Sharfuddin, Patna, Bihar ; April, 1981.

External measurements : Head and body 151, tail 161, hindfoot 40, Ear 14.

Cranial measurements : Occipitonasal length 36.5, condylobasal length 36, palatal length 19.5, palatal width 9, diastema 8.5, anterior palatal foramina 2, bulla 7.5, nasal length 11, nasal width 4.5, upper tooth row 7.5, orbital length 12, least interorbital width 11.5, zygomatic width 21.5, cranial width between posterior zygomatic roots 17.5, postmolar length 17, frontals width behind postorbital bars 14.5, mandibular length 21.5, lower tooth row 7.5.

Colour : The whole body is covered with soft and spotless white fur. The dorsal and

ventral colour do not show any difference. The dorsum, which is striped in normal case, does not show even the remotest sign of striped pattern.

The freshly killed specimen showed pink eyes (Characteristic of true albinism). The naked skin areas such as rhinarium and anal openings etc. also bore a pinkish tinge, even the nails were of pale colour.

The external and cranial measurements were compared with those of *F. pennanti* and *F. palmarum*. The specimen differs from *F. palmarum* in various cranial characters specially by larger bullae (under 1/5 of occipitonasal length in *F. palmarum*—Agrawal, 1967). It tallies well with *F. pennanti* in all respects.

Albinism is known to be a genetical phenomenon in which due to an autosomal recessive gene pigments fail to develop. Rajagopalan (1967) opines that albinism carries with it the trait of tameness. Hutt (1969) considers it an indication of infertility.

ACKNOWLEDGEMENTS

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work. Thanks are due to Shri Ram Babu Sharma, Photographer, Z S I, G. P. R. Stn., Patna for taking the photograph.

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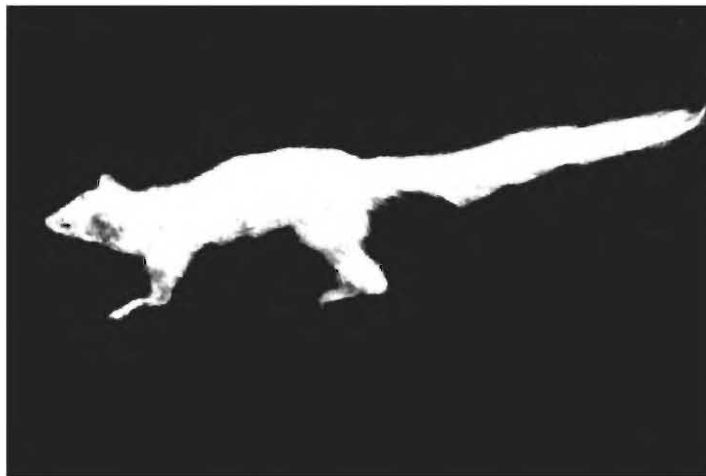
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AND
A. K. GHOSH

CHATURVEDI & GHOSH

PLATE XVII



Albino *Funambulus pennanti* Wroughton in lateral view.

NEW RECORDS OF ZOOCECIDIA FROM ANDAMAN ISLANDS, INDIA

This contribution records six Zoocecidia collected on six different plant species during the survey of gall causing insects of the Andaman Islands. Among these cecidozoa, two belong to Homoptera, one to Lepidoptera two to Diptera and, one unknown insect, which are being recorded for the first time from the Andaman Islands. These galls are deposited in the collections of the Zoological Survey of India, Port Blair.

1. *Ficus nervosa* Roth. by *Dynopsylla grandis* Mathur (Homoptera)

Leaf gall (Pl. XVIII, A). Epiphyllous, simple, globose, rarely ovoid, sessile, solitary or agglomerate, smooth, fleshy, unilocular pouchgall, enclosing a single nymph inside, not localized, dehiscent, pale yellowish-green to reddish or reddish-brown when young, becomes dark brown on aging. Ostiole hypophyllous. Galls burst open from above at emergence of an adult and give the peculiar peteloid appearance. Nymphal exuviae were noticed in fully developed galls indicating their moulting into adults in gall cavity itself. Number of galls per leaf varies from 9-50. Size : 4-7 mm. high and 7-9 mm. in diameter. Coll. R. M. Sharma, 26.xi.1981 ; 20.i.1982, 25.vi.1982, and 26.ix.1982.

Distribution : SOUTH ANDAMAN : Carbyn's Cove, Wandoor, Rutland Island (very common), Neil Island.

2. *Ficus recemosa* Linn. by *Pauropsylla depressa* crawf (Homoptera)

Leaf gall (Pl. XVIII, B). Epiphyllous, simple, sub-globose, sessile, perfoliate pouch-gall, usually aggregated on the leaf resulting in multilocular agglomerate-masses, yellowish green when young, dark-brown when old, dehiscent, letting out an adult from openings on the underside. Number of galls varies from 5-25 per leaf. Size : 2-7 mm. in diameter. Coll. R. M. Sharma, 10.x.1981 and 17.iv.1982.

Distribution : SOUTH ANDAMAN : Jungli-ghat, Port Blair, Caddle gunj, Manpur.

3. *Thunbergia laurifolia* Lindl. by an unidentified Lepidoptera.

Leaf gall (Pl. XVIII, C, D). Epiphyllous or hypophyllous, free, solitary or paired but never agglomerate, fusiform, stout, thick-walled, fleshy, solid, glabrous pouch gall, inserted on the blade by a short and stout stalk, usually occur on the mid rib or on one of the larger lateral veins, greenish when young, becomes light to dark-brown when old, indehiscent, persistent. Gall cavity axial, elongate, wide, cylindrical and extending from nearly the very base of the gall to its tip, unilocular enclosing a single caterpillar, pupates in the gall itself, pupal period 6-7 days and mature by lacerated openings on the lateral side from which an adult emerges out. Larvae parasitized by hymenopterous parasites. Size of the gall varies from 25-28 mm. long and 5-8 mm. thick medially. Number of galls per leaf ranges from 2-4. Coll. R. M. Sharma, 26.xi.1981, 26.v.1982, and 20.vi.1982., Feb./March, 1983.

Distribution : SOUTH ANDAMAN : Carbyn's Cove, Chidiatapu, Dandus Point, Namun-agar, Rutland Island. MIDDLE ANDNAMAN : Very common throughout the Island.

4. *Gnetum acutum* Markgr, by unknown

Diptera

Leaf gall (Pl. XVIII, E). Epiphyllous, free, solitary or at times two galls unite at the base but never agglomerate, fusiform, pedicellate, operculate, stout, thick-walled, fleshy, solid, glabrous, indehiscent, persistent, pouch-gall, inserted on the mid rib or one of the larger lateral veins, greenish when young, blackish and woody on aging. Gall cavity unilocular, axial, elongate, wide, cylindrical and extending from nearly the very base of the gall to its tip, exit hole at its apical tip. Size of the gall varies from 22-25 mm. long and 4-5 mm. thick at centre. Number of galls per leaf varies from 2-5. Coll. M. K. Vasudeva Rao, 23.i.1982.

Distribution : SOUTH ANDAMAN : Rutland Island.

5. *Dehaasia kurzii* King by unknown insect.

Leaf gall (Pl. XVIII, F). Epiphyllous, very rarely hypophyllous, pustuloid or conoid, sessile, solitary or at times two or three galls unite at base but never agglomerate, unilocular, fleshy, glabrous pouch-gall, occur throughout the laminar surface, indehiscent, persistent, greenish when young, black and woody when old. Larval cavity small; minute, circular exit hole present at the tip of the gall. Size : 2-3 mm. high and 1-2 mm. in diameter.

Often as many as 250 galls arise on a single leaf. Coll. R. M. Sharma, 10.vi.1981 and 25.vii.1982.

Distribution : SOUTH ANDAMAN : Dhani-khari, Wandoor.

6. *Phaeanthus andamanicus* King by unknown

Diptera

Leaf gall (Pl. XVIII, G, H). Hypophyllous, simple, sessile, solitary, occur mostly on mid rib, globose with rough surface, solid, hard, pouch-gall, greenish when young, blackish on aging; indehiscent, persistent. Gall cavity unilocular usually there are 3-4 circular exit holes in a mature gall. Size : 10-15 mm. in diameter. Mostly a single gall arise on a leaf. Coll. R. M. Sharma, 17.iv.1982.

Distribution : SOUTH ANDAMAN : Chidiatapu.

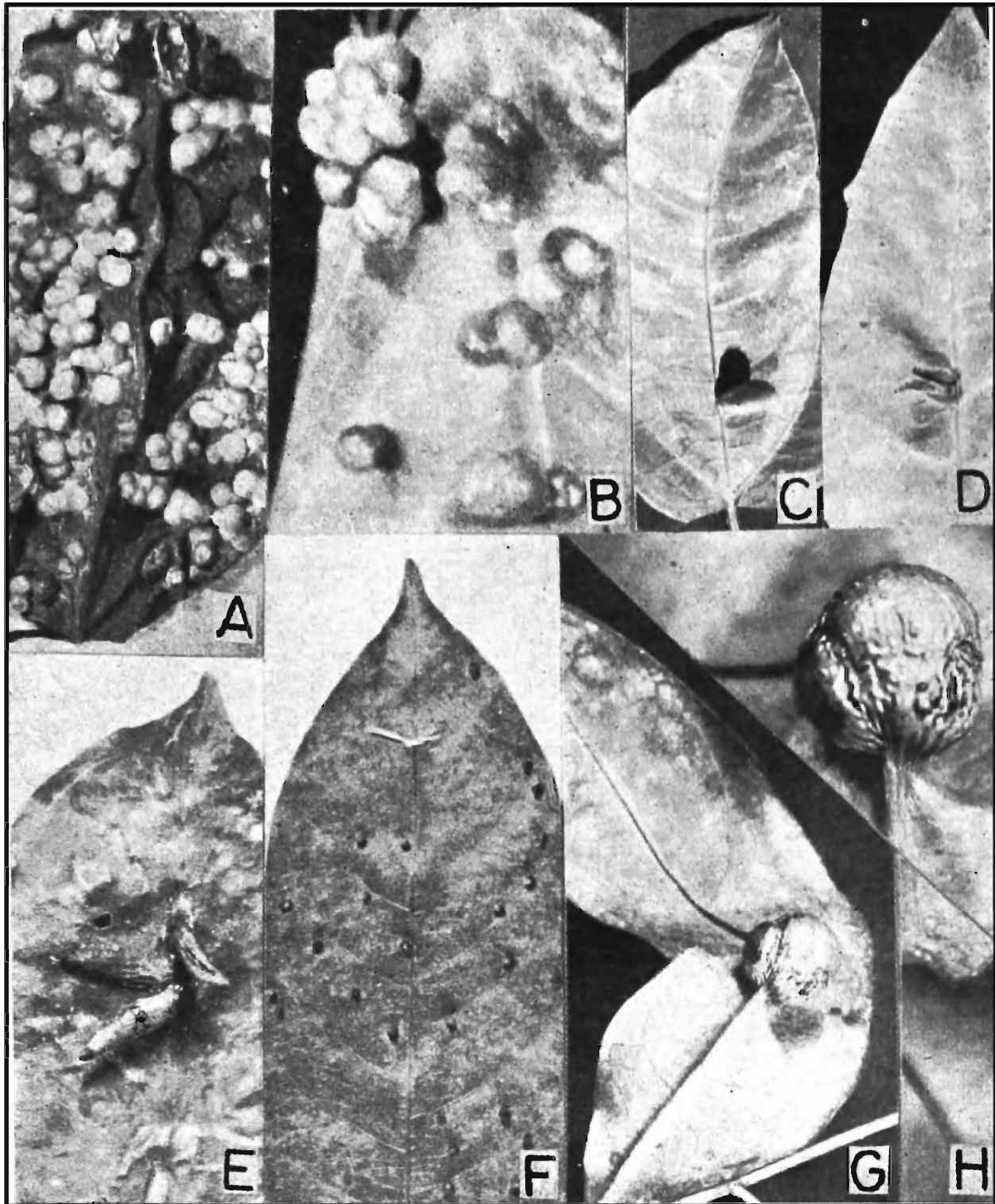
I am grateful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta and Dr. A. K. Das, Officer-in-Charge, Zoological Survey of India, Port Blair for encouragement and facilities. My sincere thanks are due to Shri M. K. Vasudeva Rao, Systematic Botanist, Botanical Survey of India, Port Blair for kindly identifying the host plants and critically going through the manuscript.

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SHARMA

PLATE XVIII



Leaf galls on : A. *Ficus nervosa* ; B. *Ficus recemosa* ; C. *Thunbergia laurifolia* (Upper surface) ; D. same (Under surface) ; E. *Gnetum acutum* ; F. *Dehaasia kurzii* ; G. *Phaeanthus andamanicus* ; H. Same enlarged view.

Bull. zool. Surv. India, 6 (1-3) : 325-326, 1984

A PRELIMINARY SURVEY OF SEA TURTLE OF THE ANDHRA COAST

VISAKHAPATNAM SEA COAST

Investigation about the sea turtle was carried out at the Lawson Bay, Waltair, one of the most important fish landing centre in Andhra Pradesh.

Though *Lepidochelys olivacea* Eschscholtz, commonly known as Olive Ridley, is the predominant species of the Waltair coast. There are instances of other three species of sea turtle being caught in the sea of Visakhapatnam or coming for nesting occasionally on the shore. These species are *Chelonia mydas agassizii* Bolour, *Eretmochelys imbricata* (Linn.) and *Dermochelys coriacea* (Linn.)

The coastal sea bed between Lawson Bay and Bimilipatnam is a very good pasture ground of Green Turtle, its bed being rocky sea algae or the turtle grass grow well. This sea algae is favorite food of green turtle. Occasionally Green turtle is caught in the nets of fishermen at Waltair coast though they seldom nest on the beach. This species is mainly insular in distribution. Such a male Green turtle was caught in December 1978. This specimen is being maintained at the Waltair Zoogarden in a cemented tank on the fresh algae food more than a year. One juvenile Hawkbill, *Eretmochelys imbricata* (carapace, 20.5 cm×15 cm., Plastron, 15.8×13.5 cm.) was collected from fishermen at the Lawson Bay. The specimen was caught in the net of a fishermen in the middle of November and it was kept alive more than two months in a small enclosure of stones on

the beach fed with small fishes. It was informed that one Hawkbill laid on this beach a clutch of hundred eggs on 1978.

The main turtle fishing season only of Olive Ridley in this area is November and December. In the peak period minimum 100 turtles are caught per day depending on number of boats operating during this period. Turtle fishing ends usually in 3rd week of January. Due to Government ban turtles are not at present booked by train to the Calcutta but by truck. Reliable information is that businessmen from Dumduma, a place in Koraput district of Orissa come to the Bay to purchase turtle.

It is known from a report of CMFRI (1979) that 23,282 kgs., was the estimated annual catch in that year from this area. No estimate of previous years are available.

INFORMATION FROM OTHER AREAS OF THE ANDHRA COAST

Information from Masulipatnam area shows that though turtles lay egg on sea shore between Peddopatanam & Samaldevi neither turtle fishing nor marketing is being carried out in this area. The reason is most of the fishermen of this area belong to "Agni Kula Kasthrya", a sect of Hindu religion who revered turtle as the representative of god.

Turtle also nest on beach from the Sriakulam area of Andhra Pradesh upto Gopalpur on sea of Orissa coast.

Some informations of turtle fishing in the Andhra coast bordering Ganjam district of Orissa during period of 1970 to 1973 were available. Some such places in the Srikakulum coast of Andhra are Kalingapatnam, Srikakulum, Balarampuram, and Kunduvanipata.

PROPOSAL FOR CONSERVATION OF SEATURTLE IN THE ANDHRA COAST

Winter season is the peak period of fishing in the Vizag coast when copulated turtles float on the surface of the sea. Therefore they become easy victim to the nylon drag nets (Biswas 1982). Fishing operation by trawlers should be carried out off the coast.

There is a good site in the Waltair zoogarden adjacent to the Lawson Bay for

starting a pilot project of Turtle Ranch or breeding centre as is in operation at Field Station of Surinam Forest Service to raise hatched sea turtle in captivity. (Marine turtle News letter No. 7, April, 1975.).

ACKNOWLEDGEMENTS

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Zoological Survey of India
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REPORT ON THE MARINE WOOD BORERS FROM THE MANGROVES
OF NEIL, HAVELOCK AND PEEL ISLANDS, RITCHIE'S
ARCHEPELAGO, ANDAMAN, INDIA

Ganapati and Rao (1960), Kalyansundaram and Ganti (1975), Karande (1978), Das and Roy (1980) and Tiwari *et al.*, (1980) have reported the occurrence of some marine wood borers from Andaman island, India. But their works on this group are solely based on the materials collected in and around Poart Blair, Baratang island (South Andaman), Bakultala and Mayabundar (Middle Andaman). In the course of a recent survey in the mangrove zones of Neil, Havelock and Peel islands, Ritchie's Archipelago, Andaman, 8 species of teredinid borers (Mollusca : Bivalvia) and 1 species of crustacean borer have been collected. These are being reported in the present communication as they constitute first records from Ritchie's Archipelago. All the teredinid borers were found to infest dead stumps and stilt roots of the mangroves while the crustacean borer was found to attack mostly the stilt roots of the live mangroves.

OBSERVATION

A. Tereidid borers

Family TEREDINIDAE

1. *Bactronophorus thoracites* (Gould)

Material : 3 exs., Peel Is., 15.vi.80 ; 9 exs., Havelock Is., 18 & 19.vi.80.

Distribution : India : Sundarbans ; Mahanadi estuary ; Visakhapatnam ; Vellar-Cole-

room estuary (Porto Novo) ; Bombay ; South Andaman (places around Port Blair and Baratang Is.) and Ritchie's Archipelago (present record).

Outside India : Indian Ocean islands ; Burma ; Malaysia ; Indonesia ; Australia ; New Zealand ; Pacific islands and Philippine islands.

2. *Dicyathifer manni* (Wright)

Material : 1 ex, Peel Is. ; 15.vi.80 ; 2 exs., Havelock Is., 18.vi.80.

Distribution : India : Sundarbans, Mahanadi estuary ; Visakhapatnam ; Madras Harbour, Pulicat Lake ; Cochin ; Mangalore ; Bombay ; South Andaman (places around Port Blair), Middle Andaman (Bakultala) and Ritchie's Archipelago (present record).

Outside India : Indo-Malay Archipelago, Australia, New Zealand, Pacific islands, Philippine islands and East coast of Africa.

3. *Lyrodus pedicellatus* (Quatrefages)

Material : 1 ex., Peel Is., 15.vi.80 ; 2 exs., Havelock Is., 17.vi.80 ; 8 exs., Neil Is., 25 & 26.vi.80.

Distribution : India : Mahanadi estuary ; Visakhapatnam ; Madras, Pamban ; Tondi and Adiramapatnam ; Tuticorin ; Kayamkulam ; Cochin, Mangalore, Karwar, Panaji, Ratnagiri, Bombay, Daman ; Veraval ; Okha ; Kandla ;

South Andaman (around Port Blair) and Ritchie's Archipelago (present record).

Outside India : Widely distributed in tropical and temperate seas.

4. *Nototeredo edax* (Hadley)

Material : 2 exs., Peel Is., 15.vi.80.

Distribution : India : Visakhapatnam ; Madras Harbour ; South Andaman (around Port Blair) and Ritchie's Archipelago (present record).

Outside India : Indian ocean islands ; Burma ; Malaysia ; Indonesia ; Australia ; New Zealand ; Pacific islands ; Philippine islands ; Japan and New Guinea.

5. *Nausitora hedleyi* Schepman

Material : 2 exs., Peel Is., 15.vi.80 ; 1 ex., Neil Is., 25.vi.80.

Distribution : India : Mahanadi estuary ; Madras Harbour ; Cochin ; South Andaman (around Port Blair), Middle Andaman (Bakultala) and Ritchie's Archipelago (present record).

Outside India : Indian Ocean islands, Burma ; Malaysia Indonesia and Pacific islands.

6. *Teredo furcifera* von Martens

Material : 1 ex., Peel Is., 15.vi.80.

Distribution : India : Visakhapatnam ; Godavari estuary ; Madras ; Pulicat lake ; Pamban ; Tuticorin ; Neendakara & Kayamkulam ; Cochin ; Bombay ; Daman ; Okha ; South Andaman (around Port Blair) and Ritchie's Archipelago (present record).

Outside India : Red Sea, ; Persian Gulf ; Indian Ocean islands, Pacific islands ; Hawaii and Midway, Indonesia and East Coast of South America.

7. *Bankia bipennata* (Turton)

Material : 6 exs. Peel Is., 15.vi.80.

Distribution : India : Visakhapatnam ; Madras, South Andaman (around Port Blair) ; Middle Andaman (Bakultala, Mayabunder) and Ritchie's Archipelago (present record).

Outside India : England ; Philippine Is. ; and Japan.

8. *Bankia rochi* Moll

Material : 3 exs., Peel Is., 15.vi.80 ; 2 exs., Havelock Is., 17.vi.80.

Distribution : India : Sundarbans, Middle Andamans (Bakultala) and Ritchie's Archipelago (present record).

Outside India : Java and Madagascar

B. Crustacean borer

Order ISOPODA

Family SPHAEROMIDAE Bate

9. *Sphaeroma terebrans* Bate

Material : 99 exs., Havelock Is., 7.vi.80 & 10.vi.80 ; 53 exs., Neil Is., 21.vi.80 & 24.vi.80.

Distribution : India : Kerala, Karnataka, South Andaman (around Port Blair) and Ritchie's Archipelago (present record).

Outside India : California ; Florida ; Congo ; South Africa ; Mozambique ; Zanzibar ; Mediterranean ; Sri Lanka ; Australia and New Zealand.

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Bull. zool. Surv. India, 6 (1-3) : 331-332, 1984

DEFENSIVE BEHAVIOUR OF THE HOUSE SHREW, *SUNCUS MURINUS* (LINNAEUS)
TOWARDS HOUSE CROW, *CORVUS SPLENDENS* VIEILLOT

The house crow, *Corvus splendens* Vieillot is a diurnal scavenging as well as a predatory bird. It is usually found that whenever live house mice and rats are released in open, attention of crows is drawn and they immediately attempt to pick them up to devour. The house shrew, *Suncus murinus* (Linnaeus), which is a nocturnal animal, leaves its abode, which is generally any hole in the ground near bushes, walls or pipes under trees and below stones, for foraging after nightfall. It has been recorded to be predated by the Barn Owl, *Tyto alba* (Scopoli) (Khajuria & Ghosal, 1970).

Practically no attempt has been made to study its interaction with a diurnal predatory bird like the house crow. The author had the opportunity of studying its behaviour towards the house crow.

A house shrew trapped in November, 1981 from Barisha, the south suburb of Calcutta, by using a wooden trap was released in the morning hours in a field to find its interaction with the house crow. The crow immediately came very close to the shrew and attempted to pick it up by holding its tail. The shrew at once turned towards the crow and opened its mouth emitting a deep whistling sound and jumped towards the crow to frighten it off. The crow withdrew a few steps back and then assisted by two other crows made another attempt but were not successful to either injure it or hold its

neck or tail due to the aggressive attitude of the shrew. The shrew was very agile and challenged the crow rushing to bite the birds. This continued for nearly 4-5 minutes until it was able to move towards a bush near about and hid itself under some weeds. The crows after a search of the area were unable to find their prey, gave up the attempt and moved out of the area. Thus, the house shrew escaped predation by the crows. To further study the interaction two shrews were released in the same situation the very next morning at about eight o'clock. The house crows were unable to kill either of them since one was observed to defend themselves by keeping back to back and fighting out the foes from whichever direction they attacked and moved to the shelter quickly only when they found a place to hide. The shrews in this case went under broken brick-chips. Pradhan (1980) observed that because of the extreme aggressive nature of the shrews irrespective of its size and smell they manage to keep all the rats (*Bandicota indica*, *Bandicota bengalensis*, *Rattus rattus*) at bay. The above observations confirmed that the house shrew is able to fend itself from diurnal predatory bird like the house crow by its sheer aggressive attitudes.

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AJOY KUMAR MANDAL

Bull. zool. Surv. India, 6 (1-3) : 333-334, 1984

AGGRESSIVE BEHAVIOUR OF THE HOUSE SHREW, *SUNCUS MURINUS* (LINNAEUS) TOWARDS DOMESTIC CAT

House rats and mice fall easy prey to Domestic Cat whenever they come across or are released from traps in front of cats in the open. Whereas the House Shrew, *Suncus murinus* (Linnaeus) which has been recorded to be predated by the Barn Owl, *Tyto alba* (Khajuria and Ghosal 1970), and it itself has the records of attacking frogs (Dharmakumar-sinhji 1946 ; McCann 1937 ; Vasu 1946), snake (Behura 1958), leeches (Sanjeeva Raj 1959), scorpions and cockroaches (Blandford 1888), but has practically no record of interaction with a predator like the Domestic Cat. The authors had the opportunity of studying its behaviour towards Domestic Cat which is recorded hereunder.

A House Shrew trapped on 8th May, 1982 from Rajchandrapur, District Haora, West Bengal, by using wooden trap was released in the morning hours in a field in front of a Domestic Cat to find their interaction. The cat immediately came very close to the Shrew and attempted to pick it up by holding its tail. The shrew at once turned towards the cat and opened its gape emitting a deep whistling sound and jumped towards the cat to frighten it off. The cat seemed to become nervous, withdrew a few steps back, and then made several attempts to catch it again but was not successful to either injure it or hold its neck or tail due to the aggressive attitude of the shrew. The shrew was very agile and challenged the cat rushing to bite

it. This continued for nearly 4-5 minutes till it was able to move towards a bush nearby and hid under some weeds. The cat after a search of the area failed to find its prey, and it gave up the attempt and moved out of the area. Thus, the House Shrew escaped predation by the Domestic Cat. To further study the interaction another shrew trapped from the same locality was released in the same situation next morning at about 7 hours. The Domestic cat was unable to kill it since the shrew defended itself in a similar manner to the shrew of the previous day, and only when it found a suitable hiding place it quickly took the shelter. The shrew in this case went under broken brick-chips. Pradhan (1980) observed that because of its aggressive nature, and irrespective of its size and smell, the House Shrew managed to keep all the rats (*Bandicota indica*, *Bandicota bengalensis*, *Rattus rattus*) at bay. The above observations confirmed that the House Shrew is able to fend for itself from predator like the Domestic Cat by its sheer aggressive attitude.

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Bull. zool. Surv. India, 6 (1-3) : 335-336, 1984

STUDIES ON THE LAND SNAIL *GLESSULA GEMMA* (REEVE) [MOLLUSCA : GASTROPODA]-I. GROWTH RATE

Bioecological aspects of some of the more common land snails have been worked out in recent years by Ghose (1963), Raut and Ghose (1980), Raut (1981), Rahman *et al* (1975), Masurekar and Bagalkote (1976) and Subba Rao *et al* (1981) etc. But *Glessula gemma* (Reeve), a common land snail of West Bengal, continues to be a very little known species. Its bioecological aspects have remained completely uninvestigated so far. An attempt is made to study the ecological aspects of this species and the findings on its growth-rate are presented here.

For the study of growth-rate, 10 newly hatched individuals were selected and were released in a terrarium measuring 30×20×20 cms. The other methods were followed after Subba Rao *et al* (1981). Growth-rate was ascertained from shell length, shell breadth and the number of whorls at the end of each week. The experiment was started on July 15, 1980 and continued up to October 21, 1980, when all snails died.*

Length of the shell of a newborn individual was between 1.7-2.77 with an average of 2.07 mm. (N=10). Breadth of the shell was

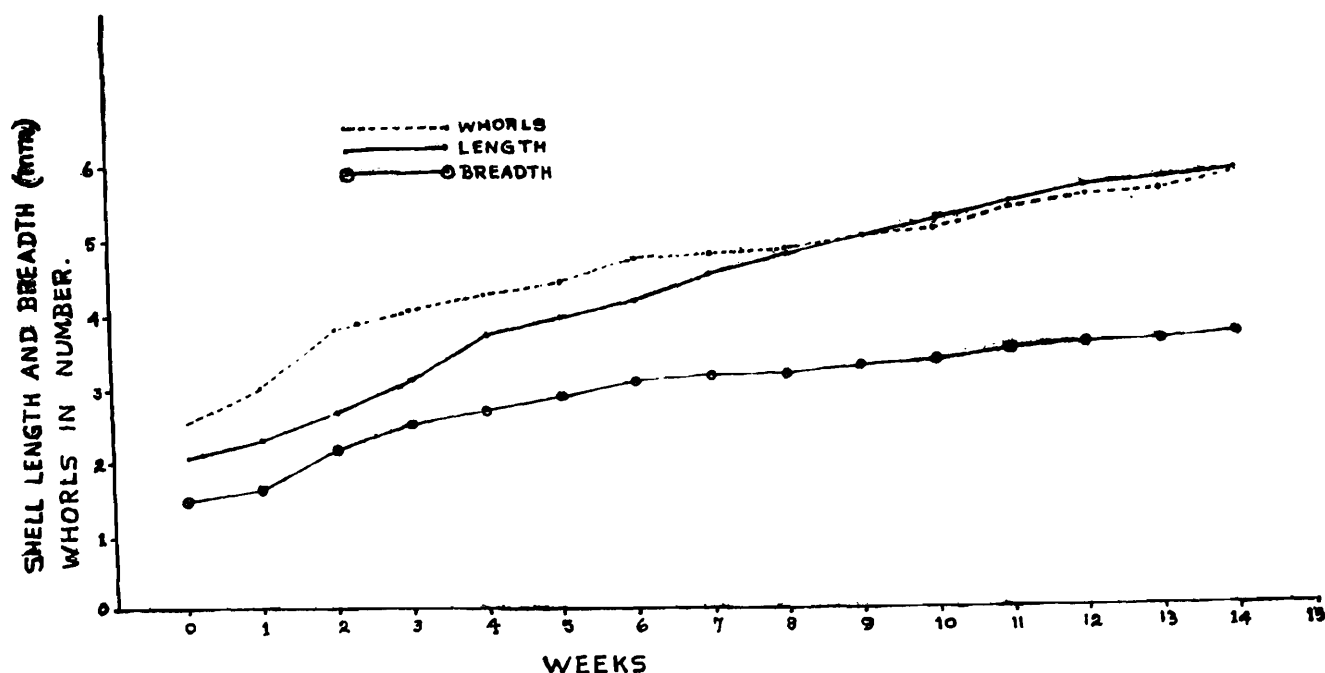


FIG. 1.

Fig. 1. Rates of growth in the shell length, breadth and the body whorl of *Glessula gemma*.

*It is not quite clear whether the snails died of age or not. However, the mean shell length of the snails at the time of death was above 6 mm, (average adult size) and one of the snails had produced a young one also.

1.32-1.87, on the average 1.52 mm. (N=10) and the number of whorls ranged between 2.1-3, on an average 2.5 (N=10). The growth, as evidenced, is a continuous process. However, the rate varied with the age. During the first week, the addition in length* and breadth was equal, i. e. 0.15 mm. for both, while the growth in whorl was 0.51. The maximum growth in length (0.6 mm.) was recorded in the 4th week, and those in breadth and in number of whorls, 0.51 mm. and 0.76, respectively were in 2nd week. Of the 10 individuals, 3 survived up to 98 days and at the end, the average length, breadth and whorl count were 6.35 mm., 4.05 mm. and 5.8 respectively (Fig. 1). Thus the total growth as recorded during the life span of 98 days for an individual was 3.78 mm., 2.03 mm. and 3.3, in length, breadth and and number of whorls respectively.

From the results of the present study on *G. gemma* and also from earlier reports on *Achatina fulica* (Rees, 1950 ; Ghose, 1963), *Ariophanta maderaspatana* (Masurekar and Bagalkote, 1976) and *Opeas gracile* (Subba Rao *et al*, 1981), it is clear that the rate of growth in land snails is faster in the first few weeks. This phenomenon may perhaps be associated with the attainment of early sexual maturity and their fight against adverse climatic conditions. Regarding other aspects, the possible reasons may be similar as discussed by Subba Rao *et al* (1981).

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A CASE OF HYALOMMA TICK INFESTATION IN MAN

Hyalomma ticks chiefly parasitise domestic animals and immature stages usually attack the same host as adults. The present note on the occurrence of a nymph of *Hyalomma anatolicum anatolicum* Koch, 1844-as far as the authors are aware is the first account of its incidence in man in India.

A nymph was encountered from a resident of Goghat, in the Hooghly district of West Bengal, who happens to attend cattle almost regularly. The nymph was found attached at the margin of the upper eye-lid amongst eye-lashes. The margin as well as the adjoining portion of the eye-lid was swollen and the man suffered pain and itching in addition to uneasy sensation.

The nymph, in general, agreed well with the description of *Hyalomma a. anatolicum* given by Singh and Dhanda (1965).

Hyalommas are known to be unusually efficient vectors of a variety of disease causing organisms including viruses and rickettsiae and may even cause paralysis in man and

animals (Hoogstraal, 1956, Kaiser and Hoogstraal, 1964). In view of these, the occurrence of *Hyalomma a. anatolicum* in man, appears to be a bio-medically significant host-parasite relationship.

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INFESTATION OF WHITEFLY *ALEUROCANTHUS RUGOSA* SINGH
(ALEYRODIDAE : INSECTA) IN BETEL VINE

Among the insect pests of betel crop the whitefly, *Aleurocanthus rugosa* Singh appears to be a serious menace to this premier agricultural crop in some parts of India. The present note describes the infestation of whiteflies and its impact on betel vine industry.

In a survey made since 1971 from over 500 'borojes' in the districts of Midnapore, Howrah, Hooghly, 24-Parganas and Nadia of West Bengal and Balasore district of Orissa it has been observed that *A. rugosa* initiate infesting betel leaves at the offset of winter in February, multiply throughout summer (March-May) and disappear by early monsoon i.e., in the middle of July each year. The flies choose to reside on the under surface of the sprouting tender leaves probably for concealment, protection and photosensitivity and have a peculiar habit of frequently raising their wings at an obtuse angle from the body. The females start ovipositing within 2-3 days following first attack. The eggs are laid irregularly on the underside of the leaf, preferably in depressions of the interveinular portions of lamina (Fig. 1); not on the ribs, petioles or stem body. The newly laid eggs are pale white but turn brownish yellow by next day. The length, breadth and stalk of the eggs measure 0.020, 0.07 and 0.032 mm respectively in February when temperature inside the 'boroj' ranges between 9.2°C (absolute minimum) to

27.3°C (absolute maximum) with a relative humidity of about 95% and were 0.218, 0.08 and 0.041 mm respectively in the summer brood (March-May) when temperature ranges between 18.3°C (absolute minimum) to 37°C (absolute maximum) and a relative humidity of 94%. The larvae are pale white which prior to the formation of pupal case become light brown. The pupal case is translucent white with a ting of golden yellow. On emergence the adult move to an unoccupied place of the lamina or, if crowded, to next sprouting leaves or migrate to a fresh plant.

The adults and the larvae freely excrete either on the same surface of the leaves on which they live or shed it on the leaves situated immediately below the one on which they are living. The adhered eggs, pupal cases and the excreta impose blocking up of the stomata to such an extent that may hinder the physiological activity of the host plant, eventually cause discolouration and scarring of leaves. These excrements further offer extremely suitable beds for the growth of fungi that spread over the leaf surface, eventually the growth of the plant becomes stunted. Both the adult and the larval white flies pierce particularly the vein and veinlets with their stylets which also causes considerable damage to leaves.

To make the infested leaves marketable a thorough washing of the leaves with the help of a piece of wet cloth, though removes the

adhered excreta, eggs, pupal cases and fungal hyphae, hardly serves the desired purpose of the growers. A good number of scars and/or overall sign of infestation could easily be noticed on the leaves and these infested betel leaves are highly susceptible to damage and decay during transport. A bad smell is also produced by these leaves even after thorough washing which add apathy towards chewing infested leaves by the betel chewers,

A perusal of literature indicates that Singh (1931) first recorded this pest species from a number of host plants viz. *Syzigium jambolanum*, *Psidium guajava*, *Michelia champaka* including betel (*Piper betel*) from Pusa of Bihar State. While David and Subramaniam (1976) listed some new host plants viz. *Anona* sp., *Polyathia longifolia* and *P. pendula* from Tamil Nadu (South India). However, further specific research on this insect pest is urgently needed.

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PLATE XIX



Betel leaf showing eggs and pupae of *A. rugosa* Singh

IN-VITRO DEVELOPMENT OF *DAPHNIA LUMHOLTZI* SARS
(CLADOCERA : DAPHNIIDAE)

The present communication deal with the embryonic development of the parthenogenetic eggs of the cladoceran, *Daphnia lumholtzi* Sars. This species is widely distributed in tropical and subtropical regions of Asia, Australia and Africa. From India, it has been so far reported from West Bengal, Bihar, Rajasthan, Tamil Nadu, Orissa and Andhra Pradesh.

The material for this study was collected from Ward's Lake, Shillong (Lat. 25°5' N ; Long. 91°9' E) with a plankton net of bolting silk (No. 25 ; mesh size 64 μ m). Several parthenogenetic females were sorted out from the field samples and were kept in glass troughs in the laboratory. Subsequently, two sets of 20 primiparous females each were reared individually, in the filtered lake water, at each of the mentioned temperatures. The eggs in one set were allowed to develop normally within the brood pouch of the mother and observed at frequent time intervals to record conspicuous morphological changes ; those developing in the second set were dissected out simultaneously and fixed in 4% formalin to study the different embryonic stages.

In the mature females, the parthenogenetic eggs were released about 30-35 minutes after ecdysis of the mother. As reported in *Daphnia magna* (Green, 1965) and *Daphnia carinata* (Murugan and Venkataraman, 1977 ; Venkataraman and Job, 1980), the embryonic development in *D. lumholtzi* could also be conveniently divided into eight stages. The details of the various stages were almost similar with that of *D. carinata* (Murugan and Venkataraman, loc. cit.).

The embryonic development, in *D. lumholtzi*, took 72 hours (range 64-78 hours) at 16°C and 60 hours (range 56-64 hours) at 20°C. With further increase in temperature to 28°C, the embryonic duration was reduced to 40 hours (range 38-42 hours). Thus the rise in the temperature exhibited an inverse co-relation with the duration of embryonic development. In this context, the durations of embryogenesis of various other species of *Daphnia* (as evident from the scattered literature) are compared in TABLE I.

TABLE 1. Embryonic durations in different species of *Daphnia*.

Species	Temp. (°C)	Embryonic duration (hrs.)	Remarks
<i>D. carinata</i>	15	181-189	Tropical
	28-33	28-30	
	35	23-25	
<i>D. magna</i>	15	117	Temperate
	22	70	
<i>D. hyalina</i>	5	394	Temperate
	10	195	
	15	102	
	20	70	
<i>D. galeata mendotae</i>	5	432	Temperate
	20	62	
<i>D. schodleri</i>	18	57	Temperate
<i>D. lumholtzi</i>	16	72	Present study
	20	60	
	28	40	

The presence of two embryonic membranes in the parthenogenetic eggs has been demonstrated in some members of Daphniidae (Obreshkove and Fraser, 1940 ; Murugan, 1977 ; Murugan and Sivaramakrishnan, 1973, 77 ; Murugan and Venkataraman, 1977). In *D. lumholtzi* also, the two membranes i.e., the outer thick egg membrane and the inner thin

naupliar membrane were noticed in the present study. Further, the egg membrane was cast off at the 4th stage and the naupliar membrane at the 6th stage.

Till the release of the embryos to the exterior, the caudal spine usually remained reflexed on the ventral side. It is believed that especially when the brood pouch was full, the embryos themselves exerted some pressure which, combined with the movement of the abdominal processes, enabled them to be released. However, when the embryos were few in numbers, probably due to low internal pressure, they straightened their caudal spines even while within the brood pouch which is likely to facilitate their release.

It was of interest to note the process of development of the characteristic, pointed anterior spine (helmet) in this daphnid. The head of the embryos remained more or less rounded till the 7th stage, elongated slightly in the early part of the 8th stage and the helmet was fully formed only when the embryos were ready for their release from the brood pouch of the mother.

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Bull. zool. Surv. India, 6 (1-3) : 343-344, 1984

**OCCURRENCE OF THE TAIL-LESS FRUIT BAT, *MEGAEROPS ECAUDATUS*
(TEMMINCK, 1837), IN NAMDAPHA, TIRAP DISTRICT, ARUNACHAL
PRADESH : AN ADDITION TO THE INDIAN FAUNA (MAMMALIA :
CHIROPTERA : PTEROPODIDAE)**

A mammalian collection made in the course of the faunistic survey in Namdapha, Tirap District, Arunachal Pradesh, India, during March-May 1981 by a team headed by Dr. Shyamrup Biswas, Zoologist, Zoological Survey of India, contains two specimens of the Tail-less Fruit Bat, *Megaerops ecaudatus* (Temminck, 1837), along with other mammals.

The Tail-less Fruit Bat, *Megaerops ecaudatus* (Temminck) is a member of the Cynopterine section of the family Pteropodidae, suborder Megachiroptera (Chiroptera : Mammalia). Its distribution, according to extant literature, ranges over Malay Peninsula, Sumatra, Borneo and to Annam (Andersen 1912, Walker *et al.* 1964, and Ellerman & Morrison-Scott 1966). In recent years it has been also recorded from Thailand (Hill & Thonglongya 1972). Hence, its occurrence in Namdapha, Tirap District, Arunachal Pradesh, India is of much academic interest.

Material : 2 ♀ (one stuffed dry skin & skull, and the other wet in alcohol), collected from Gibbonsland, c. 16 km east of Miao, Namdapha, Tirap District, Arunachal Pradesh, India, by Dr. Shyamrup Biswas, on 30 April 1981.

Measurements : Head & body 84, 90 ; Forearm 59.6, 62.7 ; Ear 18.5, 19 ; Tibia

25.5, 26 ; Foot & claw 14.5, 15 ; Wing span —, 424.

These bats were trapped in Japanese Nylon Mist Nets set amidst thick foliages between half-a-metre and two metres above the ground, near a small stream. In the same area and in the same set of nets other species of fruit bats belonging to the genera *Cynopterus*, *Sphaerias* and *Macroglossus* were also trapped.

Since the detailed report on the Namdapha Survey Collection will be dealt with in a separate comprehensive account and will take some more time to appear, the opportunity is taken here to register the new record which is an addition of a genus and a species of fruit bat to the list of fauna of India, Mammalia.

I thank the Director, Zoological Survey of India, for the facilities enabling me to carry out this work. I acknowledge my thanks to Dr. Shyamrup Biswas and Shri Nemai Charan Gayen, with whom I shared my pains and pleasures in course of the Namdapha Survey. I am also thankful to Dr. V. C. Agrawal and Shri P. K. Das for valuable suggestions in the preparation of this communication.

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