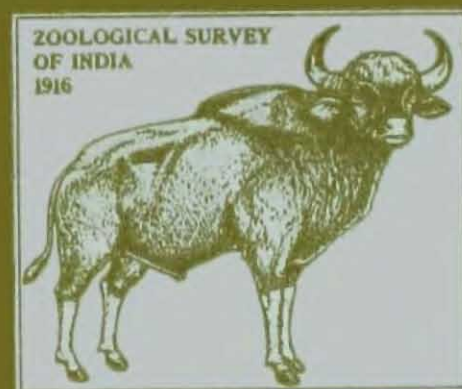


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OF INDIA



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CHROMOSOMES OF FOUR SPECIES OF APHIDS (HOMOPTERA : APHIDIDAE)

P. P. KULKARNI AND R. K. KACKER

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ABSTRACT

Chromosomes of four species of aphids viz. *Aphis gossypii* Glover ($2n=8$); *Aphis craccivora* Koch. ($2n=8$); *Lipaphis erysimi* Kalt. ($2n=10$) and *Greenidea* (*Trichosiphum*) *formosana* (Maki) ($2n=18$) were studied and their morphometric analysis was carried out.

INTRODUCTION

Chromosomes of aphids have attracted the attention of cytologists from as early as 1905 (Stevens 1905, 1909; Morgan, 1909). The first detailed account on aphid chromosomes, with emphasis on their evolutionary significance was given by Shinji (1931). Handling of aphid chromosomes posed a considerable problem. Many efforts were made to devise the suitable methodology and evaluate their phylogenetic significance (Colling 1955; Dionne and Spicer 1957). Recently Rou Yen Sen & Robinson (1966) attempted to study the chromosomes of fifty species of aphids and their possible application in systematics of Aphidoidea.

Behura (1978) enumerated work on Indian species. We have studied the chromosomes in the embryos from apterous viviparous females of four species of aphids, namely, *Aphis gossypii* Glover; *Aphis craccivora* Koch; *Lipaphis erysimi* Kalt. and *Greenidea* (*Trichosiphum*) *formosana* (Maki).

MATERIAL AND METHODS

Only apterous viviparous females were

used in our studies. Their details are given in Table 1.

The embryos were dissected out in 0.67% NaCl and were treated with 0.56% KCl for 2-3 minutes and finally fixed in 1:3 aceto-alcohol for nearly an hour. The embryos were kept in 50% acetic acid till they became soft and then were squashed on albuminized slides. The slides were kept in the vapours of 50% acetic acid over night at 5°C. The following day, the slides were brought to room temperature and immersed in 1:3 aceto-alcohol for one hour. Cover slips were removed carefully. The slides were air dried for 6 hours. Staining was done in 2% giemsa.

OBSERVATIONS AND REMARKS

Diploid number in *Aphis gossypii* Glover & *Aphis craccivora* Koch were observed to be $2n=8$ (Pl. I A & B). This confirms to the earlier observations of Behura (1978). *Lipaphis erysimi* Kalt. and *Greenidea* (*Trichosiphum*) *formosana* (Maki) have $2n=10$ and 18 respectively (Pl. I C & D).

TABLE 1

Sr. No.	Name of the species	Host	Date of Collection	Locality
1.	<i>Aphis gossypii</i> Glover	<i>Solanum melongena</i>	8. 8.1977	Baruipur, 24-Parganas
2.	<i>Aphis craccivora</i> Koch	<i>Cassia festula</i>	22. 7.1977	Science College Campus Ballygunge, Calcutta
3.	<i>Lipaphis erysimi</i> Kalt	<i>Brassica oleracea</i>	16.11.1977	Barrackpur, 24-Parganas
4.	<i>Greenidea</i> (<i>Trichosiphum</i>) <i>formosana</i> (Maki)	<i>Psidium guajava</i>	8.11.1977	Rantara, 24-Parganas

TABLE 2. Relative percentage length of autosomal pairs

Sr. No.	Name of the species	Autosomal pair nos.			
		1	2	3	4
1.	<i>Aphis gossypii</i> Glover	33.85	27.03	23.94	15.02
2.	<i>Aphis craccivora</i> Koch.	30.72	28.06	24.42	17.09

All these species are chromosomally distinct. The two congeneric species of *Aphis* having similar diploid number ($2n=8$) show difference in the relative percentage lengths of their pair numbers 1 and 4 (Pl. IE.). The mean relative percentage lengths of their pairs are given in Table 2:

ACKNOWLEDGEMENTS

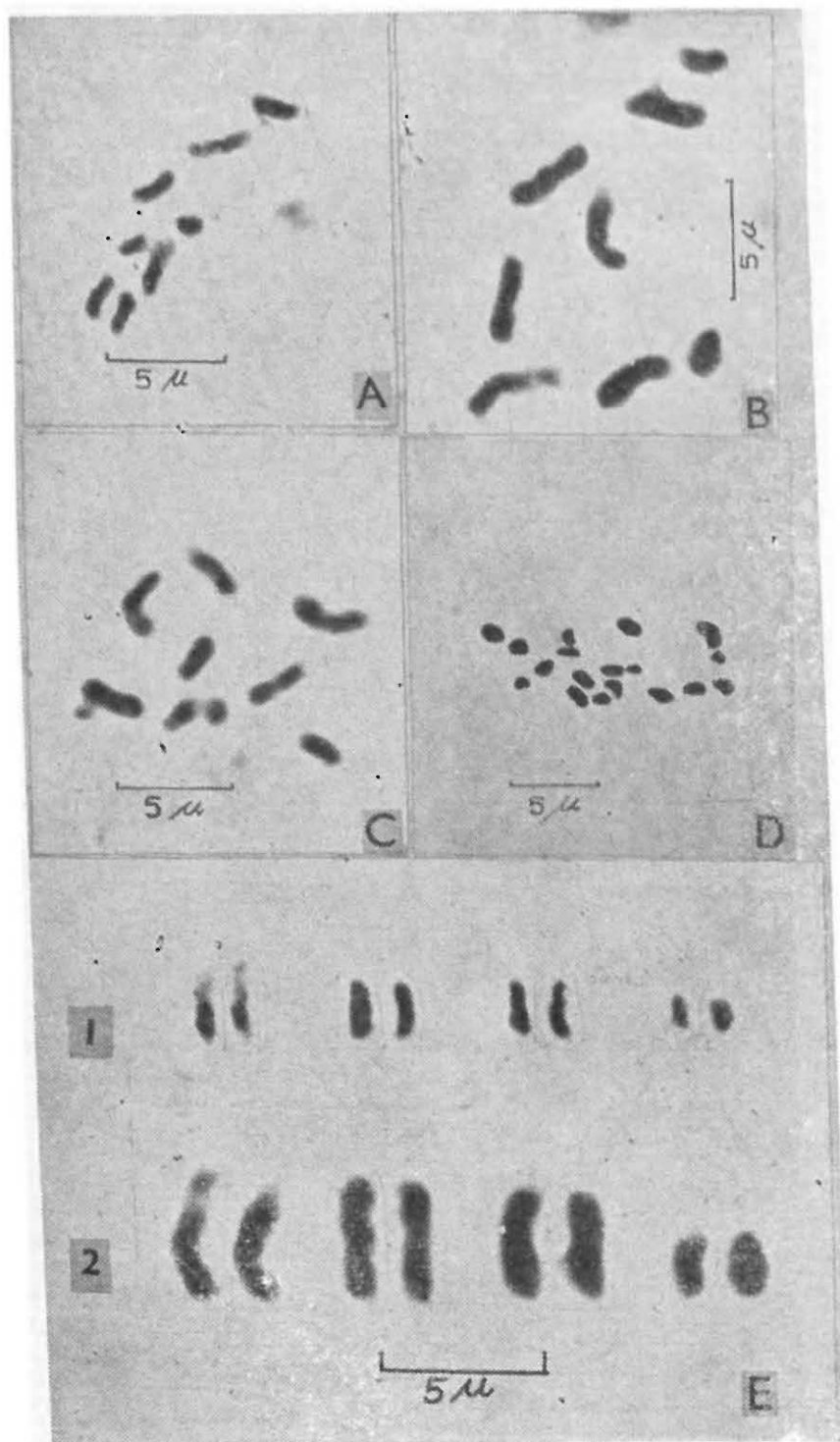
The authors are indebted to the Director, Zoological Survey of India, for the laboratory facilities and constant encouragement. Thanks are also due to Mr. L. K. Ghosh, for the collection of the species *Greenidea* (*Trichosiphum*) *formosana* (Maki).

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KULKARNI & KACKER

PLATE I



A—*Aphis gossypii* Glover. ($2n=8$), B—*Aphis craccivora* Koch. ($2n=8$), C—*Lipaphis erysimi* Kalt. ($2n=10$), D—*Greenidea*. (*Trichosiphum*) *formosana* Tak. ($2n=18$) (Camera lucida drawing), E—Karyotypes: 1—*Aphis gossypii* Glover; 2—*Aphis craccivora* Koch.

**EFFECT OF MILD FUMIGATION ON THE PATTERN OF EGG LAYING AND
ADULT EMERGENCE IN THE RICE MOTH, *CORCYRA CEPHALONICA*
(STANTON) (LEPIDOPTERA).**

G. JOSHI

Zoological Survey of India, Calcutta.

ABSTRACT

Observations on the effect of mild fumigation on the gravid females during egg laying and on the eggs produced by the fumigated females of the rice moth, *Corcyra cephalonica* (Stainton) are noted. Seven to ten percent of the emerging adults displayed deformities in the nature of atrophied or curled wing and underdevelopment of its antennae and limbs.

The Rice moth, *Corcyra cephalonica* (Stainton) was first described in 1866. Chittenden (1919) mentioned that as regards work and injury the moth resembles *Ephes-
ta cautella* Walk., its related species and *Plodia interpunctella* Hbn. It was observed that the caterpillars of *Corcyra*, which feed and live mainly in and around dried-vegetable products, are by far most destructive. The species is present at times in practically all the warehouses where grains, seeds and dry fruits are handled or stored.

Information concerning different aspects of the species has been published from time to time. Mukherjee (1971) recorded *Reduvius* sp. as predatory to *C. cephalonica*, which could share in the biological control of the latter. Joshi (1976) while working on the moth noted that the larvae had a special liking to feed from towards the plane surface of the pulse-halves.

fumigatory effect on gravid females during egg deposition and also on the eggs produced in consequence.

MATERIALS, METHODS AND RESULTS

A sample of pulse-halves of *Cajanus indicus* Sprengl. which was infested by the rice moth, was collected from the local Kidderpore market, from a retailer. The inedible product comprised of larvae, their faecal granules, cocoons with pupae and dead adults. A rich pure culture of the moths was prepared by 'inoculating' forty-one active and healthy larvae to some fresh, dry and uninfested pulse-halves of *C. indicus*. The implanting of small larvae to the food was made through and on cotton-wool. The entire rearing was brought in the specifically designed, wooden sleeve cage (Pl. II A).

This paper is intended to account for the

The fumigant chosen for these trials was

a mixture of benzene and toluene in a quantitative relation of 1.5 : 1 (v/v), respectively. It may be mentioned that the selection of the fumigant was rather arbitrary and was to acquire knowledge about the cumulative after-effects, if any, of the two compounds.

Twenty three egg bearing females which had just started egg laying, were tried at different occasions depending upon the availability of such females.

These moths were confined in covered petri dishes (diameter 12.5 cm), one at a time, and were exposed to the fumigant from five to twenty five seconds, sometimes more to make sure that they fall unconscious sans apparent movement. Data on the dosage of the fumigant, applied as only droplets could not be taken. Loss of sensibility was almost always immediate followed after a feeble to strong flutter of wings. Fresh air was immediately provided to the moths and all the traces of the fumigant were withdrawn from the bounded enclosure. The moths regained a semi-conscious state, steadily, in degrees except in three instances, when they died. The live moths were turned ventral side upwards in their petri dishes to observe the egg laying which was little or more symbolic or distinctly clear in all the cases. The females appeared spasmodic and the egg production subnormal, simultaneous to frequent abdominal pulsating gestures. Perfect incoherence from standard pattern of egg laying was observed a number of times when the eggs came out in the form of a

continuous string, joined end to end and made moniliform. Conforming to type, otherwise the eggs are laid singly, in isolation with inermittent pauses. The strings, as noted, were straight in the beginning but with the addition of eggs they became looped and twisted, and in one of the instances it looked like an incomplete '8' (Pl. II B). The fumigated females could seldom release the eggs approximating to the three-quarters of their total fecundity and died. This was made certain by the abdomens of a number of dead females, where stranded eggs were evident.

The egg-strings and the isolated eggs which were successfully laid were transferred by means of soft and fine brushes to small covered petri dishes (diameter 8cm), lined with round, smooth and glossy-black papers. Here the eggs were mildly treated with the fumigant for a short time (30 seconds max.) depending upon the number of eggs. Immediately after, all the fumigant traces were removed once again and the eggs transferred to clean, covered petri dishes of the same size. Care was taken that only fumes should come in contact with the living stages (females and the eggs) in both the treatments.

Regular observations were made on the eggs which were in good shape, with entire and wrinkle-free margins. Hatching was restricted to nearly 70% of the eggs and the rest got crumpled and finally decayed. The newly hatched larvae were provided with fresh, uninfested pulse-halves as food. Perio-

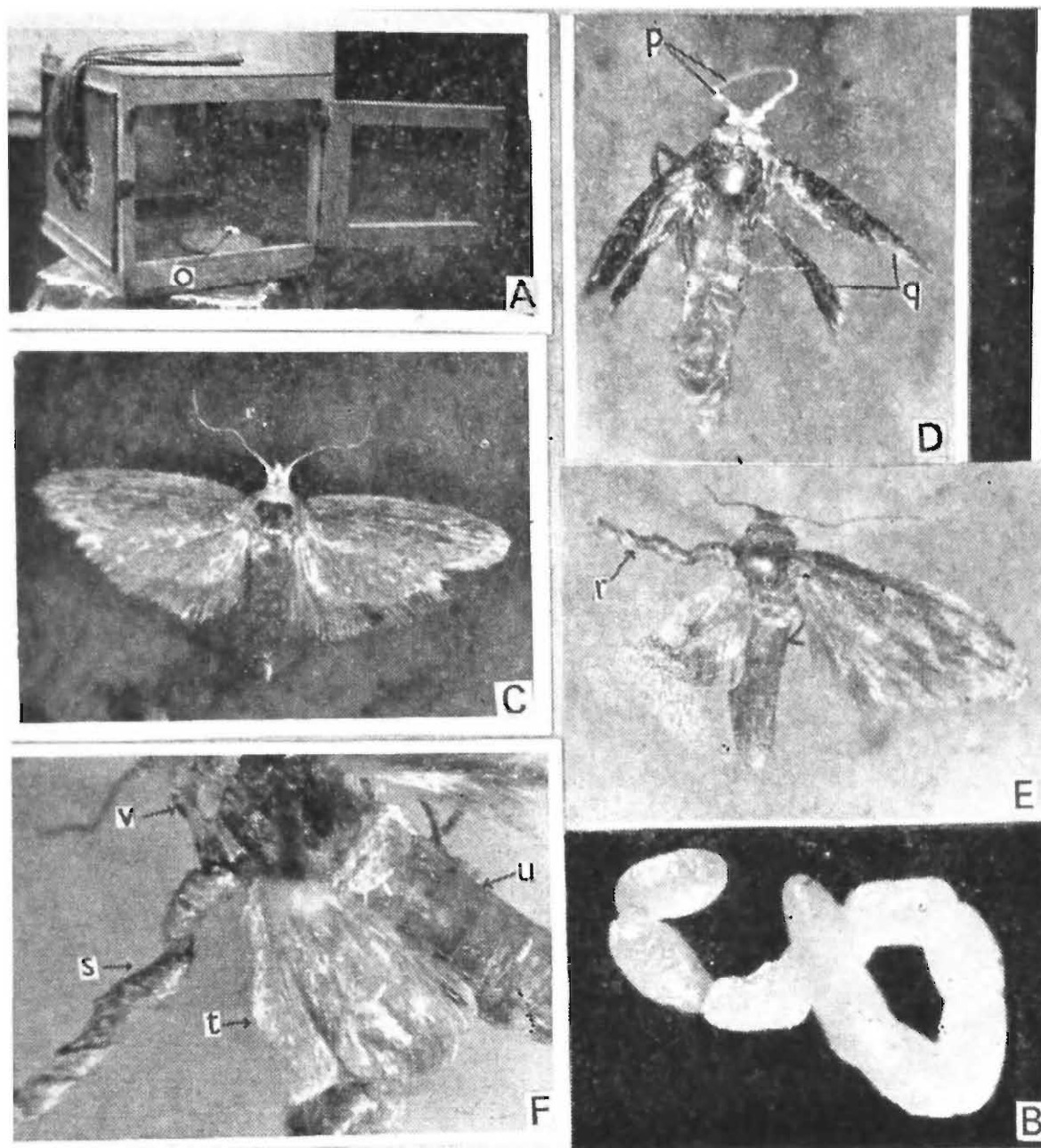
-
- (a) Benzene (Crystallizable)

Boiling range (95%)	79-81°C
Freezing point	4-6°C
Wt./ml. at 20°C	0.875-0.879 gm.
Non-volatile matter	0.002% max.
 - (b) Toluene

Boiling range	110-111°C
Non-volatile matter	0.0025%

JOSHI

PLATE II



A. Wooden sheave cage, o-Cotton wool; B. Eggs (10) 'beaded' in a string; C. Well-built and symmetrical 'female moth that laid eggs; D. p-Antennae reduced, q-Wings strophied; E. r-Forewing in permanent torsion; F. Spreading of hind wing (t) is repressed by the twisting of the forewing (s). u-Abdomen, v-Eye.

dical observations were made on the immature stages.

The larvae moulted and pupated almost as scheduled, as usual but the pigment of just moulted larvae and pupae was seemingly chalky white at different occasions, instead of being pale. The emerging adults were collected in spacious glass jars and were permitted unrestricted flights. It was here that some structural discrepancy in 7 to 10% moths as against their proportionate and balanced parents (Pl. II C) was noticed in the form of atrophied or curled wings and in the underdevelopment of antennae and limbs (Pl. II D & E). In four specimens the curling of the forewing effected the stretching of the hind wing of the same side (Pl. II F). Such ill-formed moths could not fly for obvious reasons but in general, undertook short leaps and / or moves to bring about locomotion.

Nevertheless, they were observed to mate with their healthy counterparts, lay fertile eggs and add to their colony.

ACKNOWLEDGEMENT

Thanks are due to the Director, Zoological Survey of India, Calcutta for providing laboratory facilities.

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**DISTRIBUTION AND POPULATION OF TWO PESTIFEROUS LAND SNAILS,
ACHATINA FULICA BOWDICH AND *MACROCHLAMYS INDICA*
GODWIN-AUSTEN, IN WEST BENGAL**

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ABSTRACT

Studies on the distribution and population status of *Achatina fulica* Bowdich and *Macrochlamys indica* Godwin-Austen have been made from West Bengal. Population density of the snails was estimated by counting the snails from five different square metre areas of the infested pocket and the mean was considered for actual population per square metre area. The snails are found abundant in the districts of lower and North Bengal. In West Bengal, *A. fulica* predominates except in Calcutta and Coochbihar districts where density of *A. fulica* and *M. indica* is nearly equal. In heavily infested pockets 18-32 *A. fulica* and 22-34 *M. indica* has been recorded. Of the sixteen districts Purulia is free from both the species of snail. Bioecological factors in relation to distribution and population density have been discussed. The variation in the size of snail population in different districts is directly related with the climatic conditions of the areas.

INTRODUCTION

Since its introduction in 1847 in Calcutta, West Bengal, no study on the distribution and population of the giant African land snail *Achatina fulica* Bowdich has yet been made. *Macrochlamys indica* Godwin-Austen, a native of India has also registered its name as an agri-horticultural pest but no report is available on its status and distribution. Both the species of snails are a menace to agri-horticulture in West Bengal as well as in other States of the Indian Union.

In West Bengal there are six well defined

seasons—summer (from the middle of April to the middle of June), rainy (from the middle of June to the middle of August), autumn (from the middle of August to the middle of October), dewy (from the middle of October to the middle of December), winter (from the middle of December to the middle of February) and spring (from the middle of February to the middle of April). However, each season may overlap to some extent with the other.

MATERIALS AND METHODS

While surveying the distribution and present status of *A. fulica* and *M. indica* in West

engal attention was given to estimating the opulation density of these snails. In each ifested area 5 gardens were selected at ndom and 5 sites from each garden were nsidered for study, irrespective of snail opulations. From each of such selected tes snails present in a square meter area ounted during evening, between 6—30 to —00 P.M., when almost all the snails in the arden became active and usually found to rawl on the ground for feeding. The mean

of such five reading from one garden was considered as the actual snails present in the garden in a square meter area. Accordingly, the mean of the readings from five gardens was considered as the actual snail population present per square meter area of the infested pocket. Only living snails were counted.

OBSERVATIONS

Distribution : Survey on the distribution

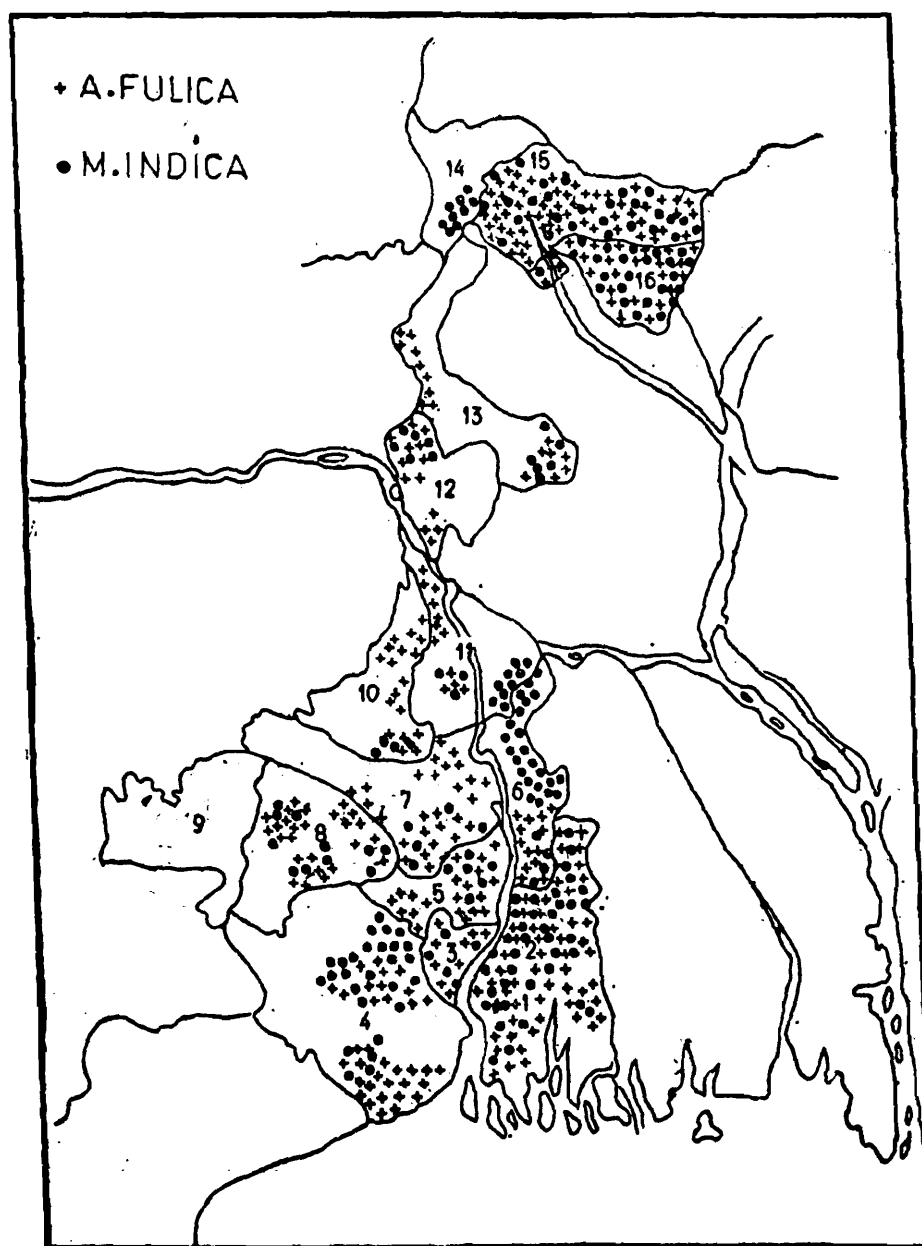


Fig. 1. Map of West Bengal showing distribution of *Achatina fulica* and *Macrochlamys indica*.
 1=24-Parganas, 2=Calcutta, 3=Howrah, 4=Midnapore, 5=Hooghly, 6=Nadia, 7=Burdwan,
 8=Bankura, 9=Purulia, 10=Birbhum, 11=Murshidabad, 12=Malda, 13=West Dinajpur,
 14=Darjeeling, 15=Jalpaiguri, 16=Coochbihar.

of *A. fulica* and *M. indica* in all the 16 districts reveals that *A. fulica* are present and widely distributed in 14 districts (Fig. 1). They have not been found so far in Purulia and Darjeeling districts. *M. indica* have a similar distribution but they have been able to establish themselves in the Siliguri sub-divisions of Darjeeling district. So far Purulia district is devoid of *M. indica*.

species of snails are found, while in some areas either *A. fulica* or *M. indica* are present. The Contai sub-division of Midnapore district, Sainthia of Birbhum and Katoa of Burdwan are inhabited by *A. fulica* only. On the contrary, the northern half of Nadia district is *M. indica* dominated. Both the species of the snails on the whole, are equally common in wild and cultivated areas.

In most of the infested areas both the

Population : Density of snail population

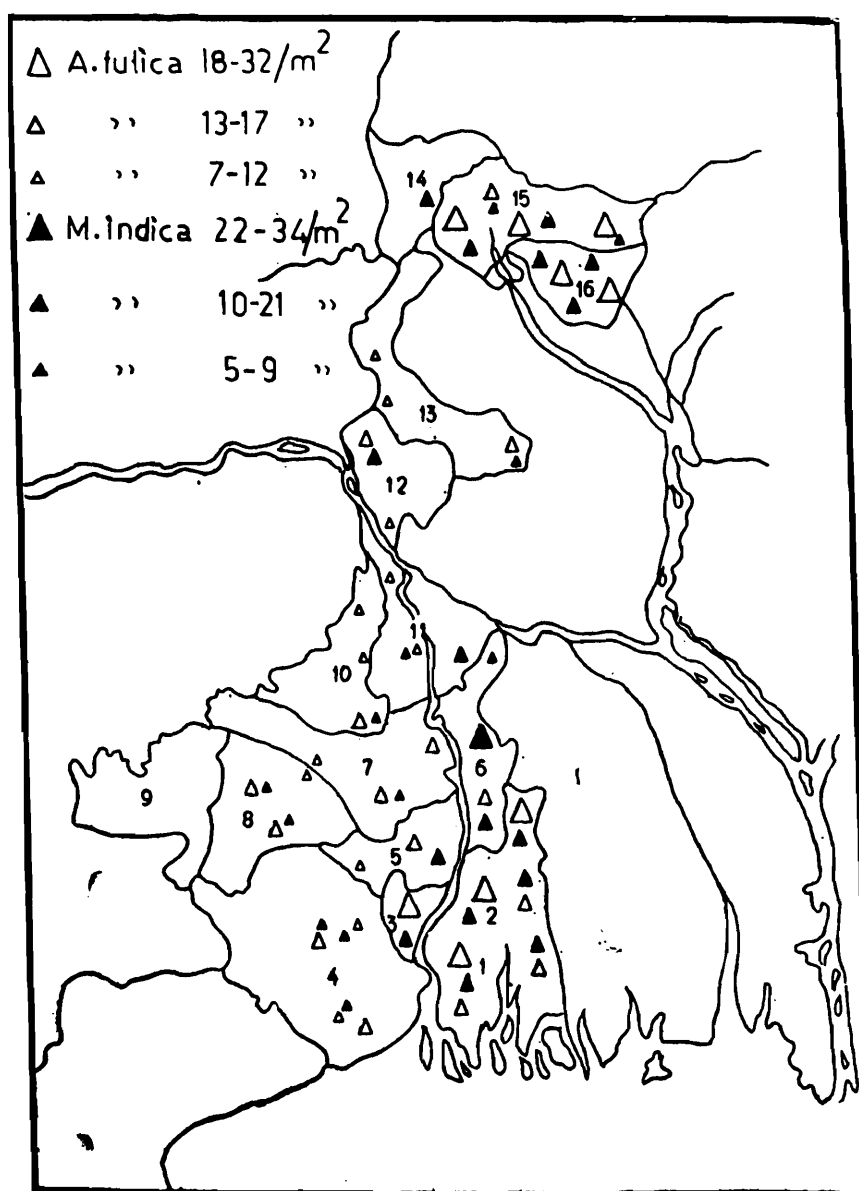


Fig. 2. Map showing population density of *Achatina fulica* and *Macrochlamys indica* in different infested pockets of the State of West Bengal. (For explanations (1-16) see Fig. 1)

in both the species showed a wide range of variation from one infested pocket to another. It is noteworthy that in west Bengal *A. fulica* predominates except in Calcutta and Coochbihar districts where density of *A. fulica* and *M. indica* population is nearly equal (Fig. 2). The maximum *A. fulica* population has been recorded from the districts—Calcutta, Howrah, 24-Parganas, West Dinajpur,

Malda, Jalpaiguri Coochbihar. In heavily infested areas of these districts *A. fulica* were counted 18–32 in a square meter area with an average 25 snails. Minimum population was 7–12 with an average, 9 snails per square meter in the sparsely populated areas of the same districts. However, population is medium to low in the districts—Birbhum and Murshidabad. *M. indica* is

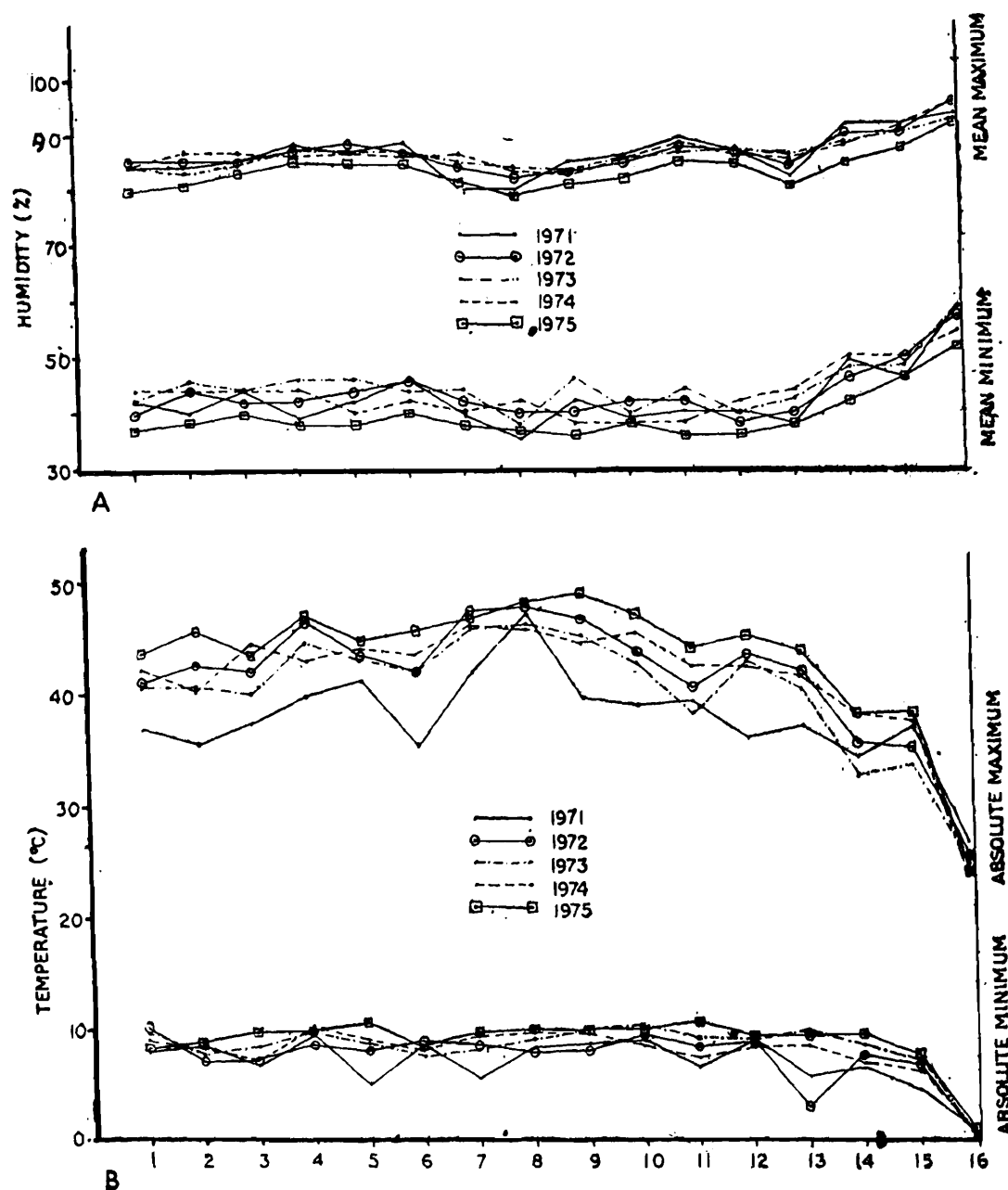


Fig. 3A. The temperature figures, the absolute maximum and the absolute minimum temperature (°C) for the 16 districts of West Bengal in the five years, 1971 to 1975.

3B. The mean relative humidity figures in percentages for the 16 districts of West Bengal in the five years, 1971 to 1975. (For names of districts (1-16) see Fig. 1.)

maximum in the northern part of Nadia, the number was 31 per square meter area. In other parts of the State West Bengal *A. fulica* is 7-16 in a square meter while it is 11-24 for *M. indica*. (Fig. 3 A)

Bioecological factors in relation to snail population and distribution : Population density of both *A. fulica* and *M. indica* exhibits variations from district to district, and even from one locality to another in the same district. It is rather common that snails are present in considerable number in one part, but completely absent in other part of the same district.

Physical and biotic factors of all the districts of West Bengal were considered to ascertain their role on the survival and multiplication of the snails. Information on soil was obtained from Mukherjee (1974). Data on the temperature, rainfall and humidity were supplied partly by the meteorological stations of the Government of India.

Soil : There are eight distinct groups of soil in West Bengal (Table I). In general, towards the south West Bengal, the maximum area is covered either by Gangetic alluvium or Vindya alluvium while it is mainly Terai and Testa alluvium in the north West

TABLE 1. The types and nature of soil in West Bengal (district wise)

District	Types of soil	Nature of soil		
		Acid (%)	Normal (%)	Alkaline (%)
Calcutta	Gangetic alluvium ; Coastal.	47	53	—
Howrah	Gangetic alluvium ; Coastal.	36	63	1
Hooghly	Gangetic alluvium ; Vindya alluvium.	56	44	—
Burdwan	Gangetic alluvium ; Vindya alluvium Laterite ; Gravelly (Western part).	69	31	—
Midnapore	Vindya alluvium ; Coastal ; Laterite ; Red ; Gravelly.	64	36	—
24-Parganas	Gangetic alluvium (North and South) ; Coastal.	27	71	2
Bankura	Vindya alluvium ; Laterite ; Red.	65	35	—
Purulia	Vindya alluvium ; Red ; Gravelly.	68	32	—
Birbhum	Vindya alluvium ; Laterite ; Red ; Gravelly (Western part).	82	18	—
Murshidabad	Gangetic alluvium ; Vindya alluvium (Western part)	25	74	1
Nadia	Gangetic alluvium.	28	70	2
Malda	Gangetic alluvium ; Red.	36	63	1
West Dinajpur	Terai and Testa alluvium (Only Islampur sub-division) ; Red.	75	25	—
Jalpaiguri	Terai and Testa alluvium	73	27	—
Coochbihar	Terai and Testa alluvium.	82	18	—
Darjeeling	Terai and Testa alluvium (Only Siliguri sub division) Brown forest.	92	8	—

Bengal districts. A peculiar soil character has been recorded in the districts—Purulia, Bankura, Birbhum and the western part of Midnapore, where laterite, red and gravelly groups of soil are found. Only a few pockets of the districts Birbhum and Bankura contain the Vindya alluvium.

In West Bengal, the soil is either acidic or normal (Table I). Acid soil prevails in the districts—Darjeeling, Jalpaiguri, Burdwan, Midnapore, Bankura, Purulia and Birbhum while the soil is mostly normal in Murshidabad, Malda and Howrah districts. Alkaline soil is practically absent in West Bengal.

Vegetation : It is rather rich in lower and north West Bengal. Both wild and cultivated vegetables are almost similar in lower West Bengal, viz., Calcutta, 24-Parganas, Hooghly,

Howrah and part of Nadia and Midnapore district and in north West Bengal viz., Jalpaiguri and Coochbihar district. Contrast to this, vegetation is rather poor and restricted to some areas only in rest of the districts of the State.

Temperature : Range of temperature is rather wide in West Bengal (Fig. 3A), the lowest is recorded from Darjeeling district and highest from Purulia and Birbhum districts. The temperature range 20—30°C encouraging land snail population prevails in Calcutta, 24-Parganas, part of Howrah and Nadia, Jalpaiguri and Coochbihar, and population density in these districts is considerably higher than that in the rest of West Bengal.

Rainfall : The rainfall is highest in

TABLE 2. Average rainfall (mm) in different districts of West Bengal during the period 1971-1975

District	1971	1972	1973	1974	1975
Calcutta	2201.2	1966.6	1909.0	1864.2	1970.4
Howrah	2379.5	1367.4	2083.1	2240.8	1741.4
Hooghly	1900.0	1741.5	1805.0	1445.3	2105.0
Burdwan	2045.2	1407.2	1631.7	1704.4	1931.0
Midnapore	2060.3	1681.0	1478.4	1905.4	2207.2
24-Parganas	2621.5	2905.2	1968.0	2305.4	2281.9
Bankura	1868.0	1154.3	1601.4	1360.1	1465.1
Purulia	1789.5	943.1	1468.7	1001.6	1106.4
Birbhum	2043.8	1040.6	1610.5	1469.7	1421.2
Murshidabad	2769.2	2069.2	1915.4	1805.9	1701.4
Nadia	1682.9	1942.4	1508.2	1771.5	1626.1
Malda	1611.6	1040.5	1609.2	1711.4	1321.6
West Dinajpur	1989.0	1054.2	2065.4	1400.0	1700.0
Jalpaiguri	2870.0	2736.6	2264.1	2961.3	2884.6
Coochbihar	3221.2	2667.3	2960.6	2114.0	3040.0
Darjeeling	3436.1	2206.0	3442.4	3540.2	3345.5

Darjeeling while Jalpaiguri and Coochbihar districts are next in order (Table 2.). Rainfall is minimum in Purulia district. It has been observed that rainfall is sometimes continuous in Darjeeling district and most of the areas of the Siliguri sub-division remain under water for a considerable period during rains. The rainfall occurs mainly in monsoon months for a period of 3-5 months from June to October (including pre and post-monsoon months).

A number of districts usually face a long dry spell with no rainfall for a period of 5-8 months (Table 3) during winter and summer—the period when the snails take their aestivating shelter.

Humidity : It is almost similar in all the

districts during monsoon, but varies considerably in other seasons of the year (Fig. 3B). The overall annual range of mean maximum and mean minimum humidity is apparently not significant in different district of West Bengal though this range is comparatively lower in Purulia district. But it is interesting to note that there exists a considerable degree of variability in humidity percent in different seasons except in monsoon.

Natural enemies : A number of predators viz. rat (*Bandicota indica*), birds (*Dendrocitta vagabunda*, *Centropus sinensis*) and planaria (*Bipalium indica*) and parasites—nematodes, some ciliates and microbes have been recorded. A leucodermia-like disease has also been observed (Raut and Ghose, 1977). Rat and planaria are equally effective in lowering the

TABLE 3. The period of dry spell in different districts of West Bengal during the period 1971-1975 (months indicate the period of dry spell, '—' indicates no dry spell period).

District	1971	1972	1973	1974	1975
Calcutta	—	—	—	—	—
Howrah	—	November to March	—	—	—
Hoogly	—	November to March	—	November to May	—
Burdwan	—	December to April	—	—	—
Midnapore	—	November to April	November to May	—	—
24-Parganas	—	—	—	—	—
Bankura	—	October to April	—	November to May	—
Purulia	—	October to June	—	November to April	—
Birbhum	—	November to June	—	—	—
Murshidabad	—	—	—	—	November to March
Nadia	—	—	—	November to April	—
Malda	—	November to May	—	—	November to March
West Dinajpur	—	November to June	—	—	—
Jalpaiguri	—	—	—	—	—
Coochbihar	—	—	—	—	—
Darjeeling	—	—	—	—	—

population of *A. fulica*. Rats are found in all the districts of West Bengal and their effectiveness in controlling the giant snail population has been studied (Raut and Ghose, 1978 In Press), while the role of planarians in monitoring the giant snail population is also encouraging (Raut and Ghose, 1978 In Press).

In general, it is estimated that around 14% of the *A. fulica* population is being controlled by the predators and parasites.

DISCUSSION

From the study of distribution of *Achatina fulica* and *Macrochlamys indica* it is evident that the ecological conditions for their establishment and survival are most favourable in all the district other than purulia and Darjeeling (except Siliguri Sub-division). The variation in population density in both the species from district to district is probably due to a number of factors—biotic and abiotic.

As the snail population is maximum in the districts Jalpaiguri, Coochbihar and 24-Parganas, it is very likely that the snails preferred alluvium soil most. But they are also well established in some areas of a number of districts having only the coastal group of soil. The absence of both the species from areas with laterite, red and gravelly group of soils suggests that the soils imposed certain limiting factors for the snail's distribution. It is, probably, due to the fact that the laterite, red and gravelly group of soil become rather hot in sunny summer days and are incapable of retaining moisture. On the other hand, alluvium groups of soil can absorb and retain moisture, thereby suitable for luxuriant growth of vegetations, and offered a humid environment to the animals living there.

Distribution in respect to the pH of the soil clearly pointed out that acid soil has got

no impact on the distribution of snails. They can thrive equally both in acid and normal soil. The role of alkaline soil on distribution of the snail species under observation can not be ascertained as there is no alkaline soil in the State.

Vegetation is one of the most important factors for the distribution and multiplication of animals. But in case of *A. fulica* and *M. indica*, vegetation does not appear to interfere much in the distribution as these snails have been found to establish themselves in a number of wild areas also, suggesting a wide range of food (plants) acceptability.

The influence of temperature on the distribution of snails is, however, significant. From the present study it can safely be concluded that the snails may establish in any part of West Bengal other than the hilly regions of Darjeeling. At present, *M. indica* is thriving successfully in the plains of Darjeeling (Siliguri sub-division). The ecological condition of Siliguri and Jalpaiguri are similar, but *A. fulica* is not found in Siliguri while both the species are available in large numbers in Jalpaiguri. This clearly suggests that *A. fulica* will find a new home at Siliguri in near future. But it may not be possible for both the species to establish in any other part of the Darjeeling district as the night temperature in those parts generally falls below 12°C during September–October while in other months it is below 8°C. The snails, being nocturnal are unable to withstand such temperatures. The absence of both the species from Purulia does not suggest that these snails will not survive there, because, inspite of almost similar temperature range, both the species of snails are still thriving well in the district town of Bankura and Midnapore, at Joypur of Bankura, Sainthia and Santiniketan of Birbhum and Calcutta also. Usually, these pockets are used to face an adverse climatic conditions (higher temperature 39°C–46.8°C)

similar to Purulia and Jhargram sub-division of Midnapore but still large number of snails are living there. This indicates that the snails can tolerate higher temperature. In fine, it may be concluded that such a higher temperature (upto 47°C) is not a limiting factor.

Humidity is the prime need for terrestrial animals and it is chiefly regulated by the rainfall, temperature and the velocity of the wind. From the collected data on rainfall it has been observed that there is a great variation in rainfall from district to district which has got a tremendous impact in maintaining the moisture of the soil and atmospheric humidity. As the population is variable with the amount of rainfall it indicates that the distribution and multiplication of both the species are dependent on it. Rainfall is higher in the districts—Coochbihar, Jalpaiguri and 24-Parganas and accordingly the snail population is higher—a direct relation with the size of the population and amount of rainfall would ensue.

However, inspite of nearly similar climate and vegetation, with fair chances of distribution the absence of *A. fulica* (if ever introduced) and less number of *M. indica* in the Siliguri sub-division of Darjeeling district are presumably due to higher rainfall and consequent inundation of most of the areas during rainy season. The ability of *M. indica* to stay at high places and even laying eggs there perhaps help them to survive in such areas (Raut, 1977)

The variation in the size of snail-population in different districts presumably due to the variance in the climatic conditions prevailed in the district concerned. Monsoon is the breeding season of *A. fulica* and *M. indica* and presumably it has no impact on the mass mortality of the snails. It appears to be influenced by the length of

dry spell with which the snails are subjected. The snails in all the districts used to overcome an adverse climatic condition (such as long dry spell) from November to June by undergoing aestivation. During this period a large number of snails usually die due to drying up and dehydration. From the collected data it appears that all the districts other than Jalpaiguri, Coochbihar, Darjeeling and 24-Parganas had to overcome a long dry spell for a period of 5-8 months at a stretch either once or twice during the last five years, 1971-75. This might have resulted in higher mortality during aestivation in other districts. The present study, thus, lends support to the contention of Raut and Ghose (1978) that "the longer the dry spell the higher the mortality rate".

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STUDIES ON THE HAEMATOZOA OF SOME CATFISHES BELONGING TO THE GENUS *MYSTUS* SCOPOLI FROM INDIA.

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ABSTRACT

A study on the haematozoa of fishes belonging to the genus *Mystus* Scopoli has been made. As a result two new species viz. *Trypanosoma bengalensis* sp. nov. from *M. bleekeri* and *Cryptobia indica* sp. nov. from *M. vittatus* have been described. A *Dactylosoma* sp. has also been described along with the redescription of *T. vittati* Tandon and Joshi, 1973 from *M. vittatus*. While describing the new species their affinities with the allied species have been discussed. Moreover, a comment on the host specificity of these haemoflagellates have been made.

INTRODUCTION

The present paper is the fifth instalment of the series and deals with the haematozoa of Indian fishes of commercial importance. It includes the description of the parasites harbouring in the different species of the genus *Mystus* Scopoli. In total 38 species are known in the genus *Mystus* of which, 13 are found in India. In this part of this country 6 commercially important species viz., *M. bleekeri* (Day), *M. cavasius* (Hamilton), *M. gulio* (Hamilton), *M. tengara* (Hamilton), *M. vittatus* (Bloch), and *M. menoda* (Hamilton) are readily available, and were examined for the blood parasites. Previously from this genus, only *Mystus vittatus* was reported to harbour a blood parasite viz. *T. vittati* Tandon and Joshi, 1973.

During the course of investigation one new species of *Trypanosoma* from *M. bleekeri*, one new species of *Cryptobia* from *M. vittatus* have

been described. In addition, a comment on *T. vittati* Tandon and Joshi, 1973 have been made after obtaining the specimen from *M. vittatus* along with the redescription of the parasite. Moreover, a *Dactylosoma* sp. has also been reported from *M. vittatus* which constitute the new host-parasite record. The type materials will be deposited to Zoological Survey of India, Calcutta.

MATERIAL AND METHODS

The fishes were brought alive from different markets of Calcutta and kept in the Laboratory for examination. The blood smears were normally taken after puncturing the branchial blood vessels. Wright, Leishman and 'Giemsa's stains were used for routine staining. In case of positivity, some organ smears have been prepared and subsequently examined for further observations. But except in the peripheral blood of the host no where the parasites were possible to trace.

About 40 examples of *M. vittatus*, 30 examples of *M. cavasius*, 30 examples of *M. bleekeri*, 60 examples of *M. gulio*, 5 examples of *M. menoda* and 10 examples of *M. tangra* have been examined. Of which, only 4 examples of *M. vittatus* were harbouring *T. vittati*, one was harbouring a *Dactylosoma* sp. and 3 were found to be infected with a cryptobian in the blood. Four examples of *M. bleekeri* was positive for trypanosome. Infections in the individual fish were found to be moderate. While conducting routine examination, each slide was observed until all the parasites were located and in each instance about 50 individuals were measured. No parasitemia has been observed in any of the infected individuals reported herein.

OBSERVATION

Trypanosoma bengalensis sp. nov.

Fig. 1. A—E

Type Host : *Mystus bleekeri*

Locality - Canning, W. Bengal, India.

Site of Infection : Blood.

Vector and life cycle : Unknown.

Registration No. Holotype pt. 1896

Paratype pt. 1897

DESCRIPTION

The organism is monomorphic, elongated and attenuated at both ends. The configuration generally varies from C to S. Length of the cell body 14.00—17.5 μ m (mean 15.5 μ m), length of the free flagellum 8.5—12.5 μ m (mean 10.5 μ m); distance from anterior end of the body to the anterior end of the nucleus 5.5—8.5 μ m (mean 7.5 μ m), length of the nucleus 2.00—3.00 μ m (mean 2.5 μ m); width of the nucleus 0.5 μ m; distance from posterior end of the nucleus to the Kinetoplast 4.5—5.5 μ m (mean 5.00 μ m); diameter of the Kinetoplast 0.5 μ m—1.00 μ m (mean 0.75 μ m); distance from Kinetoplast

to the posterior tip 1—1.5 μ m (mean 1.10 μ m), width of the undulating membrane 0.5 μ m; maximum width of the cell body 1.5—2.00 μ m (mean 1.75 μ m).

Cytoplasm : Granular, the granules are arranged along the border opposite to undulating membrane. The matrix of the body cytoplasm stains light blue. Two large vacuoles are found at both extremities of the nucleus.

Nucleus : Elongated, almost bean-shaped, homogenous, placed centrally; sometimes slightly shifted a little towards the posterior end. It never occupies the entire width of the body.

Kinetoplast : Round, stains deep appearing as dark blue. Normally it does not extend the width of the body where it is situated.

Flagellum and undulating membrane : The flagellum arises from the kinetoplast and trails along the border of the undulating membrane and extends beyond the body as free flagellum. The undulating membrane stains light blue having 3—7 folds. The flagellum is very weak, appears very faint when stained with Leishman, which generally gives very good result for staining the flagella of the blood inhabiting forms.

Diagnosis : The trypanosome is monomorphic, measuring 26.00 μ m in total length with a considerable amount of volutin granules in the cytoplasm, concentrated more at the portion anterior to nucleus. Nucleus bean-shaped, generally provided with a vacuolated area at each end. Kinetoplast round, normally does not exceed beyond the width of the body where it is situated. Undulating membrane prominent bordered by a thin flagellum having 3—7 folds.

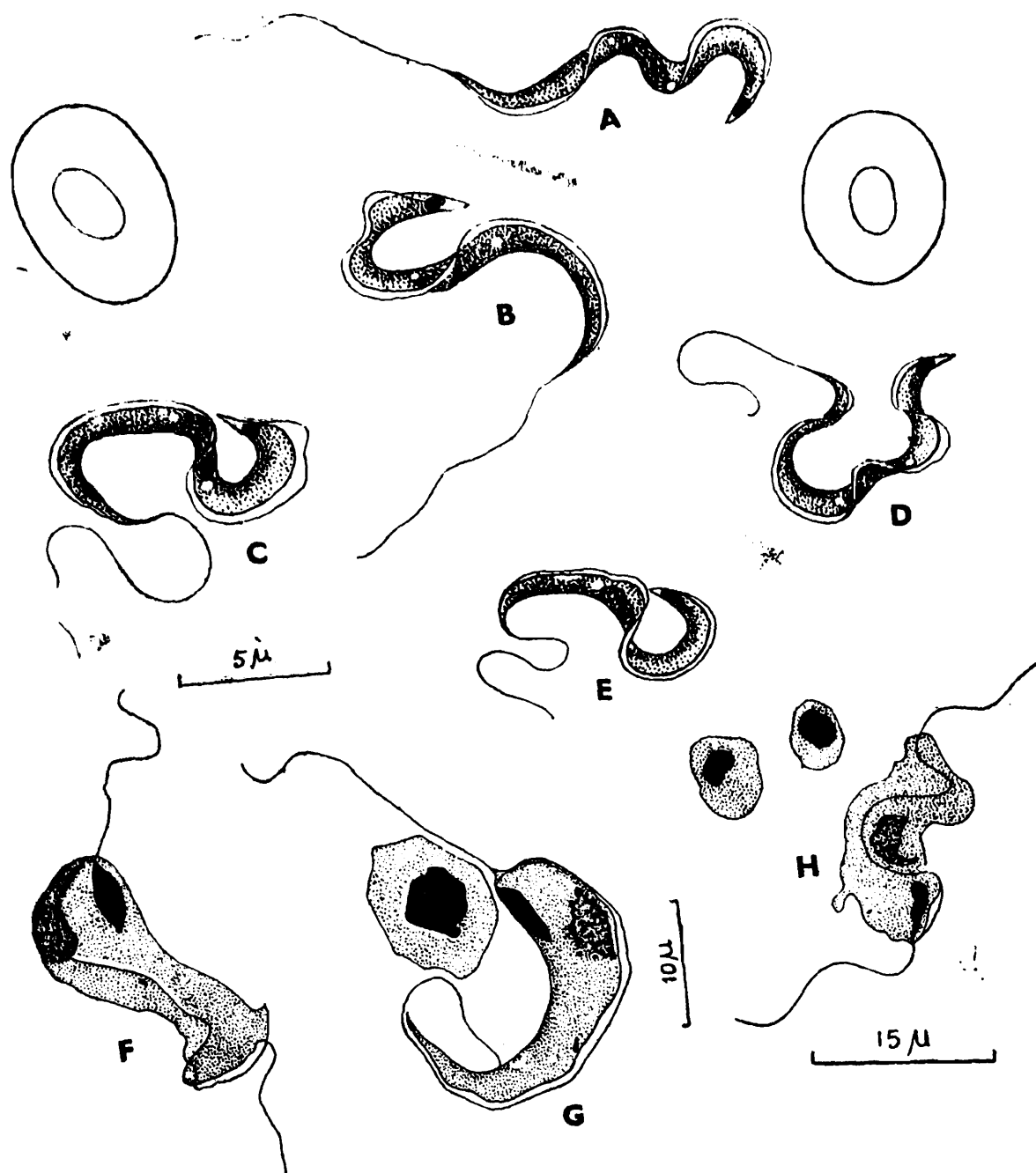


Fig. A—E—*Trypanosoma bengalensis* sp. nov. from *Mystus bleekeri*, F—H—*Cryptobia indica* sp. nov. from *Mystus vittatus*

Remarks : Due to its monomorphic nature, the present species resembles *T. batrachi* Qadri, 1962, *T. punctati* Hassan and Qasim, 1962, *T. denileswkyi saccobranchi* Qadri, 1962, *T. parcali* Mandal, 1975, *T. chaudhuryi*

Mandal, 1977, *T. anabasi* Mandal (In press) and *T. canicli* Mandal (In press).

It differs from all the species due to the possession of very thin flagellum bordering

the prominent undulating membrane having 3—7 folds. Present species also resembles *T. denileswkyi* due to the presence of vacuolated areas at both extremities of the nucleus but differs in having the nucleus almost at the middle of the body whereas in the latter it is shifted towards the posterior region. The present species also comes close to *T. cancelli* due to thin flagellum but differs in size of the body. The species under consideration is smaller than *T. cancelli* 18.5—28.5 μm Vs 14.00—17.5 μm / mean 30 μm Vs 26 μm]. Therefore it is evident that the present species is unique in having a thin flagellum, extending the 3/4th of the length of the body as free end and described as *T. bengalensis* sp. nov.

***Cryptobia indica* sp. nov.**

Fig. 1 F—H

Type Host : *Mystus vittatus*

Locality : Champahati, 24-Parganas, West Bengal, India.

Site of Infection : Blood.

Registration Number...Holotype pt. 1898
Paratype pt. 1899

DESCRIPTION

In the living condition the parasite appears like a thick form having 2 flagella, one trails along the margin of the body and other is placed at the anterior end. It is monomorphic, broad, more or less sickle-shaped, measuring 25.00—30.00 μm in length (mean 28.5 μm) and 6.00—10.5 μm in width (mean 8.0 μm). The cytoplasm stains faint blue having fine granules all over the body less so at the posterior region. The nucleus is just opposite to the kinetoplast almost situated anteriorly, reniform or ovoidal in shape, depending apparently on the distortion of specimens. The nucleus measures 5.00—8.5 μm in length (mean 7.5 μm) and 2.5—3.5 μm in width (mean 3.00 μm) and loosely

packed with large irregular chromatic mass. The kinetoplast large, oblong or reniform measuring 5.00—6.00 μm in length (mean 5.5 μm) and 0.75 μm —2.00 μm in width (mean 1.5 μm), situated close to the ventral surface towards the anterior end and stained densely pink with Leishman or Wright Stain. In most of the specimens, the kinetoplast lies opposite to the nucleus but sometimes it is seen close to each other. The anterior flagellum measures 21.00—30.00 μm in length (mean 25.00 μm) and the posterior one trails along the margin of the body, forms an undulating membrane measuring 0.25 μm wide and the flagellum then extends as free terminal portion measuring 9.00—12.00 μm (mean 10.5 μm).

Diagnosis : The parasite is broad, measuring 25.00—30.5 μm in length and 6—10.5 μm in width. Nucleus anteriorly placed, just opposite to kinetoplast, reniform or ovoidal in shape measuring 5.00—8.5 μm in length and 2.5—3.5 μm in width. Kinetoplast large situated close to ventral surface towards anterior end. Anterior flagellum large 21.00—30.00 μm in length and the posterior one extends as free portion of 9.00—12.00 μm in length.

Remarks : While discussing the haematozoa of fishes with emphasis on North American records, Becker (1970) has stated clearly about the difficulties in describing the new species of *Cryptobia*. Putz (1972) has brought forward almost similar opinion for describing a species. The taxonomic position of this organism has further vividly been narrated by Becker (1977). Mandal (1978) has discussed about the occurrence of this organism in *Mystus vittatus* from this part of the globe.

From the available literature it appears that most of the species described (about 30 from fresh water fishes) can be broadly

placed under two valid species viz. *C. borrelli* Laveran and Mensnil, 1902 and *C. salmonistica* Katz, 1951. Accordingly a table (Table 1) has been prepared showing the comparative morphometric variations of the present species along with those 2 species and *C. cataractae*, another species, inhabiting the blood of fresh water fishes. It indicates that the species, reported here in though resembles in shape and other characters like the position of the Kinetoplast and nucleus, with *C. borrelli* and *C. salmonistica* but differs from them in having the large size of the body as well as the possession of large anterior flagellum.

**Trypanosoma vittati Tandon and
Joshi, 1973
Pl. III C.**

Host : *Mystus vittatus*.

Locality : Taldi, West Bengal, India.

Tandon and Joshi, 1973 described *T. vittati* after obtaining a *Trypanosoma* from *Mystus vittatus*. It is described as polymorphic viz. large and small.

The species encountered by the present author is identified as *T. vittati* but it is monomorphic. The size range varies as indicated in Table 2, which further substitute

Table 1. Showing the comparative morphometric parameters of the species described and the allied species in micron and mean shown in parenthesis.

	Body Length	Body Width	Length of ant. flagellum	Length of post. flagellum	Length / width of Nucleus	Length / width of Kinetoplast
1. <i>Cryptobia indica</i> sp. nov.	25-30.5 (28.5)	6-10.5 (8.5)	21-30 (25.00)	9-12 (10.5)	7.5/5	5/1.5
2. <i>C. borrelli</i> Laveran & Mesnil, 1901	20-25	3-4	..	..	..	..
3. <i>C. salmositica</i> Katz, 1951	14.9	2.46	16.05	8.96	1.5/3.5	4.58/0.78
4. <i>C. cataractae</i> Putz, 1972	14.7-18.9 (17.)	1.54-2.2 (2)	9.6-13.2	..	..	5-6/1.75-2.00

The large size of the body along with long free end of the trailing flagellum and anterior flagellum are unique to the species dealt with. Therefore it is described here as new and named as *Cryptobia indica* sp. nov.

the fact that there is no definite large or small forms as stated earlier but it is monomorphic with some variations in size.

Therefore, the species as such requires

Table 2. Showing the different measurements of *T. vittati* in micron with mean in parenthesis.

1. Length of the cell body 20-35.5, (25.5)
2. Length of the free flagellum 8.5-14.00 (12.5)
3. Distance from ant. end of the body to the anterior end of the nucleus 9.5-12.5 (10.5)
4. Length of the nucleus 2-4.5 (3.00)
5. Width of the nucleus .7-1.4 (1.2)
6. Distance from post. end of the nucleus to Kinetoplast. .8.5-11.5 (9.00)
7. Length/width of the Kinetoplast 1.5
8. Distance from Kinetoplast to the post. tip 2.00-3.00 (2.25)
9. Width of the undulating membrane .5-1.5

redescription and described as "Monomorphic, configuration varies from C to S. Body cytoplasm uniformly granular, a little dense towards the portion anterior to the nucleus. Sometimes a few stray small vacuoles are seen throughout the body. Nucleus bean-shaped almost situated at the middle densely compact with chromatin materials, occasionally a clear area is visible at both extremities of the nucleus. The nucleus does not cover the entire width of the body in any of the specimen observed. Kinetoplast almost round and always stains deep. Undulating membrane distinct clearly outlined, can be differentiated easily from the body cytoplasm and bordered by the thick flagellum throughout the entire length of the body. The flagellum extends as free portion and beautifully stained with Romanowsky type of stain."

Remarks : Robertson (1908) described *T. vittatae* after obtaining a trypanosome from Ceylon tortoise. Without aware of this fact, Tandon and Joshi (1973) described *T. vittati* from *Mystus vittatus*. Though in pronunciation of the specific names both appear same but their spelling is different. According to the International code of zoological

nomenclature both the names can run side by side and treated as valid.

Dactylosoma sp.
(Pl. III A & B)

Host : *Mystus vittatus*

Locality : Taldi, West Bengal, India.

Intraerythritically an organism with granular cytoplasm and a clear nucleus was observed in the one host out of 40 examined. It is placed under the genus *Dactylosoma* Labbe, 1894. The merozoites are 5 in number arranged in the form of fan-shape. Some nuclear divisions have also been observed in the preparation. The specific determination will be made subject to the availability of some more materials.

DISCUSSION

All the 6 species of *Mystus* examined are the inhabitant of the fresh water bodies except *M. gulio* which is found in estuarine water. However, all the materials used for the present study particularly the 4 species, viz. *M. vittatus*, *M. cavasius*, *M. bleekeri* and *M. gulio* were procured from the fresh water bodies of lower Bengal.

In total, 175 examples of fishes were examined and 11 were found to be infected (about 6.2%). Only in one occasion, the double infection of blood parasites, viz. *T. vittati* and a species of *Dactylosoma* were found in *M. vittatus*. Mention may be made that *M. vittatus* is the only species to harbour 3 different types of blood inhabiting forms, viz. *Trypanosoma*, *Cryptobia* and *Dactylosoma*. The parasite belonging to the same genus was not found in more than one instance.

The positivity in *M. vittatus* and *M. bleekeri* with simultaneous absence of para-

sites in *M. cavasius* (30 examined) and *M. gulio* (60 examined) from the same ecological niche, are interesting and can be attributed in relation to host specificity. It may so happen that the vector like the leeches may play some important role in transmission of parasites due to their differential host preference. Loam (1973) conducted some experiments and found that no strain appeared to be specific for the host from which it was recorded. Becker (1977) has discussed a lot and stated that the host relationship of piscine haemoflagellates was euryhostpatalic. These haemoflagellates are rather more vector specific than that of host. However, all the four important agencies, viz. the parasite-vector-host and the environments are equally important in determining the host specificity if any in piscine haemoflagellates.

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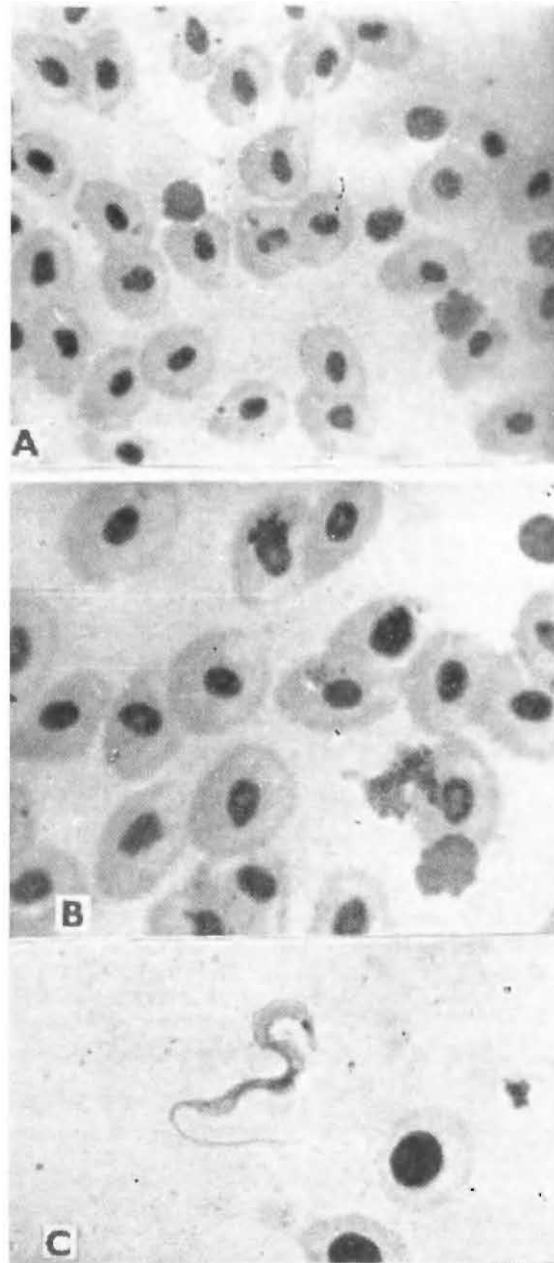
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MANDAL

PLATE III



A & B—*Dactylosoma* sp. from, *Mystus vittatus* ; C—*Trypanosoma vittati* Tandon and Joshi from *Mystus vittatus*.

OBSERVATIONS ON NOCTURNAL SWARMING OF THE PLANKTONIC OSTRACOD *CYPRIDINA DENTATA* (MULLER) FOR MATING IN THE NORTHERN ARABIAN SEA

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ABSTRACT

Nocturnal swarming of the ostracod, *Cypridina dentata* (Muller), in abundance for mating on the sea surface and the associated bioluminescence observed at ten stations in the northern Arabian Sea during the Oceanographic Expedition on INS DARSHAK from December 1973 to May 1974, are recorded. The occurrence of this species in high numbers contributed to the increase in the total biomass of neuston. Dominance of *C. dentata* over the other major crustacean elements in plankton existing in northern Arabian sea is considered unique.

INTRODUCTION

During the Oceanographic Expedition on INS DARSHAK in the northern Arabian Sea from December, 1973 to May, 1974, 188 neuston stations (99 day and 89 night Stations) were established (Fig. 1). Detailed analysis of the zoological constituents of the neuston samples revealed that there were 82 ostracod positive stations (64 night and 18 day stations) in which the Ostracod, *Cypridina dentata* (Muller) was swarming at the sea surface during the night at ten stations. It was also evident that the swarming was due to planktonic mating, since adult males and egg bearing females occurred in very high numbers and were the main constituents of the neuston, resulting in an increase in the total biomass of the samples at these ten stations. Observations in the experimental aquarium tanks in the ship's laboratory confirmed that

the *Cypridina* were swarming for mating. The neuston samples at the remaining 72 *Cypridina* positive stations (54 night stations and 18 day stations) were constituted of adult males and a few immature females. Further, this species outnumbered the other usually dominant major planktonic constituents like the Copepods and the Amphipods, which feature appears to be unique for that area (*i.e.* northern Arabian Sea) and has not been reported in any other part of the World Oceans. Furthermore, these Ostracods occurred far more abundantly at the sea surface in the night to the extent of creating dense patches of luminescence at the surface. These observations are reported in this paper.

MATERIAL AND METHODS

Neuston samples were collected with a

compact sampler consisting of a rectangular metallic frame (55 cm×15 cm) with a stream lined float provided with a stabilizing keel and fitted with a conical net of 190 cm. length made of bolting silk bearing 60 meshes to the linear centimetre. Daniel and Jothinayagam (1977) and Daniel, Nagabhushanam and Chakrapani (1977) give details of the neuston net used and the technique followed for estimating the total displacement volume in millilitres. The numbers of organisms in the entire surface sample collected during a five minute haul was analysed for estimating the numbers of organisms in a haul. Continuous observations during the night at the various neuston stations were made to assess the bioluminescence exhibited during the night. Observations on the mating procedure and associated bio-luminescence during the mating period were also made at these ten stations in aquarium tanks in the ship's laboratory.

OBSERVATIONS

In Fig. 2 the total displacement volumes of the neuston and the numbers of *Cypridina* occurring in a sub-sample of 1 ml and per haul of 5 minutes duration in the 82 *Cypridina* positive stations are presented.

A perusal of Figs. 2 and 3 show that of the 82 *Cypridina* positive stations, the total displacement volume of neuston was ranging from 0.5–5.9 ml at 34 night stations and 16 day stations, 6.0–10.9 ml at 9 night stations and 2 day stations, 11.0–20.0 ml at 9 night stations and above 20 ml at 12 night stations. The 21 stations wherein the total displacement volume was above 11.0 ml were established during the night and excepting at 4 stations (Stn. 09.07, Stn. 11.13, Stn. 29.05 and Stn. 45.08) the occurrence of the ostracod *Cypridina dentata* in very high numbers contributed to the

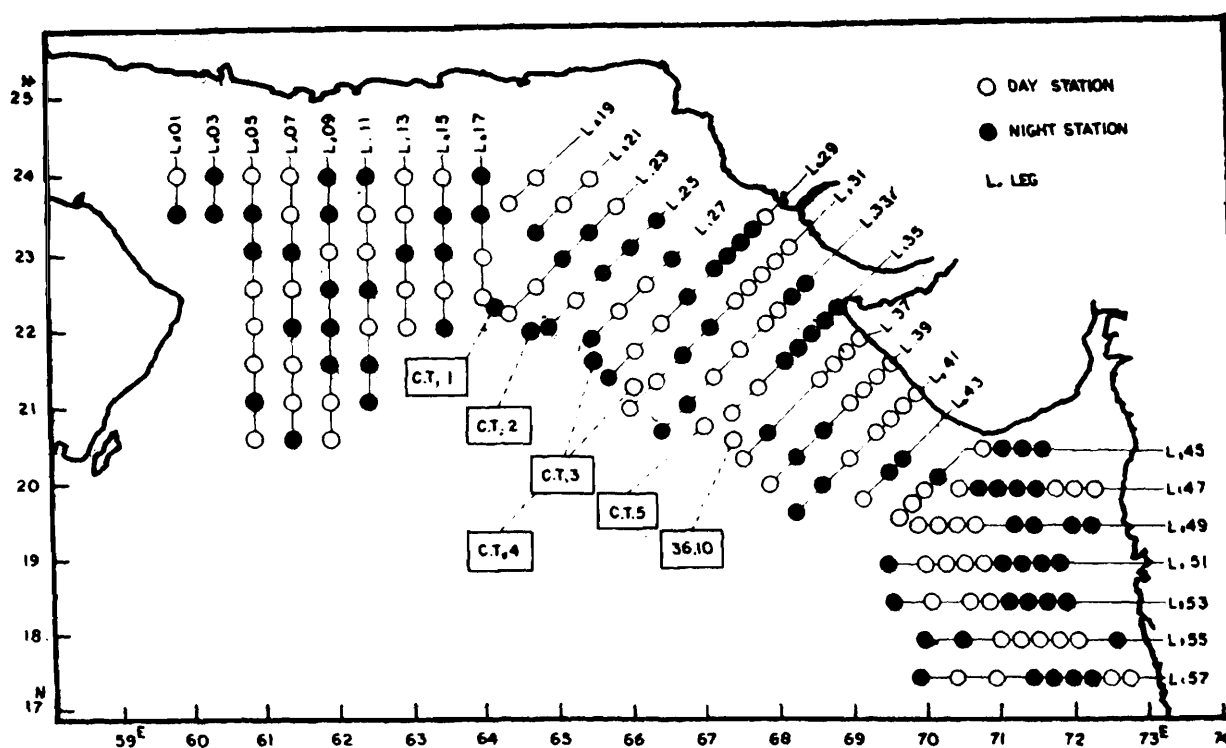


Fig. 1. Neuston stations established during expedition.

TABLE 1. Number of *Cypridina* ♂ and egg bearing ♀ and other zooplanktons occurring per haul of 5 minutes duration for 10 *Cypridina* swarming stations.

Sl. No.	Stn. No.	Total volume	No. of <i>Cypridina</i>		Amphi-poda	Cope-poda	Mysids-	Sipho-nopho-ra	Chae-tog-natha	Decap-od-larvae	Moll-usca	Shrimp-larva	Luci-fera	Medu-sae	Oth-ers	Remark
			Males Adult	Females Egg-bearing												
1.	03.03	95.0	10355	10070	2280	570	3800	—	95	95	190	—	—	—	95	—
2.	07.05	31.0	1240	2976	124	93	155	31	—	—	—	—	—	—	31	—
3.	09.09	80.0	12960	11040	400	160	320	—	—	—	—	80	—	—	—	Immature females also present
4.	11.07	36.0	2376	2844	432	144	720	—	—	72	72	—	—	—	180	—
5.	21.05	97.0	21720	12222	485	388	485	—	—	97	194	—	—	—	388	—
6.	25.03	62.0	8308	8432	310	372	1116	—	62	—	62	—	62	—	496	—
7.	27.03	41.0	4551	4674	028	82	492	82	—	—	—	—	—	82	410	Immature females also present
8.	31.07	64.0	11008	9472	121	192	64	64	—	—	—	—	—	—	123	—
9.	35.05	60.0	8760	9840	120	120	60	—	—	300	—	—	—	—	120	Immature females also present
10.	57.13	315.0	56070	66780	315	315	1575	—	—	—	—	—	—	—	—	—

increase in the total biomass of the neuston. At 10 stations—8 deep stations and 2 shallow stations—(Stn. 03-03, Stn. 07-05, Stn. 09-09, Stn. 11-07, Stn. 21-05, Stn. 25-03, Stn. 27-03, 31-07 Stn. 35-05 and Stn. 57-13) *Cypridina dentata* was occurring in very high numbers and constituted mainly of adult males and egg-bearing females (Table 1) indicating that the swarming of this species at the sea-surface during the night was for planktonic mating.

Mating procedure and associated bioluminescence :

Observations on the mating procedure in the aquarium tanks showed that the male spreads its valves apart, lampers on to the postero-dorsal part of the carapace of the female, clasps the edges of the female valves with the palps of the 1st thoracic legs, unfolds and extends the ends of the paired penis and inserts them into the paired vagina of the female. The female remains passive and the copulation is accomplished in minutes. During this period both male and female exhibited bright luminescence. After the mating the bioluminescence became feeble and finally disappeared.

REMARKS

Although the ostracod, *Cypridina dentata* (Muller) has been recorded as a dominant species in the Arabian Sea by George (1967), this species has not so far been known to outnumber the other usually dominant major planktonic constituent i.e. the Copepods. This appears to be a unique feature in the northern Arabian Sea during November 1973 to May 1974. Similar observations by Paulinose and Aravindakshan (1977) while studying the zooplankton collections from 200—0 m during the same expedition, lend support to these observations.

Several marine species of Cypridinidae are known to have planktonic mating (Kesling, 1961). Bioluminescence in Cypridinid ostracods has been thoroughly investi-

gated (Harvey, 1952). However, planktonic mating of *Cypridina dentata* and its associated bioluminescence have not been reported so far. This underlines the need for further investigations on this subject.

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The authors are grateful to Captain K. L. Chopra, Commanding officer, Lt. Commander S. Issacs, Executive Officer and all officers and crew of the INS Darshak and other participating scientists for help, several courtesies, technical discussions and for collection of samples and data during the course of these investigations. The authors are also grateful to the Director, Zoological Survey of India for encouragement and facilities given to undertake this work.

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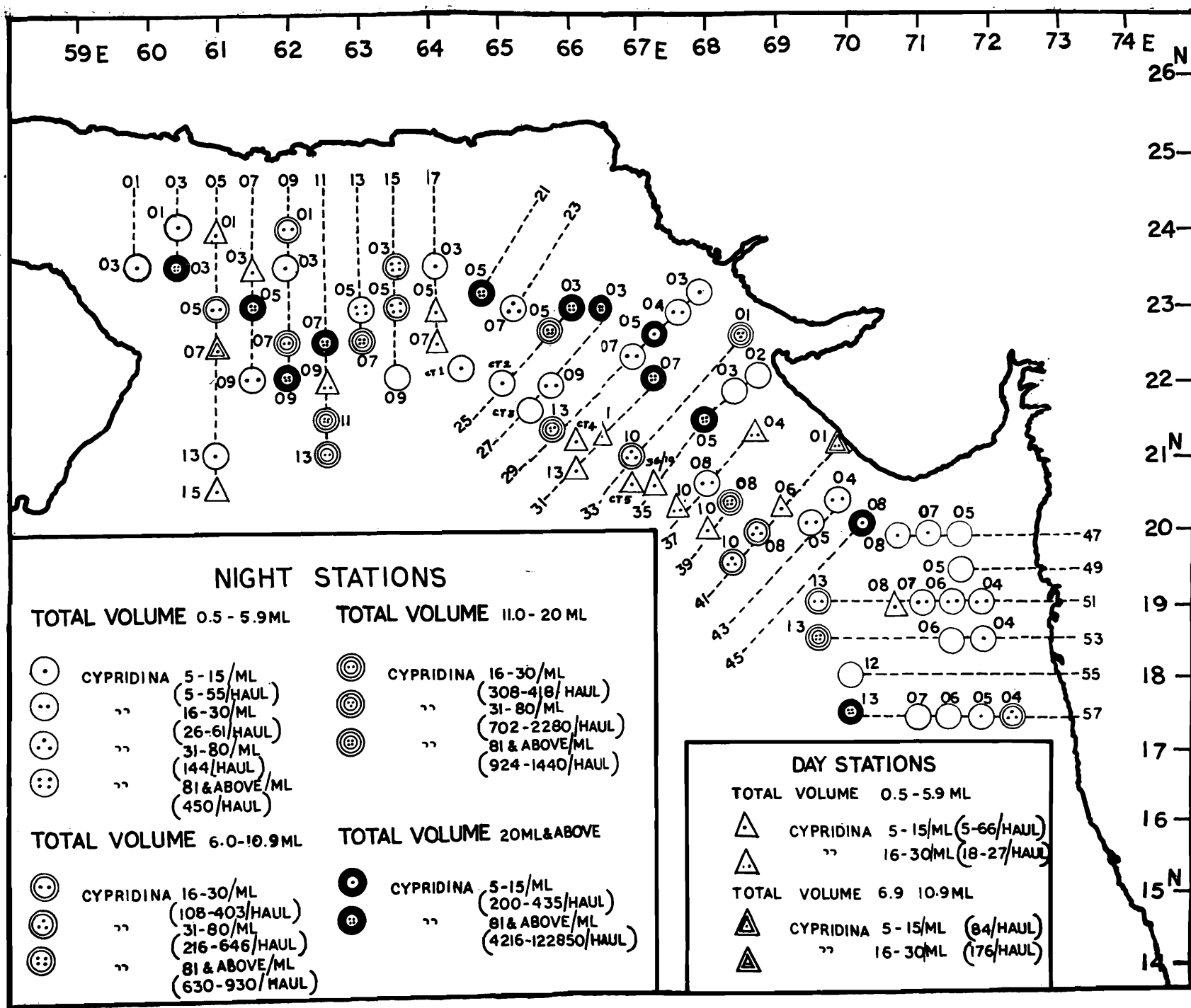


Fig. 2. Total displacement volumes of neuston and the numbers of *Cypridina dentata* occurring in a subsample of 1 ml and per haul in the 82 *Cypridina* positive stations.

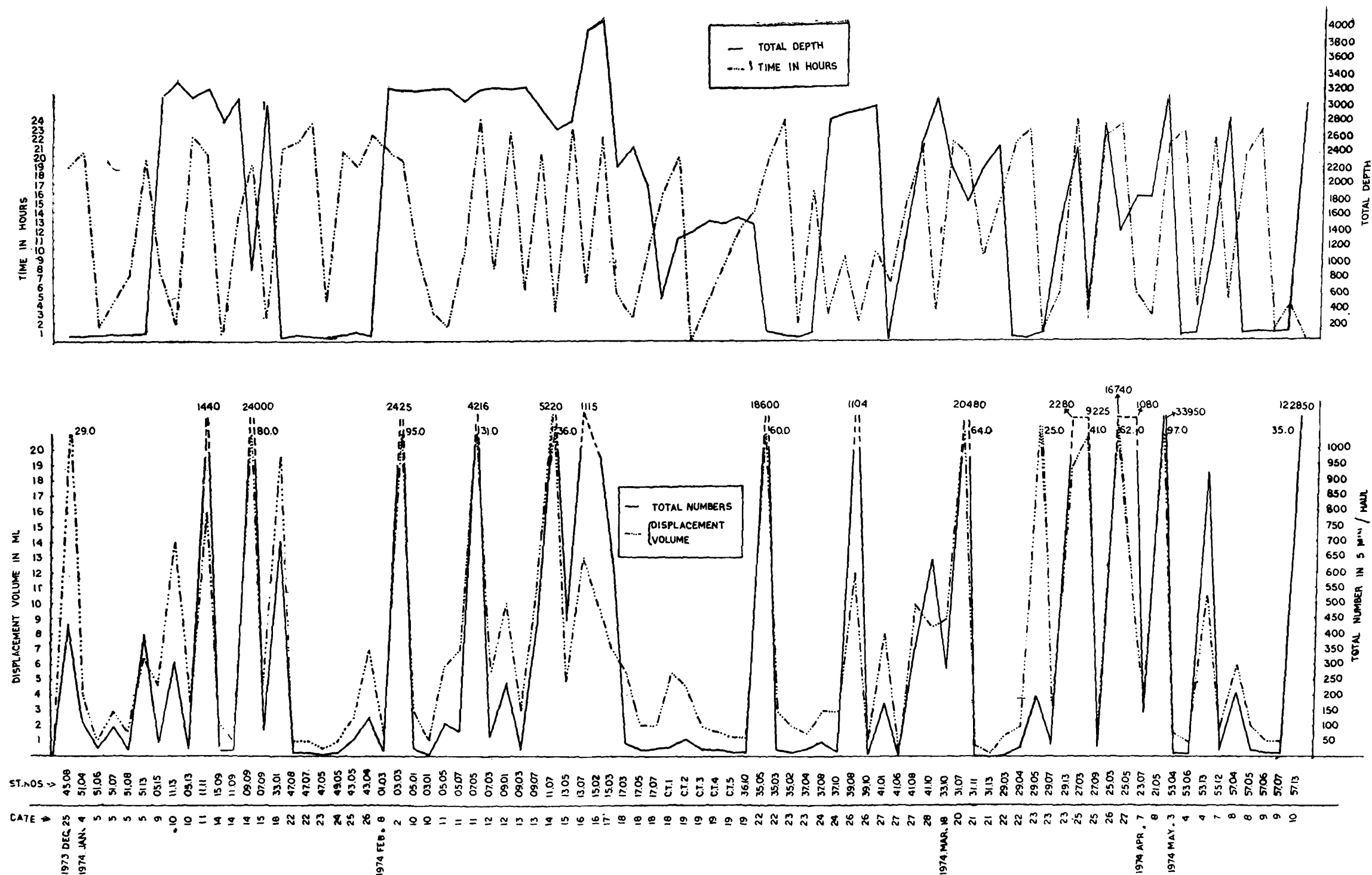


Fig. 3. Graph showing the station numbers, date, time of haul, total depth, total number and volume of *Cypridina dentata* in the 82 *Cypridina* positive stations established during the Oceanographic Expedition on INS Darshak from Dec. 1973 to May 1974.

ROLE OF ASYMMETRY IN THE SPECIATION OF CERTAIN LICE (PHTHIRAPTERA : INSECTA)

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ABSTRACT

It has been recognized that asymmetry plays a considerable part in animal speciation, particularly in insects. This aspect has been examined in certain "Chewing-lice" infesting birds. Two kinds of asymmetry is noticed, one affecting the body parts other than genitalia, and the other only genitalia. While the former is due to the ecological adaptations, the latter occurs during the sympatric speciation. Occasionally asymmetric forms also appear due to accidental damage, as in certain individuals hurt during preening, but recovered from the injury.

INTRODUCTION

Though insects also exhibit the bilateral symmetry as in many other Metazoa, occasionally we come across cases of asymmetry either in one or both the sexes. In the chewing-lice (Mallophaga *sens. lat.*) this phenomenon seems to be more common than so far appreciated.

Harrison (1914) was the first to draw our attention to the asymmetry of the head structure in the lice parasitic on ostrich, rheas, nandu, and emu. Cummings (1916) proposed the genus *Struthioliperus*, for some of the lice parasitic on ostrich, rhea and nandu, suggesting that possibly two other species parasitic on rheas and nandu, and also the one on emu belong to distinct genera, but all of them, however, closely related. Kéler (1936) established the genus *Dahlehornia* for species on emu, and Eichler (1940) erected the genus *Meinertzhageniella* for rest of the

species parasitic on rhea and nandu. Paine (1917) referred to the symmetry of the head in *Philopterus ambiguus* Giebel (now *Bizarri-frons magus* (Nitzsch) (parasitic on Icteridae for the first time, and Eichler (1938) established the genus *Bizarri-frons* for it and other species parasitic on Icteridae with similar heads. Clay (1950) stated that the asymmetry might have originated more than once in bird infesting lice. Eichler (1936) stated that the asymmetry in mandibles and the front of the head is common amongst the Ischnocerophthirina, probably correlated with the feeding habits, the feather structure of the host, and that such asymmetry is also met with in Psocoptera, from which the lice are believed to have descended. While head asymmetry in *Struthiolipeurus* is due to the feeding habits (Lakshminarayana, 1973), the asymmetry phenomenon is perhaps more predominant in Amblycercophthirina than in Ischnocerophthirina. Lakshminarayana and Emerson (1971) recognized the species of

Goniocotes parviceps (Piaget) and its counterpart *G. mayuri* Lakshminarayana and Emerson in the sympatric pair, which evaded the notice of systematists for well over a hundred years, chiefly by the asymmetry in the male genitalia in the former. Price (1966 a) redefined the *Eomenopon* parasitic on Psittaciformes as having asymmetrical genitalia in all the members included in this genus ; this condition is also exhibited in another closely related genus *Pacifimenopon* (Price, 1966 b). Price (1967) described a new subgenus *Cacamenopon* in the genus *Franciscoloa* Conci (also parasitic on Psittaciformes), where the male genitalia and the sternites VI-VII also exhibit the asymmetry. The genus *Trinoton* Nitzsch is very well known, but none has pointed to the asymmetry of its male genitalia. The present paper aims to draw the attention of phthirapterologists, that the development of asymmetry is not a passive phenomenon amongst the bird infesting lice, but seems to be more frequent than hitherto recognized ; perhaps of considerable significance in the speciation and therefore, can conveniently be used for specific and even generic diagnosis.

The asymmetry in the lice can be grouped under the following heads :—

ECOMORPHIC ASYMMETRY

The head and body structure of the avian infesting lice is largely influenced by the occupational niche, viz., round and stout bodied forms with circumfasciate heads generally occupy the head and neck niches (where they are not exposed for preening), while the slender forms, often with specialized heads are found in the wing and abdominal regions of the host (thus escape the preening) (Clay, 1949, 1950 ; Lakshminarayana, 1977). Lakshminarayana (1973) suggested that the asymmetry of the head of *Struthiolipeurus* (Fig. 1A) must have been primarily derived from an ancestor with a symmetrical

head and incassations as in the genus *Falcolipeurus* Bedford (Fig. 1B) consequent to a secondary infestation on ostrich, rheas, and nandu. The feather structure of the new hosts must have exerted considerable stress on the mandibular musculature during feeding, and the differential pull on either side might have altered the mandibular framework leading to the asymmetry of the head. Perhaps, the same factors might have been responsible for the head asymmetry in *Dahlehornia* (Fig. 1C) and *Meinertzhageniella* also. Though, Cummings (1916) believed that the asymmetrical condition develops at later instars, it was noticed even in earlier instars in *S. stresemanni* Kéler (Lakshminarayana, 1973). The reason for the head asymmetry in *Bizarrifrons* (Fig. 1D) is not clearly understood at the time. In *Ornithopeplechthos opisthocomi* (Cummings) only the male shows the mandibular asymmetry, while the mandibles are normal in the female (Figs. 1E & F) and is useful in generic diagnosis within the *Laemobothrion*-complex (Lakshminarayana, 1970). Since the asymmetry is confined to only one sex, it is not certainly correlated to feeding or feather structure of the host, but may be connected to the sex, and the functional significance is worth investigating.

ASYMMETRY DUE TO PHYSIOLOGICAL CAUSES

The variation in number and size of certain setae associated near the genital region, especially in the females of *Goniodes*-complex may be due to some physiological disturbance in the sexes. In *Myrsidea* the sternite II always carries an aster of setae on either side from a prominent or reduced tubercle (Fig. 1G). The length and number of the setae are variable between the species, sexes, and even on the two sides ; this variation has been used in specific and even generic diagnosis. The functional significance of these tubercles and setae is not known and probably chemoreceptive. Basing generic

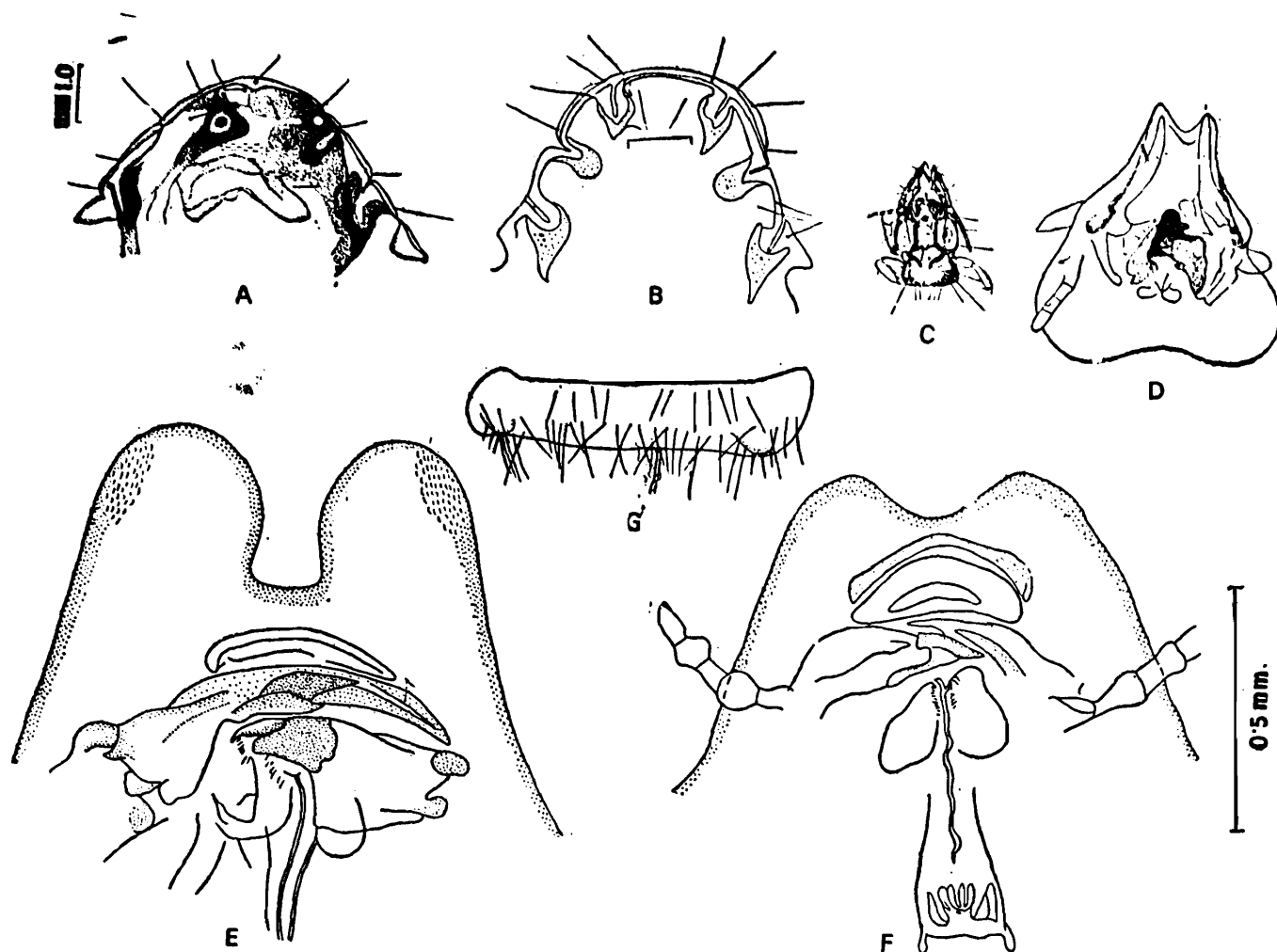


Fig. 1. (A-F) Heads of : A—*Struthiolipeurus stresemanni* ; B—*Falcolipeurus quadripustulatus* ; C—*Dahlehornia asymmetrica* ; D—*Bizarrifrons* ; E—*Ornithopeplechthos opisthocomi*, male ; F—*O. opisthocomi* female ; G—II sternite of *Myrsidea cornicis* ;

diagnosis on their nature and number alone may lead to erroneous conclusions.

ASYMMETRY IN THE GENITALIA AS ISOLATING MECHANISM IN BREEDING

Goniocotes parviceps (vide supra) with asymmetrical genitalia can easily be derived from its counter part in the sympatric pair, *G. mayuri* with asymmetrical male genitalia (Fig. 2A & B). Both evolved on the two closely related host species, viz., *Pavo cristatus* Linne, and *P. muticus* Linne. It is assumed that some of the original *mayuri* populations on the *cristatus* host might have

been passed on to the *muticus* host, when the latter evolved (probably from *cristatus*) in thick forest belt of Assam-Burma axis and the island chain, and got isolated from the parent *mayuri* populations on *cristatus* for some time. When the two host populations were united later due to altered geographical conditions, their respective louse populations also had perhaps chance meeting. The cross breeding between the two populations might have been prevented owing to the development of asymmetrical male genitalia in one of them, thus leading to the speciation of *parviceps* (cf. Lakshminarayana and Emerson, 1978). The females of both the species

are identical and separable only with considerable difficulty.

The genera *Eomenopon*, *Pacifimenopon* and *Trinoton* (Fig. 2C, D & F) also might have evolved from ancestors with symmetrical

male genitalia in the bygone, but the number of species with asymmetrical genitalia included under the genera are considerable, and therefore, the species with asymmetrical genitalia seem to be quite successful over the species with symmetrical genitalia. The

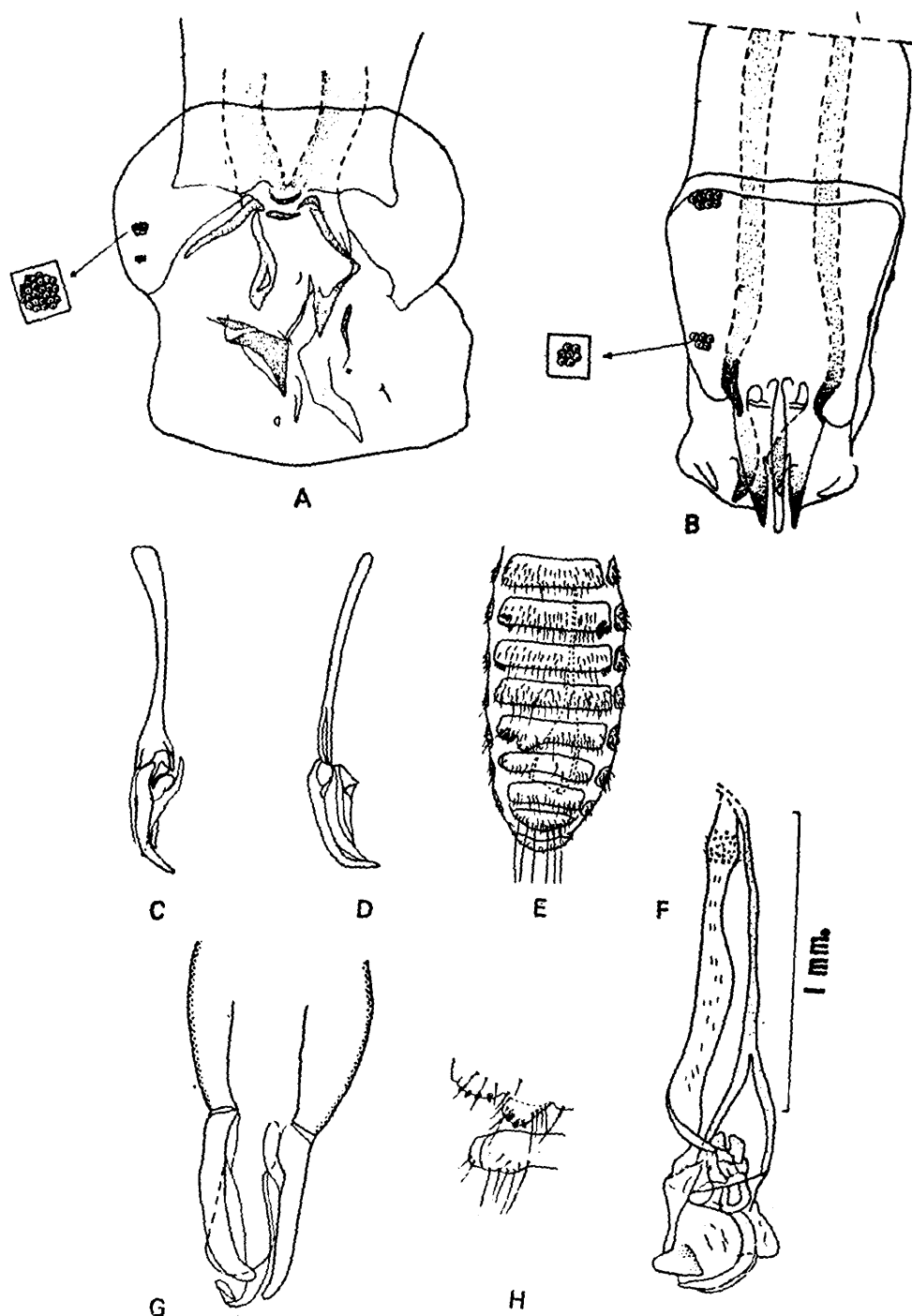


Fig. 2. (A-G) Male genitalia : A—*Goniocotes parviceps* ; B—*G. mayuri* ; C—*Eomenopon sintillatae* ; D—*Pacifimenopon fuscatae* ; E—*Franciscocola* (*Cacamenopon*) *hodsoni* ; F—*Trinoton querqulac* ; G—*Dahlehornia asymmetrica* ; H—Sternites VI-VIII of *F. (C) hodsoni*.

(Figs. 2C, D, E, H After Price)

extreme development of asymmetry of not only in the male genitalia, but also of sternites VI-VII in the subgenus *Cacamenopon* (Fig. 2E & H) also suggestive that asymmetry is playing an important role in the evolution. Eichler (1963) figured the asymmetry of male genitalia in *Halipeurus mirabilis* Thompson (1940). *Dahlehornia asymmetrica* in addition to the asymmetry of the head, also shows asymmetry in male genitalia (Fig. 2G) which was hitherto escaped notice. This fact further confirms that this species might not only have secondarily infested a new host and developed asymmetry, but also the back cross with its ancestral form must have been prevented by its asymmetrical male genitalia.

TERATOLOGICAL ASYMMETRY

The host while preening might injure few of the early instars, which some how escape and survive. The healed wound occasionally persists in later instars, thus giving an abnormal appearance often referred to as a freck. Blagovashtchensky (1950) figured the abnormalities in *Brueelia* and Eichler (1963) the teratological asymmetry of the posterior part of *Strongylocotes complanatus* (Piaget). The teratological asymmetry has no significance in the speciation problem.

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***LEPIDOCEPHALUS DIBRUENSIS*, A NEW COBITID FISH FROM DIBRU RIVER,
DIBRUGARH, ASSAM, WITH A KEY TO THE INDIAN SPECIES OF
LEPIDOCEPHALUS BLEEKER**

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ABSTRACT

A new species of *Lepidocephalus* from Dibru river, Gujjan, 60 km. from Dibrugarh, Assam, is described and a key to the identification of the Indian species of the genus *Lepidocephalus* provided.

INTRODUCTION

During the course of my studies on the freshwater fish fauna of Assam, I came across two well preserved specimens belonging to the genus *Lepidocephalus* and measuring 90.0-100.0 mm in total length, collected by the author on 4. 12. 75, from Dibru river, Gujjan, 60 km. from Dibrugarh Assam. These specimens on careful study, appear to represent hitherto unknown species. A detailed description of this new species along with a revised key to the genus *Lepidocephalus* is provided in the present paper.

***Lepidocephalus dibruensis* sp. nov.**
(Figs. 1 & 2)

Material : Two specimens including the holotype, 90.0-100.0 mm total length, collected by T. K. Sen on 14. 12. 1975 from Dibru river, Gujjan, 60 km. from Dibrugarh, Assam.

MEASUREMENTS AND DESCRIPTION

Body depth at dorsal fin origin 14.00-15.55

(M—14.77), at anal fin origin 13.00-13.33 (M—13.16), head length 13.00-14.44 (M—13.72), dorsal fin base 11.00-11.11 (M—11.55), distance between anterior tip of snout and origin of dorsal fin 42.00-45.55 (M—43.77), Caudal peduncle length 11.00-11.66 (M—11.33), distance between anterior origin of pelvic and anal fin 23.00-23.33 (M—23.16), distance between anterior origin of pelvic and base of caudal fin 40.00-41.11 (M—40.55), all in percent of total length. Eye-diameter 23.07-26.92 (M—24.99), snout length 38.46-42.85 (M—40.65), pectoral fin length 70.37-73.09 (M—16.75), inter-orbital space 3.33-3.50 (M—3.41), all in percent of head length. Eye-diameter 36.36-38.88 (M—37.62) in percent of snout length.

Body comparatively more elongated with the distinguishing height of the body, a median longitudinal groove more prominent anteriorly extending from head to base of the caudal fin leaving the impression of the lateral line. Six barbels longest one reaches up to the post orbital margin, mandibular flap is distinct, the sub, and post orbital regions and also the upper part of the opercle

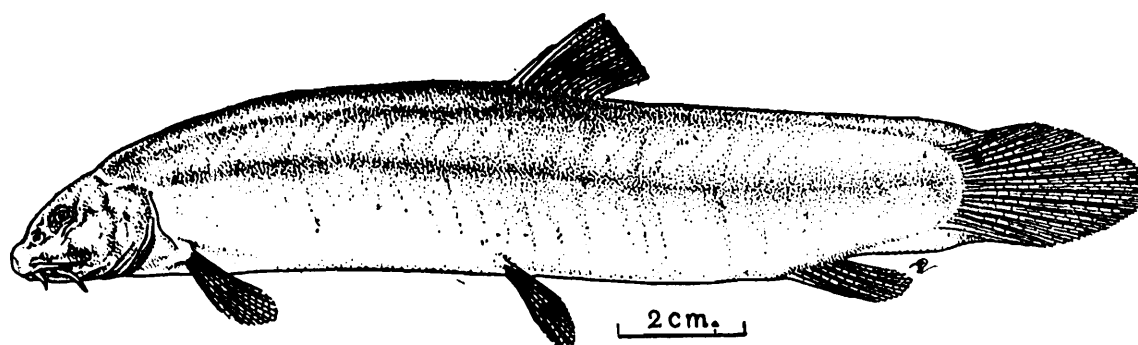


Fig. 1. *Lepidocephalus dibruensis* sp. nov. Lateral view.

scaled (Cycloid), the Sub-orbital bifid spine is typically (Bird) shaped with two convex bonny elevations or curves on both the right and left sides of the spine anteriorly (Fig. 2), eye-diameter distinctly broad, inter-orbital

space distinctly convex, the distance between the base of the head and the snout dorsally is like a round bonny arch, snout constricted, the dorsal profile is prominently convex towards the head region and gradually slopes

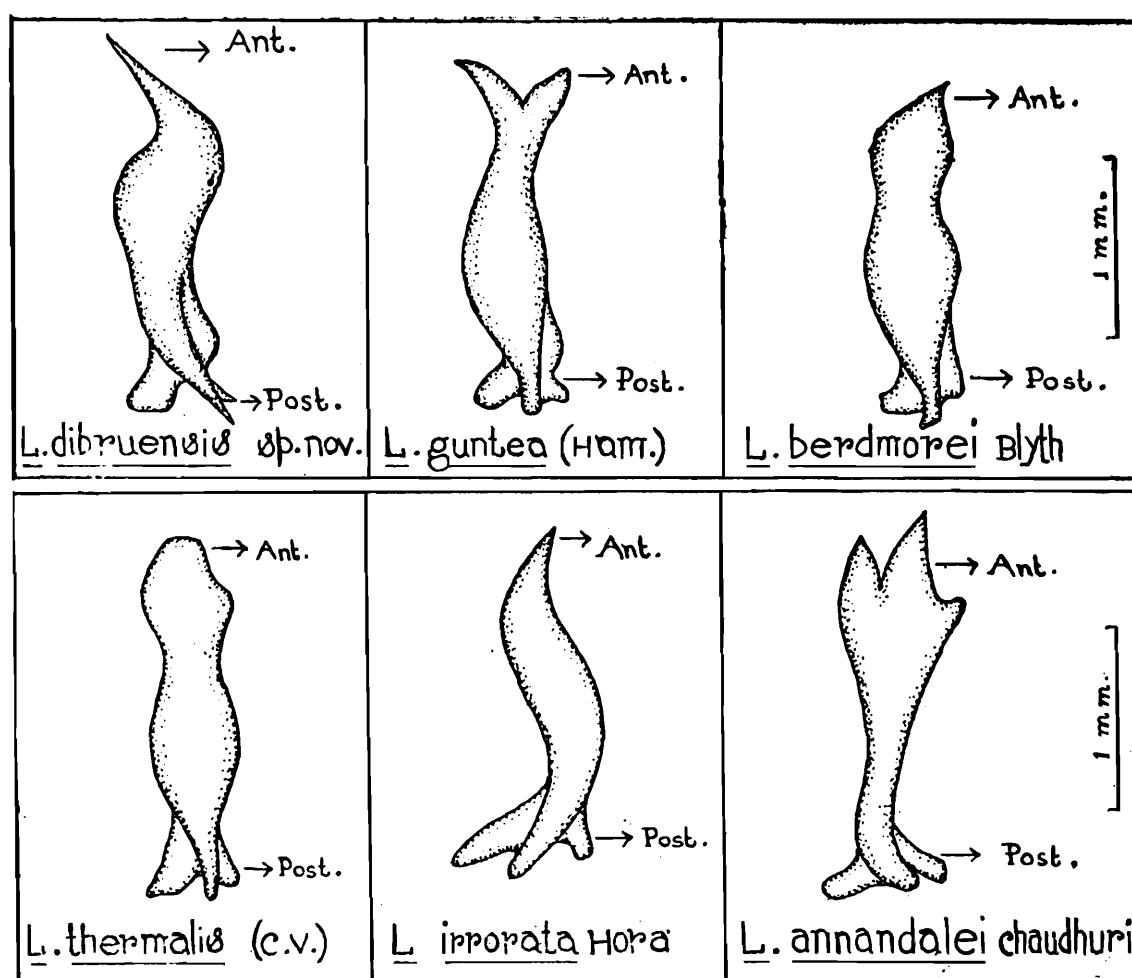


Fig. 2. Comparative structural representation of the bifid sub-orbital spine of *Lepidocephalus dibruensis* sp. nov. and other allied species under this genus.

downward to the snout, ventral profile more or less horizontal with a longitudinal integumental groove extending from the middle of the paired pectoral fins to the base of the paired pelvic fins, dorsal fin slightly towards the head and opposite to the origin of the pelvic fins, caudal fin lanceolate type, anal, pectoral and pelvic fins are shortened comparatively with the size of the body, lateral line absent.

MERISTIC CHARACTERS

Dorsal fin with 2 weak flexible spines and 6 rays, pectoral 8, pelvic 7, anal 7 and caudal 17-18 rays.

Colour : In alcohol yellowish all over the body with a conspicuous light dark median band (composed of black fused dots) extending from the base of the head to the base of the caudal fin, minute black dots on the dorsal surface of the body more densely in the head region-absent in the abdominal regions, all the fins are light yellowish without any colour pattern. A black ocellous on the middle of the base of the caudal fin, present.

Distribution : Dibru river, Guijan, 60 km. from Dibrugarh, Assam.

TYPE SPECIMENS : FF 1203. holotype, 78.0 mm S. L. and 90.0 mm T. L. Dibru river, Guijan, 60 km. from Dibrugarh, Assam, T. K. Sen, 4. 12. 1975. FF 1204. paratype, 84.0 mm S. L. and 100.0 mm T. L. collected along with the holotype, all deposited in the National Zoological Collection of the Zoological Survey of India, Head quarter, Calcutta.

DIAGNOSIS AND AFFINITIES

Lepidocephalus dibruensis sp. nov. can be easily distinguished from all the other valid species viz., *Lepidocephalus guntea*, *Lepidoce-*

phalus irrorata, *Lepidocephalus berdmorei*, *Lepidocephalus thermalis* and *Lepidocephalus annandalei* by the presence of the typically (Bird) shaped sub-orbital spine (versus different shaped suborbital spines), lanceolate type of caudal fin (versus truncate and semimarginate types in all the other valid species viz. *L. guntea*, *L. irrorata*, *L. berdmorei*, *L. thermalis* and *L. annandalei*), eye-diameter broader—5 times in H. L. (Versus 4, $3\frac{1}{2}$, $4\frac{1}{2}$, 3 and 4 times in *L. thermalis*, *L. guntea*, *L. berdmorei*, *L. irrorata* and *L. annandalei* respectively), number of scales—22-25 rows of scales between the base of the anal fin and back (versus 25-30, 30-40, 40, 32 and 34 in case of *L. guntea*, *L. thermalis* and *L. annandalei* respectively), head length $7\frac{1}{2}$ times in TL (versus $6\frac{1}{2}$, $5\frac{1}{2}$, $6-6\frac{1}{4}$, $5\frac{2}{3}$ —and $5\frac{1}{2}$ times in *L. guntea*, *L. thermalis*, *L. berdmorei*, *L. irrorata* and *L. annandalei* respectively), light dark longitudinal colour band with only a few very minute scattered black dots on the dorsal surface of the body without any colour pattern on the fins (versus all the species and their fins are with irregular colour-bars, cross-bars, vertical-bands with rows of black spots, irregular blotches etc.). *L. dibruensis* sp. nov. can be distinguished from other closely related group of fishes under different genera having bifid erectile spines. It is distinguished from *Acanthophtalmus*, vanhasselt group by the position of dorsal fin—it is situated more or less in the middle (versus towards the caudal fin), dorsal fin opposite to the anal fin (versus dorsal fin in advance of the anal fin), eye-diameter broader (versus minute eyes), colour pattern etc. It is distinguished from *Aborichthys*, Chaudhuri group by (1) Colour bands, (2) Caudal fin structure and (3) body being very much elongated. It is distinguished from *Botia*, Gray group by (1) absence of scales on head, (2) caudal fin structure, (3) depth of body, (4) head length, (5) dorsal fin ray and (6) colour pattern. It is distinguished from *Somileptes*, Bleeker group by (1) Caudal

fin structure, (2) head-profile, (3) absence of scales on head and (4) Colour pattern. It is distinguished from *Apua*, Blyth group by (1) absence of pelvic fins, (2) No. of barbles and (3) position of dorsal fin. It is distinguished from *Jerdonia* Day group by (1) No. of barbels, (2) No. of dorsal fin rays, (3) caudal fin structure and (4) position of dorsal fin.

REMARKS: The species is named after its locality, a small hillstream river named 'Dibru' at Guijan, 60 km. from Dibrugarh, Assam.

Key to the Indian species of *Lepidocephalus*

1. Head length less than 6 in T. L.,
Caudal fin slightly emarginate.. (2)
- Head length 6 or more in T. L.,
Caudal fin truncate or lanceolate (4)
2. Eye-diameter 3. in H L. scale
rows between anal fin base and
back 34; height not more
than 7.... (3)
3. Scale rows between anal fin
base and back 32; height of the
body $7\frac{1}{4}$ in T. L. *L. annandalei*
Choudhuri
- Scale rows between anal fin base
and back 30-40; height of the
body $7\frac{1}{2}$ in T. L. *L. thermalis* (C.V.)

4. Caudal fin truncate; scale rows
between anal fin base and back
40; height of body more
than 7. *L. berdmorei*
(Blyth)
- Caudal fin truncate or lanceo-
late; scale rows between anal
fin base and back 22-30, height
not more than 7. (5)
5. Caudal fin truncate, scale rows
between anal fin base and back
25-30; height of the body $6\frac{3}{4}$ in
T. L., suborbital spine without
convex side elevations or curves
on the anterior side..... (Ham.) *L. guntea*
- Caudal fin lanceolate, scale
rows between anal fin base and
back 22-25, height of the body
 $6\frac{1}{4}$ in T. L., typical suborbital
spine with two convex side cur-
ves or elevations on the anterior
side.. Sen *L. dibruensis*

ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India, for the encouragement and facilities, to Dr. K. C. Jayaram, Dy. Director, for kindly confirming the identity of the species and for the continued guidance, help and co-operation during the course of study.

A NEW SPECIES OF *RANA* (FAMILY RANIDAE) FROM WESTERN GHATS, S. INDIA.

R. S. PILLAI

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ABSTRACT

A new species of frog belonging to the genus *Rana* is being described from Naduvattom, Gudallur (Western Ghats) on the basis of four males, two females and four juveniles. It bears resemblance to *Rana limnocharis*, *Rana brevipalmata* and more so to the Ceylonese species, *Rana greeni* from which it differs in many respects and in the presence, in males, of two patches bearing papillae on the breast. It has also been compared with other species of *Rana* wherein spinose patches are present on the breast in males.

INTRODUCTION

While examining the Amphibia material collected from the Western Ghats, South India, the author came across a hitherto undescribed species of *Rana* (Family Ranidae) which is being described here as *Rana murthii* sp. nov.

MATERIAL

The material consists of four males, two females and four juveniles and were all collected from a forest at Naduvattom, Gudallur, Tamil Nadu by Shri T. S. N. Murthy on 23 March 1978.

Family RANIDAE

Genus *Rana* 1766

Rana murthii sp. nov.

(Pl. IV, Fig. A & B)

Diagnosis : Medium-sized frogs with tympanum fairly distinct ; forelimbs short and robust, digits without discs ; feet half-webbed, a small inner metatarsal tubercle and a tiny nodule-like outer tubercle present. Skin of dorsum beset with interrupted folds and

tubercles, head smooth. Males with external vocal sacs, anterior part of lower jaw and two triangular patches on breast beset with small pearl-like papillae.

DESCRIPTION

Head : Slightly depressed, a little longer than broad. Snout pointed, longer than eye. Canthus rostralis indistinct, loreal region slightly concave. Nostrils a little nearer to tip of snout than to eye. Eyes not much protruding, upper eyelids being almost flat. Interorbital space convex, narrower than upper eyelid and two-third times the internarial distance. Tympanum fairly distinct, its diameter half to two-thirds that of eye and about as broad as upper eyelid. Pupil rounded. Vomerines cushion-like and close together. Tongue small, free and bicornuate behind, without median papilla.

Forelimbs : Short, robust, its length about half distance from tip of snout to vent. Fingers free, tips blunt, rounded ; terminal phalanges simple. First and second fingers

about equal or first extending a little beyond second which in turn is equal to fourth. Subarticular tubercles fairly prominent.

Hindlimbs : Relatively short, being $1\frac{1}{2}$ times the total length from tip of snout to vent, heels just meeting when limbs are folded at right angles to body. Tibio-tarsal articulation of adpressed limb reaching eye ; tibia about half body length, equal to fore-limb and about 3 times as long as broad. Tip of toes as in fingers, half-webbed, web not reaching any of toe-tips. Three digits of fourth toe free or narrowly fringed. Mid-part of web separating third and fourth toes terminating at the level of the distal tubercle on third toe and that between fourth and fifth at the level of the distal tubercle of fifth toe. Subarticular tubercles not very prominent, inner metatarsal tubercle present as a tiny whitish nodule at the base of the dermal fringe of the outer toe. Outer metatarsal separated almost to base. An indistinct serrated tarsal fold. External fringes along outer edge of first and fifth toes present but not well developed.

Skin : Dorsal surface rough, beset with fairly large irregular glandular tubercles and wrinkles barring the snout and interorbital part which are smooth, these two regions being separated by a distinct groove running across the hind part of the two upper eyelids. Some of the tubercles coalesce to form longitudinal dorsal folds, some others though not confluent form linear rows. Flanks with larger glandules. A weak supra-tympanic fold present. Hind part of dorsum, tibia and tarsus with smaller conical tubercles interspersed with minute whitish pustules. Ventrally smooth except in males (See secondary sex characters).

Colour : Dorsum dark brownish with irregular markings. A transverse dark band across the hind margin of eye. An inverted

V-mark on dorsum at shoulder level. A median yellowish or pale line present in three examples from tip of snout to vent. Hind aspects of thigh variegated. Limbs with incomplete transverse markings. Venter immaculate with a few scattered chromatophores on throat and breast which in males are dense rendering the area sepia brown in colour. Upper jaw uniformly dark while lower jaw has whitish bars along its margin.

Secondary sex characters : Males with external vocal sacs forming longitudinal folds on the dark throat. Anterior part of lower jaw and throat beset with evenly-spaced tiny pearl-like papillae. Two triangular patches of similar papillae on either side of the breast. A swollen nuptial pad devoid of spinules present on the dorso-median aspect of the first finger extending from the level of articular tubercle to wrist.

The largest male specimen measures 34 mm. from tip of snout to vent while the largest female measures 35 mm.

Measurements : See Table 1.

Type-specimens :

Holotype : An adult ♂ frog, loc. Naduvattom, 18 km. from Gudallur, S. India, Alt. 1829 metres. 23 March 1978, coll. T. S. N. Murthy.

Paratypes : 2 adult ♂♂ and 2 adult ♀♀ frogs with other data same as above.

All type specimens are deposited with the Southern Regional Station, Zoological Survey of India, Madras.

Field Notes : The specimens were collected from a small stream following over a sandy bottom in a dense forest. The water was very shallow and all the frogs were taken from under stones. They were fairly active and agile.

TABLE 1. Body measurements in mm. of *Rana murthii* Pillai.

	1	2	3	4	5	6	7
	(M)	(M)	(F)	(M)	(M)	(F)	(?)
1. Total length (from tip of snout to vent).	34	32.5	35	27	29.5	28.5	20
2. Length of head (from tip of snout to angle of jaw) ..	10	9	10	8.5	8.5	9	6.5
3. Width of head (at angle of jaw) ..	11	11	12	10	9.5	10	7
4. Max. length of eye ..	5	5	5	4	4	4	3
5. Width of upper eyelid ..	3	3	3.5	3	3.5	3	2
6. Minimum inter-orbital distance ..	2	1.5	2	1.5	2	1.5	1.5
7. Diameter of tympanum ..	3	2.5	2.5	2.5	2.5	2	2
8. Length of forelimb ..	14	14	16	13	14	15	11
9. Length of hindlimb ..	50	49	57	44	44	45	30
10. Length of tibia ..	15	15	17	13	13.5	14	10

REMARKS

Teethed upper jaw, bifid tongue, roundish pupil, vomerines, absence of intercalary ossicle, simple terminal phalanges and the free outer metatarsals are all characters which go to show that *Rana murthii* is a member of the subgenus *Rana* s. str. under genus *Rana*. It bears good resemblance to *Rana limnocharis* Wiegmann, *R. brevipalmata* Peters and more so to the Ceylonese species, *R. greenii* Boul. from which it differs in many respects and in the presence in males, of two patches bearing papillae on the breast. Similar spinose patches on breast are present in the males of most of the species which Boulenger (1920) has, on phyletic grounds, grouped under "Ranae liebighianae" such as *R. fae* Boul., *R. tibetana* Boul., *R. sternosignata* Murray, *R. spinosa* David, *R. phrynoides* Boul., *R. gammiei* Anderson, *R. liebighii* Gunther, *R. annandalii* Boul. and *R. assamensis* Sclater. However, the fully webbed feet,

horny black spines on each side of the breast and on the first and second fingers in males and absence of external vocal sacs would easily differentiate *R. fae* (known from Burma) *R. tibetana* (Tibet), *R. sternosignata* (Sind, Baluchistan, Kashmir), *R. phrynoides* (China), *R. spinosa* (China) and *R. liebighii* (Himalayas) from the present species. *R. gammiei* (Darjeeling) has toetips swollen into small discs, no vocal sacs in male and possess horny spinules on forelimbs and breast. *R. annandalii* (Darjeeling) has much smaller, almost hidden tympanum, no vocal sacs in male, black spines on each side of the breast, first finger and metacarpal tubercle, and smaller spines on the inner side of forelimb and second finger. *R. assamensis* (Khasi Hills and E. Himalayas) differs from *R. murthii* in the presence of entirely webbed feet, smooth skin, absence of nuptial pads on inner finger and "Presence of a cutaneous flap of almost circular outline covered with small papillae, each of which bears a short retroverted spine" (Boulenger, 1920). It is thus clear

that the present example is not conspecific with any of the above Ranids and the erection of a new taxon to accommodate it is fully warranted.

ACKNOWLEDGEMENTS

I am thankful to the Director, Zoological

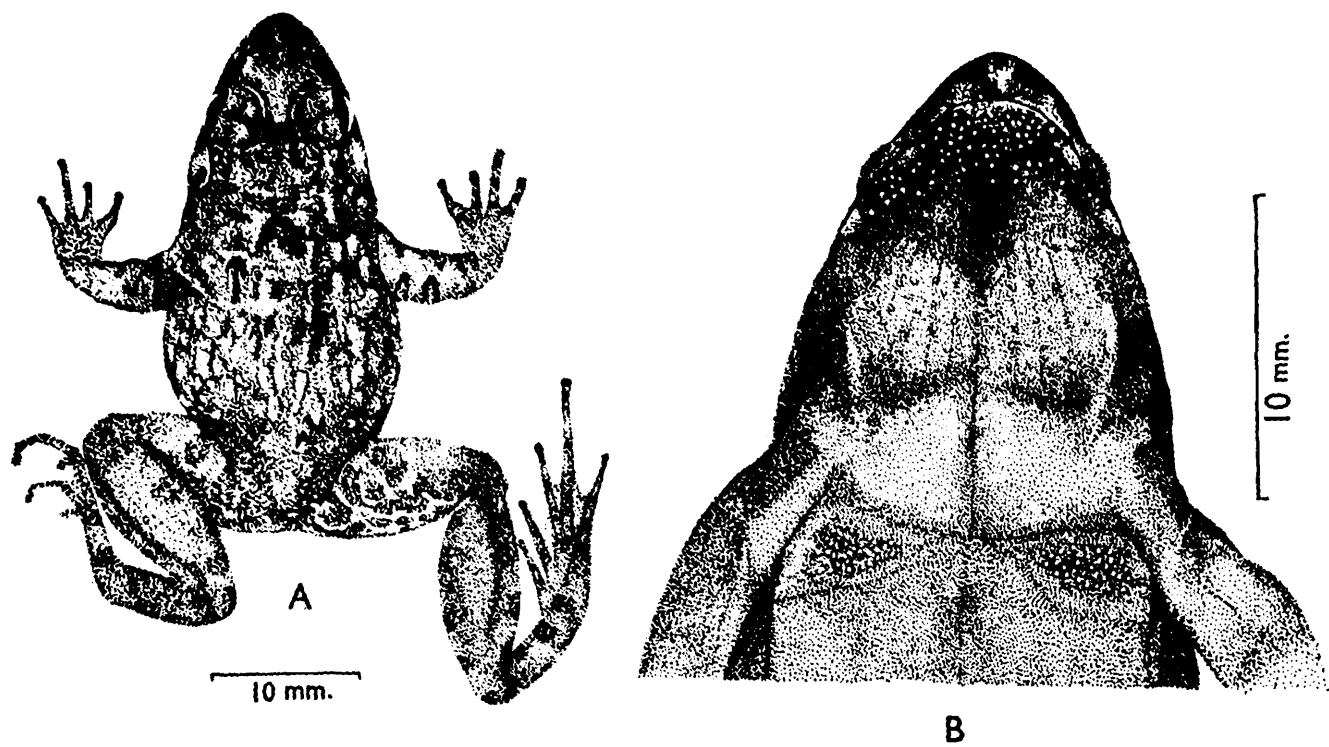
Survey of India, Calcutta and to Dr. A. G. K. Menon, Deputy Director, Zoological Survey of India, Madras for all the facilities and help.

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PILLAI

PLATE IV



(A, B) *Rana murthii* Pillai ; A—Dorsal view, B—Ventral view of head and breast of adult ♂

A NEW SPECIES OF *CUBARIS* BRANDT (CRUSTACEA : ISOPODA :
ARMADILLIDAE) FROM INDIA

LAKSHMAN RAM AND BINOD KUMAR

Zoological Survey of India, Gangetic Plains Regional Station, Patna

ABSTRACT

Cubaris pataliputraensis sp. nov. (Crustacea : Isopoda : Armadillidae) 1;
described from Patna, Bihar, India.

INTRODUCTION

The genus *Cubaris* Brandt (1833) is known only by 17 species from India. The work on Indian Armadillidae includes those of Arcan-
(eli (1934), Chilton (1916, 1924), Chopra (1924a, b), Collinge (1914a,b, 1915a,b, 1916a,b) Ramakrishna (1971) and Verhoeff (1936). The Indian authors have relied more on the structure of head appendages while Budde-lund (1904), Chilton (1915), Collinge (1917) and van Name (1936, 1940, 1942) are depending more on the external outline and tuberculations of the body in recognising species of the genus, particularly in tuberculate species. To avoid confusion both the aspects have been dealt with in the present species.

Cubaris pataliputraensis sp. nov.
(Figs. 1-2)

Body (4.5 mm. long) broadly oblong in dorsal view, parallelsided, broadly rounded in front and behind and highly arched. The epimeral ends of both the thoracic and abdominal segments bend or flare strongly outward. The front outline of the head is slightly convex. The upper border of the

epistome forms a wide, rather thin, horizontally projecting border. Number of ocelli in eyes variable, 16 in holotype but upto 20 in some other specimens.

The lateral margin of thoracic segment I is curved outward though not very abruptly, forming a fairly wide horizontally extending border. Anterior and posterior angles rounded, dorsal surface of epimera concave (excavate). Seen from below, the first thoracic epimera exhibit an oblique coxopodite ridge (Sulcus) which is produced posteriorly into the inner plate (Fig. 2D) of a notch for receiving the second segment when the body is rolled up. The cleft at the posterior angle of segment I is small but is continued forward (Fig. 2D) as a diminishing groove for half the length or somewhat more of the border of the segment. The thoracic segment II bears a well developed posteriorly directed (Fig. 2E), tooth like coxopodite process.

Telson (Fig. 1) is much wider than long and has the lower or terminal part strongly bent out horizontally ; upper part, nevertheless appears to extend the length of the segment in its width. The middle part of

the telson is constricted in width and bears a pair of tubercles. The basal joints of uropods are short and wide and do not project beyond the telson. The internal branches are very short, the external branch is minute.

The whole body surface including tubercles is sculptured with scales as shown in figure 2C.

Tuberculation : The dorsal surface (Fig. 1) is ornamented with large regularly arranged

tubercles. These are conical or rectangular with the tips rounded off.

The head has normally three transverse rows of tubercles, the posterior row having six which are larger than those of anterior ones. The middle row has two and anterior row has four tubercles. Tubercles of anterior and middle rows are conical. In a few specimens other than holotype there is a pair of tubercles further anterior on the head.

On the segments of thorax (except the first

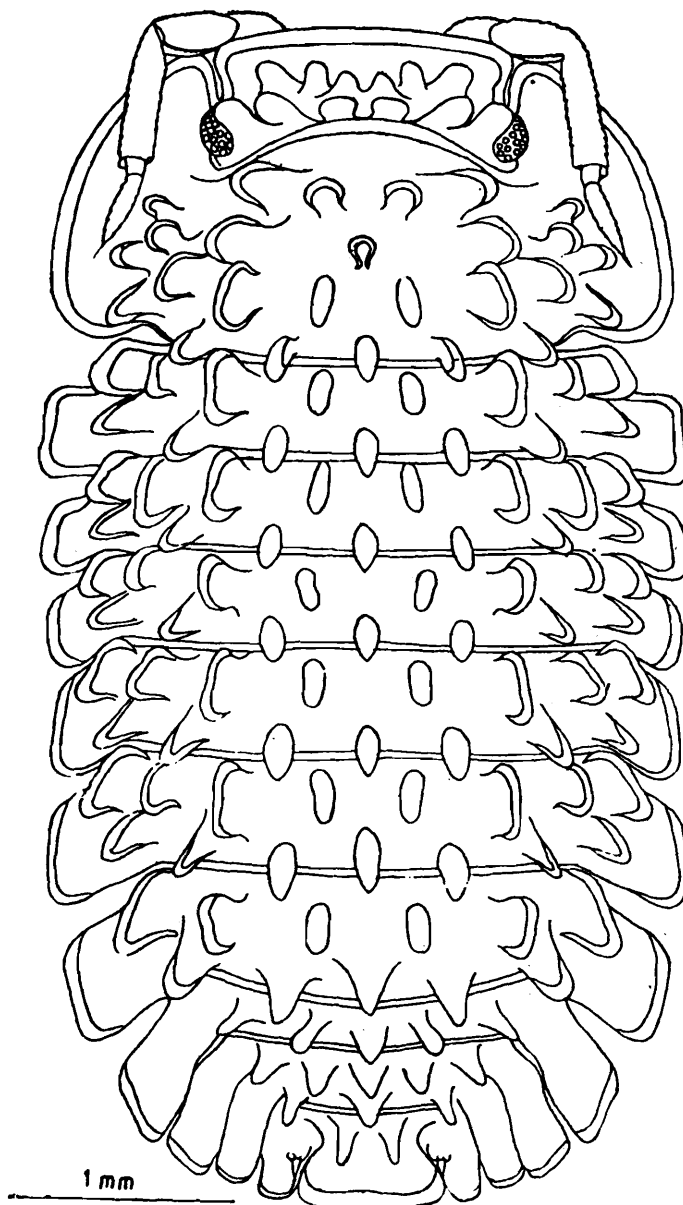


Fig. 1. *Cubaris pataliputraensis* sp. nov. (Dorsal view of the type specimen.)

on which there are four rows) they form two rows ; an anterior row of eight and a posterior row, very close to the posterior

margin of each segment, of seven (6 and 5 on segment VII). The lateral most tubercles of anterior row on the segments of thorax are

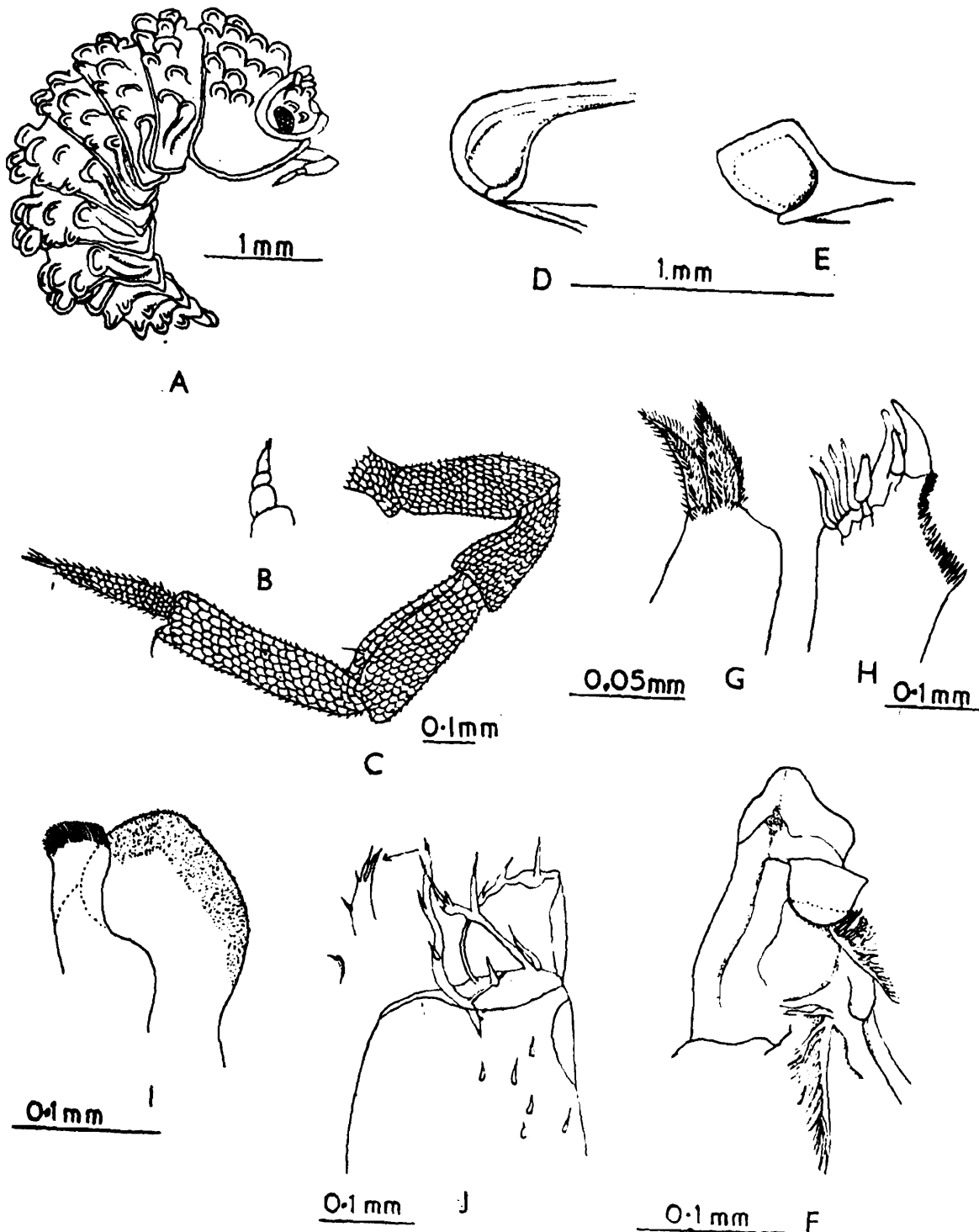


Fig. 2. (A-J) *Cubaris pataliputraensis* sp. nov., A-Lateral view of the animal showing ridges, B-Antennule, C-Antenna showing arrangement of scales, D-E-Ventral view of thoracic segment I and II showing ridge and groove, F-Terminal portion of right Mandible, G-H-Terminal part of Maxilla I, Inner and outer lobe, I-Terminal portion of Maxilla II, J-Terminal portion of Maxilliped,

the largest. From this large tubercle a fairly well defined curved ridge or keel (Fig. 2A) extends down towards the lateral end of the segment.

Abdominal segments are smooth except for a horizontal row of five conical tubercles on each segments III and IV and three tubercles on segment V and a pair on the telson. The tubercles are more pronounced with the age.

Head appendages : The antennule (Fig. 2B) is three jointed with distal joint attenuated and provided with a number of fine setae.

Antenna (Fig. 2C) short, sparsely setaceous, joints three to five slightly grooved on their outside, flagellum two-jointed, the distal being the longer with stout terminal style and two fine setae. The flagellum is narrow, thickly setose and is equal to the 4th peduncular segment. Distal joint of flagellum is five times as long as the proximal one. There is a long seta (Fig. 2C) on the outer margin of the distal end of the 4th and another on inner margin of the distal end of 5th segment.

Mandible (Fig. 2F) is provided on its outer cutting edge with trifold blunt tooth and another flattened tooth on its inner side with two tufts of setae below it.

First maxilla (Fig. 2G, H) has outer lobe (Fig. 2H) terminating in four stout incurved and five small inner spines. It has short simple hair-like setae on its outer margin. The inner lobe (Fig. 2G) is short nearly rounded distally with two setaceous spines on a wide projection.

Second maxilla (Fig. 2I) is thin and plate-like, terminating distally in a bilobed manner ; the outer lobe is fringed with setae and those on the inner, form a brush-like lobe.

Maxilliped (Fig. 2J) with the outer palp terminating in a large trispinous process with another three small spines on its outer margin which is not straight, and two large and one small on its inner margin. Inner palp broad with two stout blunt teeth like spines having broad bases and one large pointed spine near the middle of its apex. A large pointed spine at the base of the outer palp at its inner margin, and a smaller one about its middle. Ventral surface of the maxilliped behind the palp provided with a number of short spines.

Colour : Reddish brown with white spots and whitish narrow band along mid dorsal line. The Uropods are light yellow.

Type Specimens :

Holotype : ♂ (Z. S. I. / G. P. R. S. Reg. No. A888), INDIA : BIHAR : Patna, Rajendra Nagar, Under stones, 11. VII. 1976 (Coll. Lakshman Ram).

Paratypes : 1 ♀ (Z. S. I. / G. P. R. S., Reg. No. A889), data same as for holotype. 3 ♀♀, 3 ♂♂ same locality as for holotype, 4. II. 1977 (Coll. Lakshman Ram).

Remarks : *Cubaris pataliputraensis* sp. n. is closely allied to *C. tuberosus* Budde-lund (1904) but can easily be distinguished from it by the presence of 3 tubercles on abdominal segment V and by the presence of greater number of ocelli. It differs from *C. mineri* van Name (1936) and *C. phylax* van Name (1936) in the number of tubercles on body and in the shape of the coxal ridge under the thoracic segment I.

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Z. S. I., Patna for providing laboratory facilities and encouragement and also to Dr. S. K. Gupta, for his helpful suggestions. Thanks are also due to Shri G. Ramakrishna of Z. S. I., Calcutta, for providing us the literature. We are also thankful to Sri N. M. Chatterjee, Artist, for his assistance in the drawings.

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ON A NEW SPECIES OF GENUS *EUBORELLIA* BURR (DERMAPTERA : CARCINOPHORIDAE) FROM PHILIPPINES

G. K. SRIVASTAVA

Zoological Survey of India, Calcutta

ABSTRACT

A new species of Dermaptera, *Euborellia philippinensis* sp. n., from Laguna, Agriculture College compound, Philippines, is described. A key to the known species of *Euborellia* Burr from Philippines is also provided in the paper.

Recently, a small collection of Dermaptera from Philippines was sent to me for identification by Mr. Jesmandt Situmorang, University of the Philippine at Los Banos, College of Agriculture, Laguna. It contained a few examples of *Labidura riparia* (Pallas), *Nala lividipes* (Dufour) and *Euborellia stali* (Dohrn). Besides, a new species is also represented which is being described here.

The genus *Euborellia*, is represented by four species, i. e., *E. stali* (Dohrn) *E. annulipes* (Lucas) ; *E. plebeja* (Dohrn) and *E. femoralis* (Dohrn), in Philippines. The record of last specis from Philippines rests on a ♀ doubtfully referred by Borelli (1916) to this species.

A key to the known species from Philippines including the new species described.
(Based on males only)

- | | |
|---|------------------------------------|
| 1. Sides of abdominal segments
7 to 9 ecarinate | 2 |
| —Sides of abdominal segment
7 to 9 carinate | 3 |
| 2. Elytra and Wings well developed | <i>E. plebeja</i> (Dohrn) |
| —Elytra abbreviated in the
from of narrow ovate flaps
one mesonotum | <i>E. philippinensis</i>
sp. n. |
| 3. Usually apterous : paramere
without a distinct inner apical
concavity | <i>E. annulipes</i> (Lucas) |
| —Elytra and wings present or
former abbreviated and
latter wanting ; parameres
with a distinct inner apical
concavity | 4 |
| 4. Elytra and wings well developed..... | <i>E. femoralis</i> (Dohrn) |

—Elytra abbreviated in the
from of narrow ovate flaps
on mesonotum and wings
absent *E. stali* (Dohrn)

Euborellia philippinensis sp. n.

(Fig. 1E—H)

Material examined : Philippines, Laguna, Agriculture College Compound, Holotype ♂ (Regd. No. 7505/H5), 19. x. 1977, paratypes 2 ♂♂, 3 ♀♀, 19. x. 1977 ; m 1, 3 ♀♀, 20. i. 1978 (*J. Situmorang* Coll.) all deposited in the National Collections of the Zoological Survey of India except paratype 1 ♂, 3 ♀♀ in the Department of Entomology, College of Agriculture, Laguna, Philippines.

General colour dark brownish black or black, mouth parts, two basal as well as one or two ante-apical antennal segments yellowish bown ; legs clear yellow, in some females apical portion of femora close to knee joint with a faint brownish black spot dorsally.

♂ : Head triangular, smooth, pilose, sutures obliterated, about as long as broad or slightly longer, hind margin feebly emarginate in middle. Antennae 16-segmented, 1st segment slightly longer than the combined length of 2nd and 3rd ; 2nd small ; 3rd long and slender, almost equal to 6th ; 4th onwards segments becoming stouter and increasing in length. Pronotum slightly longer than broad, anterior and lateral margins straight, latter

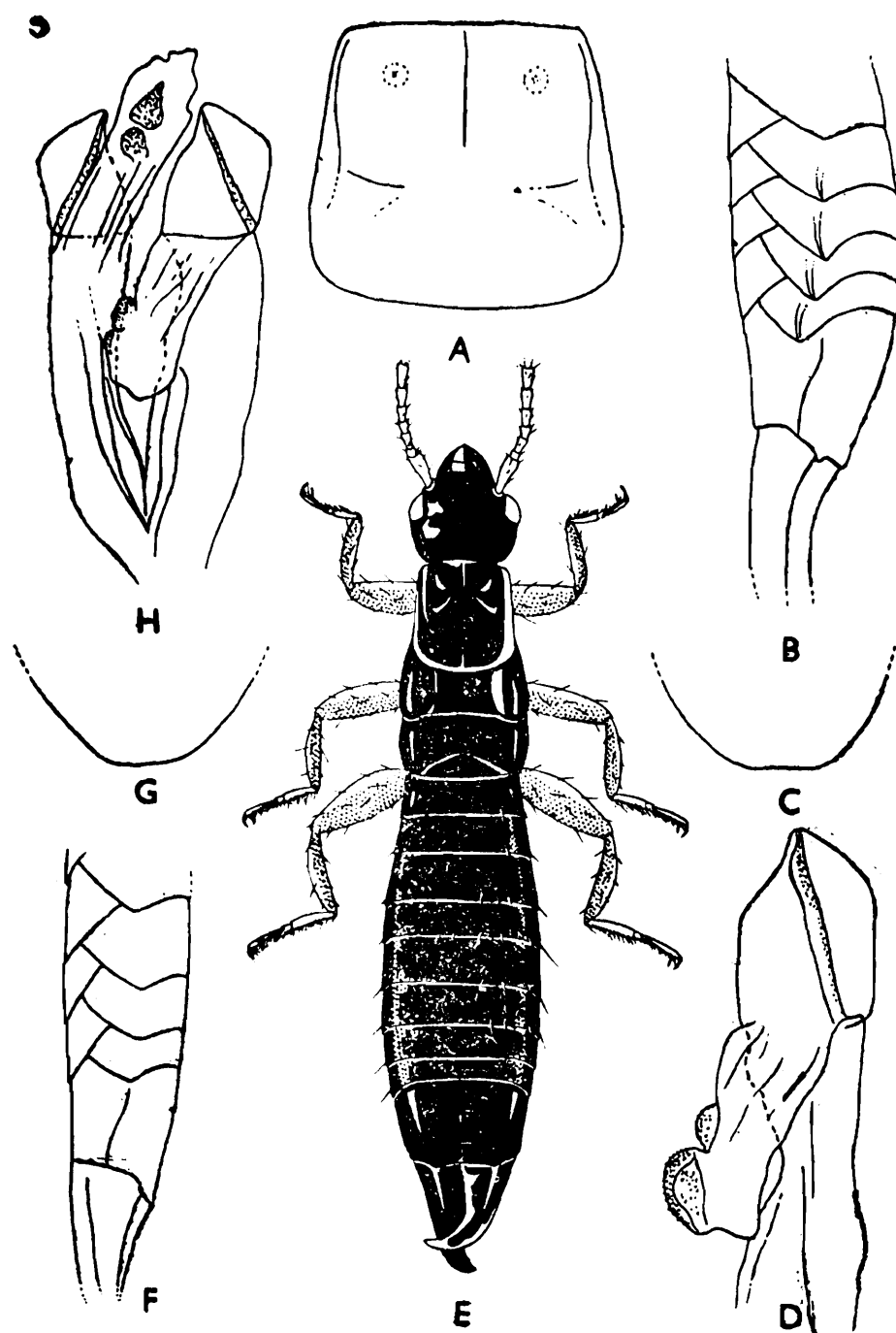


Fig. 1. (A-D) *Euborellia stali* (Dohrn) ♂ ; A—pronotum, B—Lateral view of abdomen, C—posterior margin of penultimate sternite, D—A portion of genitalia ; (E-H) *Euborellia philippinensis* sp. n., Holotype ♂ ; E—Dorsal view, F—Lateral view of abdomen, G—posterior margin of penultimate sternite, H—Genitalia.

gently reflexed, slightly widened posteriorly with angles and margin broadly rounded, median sulcus faintly marked, prozona weakly raised and metazona less so. Elytra present as narrow ovate flaps on mesonotum with

hind margin convex or truncate in some specimens only. Legs typical of the genus. Abdomen long and slender, weakly convex, smooth, lateral tubercles poorly developed, gently enlarged in middle, sides of segments

6th to 9th obtuse, smooth or sometimes with faint striations but always ecarinate. Penultimate sternite posteriorly with hind margin obtusely rounded, manubrium about two and half times longer than the sternite and dilated at apex. Forceps with branches contiguous or subcontiguous, tapering apically, right branch almost straight, only slightly curved a little before apex whereas right branch strongly curved at about middle and crosses over the left a little before apex, trigonal above in basal one third, afterwards somewhat depressed, inner margin serrated. Genitalia with parameres about as broad as long, external apical angle distinct.

♀ : Agrees with males in most characters except that the sides of abdominal segments rounded, penultimate sternite comparatively more narrowed posteriorly and forceps simple and straight.

Measurements (in mm.)

	Holotype		Paratype
	♂	♂♂	♀♀
Length of body	8.6	9.0—10.0	10.1—13.4
Length of forceps	1.3	1.25—1.3	1.0—1.6

(In case of ♀♀ body segments are greatly distended due to preservation in spirit therefore it is not possible to give accurate measurements).

REMARKS

This species comes very close to *Euborellia stali* (Dohrn) but differs in having hind margin and angles of the pronotum broadly rounded ; sides of abdominal segments somewhat obtuse and ecarinate and parameres with external apical angle sharp.

In *E. stali* (Dohrn), from various localities, from Ceylon, India and Philippines, it has been found that the hind margin of pronotum is subtruncate ; sides of 7th and 9th abdominal segments are carinate and the external apical angle of parameres is broadly rounded (Fig. 1A-D).

ACKNOWLEDGEMENTS

I am thankful to the Director, Zoological Survey of India, Calcutta for providing necessary facilities. My thanks are also due to Mr. J. Situmorang, Department of Entomology, University of Philippines at Los Banos, College of Agriculture, Laguna, Philippines for placing this interesting collection at my disposal.

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A NEW SPECIES FROM INDIA OF THE TERMITE-GENUS *PROCRIPTOTERMES* HOLMGREN (KALOTERMITIDAE), WITH A DESCRIPTION OF THE HITHERTO UNKNOWN IMAGO OF *P. DHARI* ROONWAL AND CHHOTANI

GEETA BOSE

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ABSTRACT

While working out a collection of termites from southern India a new species of the genus *Procryptotermes* Holmgren, first reported from India by Roonwal and Chhotani (1963), has come to light. It is described from imago, soldier and pseudoworker. The hitherto unknown imago of the species *Procryptotermes dhari* Roonwal and Chhotani is also described here from an associated collection of an imago, soldiers and pseudoworkers from Coimbatore, which is the type-locality of the species. The affinities of the new species with *P. dhari* and *P. hunsurensis* are also discussed.

INTRODUCTION

Roonwal and Chhotani (1963) recorded the occurrence of the genus *Procryptotermes* Holmgren from the Indo-Malayan region and they described the species, *P. dhari*, from soldier and pseudoworker castes. While studying the termites of southern India, I have come across a new species and a collection of *P. dhari* from Coimbatore, the type-locality of the species, containing a dealated imago associated with soldiers and pseudoworkers. Both the new species and the imago of *P. dhari* are described here.

In addition to the usual type categories, the categories 'morphotype' and 'paramorphotype' have been used to designate the specimens of different castes as they are widely used in social insects where caste polymorphism is prevalent.

I am grateful to the Director, Zoological Survey of India, for facilities and encouragements ; to Dr. D. N. Raychaudhuri, Professor in Zoology, Calcutta University, for guidance and to Dr. O. B. Chhotani for confirming my determinations and going through the manuscript of this paper.

Procryptotermes valeriae sp. nov.

DESCRIPTION

Imago (Dealate) (Fig. 1 A & B) : Head-capsule, postclypeus, wing-scales and abdomen light chestnut brown ; head slightly darker near ocelli and in region of frons ; anteclypeus hyaline ; labrum yellowish brown ; antennal segments brownish and chitinated, apically pale yellowish. Head and body sparsely pilose. Total length without wings c 5.9 mm.

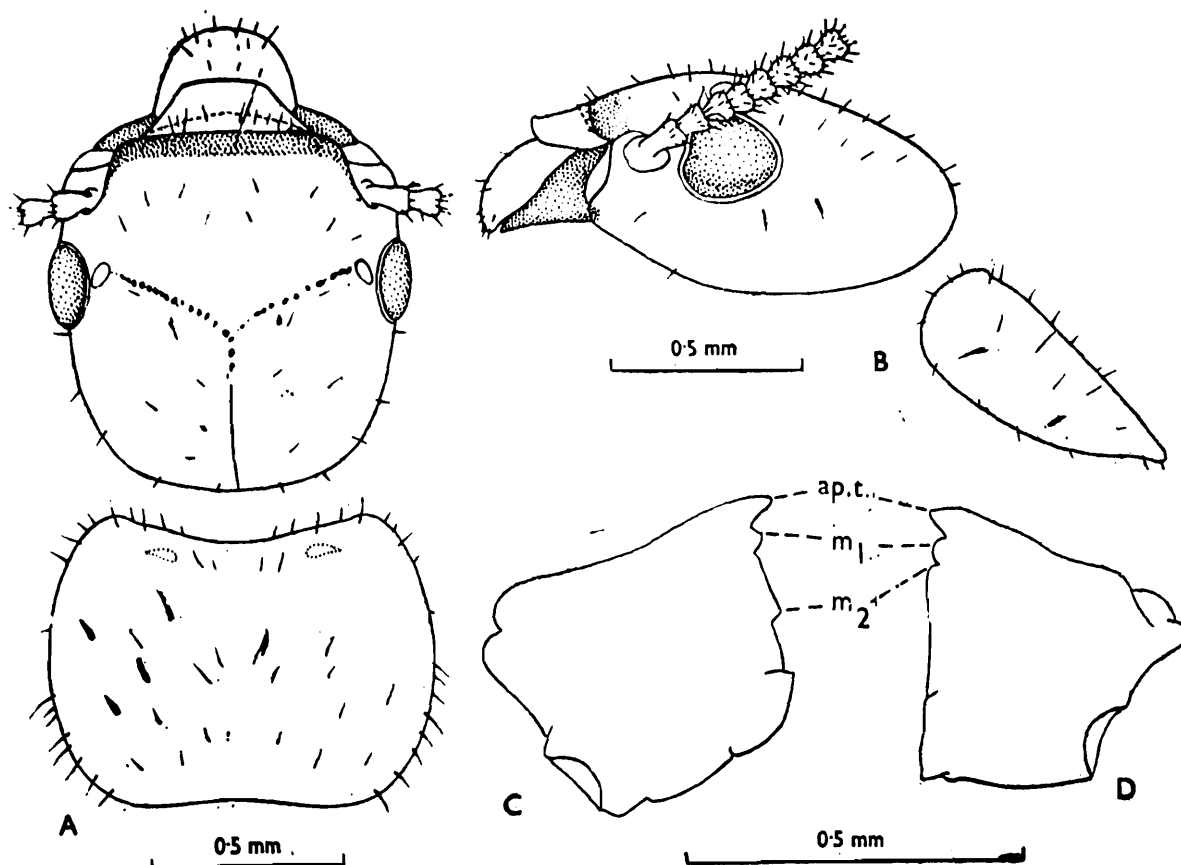


Fig. 1 *Procryptotermes valeriae* sp. n. Imago (de alate) and pseudoworker. A—head and pronotum of imago in dorsal view ; B—head and pronotum of imago in side view ; C, D—left and right mandibles respectively of pseudoworker, in dorsal view. ap. t. - apical tooth ; m_1 , m_2 - first and second marginal teeth, respectively.

Head-capsule subrectangularly oval, broadest in region of eyes ; length to base of mandibles (1.0 mm) equal to width including eyes ; with a few hairs scattered all over ; frons slightly sloping in front up to postclypeus ; Y-suture faint, lateral arms hardly discernible. Eyes medium sized, black, sub-circular (max. diameter 0.30, min. 0.24 mm), anteriorly faintly incurved ; lying close to antennae (eye-antennal distance 0.04 mm). Ocelli suboval (max. diameter 0.1 mm), translucent, small, situated very close to eyes (eye-ocellus distance 0.02 mm). Antennae broken, only 9 segments present ; segment 1 large, cylindrical, 2 shorter than 1, subequal to 3 ; 3 and 5 subequal, shortest ; 6 onwards gradually increasing in size. Postclypeus flat, narrow, faintly demarcated from

frons ; with a few short hairs at anterolateral corners. Anteclypeus trapezoidal, as broad as postclypeus and straight, at anterior margin. Labrum broadly tongue-shaped (length 0.23, width 0.40 mm) ; broadest near middle, converging therefrom to substraight anterior margin and narrowing posteriorly somewhat ; with a number of short, bristle-like hairs anteriorly. Mandibles not examined in the single specimen available. Pronotum stout, shield-like, subrectangular (length 0.73, width 1.04 mm) ; a little broader than head with eyes ; with a few, long and short hairs on anterolateral and posterolateral margins and some on body ; anterior margin concave, posterior margin faintly incurved. Legs rather short and stout ; sparsely pilose with short hairs ; each tibia with 3 apical

spurs; empodium between claws present. Abdomen elongate, oval. Cerci 2-segmented; 0.05 mm long. Styli single-segmented; 0.06 mm long.

Soldier (Fig. 2, Table 1): Head-capsule at frons, postclypeus and mandibles dark chestnut brown; antennae, posterior part of head and thorax paler, reddish brown; legs and abdomen brownish yellow. Head and body fairly pilose.

Head-capsule subrectangular; a little longer than broad; frons impressed centrally and sloping in front up to postclypeus; an erolateral region with two, bluntly pointed, horn-like projections just above antennae on each side, one situated near lateral margin of postclypeus and other as a prolongation of ventral genae. Eyes elongately suboval, translucent; maximum diameter 0.15-0.18 mm, minimum diameter 0.10-0.13 mm; from

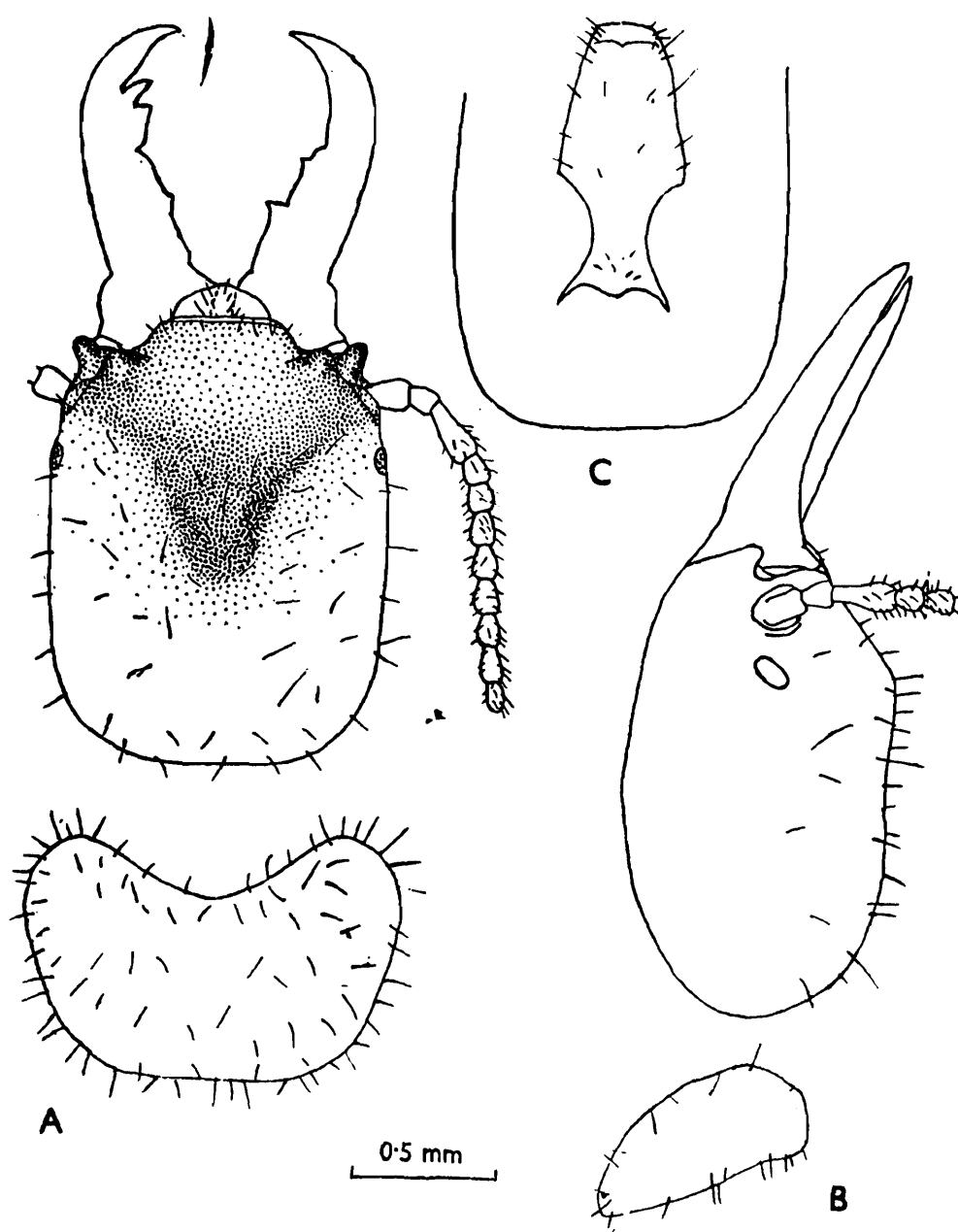


Fig. 2 *Procryptotermes valeriae* sp. n. Soldier, A—head and pronotum in dorsal view; B—head and pronotum in side view; C—head in ventral view; showing postmentum,

TABLE 1. Measurements (in mm), etc, of soldier of *Procryptotermes valeriae*.

Body - parts	Range (6 ex)	Holotype
Total body-length (excluding antennae) c	4.95—6.44	6.44
Length of head to lateral base of mandibles	.. 1.48—1.57	1.57
Maximum width of head	.. 1.20—1.28	1.27
Maximum height of head	0.85—0.93	0.93
Head Index I (Width/Length)	0.81—0.83	0.82
Head Index II (Height/Width)	0.68—0.73	0.73
Head Index III (Height/Length)	0.57—0.60	0.60
Maximum length of labrum	0.10—0.15	0.13
Maximum width of labrum	... 0.30—0.33	0.33
Length of mandibles (from upper base of condyle to tip) :—		
(a) Left mandible	.. 1.00—1.10	1.10
(b) Right mandible	.. 1.00—1.07	1.05
Head-mandibular length index (Left mandible-length/Head-length)	.. 0.66—0.72	0.71
Maximum diameter of eye	.. 0.15—0.18	0.15
Minimum diameter of eye	.. 0.10—0.13	0.10
Minimum median length of postmentum	.. 0.75—0.84	0.75
Maximum width of postmentum	.. 0.38—0.40	0.40
Width of postmentum at waist	.. 0.20	0.20
Maximum length of pronotum	.. 0.70—0.75	0.70
Maximum width of pronotum	1.20—1.28	1.23
Pronotum-head Index (Pronotum-width/Head-width	.. 0.96—1.06	0.96
Pronotum Index (Length/Width)	.. 0.54—0.60	0.57
Maximum width of mesonotum	.. 1.00—1.05	1.03
Maximum width of metanotum	1.08—1.13	1.08

antennae lying at a distance of a little less than their minimum diameter. Ocelli absent. Antennae 11 to 13-segmented ; segment 1 long cylindrical ; 2 shorter than 1, 3 club-shaped 1. almost twice of 2 ; 4 shorter than 2 ; 5 to penultimate gradually increasing in size ; last short, ovate. Clypeus divided into an ante- and a postclypeus. Postclypeus much wider than long, trapezoidal ; with a few pairs of long hairs on anterior margin. Anteclypeus

thin, hyaline, apilose, strip-like. Labrum broad, short, pointed in front and with a cluster of hairs on tip (2 long and a few shorter ones) and a few medium-sized hairs on body. Mandibles strong and large ; curved strongly at apex and robustly toothed. Left mandible with four marginal teeth ; 1st marginal short, conically pointed ; 2nd broader, with a blunt tip and long posterior margin ; 3rd small, with long anterior and

posterior, margins ; 4th a short one at base. Right mandible with 2 marginals ; 1st situated at about middle, fairly large, sharply pointed and with a long posterior margin ; 2nd large, broad, bluntly pointed and with a long posterior margin, situated at about basal one-third of mandible. Postmentum short, club-shaped ; at waist about half as wide as at maximum width. Pronotum flat, semicircular ; sides rounded ; anterior margin deeply concave ; posterior margin substraight ; with long hairs on margins and on body. Mesonotum narrower than pronotum, pilose. Metanotum as broad as pronotum pilose. Legs moderately long, pilose ; apical tibial spurs 3 : 3 : 3. Abdomen oblong, pilose ; cerci 2—segmented ; 0.08-0.13 mm long ; styli, when present, single-jointed ; 0.05-0.08 mm long.

Pseudoworker (Fig. 1 C & D) : Pale creamy white, generally ; postclypeus on sides and labrum basally, yellowish ; mandibular teeth dark brown. Fairly pilose.

Head-capsule subcircular. Eyes rudimentary, oval, unpigmented spots. Antennae 13-segmented ; segment 1 long, cylindrical ; 2 shorter than 1 ; 3 shorter than 2 ; 4 and 5 subequal, shorter than 3 ; 6 onwards increasing in size ; last (13th) thin, ovate and a little smaller than penultimate. Labrum broad, tongue-shaped, with a large group of hairs a little below anterior margin and another smaller cluster (of 2-4 hairs) medially. Clypeus divided into an ante and a postclypeus. Postclypeus trapezoidal ; with a row of long hairs at base and smaller ones on body. Anteclypeus thin, hyaline, apilose, strip-like. Right mandible with a large apical and 2 marginals ; 1st marginal short bluntly pointed ; 2nd much shorter, with a long posterior margin ; molar plate shorter than posterior margin of 2nd marginal. Left mandible with a large, finger-like apical and 2 marginals ; 1st marginal small and weakly

triangular ; 2nd pointed backwards, with a long anterior and a short posterior margin. Pronotum broader than long, semicircular, pilose ; anterior margin concave ; posterior margin substraight. Meso—and metanotum broader than pronotum. Legs fairly long, pilose ; apical tibial spurs 3 : 3 : 3. Abdomen oblong, pilose.

Measurements (in mm) of pseudoworker (range of five examples) : Total body-length (excluding antennae) c 4.8-6.6 ; length of head to base of mandibles 1.05-1.10 ; maximum length of pronotum 0.6-0.70 ; maximum width of pronotum 1.08-1.10.

Material : Holotype Soldier (Z. S. I. Reg. No. 543/H11) ; Tirunelveli-Nagercoil Road, between 11-12 milestones from Nagercoil, Tamil Nadu, collector *O. B. Chhotani*, 27. ii. 1969, ex dead branch of *Ficus* tree. Paratypes : morphotype imago (dead) and a pseudoworker (Z. S. I. Reg. No. 544/H11) and paratype soldiers (8) and paramorphotype pseudoworkers (4) (Z. S. I. No. 545/H.1), with the same data as for the holotype. All in spirit, in separate vials, deposited in the National Zoological Collections, Zoological Survey of India, Calcutta.

Distribution : Known only from type-locality.

COMPARISON

This species differs from the other known Indian species as follows :

From *P. dhari* Roonwal & Chhotani (1963) :

Imago : (i) Darker ; antennae brown, strongly chitinized (pale and weakly chitinized in *P. dhari*). (ii) 2nd segment of antennae subequal to 3 vs. shorter. (iii) Eyes slightly smaller (maximum diameter 0.30, minimum

diameter 0.24 mm vs 0.32 and 0.25 mm, respectively in *dhari*) and different in shape.

So'dier: (i) Head shorter and comparatively wider (length 1.48-1.57 vs 1.68-1.77 mm; index width/length 0.81-0.83 vs 0.72-0.74). (ii) Mandibles stronger, not as strongly incurved at apices as in *dhari* and very different in dentition; 1st marginal tooth on left mandible comparatively small, triangular and pointed (vs large and somewhat roundly triangular). Right mandible with more pro-

(absent in *hunsurensis*). (ii) Eyes smaller and straight anteriorly (vs larger and ovally rounded anteriorly). (iii) Ocelli larger and more widely separated from eyes (vs smaller and very close to eyes). (iv) Pronotum differently shaped.

Soldier: Smaller in size (head length to lateral base of mandibles 1.48-1.57 vs 1.60-1.80 mm). (ii) Mandibles more robust and strongly incurved apically, shorter in length (1.00-1.10 vs 1.15-1.25 mm) and with different

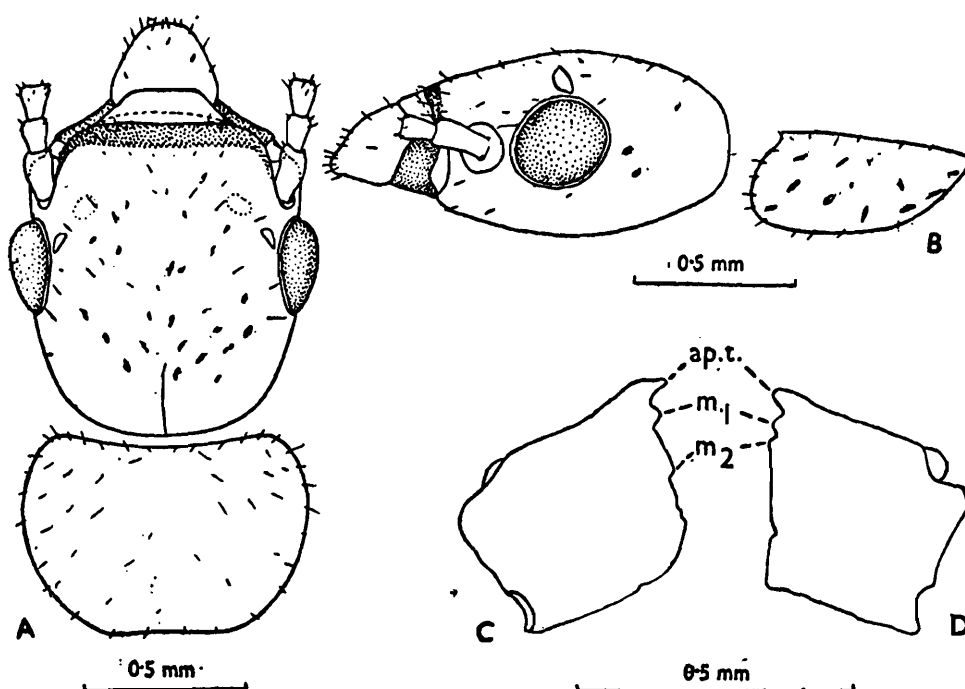


Fig. 3 *Procryptotermes dhari* Roonwal and Chhotani. Imago (dealate) and pseudoworker.

A—head and pronotum of imago, in dorsal view; B—head and pronotum of imago in side view; C, D—left and right mandibles respectively of pseudoworker, in dorsal view. ap. t. -Apical tooth,; m₁, m₂-first and second marginal teeth respectively,

minent marginal teeth. (iii) Postmentum stalk short and broad (long and slender in *dhari*).

From *P. hunsurensis* Thakur (1975) :

Imago: (i) Head-capsule somewhat sub-rectangular and narrower (vs subcircular and somewhat wider) and with a faint Y-suture

dentition. (iii) Pronotum strongly incurved anteriorly vs less so in *hunsurensis*.

Imago of *Procryptotermes dhari* Roonwal and Chhotani

Imago (Dealate) (Fig. 3 A & B) : Head-capsule, postclypeus and mandibles dark reddish brown; anteclypeus hyaline;

antennae, labrum and palpi deep golden yellow ; thorax and abdomen darker dorsally, paler ventrally ; legs pale reddish brown. Fairly pilose, pilosity pale yellowish. Length without wings 4.90 mm.

Head-capsule slenderly oval ; a little longer than broad ; head-length to base of mandibles (0.95 mm), equal to head-width with eyes ; only longitudinal arm of epicranial suture discernible in posterior region. Eyes medium-sized (max. diameter 0.29, min. 0.25 mm), oval, anteriorly substraight and situated close to antennae. Ocelli elongate, oval, small (long diameter 0.10, short diameter 0.06 mm) ; lying very close to eyes (eye-ocellus distance 0.02 mm). Antennae broken, only 8 segments present ; segment 1 long, cylindrical ; 2 shorter than 1 ; 3 little longer than 2 ; 4 and 5 slightly shorter than 2 and subequal ; 6-8 elongate. Postclypeus faintly demarcated from frons ; roughly trapezoidal ; with a few short hairs on anterior margin. Anteclypeus also roughly trapezoidal, hyaline and apilose. Labrum broad, tongue-shaped (length 0.2, width 0.33 mm) ; with a cluster of hairs anteriorly. Mandibles not

examined in the single specimen available. The pseudovicer mandibles examined (Fig. 3 C and L) are generally similar to those of *P. valeriae*. Pronotum flatly rhomboidal ; much wider than long (length 0.58, width 0.93 mm) and as wide as head with eyes ; with a few long and short hairs on margins and body ; anterior margin weakly concave ; posterior margin substraight. Legs short, stout, sparsely pilose ; tibia whitish, each with 3 apical spurs ; empodium between claws pale yellow. Abdomen oval, strongly chitinated ; cerci 2-jointed, 0.08 mm long ; styli single-jointed, 0.06 mm long.

Comparison : see *P. valeriae* above.

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ON A COLLECTION OF PSYLLIDS (HOMOPTERA : PSYLLIDAE) FROM SHILLONG, KHASI HILLS*

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ABSTRACT

Five Psyllid species, viz. *Cicidopsylla schimae* Kieffer, *Euphyllura eastopi* Mathur, *Psylla murrayi* Mathur, *P. viburni* Loew, and *Trioza gigantea curia* Mathur have been recorded for the first time from Meghalaya, India and a new Psyllid genus *Cryptotrioza* with *C. mathuri* sp. nov. as type species has been described from the state.

INTRODUCTION

Very little information is available in literature concerning the Psyllid fauna of Meghalaya, a state adjacent to the North Eastern boundary of Bangladesh in North Eastern India. Mathur (1975) in his monograph on the Psyllidae of the Indian sub-continent reported the occurrence of only two species in the state, viz. *Livia khaziensis* Heslop-Harrison and *Acizzia indica* Heslop-Harrison. In course of survey carried out in 1976-1977, a number of Psyllid specimens could be collected from various parts of Shillong. The collection comprised of six different Psyllid species, including one gen. et. sp. nov. and another five which are all new records from Meghalaya. These have been dealt with in the present paper along with notes and illustration. Type material of the new species has been deposited in the National Zoological collection.

SYSTEMATIC ACCOUNT

Key to subfamilies

- | | |
|--|----------------|
| 1. Head very deeply cleft in front between the antennae ; forewing with more than usual marginal cells..... | Ciriacreminae. |
| —Head not unusually cleft in front ; forewing with only the usual two marginal cells | 2 |
| 2. Forewing with a cubital stem, i. e., media and cubitus with a common stem : basal tarsal segment of hind legs with two claw like spines at apex | Psyllinae. |
| —Forewing without a cubital stem, radius, media and cubitus diverging from a common point or, cubitus branching separately ; basal tarsal segments without claw like spines at apex..... | Triozinae |

Subfamily CIRIACREMINAE

Genus *Cecidopsylla* Kieffer

Cecidopsylla schimae Kieffer

Cecidopsylla schimae Kieffer, 1905, *Ann. Soc. Sci. Bruxelles*, : 165.

* Part 14 of "A preliminary study of the Insect fauna of Meghalaya."

Material examined : 1 ♀, adult, collected on 15. iv. 1977 ex *Schima wallichii* Choisy, at Risha colony, Shillong.

Distribution : India, West Bengal (Kalimpong) and Meghalaya (Shillong).

Remark : Present study extends the distribution of this species further eastwards from earlier records of its occurrence in Bengal.

Subfamily PSYLLINAE

Key to the genera of the subfamily Psyllinae

1. Forewing strongly rhomboidal and thickened ; genae produced into two transverse, contiguous lobes, on the same plane with vertex *Euphyllura* Foerster

—Forewing elongate ovate and hyaline ; genae produced into two subconical, divergent lobes, which are markedly produced in front of vertex *Psylla* Geoffroy

Genus *Euphyllura* Foerster

Euphyllura eastopi Mathur

Euphyllura eastopi Mathur, 1973, *Oriental Ins.*, 7 (4) : 519.

Material examined : 1 ♂, 1 ♀, adults, collected on 24. vi. 1976 ex unidentified host plant, at Okland road, Shillong.

Distribution : India, Himachal Pradesh (Manali) and Meghalaya (Shillong).

Remarks : Present study extends the distribution of this species in North Eastern India. The nymphs cause heavy infestation on young foliage and yield profuse sticky whitish wooly secretion on the back surfaces of leaves (Pl. V), and remain covered by the same.

Genus *Psylla* Geoffroy

Key to the species of the genus *Psylla* Geoffroy

1. Hind tibiae without a basal spur *P. murrayi* Mathur
- Hind tibiae with a basal spur *P. viburni* Loew

Psylla murrayi Mathur

Psylla murrayi Mathur 1975, *Psyllidae of the Indian subcontinent*, : 268.

Material examined : Sev. exs., ♂♂ and ♀♀, adults and reared from nymphs, collected between March to October, 1978, ex. *Citrus acida* Korels, *C. auranticum* L. and *C. medica* L. Risha colony, Shillong.

Distribution : India, Uttar Pradesh (Dehra-Dun) and Meghalaya (Shillong).

Remarks : First described from New Forest, DehraDun, this species was so far known to infect only wild plant *Marraya koenigii* Spreng. It was revealed to be a serious pest of various cultivated Citrus plants in Shillong in course of present investigation. A detailed study on the biology of this species will be published elsewhere.

Psylla viburni Loew

Psylla viburni Loew, 1876, *Verh. zool. bot. Ges. Wien.*, 26 : 194.

Material examined : 1 ♀, adult, collected on 23. vii. 1977, ex *Salix* sp., at Fisheries compound, Shillong.

Distribution : India, Himachal Pradesh (Chopal) and Meghalaya (Shillong) ; widely distributed from Central Europe to Japan.

Remarks : This widely distributed species has been reported here for the first time from Eastern India and also from new host plant, earlier having been known to feed upon *Viburnum* sp.

Subfamily TRIOZINAE

Key to the genera of the subfamily Triozinae

1. Cubitus branching separately ; radius and media fused at base forming a long petiole
 Genus *Cryptotrioza* nov.
- Radius, cubitus and media branching from a common point *Trioza* Foerster

Cryptotrioza gen. nov.

Body large and stout. Head including eyes narrower than thorax, deflexed ; post ocellar region moderately swollen ; front ocellus visible from top ; genal cones moderately large, separated at base, diverging apically and subrounded at apex ; vertex subquadrate, broader than long ; median suture prominent, grooved ; eyes large, hemispherical ; antennae long, nearly four times as long as the width of eyes, 10 segmented and thickly pubescent. Thorax large, arched. Pronotum narrow, collar like, convexly rounded. Prescutum as long as broad ; scutum a little broader than long ; scutellum nearly twice as broad as long ; pleural suture oblique, not extending to middle of lateral extremities of pronotum ; epimeron a little shorter than episternum. Legs slender ; hind tibiae with one or two basal spur and four apical black spines situated on inner side except one, which is situated on outer side ; basal tarsal segment of hind leg without apical spine. Wings hyaline, membranous ; forewing acute at apex, cubital petiole (M+Cu) wanting, cubitus branching separately, media fused with radius at base, the common petiole thus formed is a long one, covering half the distance from origin of cubitus and branching of radius ; Rs. long, extending nearly twice as long as the second. Hindwings considerably shorter than forewings.

Type-species : *Cryptotrioza mathuri* sp. nov.

The genus is very close to *Trioza* Foerster

1848 in general features, but differs from the same in the presence of a long petiole formed by the fusion of radius and media at base. In this character *Cryptotrioza* resembles some species of the genus *Ceropsylla* Riley 1883, but the petiole is distinctly much longer in *Cryptotrioza* and these two genera are also markedly distinct in relative length of the vein Rs.

Cryptotrioza mathuri sp. nov.

Material studied : Holotype ♂, mounted on slide, reared from nymph, collected on 24. vi. 1976, ex *Simplocos* sp. at Risha colony, Shillong. (Regd. No. E.R.S./Z.S.I. A1/4759) ; Allotype ♀, other data same as Holotype (Regd. No. ERS/ZSI. A1/4760) ; Paratypes 2 ♀ ♀, unmounted other data same as Holotype (Regd. No. ERS/ZSI. A1/4761 and 4762). Holotype and Allotype deposited in the National Zoological collection, Zoological Survey of India, Calcutta. Paratypes in the collection of the Eastern Regional Station, Z S.I., Shillong.

Measurements (in mm).

Length of body, in ♂ 3.75 ; in ♀ 3.6-4.5

Length of forewing, in ♂ 5.2 ; in ♀ 4.8-5.5.

Width of head with eyes 1.0

Width of vertex between eyes 0.55

Length of antennae 3.5-4.0.

Colouration : Beautiful grass green when alive, changing to yellowish in preserved specimens ; eyes black, fore and middle pair of legs brownish, hind legs whitish.

Structure : Body large and stout. Head (Fig. 1A) including eyes smaller than thorax, finely and sparsely pubescent ; vertex subquadrate, depressed medially, concavely raised to either eye on sides, convexly sloping downwards posteriorly a little, more markedly so in front ; posterior margin arquate with slightly swollen postocular lobes ; anterior ocellus visible from above ; median suture at

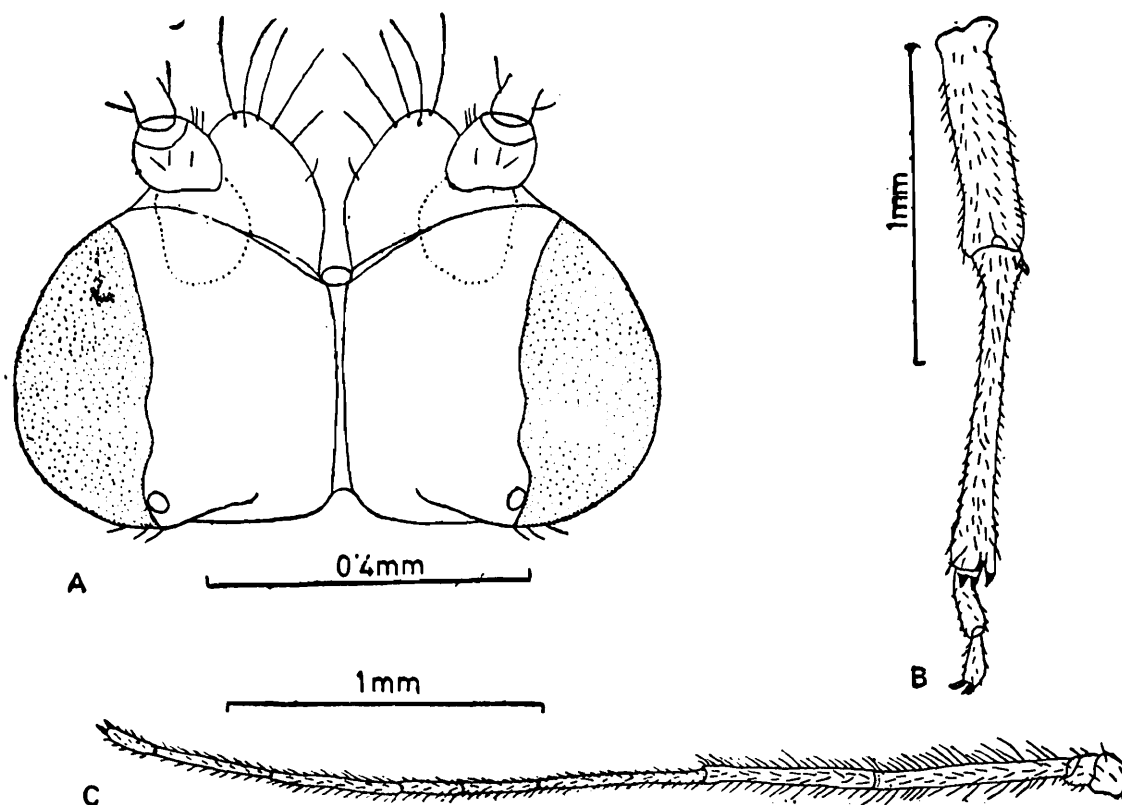


Fig. 1. (A—C) *Cryptotrioza mathuri* gen. et sp. nov. ; A—head in dorsal view ; B—hind tibiae in lateral view ; C—antenna in lateral view.

base of anterior ocellus markedly by a short subacute impression on either side ; genal cones moderately large, with longer setae than on vertex, separated at base, diverging apically and subrounded at apex ; eyes large, hemispherical.

Antennae (Fig. 1C) long, 10 segmented, thickly pubescent ; 3rd segment longest and little longer than the segments 4th, 5th, 8th and 9th, which are subequal and nearly twice in length than the segments 6th, 7th and 10th, which are again subequal to each other.

Thorax moderately arched, finely and sparsely pubescent. Prothorax of nearly equal length throughout, convexly rounded ; prescutum nearly as broad as long, broadest in centre, markedly rounded anteriorly, less so

posteriorly ; scutum a little broader than long, slightly smaller than prescutum in length ; scutellum broadly transverse, nearly twice as broad as long.

Legs long (Fig. 1B) ; fore and middle legs moderately thickly pubescent, hindlegs distinctly much less so ; hind tibiae with a row of 6-7 comblike subapical hairs, a small basal and four conspicuous spurs at apex with thick black tooth, of which one is subapical and three are apical ; in addition a smaller accessory basal tooth usually present ; middle and hind femora with subapical thick setae on either side ; basal tarsal segment a little longer than the apical on all legs, without apical spine ; meracanthus narrowly triangular.

Forewings (Fig. 2A) very large, hyaline,

nearly two and a half times as long as broad, broadest across about middle of the wing, apex acute ; costal margin with regularly spaced short hairs ; the basal vein, radius and R_1 , thick and dark brown, the membrane narrowly on either side of the same is also so ; the inner margin brownish in basal half, rest of the veins yellowish ; three distinct small triangular clouding of points along inner margin, one each at the centre of each marginal cell and another in between these two ; details of venation as stated for genus.

Hindwings (Fig. 2B) a little more than half the length of forewing, its membrane clouded with minute points, the costal margin near base bearing 5-6 moderately long setae.

Genitalia : Male genital segment much

smaller than abdomen. Anal valve (Fig. 3A) 0.40 mm long, anterior margin almost straight, posterior margin subtriangular ; outer surface in posterior half beset with long setae. Parameres (Fig. 3C) 0.30 mm long, strongly bowed in lateral view, ending in a short, thick black tooth. Aedeagus and sperm pump as shown in Figs 3B and 3D respectively.

Female genital segment (Fig. 3E) more than half the length of abdomen. Both plates broad basally and narrowed caudally, sparsely beset with long setae. Apex of dorsal plate subacute, that of ventral plate acute. Circum-anal ring with a double ring of pores. Ovipositor acutely pointed.

Distribution : India, Meghalaya (Shillong).

Remarks : This new species with distinctive large and stout body infects young leaves of *Simplocos* sp. from last week of May and

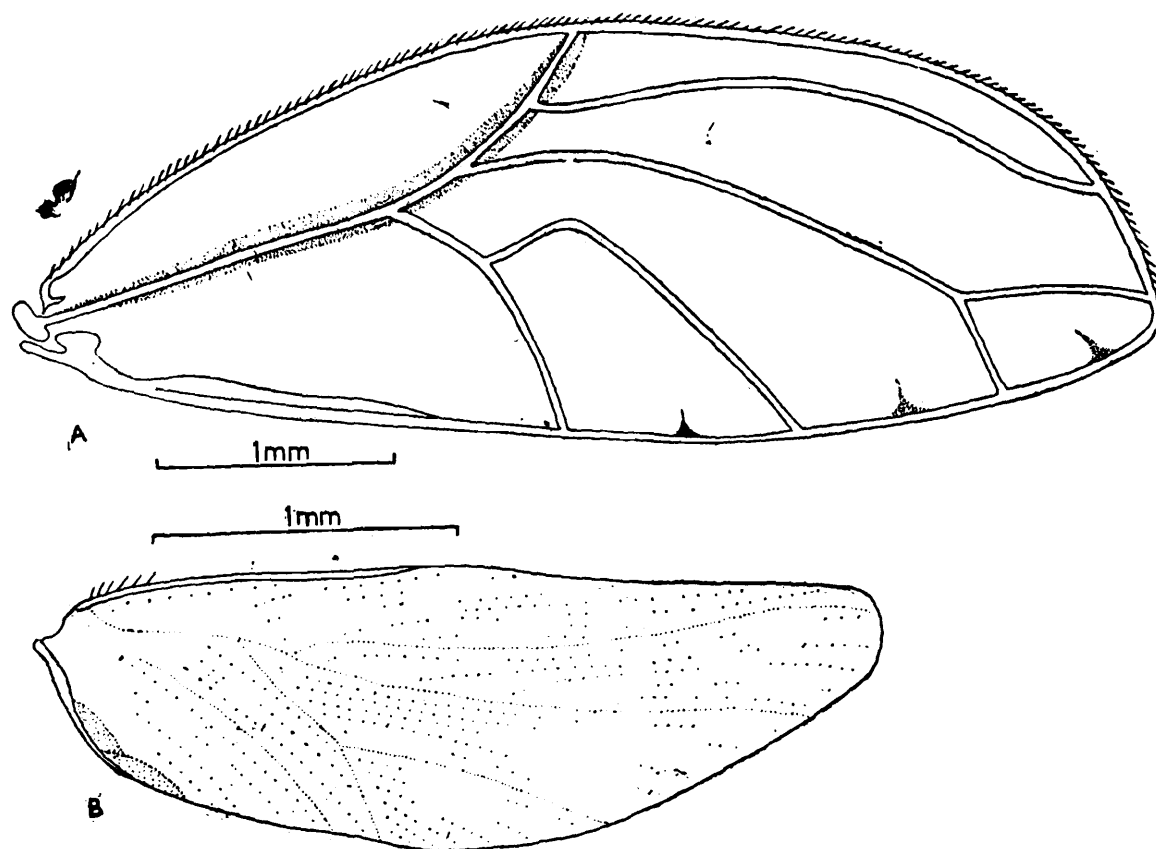


Fig. 2. *Cryptotrioza mathuri* gen. et sp. nov. A—forewing ; B—hind wing ;

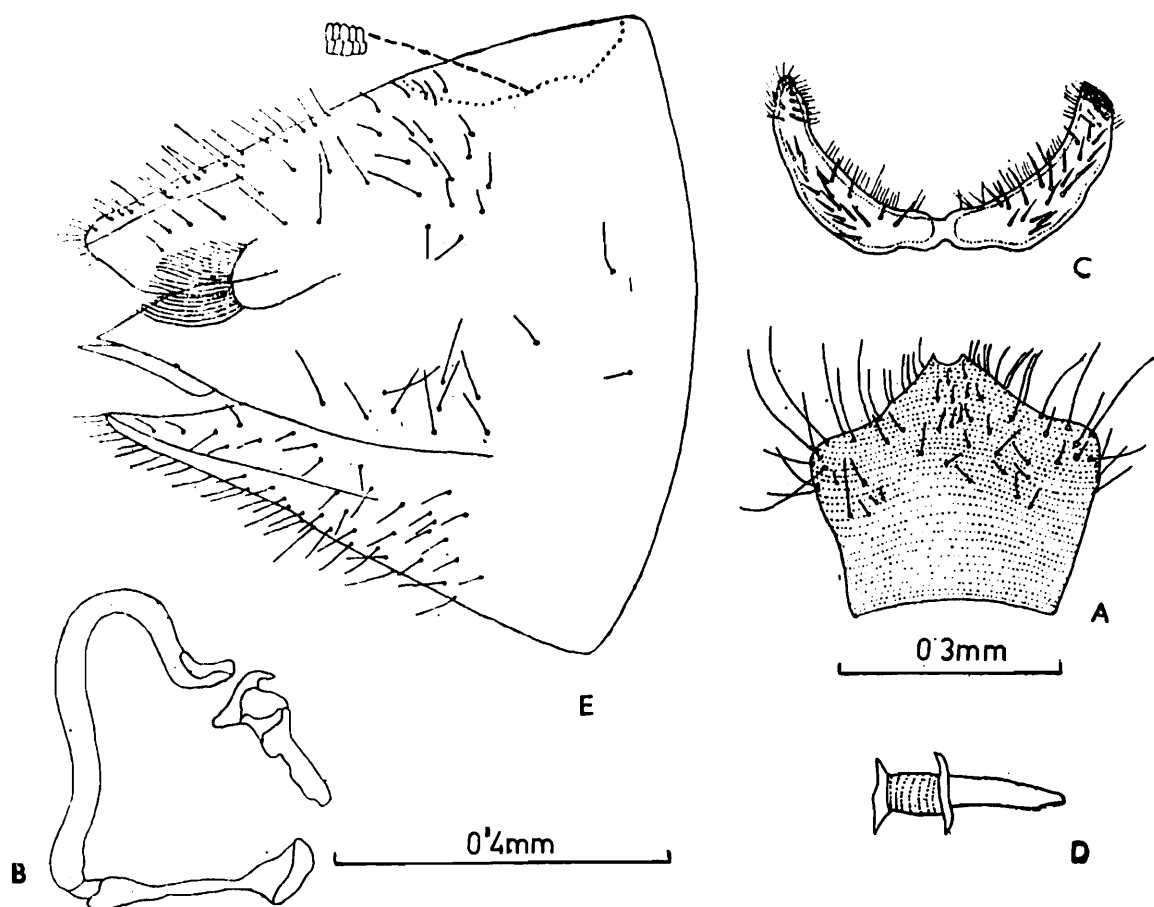


Fig. 3. *Cryptotrioza mathuri* gen. et sp. nov. (A—D) male genitalia ; A—anal valve ; —aedeagus ; C—parameres ; D—sperm pump ; E—female genitalia in lateral view. [Fig. (A & C) and (B, D & E) are drawn on same scale]

the infection becomes over by the first week of June. The nymphs harbour inside the longitudinally curled leaves. The final instar nymphs emerged into adults in the laboratory between 24 to 72 hours of collection.

The new species is dedicated to Lt. Dr. R. N. Mathur.

Genus *Trioza* Forester

Trioza gigantea curta Mathur

Trioza gigantea curta Mathur, 1975, *Psyllidae of the Indian subcontinent*, : 375.

Material examined : 4 ♂♂, 6 ♀♀, adults

and reared from nymph, collected on 15 and 18. iv. 1977, ex. *Schima wallichii* Choisy, at Risha colony, Shillong.

Distribution : India, West Bengal (Darjeeling), Meghalaya (Shillong).

Remarks : Present study extends the distribution of this subspecies further eastwards from its earlier distributional record in West Bengal. Its host plant was unrecorded so far. The nymphs are free living and aggregate on the back surfaces of leaves. The newly emerged flies are pale green in colour and unmarked, thus differing from the adults which are marked conspicuously with black.

ACKNOWLEDGEMENTS

The authors are thankful to the Director, Zoological Survey of India, Calcutta, for providing an opportunity to carry out this study, to the Officer-in-Charge, Eastern Regional Station, Zoological Survey of India, Shillong, for providing laboratory facilities and to Lt. Dr. R. N. Mathur, Dehra Dun, for

his kind remarks on the identity of the species.

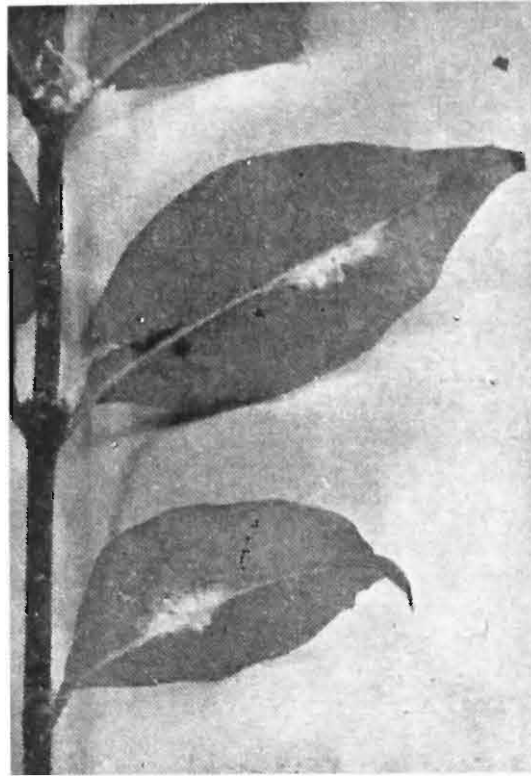
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LAHIRI & BISWAS

PLATE V



Wooly secretion yielded by the nymphs of
Euphyllura eastopi Mathur

STUDIES ON SOME SPIDERS OF THE GENUS *SOSTICUS* FROM INDIA
(ARANEAE : GNAPHOSIDAE)

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ABSTRACT

The present paper deals with four new species of *Sosticus* (*naintalensis*, *dherghanalensis*, *sundargarhensis*, *solanensis*.) Key to the identification of the Indian species has been given.

The spiders of the genus *Sosticus* are very little known. The genus was erected by Chamberlin (1922) to accommodate two species collected from America and subsequently Fox (1938) described a third species from Indiana. Ubick and Roth (1973) synonymised the three species into one species. Platnick and Shadab (1976) described two more species from America.

While studying the spiders of the family Gnaphosidae the author encountered four new species of *Sosticus*. This genus is being recorded here for the first time from India.

All type specimens are deposited in the collection of Zoological Survey of India, Calcutta.

Genus *Sosticus* Chamberlin

1922. *Sosticus* Chamberlin, *Proc. Biol. Soc.*, Washington, 35 : 160.

1940. *Sosticus* : Comstock, *The Spider Book*, New York, 329.

1976. *Sosticus* : Platnick and Shadab, *Amer. Mus. Novitates*, 2594 : 9.

Characters : Cephalothorax longer than wide, rounded in dorsal view, widest behind coxae II and gradually narrowed anteriorly, darkest at borders and ocular area. Cephalic area not elevated. Eyes rows distinctly separated. Anterior row of eyes slightly precurved (as seen from in front) ; medians smaller than the laterals. Posterior row of eyes straight or slightly recurved, medians triangular or irregular and smaller than the laterals. Anterior median eye diurnal, other nocturnal. Median ocular quadrangle longer than wide or roughly square. Clypeal height greater than the diameter of anterior median eye. Inner and outer margin of chelicerae with one or two and two or three teeth respectively. Sternum heart-shaped, pointed behind and strongly rebordered. Two spines are present on the dorsal surface of fourth tibia. Abdomen dark gray to black dorsally. Six spinnerets, anteriors widely separated.

Type-species : *Sosticus insularis* (Banks)

Distribution : America.

Key to Indian species of the genus *Sosticus* Chamberlin

1. Abdomen dorsally with white bands

- Abdomen dorsally without white bands... .. 8
2. Inner and outer margin at chelicera with two and three teeth. Abdomen with three transverse white bands... .. *nainitalensis* sp. nov.
- Inner and outer margin of chelicera with two teeth each. Abdomen with two transverse white bands *dherikanalensis* sp. nov.
3. Abdomen with chalk-white round spots. Outer margin of Chelicera with two teeth. Patella of all legs with deep brown patches..... .. *sundargarhensis* sp. nov.
- Abdomen uniform, without chalk-white round spots. Outer margin with three teeth. Patella of all legs without deep brown patches *solanensis* sp. nov.

1. *Sosticus nainitalensis* sp. nov.

(Fig. 1, A—E)

General : Cephalothorax deep brown, legs brown, abdomen deep brown to black. Total length 6.50 mm. Carapace 2.50 mm. long, 2.20 mm. wide ; abdomen 3.80 mm. long, 2.30 mm. wide.

Cephalothorax : Longer than wide, oval, clothed with pubescence, posterior middle of cephalothorax provided with an inconspicuous short fovea. Radiating dark streaks diverge from short fovea to lateral sides of cephalo-

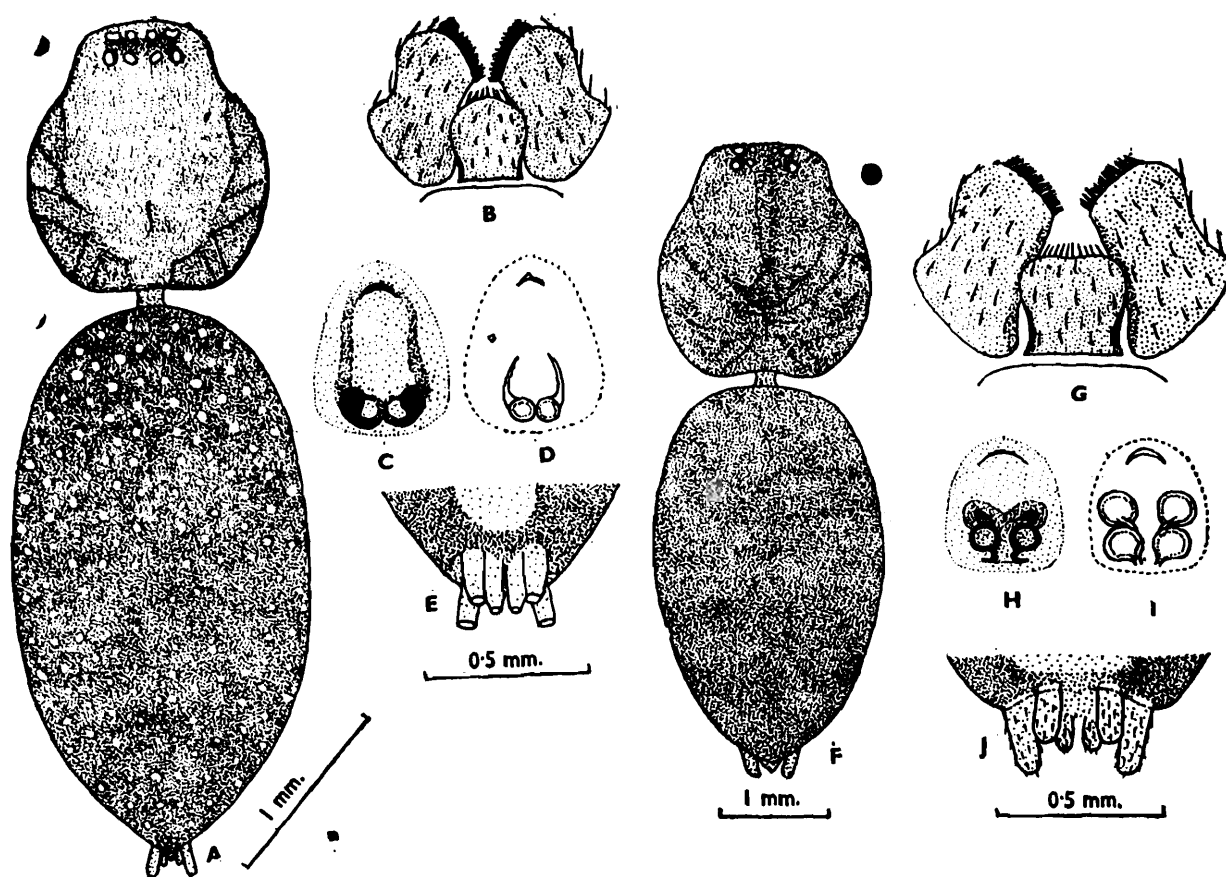


Fig. 1 (A—E) *Sosticus nainitalensis* sp. nov., A—Dorsal view of female, legs omitted, B—Labium and maxillae, C—Epigyne, D—Internal genitalia, E—Spinnerets, (ventral view) ; (F—J) *Sosticus dherikanalensis* sp. nov., F—Dorsal view of female, legs omitted, G—Labium and maxillae, H—Epigyne, I—Internal genitalia, J—Spinnerets, (ventral view).

thorax. Eyes row distinctly separated, pearly white except anterior medians which are black, posterior row of eyes slightly longer than the anterior row. Anterior row of eyes slightly procurved (as seen from in front); medians smaller than the laterals and closer to adjacent laterals than to each other. The median ocular quadrangle longer than broad and wider behind than in front. Clypeal height greater than the diameter of the anterior median eye. Sternum heart-shaped, pointed behind, strongly rebordered, clothed with black hairs. Labium longer than wide, anterior end of labium and maxillae provided with scopulae, shape as in fig. 1B. Chelicerae moderately strong, vertical, inner margin provided with two small teeth and outer margin with three teeth. Legs relatively long and thin, clothed with hairs and spines. Tibia IV provided with two dorsal spines. Scopulae reach up to the base of metatarsi I and II and up to the middle of metatarsi III and IV. Leg formula 4123.

Abdomen : Longer than wide, nearly elliptical, clothed with thick pubescence. Abdomen dorsally provided with three transverse white bands, one at the anterior end, second at just above the middle and third above the anal tubercle as in fig. 1A. Ventral side lighter than the dorsal. Epigyne as in fig. 1C. Internal genitalia as in fig. 1D. Spinnerets prominent, anterior spinnerets widely separated, posterior spinnerets longer than others as in fig. 1E.

Male : Unknown

Holotype : Female in spirit.

Type-locality : INDIA : Uttar Pradesh ; Koladurgi forest, Dist. Nainital. date 22.xii. 1970. coll. Asket Singh. (Reg. No. 4318/18).

This species resembles *Sosticus insularis* (Banks) but differs from it as follows :
(i) Inner margin of chelicera provided with

two teeth but *S. insularis* inner margin of chelicera with one tooth. (ii) Abdomen provided with three transverse white bands but in *S. insularis* abdomen uniform gray. (iii) Epigyne also structurally different.

2. *Sosticus dherikanalensis* sp. nov.

(Fig. 1 F—J)

General : Cephalothorax brown, legs reddish-brown, abdomen brownish-black. Total length 6.40 mm. Carapace 2.60 mm. long, 2.20 mm. wide ; abdomen 3.60 mm. long, 2.20 mm. wide.

Cephalothorax : Longer than wide, oval, convex, clothed with pubescence, posterior middle provided with a conspicuous short fovea. Radiating black streaks diverge from short fovea to lateral sides of cephalothorax. Eye rows distinctly separated, pearly white except anterior medians which are black, posterior row of eyes slightly longer than the anterior row. Anterior row of eyes slightly procurved (as seen from in front); medians smaller than the laterals and closer to adjacent laterals than to each other. Posterior row of eyes slightly recurved, medians oval, smaller than the laterals and slightly closer to adjacent laterals than to each other. The median outer quadrangle longer than broad and wider behind than in front. Clypeal height greater than the diameter of the anterior median eye. Sternum heart-shaped, pointed behind, strongly rebordered, clothed with some black hairs. Labium longer than wide, anterior end of labium and maxillae provided with scopulae, shape as in fig. 1G. Chelicerae moderately strong, vertical, inner and outer margin provided with two small and two bigger teeth each. Legs relatively long, thin, clothed with hairs and some spines. Tibiae IV, provided with two dorsal spines. Scopulae reach up to the metatarsi I and II and up to the middle of metatarsi III and IV, legs formula 4123.

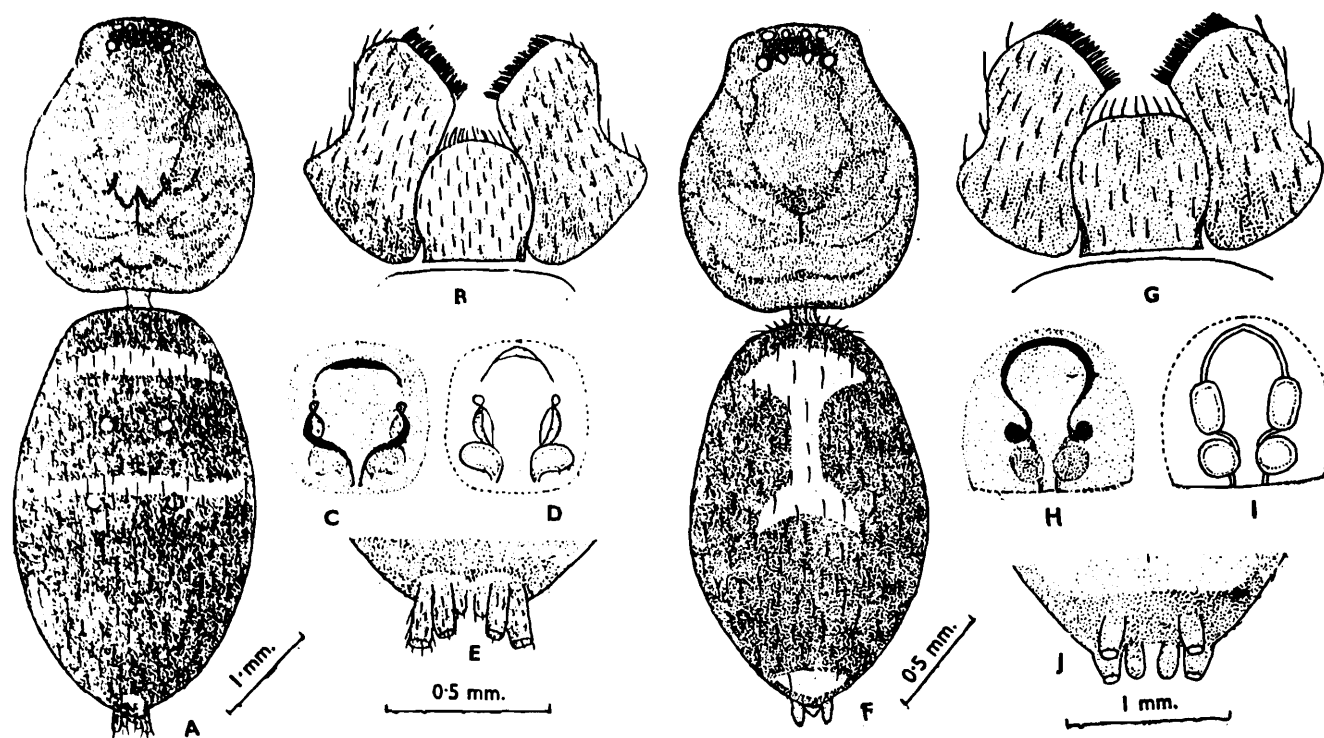


Fig. 2 (A—E) *Sosticus sundargarhensis* sp. nov. A—Dorsal view of female, legs omitted, B—Labium and maxillae, C—Epigyne, D—Internal genitalia, E—Spinnerets. (ventral view : (F—J) *Sosticus solanensis* sp. nov., F—Dorsal view of female, legs omitted, G—Labium and maxillae, H—Epigyne, I—Internal genitalia, J—Spinnerets (Ventral view).

Abdomen : Longer than wide, broadest behind the middle, clothed with pubescence and some spine like hairs. Abdomen dorsally provided with two white bands, one at the anterior to the middle and second just above the anal tubercle as in fig. 1F. Ventral side much lighter than the dorsal and clothed with hairs. Epigyne as in fig. 1H. Internal genitalia as in fig. 1I. Spinnerets prominent, anterior spinnerets widely separated and same in size to the posterior spinnerets as in fig. 1 J.

Male : Unknown.

Holotype : Female in spirit.

Type-locality : INDIA : Orissa, Tikarpara Dist. Dherikanal, date 29.ii.1972, Coll. J. K. Sen (Reg. No. 4319/18).

This species resembles *Sosticus nainitalensis* sp. nov. but differs from it as follows : (i) Inner and outer margin of chelicera provided with two teeth each but in *S. nainitalensis* inner margin with two and outer margin with three teeth. (ii) Abdomen dorsally provided with two white bands but in *S. nainitalensis* abdomen with three bands. (iii) Epigyne also structurally different.

3. *Sosticus sundargarhensis* sp. nov.

(Fig. 2 A—E)

General : Cephalothorax and legs reddish-brown, abdomen brownish black. Total length 4.40 mm. Carapace 1.40 mm. long, 1.30 mm. wide ; abdomen 2.90 mm. long 1.60 mm. wide.

Cephalothorax : Longer than wide, oval, narrow in front, clothed with pubescence, posterior middle provided with inconspicuous short fovea. Black reticulations are present on the lateral sides of cephalothorax. Eye rows distinctly separated, pearly white except anterior medians which are black, posterior row of eyes very slightly longer than the anterior row.

Anterior row of eyes slightly procurved (as seen from in front) ; medians smaller than the laterals and closer to laterals than to each other. Posterior row of eyes straight, medians oval, smaller than the laterals and closer to adjacent laterals than to each other. Median ocular quadrangle longer than wide and wider behind than in front. Clypeal height more than the diameter of anterior median eye. Sternum heart-shaped, pointed behind, strongly reborded, clothed with fine hairs. Labium longer than wide, anterior end of labium and maxillae provided with conspicuous scopulae, shape as in fig. 2B. Chelicerae moderately strong, vertical, inner margin provided with one minute tooth and outer margin with two larger teeth, Legs relatively long and thin, clothed with hairs and same spines. Patella of all legs much larger and provided with deep brown patches. Tibiae IV provided with two dorsal spines. Scopulae reach up to the base of metatarsi I and II and up to middle of metatarsi III and IV. Leg formula 4123.

Abdomen : Longer than wide, narrowing posteriorly ; clothed with pubescence and provided with some round chalk-white spots as in fig. 2A. Ventral side lighter than the dorsal. Epigyne as in fig. 2C. Internal genitalia as in fig. 2D. Spinnerets six, anterior spinnerets widely separated, posterior spinnerets longer than others as in fig. 2E.

Male : Unknown.

Holotype : Female, *paratypes* two females in spirit.

Type-locality : INDIA : Orissa ; Bonai-garh Dist. Sundergarh, date. 15. VI. 1972, coll. D. P. Sanyal (Reg. No. 4320/18). *Paratypes :* 1 ♀, Orissa ; Barkuda Islands, Chilka Lake, Ganjam Dist. date. 20. VII. 1916, coll. F. H. Gravely (Reg. No. 4321/18). 1 ♂, Assam ; Bhungtilang Aigal, Dist. Mizo, date. 22.X.1960, coll. T. G. Vazirani. (Reg. No. 4322/18).

This species resembles *Sosticus solanensis* sp. nov. but differs from it as follows : (i) Outer margin of chelicera provided with two teeth but in *S. solanensis* outer margin with three teeth. (ii) Abdomen dorsally provided with some rounded chalk-white spots but in *S. solanensis* abdomen uniform. (iii) Epigyne also structurally different.

4. *Sosticus solanensis* sp. nov.

(Fig. 2, F—J)

General : Cephalothorax deep brown legs reddish-green, abdomen gray. Total length 5.80 mm. Carapace 2.10 mm. long, 1.90 mm. wide ; abdomen 3.60 mm. long, 2.10 mm. wide.

Cephalothorax : Longer than wide, oval, narrowed in front, clothed with pubescence, posterior middle provided with a conspicuous short fovea. Radiating dark streaks diverge from fovea to lateral sides of cephalothorax. Eye rows distinctly separated, pearly white except anterior medians which are black, posterior row of eyes very slightly longer than the anterior row. Anterior row of eyes straight (as seen from in front) ; medians smaller than the laterals and closer to adjacent laterals than to each other. Posterior row of eyes slightly recurved, medians oval, smaller than the laterals and closer to adjacent laterals than to each other. Median ocular quadrangle longer than wide and wider

behind than in front. Clypeal height more than the diameter of anterior median eye. Sternum heart-shaped, pointed behind, strongly rebordered, clothed with fine hairs. Labium longer than wide, anterior end of labium and maxillae provided with conspicuous scopulae, shape as in fig. 2G. Chelicerae moderately strong, vertical, inner margin provided with one minute tooth and outer margin with three longer teeth. Legs relatively long and thin, clothed with hairs and some spines. Tibiae IV provided with two dorsal spines. Scopulae reach up to the base of metatarsi I and II and up to middle of metatarsi III and IV. Leg formula 4123.

Abdomen : Longer than wide, elliptical, uniform, clothed with pubescence and some long hairs as in fig. 2F. Ventral side lighter than the dorsal. Epigyne as in fig. 2H. Internal genitalia as in fig. 2I. Spinnerets prominent, anterior spinnerets widely separated posterior spinnerets slightly larger than the anterior as in fig. 2J.

Male : Unknown.

Holotype : Female in spirit.

Type-locality : INDIA : Himachal Pradesh ; Simla Hills, Dist. Solan, date. 24. VI. 1968. coll. O. B. Chhotani, (Reg. No 4323/18). This species resembles *Sosticus nainitalensis* sp. nov. but differs from it as follows ; (i) Inner margin of chelicera provided with one minute tooth but in *S. nainitalensis* inner margin with two teeth. (ii) Abdomen dorsally uniform but in *S. nainitalensis* abdomen dor-

sally provided with three transverse white bands. (iii) Epigyne also structurally different.

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A NEW SPECIES OF HORSEFLY (DIPTERA : TABANIDAE) FROM BHUTAN

M. DATTA

Zoological Survey of India, Calcutta

ABSTRACT

Hybomitra bhutanensis, sp. nov. from Bhutan is described and illustrated.

INTRODUCTION

A collection of horseflies made in 1969 by Dr. B. Biswas, Deputy Director, Zoological Survey of India, Calcutta constitutes a new species described below, belonging to the genus *Hybomitra* Enderlein. This genus has, however, been recorded from the neighbouring India, Nepal, Burma and China and hence the study has obvious impact from the zoogeographical point of view.

Subfamily TABANINAE

Tribe TABANINI

Genus *Hybomitra* Enderlein

Hybomitra Enderlein, 1922, *Mitt. zool. Mus. Berl.*, 10 : 347. Type-species : *Tabanus solox* Enderlein, 1922 (= *Tabanus rhombica* Osten Sacken, 1876), by original designation.

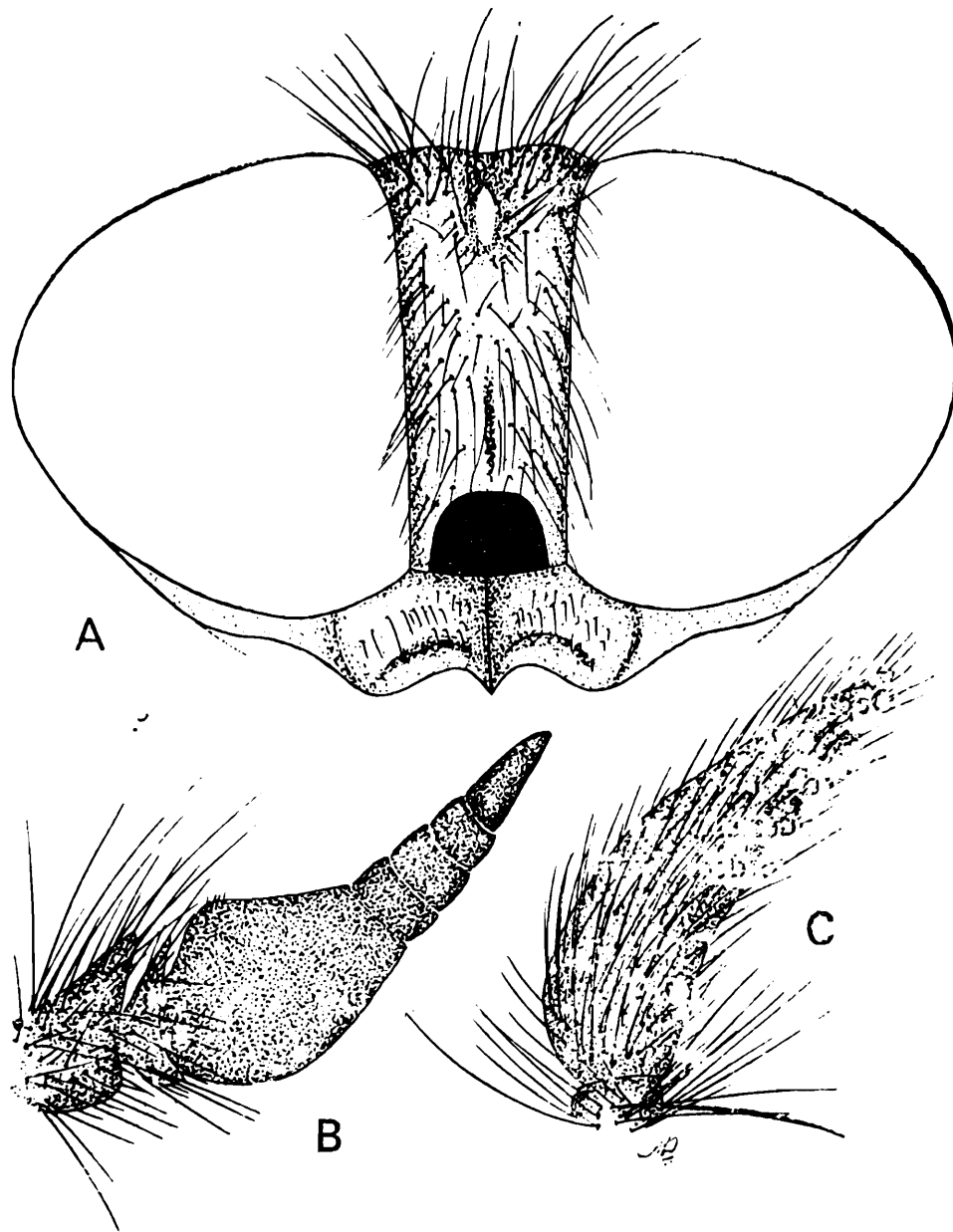
Hybomitra bhutanensis, sp. nov.

(Fig. 1)

A hairy, medium-sized greyish black species with wide frons, mainly greyish black legs, cloudy wings and golden haired abdomen having tergum 2 dark red laterally and fringes of yellow hairs on all segments posteriorly.

Holotype ♀, 15.0 mm. Eyes greyish black with long erect hairs. Frons (Fig. 1A) wide, nearly parallel-sided, index 1 : 2.6, buff-grey pollinose, with dense black hairs nearly double-length of hairs on eyes ; vertex with longest black hairs. Ocellar tubercle prominent, ovoid, greyish black, shiny ; basal callosity greyish black, shiny, subquadrate with rounded apical corners, touching subcallus but separated from eye-margins laterally, very inconspicuous median callosity separated from basal callosity. Subcallus greyish black, thickly buff-yellow pollinose and thinly pilose. Face and para-facials buff-yellow pollinose and with dense long yellow and dark hairs. Antenna (Fig. 1B) black, pilose ; scape heavy ; pedicel small ; plate of flagellum flat, dorsal angle of plate almost rounded, with a few small black hairs ; excision very shallow. Palpus (Fig. 1C) black, with long black hairs, second segment stout basally, gradually tapered apically.

Thorax including antealar tubercles and scutellum greyish black, with dark hairs intermixed with some yellow hairs. Legs mainly greyish black ; mid and hind tibiae only somewhat dark grey. Wings light brown, darkened in costal cell, on cross-veins and



Figs. 1, *Hybomitra bhutanensis*, sp. nov. A—head ; B—antenna ; C—palpus.

behind stigma ; spur vein longer than stem, Halteres greyish, tip of knob light.

Abdomen with first two terga greyish black and rest black ; tergum 2 dark red laterally ; terga and sterna yellowish posteriorly with fringes of yellow hairs, more congregated medially more or less in triangular form ; terga 1 and 2 with long recumbent golden hairs and rest of abdomen with black hairs.

Holotype ♀, Z.S.I. Reg. No. 5544/H6, Western BHUTAN : Paro, 16.ii. 1969, coll. *B. Biswas* ; *Paratypes* : 2 ♀♀, Z. S. I. Reg. Nos. 5545/H6 and 5546/H6, same data as holotype ; 6 ♀♀, Z. S. I. Reg. Nos. 5547/H6—5552/H6, Susuna, 11-12. ii. 1969, coll. *B. Biswas*.

Variations observed are in the shape of basal callosity and prominence of median callosity, depth of excision on the plate of

antenna, length of spur vein in wings and in the tinctorial intensity of the second tergum laterally to certain extent from the holotype specimen.

This new species is more closely related to *Hybomitra lyneborghi* Chvála, 1969, described from Nepal than to *H. himalayana* (Enderlein, 1925) and *H. wyveillei* (Ricardo, 1911) described from Northern India; *H. hirta* (Walker, 1850) from East India and *H. nola* Philip, 1961, from China. *Hybomitra himalayana* is a smaller species (12.0 mm.) having its rusty brown antenna and legs. Although *lyneborghi* is only slightly smaller (14.0 mm.) than or in other words almost of the same size as *bhutanensis*, the former species differs in having brownish black palpi and clear wings with small brown spot on vein R₄. *Hybomitra wyveilli* is distinguishable by the presence of reddish yellow palpi and by the absence of spur vein on wings. There is, however, considerable resemblance of this species with *nola* but the latter is distinct with reddish brown antenna and palpus, and with bell-shaped callosity but without spur vein among certain other characters. And *Hybomitra hirta* possessing dull reddish palpi and reddish yellow abdominal terga 1 and 2, occasionally 3 also, differs from this new species.

ACKNOWLEDGEMENTS

I express my gratitude to the Director and the Officer-in-Charge of the Diptera Section, Zoological Survey of India, Calcutta, for the cooperation and encouragement. It is with pleasure I also express my deep gratitude to Dr. Hiroshi Takahashi of Tokyo, Japan, without whose help studies on any of the Oriental Tabanidae would have been extremely difficult.

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THE GENUS *PARAPHYTOSEIUS* SWIRSKI AND SHECHTER WITH A NEW
SUBGENUS AND ONE NEW SPECIES FROM INDIA

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ABSTRACT

The genus *Paraphytoseius* Swirski and Shechter is revived. *Tropicoseius*, a new subgenus under *Paraphytoseius*, is erected to embrace a new species.

INTRODUCTION

The genus *Paraphytoseius* was erected by Swirski and Shechter (1961) with *Paraphytoseius multidentatus* Swirski and Shechter (1961) as its type. But Chant (1965), while reviewing the genera under Phytoseiidae, synonymised it with *Amblyseius* Berlese. Although *Paraphytoseius* bears similarities with *Amblyseius* in characters, viz. presence of 4 pairs of anterior lateral setae, Sub lateral setae present on lateral integument, sternal shield with 3 pairs of setae, 4th pair present on metasternal plates, ventrianal shield with 3 pairs of preanal setae and usually 4 pairs of setae present on postero-lateral integument, but the characters, viz. elongated body, dorsal shield leaves some part of post dorsum uncovered, usually 13 pairs of setae present on dorsal shield of which i_3 , s_4 , z_4 and z_5 always long, thick and serrate, presence of notch on dorsal shield at the level of s_4 , presence of a pair of large pores associated with z_5 , presence of 2 pairs of post lateral setae and macrosetae on leg IV always long with spatulate tip are some of the unique features which are neither universally present in *Amblyseius* nor are met with constantly in any known genera

under Phytoseiidae. All these warrant to keep these group of species separately and, hence, the genus *Paraphytoseius* is re-established to accommodate the species viz. *multidentatus* Swirski and Shechter (1961), *orientalis* Narayanan, Kaur and Ghai (1960), *horrifer* Pritchard and Baker, (1962), *santurcensis* De Leon (1965), *urumanus* Ehara (1967), *bhadrakaliensis* Gupta (1970).

Now, the author collected another related species bearing characters viz. presence of S_2 and thus making the total number of setae on dorsal shield to 14 pairs (13 pairs present in other known species), s_2 and s_3 being thick and serrate (minute in other known species) and presence of 2 pairs of metapodal plates (single pair in other species). Because of the presence of these combination of characters, this species could not be accommodated under subgenus *Paraphytoseius s. str.* and, hence, a new subgenus *Tropicoseius* is erected to accommodate this new species.

In view of this, the genus *Paraphytoseius* is re-defined, key to the subgenera is provided and a new species is described to serve as type of the subgenus.

The measurements given in the text are in microns. The material treated in this paper were collected by the author. Setal nomenclature as that of Chant and Hansell (1971) is followed.

Type material dealt with in this paper is deposited in the National Collection of the Zoological Survey of India, Calcutta.

Genus *Paraphytoseius* Swirski
and Shechter

Type : *Paraphytoseius multidentatus*

Swirski and Shechter, 1961

(By original designation)

Diagnosis : Body elongated, dorsal shield moderately sclerotized, posteriorly leaves some part of dorsum uncovered, with 13-14 pairs of setae, of these 4 pairs of anterior lateral, 2-3 pairs of post lateral, 2 pairs of medio-lateral and 5 pairs of dorso-central. Setae j_3 , s_4 , Z_5 and Z_4 being always long, thick and serrate, sometimes s_2 and s_3 also serrate (in *Tropicoseius* subgen. nov.), 2 pairs of sub-lateral setae present on lateral integument, anterior pair long, serrate, posterior pairs short. A pair of large pores always associated with z_5 . Dorsal shield notched at the level of s_4 . Sternal shield with 3 pairs of setae, metasternal plate with seta present or absent. Ventrianal shield longer than broad with 3 pairs of preanal setae ; 3-4 pairs of setae present around ventrianal shield. Macrosetae on leg IV usually with spatulate tip.

Key to the subgenera

1. Dorsal shield with 13 pairs of setae, only 2 pairs of postlateral setae present, s_2 and s_3 minute, presence of only one pair of metapodal plates..... *Paraphytoseius* Swirski and Shechter, 1961.

—Dorsal shield with 14 pairs of setae, 3 pairs of post-lateral setae present, s_2 and s_3 serrate, presence of two pairs of metapodal plates.. *Tropicoseius* subgen. nov.

Tropicoseius subgen. nov.

Diagnosis : Dorsal shield with 14 pairs of setae, S_8 (= L_8) thick and serrate, s_2 and s_3 fairly long and weakly serrate, 2 pairs of metapodal plates present.

Type : *Paraphytoseius (Tropicoseius)*
nucifera sp. nov.

Paraphytoseius (Tropicoseius) nucifera sp. nov.

(Fig. 1.)

Female : Body elongated oval, peritreme extends anteriorly beyond j_1 and posteriorly narrowed and curves around coxa—IV. Dorsal shield 305 long, 165 wide, deeply notched at the level of s_4 . j_1 , j_3 , s_2 , s_3 , s_4 , S_2 , Z_5 , Z_4 , r_3 , all being long, thick and serrate, other setae small. Measurements of setae : j_1 -28, j_4 - j_6 -4 each, j_3 -68, s_2 -16, s_3 -32, s_4 -80, S_1 -4, S_2 -40, Z_5 -76, z_5 -4, Z_4 -68, r_3 -56, R_1 -28. Sternal shield weakly sclerotized as long (10) as wide with 3 pairs of long sternal setae, metasternal plate triangular with seta distinct. Genital shield wider (80) than greatest width of ventrianal shield. Ventrianal shield smooth, 80 long, 60 wide with 3 pairs of preanal setae, 3 pairs of setae present around ventrianal shield, JV_5 -28 long, 2 pairs of metapodal plates present. Fixed digit of chelicera multi-dentate, tooth on movable digit not discernible, Spermatheca with bell shaped cervix. Leg IV with macrosetae on genu-44, tibia-36, basitarsus-64 and distitarsus-40 ; leg chaetotaxy : genu II 7 setae (4 dorsal, 3 lateral), genu III 7 setae (4 dorsal, 2 lateral, 1 ventral), genu IV 7 setae (4 dorsal, 2 lateral, 1 ventral), tibia II 7 setae (3 dorsal, 2 lateral, 2 ventral), tibia III 7 setae (3 dorsal, 2 lateral, 2 ventral), tibia IV 6 setae (3 dorsal, 2 lateral, 1 ventral).

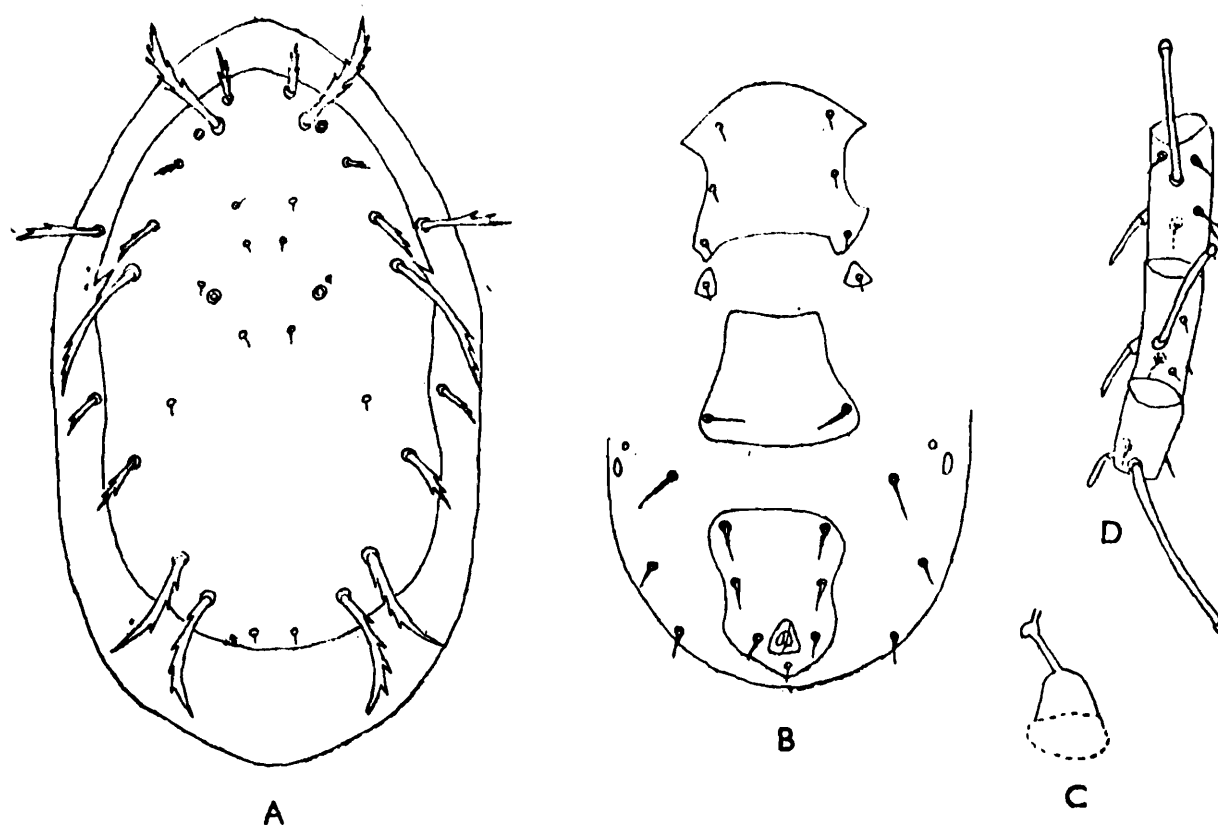


Fig. 1. (A—D) *Paraphytoseius (Tropicoseius) nucifera* sp. nov. A—dorsal shield, B—ventral surface, C—spermatheca, D—leg IV.

Male : Unknown

Material : Holotype Reg. No. 3057 / 17
INDIA : Kerala : Neyyar Dam, 15. xii. 1975,
ex *Cocos nucifera*.

Remarks : This species is easily distinguished from all other known species by presence of S_2 , setae s_1 and s_3 fairly thick and serrate and by presence of two pairs of metapodal plates.

Subgen. *Paraphytoseius* Swirski and Shechter

***Paraphytoseius (Paraphytoseius) bhadrakaliensis* (Gupta) comb. nov.**

Amblyseius bhadrakaliensis Gupta, 1970. *Bull. Ent.* 10 : 127-128.

Material : 1 ♀, TAMIL NADU : Tozhupedu, 3. xii. 1975, ex banana ; 1 ♀, Kodai-kanal, 6. xii. 1975, ex. pear ; 3 ♀ ♀, Batlagundu, 7. xii. 1975, ex. seem ; 6 ♀ ♀, Oothu, 8. xii. 1975, ex. sunflower ; 1 ♀, Therakalpathur, 12. xii. 1975, ex. cashewnut ; 1 ♀, KERALA : Neyyar Dam area, 15. xii. 1975, ex. rose ; 2 ♀ ♀, Coimbatore, Agricultural University campus, 19. xii. 1975, ex. brinjal ; 1 ♀, Top slip, 24. xii. 1975, ex. unknown host ; 7 ♀ ♀, Top slip, Ambuliperai, 24. xii. 1975, ex. unknown host ; 1 ♂, Aruvankadu, 26. xii. 1975, ex. eucalyptus ; 4 ♀ ♀, 1 ♂, Aruvankadu, 26. xii. 1975, ex. tea ; 6 ♀ ♀, 2 ♂ ♂, Coonoor, Wellington, 26. xii. 1975, ex. rose ; 4 ♀ ♀, Wellington, 27. xii. 1975, ex. pear ; 1 ♀, KARNATAKA : Bandipur, 30. xii. 1975, ex. unknown host ; 2 ♀ ♀, ANDHRA PRADESH : Simachalam, 5. i. 1976, ex. cashewnut.

Remarks : This species was described from West Bengal and later was collected from different parts of India on a wide range of hosts but chiefly on vegetables and mostly found associated with *Tetranychus* spp.

ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India, for the facilities and to Dr. P. D. Gupta, Officer-in-Charge, G. P. R. Station, Patna for the constant encouragements.

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FURTHER STUDIES ON SOME SPIDERS OF THE GENUS *ZELOTES* GISTEL
(ARANEAE : GNAPHOSIDAE) FROM INDIA

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ABSTRACT

Five new species of spiders of the genus *Zelotes* Gistel from Maharashtra State, India, are described in the paper. A Key to the Indian species of *Zelotes* is also provided.

INTRODUCTION

Practically there was no work in the past on the spiders of the family Gnaphosidae from India, although gnaphosid spiders are abundant throughout the country. Very recently Tikader (1962, 1964, 1966, and 1973) and Tikader and Gajbe (1975, 1976) have published some papers on these interesting group of spiders from India.

While examining the spiders of the family Gnaphosidae from India, we came across many new species of gnaphosid spiders, some of which are described elsewhere.

We have described in this paper five new species of spiders of the genus *Zelotes* Gistel. So far eight species of *Zelotes* spiders are known from India, namely *Z. ashae* Tikader and Gajbe, *Z. poonaensis* Tikader and Gajbe, *Z. surekhae* Tikader and Gajbe from Poona ; *Z. nasikensis* Tikader and Gajbe from Nasik, Maharashtra ; *Z. mandlaensis* Tikader and Gajbe from Mandla ; *Z. jabalpurensis* Tika-

der and Gajbe from Jabalpur, M. P. ; *Z. nainitalensis* Tikader and Gajbe from Nainital and *Z. chandosiensis* Tikader and Gajbe from Moradabad, U. P. A key to the thirteen species (eight known and five new) is given. The type specimens will in due course be deposited in the collection of Zoological Survey of India, Calcutta.

Key to the Indian species of *Zelotes*

- | | |
|---|----------------------|
| 1. Spiders of small size, upto 6 mm. | 2 |
| — Spiders of bigger size upto 9 mm. | 9 |
| 2. Posterior row of eyes straight. Tibiae III and IV with three pairs of ventral spines. . . | 3 |
| — Posterior row of eyes slightly procurved. Tibiae III and IV with two pairs of ventral spines. | <i>chandosiensis</i> |
| 3. Posterior median eyes irregular in shape, smaller than the posterior laterals | 4 |
| — Posterior median eyes oval, larger than the posterior laterals | <i>poonaensis</i> . |

* Zoological Survey of India, Central Regional Station, Jabalpur,

- | | | | |
|--|---|---|----------------------|
| 4. Eyes of the posterior row equally spaced .. | 5 | 12. Eyes of posterior row equally spaced. Inner and outer margin of chelicera with two and six teeth respectively .. | <i>jabalpurensis</i> |
| — Eyes of the posterior row not equally spaced | 7 | — Eyes of posterior row not equally spaced. Inner and outer margin of chelicera with two and four teeth respectively | <i>choubeyi</i> |
| 5. Abdomen dorsally provided with black patches or chevrons. Inner margin of chelicera with two teeth. | 6 | | |
| — Abdomen dorsally without black patches. Inner margin of chelicera without tooth .. | | | |
| 6. Abdomen dorsally provided with some black patches. Outer margin of chelicera with four teeth .. | | | |
| — Abdomen dorsally provided with seven deep brown transverse chevrons. Outer margin of chelicera with three teeth | | | |
| 7. Inner margin of chelicera with one tooth. Anterior row of eyes procurved (as seen from in front) | | | |
| — Inner margin of chelicera with four teeth. Anterior row of eyes recurved (as seen from in front) | | | |
| 8. Outer margin of chelicera with two teeth | | | |
| — Outer margin of chelicera with three teeth | | | |
| 9. Anterior row of eyes slightly procurved (as seen from in front) —..... | | | |
| — Anterior row of eyes nearly straight (as seen from in front) .. | | | |
| 10. Posterior median eyes larger than the posterior laterals and equally spaced. Inner and outer margin of chelicera with two and four teeth respectively | | | |
| — Posterior median eyes smaller than the posterior laterals and closer to posterior laterals than to each other. Inner and outer margin of chelicera with one and two teeth respectively | | | |
| 11. Posterior median eyes slightly larger than the posterior laterals | | | |
| — Posterior median eyes slightly smaller than the posterior laterals | | | |
- nainitalensis*
- surekhae*
- sajali*
- nalinae*
- nasikensis*
- mandae*
- ashae*
- sataraensis*
- mandlaensis*
1. *Zelotes sajati* sp. nov.
(Fig. 1 A—E)
- General :** Cephalothorax and legs reddish-brown, abdomen brown. Total length 6.00 mm. Carapace 2.90 mm. long, 2.00 mm. wide ; abdomen 3.20 mm. long, 2.10 mm. wide.
- Cephalothorax :** Longer than wide, narrow in front, slightly convex, clothed with pubescence, posterior middle provided with a conspicuous fovea and with a deep brown narrow line encircling almost the entire border. Eyes closely grouped, silvery white except anterior medians, posterior row of eyes slightly longer than the anterior row. Anterior row of eyes very slightly procurved (as seen from in front), medians smaller than the laterals and closer to laterals than to each other. Posterior row of eyes straight, medians irregular in shape, slightly smaller than the laterals and nearly equally spaced. Sternum oval, pointed behind, clothed with fine hair. Labium and maxillae as in fig. 1D. Chelicerae moderately strong, vertical, inner margin provided with two teeth and outer margin with three teeth. Legs relatively longer and strong, clothed with hair and spines. Tibiae III and IV provided with three pairs of ventral spines. Scopulae reach upto the base of metatarsi I and II and upto apices of metatarsi III and IV. Legs formula 4123.
- Abdomen :** Longer than wide, elliptical, clothed with fine hair and posterior half of abdomen provided with seven deep brown transverse chevrons as in fig. 1A. Anterior

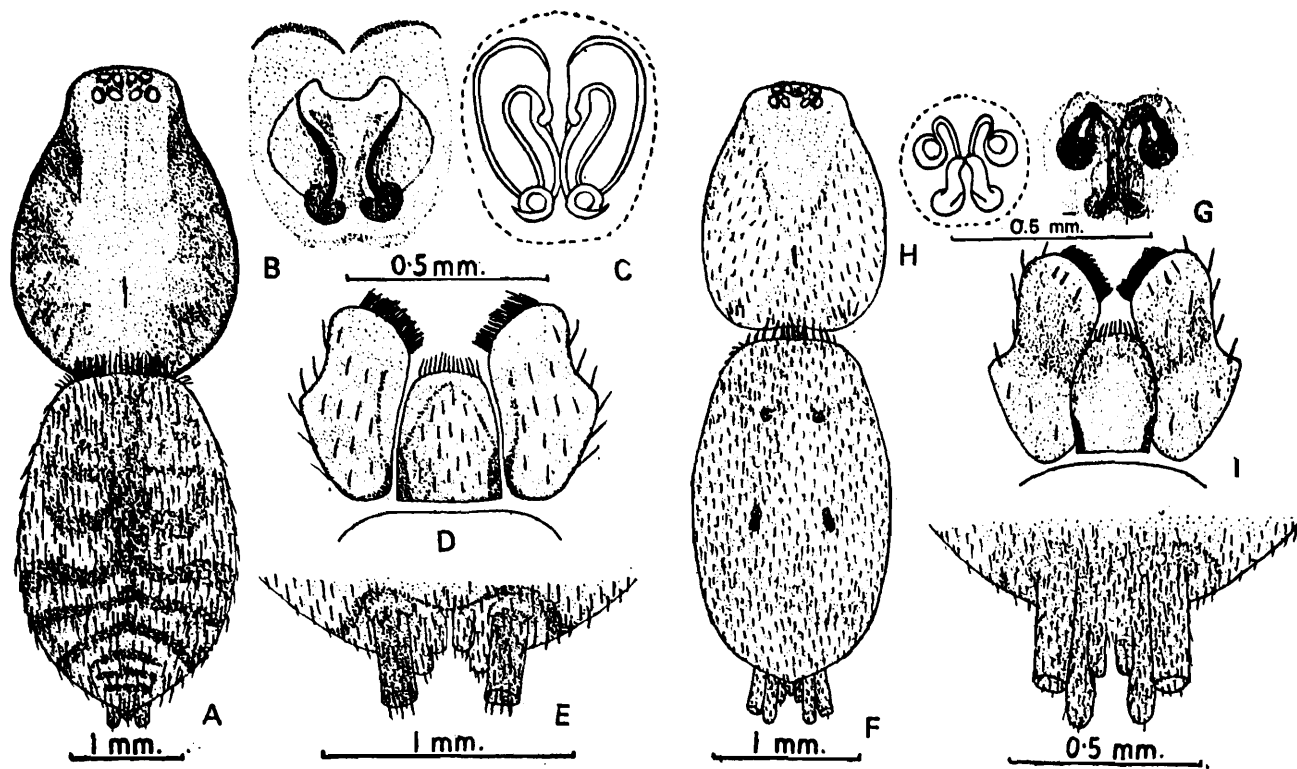


Fig. 1. (A-E) *Zelotes sajali* sp. nov., A—Dorsal view of female, legs omitted, B—Epigyne, C—Internal genitalia, D—Labium and maxillae, E—Spinnerets; (F-J) *Zelotes naliniae* sp. nov., F—Dorsal view of female, legs omitted, G—Epigyne, H—Internal genitalia, I—Labium and maxillae, J—Spinnerets.

margin of abdomen provided with very thick spines like hair directed forward. Ventral side much lighter than the dorsal. Epigyne and internal genitalia as in figs. 1 B,C. Spinnerets very prominent, anterior spinnerets widely separated, larger than others as in fig. 1E.

Holotype : Female in spirit, Mukund Nagar, Poona, Maharashtra, India, 11.3.1976. Coll. Sajal Tikader.

This species resembles *Zelotes surekhae* Tikader and Gajbe but differs from it as follows : (i) Cephalothorax provided with a deep brown narrow line encircling almost the entire border but in *Z. surekhae* cephalothorax not provided with a deep brown line. (ii) Outer margin of chelicera with three

teeth but in *Z. s rekhae* outer margin of chelicera with four teeth. (iii) Epigyne and internal genitalia also structurally different.

2. *Zelotes naliniae* sp. nov. (Fig. 1 F—J)

General : Cephalothorax and legs light brownish-green, abdomen light brown. Total length 4.00 mm. Carapace 1.60 mm. long, 1.20 mm. wide; abdomen 2.30 mm. long, 1.40 mm. wide.

Cephalothorax : Longer than wide, oval, slightly narrow in front, slightly convex, clothed with fine hair, posterior end of cephalothorax provided with some spine like hair. Posterior middle of cephalothorax provided with conspicuous short fovea. Eyes

closely grouped, silvery white except anterior medians, posterior row of eyes slightly longer than the anterior row. Anterior row of eyes slightly recurved (as seen from in front); medians smaller than the laterals and closer to adjacent laterals than to each other. Posterior row of eyes straight, medians irregular in shape, slightly smaller than the laterals and closer to adjacent laterals than to each other. Sternum heart-shaped, pointed behind, clothed with black hairs. Labium and maxillae as in fig. 1, I. Chelicerae moderately strong, vertical, both inner and outer margin provided with four small teeth. Legs relatively long and strong, clothed with hair and spines. Tibiae III and IV

with two and three pairs of ventral spines respectively. Scopulae reach upto the tarsi of all the legs. Legs formula 4123.

Abdomen : Longer than wide, elliptical, clothed with fine hair and provided with two pairs of sagilla as in fig. 1F. Ventral side slightly higher than the dorsal. Epigyne and internal genitalia as in figs. 1G, H. Spinnerets very prominent, posterior spinnerets smaller in size than the anterior but longer than others as in fig. 1G.

Holotype : Female in spirit, Katraj near Poona, Maharashtra, India, 2.10.1975. Coll. U. A. Gajbe.

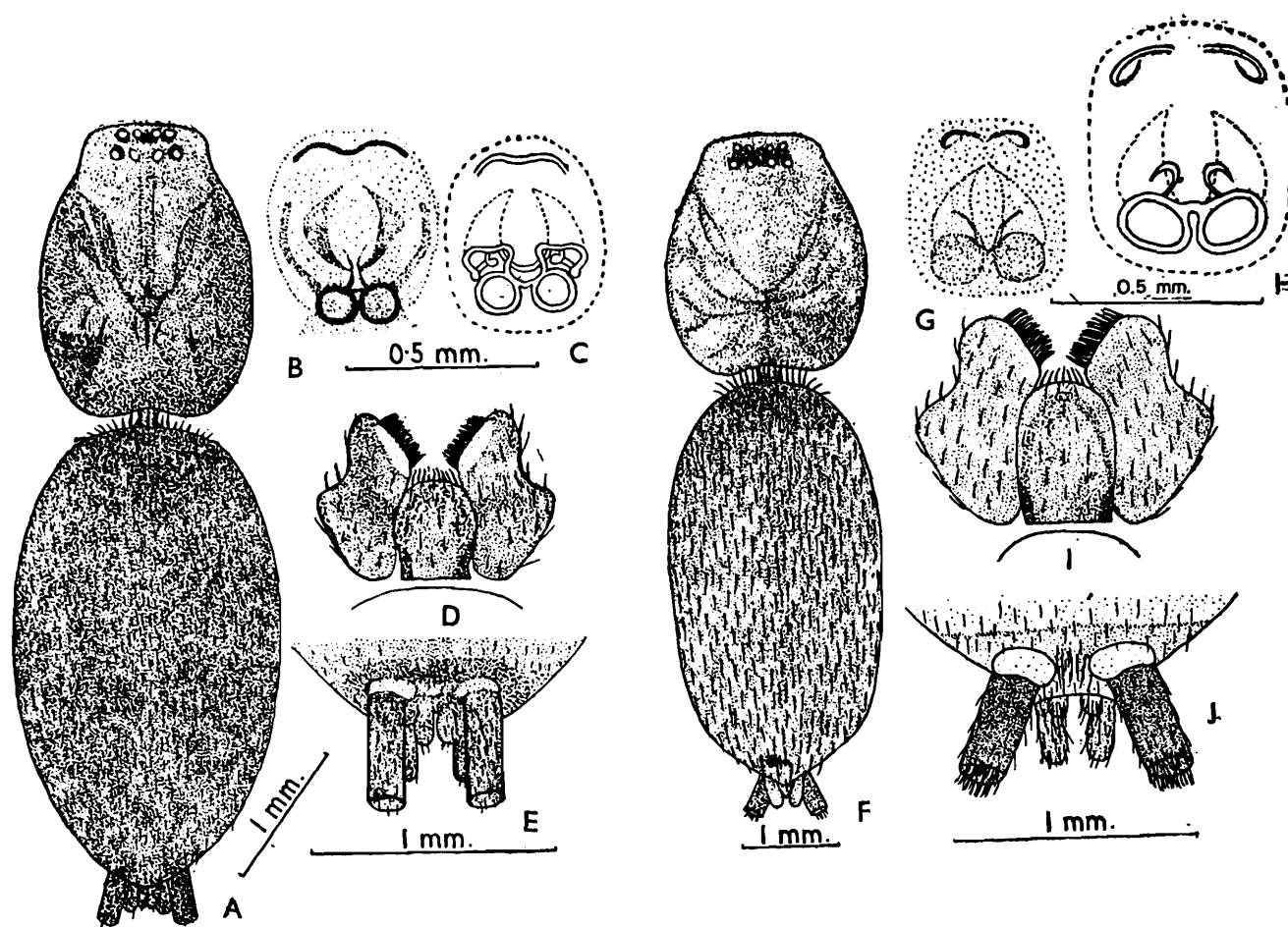


Fig. 2. (A-E) *Zelotes mandae* sp. nov., A—Dorsal view of female, legs omitted, B—Epigyne, C—Internal genitalia, D—Labium and maxillae, E—Spinnerets, (F-J) *Zelotes sataraensis* sp. nov., F—Dorsal view of female, legs omitted, G—Epigyne, H—Internal genitalia, I—Labium and maxillae, J—Spinnerets.

This species resembles *Zelotes mandae* sp. nov. but differs from it as follows : (i) Anterior row of eyes slightly recurved but in *Z. mandae* anterior row of eyes slightly procurved. (ii) Both inner and outer margin of chelicera provided with four small teeth but in *Z. mandae* inner and outer margin of chelicera provided with one and three teeth respectively. (iii) Epigyne and internal genitalia also structurally different.

3. *Zelotes mandae* sp. nov.
(Fig. 2 A—E)

General : Cephalothorax deep brown, legs brownish green, abdomen black. Total length 5.20 mm. Carapace 3.20 mm. long, 1.40 mm. wide ; abdomen 1.90 mm. long, 1.80 mm. wide.

Cephalothorax : Longer than wide, oval, slightly narrow in front, convex, clothed with some spine like hair, posterior middle of cephalothorax provided with an conspicuous short fovea and radiating streaks diverge from fovea to lateral sides of cephalothorax. Eyes closely grouped, pearly white except anterior medians, posterior row of eyes slightly longer than the anterior row. Anterior row of eyes slightly procurved (as seen from in front) ; medians smaller than the laterals and closer to adjacent laterals than to each other. Posterior row of eyes straight (fig. 2A), medians irregular in shape, slightly smaller than laterals and closer to adjacent laterals than to each other. Sternum oval, pointed behind, clothed with black hairs. Labium and maxillae as in fig 2D. Chelicerae moderately strong, vertical, inner margin provided with one small tooth and outer margin with three moderate teeth. Legs relatively long and strong, clothed with hairs and spines, tibia III and IV with three pairs of ventral spines. Scopulae reach upto the base of metatarsi I and II and upto tarsi III and IV. Legs formula 4123.

Abdomen : Longer than wide, elliptical clothed with hair. Ventral side slightly lighter than the dorsal. Epigyne and internal genitalia as in figs. 2B and C. Spinnerets very prominent, anterior spinnerets cylindrical, longer and darker in colour than others as in fig. 2E.

Holotype : Female, **paratypes :** five females in spirit, Range Hill, Poona, Maharashtra, India, 30.5.1975. Coll. U. A. Gajbe.

This species resembles *Zelotes ashae* Tikader and Gajbe but differs from it as follows : (i) Posterior median eyes slightly smaller than the posterior laterals but in *Z. ashae* posterior median eyes slightly larger than the posterior laterals. (ii) Inner and outer margin of chelicera provided with one and three teeth respectively but in *Z. ashae* inner and outer margin of chelicera provided with two and four teeth respectively. (iii) Epigyne and internal genitalia also structurally different.

4. *Zelotes sataraensis* sp. nov.
(Fig. 2F-J)

General : Cephalothorax and legs deep brown, abdomen grey. Total length 7.00 mm. Carapace 2.40 mm. long, 2.10 mm. wide, abdomen 4.50 mm. long, 2.20 mm. wide.

Cephalothorax : Longer than wide, oval, slightly narrow in front, convex, clothed with pubescence, posterior middle provided with a conspicuous short fovea and radiating streaks diverge from short fovea to lateral sides of cephalothorax. Eyes closely grouped (Fig. 2F), silvery white except the anterior medians, posterior row of eyes slightly longer than the anterior row. Anterior row of eyes very slightly procurved (as seen from in front), medians smaller than the laterals than to each other. Posterior row of eyes straight, medians irregular in shape, slightly smaller than the laterals and closer to late-

als than to each other. Sternum oval, pointed behind, clothed with fine hairs. Labium and maxillae as in fig. 2 I. Chelicerae moderately strong, vertical, inner margin with one minute tooth and outer margin with two larger teeth. Legs relatively long and strong, clothed with hair and spines. Tibiae III and IV provided with three pairs of ventral spines. Scopulae reach upto the base of metatarsi I and II and upto apices of metatarsi III and IV. Legs formula 4123.

anterior spinnerets widely separated, longer than others as in fig. 2 J.

Holotype: Female, in spirit, Protapgarh near Mahabaleswar, Dist. Satara, Maharashtra, India, 26.3.1976. Coll. B. K. Tikader.

This species resembles *Zelotes mandae* sp. nov. but differs from it as follows: (i) Inner and outer margin of chelicera provided with

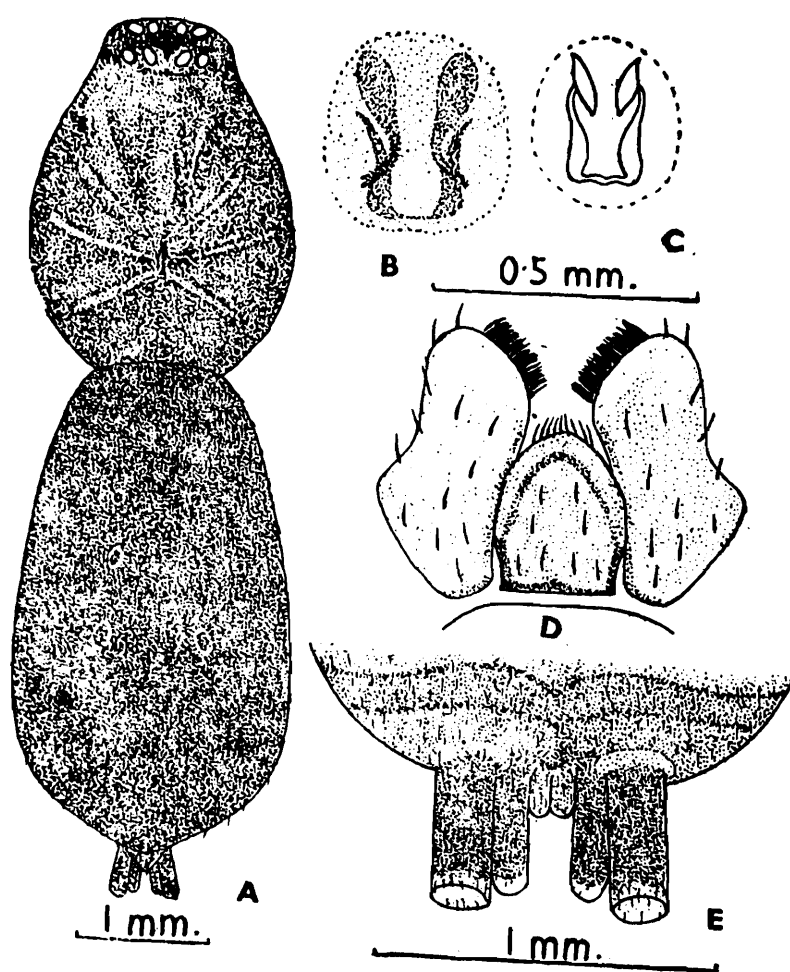


Fig. 3. (A-E) *Zelotes choubevi* sp. nov. A—Dorsal view of female, legs omitted, B—Epigyne, C—Internal genitalia, D—Labium and maxillae, E—Spinnerets.

Abdomen: Longer than wide, nearly elliptical, narrowing posteriorly, clothed with fine hair. Ventral side lighter than the dorsal. Epigyne and internal genitalia as in figs. 2G & H. Spinnerets very prominent,

one and two teeth respectively but in *Z. mandae* inner and outer margin of chelicera provided with one and three teeth respectively. (ii) Epigyne and internal genitalia also structurally different.

5. *Zelotes choubeyi* sp. nov.

(Fig. 3 A—E)

General : Cephalothorax and legs reddish brown, abdomen deep brown to black. Total length 6.50 mm. Carapace 2.60 mm. long, 2.00 mm. wide ; abdomen 4.00 mm. long, 2.10 mm. wide.

Cephalothorax : Longer than wide, oval, narrow in front, convex, clothed with pubescence, posterior middle of cephalothorax provided with an inconspicuous fovea and radiating streaks diverge from fovea to lateral sides of cephalothorax. Eyes situated closely grouped, silvery white except anterior medians, posterior row of eyes slightly longer than the anterior row. Anterior row of eyes nearly straight (as seen from in front) ; medians smaller than the laterals and closer to adjacent laterals than to each other. Posterior row of eyes straight, medians irregular in shape, slightly larger than the laterals and closer to adjacent laterals than to each other. Sternum heart-shaped, pointed behind, clothed with fine hair. Labium and maxillae as in fig. 3D. Chelicerae moderately strong, vertical, inner and outer margin provided with two and four teeth respectively. Tibiae III with two pairs of ventral spines. Legs formula 4123.

Abdomen : Longer than wide, nearly elliptical, broader just behind the middle, clothed with fine hair and three pairs of sagilla as in fig. 3 A. Ventral side same in colour as dorsal. Epigyne and internal genitalia as in fig. 3 B & C. Spinnerets prominent, anterior spinnerets larger than others as in fig. 3 E.

Holotype : Female, in spirit, Vetar Hill, Poona, Maharashtra, India, 17.9.1964. Coll.

S. N. Choubey.

This species resembles *Zelotes naliniae* sp.

nov. but differs from it as follows : (i) Posterior median eyes slightly larger than the posterior laterals but in *Z. naliniae* posterior medians slightly smaller than the laterals. (ii) Inner and outer margin of chelicera provided with two and four teeth respectively but in *Z. naliniae* both inner and outer margin of chelicera provided with four teeth. (iii) Epigyne and internal genitalia also structurally different.

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ON THE POPULATION TRENDS OF *ANEUROTHRIPS PRIESNERI* BHATTI
(INSECTA : THYSANOPTERA) FROM THE LEAF GALLS OF *CORDIA OBLIQUA*

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ABSTRACT

Populations of *Aneurothrips priesneri* Bhatti inducing galls on the leaves *Cordia obliqua* Willd., (Boraginaceae) have been studied in relation to the gall development.

Earlier studies on the ecology and population dynamics of gall thrips communities are restricted to the tubuliferan galls discussing the host-parasite and host-predator interactions with reference to *Schedothrips orientalis* in *Ventilago maderaspatana* galls (Ananthakrishnan and Swaminathan, 1977) as well as their role in relation to gall development as in *Gynaikothrips flaviantennatus* induced *Casearia tomentosa* galls (Raman *et al.*, 1978). The present study reports the populations of a gall making terebrantian, *Aneurothrips priesneri* inducing galls on the leaves of *Cordia obliqua* (Ananthakrishnan and Jagadish, 1969 ; Ananthakrishnan, 1978 ; Krishnamurthy *et al.*, 1977), with a view to assess the periodicity, population interactions and their role in pathogenicity.

MATERIALS AND METHODS

Populations of the gall maker were analysed from 10 samples of galls from a local tree by random sampling method.

OBSERVATION AND DISCUSSION

The individual gall has a life of 80 days (Fig. 1) with the gall maker population active upto 40 days. The galls are initiated with the feeding effect of 1—2 adults as observed in the 2—5 day old gall ; the population reached the maximum of 110 in 10 to 30 days of gall development and commenced to decline by the 40th day after which there was no population.

The gall maker—*Aneurothrips*—was restricted to summer months (March to July, 1978) (Fig. 2), with a few adults establishing the population by the last week of February, and displaying two generations in about 130 days—each manifested for approximately 50—60 days and the two separated by a gap of about 10—20 days. The overall population build-up in the field was as follows : (i) the larval population was high (210/10 galls) by the 10th day of population initiation (10th March 1970), (ii) the adult (242/10 galls) and

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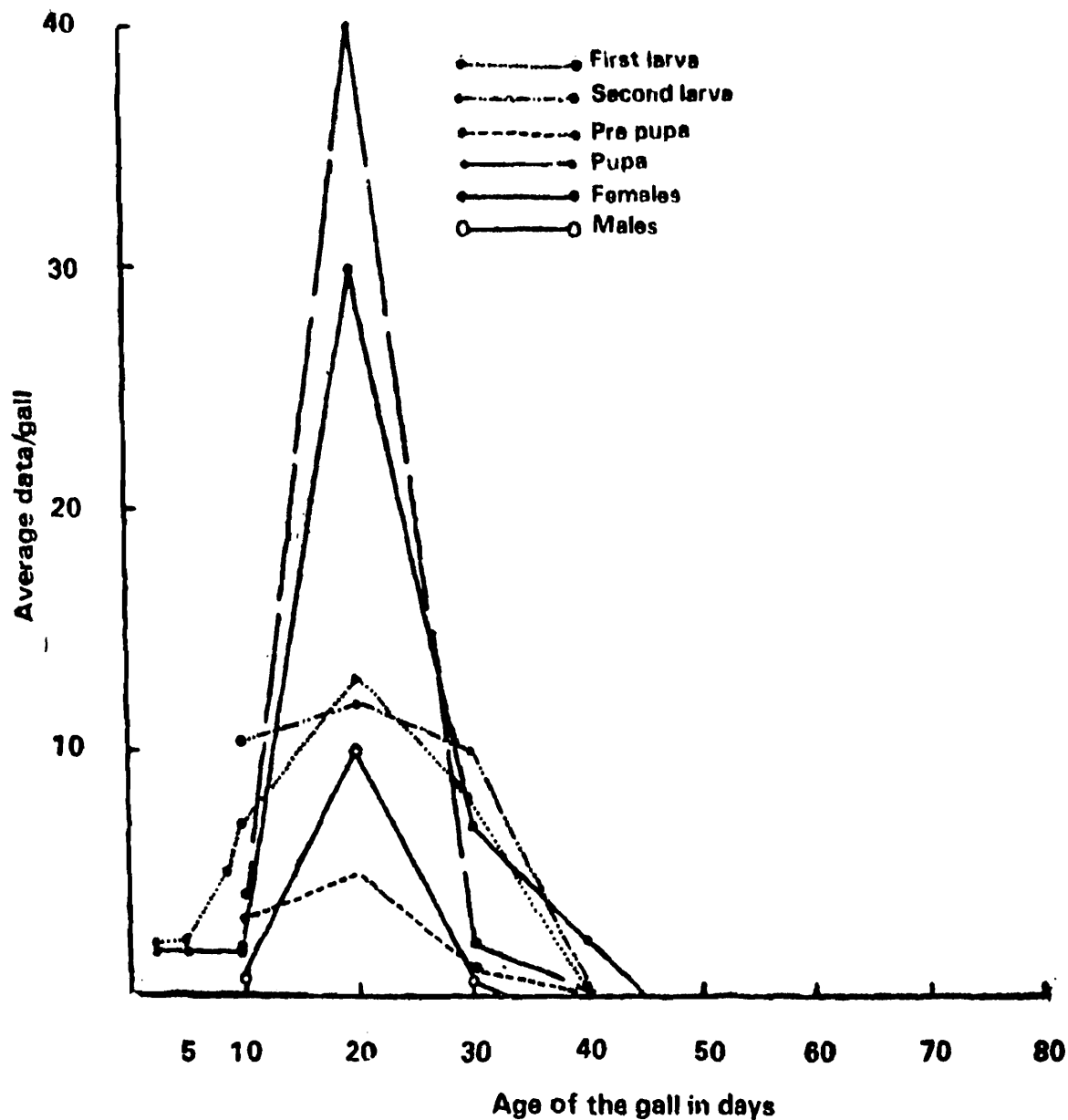


Fig. 1. Population trend of the gall maker in the context of gall development.

pupal (68/10 galls) populations reached the maximum in 20 days (20th March 1978), (iii) by 40th day the entire population started declining, (iv) the population including all developmental stages was maintained at a considerably low level from the 50th to 60th day (third and fourth weeks of April 1978) during which period a spider population was observed (1–2/10 galls), (v) again there was an increase in the population of all stages from 70th day (10th May 1978) with another peak by the 80th day (20th

May 1978) (172 larvae, 190 pupae and 160 adults / 10 galls), and (vi) finally the population declined by the 90th day (30th May 1978) with the adult population maintained at a low level (2–3/10 galls) till the 130th day (10th July 1978).

The average total population of the gall maker was seen to be 12 per gall inclusive of first and second larvae, pupae and adults with the minimum of 0.2 per gall as observed on the 130th day and maximum of 52.2 per

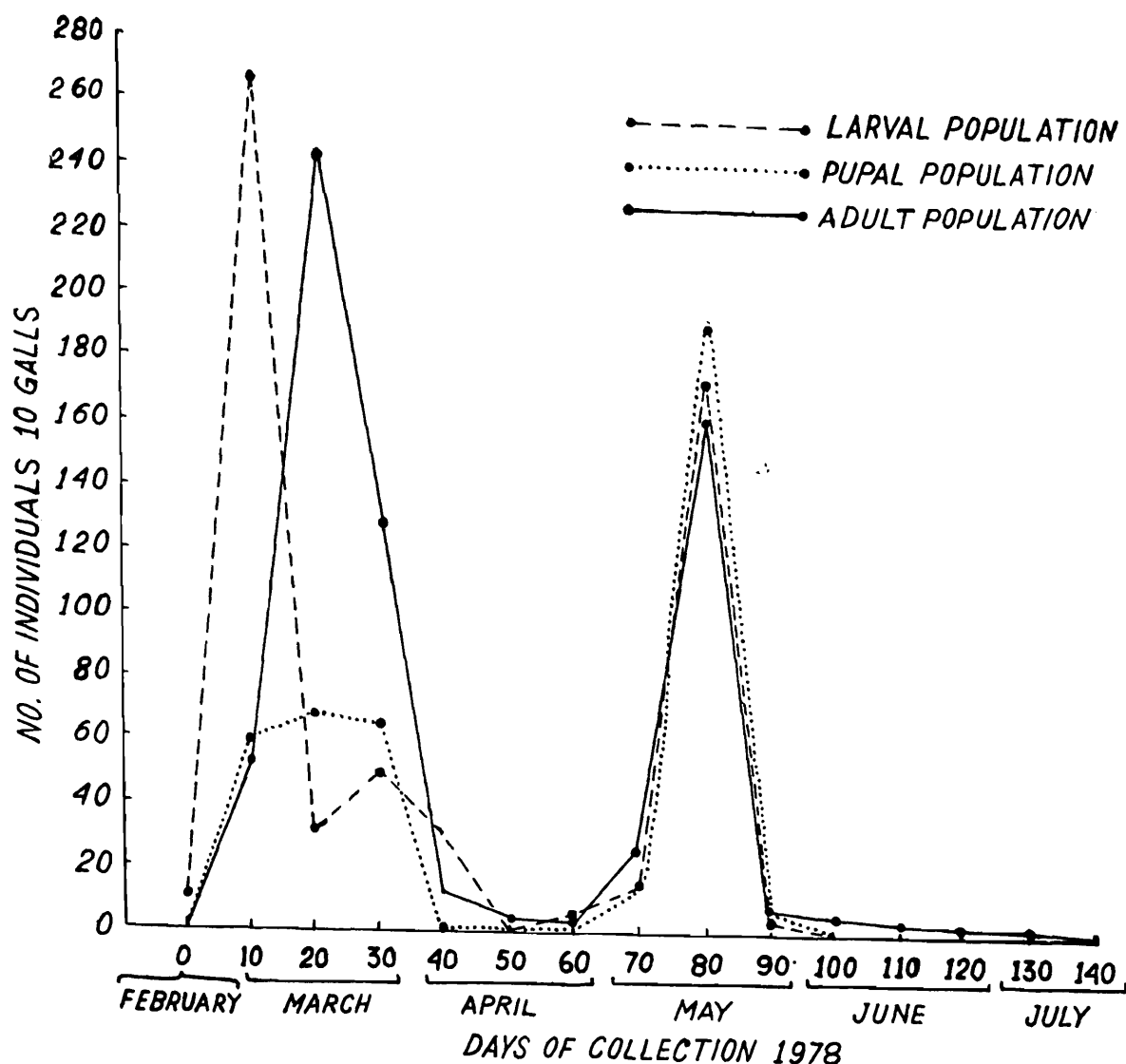


Fig. 2. Overall population trend of *Aneurothrips priesneri*.

gall as observed on the 80th day. The total count for each month during the peak population period indicated that the immature stages were always higher than the adult stage which could be attributed to high mortality during developmental stages. Throughout the study, the average sex ratio was 1 : 1.8 (male : female) the females outnumbering the males. By the 130th day in most of the galls, the larvae, pupae and adults (30-40/10 galls) were found to be infected by an unidentified entomogenous fungus. Population of the predator species *Montandoniola mora-*

guesi (Anthocoridae) (Muraleedharan and Ananthakrishnan, 1971 ; Muraleedharan, 1973 ; Raman *et al.*, (1978) and *Androthrips* (Ananthakrishnan and Varadarasan, 1977) were weak i.e., 1 and 2-5/10 galls respectively during the period from the 40th to 50th day (May 1978).

The populations of gall tubulifera (species of *Gynaikothrips* and *Schedothrips*) were generally known to occur between summer and autumn months (July to September) (Ananthakrishnan and Swaminathan, 1977 ; Raman *et al.*, 1978), but *Aneurothrips* population

TABLE I. Total count of immature and adult stages/month and sex ratio.
(average for 10 galls)

Months for 1978	Immature stages	Adult stages	Sex ratio Male : Female
February	10	6	1 : 2
March	539	434	1 : 1.6
April	35	17	1 : 2
May	402	193	1 : 2.7
June	—	10	1 : 2.3
July	—	2	1 : 2
Total	986	662	Mean 1 : 1.8

was evident only during summer months. The total duration of this terebrantian was restricted to a 3-4 month period, which is lesser than that of the other two tubulifera reported viz. *S. orientalis*, 12 months and *G. flaviantennatus*, 8-9 months. Besides, the great deal of interaction between the gall makers, and their parasites and predators, known in tubuliferan gall communities, was lacking in the case of *Cordia* gall community.

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A NEW SPECIES OF GENUS *CRYPTOCHIRONOMUS* KIEFFER
(CHIRONOMIDAE, DIPTERA) FROM INDIA

Genus *Cryptochironomus* was established by Kieffer (1918) on the basis of an European specimen, *Cryptochironomus chlorolobus* as its type-species. Edwards (1929) included it under the subgenus *Chironomus* Meigen. Goetghebuer (1936, '37) placed it as a separate subgenus which was subsequently supported and used by authors like Freeman (1957, 59 and '61) who also synonymised a number of genera with this *Cryptochironomus*. Recently, the generic status has been revived by Sublette and Sublette (1965, '73). The genus was previously known from India by one species, *Cryptochironomus polius* (Kieffer) only.

In describing this species the terminologies and usages have been followed after Frommer (1967) and Saether (1976).

Cryptochironomus fuscitarsus sp. nov.
(Figs. 1 A-C)

Male :

Head : Light brown in colour. Vertex with 9 setae (post ocular, 2, outer verticles 5, and inner verticles, 2), corona with 2 setae, Clypeus with 8-10 setae, clypeal ratio 0.81. Maxillary palp pale to brown, ratio of length of palpoles from I to V 10 : 10 : 19 : 26 : 35, L/W 3.8. Eyes bare, reniform and extended dorsally. Antenna brown, flagellomere XII long with apical seta, AR 1.15. CA 0.62, C. P. 1.

Thorax : Light brown. Pronotum without V shaped emargination, anteropronotals

5, acrostichals 12, dorsocentrals 16, humerals, 4 and prealars, 4, Scutellum with 10 setae, post-scutellum yellow and bare.

Wing : Hyaline, posterior veins inconspicuous. Brachiolium with 2 setae, R with 15, R_1 , 8 and R_{4+5} with 16-18 setae, R_{2+3} mee's C very close to R_1 , distance being 0.1 mm, r-m faint and proximal to f-cu ; An ends below f-cu. Squama with 6 setae. CR 1.03, VR 1.2. Haltere with yellow stem and knob.

Legs : Yellow in colour. Fore tibial scale with 2 long setae, mid and hind tibia with 2 spurs in each comb. Spurs of mid tibia equal and 0.24 mm long, ratio of length of spurs to the apical diameter of mid tibia 4 : 9 ; spurs of hind tibia unequal, 0.042 mm and 0.024 mm long, ratio of lengths of spurs to the apical diameter of hind tibiae 9 : 11 and 4 : 11. Fore tarsomeres grey, tarsomeres IV-V of mid and hind leg grey, tarsomere V flattened. LR 1.6 in fore leg, 0.5 in mid leg and 0.6 in hind leg. TR of hind leg 1.7.

Abdomen : Yellow in colour. Terga uniformly setaceous.

Hypopygium (Fig. 1 A) : Anal point 0.32 mm long, proximal part slightly swollen with subacute tip, base with 3-4 (4) setae on each side. Appendage 2 absent, appendage 1 slightly bent inward. Gonocoxite moderate and small, inner margin with fine setae gonocoxite with 8-9 (8) setae ; gonostylus long, proximal part little dilated, distal part narrowed, slightly bent inward with 4-5 (4) weak setae

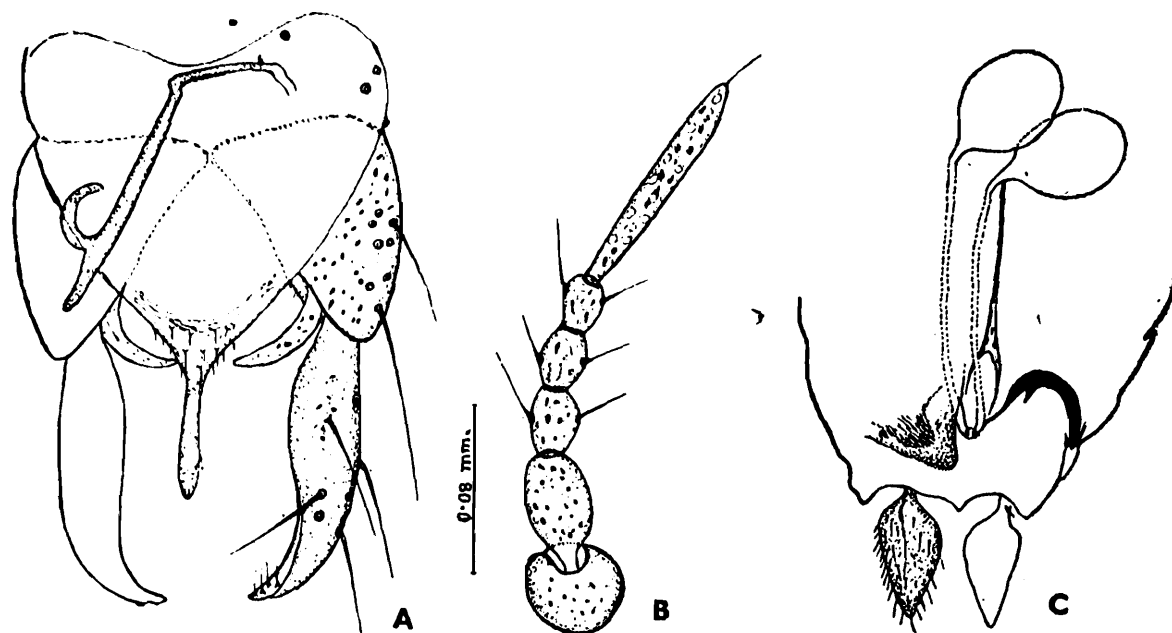


Fig. 1. (A—C) *Cryptochironomus fuscitarsus* sp. nov., A-♂, hypopygium, B-♀ antenna, and C-♀ genitalia.

at the inner apical margin. Laterosternite with 10 setae lateral sternapodeme 0.5 mm, transverse sternapodeme 0.02 mm HR 0.64, HV 0.51.

Female :

Similar to male with usual sex differences. Antenna (Fig. 1B) brown, flagellomeres drum-shaped, flagellomeres I to IV with 3 long setae, flagellomere V dark with a long apical seta and 7-8 sensilla ; ratio of length of flagellomeres from I—V 15 : 8 : 8 : 8 : 26, AR 0.67. Wing with 15-16 setae on R_1 , 6-7 on R_1 and 17 on R_{4+5} . Genitalia (Fig. 1C) : Notum 0.84 mm long. Tergum IX with 6-7 long setae in a row, tergum X with 4 long setae along its margin. Gonocoxite with 2 setae, cerci long, elongated, finely setaceous and a few long setae. Seminal capsule (Fig. 1C) unequal, oval, moderately sclerotized measuring 0.15 mm by 0.09 mm and 0.12 mm by 0.08 mm.

This species has been named *Cryptochironomus fuscitarsus* sp. nov. due to its dark

colour of the tarsomeres of legs. It seems close to other species of the genus especially *Cryptochironomus forcipatus* Freeman (1957, '61) from South Africa and Australia and *C. distractus* Johannsen from Java but can easily be identified from them by, i) colour of the specimens, ii) chaetotaxy of head, thorax and wing, iii) tarsomeres of all legs, iv) structure of anal point bare and curved appendage 1 and vi) shape of gonostylus with terminal apical setae.

Measurements :

Body length ♂, 2.96 (2.92-3.34, $n=8$) mm, ♀, 2.20 mm ($n=4$) ♂ Wing length 1.4 mm ($n=6$), breadth 0.05 mm ($n=7$), ♀, wing length ♀ 1.60 mm ($n=4$), breadth 0.70 mm ($n=4$). Dorsal extension of eye (♂, ♀) 0.6 mm.

Holotype : ♂, (Z. S. I. Reg. No. 6512/H6) West Bengal, Bolpur, 18. viii. 1977, Coll. D. Chatterjee.

Allotype : ♀, (Z. S. I. Reg. No. 6513/H 6) data same as holotype.

Paratypes : 10 ♂♂, (Z. S. I. Reg. No. 6514/H 6—6518/H 6) 7 ♀♀, 15-21, viii, 1977, rest data same as types. Rest paratypes in the collection of Zoology Dept., Burdwan University.

Additional specimens : 18 ♂♂, 11 ♀♀, in spirit, data same as types.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, Zoological Survey of India, Calcutta and to Prof. D. K. Chaudhuri, Head of the department of Zoology, University of Burdwan for various courtesies.

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ON *EOEURYSIA FLAVOCAPITATA* MUIR (HOMOPTERA :
DELPHACIDAE) FROM INDIA

Distant (1906-1917) made a salient contribution on Indian Delphacidae approximately consisted of 94 species which pertain to 15 genera. Muir in 1921 revised and synonymised a fraction of Distant's record on genera and species. The incidence of *Eoeurysia flavocapitata* Muir on sugarcane is not yet reported as a pest of major economic importance. The species is recorded from Malaya, South

China, Krakatna (East Indies) and India. Muir (1913) being an original author of his new genus *Eoeurysia*, subsequently designated the type-species *E. flavocapitata* in 1915.

The objective of this paper is to supplement genital armature with illustration as key characteristics which remained omitted by Muir (1913) and Mammen and Menon (1974).

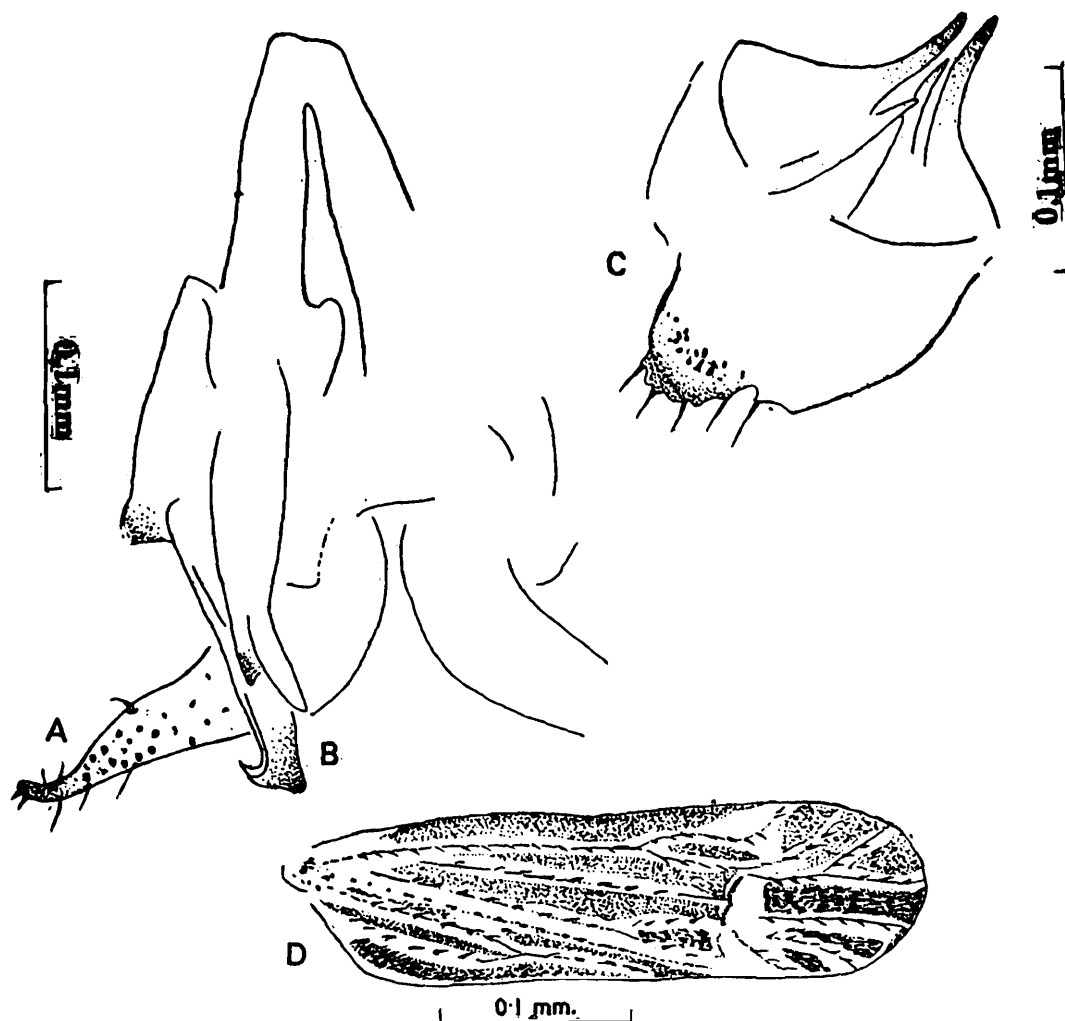


Fig. 1. *Eoeurysia flavocapitata* Muir, A-Aedeagus ; B-Genital style : C-Anal lobe ; D-Tegmina.

Eoeurysia flavocapitata Muir1913. Muir, *Proc. Hawaiian Ent. Soc.* 2 : 2491930. Muir, *Treubia*, 12 : 301935. Wu, *Cat. Ins. Sinensum*, 2 : 120

Vertex and pronotum creamy white excepting anterior marginal pronotum with a dark brown stripe, face fuscous piceous, pro- and mesothoracic legs fuscous and hind pair of legs light brown, presence of teeth on caecar. Abdominal segments with fuscous tinge.

Tegmina (Fig. 1D) fuscous, translucent, with a transverse transparent band crossing entire length through stigma. Veins setose.

Pygofer simple. Anal lobe (Fig. 1C) with two pairs of sharp spinose processes, directed cephalad, inner one shorter than the lateral ones. Aedeagus (Fig. 1A) tubulate, gradually tapering distad, apical part foot-shaped, bifurcated in the form of a pair of short sharp spines directed laterad. Genital styles (Fig. 1B) stout, tubulate, gradually divergent, apical 1/3 abruptly narrowed, apical margin ends with a pair of very short spines.

Length : Male 2.5 ; tegmen 3.

Female 3 ; tegmen 3.2.

Material : 2 ♀ ♀, dry pinned, on Sugarcane, INDIA : W. B., Kalyani, 25.9.1962, A. K. Bhattacharya Coll. ZSI (Reg. No. 8946/

H7) ; 1 ♀ dry pinned, on Sugarcane, INDIA : W. B., Haringhata, date and coll. ?, (ZSI Regd. No. 8947/H7) ; 1 ♀ dry, pinned, on Sugarcane, INDIA : W. B., Kalyani, date ? Coll. A. K. Bhattacharya (ZSI. Regd. No. 8950/H7) ; ♀ genitalia dissected on slide and wing on slide on Sugarcane, INDIA : W. B. Bethuadahari, 31. 12. 1976, Coll. A. K. Ray.

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The authors express their gratitude to the Director, Zoological Survey of India, Calcutta for necessary laboratory facilities and encouragement.

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THE PLANARIA, *BIPALIUM INDICA* AN EFFECTIVE PREDATOR OF
ACHATINA FULICA

All attempts to control the notorious agri-horticultural pest, the giant African land snail, *Achatina fulica* with chemicals (Mead, 1961 ; Mandal and Ghose, 1970 and Manna and Ghose, 1972) have failed. The protective shell, capacity of secreting profuse thick mucus, and nocturnal habit are almost insurmountable barriers in controlling this pest, and greater attention is now being paid to the biological control.

A number of predators of *A. fulica* have been reported from Indo-Pacific Islands (Mead, 1961 ; Mead, 1963 ; Srivastava and Srivastava, 1967 and Srivastava, 1968). Recently, the authors (Raut and Ghose) have also recorded two birds—*Dendrocitta vagabunda* and *Centropus sinensis* and one bandicoot rat, *Bandicota indica*, as predators of this snail. However, the possibility of employing them as a biological means of control, is yet to be evaluated. In the present communication a terrestrial planaria *Bipalium indica* is reported for the first time as an effective predator of *A. fulica*. *B. indica* is rather common in and around the gardens in lower West Bengal where *A. fulica*, are found in abundance. They, like *A. fulica*, are also nocturnal and most active only in monsoon.

During behavioural studies on *A. fulica* in the morning of August, 1976, in the gardens of Calcutta University campus, Ballygunge, Calcutta, a number of dead juvenile snails still with fresh flesh indicating that

they met with unnatural death in the previous night were recorded. No visible sign of damage could be detected either on the shell or on the body. A careful watch in the next night revealed that the snails were being attacked by the planaria, *B. indica*. The predation was, however, restricted only to the juvenile snails with 15-25 mm shell size.

The worm crawls on a moving snail and supporting either the anterior or the posterior end of its body on the soil, turns the snail upside down. Immediately the worm moves to reach the exposed flesh in the upwardly directed shell aperture and secretes a toxic fluid to paralyse the victim. The snail reacts violently by spontaneous secretion of a considerable amount of mucus and quick withdrawal of the body inside the shell. This is followed by an inactive stage, and the worm moving inside the shell, pushes the pharynx in the flesh of the snail, and sucks the fluid for about 20 to 30 minutes. The snail does not regain activity and dies afterwards.

The planaria (*B. indica*) is an effective predator of *A. fulica* but its role in the control of the giant snail is not significant in this area due to imbalanced predator-prey population, the predator (planaria) being much less in number. The possibility of utilising *B. indica* in the control of the giant land snail appears to be encouraging if the population density of the former can be raised to a certain level.

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OCCURRENCE OF THE SEA URCHIN, *STOMOPNEUSTES VARIOLARIS*
(LAMARCK, 1816) ALONG THE COASTS OF KANYAKUMARI (S. INDIA)

During an ecological and faunistic survey of the east coast of India the author had an opportunity to collect specimens of Echinoid from rocky shores along the coasts of Kanyakumari at Chinnamutiom, Muttom and Cola-chal. Detailed examination of these specimens revealed that they are *Stomopneustes variolaris* (Lamarck, 1816).

Diagnosis : General colouration deep purple : spines long stout and solid (Pl. VI. Fig. A) : ratio of spine length to the test diameter is 0.90. (Pl. VI. Fig. B).

Test low and finely texture (Pl. VI. Fig. C), consisting of doubly compound ambulacral plates, and the boundary between two cre-

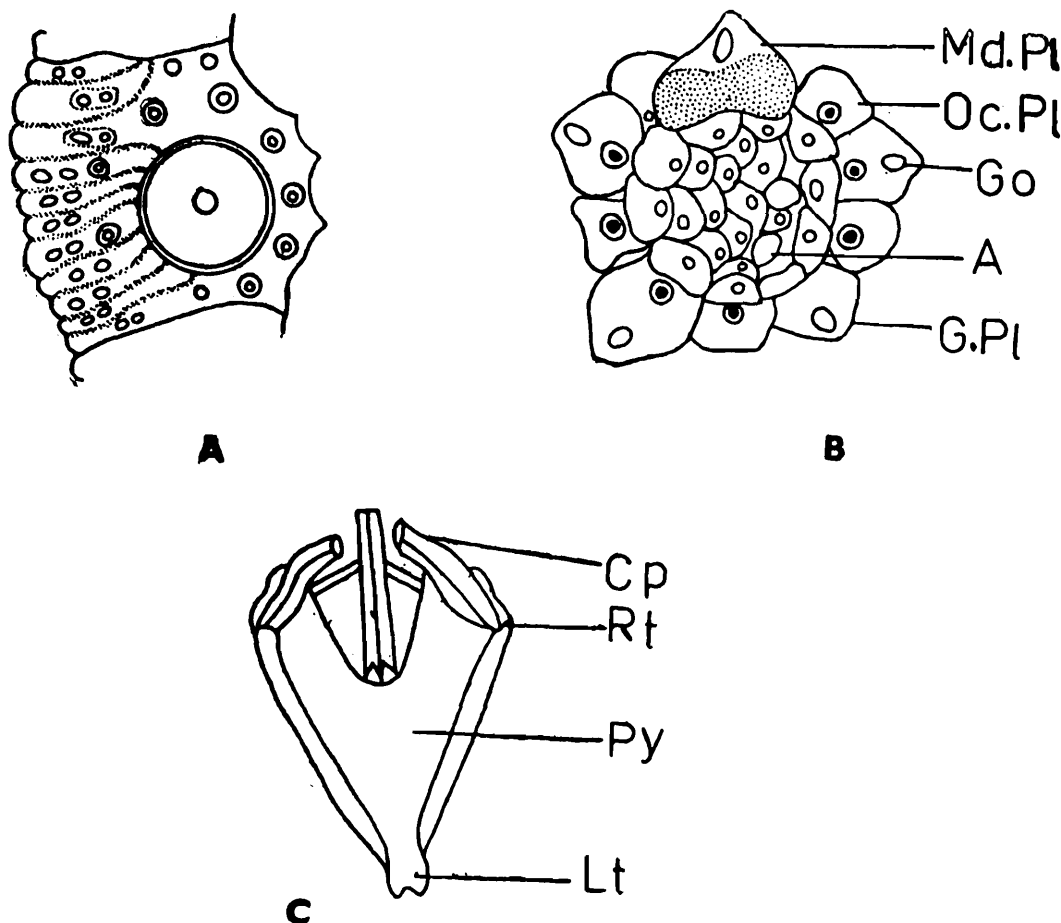


Fig. 1 (A—C) *Stomopneustes variolaris* A—Ambulacral plate, B—*S. variolaris* : Apical system, C—Aristotle's lantern. A—anus ; G. O—gonadial opening ; G. pl—gonadal plate ; Oc. Pl—ocular plates ; Md. Pl—madreporitic plate.

nulate, imperforate ; secondary tubercles vary from 468 in number 10-12 pore-pairs (poly-porous) can be seen (Fig 1A) through which the pedicellariae protrude ; for a test diameter of 60 mm. there are about 12 ambulacral plates.

Interambulacral plates sutured and the boundary between one and the next one (in vertical line) is not conspicuous ; one primary tubercle and 4—8 secondary tubercles.

Apical system conspicuous : consists of five basal and five ocular plates which are insert. The basal plate, in which the madreporite opens, is very thick and large when compared to the rest of the plates (Fig. 1B) ; periproct large with numerous surnal plates ; for the test diameter of 60 mm. the apical system measures about 10 mm. in diameter. In the Aristotle's lantern the arch is not complete (Fig. 1C).

Distribution : This species is a common Indo-pacific form (Clark and Rowe, 1971). In India it has been recorded from Laccadives (Koehler, 1927), Kavar (Patil, 1953). Mandapam (Gulf of Mannar), Waltair, Minicoy, (James 1959) and Madras (Gravely 1941). The localities recorded in this paper extend the distribution of this species. As the species dwells among rocks, it is likely to have a wider distribution along the rocky coasts of S. India.

Remarks : The gonad of this sea urchin is eaten raw by the people of these localities as a delicacy. The study of their reproductive biology and culture of these rocky coasts will be of great value.

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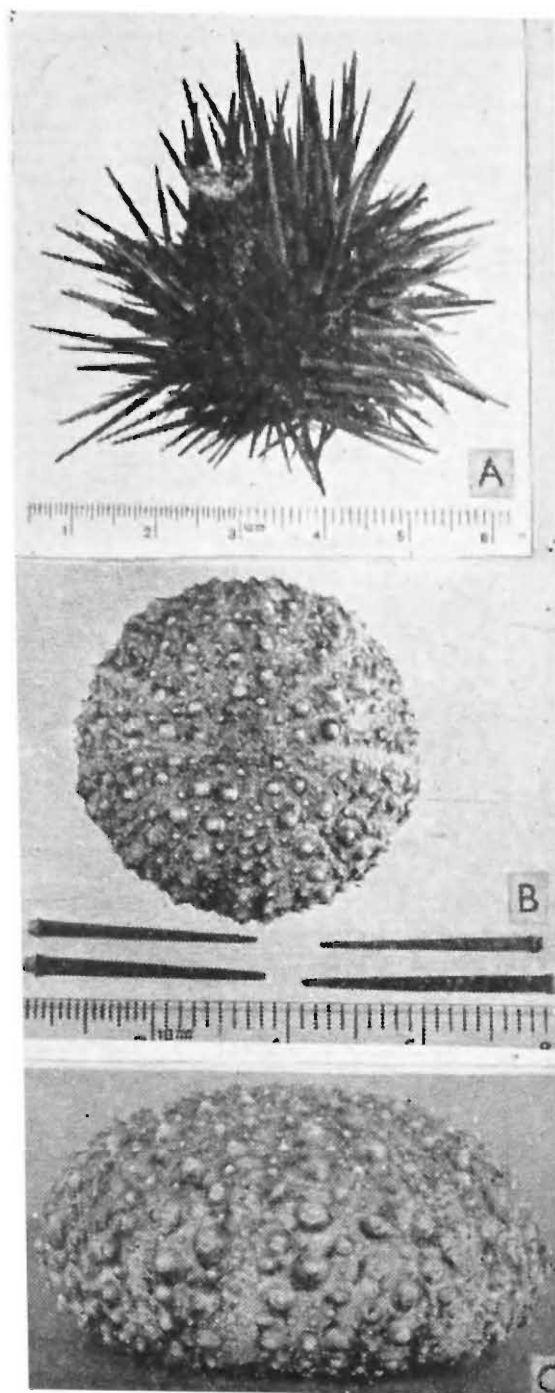
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PLATE VI



(A—C) *Stomopneustes variclaris* : A—Whole animal seen from above, B—test shown with spines to show the pattern and comparative length of the spines to the test, C—test lateral view.

Bull. zool. Surv. India, 2 (1) : 105, 1979

RECORD OF THE ROTIFER *TRIPLEUCHLANIS PLICATA* (LEVANDER) FROM
A FRESHWATER TANK IN CALCUTTA, INDIA

Among the enchlanid rotifers recorded from freshwaters of Indian sub-continent, *Tripleuchlanis plicata* (Levander) is of rare occurrence. So far it was only been recorded from Kaikalur (Andhra Pradesh) by Dhanapathi (1975). However, during the present studies on the rotifer fauna of Calcutta and its adjacent areas, 2 specimens of this rotifer were collected on 19.9.1975 from a freshwater tank situated in the compound of Indian Museum, Calcutta. Later on a large number of individuals made a sporadic appearance in the plankton samples collected on 31.5.1976 from the same tank. The present report is first record of this species from North-East India.

The occurrence of large numbers of individuals of this species from a freshwater tank has some importance from distribution point of view as this rotifer is mainly restricted to marine waters. Myers (1938) stated that "*Tripleuchlanis plicata* is common in salt water of bays and inlets, where there is growth of marine algae, it is the only marine Euchlanid rotifer known". Rodewald (1940) described var *razelmi* of this rotifer, from brackish waters of Rumania. The occurrence of this rotifer from marine waters of Denmark has been

reported by Thane-Fenchel (1968). Chengalath, Fernando and Koste (1973) recorded it from a tank in Ceylon. This rotifer has also been collected from a freshwater reservoir in Madras by Dr. Donner, Austria (personnel communication of Dhanapathi). Dhanapathi (1975) collected 3 specimens of this species from a freshwater tank in Kaikalur (Andhra Pradesh) but considered it to be of rare occurrence in freshwaters. But the blooming of this rotifer in a freshwater tank, as is in the present case, points the possibility of its wide range of toleration to the varying degree of salinity values. Some specimens of this rotifers have also been collected by me from brackish waters from Diamond Harbour (24-Parganas). Further studies on this rotifer from different geographical areas are desired to highlight its exact distribution.

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Zoological Survey of India,
Calcutta

B. K. SHARMA

Bull. zool. Surv. India, 2 (1) : 107-108, 1979

ON A NEW ASSOCIATION BETWEEN PEA-CRAB *PINNOTHERES CARDII* BURGER
AND THE BIVALVE *MACTRA LUZONICA* DESHAYES IN INDIAN WATERS

The Pinnotherids are popularly known as pea-crabs, have been known to associate with bivalves and regarded as an example of mutual friendship. More recently they have been recognized to occur as associates in bivalves, brachiopods, holothurians, ascidians and even in the tubes of polychaetes.

During a recent collection trip to Digha coast in the mouth of river Hooghly, West Bengal, India, undertaken by the senior author, five examples of bivalves were collected. While narcotizing the material, one pea-crab was found to occur in the internal cavity of one of the bivalves. The pea-crab has been determined as *Pinnotheres cardii* Burger 1895 and its partner, the bivalve, as *Mactra luzonica* Deshayes. The present report deals with the new locality record of the pea-crab in Indian waters and also a new association.

Pinnotheres cardii Burger

Material : One example ; mouth of Hooghly river, Digha, West Bengal, India ; 12.2.78 ; ♀ ; Coll. A. Misra ; Regd. No. D 2017/2.

Measurement : Length of the carapace 6.9 mm. ; Width 7.2 mm. ;

Distribution : Burias, Philippines ; Gulf of Siam ; Broome, Australia ; Japan (Tokyo Bay, Izu, Peninsula, Ise Bay, Nagasaki Yueyama).

Remarks : *Pinnotheres cardii* was described by Burger (1895) from the host *Cardium unedo* from Burias, Philippines. Later, it was reported from other parts of the world in association with other species of molluscs by various authors, as shown below :

Author	Host	Locality
Rathbun (1910)	<i>Cardium unedo</i>	Gulf of Siam
Rathbun (1924)	<i>Pinna bicolor</i>	Broome, Australia,
Sakai (1939)	<i>Ostrea denselamellosa</i>	Tokyo Bay, Japan
	<i>Mactra sachalinensis</i>	Kyusyu, Japan
	<i>M. sulcataria</i>	Simoda, Japan
	<i>Mytilus crassirostris</i>	Ise Bay, Japan

Now this pea crab, *Pinnotheres cardii* is reported for the first time from the Indian waters in association with a new host, *Mactra luzonica* Deshayes.

Recent observations on the association between pea crabs and other marine animals revealed that these are mainly commensalic association, though in some of the balance may tilt in the direction of parasitism.

Though the senior author did not observe any damage on the part of the host containing the pea-crab, a detailed study in the field as well as in the laboratory, is required definitely to say whether the particular association is parasitic or not. Hence the term association has been used and the individual partner is termed as an associate.

This brackish water clam is commercially important because of its use as an item of food article at least in some parts of India. As observed by Silas and Alagarwami (1967), the pea crabs are responsible for quite a good deal of damages on their hosts, and hence it is now badly needed to make a thorough investigation on the problem in the eastern coast of India, so as to indicate effective measures to save the edible molluscs.

ACKNOWLEDGEMENTS

We are grateful to the Director, Zoological Survey of India, Calcutta for providing laboratory facilities and Sri G. Ramakrishna, Superintending Zoologist for guidance and offering valuable suggestions in the preparation of this note.

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AND
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ON SOME EPIZOIC ROTIFERS FROM WEST BENGAL

Very little is known about the epizoic nature of the rotifers though Pennak (1953) pointed that free-living rotifers live as commensals or epizoics on a wide variety of freshwater invertebrates, especially on insects and crustaceans. During the course of my studies on the rotifer fauna of West Bengal, I came across certain epizoic associations between rotifers and other organisms which are described in this note.

The following species were found to show epizoic association :

1. *Brachionus rubens* Ehrenberg, 1838 ; Ahlstrom (1940) stated that this species occurred both free-swimming as well as a commensal on the cladoceran *Daphnia*. He however, did not specify any species of the above mentioned genus. Nayar (1968) reported a large number of individuals of *B. rubens* attached to the body of the fairy shrimp, *Brachinella kugenumaensis* (Ishikawa) [Crustacea : Branchiopoda : Anostraca]. Moreover, Mohan and Rao (1976) found it attached to dragonfly nymphs. My observations on this rotifer indicate that whereas it lived mostly as free-swimming ($85 \pm 5\%$), occasionally it also occurred in epizoic association with a number of cladoceran taxa i.e., *Daphnia carinata* King, *Moina micrura dubia* (Guerne et Richard), *Diaphanosoma excisum* Sars, and *Diaphanosoma sarsii* Richard. The degree of commensalistic association of this rotifer with the first two cladoceran taxa was high ($8 \pm 2\%$ and $5 \pm 3\%$ respectively). No other species of cladocerans seemed to be

involved in this association though 37 taxa spread over several genera were recorded in the present material.

2. *Brachionus caudatus* Borris and Daday, 1894 : This species represents a planktonic form but it has also been noticed to be attached to the damselfly nymphs by Mohan & Rao (1976). I have also observed three individuals of this species attached to a dragonfly nymph.

3. *Brachionus sessilis* Varga, 1951 : This species was described by Varga (1951) as an epizoic form on the cladoceran *Diaphanosoma brachyurum* (Lieven). Recently, Chengalath *et al.*, (1973) found that this species was epizoic on *Diaphanosoma excisum* Sars in Pavatkulam lake, Sri Lanka. Though very rare in the present material, my observations indicate it to epizoic on *Diaphanosoma excisum* Sars and *Diaphanosoma sarsii* Riahrd. I agree with Chengalath *et al.*, (*loc. cit.*) that the epizoic association of this species seemed to specific to the genus *Diaphanosoma*.

4. *Lepadella ovalis* (Muller, 1786) : *L. ovalis* is common in weedy lakes and ponds all over the world (Voigt, 1957, Kutikova, 1970). In this material it was also collected from some open water habitats and in one instance was also noticed to be attached with the help of its toes to the legs of damselfly nymph. The present example needs further confirmation before it could be accepted as an instance of epizoic association.

Thanks are due to the Government of India (Department of Science and Technology) for the award of a research fellowship and to the Director, Zoological Survey of India for providing me the necessary facilities. Thanks are also due to Dr. K. K. Tiwari, Joint-Director, Zoological Survey of India for his valuable comments.

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OCCURRENCE OF *EXALLIAS BREVIS* (KNER, 1868) [BLENNIIDAE : SALARIINAE] AND *SCARTELAOS TENUIS* (DAY, 1876) [GOBIIDAE : GOBIONELLINAE] IN INDIAN WATERS

Although the apparently monotypic genus *Exallias* Jordan and Evermann, 1905 of the blennioid fish tribe Salariaini is widely distributed in the tropical Indo-Pacific region (Smith-Vaniz and Springer, 1971, Carcassan, 1977), *Exallias brevis* was hitherto not known to inhabit Indian waters. This communication on *E. brevis* is, therefore, first from India. Coincidentally, *Scartelaos tenuis* also forms new distributional report, first from India since the original discovery and description by Day (1876) from Karachi. In the course of investigative taxonomic studies on sea fishes of Gujarat one example each of *Exallias brevis* and *Scartelaos tenuis* were noted. Brief taxonomic attributes of the species and their range of distribution is dealt hereunder.

Exallias brevis (Kner, 1868)

Salaria brevis Kner, 1868, *Sitz. Ber. Akad. Wiss. Wien*, 58 (1) : 29, 334, pl. 16, fig. 18 (type loc, Samoa).

Salaria leopardus Day, 1869, *Proc. zool. Soc. Lond.* : 518 (type loc, Ceylon).

Blennius leopardus (Day, 1869) ; Day, 1876, *Fishes of India*, (2) : 325, pl. 68, fig. 5 (type loc. Ceylon).

Exallias brevis (Kner, 1868) : Smith-Vaniz and Springer, 1971, *Smith. Contr. Zool.*, 73 : 1-72 (Key to genera).

Material : A male specimen, 75 mm. standard length, trawled off Veraval, Gujarat, ca. 30-40 fms, 26.XI.68, Coll. A. Daniel, ZSI Regd. No. F. 7221/2.

Description : D. XII ; 13 A. II, 14 ; P. 15 ;

V. I, 4 ; Caudal rays 13. Gill rakers on first gill arch 4+12.

Body stout and robust. Depth of body approximates length of head, both 34.66 % in standard length. Eye diameter 26.92 %, inter-orbital 15.35 %, postorbital length of head 57.60 % ; all in percent of head length. Snout obtuse, not overhanging the mouth, 30.70 % in head length. A pair of barbels on each side of chin. Occipital crest absent. Supraorbital cirrus multifid, a slender fleshy peduncle with 7 minute branches. Nasal cirri 5 branches. Nuchal cirri consist of an elongate, transverse series of cirri, interrupted at mid-line of nape by a narrow hiatus. Upper lip with 24 well developed crenulae, lower lip fully cremalate. Lateral line complete, no imbricate scale-like flaps covering anterior lateral line pores.

Teeth close-set, fine ; premaxillary teeth, numbering about 200 ; dentary teeth fairly rigid, number 50-60. Dentary canines absent, vomer teeth wanting. Dorsal fin with a deep notch ; terminal ray not bound by a membrane to caudal peduncle. Pectoral fin, a little shorter than head, 29.33 % in SL, lower 6 rays thickened. Anal spines in mature males embeded in fleshy dark coloured pads ; terminal anal ray not bound by a membrane to caudal peduncle. Caudal emarginate, 13, middle 9 rays branched.

Colour : (in alcohol) pale brownish, whitish below ; head, body and fins covered by numerous clusters of small brown spots.

Range : Entire Indo-Pacific including Hawaii.

Scartelaos tenuis (Day, 1876)

Boleophthalmus tenuis Day, 1876, *Fishes of India* (2) : 305, pl. 1 xv, fig. 1 (type loc. Estuaries of Kurrachee).

Boleophthalmus tenuis Day, 1889, *Day, Fauna Br. India. Fish.* 2 : 282.

Scartelaos tenuis Koumans 1941, *Mem. Indian Mus.* 13 : 284 (Revision of Gobies of India).

Material : 1 ex., standard length 68 mm., Rukmati River mouth, Gujarat, 26. VII. 72, Coll. *Surya Rao*, ZSI Regd. No. F 7367/2.

Description : D V ; 1/27-28 ; A I/25 ; P 13.

Body elongate, subcylindrical anteriorly. Frontal profile of head gently raised from bluntly pointed snout to eye. Depth of body 11.06%, head 25% in standard length. Snout 5.88% in head length. Eyes 4.4%, located in anterior third of head. Maxilla reaching posterior third of eye. Mouth oblique, upper jaw scarcely prominent. On the underside of head, on each side, 10 short barbels along lower edge of rami of lower jaw. Teeth in jaws in a single row ; caninoid in upper jaw, anteriorly subhorizontal in lower jaw, posteriorly scarcely erect. On each side in front in upper jaw 9 large canines, followed laterally by 10 much smaller teeth. A pair of canines behind symphysis of lower jaw. Spinous dorsal fin with anterior spines elongate into filaments. Soft

dorsal fin not conneted with caudal fin. Caudal lanceolate, longer than head. Ventral united oblong.

Colour : (in alcohol). Dorsal head and body brownish gray, paler below and underneath. Numerous dark spots on head and anterior body. Dark cross bars, on anterior two thirds of sides and blotches beyond. Soft dorsal fin brownish gray with 5 oblique bands in its lower half, reaching sides ; free edge lined by black followed immediately behind by a pale line. Caudal fin brownish gray ; upper margin bordered by a black and pale line in a fashion similar to soft dorsal fin ; lower half dark black spots. Anal and pelvic fins light yellowish orange.

Range : Sind and Persian Gulf (Katsuzo and Kuromma, 1972). This record extends its range further downwards to Indian waters.

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TAXONOMIC STATUS OF THE EASTERN GREY BUSH CHAT, *SAXICOLA*
FERREA HARRINGTONI (HARTERT)

The Grey Bush Chat was described by C. R. Gray (1847) from Nepal as *Saxicola ferrea*. Later, Hartert (1910) described *Oreicola ferrea harringtoni* from Lien Kiang, near Foochow, Fukien, China, as the eastern subspecies of the Grey Bush Chat.

Baker (1924), Vaurie (1959) and Biswas (1961) recognized the eastern subspecies in their works, but Kinnear (1934), Stressemann (1940), Mayr (1941), Ripley (1961) and Ali and Ripley (1973) did not accept Hartert's

eastern subspecies, and synonymized it with the nominate subspecies.

While working on the collection of this species of bird recently taken in Kashmir, Bhutan and Assam, we strongly felt the necessity to recognize the eastern subspecies *harringtoni*. We wholly agree with the view of Vaurie (1959) that *Saxicola ferrea harringtoni* (Hartert) is darker in both sexes than the nominate *ferrea*. Baker (1924), however, stated that *harringtoni* was paler than *ferrea*,

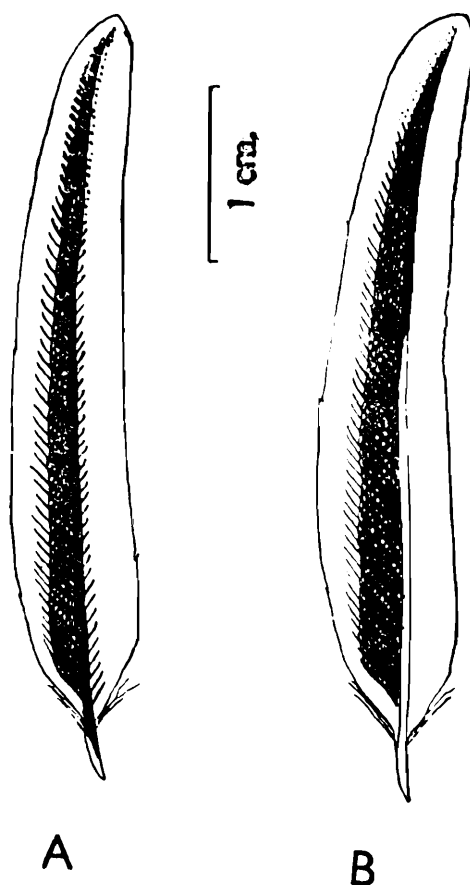


Fig. 1. Left outer-most rectrix showing the colour pattern of A—*Saxicola ferrea harringtoni* (Hartert), B—*Saxicola ferrea ferrea* Gray.

probably due to some clerical error. We would like to add that in the males of the nominate subspecies, the outer web of the outermost tail feather, including the basal two-third of the shaft, is entirely white. In *harringtoni*, on the otherhand, the shaft of the outermost tail feather, except its extreme tip is entirely sepia and in its outer web a brownish grey line runs between the shaft and the marginal white. In the female birds, the ferrugineous of the upper tail-coverts and the outer margin of the basal half of the rectrices is deeper, nearly cinnamon in *harringtoni* (Fig. 1).

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SUBHENDU SEKHAR SAHA
AND
BARID BARAN DATTA



ON ABNORMAL DEVELOPMENT OF MALE GENITALIA IN DIGENETIC TREMATODES*

Teratology and aberrations are of infrequent occurrence in animal kingdom reasons of which are varied and manifold being genetical, physiological or otherwise. In the course of routine examination of helminth parasites we have observed structural and morphological anomalies in some population as a whole or in a particular specimen out of the lot. A survey of the literature also reveals that several records of abnormalities in helminth parasites do exist. These abnormalities have been interpreted variously by different authors, at times resulting in new taxa. In an earlier communication (Ghosh and Srivastava, 1976) we discussed the abnormal development of vitellaria. This paper presents the abnormalities observed in male genital complex of digenetic trematodes and discusses their taxonomic importance.

Barker and Parsons (1917) observed that male and female reproductive organs in *Aorchis extensus* Barker and Parsons, 1917 develops normally in young (smaller) forms but disappear in older (larger) worms. Ruszkowski (1925) reported a specimen of *Isthmiophora melis* (Schränk, 1788) Luhe, 1909 having single testis with slight rudiments of posterior testis. He further recorded a specimen of *Echinostoma revolutum* (Froelich, 1802) Looss, 1899 with degenerated anterior and normal posterior testis. Bhalerao (1926) recorded single testis along with some other abnormalities in a population of about a

dozen worms of *Echinochasmus corvus* Bhalerao, 1926. Manter (1930) reported single testis along with other abnormalities in *Helicometra torta* Linton, 1910 due to early injury in the worm. Stunkard and Nigrelli (1930) noted the presence of single testis instead of normal two in *Lintonium vivax* (Linton, 1900). Ciurea (1933) recorded complete disappearance of left testis in a specimen and also noted complete disappearance of both testes in another specimen of *Metagonimus yokogawai* (Katsurada, 1912) Katsurada, 1913. Chen and Wang (1933) recorded several cases of various abnormalities in genital organs in *Clonorchis sinensis* (Cobbold, 1875) Loose, 1907. In his opinion some abnormalities in respect of male genital organs might be due to presence of eggs in so many places. They had also observed presence of egg into the testes and after discussing several probable reasons thought that all the theories proposed are "entirely speculative and the question is still open to other suggestions." Ameel (1938) reported the transitory nature of single testis in *Euryhelminis monorchis* Ameel, 1938. Odlaug (1939) observed abnormal condition of testes, vitellaria and uterus in *Gorgoderia amplivava* Loose, 1899. He concluded that degeneration and disintegration of testes and vitellaria are, "...intrinsic in the reproductive system of trematodes themselves, although it is entirely possible that certain changes in the physiology or habitat of the host such as a condition of starvation might

* Abstract presented in First Congress of Parasitology, Baroda, 1977.

induce atrophy of the genital organs in parasites. Degeneration is cyclic phenomenon with alternate atrophy and reconstitution of reproductive organs. Infrequent occurrence of the degenerate condition make this explanation seem improbable." Mehra (1947) recorded complete disappearance of testes and ovary in some specimens of *Gogatea birmanicus* (Chatterji, 1940) (= *Mesostephanoides birmanicus*)

(Chatterji, 1940) Dubois, 1951) and concluded that the gonads disappear in this trematode soon after sexual maturity. Malviya (1966) reported a specimen of *Echinochasmus perfoliatus* Tubangui, 1922 with a single testis.

We observed the presence of single testis in a specimen out of a large population of

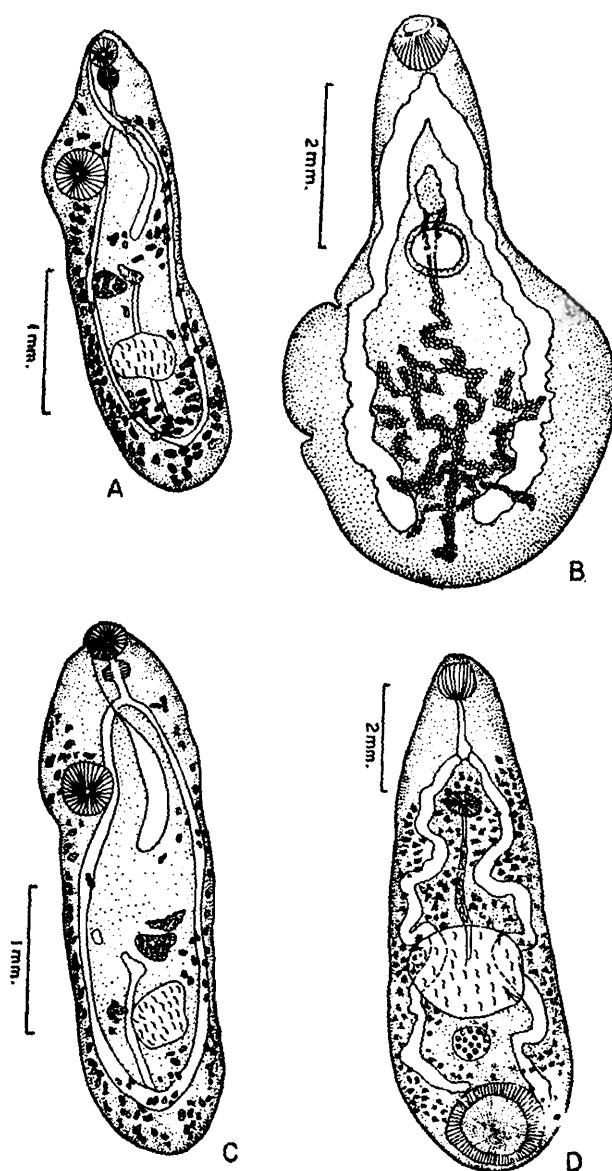


Fig. 1. Digenetic trematodes showing abnormal development in male genitalia : A—*Opegaster jamunicus* Srivastava, 1968, having single testis ; B—*Phyllodistomum chauhani* Motwani and Srivastava 1961, showing absence of all the gonads and vitellaria ; C—*Nicolla allahabadensis* (Srivastava, 1968), having a single testis. D—*Cotylophoron indicum* Stiles and Goldberger, 1910, showing the development of single testis.

Cotylophoron indicum Stiles and Goldberger, 1910 (Fig. 1D). In another paramphistomid, *Ceylonocotyle* sp. presence of single testis was noted. The specimens were otherwise normal without any gross structural deformity. Another specimen in a lot of *Opegaster jamunicus* Srivastava, 1968 (Fig. 1A) showed the presence of a single testis. The specimen was having normal development of all other organs. Possession of a single testis was also observed in a specimen of *Nicolla allahabadensis* (Srivastava, 1968), (Fig. 1C).

A single specimen in a population of *Phyllodistomum chauhani* Motwani and Srivastava, 1961 (Fig. 1B) was found to be peculiarly abnormal is not possessing any of the gonads including vitelline glands. The uterus in this specimen was full of eggs. Cirrus sac was found to be massive but in other respects the specimen appeared to be normal. It may be inferred that the gonads have disintegrated after discharging their function as observed by Mehra (1941) in *Gogatea birmanicus* (= *Mesostephanoides birmanicus*). But this contention does not find support as we have observed in another specimen of the same lot where one testis and one compact vitelline gland were absent. Secondly in majority of the adult specimens all the gonads were present. As such in this particular case there is some additional factor responsible for the type of apparent abnormalities.

We are very much aware that at the present stage of our knowledge the reason for these abnormalities are obscure. Yet it can be said that this may be three fold *i. e.* (1) genetic, (2) due to hyperparasitism, (3) early injury at some developmental stage.

We very much agree with the comments of Dawes (1946 p. 63) regarding abnormalities and artefacts that "No doubt such abnormalities are more common than a perusal of

the literature would have us to believe, and they should be recorded."

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RECORD OF *TACHYSURUS CROSSOCHEILUS* (BLEEKER) (PISCES :
SILURIFORMES : ARIIDAE) FROM THE EAST COAST OF INDIA

Bleeker (1846) described *Arius crossocheilus* (= *T. crossocheilus*) from specimens collected from Batavia, East Indian Archipelago. Günther (1864), Weber and de Beaufort (1913), Harre (1926, 1953), and Fowler (1941) subsequently extended the range of distribution of this species to the Indo-Pacific seas.

Chandy (1953) recorded this species for the first time in India from Bombāy and

observed that it is not common. No record of this species subsequent to Chandy's observation has been made from any where else in India or even from Arabian sea. It is unfortunate that the two specimens obtained by Chandy, 191 mm. and 251 mm. in total length respectively are not present in the National Zoological Collections, Z. S. I., Calcutta, nor it has been included in the list of specimens present in the C. M. F. R. I.,

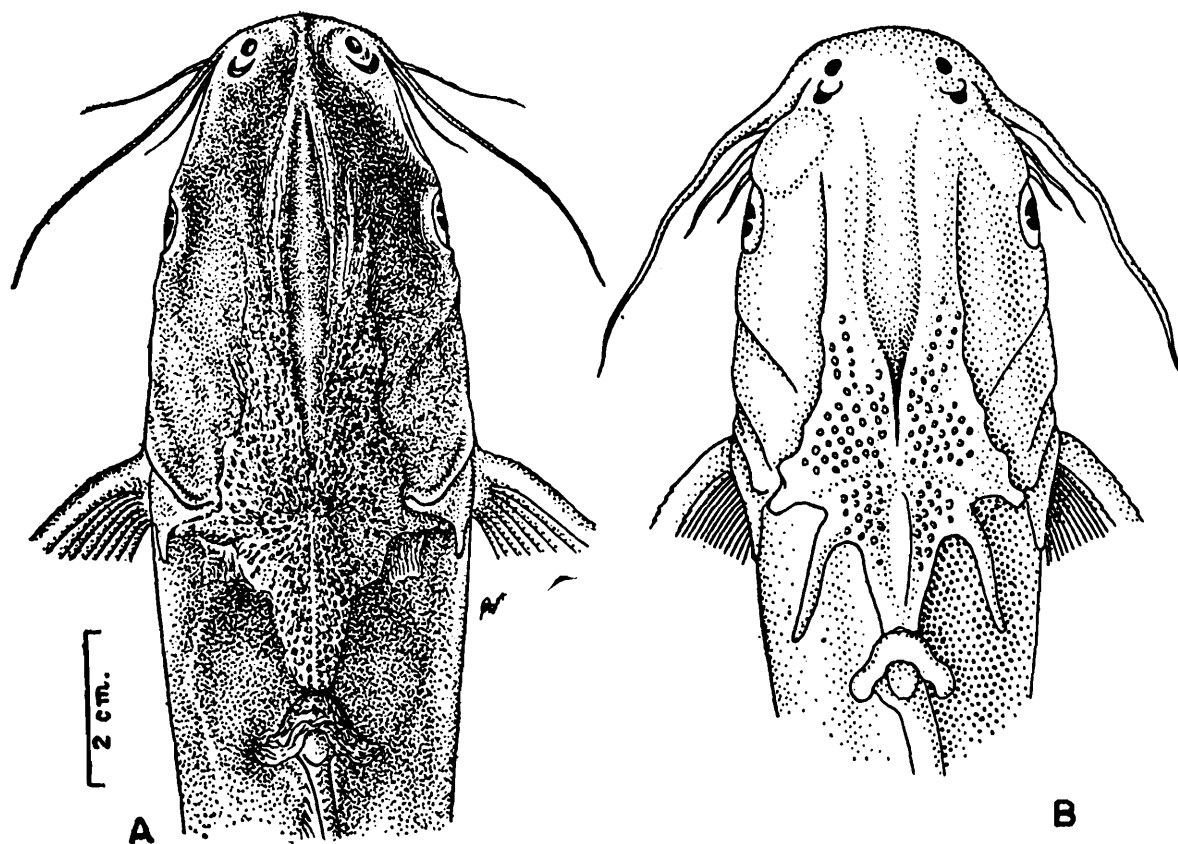


Fig. 1. A—Dorsal view of head and body of *T. crossocheilus* (Bleeker) showing the acute snout, absence of lateroethmoid protuberance in front of the eyes. B—Dorsal view of head and body of *T. dussumieri* (Valenciennes), to show the obtuse snout and the lateroethmoid protuberance in front of the eyes.



Fig. 2. A—Dentition in *T. crossocheilus* (Blk.), B—Dentition in *T. dussumieri* (Val.)

Mandapam (Murty, 1969). No other material of this species is present in Z. S. I.

In the light of the above uncertainty of the provenance of this species, it is worth while to report here the collection of four examples of *T. crossocheilus* (Bleeker) from the Bay of Bengal. During a recent survey of the West Bengal and Orissa coast the authors collected two examples measuring 225 mm, 240 mm from Balramgudi and two examples 155 mm, 170 mm from Gopalpur, in standard length respectively.

The species is clearly differentiated from *T. dussumieri* (Valenciennes) common in Bay of Bengal and Arabian sea by its possessing two patches of teeth on each side of the palate (Fig. 2) but with the posterior patch of teeth pyriform in shape (vs. elongated in *T. dussumieri*), besides the teeth themselves

being globular in shape (vs. Villiform) and the snout (Fig. 1) being more acute (vs. obtuse). Moreover the characteristic lateroethmoid protuberance over the eyes present in *T. dussumieri* is absent here.

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