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Dr. A. K. Ghosh
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RECORDS
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TAXONOMIC STUDIES OF SOME PHOLCID SPIDERS FROM INDIA (ARANEAE : PHOLCIDAE)

S. C. MAJUMDER AND BIJAN BISWAS
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INTRODUCTION

Spiders of the family Pholcidae in India have not received much attention in the past. The *fauna of British India, Arachnida* by Pocock (1900) and Dyal (1935) had taken some interest on the pholcid spiders. Recently Tikader (1961-1963), Tikader (1977) and Tikader & Biswas (1981) described and studied on Pholcid spiders. Walckenaer (1805) was the first to observe that the earlier known species *Pholcus Phalangoides* under the family Pholcidae.

Genus **Artema** Walckenaer

1837. *Artema* Walckenaer, *Ins. Apteres.* **1** : 656.

Type species ; *Artema mauricia* Walck.

Distribution : Africa, Asia, America, Arabia, India and Malaysia.

Artema atlenta Walckenaer

1837. *Artema atlenta* Walckenaer, *Ins. Apteres*, **1** : 656.

1900. *Artema atlenta* : Pocock, *Fauna Brit. India Arch*, : 238.

1961. *Artema atlenta* : Tikader, *Rec. Indian Mus.*, **59** : 437.

1981. *Artema atlenta* : Tikader & Biswas, *Rec. zool. Surv. India.* occ. pap. No. 30 : 18.

Specimen examined : 12 ♀ ♀, 13 ♂ ♂, Poona City, Maharashtra, 18.12.1973. coll. *B. K. Tikader*. 15 ♀ ♀, 7 ♂ ♂, Dhakuria, Calcutta, West Bengal, 10.10.1958. coll. *B. K. Tikader*. 1 ♀, Sirpur, Saran, Bihar, 1930. coll. *Machanzie*. 15 ♀ ♀, 8 ♂ ♂, Petrapole, (N), 24 Parganas, West Bengal, 1.4.1984. coll. *Bijan Biswas*.

Distribution : India : Calcutta, West Bengal ; Travancore, Tamil Nadu ; Poona, Maharashtra ; Punjab.

Genus **Crossopriza** Simon

1893. *Crossopriza* Simon, *Hist. Nat. Araign.*, **1** : 476.

Type species : *Crossopriza pristina* Simon

Distribution : Egypt, Arabia and India.

Crossopriza lyoni (Blackwall)

1867. *Pholcus lyoni* Blackwall, *Ann. Mag. Nat. Hist.*, **19** (3) : 302.

1960. *Crossopriza lyoni* : Pocock, *Fauna Brit. India Arach.*, : 240.

1935. *Crossopriza lyoni* : Dyal, *Bull. zool. Punjab Univ.*, **1** ; 162.

1981. *Crossopriza lyoni* : Tikader & Biswas, *Rec. zool. Surv. India*, occ. pap. No. 30 : 18.

Specimen examined : 12 ♀ ♀, 5 ♂ ♂, Dhosa, Dist. Bhabnagar, Gujarat, 28.12.1973, coll. *S. K. Gupta.* 15 ♀ ♀, 3 ♂ ♂, Chotonagpur, Dist. Singhbhum, Bihar, 26.1.1955, coll. *A. P. Kapoor*, 5 ♀ ♀, 2 ♂ ♂, Wadgaon, Gujarat, 15.11.1976. coll. *B. Dutta.* 2 ♀ ♀, Pali, Jodhpur, Rajasthan, 4.2.1962. coll. *A. K. Dutta.*

Distribution : India : Calcutta, West Bengal ; Madras, Tamil Nadu ; Allahabad, U. P. ; Punjab ; Rajasthan and Gujarat.

Genus **Pholcus** Walckenaer

1805. *Pholcus* Walckenaer, *Tabl. Aran.*, : 80.T—8.F—79.

Type species : *Pholcus Phalangoides* Walckenaer

Distribution : Cosmopolitan.

Pholcus kapuri Tikader

1977. *Pholcus kapuri* Tikader, *Rec. zool. Surv. India*, **72** : 165.

Specimen examined : 3 ♀ ♀, 1 ♂, Neil Island, Reserve forest, Andaman and Nicobar Islands, 11.4.1979. coll. *B. K. Tikader.*

Distribution : Neil Island (Type-locality) Andaman and Nicobar Island.

Summary

130 specimens were examined and identified. Altogether three species and three genera are treated here under the family Pholcidae.

Acknowledgements

Authors are thankful to Dr. Asket Singh, Scientist-SF, in-Charge, Zoological Survey of India, Calcutta for facilities provided for the work. They are also thankful to Dr. S. K. Gupta, Scientist-SD for his suggestion.

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Rec. zool Surv. India, **92** (1-4) ; 5-8, 1992

A NOTE ON THE DOMESTIC MAMMALIAN REMAINS FROM CHALCOLITHIC KOTASUR, DISTRICT BIRBHUM, WEST BENGAL

M. Ghosh, K. D. Saha, S. K. Roy & B. Talukder
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While digging a pond in the village Kotasur (*c.* 22°55'N and 87°45'E), dist. Birbhum, West Bengal, in 1982, a few bones of domesticated mammals along with some broken potteries and terrakotta figurines had been unearthed from a depth of four metres below the earth surface. The material was collected by Shri Prafulla Kumar Panda & Shri Srinivash Pal, two residents of the locality, and brought to the notice of the District Magistrate. It was by the kind courtsey of the D. M. that we received a request to collect and identify the material.

The terrakotta figurines include a pot-belly Yaksho, motifs of two well decorated elephants and one humped bull. Shri Sudhin Dey, a Senior Archaeologist in the Directorate of Archaeology, Government of West Bengal, opined that the age of antiquities may be attributed to between 1st Century B. C. and 2nd Century A. D. Though the site was originally assigned to Chalcolithic period by the aforesaid department, Shri V. Sen of the Archaeological Survey of India reported the occurrence of sherds of black & red ware, a doubtful piece of northern-black polished ware and a few waste flakes from the site (Ghosh, 1962-63).

The faunal material mentioned in the present study is tabulated below :

Genus/Species	*Material*	*Remarks*
Equus sp. (Horse/pony)	Right lower 2nd premolar	This is a lophodont tooth with a squarish and molariform crown.
Sus scrofa (The Indian pig)	Broken right mandible with 3rd premolar and 1st, 2nd molars	The mandible has lateral bulging, sectorial premolar and bunodont molars, the last having less eroded tuberculated cusps.
Bos indicus (The Humped Cattle)	(i) Left mandible with 4th milk premolar and 1st molar	The mandible is narrow, laterally flattened with selenodont teeth.

Genus/Species	*Material*	*Remarks*
	(ii) Distal fragment of left humerus	
	(iii) Distal end-fragment of radio-ulna with condylar portion chopped off	
	(iv) Right radio-ulna without distal end	
	(v) Fragment of condylar portion of right radius	
	(vi) Two pieces of left metatarsal	
	(vii) Left metatarsal without proximal end	
Bubalus bubalis (The Water Buffalo)	Left upper 2nd molar	The molar is thick-walled, eroded, its broad cresentic islands having little corrugated & extended horns with adequate cementum.
Elepas maximus (The Indian Elephant)	Lower left 3rd molar	The molar is broad and high, with transversely arranged oppressed enamel ridges, having 10 lamellae. The tooth is a little smaller than that of an average fully adult elephant.

Discussion

The remains represent five species of domestic mammals, of which two were draught animals—the pony and the elephant. Since when the pony was introduced in West Bengal is not precisely known. However, it is believed that the Equids were first tamed around 5,000 years B. P. somewhere in eastern Europe, more exactly in southern

Ukraine (Bibikova, 1967). The true caballine horse (not Asinine) entered the Indian subcontinent with the the Aryan invaders, and supplanted at least the elephant, if not the camel in major areas of northern India around 2,000 B. C. The indigenous species of *Equus*, i.e., Asiatic Wild Ass and allied forms like the Gorkhur, Kiang, etc., were never reported to be domesticated in the Orient. The elephant, however, was domesticated in the country long before the entry of horse, even prior to the Indus Valley Civilization. This finds support from the fact that bony remains and a number of seals from Mohenjodaro depict the motifs of tame elephants, which are indicative of their domestication (Zeuner, 1963). Numerous archaeological sites and stratified zones in West Bengal have unveiled the remains of both tame and wild elephant (*Elephas maximus*) respectively. The latter was unearthed from the upper Pleistocene Dhuliapur and Jamtholgora in Midnapur district by the State Archaeology Department in 1969 and subsequently identified by Shri M. Ghosh. Besides deploying in transport or war, elephants were also exploited for the extraction of ivory. The first author reported on the ancient ivory crafting in West Bengal on the basis of sawed or whittled bone-fragments unearthed from the old sites in West Bengal (Ghosh, 1984). While discoursing on elephants in captivity and domestication, Oliver (1984) quoted "Bengal" as one of the centres for capturing local Indian wild elephants.

The three other species, namely, pig, cattle and buffalo, were obviously meant for the flesh and milk. This suggests that the inhabitants of the area used to maintain pig, cattle and buffalo as dairy animals and the pony and elephant as draught animals for the sustenance of a settled life during that period. Of course, the cattle had also been used in transport in early days. A brief discussion on the ancestry and probable centres of domestication of the species quoted above has recently been made by Badam (1984).

ACKNOWLEDGEMENTS

The authors are grateful to the Director, Zoological Survey of India, for providing laboratory facilities to Dr. V. C. Agrawal, Scientist SF and also, for going through the manuscript. The chronological assessment of the antiquities was kindly made by Shri Sudhin Dey, Sr. Archaeologist, Government of West Bengal, which deserves special thanks.

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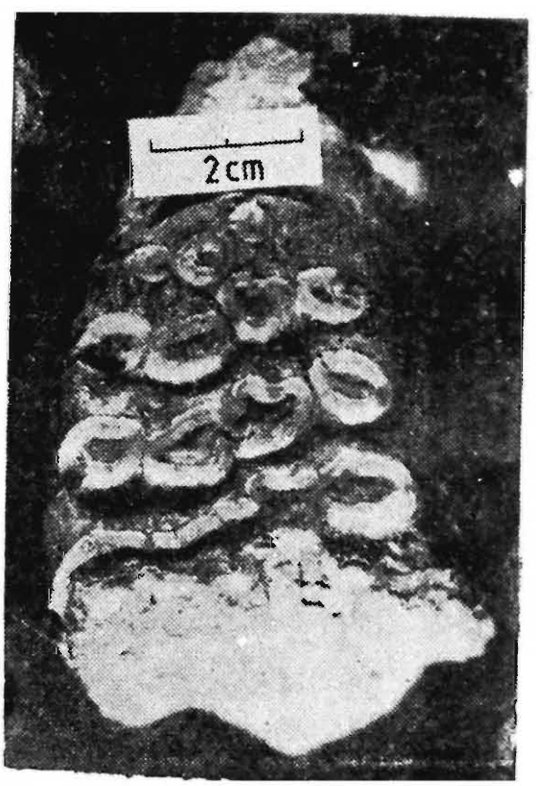
M. GHOSH *et al.* PLATE I

1a



1b

Fig. 1a & 1b. View of the grinding surface of the two broken pieces of 3rd molar of Indian Elephant, *Elephas maximus* Linnaeus.

Rec. zool. Surv. India, 92 (1-4) : 9-17, 1992

ON A SMALL COLLECTION OF CTENUCHIDAE (INSECTA : LEPIDOPTERA) FROM ARUNACHAL PRADESH

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I. Introduction

The Zoological Survey of India has undertaken several faunistic surveys of Arunachal Pradesh including one expedition during the period 1961-1973. The surveys cover different districts of Arunachal Pradesh including Kameng, Subansiri, Siang, Lohit and Tirap.

Very little information is hitherto available regarding Ctenuchidae of Arunachal Pradesh. However, Hampson (1892, 1898 & 1914), Zerny (1912), Seitz (1913), Fletcher (1925) and Arora (1980) have worked on Indian Ctenuchidae. In addition, Obraztsov (1966) made a valuable contribution on Ctenuchidae while revising the Palaearctic species of the genus *Amata* Fabricius.

The authors in course of their studies on Ctenuchidae from Arunachal Pradesh identified eleven species in four genera and all of them constitute new records from the State. In this connection it may be mentioned that following Obraztsov (1966), *Syntomis luteifascia* Hampson and *Callitomis multifasciata* Hampson have been kept under the genus *Amata* (*Amata*) Fabr. and *Syntomis diaphana* Kollar, *S. hydatina* Butler and *S. bicincta* Kollar have been treated under *Amata* (*Syntomis*).

II. Systematic Account

Family Ctenuchidae

Proboscis well developed or aborted. Labial palpi present, short and porrect, long and down-curved or upturned. Frons simple, rounded. Antennae variable, being either simple or with short branches in males, or simple in both the sexes. Tibiae with the spurs short. Fore wing with vein 3A forming a fork with 2A ; 1A absent ; M_2 from near the lower angle of cell : R_5 stalked with R_3+R_4. Hind wing small ; Sc absent, rarely rudimentary from base and not reaching costa, or forming a fork with Rs ; frenulum present, retinaculum bar-shaped ; 3A absent.

*Present address : Northern Regional Station, Zoological Survey of India, Dehra Dun.

Key to the identification of genera from Arunachal Pradesh.

1. Hind wing without vein Cu_{1a} ... *Ceryx* Wallengren
   —Hind wing with vein Cu_{1a} 2
2. Fore wing without vein R_5 ; hind wing with vein M_2 from lower angle of cell ... *Psichotoe* Boisduval
   —Fore wing with vein R_5 present ; hind wing with M_2-Cu_{1a} variable. ... 3
3. Hind wing with vein M_2 from angle, connate with Cu_{1a} or rarely above it. Hind tibia with two pairs of spurs. ... *Amata* Fabr.
   —Hind wing with vein M_2 always from above the lower angle. Hind tibia with a single pair of spurs. ... *Eressa* Walker

Genus **Ceryx** Wallengren

1863. *Ceryx* Wallengren, *Wien. Ent. Mon.*, **7** : 140.

Type : *Naclia anthraciformis* Wallengren (1860).

Diagnosis : Labial palpi porrect, not extending beyond the frons. Fore wing with vein R_1-R_5 stalked ; M_1 from or from below the upper angle of cell. Hind wing with Rs coincident with M_1 ; M_2 present ; M_3 and Cu_{1a} absent ; Cu_{1a} from behind the angle of cell. Mid and hind tibia each with a minute pair of spurs, hind tibia rarely with two pairs.

Distribution : Indo-Australian region. Also in part of the African region.

Remarks : Fletcher (1925) recorded eight species of *Ceryx* from the Indian region, including one from Burma. Later, Arora (1980) recorded it from Andaman Islands.

The present study includes two species of Arunachal Pradesh, and these are differentiated by the following key.

Key to the identification of the species of **Ceryx** Wallengren

Hind wing with narrow terminal black band ... *godartii* (Boisduval)
—Hind wing with broad terminal black band extending nearly to cell. ... *imaon* (Cramer)

1. **Ceryx godartii** (Boisduval)

1829. *Syntomis godartii* Boisduval, *Mon. Zyg*,,—115, pl. 7, fig. 3.

Material examined : Arunachal Pradesh : Siang Dist., Siji, 200m., 1♂., 8.x.1966 ; Padding Village, 300 m., 2♂♂, 11.x.1966 ; Kambang, 200 m., 2♂♂, 14,/16.x.1966 ; Newjining, 200 m., 2♂♂, 18.x.1966 ; Tappi Dulla, 500 m ; 1♂, 22.x.1966 ; Tachidoni, 400 m. 1♂, 24.x.1966 ; Daporijo, 150 m., 2♂♂, 1♀, 26, 27, 28.x.1966 ; Bame, 550 m.,

2♂ ♂, 31.x.1966 (*S. K. Tandon & G. S. Arora* Coll.), Lohit Dist., Chowkham, 100 m., 1♂, 16.ii.1969 ; Bhalukpong, 195 m., 1♂, 23.ii.1969, Sadiya, 100 m., 2♂ ♂, 28.ii.1969 ; Shantipur, 100 m., 1♂, 2.iii.1969 ; Sunpura, 100 m., 1♂, 3.iii.1969 ; Roing, 300 m., 2♂ ♂, 1♀, 7, 8, iii.1969 (*S. K. Tandon* Coll.), Daphabhum, Chowkham ; 244 m., 1♂, 1♀, 26.xi.1969 (*J. M. Julka* Coll.), Tirap Dist., Margherita Inspection Bunglow, 125 m., 1♂, 23.x.1971 ; Jairampur, 200 m., 3♂ ♂, 24.x.1971, Guest House, Jairampur, 225 m., 1♂, 1♀, 25.x.1971 (At light) ; Changlong, around Camp, 540 m., 3♂ ♂, 4♀ ♀, 30, 31.x.1971 ; Power House, Khonsa, 800 m., 3♂ ♂, 3♀ ♀, 6.xi.1971 ; Deomali, 200 m., 3♂ ♂, 1♀, 9. 10, 11, 12.x.1971 (all *G. S. Arora* Coll.)

Wing expanse : ♂ 22-30 mm. ; ♀ -25-29 m.

Distribution : India (Sikkim, Assam, Arunachal Pradesh, West Bengal (Calcutta) and South India) ; Sri Lanka ; Burma (Yunnan) ; Malay and Sumatra.

Remarks : The wing expanse as reported by Hampson range between 26-32 mm., but in the specimens under study are within 22-30 mm.

2. **Ceryx imaon** (Cramer)

1780. *Sphinx imaon* Cramer, *Papil. Exot.*, **3** : 94, pl. 248, fig.

Material examined : Arunachal Pradesh : Kameng Dist., Amatulla, 2800 m., 1♀, 23.v.1961, Ankaling, 2000 m., 1♂, 1♀, 25.v.1961 (*K. C. Jayaramakrishnan* Coll.), Subansiri Dist., Pinjuli, 244 m., 1♀, 4.v.1966 ; Bhalukpong, 213 m., 3♀ ♀, 6.v.1966 ; Charduar, 79 m., 1♂, 29.v.1966 (*A. N. T. Joseph* Coll.), Lohit Dist., Sunpura, 100 m., 1♀, 3.ii.1969 (*S. K. Tandon* Coll.), Tirap Dist., Guest House, Jairampur, 225 m., 1♀, 25.x.1971 (*G. S. Arora* Coll.)

Wing expanse : ♂ -24mm., ♀ -27-32 mm.

Distribution : India (Assam, Cachar, Meghalaya (Khasi Hills), Arunachal Pradesh, Sikkim, West Bengal, Himachal Pradesh, Jammu & Kashmir, Maharashtra, Tamil Nadu and Andamans) ; Indonesia ; Sri Lanka and Burma.

Remarks : The largest wing expanse as reported by Hampson (1898) is 42 mm. but in the specimens under study, it is restricted within 32 mm.

Genus **Psichotoë** Boisduval

1829. *Psichotoë* Boisduval, *Mon. Zyg.* : 129.

Type : *P. duvauceli* Boisduval (1829).

Diagnosis : Antennae in male serrate. Forewing broad, the apex rounded. Venation mainly as in the genus *Amata* except that the vein R_s being absent in this genus and the abdominal segments are dilated and hairy.

Distribution : India (West Bengal : Calcutta) ; Arunachal Pradesh ; Pakistan (Sind and Karachi).

Remarks : Hampson (1892) recorded the genus only from North India, and mentioned Karachi, Sind [now Pakistan] and Calcutta, West Bengal : India (now Indian region), for *duvauceli*. The present record of the genus from the further east is of the geographical interest.

3. **Psichotoe duvauceli** Boisduval

1829. *Psichotoe duvauceli* Boisduval, *Mon. Zyg.* : 129, pl. 8, Fig. 5.

Material examined : Arunachal Pradesh : Siang Dist., Lekhabali, Jeep Camp, 2♂♂, 6.x.1966 (*S. K. Tandon* and *G. S. Arora* Coll.)

Wing expanse : 14 mm.

Distribution : India (Arunachal Pradesh, Assam and West Bengal) ; Burma ; Pakistan (Sind and Karachi).

Remarks : Hampson (1898) reported that the wing expanse of the species varied from 18 to 20 mm. But the males of the material under study are smaller with 14 mm. wing expanse.

The species is characterised by the presence of orange bands on the last abdominal segments and the wing being uniformly fuscous and hyaline.

Genus **Amata** Fabricius

1807. *Amata* Fabricius, *Illiger's Mag.*, 6 : 289.

Type : *Zygaena passalis* Fabricius, 1775.

Diagnosis : Head with the frons mostly smooth. Antennae in male either pectinate or simple, slightly broadened beyond middle. Labial palpi short, down-curved and hairy ; 3rd segment extremely reduced. Fore wing long and rather narrow ; veins R_1-R_5 stalked ; M_1 from near upper angle of cell ; M_2-M_3 from lower angle or stalked. Hind wing with the vein Rs coincident with M_1 ; M_3 absent ; M_2 and Cu_{1a} from angle or stalked, rarely M_2 slightly above the angle. Hind tibia with two pairs of spurs.

Distribution : Europe, the whole of African, Oriental and Australian regions.

Remarks : Fletcher (1925) recorded as many as forty species from India, including three from Andaman Islands. Later, Arora (1980) added *A. cingulata* (Weber) from the Andaman region.

The present study of the wing venation has shown that veins M_2-Cu_{1a} in hind wing are quite separate at the base as in the genus *Eressa* Walker but the species can be differentiated from the genus in having two pairs of spurs on the hind tibia. In *Eressa* there is only a single terminal spur.

Obraztsov (1966), while revising the palaearctic species of the genus *Amata* Fabr., divided it into two subgenera, *Amata* Fabr. and *Syntomis* Ochsenheimer, on the basis of the male genitalic characters. The following key may be given :

Basal process of at least one of the claspers well developed, with the end free, fused together with the aedeagus above only at basal part. Subgenus *Syntomis* Ochsenheimer

—Basal process of both claspers undeveloped, or simple and fused together with membranes of aedeagus above through the tip. ... Subgenus *Amata* Fabricius

Five species are being described here, three under the subgenus *Syntomis* Ochsenheimer and two under subgenus *Amata* Fabr. as under.

I. *Key to identification of the species of Subgenus* Syntomis

1. Abdomen with seven orange bands in male ... *diaphana* (Kollar)
   —Abdomen with two orange bands, on 1st and 5th segment in male ... 2
2. Metathorax with orange patch ... *hydatina* (Butler)
   —Metathorax without orange patch ... *bicincta* (Kollar)

4. Amata (Syntomis) diaphana (Kollar)

1844. *Syntomis diaphana* Kollar, in : Hugel's *Kaschmir und das Reich der seik*, **4** : 460, pl. 19, fig. 7.

Material examined : Arunachal Pradesh : Subansiri Dist., Pinjuli, 244 m., 1♂, 4.v.1966 (*A. N. T. Joseph* Coll.)

Wing expanse : 44 mm.

Distribution : India (Assam, Meghalaya, (Khasis), Arunachal Pradesh, N. W. Himalayas, Uttar Pradesh, (Almora, and Mussoorie), Himachal Pradesh, (Dalhousie and Kasauli) ; and Jammu & Kashmir) and Burma.

Remarks : The minimum wing expanse as reported by Hampson (1898) is 46 mm. while the male specimen under study is 44 mm.

5. Amata (Syntomis) hydatina (Butler)

1876. *Syntomis hydatina* Butler, *Journ. Linn. Zool.*, **12** : 246.

Material examined : Arunachal Pradesh : Subansiri Dist., Majgaown, 79 m., 5♂♂, 2♀♀, 30.v.1966 (*A. N. T. Joseph* Coll.)

Wing expanse : ♂, ♀—30 mm.

Distribution : India : Sikkim, Arunachal Pradesh, Madhya Pradesh and West Bengal (Calcutta).

Remarks : The wing expanse in male and female specimens under study is 30 mm. which is more than what has been reported by Hampson (1898), with the wing expanse being 24 mm.

6. **Amata (Syntomia) bicincta** (Kollar)

1844. *Syntomis bicincta* Kollar, in : *Hugels, Kaschnir und das Rich der siek*, **4** : 460, pl. 19, fig. 8.

Material examined : Arunachal Pradesh : Siang Dist., Dali Camp, 200 m., 1 ♀, 10.x.1966 (*S. K. Tandon* & *G. S. Arora* Coll.), Tappi, 175 m., 1 ♂, 20.iii.1973 (*S. K. Tandon* Coll.)

Wing expanse : ♂—24 mm., ♀—36 mm.

Distribution : India : Arunachal Pradesh : N. W. Himalayas, Himachal Pradesh (Kangra), Uttar Pradesh (Dehra Dun), Sikkim, West Bengal (Calcutta), Meghalaya (Khasia), and China (Foochow).

Remarks : Hampson (1898) reported that the first tarsal joint of hindtibia is white while in the specimens under study the first tarsal joint is white in all the legs. Hampson (*loc. cit.*) reported that the wing expanse varies between 30-44 mm. but in the present specimens variation is observed between 24-36 mm.

II. *Key to identification of the species of subgenus* **Amata Fabr.**

1. Thorax black, with yellow spots. Wings diaphanous with distal yellow border specially in hind wing. Fore wing with eight diaphanous spots ... *luteifascia* (Hampson)

   Thorax black, without yellow spots. Wings black, except the diaphanous spots and without yellow border. Fore wing with six diaphanous spots ... *multifasciata* (Hampson)

7. **Amata (Amata) luteifascia** (Hampson)

1892. *Syntomis luteifascia* Hampson, *Fauna Brit. India*, **1** : 218.

Material exomined : Arunachal Pradesh : Siang Dist., Dali Village, 200 m., 2 ♀ ♀, 10.x.1966 (*S. K. Tandon* & *G. S. Arora* Coll.)

Wing expanse : 32-40 mm.

Distribution : India (Assam, Nagaland (Naga Hills) and Arunachal Pradesh).

8. **Amata (Amata) multifasciata** (Hampson)

1892. *Callitomis multifasciata* Hampson, *Fauna Brit. India*, **1** : 225.

Material examined : Arunachal Pradesh : Subansiri Dist., Chukra, 1128 m., 6♂♂, 22.x.1966, Godak, 975 m., 1♂, 23.v.1966. (*A. N. T. Joseph* Coll.), Siang Dist., Parying Village, 200 m., 1♂, 15.x.1966 ; Kambang, 200 m., 1♀, 16.x.1966 ; Newjining, 200 m., 1♂, 19.x.1966, Tappi, 600 m., 1♂, 2♀♀, 23.x.1966, Tachidoni, 400 m., 1♂, 1♀, 24.x.1966. Daporijo, 150 m., 2♂♂, 1♀, 26, 27, 28.x.1966 (*S. K. Tandon* & *G. S. Arora* Coll.), Daphabum Expendition, Glohowel, 1186 m., 1♀, 9.xii.1966 (*J. M. Julka* Coll.)

Wing expanse : ♂—13-36 m., ♀—22-31 m.

Distribution : India (Sikkim, Arunachal Pradesh, Assam, and Nagaland).

Genus **Eressa** Walker

1854. *Eressa* Walker, *List Lep. Het. Brit. Mus.*, **1** : 149.

Type : *Glaucopis confinis* Walker (1854).

Diagnosis : Proboscis small or well developed. Labial palpi short and porrect. Frons hairy, simple. Mid and hind tibia with a pair each of minute terminal spurs. Fore wing usually broad ; veins R_1-R_5 stalked ; M_1 from below the upper angle of cell ; M_2-M_3 from angle ; Cu_{1a} from well before the angle of cell. Hind wing with the vein Rs coincident with M_1 ; M_3 absent ; veins M_2 and Cu_{1a} quite separate at origin, M_2 well above the angle of cell.

Distribution : Mainly Indo-Australian regions.

Remarks : Although Zerny (1912) included ten species in this genus, Fletcher (1925) excluded one of its species *Eressa simplex* Rothschild, as a synonym of *Trichaeta teneiformis* (Walker), thus reducing the number of Indian species to nine.

The genus *Eressa* is characterised by the presence of only single pair of terminal spurs in the hind tibia, unlike the genus *Amata*, which has two pairs and to which is otherwise closely allied because of the absence of vein M_3 and presence of Cu_{1a} in the hind wing. Hampson (1898) differentiated these two genera on the basis of the origin of vein M_2 which he described as from lower angle of cell or shortly stalked with Cu_{1a} in hind wing in the genus *Amata* and from well above angle of cell in *Eressa*. The character seems to be quite variable in the genus *Amata* where the origin of this vein may be from above the lower angle.

Key to the Identification of the species of **Eressa** *Walker*

1. Antennae of male serrate. Abdomen crimson, with series of blue-black spots. ... *multigutta* (Walker)

—Antennae of male bipectinate. Abdomen with dorsal and lateral orange yellow spots. 2

2. Hind wing with a large hyaline spot below base of cell. ... *confinis* (Walker)

—Hind wing with hyaline spot between M_2-Cu_{1a} and at the end of cell. ... *affinis* Moore

9. **Eressa multigutta** (Walker)

1854. *Syntomis multigutta* Walker, *List Lep. Het. Brit. Mus.*, **1** : 134.

Material examined : Arunachal Pradesh : Kameng Dist., Below Dengzi, 4050 m., 1♂, 15.v.1961 *K. C. Jayramakrishnan* Coll.), Daphabum Expdt., Kambang River, 518 m. f., 1♀, 17.xii.1969 (*J. M. Julka* Coll.)

Wing expanse : ♂—28 mm., ♀—34.

Distribution : India (Sikkim and Arunachal Pradesh) ; China ; Tibet ; Nepal and Burma.

Remarks : Wing expanse as reported by Hampson (1898) is ranging between 25-32 mm., unlike in the material under study.

10. **Eressa confinis** (Walker)

1854. *Glaucopis confinis* Walker, *List Lep. Het. Brit. Mus.*, **1** : 149.

Material examined : Arunachal Pradesh : Lohit Dist., Sadiya, 100 m., 1♀, 28.ii.1969, Roing, 300 m., 2♂♂, 7.iii.1969, Namsai, 100 m., 1♀, 14.iii.1969., (*S. K. Tandon* and party Coll.), Tirap Dist., Margherita Inspection Banglow, 125 m., 1♀, 23.x.1971 (at light), Jairampur, 200 m., 1♀, 24.x.1971 ; Jairampur Guest House, 225 m., 1♂, 3♀♀, 25.x.1971 (*G. S. Arora* Coll.)

Wing expanse : ♂—24 mm., ♀—27-30 mm.

Distribution : India (Arunachal Pradesh, N. W. Himalaya, Uttar Pradesh (Almorah), Himachal Pradesh (Kangra and Shimla), Sikkim, West Bengal (Calcutta), Maharashtra (Bombay), and Tamil Nadu (Nilgiri) ; Bhutan, Sri Lanka and Burma.

Remarks : Slight variation is observed in the material under study than what has been reported by Hampson, ranging between 26-32 mm.

11. **Eressa affinis** Moore

1877. *Eressa affinis* Moore, *Proc. zool. Soc. Lond.*, : 596, pl. 59.

Material examined : Arunachal Pradesh : Subansiri Dist., Kimin. 198 m., 1♀, 9.v.1966, Dedgoo, 183 m., 2♂♂, 4♀♀, 10.v.1966, Charduar, 79 m., 1♂, 1♀, 29.v.1966 (A. *N. T. Joseph* Coll.), Siang Dist., Dali Camp, 3 Km. North of Dali Village, 300 m., 1♀, 10.x.1966 (*S.K. Tandon* & *G. S. Arora* Coll.).

Wing expanse : ♂—15-20 mm., ♀—20-27 mm.

Distribution ; India (Andamans and Arunachal Pradesh).

SUMMARY

The paper deals with the taxonomic account of eleven species under four genera of Ctenuchidae from Arunachal Pradesh collected by various survey parties of the Zoological Survey of India. Keys to the identification of genera and species, geographical distribution and references have been included.

ACKNOWLEDGEMENT

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Rec. zool. Surv. India, **92** (1-4) : 19-22, 1992

AN UNUSUAL CASE OF MOUND CONSTRUCTION BY THE TERMITE *ODONTOTERMES FEAE* (WASMANN)

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INTRODUCTION

The termite *Odontotermes feae* was first described from Burma (Wasmann 1896). Later it was reported from India (Holmgren and Holmgren 1917 ; Annandale 1923 ; Silvestri 1923 ; Roonwal and Chhotani 1962, 1966 ; Bose 1984 and several others), Bhutan (Roonwal and Chhotani 1977), Bangladesh (Chaudhury et. al. 1972 ; Akhtar 1975) and Thailand (Ahmad 1965 ; Morimoto 1973).

In the Indian subregion it is a very common species and its nests, generally found underground in soil, are large and massive, covering an area of 1.5-2.5 m in diameter. It is not a mound-building termite in the strict sense of the term. Only very rarely mounds of this species have been reported, Roonwal and Chhotani (1962, 1966) from Barkuda Island, Chilka Lake (Orissa) and by Chaudhury et. al. (1972) from Bangladesh.

The author here reports mounds of this species from two unsual sites in Manipur come across during her survey of North-eastern India, during May-June 1990.

OBSERVATIONS

During a survey of North-eastern India, the author collected this species from a large number of localities in Mizoram, Assam, Nagaland, Manipur and Meghalaya. It has also been identified from several localities from Arunachal Pradesh from the collections recently studied by the author and from Tripura by Chhotani (1976), and Sen-Sarma and Thakur (1979), showing that it is very common and widely distributed in this part of the country. So far there has been no report of this species having been collected from mounds from this region and the author also collected the same mostly from logs of wood, bamboos lying on ground, under cowdung, debris, fallen leaves and in galleries and layers of earth on tree trunks and logs. In Manipur, the author came across the strange phenomenon of this species building mounds, not in open areas but in covered and enclosed spaces. At Imphal near Mahabali temple, a huge mound of the following structure and dimensions was come across inside a recently abandoned hut. So far the very rare cases of mounds of this species reported from elsewhere have always been from open and forested areas and never from inhabited covered places.

The present mound was built in the centre of the hut occupying almost half of the area and was like a small, dome-shaped hillock. Its outer surface was without any openings (Pl. I, fig. 1). It was made up of hard dried caked earth forming a thick crust. The outer surface was raised at places forming small to large swellings, and along with this the surface was so layered, that it gave an impression of being uneven and almost corrugated.

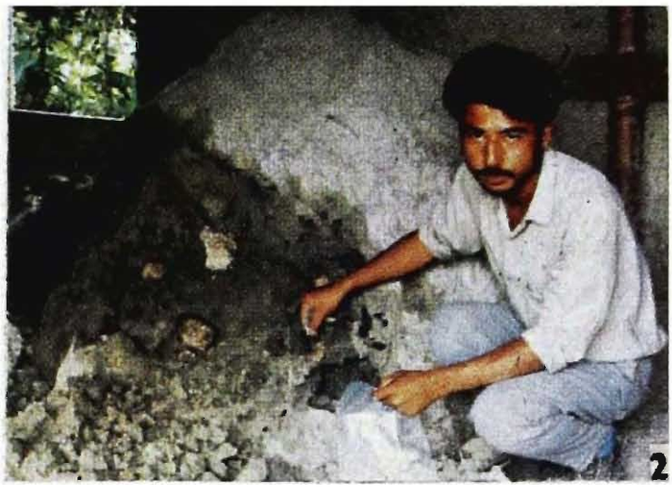
The height of the mound was c 105 cm and diameter at base c 160 cms. The mound was found to be of multilocular-type and inside a large number of rounded or irregular vaults, of the size of 10-30 cms, containing fungus combs were found. These vaults are interconnected by galleries for communication. The fungus combs are fragile, soft, brownish and sponge-like mottled with black and a large number of soldiers, workers and young ones were collected from these. The royal chamber could not be traced because of certain local religious taboos, which prevented the excavation, leading to destructien of the mound and so only a portion of the same could be examined. It was due to this taboo, which inferred that some calamity may befall if the mound was removed, that it was allowed to grow to this size, and for the same reason the owner abandoned the hut and built a dwelling elsewhere, this hut being now used partly as a cowshed.

At Loktak (Hydel Project) quite a distance away from Imphal, this termite was found again making small mini sized mounds under a show case in a shop. Here, however, the owner cleared away the soil collected by the termites every morning, but again the next morning it was seen that the insects had formed small pinnacles of excavated piled up earth. Had it not been for the cleaning up of this excavated earth every day, a mound of good size like that of at Mahabali would probably have sprung up.

Discussion

The mound of this species described by Roonwal and Chhotani 1966 from Barkuda Island was reported to be a low sprawling structure, made up of soft reddish earth with several low prominences and with a large number of round holes, but the one found at Imphal was very much larger in size and the outer surface was made up of hard caked mud plastered over and with no openings at all. The inside structure, however, was similar, that is, it was multilocular in both cases and as also found in the case of some other species such as *Odontotermes redemanni*, *Odontotermes microdentatus*, *Macrotermes gilvus* and others. The mounds of this species were also reported by Chaudhury et. al. 1972 from Madhupur Forest, Bangladesh but were found only in the open forested area. This strange phenomenon of mounds being found in huts and houses that is, in inhabited covered areas seemed to be confined only to Imphal and its surroundings in Manipur State, for the author did not come across any mounds in the

BOSE PLATE I



Mound of *Odontotermes feae* (Wasmann) inside a hut at Imphal (Manipur, India)

Fig. 1. Mound as a whole. 2. Mound with a portion of it exposed to show arrangement of fungus combs.
3. An exposed portion of mound-enlarged.
4. Fungus comb.

open or rather no mounds at all anywhere in Mizoram, Nagaland or Meghalaya during her survey in the region. This strange occurrence of mounds in covered areas is perhaps due to extremely heavy rains in that region and consequent water logging and flooding and the protection afforded by the covered area allows the termite to build its mound undisturbed.

SUMMARY

An unusual occurrence of mounds of *Odontotermes feae* (Wasm.) in covered areas has been reported here from Manipur, India. The mound is described in some detail and photographs given.

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ON A COLLECTION OF LEPIDOPTERA FROM THE NEORA VALLEY AND VICINITY, WEST BENGAL, INDIA

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INTRODUCTION

The Zoological Survey of India delegated a six-member group including the author to an expedition at the Neora Valley and vicinity. The other participants were from the Dept. of Botany, University of Calcutta, Kalimpong (Spl.) Forest Division, West Bengal, National Medical College, Calcutta, and the Signal Regiment of the Mountain Division, Eastern Command. The expedition, led by the Calcutta Section of Himalayan Club, lasted from 20th November to 12th December, 1982. The object was to gain basic information about the flora and fauna of the region, in addition to practical information relating to its sociology and medical and defence requirements.

The Neora Valley and adjacent Murti Valley are located in the Kalimpong subdivision of Darjiling district, West Bengal, between 27°5'N and 88°45'E in the East Himalaya. The Neora Valley has previously been surveyed mainly along its eastern ridge, by explorers from the Forest Development Corporation, West Bengal, in 1979, and jointly by members of the Z.S.I. and Botanical Survey of India in 1981. The interior of the region was only reached, with considerable hardship, for the first time in 1982, *via* the western ridge. The Neora Valley well deserves its recognition as one of the most important Biosphere Reserves in India.

The present work gives an account of the faunistic survey carried out, and general climatology of the area visited. It gives an inventory of the Lepidoptera encountered, together with comments on their zoogeography. Some material collected by the earlier survey party of Z.S.I. is included. An Appendix giving details of material data and a route map are provided. *Neptis mahendra samsinga*, ssp. nov., is described and compared with its allies from literature cited in the paper. All the specimens including the *holotype* of the new subspecies are in the Z.S.I. Repository.

PHYSIOGRAPHY

The terrain of the Neora Valley and vicinity occupies an approximate area of 380 sq. kms. It extends from northern tri-junction of Sikkim, Darjiling and Bhutan Himalaya up to the southern foot-hill plain of Samsing, the inter-district border between Darjiling and Jalpaiguri of West Bengal. The altitude of this mountainous domain varies between *c* 350 and 3,000 m. The western boundary of the Valley, the

West Nar, extends from the Pankhasari Block at a higher elevation in the north through Sakham down to Garubathan, leading to Kalimpong. Its eastern boundary, the East Nar, originates from a point beyond the Thosam Chu and emerges at Samsing off the Murti Valley in the south. The Murti Valley is linked by an abandoned mule-track across the upper reaches with Rechi La at the further north of Labha (a small forest village having a temporary market). At the Rechi La Chowk, the hill tribals cultivate potato crops in season and sell at Labha. There is no permanent settlement at the Rechi La Chowk, where grazing occurs during summer months, up to its lower reaches. The land belongs to the Forest Dept., Govt. of West Bengal, and is leased to F.D.C.L.

Topographically a 'V'-shaped valley, the area is extremely rugged, with high hills dissected by deep ravines and gorges covered with thick plantations. Throughout its extent, there are long ridges, and precipices of varying heights. Prolific undergrowth is also no less uncommon in many places, including near the bed of Neora Valley in particular. The hill stream, locally called 'Neora Khola', flows torrentially. Open meadows or steppes are hardly visible from both the upper and lower reaches. The forest canopy is too thick to allow the penetration of sunlight to the floor. Scattered kraging in the lower reaches has been carried out for constructing forest roads and dams, installing waterpipes, for shifting cultivation and so on. However, the centrally rugged terrain offers a safe haven for much wildlife, including butterflies and moths.

As to the riverine system, it may be noted that amongst the eight major rivers flowing in North Bengal, three drain the Neora Valley and vicinity. Extending from west to east, in turns, the river Chel, about 55 kms. long and 90-150 m. wide, arises from the Pankhasari Block and flows along the West Nar. The River Neora, about 60 kms. long and 90-125 m. wide, arises from the Rechi La Chowk below its ridge (='danda', as locally known) and flows through the central zone but inclined to the West Nar. The River Murti, about 20 kms. long and 30-60 m. wide, arises from the Thosam hills and flows along the East Nar. Of these, the longest river Neora has a catchment-basin of about 135 sq. kms. and is reported to have its maximum discharge of water amounting to about 12,000 cusecs and the minimum, 23 cusecs.

Climate

The wide range of altitudes is responsible for the marked climatic differences observed in the region. The conditions vary from tropical to temperate or even subalpine, in accordance with the elevation of the area. At Rechi La (*c* 3,000 m.), the snowfall was 30.50-61.00 cm. during 24 hours at the time of visit by the team. The rainy season prevails from the middle of May to October. Similarly, due to the topography, the annual rainfall varies from 225-750 cm. ; in the catchment area it averages 625 cm. At further lower reaches, for example, at Mo Chowki and Samsing

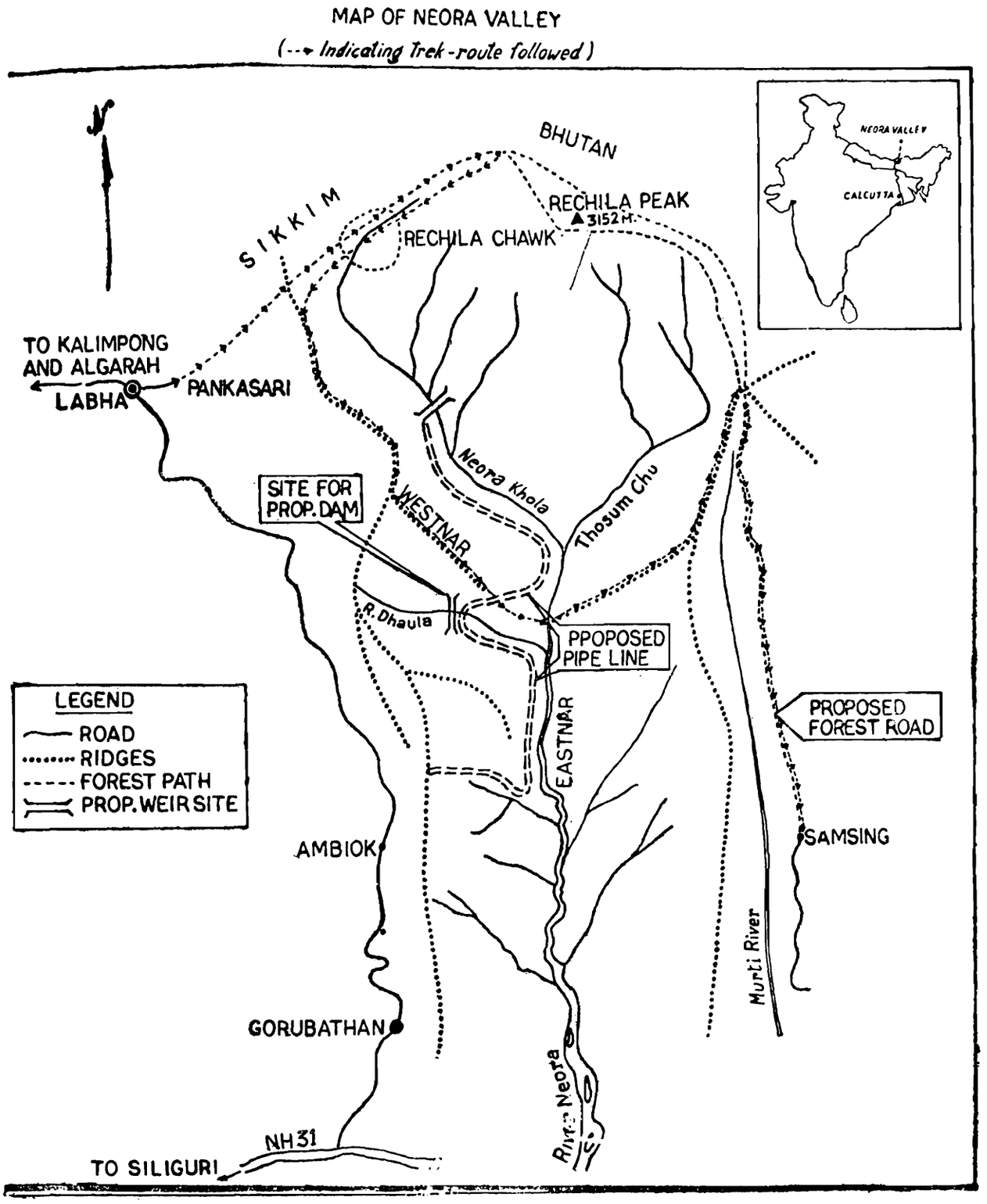

Fig. 1. Map of Neora Valley and environs

in the East Nar forest block of the Kalimpong Forest Division, the approximate annual rainfall varies from 450-500 cm.

TREKKING

The course of trekking route (*vide* fig. 1) by the latest team, including the author, is briefly described. On this occasion the team started at the higher altitude, not the lower, as in the Indian Tons Valley Expedition (*vide* Mandal, 1984).

Trekking started on Nov. 23 from the Pankhasari Block, about 8 kms. north of Labha, at *c* 2,400 m. The foot-track was followed along a distance of *c* 5 kms. northwards to the Rechi La Chowk at an altitude of *c* 3,000 m., where the team had to make two nights' halt in a cow-shed temporarily used by the local people. From here, a distance of *c* 24 kms. was traversed on the way to Jorpokhri towards the Rechi La Peak and back. Jorpokhri (*c* 3,100 m.), a spot with a couple of natural ponds, is near the Rechi La Peak, the highest point in the area along the Pankhasari-Rechi La ridge. From here, the team started moving downwards and southwards, mostly along the ridge of the Neora. The members first arrived at an unknown destination on a trek of *c* 5 kms. and pitched tents under the shade of *Rhododendron* at *c* 2,200 m. They left for the next camp at an almost similar distance, the locality of which was also unknown at *c* 2,000 m. under the shade of *Echinocarpus*. The next camp was at Doban, where the Rivers Neora and Thosam are confluent. The terrain is too steep to negotiate and marked by a fairly large rocky cave (named by the leader of the expedition as 'Mandal Cave'). In one stage, fixed rope was used to negotiate the foot-track across a high waterfall. The next camp was at Bhanjan (*c* 2,000 m.) which was reached after 15 km.-march amidst the shade of very tall Maple trees. From here, the members split up into a couple of subgroups : the smaller group proceeding westwards, while the other, including the author, southwards to reach the next camp at Mo Chowki (*c* 1,500 m.) where it lodged at the Beat House after traversing a distance of 8 kms. The final leg of the trek ended at Samsing (*c* 350-650 m.), where these members arrived after traversing a further distance of 8 kms. They had to await the smaller party in the Forest Rest House at Samsing, forming the exit from the dense forest, for four days. This was a worrying time, finally relieved by a happy reunion on Dec. 9.

The entire team did their best to gather data for their respective disciplines, especially in the Neora Valley. But the trekking was very tough. The team covered an overall distance not less than 60 kms. in 13 days, over difficult gradients from north to south of the terrain. The small party trekked even further during their 17 days, through unknown and even rougher area of the West Nar. In course of negotiating the awesome and yet picturesque terrain, the River Neora had to be crossed very cautiously several times at different places over the loose boulders and wooden logs used by the

accompanying Support-Team of High Altitude Porters (HAPS). The track was very narrow, meandering and branching, so that the way was easily lost. To avoid this, every precaution was adopted by the Advance Party to mark the foot-track with pieces of red cloth as signals being visibly tied to the twigs at regular intervals along the track from one camp to another in a routine manner.

Attempts of collecting specimens for about a couple of weeks were made during the course of trekking as well as at the different camps and stations. After collection, the specimens were treated with suitable preservatives. The rather limited results should not frequently be taken to indicate that the diversity of Lepidoptera in the Neora Valley is in any way impoverished.

Appendix : This gives the locality-wise material data of Lepidoptera and other particulars of the terrain surveyed. Material (*cf.* 'Systematic Account' for the sl. no. of spp./sspp. from the coded localities given hereunder) against the dagger (†)-marked dates have been collected by *R. K. Ghosh* & party of the Z.S.I., and the rest by the author. '††'-marked sl. no. indicate that the specimens have been collected 'at light'.

(A) **Labha** (alt. *c* 2,400 m.) : 105 kms. north of New Jalpaiguri ; sl. no. (23, 26, 28-31, 33)††, in and around the Forest Rest House ; 22.xi.1982. Climate perhumid ; temperature 4-10°C. Gradual change from tropical to temperate vegetation noticed.

(B) **Rechi La** (alt. *c* 3,000 m,) : 16 kms. north of Labha, along the Pankhasari-Thosam Ridge ; sl. no. 13, 34 ; 24.xi.1982. Temp. 3-8°C. Predominant vegetation comprising algae, fungi (*Agaricus* spp.), lichens (Crustose), mosses (*Pogonatum* and *Polytrichum* spp.), ferns (*Polypodium* sp.) and angiosperms (spp. of bamboo, maple, oak, orchid, *Rhododendron*, etc.). A cultivated land of potato also observed in the cow-shed area.

(C) **Camp III** (alt. *c* 2,200 m.) : At an unnamed locality, 5 kms. south of Rechi La, 26.xi.1982. Temp. 5°C. Flora notably represented by filamentous blue-green algae, *Agaricus*, *Phallus*, *Polyporus*, lichens, *Lycopodium*, *Selaginella*, *Equisetum* and also the angiosperms including heavy thickets of bamboo, *Rhododendron*, *Quercus*, *Acer*, *Anaphalis*, *Cutunelis* and different herbs and shrubs of Asteraceae, Campanulaceae, Convolvulaceae, Rubiaceae, etc.

(D) **Camp IV** (alt. *c* 2,000 m.) : Also at an unnamed locality, 5 kms. south of Camp III, 27.xi.1982. Temp. 7°C. The forest-floor oversaturated with wet humus and mostly occupied by maple ; the path being very soft, subsided and blocked by highly decomposed large trunks of dead trees : all these, together with precipices overhanging the dark 'Mandal Cave' and steep slope along the western spur making the trek quite punitive.

(E) Doban (alt. *c* 2,000 m.) : 5 kms. south of Camp IV ; sl. no. 12, 13, 32†† ; 29.xi.1982. Temp. 7.5°C. A change to the tropical vegetation observed once again in a clinal manner.

(F) Bhanjan (alt. *c* 2,000 m.) : 15 kms. south of Doban ; sl. no. 24†† ; 1.xii.1982. Temp. 8°C. Butterflies observed in a very scanty number as compared to their larvae.

(G) Mo Chowki (alt. *c* 1,500 m.) : 8 kms. south of Bhanjan ; sl. no. 1, 8, 11, 14, 20 ; 24.ix.1981†, sl. no. 24†† ; 3.xii.1982. Temp. 15°C.

(H1) 8 kms. west (alt. *c* 600 m.) of the **Forest Rest House, Samsing** (**S.F.R.H.**, 8 kms. south of Mo Chowki) : sl. no. 7, 9 ; 22.iv.1981†.

(H2) 13 kms. north-west (alt. *c* 1,000 m.) of S.F.R.H. : sl. no. 9 ; 23.iv.1981†.

(H3) 3 kms. south (alt. *c* 650 m.) of S.F.R.H. : sl. no. 4, 5, 16, 18, 21 ; 5.xii.1982.

(H4) 3 kms. east (alt. *c* 650 m.) of S.F.R.H. : sl. no. 6, 10, 19, from shady wet forest and along roadside ; sl. no. 25††, 27††, in and around F.R.H. ; 7.xii.1982.

(H5) 2 kms. north (alt. *c* 350 m.) of S.F.R.H. : sl. no. 2, 3, 6, 15, 17, 18, 22, along the bank of the River Murti ; 8.xii.1982. Temp. 15°C ; climate extremely foggy. Terraced cultivation of paddy, banana and tea plantations observed in plenty.

FLORA

The Neora Valley has several types of forest, with tropical and temperate vegetation amidst the deciduous, semi-evergreen and evergreen zones of the East Himalaya. All represent excellent natural resources of the area. Recently, however, certain belts at lower reaches have been denuded by the human agency.

Upper Montane Zone : This is represented by the temperate flora occurring between *c* 1,700-3,200 m. Of these, the commonest forms are *Machilus edulis* and *Alcimandra cathcartii* up to the altitude of *c* 2,100 m. Next follows the high-level oak-forest of *Quercus pachyphylis*, *Q. liniatta*, *Q. lamellosa*, etc., up to *c* 2,400 m. Other broad-leaved varieties, such as, *Acer campbella*, *Ficus nemoralis*, etc., are limited up to the further height of *c* 2,700 m. The only indigenous conifer of the area is *Tsuga dumosa*. Amongst the epiphytes, the common forms are *Coelogyne ochracea*, *C. grandiflora*, *C. elegance*, *Bolbophylum* sp., *Ploene humilis*, *P. proecox*, *Calanthis* sp., etc. The commonest parasitic plant is a species of *Harchur*. The undergrowth is mainly formed by *Girardiana heterophylla* and *Rubus ellipticus*.

Lower Montane Zone : This is represented by the tropical flora occurring between *c* 750-1,700 m. A great majority of the trees are evergreen, of which the predominant species are *Castanopsis indica*, *C. tribuloides*, *Schima wallichii*, etc., from *c* 750-1,500 m.

Amongst numerous parasitic species, the largest climber tree is *Macrocarpa*. At lower elevations, the forests are characterised by the large concentration of orchids, figs and aroids, while bamboo and cane form the typical undergrowth. Due to the dense growth and low penetration of sunlight, the ferns are rather poor. In contrast, species of *Lycopodium*, *Cyathes*, etc., are plentiful. In addition, a number of timber-yielding trees and a vast acreage of tea plantations could also be observed at Mo Chowki and Samsing.

For Further notes on the flora of the Neora Valley, *vide* Rastogi (1984) and Rastogi & Purokait (1984).

Fauna

The 34 species and subspecies of butterflies and moths recorded here represent only a small fraction of the diversity of the Lepidoptera from this tropical region. However, becuase little recent work has been done on the butterflies of the area and even less on the moths, the author considers it valuable to list all the species/subspecies found and their exact provenance. It appears that, although most of the elements are well-known to occur in north-eastern India, precise records for the Kalimpong subdivision (Darjiling District) of West Bengal have not been published previously.

LIST OF SPECIES/SSPP. OF LEPIDOPTERA ENCOUNTERED

[*, Recorded new for West Bengal ; **, new for the East Himalaya]

Order LEPIDOPTERA

Superfamily (A). Papilionoidea

Family I. Pieridae

*1. *Appias pandione lalage* (Db.)

*2. *Appias lyncida eleonora* (Bd.)

*3. *Pieris* (*Artogeia*) *canidia indica* Ev.

4. *Catopsilia pomona pomona* (Fabr.)

5. *Eurema brigitta rubella* (Wall.)

6. *Eurema hecabe contubernalis* (Mre.)

Family II. Nymphalidae

Subfamily (a). Danainae

7. *Danaus genutia genutia* (Cr.)

*8. *Parantica sita sita* (Cr.)

9. *Euploea core core* (Cr.)

Subfamily (b). SATYRINAE

10. *Mycalesis visala visala* Mre.
*11. *Mycalesis suaveolens suaveolens* W.-M. & de N.
12. *Lethe sidonis* (Hewit.)
13. *Melanitis leda ismene* (Cr.)

Subfamily (c). ACRAEINAE

14. *Acraea violae* (Fabr.)

Subfamily (d). NYMPHALINAE

15. *Neptis hylas kamarupa* Mre.
16. *Neptis mahendra samsinga*, ssp. nov.
17. *Precis lemonias lemonias* (Linn.)
18. *Precis almana almana* (Linn.)
19. *Aglais cashmirensis aesis* (Fr.)
**20. *Cirrochroa thais thais* (Fabr.)

Family III. LYCAENIDAE

21. *Lestranicus transpectus* (Mre.)
22. *Heliophorus epicles indicus* (Fr.)

Superfamily (B). BOMBYCOIDEA

Family IV. SATURNIIDAE

23. *Caligula thibeta extensa* (Butl.)

Family V. EUPTEROTIDAE

24. *Eupterote undata* (Blanch.)

Family VI. SPHINGIDAE

25. *Acherontia lachesis* (Fabr.)

Superfamily (C). NOCTUOIDEA

Family VII. LYMANTRIIDAE

26. *Leucoma sericea* (Mre.)

Family VIII. ARCTIIDAE

27. *Nyctemera adversata* (Schall.)

Family IX. NOCTUIDAE

28. *Agrotis segetum* (D. & S.)

*29. *Blenina quinaria* Mre.

*30. *Diphtherocome discibrunnea* (Mre.)

*31. *Autographa nigrisigna* (Wlk.)

32. *Eudocima tyrannus* (Guen.)

Superfamily (D). GEOMETROIDEA

Family X. GEOMETRIDAE

33. *Synegiodes sanguinaria* (Mre.)

34. *Ourapteryx ebuleata ebuleata* (Guen.)

SYSTEMATIC ACCOUNT

[For details of material examined, *vide* Appendix]

Order LEPIDOPTERA

Superfamily (A). PAPILIONOIDEA

Family I. PIERIDAE

*1. **Appias pandione lalage**, Talbot (1949 : p. 492)

[W. s. f. *durvasa* (Moore)]

Material examined : (**G**) One ♂.

Wing expanse : 58 mm.

The subspecies occurs in northern India and extends to northern Burma.

*2. **Appias lyncida eleonora**, Talbot (1939 : p. 398)

[W. s. f.]

Material examined : (**H** 5) one ♀.

Wing expanse : 50 mm.

The subspecies occurs in the East Himalaya and also elsewhere in the Oriental Region.

*3. **Pieris (Artogeia) canidia indica** Evans (1926 : p. 712)

Material examined : (**H** 5) one ♂.

Wing expanse : 55 mm.

The subspecies is widespread in the Indian subregion. Most authors would currently recognise small whites such as *canidia* as belonging to a separate subgenus, *Artogeia* Verity. The correct authority for *canidia* is Linnaeus (not 'Sparrman' nor 'Evans', as cited by Talbot, 1939).

4. **Catopsilia pomona pomona**, Corbet & Pendlebury (1978 : p. 108)

[f. *crocale* (Cramer)]

Material examined : (H3) One ♂.

Wing expanse : 58 mm.

The subspecies is widespread in the Australo-Oriental Regions. The species *crocale* (*vide* Talbot, 1939) is now considered as a form of *C. pomona* (Fabr.) by Corbet & Pendlebury (1978) following Wheeler (1943). The cold weather males, as the one examined (= ♂ f. *hilaria*, Talbot), have vinous markings on the underside of hind wing.

5. **Eurema brigitta rubella**, Talbot (1939 : p. 515)

[D.s.f. *rubella* (Wallace)]

Material examined : (H3) One ♂.

Wing expanse : 45 mm. (larger than usual, as cited by Talbot, 1939 and Wyter-Blyth, 1957).

The subspecies is widespread in the Indian subregion and also extends to southern China.

6. **Eurema hecabe contubernalis**, Talbot (1939 : p. 527)

[W.s.f. *merguiana* (Moore)]

Material examined : (H4) One ♀ ; (H5) 1♂, 1♀.

Wing expanse : 40-45 mm.

The subspecies is Indo-Malayan in distribution, being earlier recorded from the Western Garhwal Himalaya by Mondal (1984). Its dubious synonyms, *hecabeoides* (Ménétriès) and *aesiope* (Ménétriès) after Talbot (1939), should be placed with *E.h. hecabe* (Linn.) from southern China (*vide* Corbet, 1941).

Family II. NYMPHALIDAE

Subfamily (a) DANAINAE

7. **Danaus genutia genutia**, Ackery & Vane-Wright (1984 : p. 122)

[f. *grynion* (Fruhstorfer)]

Material examined : (H1) One ♂.

Wing expanse : 78 mm.

The subspecies is widely distributed in the Oriental Region. While Talbot (1943, 1949) adopted the name *plexippus* (Linn.) as conspecific with *genutia*, Ackery & Vane-Wright (1984) have considered both as distinct species, of which the former occurs in America.

*8. **Parantica sita sita**, Ackery & Vane-Wright (1984 : p. 178)

[f. *tytia* (Gray)]

Material examined : (G) One ♀.

Wing expanse : 97 mm.

The subspecies occurs throughout the Himalaya and also extends to south-eastern Tibet. All recent revisionary work on the milkweed butterflies (Danainae) recognises the distinctness of such elements as *sita* from true *Danaus*, and separates *sita* and its allies in the genus *Parantica* (e.g., Corbet & Pendlebury, 1978 ; Morishita, 1981 ; Ackery & Vane-Wright, 1984).

9. **Euploea core core**, Ackery & Vane-Wright (1984 : p. 228)

[f. *core* (Cramer)]

Material examined : (H1) One ♂, 1 ♀ ; (H2) 1 ♀.

Wing expanse ; 75-95 mm.

The subsecies is widespread in the Oriental Region.

Subfamily (b). SATYRINAE

10. **Mycalesis visala visala**, Talbot (1949 : p. 140)

[D.s.f. *indistans* (Moore)]

Material examined : (H4) 2 ♂.

Wing expanse : 52-54 mm.

The subspecies occurs in northern India and Burma.

*11. **Mycalesis suaveolens suaveolens**, Talbot (1949 : p. 152)

Material examined : (G) One ♂.

Wing expanse : 55 mm.

The subspecies (nec *suavolens*) occurs in the East Himalaya and also Burma.

12. **Lethe sïdonis**, Talbot (1949 : p. 172)

[D.s.f. *vaivarta* Doherty]

Material examined : (E) One ♂.

Wing expanse : 46 mm.

The species occurs throughout the Himalaya and also extends to Tibet. It is amongst a very few butterflies in India, that is known to cross the north of the crestline forming the semi-tropical extreme end of eastern Tibet (*vide* Mani, 1986).

13. **Melanitis leda ismene**, Talbot (1949 : p. 366)

[♂ : D.s.f. *ismene* (Cramer) ; ♀ : W.s.f. *determinata* Bulter]

Material examined : (**B**) 2♂ ; (**E**) 1♂, 1♀.

Wing expanse : 65-84 mm. (♀ larger : *cf.* Talbot, 1949).

The subspecies is widespread in the Oriental Region ; it occurs also in the Eastern Palaearctic.

Subfamily (c). ACRAEINAE

14. **Acraea violae**, Talbot (1949 : p. 466)

Material examined : (**G**) One ♂.

Wing expanse : 55 mm.

The species is widespread in the Indian subregion.

Subfamily (d). NYMPHALINAE

15. **Neptis hylas kamarupa**, Eliot (1969 : p. 61)

Material examined : (**H5**) One ♂.

Wing expanse : 55 mm.

The subspecies occurs in the East Himalaya and Burma. Evans (1932) treated it as ssp. *adara* Moore, but Eliot (1969) has considered *kamarupa* Moore as the correct subspecies name, of which *adara* is a junior synonym.

16. **Neptis mahendra samsinga**, ssp. nov. (fig. 2)

Description : Upperside fore wing with the streak beyond cell long and pointed, all the white markings narrow and lower postdiscal band directed to almost the mid-termen. Underside hind wing with fuscous lines outlining the discal and postdiscal bands absent, being confined to a prominent fuscous line on the outside of discal band, and marginal fascia brownish throughout ; both wings with ground colour deep brown.

Material examined : (**H3**) HOLOTYPE ♂ (Z. S. I. Reg. No. 22323/H 9).

Wing expanse : 60 mm.

Eliot (1969) has fixed the identity of several subspecies of *Neptis mahendra* Moore. These are ssp. *extensa* Leech [from Western China : Szechwan], ssp. *mahendra*,

Fruhstorfor [from the North-West Himalaya], ssp. *ursula* Eliot [from North-Western Yunnan] and also probably another anonymous one from South-eastern Tibet. The ssp. *samsinga*, nov., differs from the foregone counterparts basically by the fore wing lower postdiscal band not directed to termen just below apex (*cf.* sspp. *extensa*, *ursula* and the anonymous one), nor to apex (*cf.* ssp. *mahendra*). The new subspecies is otherwise very much close to the sspp. *extensa* and *mahendra*, having the fore wing upperside with all the white markings narrow and hind wing underside with marginal fascia not blotted out in M3-and Cula-areas, but differs from the former by the hind wing marginal fascia not whitish and, from the latter by the fore wing streak beyond cell not short and blunt. It differs from the ssp. *ursula* by the fore wing white markings narrow, hind wing marginal fascia not blotted out and both wings with ground colour not red. It also differs from the anonymous subspecies by the shape and size of fore wing markings and colouration of hind wing underside.

17. **Precis lemonias lemonias**, Evans (1932 : p. 176)

[W. s. f.]

Material examined : (H 5) one ♀.

Wing expanse : 53 mm.

The subspecies occurs in the East Himalaya and Burma. It is also found in the Chinese subregion. Quite a few dead and mutilated specimens were observed by the author on profile survey of the area ; this might have been caused by the attacks of lizards, also found in plenty, as main predator of *lemonias*.

18. **Precis almana almana**, Fruhstorfer (1912 : p. 519)

[♂ : D. s. f. ; ♀ W. s. f.]

Material examined : (H 3) One ♂ ; (H 5) 1 ♀.

Wing expanse : 54-55 mm. (smaller : *cf.* Wynter-Blyth, 1957).

The subspecies occurs in the Indian subregion, extending to Hong Kong, China, Taiwan, Vietnam and the Philippines,

19. **Aglais cashmirensis aesis**, Fruhstorfer (1912 : p. 527)

Material examined : (H 4) One ♀.

Wing expanse : 61 mm.

The subspecies occurs in northern India. It flies all the year round between *c* 700-5,000 m. at Darjiling and Sikkim. The butterfly was treated under the genus *Vanessa* Fabricius by Bingham (1905) and also Fruhstorfer (1912), but recently it has been placed in *Aglais* Dalman (*vide* Mandal, 1984).

20. **Cirrochroa thais thais, Evans (1932 : p. 189)

[D.s.f. *relata* de Nicéville]

Material examined : (G) One ♂.

Wing expanse : 75 mm.

The subspecies occurs in eastern and southern peninsular India. It ascends to *c* 2,000-2, 500 m. in a straight flght. The present discovery reveals its occurrence in the East Himalaya, too.

Family III. LYCAENIDAE

21. **Lestranicus transpectus**, Eliot & Kawazoé (1983 : 73)

[D.s.f.)

Material examined : (H3) One ♀.

Wing expanse : 27 mm.

The species, earlier placed in the genus *Celastrina* Tutt by Cantlie (1962), occurs in the East Himalaya and Burma. It is also found in Bangladesh, Thailand, Vietnam and China.

22. **Heliophorus epicles indicus**, Cantlie (1962 : p. 85)

[f. *indicus* (Fruhstorfer)]

Material examined : (H5) One ♀.

Wing expanse : 27 mm.

The subspecies occurs in northern India and the Andaman Islands. It it also found in Nepal and Burm. It is known to fly in the Himalaya up to *c* 2,500 m. during the spring-autumn period.

Superfamily (B). BOMBYCOIDEA

Family IV : SATURNIIDAE

23. **Caligula thibeta extensa**, Seitz (1928 : p. 515)

Material examined : (A) One ♂.

Wing expanse : 150 mm.

The subspecies is confined to the East Himalaya.

Family V. EUPTEROTIDAE

24. **Eupterote undata**, Seitz (1924 : p. 427)

[f. *consimilis* Moore]

Material examined : (F) One ♂ ; (G) 1 ♀.

Wing expanse : 95-110 mm.

The species in widespread in the Indian subregion, hiding at day time amidst the undergrowth preferably of thorny *Opuntia*, to avoid bird-attack.

Family VI. SPHINGIDAE

25. **Acherontia lachesis**, Bell & Scott (1937 : p. 55)

Materirl examined : (H4) One ♂.

Wing expanse : 125 mm.

The species is widespread in the Oriental Region.

Superfamily (C). NOCTUOIDEA

Family VII. LYMANTRIIDAE

26. **Leucoma sericea**, Bryk (1934 : p. 122)

Material examined : (A) One ♂.

Wing expanse : 40 mm.

The species, treated under the genus *Euzora* Turner by Bryk (1934), occurs in northern India. It is also known from Tibet and western China. Strand (1915), however, placed it in the genus *Caragola* Moore, but the recent authority would consider to place this species in *Leucoma* Hübner.

Family VIII. ARCTIIDAE

27. **Nyctemera adversata**, Arora & Chaudhury (1982 : p. 8)

Material examined : (H4) One ♀.

Wing expanse : 55 mm.

The species (=*plagifera* Wlk.) is widespread in the Orienal Region except Sri Lanka and possibly also peninsular India. It has been observed at Samsing to fly together with the strikingly mimicking butterfly, Pieris (*Artogeia*) *canidia indica* Evans.

Family IX. NOCTUIDAE

28. **Agrotis segetum**, Kapur & Arora (1971 : p. 101)

Material examined : (A) 3 ♂, 1 ♀.

Wing expanse : 38-43 mm. (one ♂ and ♀ larger : *cf.* Kapur & Arora, 1971).

The species is much widespread in the Indian subregion, extending to the Eastern Palaearctic up to Japan through China and also to the Western Palaearctic up to Europe

through U.S.S.R. It is also found in Africa. Its maximum altitudinal range is c 3,000 m. Warren (1909) treated the species in the genus *Euxoa* Hübner under the subfamily Euxoinae, while Kapur & Arora (1971) placed it in *Agrotis* Ochsenheimer under Agrotinae after Hamson (1903).

*29. **Blenina quinaria**, Warren (1913 : p. 293)

Material examined : (A) One ♂.

Wing expanse : 35 mm.

The species occurs in the East Himalyaya and also western China.

*30. **Diphtherocome discibrunnea**, Poole (1989 : 322)

Material examined : (A) One ♀.

Wing expanse : 37 mm. (smaller ; *cf.* Hampson, 1894).

The species is restricted in the East Himalaya. It was treated under the genus *Diphthera* Treitschke by Hampson (1894).

*31. **Autographa nigrisigna**, Kostrowicki (1961 : p. 465)

Material examined : (A) One ♀.

Wing expanse : 38 mm.

The species, that takes the place of *gamma* (Linn.) in the Palaearctic Region (*vide* Warren, 1913), occurs in northern India and also China.

32. **Eudocima tyrannus**, Poole (1989 : 401)

Material examined : (E) One ♀.

Wing expanse : 105 mm. (smaller : *cf.* Hampson, 1894).

The species is widespread in the Oriental Region ; it is also found in Japan.

Superfamily (D). GEOMETROIDEA

Family X. GEOMETRIDAE

33. **Synegiodes sanguinaria**, Prout (1934 : p. 48)

Material examined : (A) One ♂.

Wing expanse : 36 mm.

The species, which was treated in the genus *Acidalia* Treitschke under the subfamily Acidaliinae by Hampson (1895), is restricted to the East Himalaya. It has subsequently been placed with the Sterrhinae by Prout (1934).

34. **Ourapteryx ebuleata ebuleata**, Prout (1915 : p. 335)

Material examined : **(B)** One ♂.

Wing expanse : 45 mm. (smaller ; *cf.* Hampson, 1895).

The subspecies is widespread in northern India (except the North-western Himalaya) ; it also extends to western China. Prout (1915) considered the moth and its allies under the subfamily Geometrianae in place of Boarmiinae as treated by Hampson (1895).

Resume

L'article s'incorpore d'un compte-rendu systématique de la faune des Lèpidoptères du vale Néora et des environs au Bengale d'Ouest parmi les Himalayas de l'ést. C'est accompagné d'en commentaires zoogéographiques et des observations climatologiques générales de l'aire visite' par l'auteur sur une expédition en 1982. Les 22 papillons et, 12 phalenes sont inclues, la plupart desquelles sont récolte'es par l'auteur. Il raconte, avec une carte de la région, son expérience de la route de marche au pas. Une appendice par rapport aux données des échantillons est pourvue. Toutes les espèces et sous-espèces ont pour nouveaux dossiers de répartition du vale Néora et ses environs. Parmi celles-ci, 8 du Bengale d'Ouèst et une seule, *Cirrochroa thais thais* (Fabr.), des Himalayas de l'èst sont connues pour la première fois. *Neptis mahendra samsinga*, ssp. nov., est aussi de'crite.

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D. K. MANDAL

PLATE I

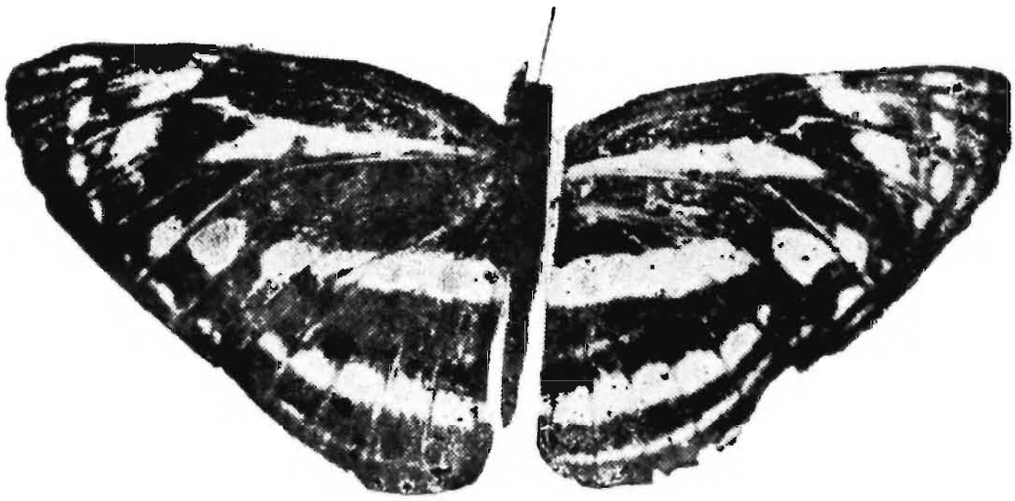


Fig. 2. *Neptis mahendra samsinga* spp. nov., ♂ UPUN

Rec. zool. Surv. India, 92 (1-4) : 41-52, 1992

TAXONOMIC STATUS OF CERTAIN GENERA OF PYGIDICRANIDAE (DERMAPTERA)

G. K. Srivastava
Zoological Survey of India, Calcutta

Steinmann (1986) erected three different genera *viz.*, *Mucrocranopygia*, *Epicranopygia*, and *Paracranopygia* for some of the species earlier included under *Cranopygia*. Of these, the first one was based on the shape of parameres and the other two on the shape and size of distal lobes and virga.

It is now well known that genera even based on the shape of parameres pose problems in certain closely related genera in Carcinophorinae, yet these structures afford valuable characters in the classification of the Order at different levels. Therefore, to much reliance on the shape and size of virga and distal lobes and its associated chitinous plates might lead to a lot of confusion in the recognition of various genera and sub-genera.

The shape of parameres does not alter during mounting whereas the shape and arrangement of virga are are likely to vary to some extent. Besides, the length of distal lobes is more or less constant in repose but it varies greatly in flexed condition. Being thin and membranous, outline of the distal lobes is often difficult to observe.

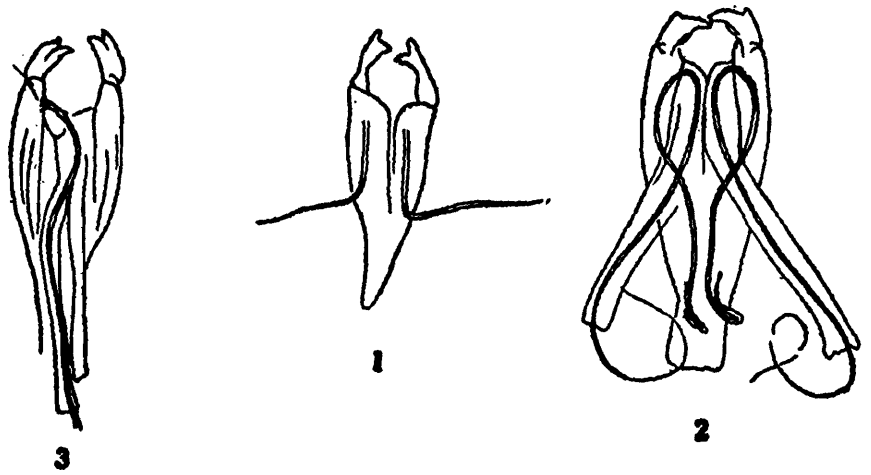
It would be worthwhile to quote here Burr's (1915) opinion—".....I certainly think that Zacher over rates the importance of the armature of the preputial sac.....I also consider the virga to afford specific rather than generic characters, for we find great diversity in the length of this organ in species that are undoubtedly closely related and in my opinion, congeneric."

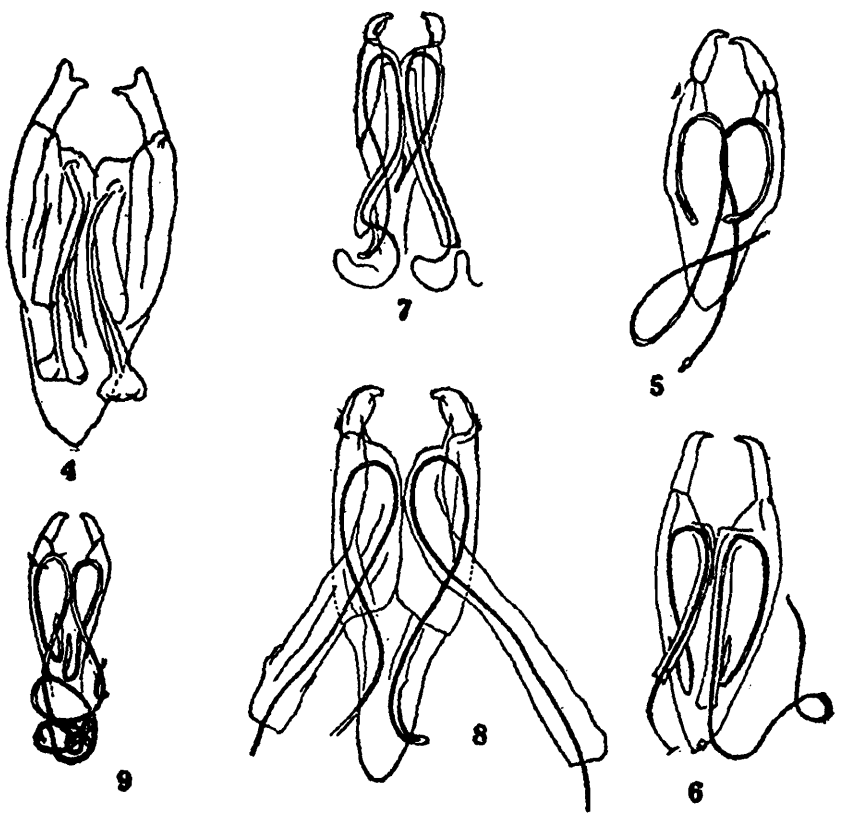
Thus from the above discussion it becomes clear that details of distal lobes including virga and other accessory structures will be of great use in the discrimination at specific level together with certain morphological details. It would be safer to base genera or subgenera on the shape of parameres along with other such details that are necessary for the stability of various taxa. Moreover, parameres are chitinised and their shape remains constant on mounting. Virga being elastic and tubular it is subject to great variation during eversion or while mounting on a slide as a result of even slight pressure sometimes.

Pygidicraninae

The genus *Cranopygia* Burr, 1908 is now characterised as having the parameres that may be provided with tooth or process internally or externally with distal lobes

and virga longer or shorter than proparameres. As a result, genera *Epicranopygia* Steinmann and *Paracranopygia* Steinmann are considered synonym of *Cranopygia* Burr. *Acrania* Burr, 1915 is reinstated and is characterised by knobless parameres that may be broad or narrow and curved into a sharp hook apically, often apex faintly bifid. The genus *Mucrocranopygia* Steinmann (1986) is also charcterised by similar parameres, is treated as synonym of *Acrania*.





Figs. 1-9 : Male genitalia, 1. *Cranopygia bhallaie* Kapoor, 2. *Cranopygia vitipennis* Hincks, 3. *Cranopygia eximia* (Dohrn), 4. *Cranopygia brindlei* Srivastava, 5. *Acrania sarawacensis* (Hincks), 6. *Acrania horsfeldi* (Kirby), 7. *Acrania picta* (Guérin—Méneville), 8. *Acrania constricta* (Hincks), 9. *Acrania bakeri* Borelli (Figs 1-4, 7 and 8 redrawn after Srivastava, 1988; figs.5 and 6 after Hincks, 1959 and fig. 9 after Srivastava, 1978).

Cranopygia Burr

1908. *Cranopygia* Burr, *Ann. Mag. nat. Hist.*, (8) **2** : 384, 389 (Type-species : *Pygidicrana cumingi* Dohrn, 1863).

1986. *Epicranopygia* Steinmann, *Das Tierreich*, **102** : 269 (Type-species : *Pygidicrana picta* Guérin—Ménéville, 1838)—**Syn. n.**

1986. *Paracranopygia* Steinmann, *Das Tierreich*, **102** : 277 (Type-species : *Forficula pallidipennis* Haan, 1842)—**Syn. n.**

Diagnostic characters : Parameres armed or provided with tooth or process internally or externally ; distal lobes and virga may be shorter or longer than the proparamere.

List of species :

C. carinata Hincks, 1959
C. opthalmica (Dohrn, 1863)
C. daemeli (Dohrn, 1863)
C. dravida (Burr, 1914)
C. parva Brindle, 1975
C. bhallaie Kapoor, 1966
C. cumingi (Dohrn, 1863)
C. nietneri (Dohrn, 1863)
C. javana Hincks, 1955
C. kallipyga (Dohrn, 1863)
C. valida (Dohrn, 1867)
C. raja (Burr, 1911)
C. sauteri (Burr, 1912)
C. imperatrix (Burr, 1899)
C. burri (Hincks, 1955)
C. curtula Hincks, 1955
C. philippinica Burr, 1914
C. appendiculata Hincks, 1955
C. marmoricrura (Audinet—Serville, 1839)
C. celebensis (Bormans in Burr, 1903)
C. viticollis (Stál, 1855)
C. vittipennis Hincks, 1955

C. eximia (Dohrn, 1863)

(=*Cranopygia angulata* Srivastava, 1975)

(=*Cranopygia meghalayana* Biswas, Lahiri and Ghosh, 1974)

C. brindlei Srivastava, 1988

C. formosa Hincks, 1955

C. burmensis Hincks, 1955

C. modesta (Bormans, 1894)

C. tonkinensis Hincks, 1955

C. semenov (Burr, 1912)

C. proxima Hincks, 1959

C. comata Hincks, 1955

C. maculipes Hincks, 1955

C. siamensis (Hincks, 1959)

C. variegata Brindle, 1965

C. similis (Zacher, 1911)

Species with doubtful position

C ? *vanderdoesi* (Boeseman, 1954)

C ? *angustata* (Dohrn, 1863)

C ? *guttata* (Kirby, 1903)

C ? *okunii* (Shiraki, 1928)

C ? *pluto* Hebard, 1923

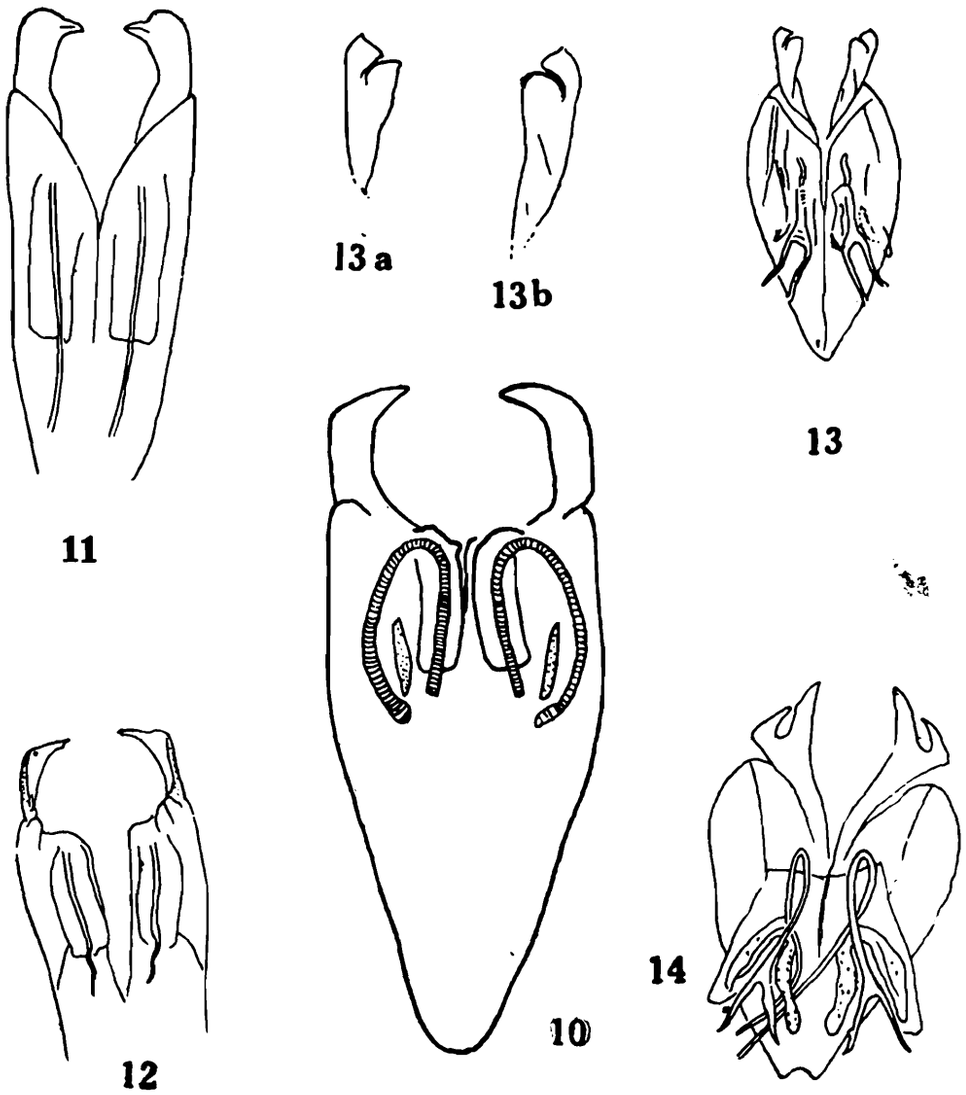
C ? *tumida* Borelli, 1931

Acrania Burr Stat. n.

1915. *Acrania* Burr, *J. R. micr. Soc.*, **1915** : 436 (Type-species : *Pygidicran picta* Guérin—Ménéville, 1838).

1986. *Mucrocranopygia* Steinmann, *Das Tierreich*, **103** : 266 (Type-species : *Pygidicrana horsefildi* Kirby, 1991)—**Syn. n.**

Diagonstic characters : Parameres are neither knobbed nor hooked externally or internally, occasionally external apical angle with a faint convexity, may be inflated internally ; narrow, of uniform width or dilated at base and tapering apically, tip hooked or bifid.



Figs. 10-14 : Male genitalia, 10. *Acrania assamensis* (Hincks), 11. *Acrania rostrata* (Brindle), 12. *Acrania luzonica* (Brindle), 13. *Nannopygia gerstaeckeri* (Dohrn), 13*a* and 13*b*. *Nannopygia gerstaeckeri* (Dohrn)—Paramere of left and right sides, enlarged. 14. *Nannopygia nigriceps* (Kirby). (Fig. 10. redrawn after Hincks, 1959 ; figs. 11 and 12 after Brindle, 1970 and 1967 and figs. 13—14 after Srivastava, 1988).

List of species :

A. sarawacensis (Hincks, 1959)

A. jacobsoni (Boeseman, 1954)

A. horsfieldi (Kirby, 1891)

A. fletcheri (Bharadwaj and Kapoor, 1967)

A. picta (Guérin—Ménéville, 1838)

(=*Cranopygia triangulata* Ramamurthi, 1965)

(=*Cranopygia livingstoni* Kapoor, 1966)

A. constricta (Hincks, 1955)
A. bakeri Borelli, 1921
A. pallidipennis (Hann, 1843)
A. vicina (Hincks, 1955)
A. assamensis (Hincks, 1955)
A. rostrata (Brindle, 1970)
A. luzonica (Brindle, 1967)
A. steinmanni (Srivastava, 1988)

Diplatyinae

A new generic classification of the subfamily Diplatyinae was proposed by Steinmann (1986*a*) which dealt with several new subgenera based upon virgal characters. As already pointed out in preceding pages that genera and sub-genera based on such characters may present lot of difficulty in discrimination from each other. For this reason, it is proposed that only those genera that are based on the shape of parameres should be considered as valid and others treated as synonyms as summarised below.

Nannopygia Dohrn **Stat. n.**

1863. *Nannopygia* Dohrn, *Stettin. ent. Ztg.*, **24** : 60 (Monobasic : *Nannopygia gerstaeckeri* Dohrn, 1863).

1974. *Schizodiplatys* Steinmann, *Acta zool. Hung.*, **20** (1-2) : 199 (Type-species : *Cylindrogaster nigriceps* Kirby, 1891)

List of species :

N. nigreceps (Kirby, 1891)
N. vosselri (Burr, 1907)
N. gerstaeckeri (Dohrn, 1863)
N. subangustatus (Steinmann, 1974)
N. angustatus (Burr, 1910)
N. mixtus (Borelli, 1923)
N. hoogstrali (Srivastava, 1978)
N. palawanensis (Srivastava, 1978)
N. sublobatus (Borelli, 1923)
N. malayanus (Hincks, 1932)
N. karnyi (Borelli, 1926)

N. sumatranus (Boeseman, 1952)

N. komodoensis (Bey-Bienko, 1965)

N. bensoni (Hincks, 1955)

Remarks : Srivastava (1988) has figured the ♂ genitalia from the Holotype of *Nannopygia gerstaeckeri* Dohrn which is the type-species of *Nannopygia* Dohrn, shows that parameres are divided by a deep, narrow or wide cleft apically. The genus *Schizodiplayts* was erected by Steinmann, 1974 for *Cylindrogaster nigriceps* Kirby, 1891 on similar characters of male genitalia, especially parameres. Since, *Nannopygia* has priority it is re-instated with *Schizodiplatys* as its synonym.

Genus **Diplatys** Serville

1831. *Diplatys* (pars) Serville, *Ann. Sci. Nat.*, **22** : 23 (Monobasic—*Forficula macrocephala* Palisot de Beauvois, 1805).

1881. *Dyscritina* Westwood, *Trans. R. ent. Soc. Lond.*, **1881** : 601, (Nymph—Monobasic : *Dyscritina longisitosa* Westwood, 1881.

1986. *Neodiplatys* (subgen.) Steinmann, *Acta. zool. Hung.*, **32** (1-2) : 174 (Type-Species-*Diplatys aethiops* Burr, 1904)—**Syn. n.**

1986. *Hypodiplatys* (subgen.) Steinmann, *Acta zool. Hung.*, **32** (1-2) : 175 (Type-Species-*Diplatys bormansi* Burr, 1910)—**Syn. n.**

1986. *Syndiplatys* (subgen.) Steinmann, *Acta zool. Hung.*, **32** (1-2) : 175 (Type-species-*Diplatys ernesti* Burr, 1910).

List of species :

D. macrocephalus (Palisot de Beauvois, 1805)

D. pictus (Zacher, 1910)

D. gedyi Hincks, 1955

D. simplex Hincks, 1961

D. aethiops Burr, 1904

D. longipennis Brindle, 1969

D. leleupi Brindle, 1966

D. ugandanus Hincks, 1955

D. rehni Hincks, 1955

D. fella Burr, 1911

D. raffrayi Dubrony, 1879

D. brindlei Steinmann, 1974

D. chopardi Hincks, 1955

D. devlensis Srivastava, 1974

D. papovi Bey-Bienko, 1959

D. annandalei Burr, 1911

D. excidense Hincks, 1954

D. confusus Hincks, 1955

D. coelebs Hincks, 1955 (=*D. jogiensis* Kapoor, 1968)

D. jawalagiriensis Kapoor, Bharadwaj and Banerjee, 1968

D. chowdhuryi Srivastava, 1989

D. nathani Hincks, 1960

D. dolens Hincks, 1959 (=*D. poonaensis* Kapoor, 1968)

D. tikaderi Srivastava, 1988

D. lefroyi Burr, 1910

D. borelli Hincks, 1955

D. menoni Kapoor and Bharadwaj, 1968

D. bormansi Burr, 1910

D. ernesti Burr, 1910

D. fletcheri Burr, 1910

D. anamalaiensis Srivastava, 1970

D. greeni Burr, 1904

D. carli Srivastava, 1988

D. adjacens Hincks, 1955

D. sinuatus Hincks, 1955

D. denticulatus Hincks, 1957

D. propinquus Hincks, 1955

D. santoshi Srivastava, 1975 (=*D. incisus* Brindle, 1975)

D. griffithsi Burr, 1911

D. fallax Borelli, 1926

D. jacobsoni Burr, 1911

D. yunnaeus Bey-Bienko, 1959

D. nilgiriensis Hincks, 1955

D. carinatus Srivastava, 1988

D. javanicus Hincks, 1955

D. degerboliae Ramamurthi, 1973

D. singularis Steinmann, 1968

D. liberatus Burr, 1910

D. flavicollis Shiraki, 1907

D. reconditus Hincks, 1955

D. nayasonei Nishikawa, 1973

D. hayashidai Nishikawa, 1973

Species with doubtful position

D ? baijali Duda and Malhotra, 1970

D ? croixi Burr, 1904

D ? dohrni Burr, 1911

D ? ridleyi Kirby, 1903

D ? flavobrunneus Chopard, 1924

Genus **Paradiplatys** Zacher

1910. *Paradiplatys* Zacher, *Ent. Rdsch.*, **27** : 105 (Monobasic—*Diplatys conardti* Burr, 1904).

1974. *Lobiodiplatys* Steinmann, *Acta zool. Hung.*, **20** (1-2) : 198 (Type-species : *Forficula coriaceus* Kirby, 1891).

1986. *Heterodiplatys* (subgen.) Steinmann, *Acta. zool. Hung.*, **32** (1-2) : 177 (Type-species : *Labia bicolour* Dubrony, 1879).—**Syn. n.**

1986. *Epidiplatys* (subgen.) Steinmann, *Acta. zool. Hung.*, **32** (1-2) : 178 (Type-species : *Diplatys radiator*; Burr, 1910).—**Syn. n.**

List of species :

P. coriaceus (Kirby, 1891)

P. beroni (Brindle, 1982)

P. taurinus (Brindle, 1982)

P. rotundicollis (Hincks, 1952)

P. burri (Hincks, 1936)

P. schoudeteni (Hincks, 1937)

P. bicolour (Dubrony, 1879)

P. conardti (Burr, 1904)

P. spinulosus (Hincks, 1961)

P. lamottei (Hincks, 1954)

P. bihamatus (Hincks, 1955)

P. pectinatus (Hincks, 1955)

P. salvazai (Burr, 1917)

P. gladiator (Burr, 1905)

Haplodiplatys Hincks

1955. *Haplodiplatys* Hincks, *Syst. mono. Dermaptera*, **1** : 17 (Type-species : ***Haplodiplatys niger*** Hincks, 1955).

1986. *Eudiplatys* (subgen.) Steinmann, *Acta zool. Hung.*, **32** (1-2) : 171 (Type-species : *Diplatys milloti* Chopard, 1940).—**Syn. n.**

1986. *Mesodiplatys* (subgen.) Steinmann, *Act. zool. Hung.*, 32 (1-2) : 171 (Type-species : *Diplatys nanus* Burr, 1941).—**Syn. n.**

List of species :

H. niger Hincks, 1955

H. jansoni (Kirby, 1891)

H. severus (Bormans, 1893) (=*Diplatys malcolmi* Hincks, 1955)

H. convexiusculus Brindle, 1984

H. coerulescens (Brindle, 1980)

H. hamatus (Brindle, 1972)

H. hincksi Steinmann, 1974

H. milloti (Chopard, 1940)

H. ruwenzoricus (Hincks, 1955)

H. sexeus (Brindle, 1982)

H. kivuensis (Hincks, 1951)

H. basilewskyi (Brindle, 1966)

H. mucronatus (Hincks, 1957)

H. raharizoninai (Brindle, 1966)

H. olsufiewi (Borelli, 1932)

H. longicornis (Hincks, 1955)

H. nanus (Burr, 1914)

H. major (Brindle, 1966)

H. gracillimus (Hincks, 1955)

H. similis (Bey-Bienko, 1959)

H. wallacei (Bey-Bienko, 1959)

H. rileyi (Hincks, 1955)

H. signatus (Bey-Bienko, 1970)
H. lobatus Srivastava, 1988
H. simlaensis (Kapoor, 1968)
H. rufescens (Kirby, 1881)
H. srivastavai (Kapoor, 1974)
H. darwini (Bey-Bienko, 1959)
H. stemmleri (Brindle, 1975)
H. triangulatus Brindle, 1987
H. trisinuatus Srivastava, 1988
H. malaisei (Hincks, 1947)
H. orientalis Steinmann, 1974
H. urbanii (Brindle, 1975)
H. tonkinensis (Hincks, 1955)
H. siva (Burr, 1904)
H. kurseongensis Srivastava, 1988
H. bilobus (Bey-Bienko, 1959)
H. bhowmiki (Srivastava and Saha, 1975)
H. bidentatus (Hincks, 1955)
H. flavens (Hincks, 1955)
H. tibetanus (Hincks, 1955)
H. chinensis (Hincks, 1955)
H. transversalis (Brindle, 1983)
H. brancuccii Srivastava, 1983 (=*H. schawalleri* Brindle, 1983)

SUMMARY

The genera based on male parameres should be recognised and those based on virga do not appear to be stable since its shape and length might vary either during mounting or the process of eversion. Accordingly, *Epicranopygia* Steinmann, 1986 and *Paracranopygia* Steinmann, 1986 are synonymised under *Cranopygia* Burr, 1908. *Acrania* Burr, 1915 with *Mucrocranopygia* Steinmann, 1986 as its synonym and *Nannopygia* Dohrn, 1863 with *Schizodiplatys* Steinmann, 1974 as its synonym, are reinstated. Besides, it is proposed to synonymise various subgenera *viz. Neodiplatys* Steinmann, 1986, *Haplodiplatys* Steinmann, 1986 and *Syndiplatys* Steinmann, 1986 under genus *Diplatys* Serville, 1831 ; *Heterodiplatys* Steinmann, 1986 and *Epidiplatys* Steinmann, 1986 under *Paradiplatys* Zacher, 1910 and *Eudiplatys* Steinmann, 1986 and

Mesodiplatys Steinmann, 1986 under *Haplodiplatys* Hincks, 1955. List of species under each genera is given.

ACKNOWLEDGEMENTS

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Rec. zool. Surv. India, **92** (1-4) : 53-61, 1992

ON THE TAXONOMIC STATUS AND IDENTITY OF *METISOLABIS CAUDELLI* (BURR) (DERMAPTERA : BRACHYLABIDINAE)

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Zoological Survey of India, Calcutta

Steinmann (1989) synonymised *Brachylabis caudelli* Burr, 1908 under *Brachylabis punctata* Dubrony, 1879 but both are distinct species and the former is reinstated. In the former the mesonotum in the anterior half is provided with a weak incurved fold only whereas in the latter the lateral keel on mesonotum is well defined and runs along its full length.

Dubrony (1879) described *Brachylabis punctata*, on a single female from Java, Buitenzorg. He under the name Bormans (1894) referred some more material from Burma and Sumatra this species. Out of this Burmese material Burr (1908) described *Brachylabis caudelli* and Srivastava (1978) *Isolabis ocellata*. Besides, Srivastava (1983) reexamined the 'Type ♀, of *B. punctata* and 1 ♂ from Sumatra, det. by Dubrony as *B. puuctata* and by Borelli as *Leptisolabis punctata*. Unfortunately, the male genitalia of the latter was not traceable, perhaps it might have been taken out earlier.

The ♂ genitalia of *B. punctata* has been figured twice by Steinmann (1978, fig. 3) showing the tip of parameres strongly hooked and (1989) with tip pointed apically. It may be pointed here that latter figure of ♂ genitalia agrees well with that of *Nannisolabis hincksi* Srivastava (1981), described on the material recorded by Hincks (1947) from Burma as *Metisolabis caudelli* (Burr). Even if we accept that Steinmanns (1978) figure of ♂ genitalia as correctly referable to *B. punctata* it differs markedly from that of *B. caudelli*.

It is found and discussed here that some variations exist in *B. caudelli* in the relative length of antennal segments, length of eye and the ♂ parameres, especially apical region with overall structure remaining same and to some extent in the arrangement of virgal sclerites which perhaps may be due to mounting. In the light above it is proposed to synonymise *Ctenisolabis aciculata* Steinmann, 1983 and *C. loebli* Steinmann, 1983 under *B. caudelli*. In addition the record of *Ctenisolabis fletcheri* and *Brachylabis philetas* by Steinmnnn (1983), both on females from India : West Bengal, are referable to this species.

Thus from the above discussion, it becomes evident that there is an urgent need to establish the identity of old species by examining their 'Type' as well as by procuring fresh material from the field recording their intraspecific variations. Both these factors would help in providing sound basis for proper understanding of various known species.

ANISOLBIDIDAE

BRACHYLABIDINAE

Metisolabis caudelli (Burr)

1894. *Brachylabis punctata* ; (nec Dubrony) Bormans, *Annali Mus. civ. Stor. nat. Giacomo Doria,* (2) **14** : 386 (part of the material from Burma).

1908. *Brachylabis caudelli* Burr, *Ann. Mag. nat. Hist.,* (18) **2** : 251 (Holotype ♂, Burma Carin Cheba), 1100 m, L. Fea, V-XII.-88, det. by Bormans as *Brachylabis punctata* Dubrony—British Museum (Natural History), London).

1910. *Metisolabis caudelli* ; Burr, *Fauna British India, Dermaptera* : 109.

1912. *Metisolabis caudelli* ; Burr, *Annln. naturh Mus. Wien,* **26** : 81.

1913. *Metisolabis caudelli* ; Burr, *Rec. Indian Mus.,* 8(2) : 138 (1♂, India : Arunachal Pradesh).

1966. *Isolobis caudelli* ; Popham and Brindle, *Entomologist,* **99** : 245.

1975. *Metisolabis caudelli* ; Biswas, Lahiri and Ghosh, *Proc. zool. Soc. Calcutta,* **26** : 28 (♀ nec ♂ ; India, Meghalaya, Shillong, Khasi Hills).

1982. *Metisolabis caudelli* ; Srivastava, *Entomologica Basiliensia,* **7** : 63, figs. 2-4 (♂, India, W.B., Darjeeling genitalia figured).

1983. *Ctenisolabis fletcheri* (nec Burr, 1910) ; Steinmann, *Revue suisse zool.,* **90**(3) : 544 (1♀ ; India, W. B., Darjeeling).

1983. *Ctenisolabis aciculata* Steinmann, *Revue suisse zool.,* **90**(3) : 545, fig. 3 (1♀ ; India, Meghalaya, Khasi Hills)—**Syn. n.**

1983. *Ctenisolabis loebli* Steinmann, *Revue suisse zool.,* **90**(3) : 546, fig. 4 (1♀ ; India, W.B., Darjeeling)—**Syn. n.**

1983. *Brachylabis philetas* (nec Burr, 1901) ; Steinmann, *Revue suisse zool.,* **90**(3) : 546 (1♂ nec ♀ ; India, W.B., Darjeeling Dist., Algarah).

Material examined : India : West Bengal : Darjeeling dist., Kurseong, on the floor of Hotel varandah, 1♂ (genitalia mounted between two coverslips and pinned with the specimen) ; 1♀, 5.7.1908 (*N. Annandale*)—both determined by M. Burr as *Brachylabis verhoeffi* ; Teesta, 250 m, 1♀, 10.10.78 (*Besuchet, Löbl*)—det. by Steinmann as *Ctenisolabis fletcheri* Burr ; Tigerhill, 2000-2300 m, 1♀, 13.10.78 (*Besuchet, Löbl*)—det. and designated as Holotype ♀ of *Ctenisolabis loebli* sp. nov. by Steinmann ; Algarah, 1800 m, 1♂ (genitalia mounted between two cover slipes and pinned with the specimen), 9.10.78 (*Besuchet, Löbl*)—det. as *Brachylabis philetas* Burr, 1♀ by Steinmann ; Meghalaya, Khasi Hills, au-dessus de Shillong, 1850-1950 m, 1♀, 25.10.78 (*Besuchet, Löbl*)—det. and designated as Holotype ♀ of *Ctenisolabis aciculata* sp. nov. by Steinmann ; Shillong, Nongthymma, 1♀, 21.8.1974 (*R. S. Giri*), Shillong, Motinagar, 2♂♂, 30.5.1974 (*S. Biswas*), Shillong, Risa Colony Building, 1♀, 23.8.1971 (*R. Giri*) and Shillong, Motinagar, 1♀, 6.9.1960 (*S. N. Prasad*)—last two specimens, det. as ♂♂ by S. Biswas, A. R. Lahiri and A. K. Ghosh.

Burma : Carin Cheba, 900-1100 m, 2♀♀, 5.12.88 ; Tenizo, 1♀, Maggio, 1886 ; Palon (Pegu), 1♂, 1♀, 5—3.9.87 (*Fea* coll.)—deposited in the Institut Royal des Sciences,

Bruxelles and determined as *Brachylabis punctata* Dubr. by Bormans; Teinzo, 1♂, Maggio, 1886 (*L. Fea* coll.)—deposited in Museo Civico di Storia Naturale 'Giacomo Doria', Genova and determined as *Brachylabis punctata* Dubr. by Bormans.

Description : General colour dark blackish brown ; antennal segments, mouth parts, apical third of femora, whole of tibiae and tarsi yellowish. Body covered with fine pubescence.

Male : Head triangular, longer than broad, frons convex, punctate, hind margin almost straight. Eyes about as long as post-ocular length or distinctly longer. Antennae (partly damaged) 12-segmented or more, 1st narrowed at base, longer than the distance between antennal bases ; 2nd small ; 3rd long, slender, slightly or distinctly longer than broad ; 4th a trifle longer than broad and slightly shorter than 3rd or almost equal ; 5th longer than broad, gently narrowed basally, generally longer than 3rd, remaining segments gradually increasing in length distally. Pronotum more strongly punctate than the head, longer than broad, anteriorly wider than head, margin straight, sides straight weakly reflexed in middle, strongly diverging posteriorly, postero-lateral angles rounded and margin subtruncate, median sulcus distinct on prozona, on either side of it with a faint depression ; prozona and metazona raised, little differentiated. Mesonotum punctate, transverse, laterally with a distinct raised carina, hind margin straight. Metanotum transverse, laterally ecarinate, punctate, hind margin broadly emarginate. Legs long and slender, hind metatarsal segment almost equal to the combined length of meso-and pro-tarsal segments. Abdomen spindle shaped, punctate, convex, sides of segments posteriorly convex, lateral tubercles on 3rd and 4th tergites weakly marked. Penultimate sternite punctate, transverse, broadly rounded posteriorly with a distinct median emarignation, manubrium short, about half as long as the sternite, faintly narrowed apically. Ultimate tergite transverse, sparsely punctate as compared to abdominal tergites, sloping backwards in middle posteriorly, sides straight, posterior margin trisinuate, laterally oblique, above the base of forceps projecting in the from of triangular or obtuse lobe. Pygidium scarcely visible from above, vertical, narrowed posteriorly. Forceps with branches cylindrical, remote, regularly curved, tapering from base to apex with apices touching or sub-contiguous ; or straight, tapering, gently curved in apical one third and crossing, apices pointed. Genitalia as seen in figs. 3, 6, 14 and 30.

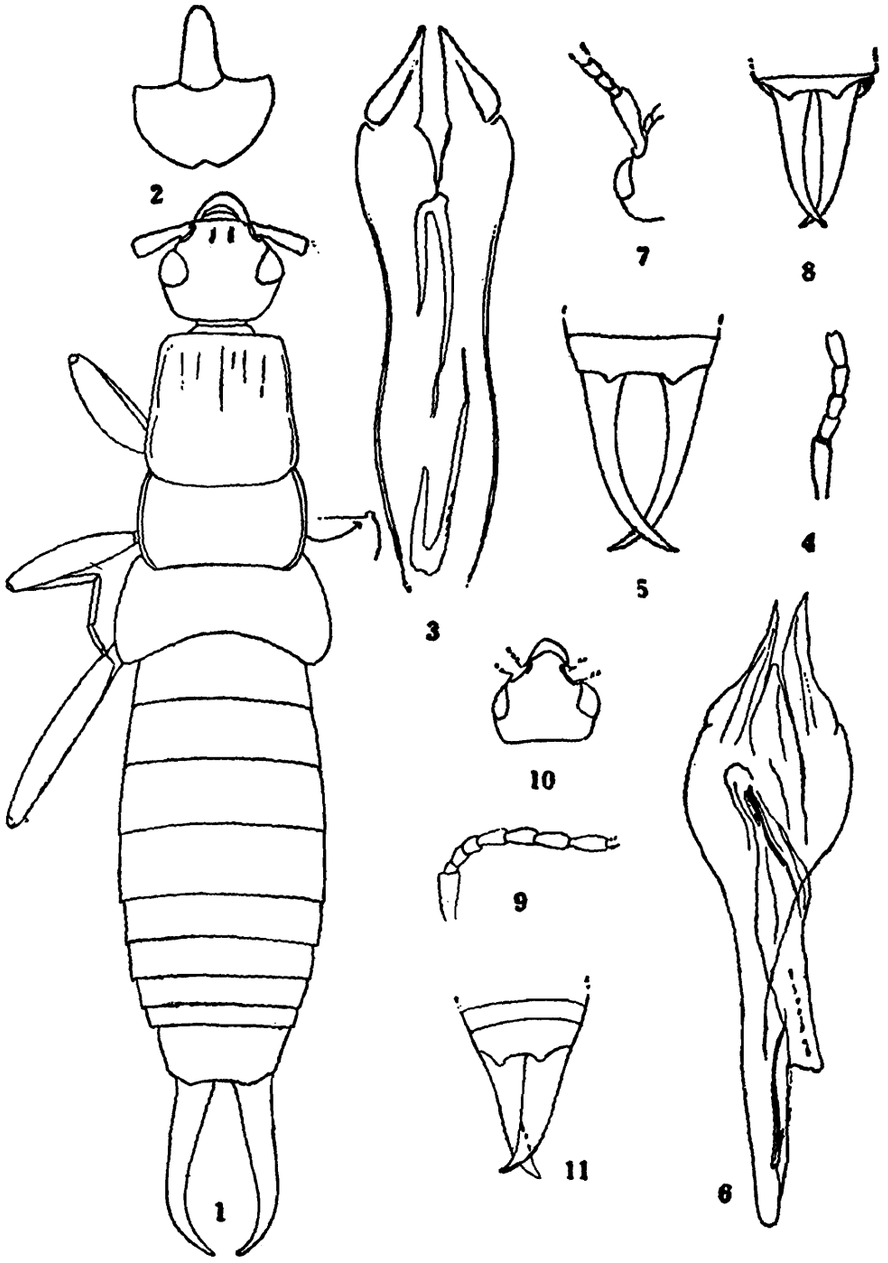
Female : Agrees with males in most characters except that the ultimate tergite strongly narrowed posteriorly and forceps simple and straight.

Measurements : (in mm)

	♂♂	♀♀
Length of body	9.3-10.3	8.2-13.1
Length of forceps	1.3-2.3	1.3-2.2

Distribution : India (North-eastern Himalayas and Khasi Hills) and Burma.

Besides there is a record of this species from Borneo (Borelli, 1932) that needs checking.

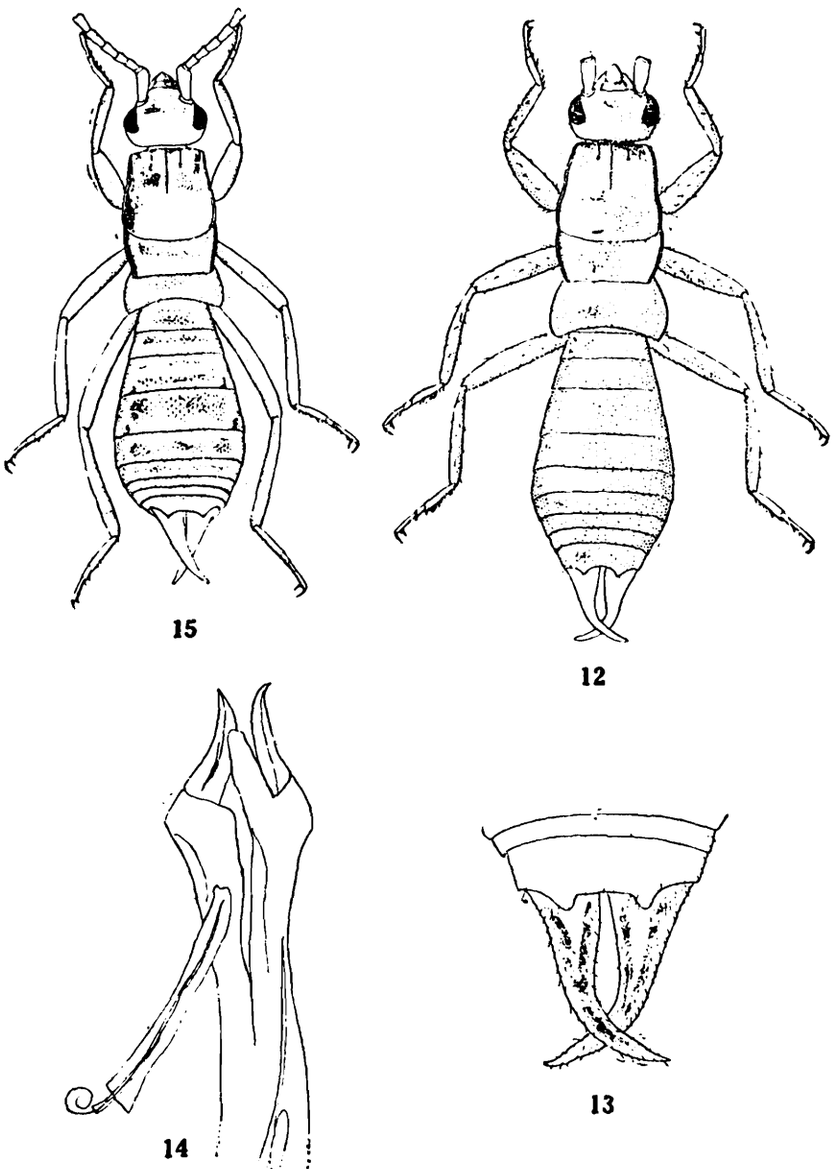


Figs. 1-11 : *Metisolabis caudelli* (Burr), Holotype ♂, (1) Dorsal view, (2) Penultimate sternite, (3) Genitalia ; 1♂ India, Shilong, Motinagar, (4) A few basal antennal segments, (5) Ultimate tergite and forceps, (6) Genetalia ; another ♂, India, Shilong, Motinagar, (7) Right half of head and antenna with a few basal segments, (8) Ultimate tergite and forceps ; 1♂, Burma, Palon (Pegu), (9) A few basal antennal segments, (10) Head, (11) Ultimate tergite and forceps. (Figs. 1-3 drawn by Mr. A. Brindle).

Remarks : Some variations in the size of eyes in relation to post-ocular length and in the length and width of 3rd and 4th antennal segments as well as the relative

length of both these segments in the antennae of two sides are noted in the present material.

Mrs. J. Marshall, British Museum (Natural History), London had supplied diagrams (figs. 1-3) and some information on the 'Holotype' of *Brachylabis caudelli* Burr, as provided by Mr. A. Brindle, which reads as "the type has the head strongly punctured, and the pronotum is more strongly punctured, the punctures relatively large and

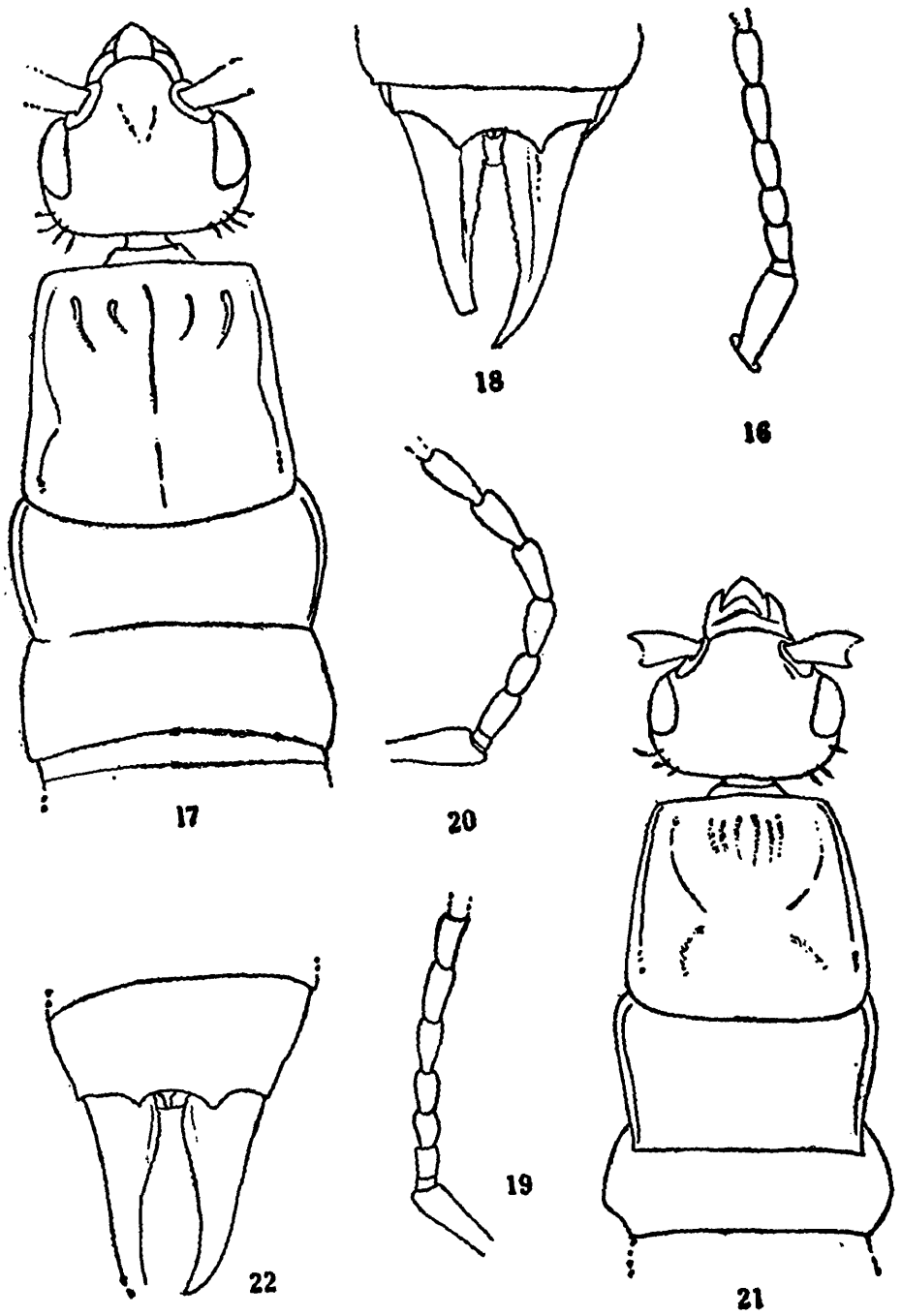


Figs. 12-15 : *Metisolabis caudelli* (Burr), ♂, India : Kurseong, (12) Dorsal view, (13) Ultimate tergite and forceps, enlarged, (14) Genitalia ; ♀, (15) Dorsal view.

close, some being confluent ; meso-and metanota similar to pronotum, but abdomen less strongly punctured. Mesonotal ridge narrow, rounded but well defined by an impressed line on dorsum (see diagram).

Genitalia rather faint in mount, especially parameres and the distal lobes are not clearly defined, but there are two sclerites, directed in opposite directions, the slender virga running through the longer arm".

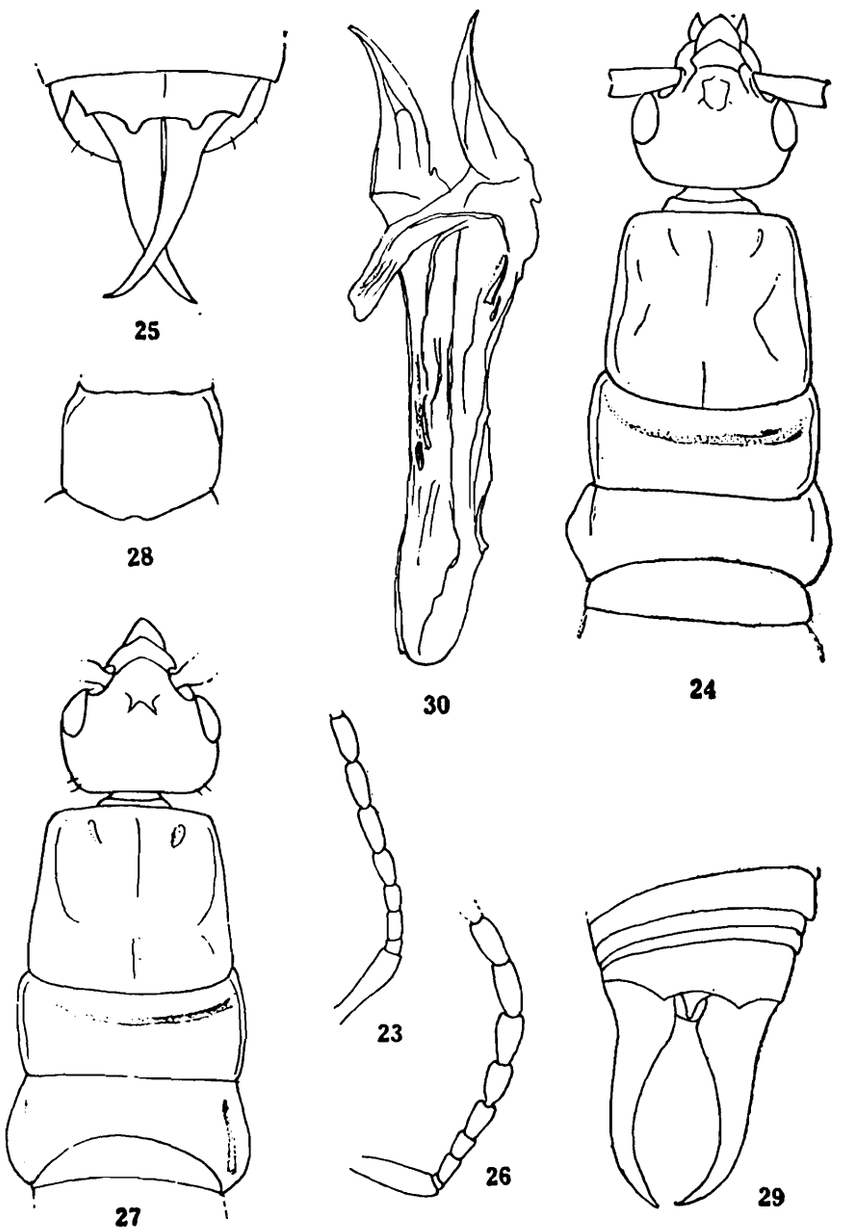
The tip of paramere (figs. 6, 14 and 30) appears to be more drawn out as compared to fig. 3 from the 'Holotype ♂' which may perhaps be due to mounting. However, general shape of parameres is same in all the four diagrams, in being broader at base and narrowing apically with tip pointed.



Figs. 16-22 : *Metisolabis caudelli* (Burr), ♂, India, Darjeeling (det. by Steinmann as *Ctenisolabis fletcheri*, ♀, (16) A few basal antennal segments, (17) Anterior portion of body, (18) Ultimate tergite and forceps ; ♀, India, Meghalaya (Holotype ♀ of *Ctenisolabis aciculata* Steinmann), (19) and (20) A few basal antennal segments of right and left side, (21) Anterior portion of body, (22) Ultimate tergite and forceps.

Steinmann (1983) described two new species viz., *Ctenisolabis aciculata* from Meghalaya and *Ctenisolabis loebli* from Darjeeling on females only. Besides, he also

recorded two other species, *Ctenisolabis fletcheri* Burr and *Brachylabis philetas* Burr, on females from Darjeeling. Of these former is confined to South India and the latter to Sri Lanka.



Figs. 23-30 : *Metisolabis caudelli* (Burr), ♀, India, Darjeeling (Holotype ♀ of *Ctenisolabis loebli* Steinmann), (23) A few basal antennal segments, (24) Anterior portion of body, (25) Ultimate tergite and forceps ; ♀, India, Darjeeling (det. as *Brachylabis philetas*, ♀ by Steinmann, (26) A few basal antennal segments, (27) Anterior portion of body, (28) Penultimate sternite, (29) Hind portion of abdomen, (30) Genitalia.

The Holotypes of first two species and specimens on which the record of third and fourth species are based, were examined. It was found that although the record of *Brachyabis philetas* Burr was based on a ♀ it was found to be a ♂ and the genitalia of the same was examined. All the above specimens appear to be

congeneric possessing eyes about as long as the post-ocular length, and anntennal segments may be slightly slender or stout, especially 3rd and 4th and the lateral carina on mesonotum is quite sharp and compelet. Since all fall within the variational limits of various morphological characters, it is proposed to synonymise here *Ctenisolabis aciculata* and *Ctenisolabis loebli* under this species. In addition, records of *Ctenisolabis fletcheri* Burr and *Brachylabis philetas* Burr from Darjeeling by Steinmann (l. c.) are rejected since these are referable to *Metisolabis caudelli* (Burr).

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I am thankful to the Director, Zoological Survey of India, Calcutta for providing necessary facilities during the course of preparation of this paper. My thanks are also due to Mrs. J. Marshall, British Museum (Natural History), London for supplying the notes and diagrams prepared by Mr. A. Brindle from the 'Holotype ♂' of *Brachylabis caudelli* Burr ; Dr. B. Hauser, Museum d'Histoire Naturalle, Geneve, Switzerland, for sending the Holotype ♀ ♀ of *Ctenisolabis loebli* Steinmann and *Ctenisolabis aciculata* Steinmann, 1 ♀ of *Ctenisolabis fletcheri* Burr and 1 ♂ (ne'c ♀) of *Brachylabis philetas* Burr, both determined by Steinmann and Dr. R. Poggi, Museo Civico di Storia Naturale 'Giacomo Doria', Genova, Italy, far sending the Burmese material of the species.

Summary

The taxonomic identity of *Metisolabis caudelli* (Burr) is discussed and the species is redescribed synonymising *Ctenisolabis aciculata* Steinmann and *Ctenisolabis loebli* Steinmann.

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FOOD AND FEEDING IN FOUR SPECIES OF COLLEMBOLA IN N. E. INDIA

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INTRODUCTION

The process of recycling of nutrients and the flow of energy between different tropic levels is greatly influenced by the soil organisms and their biotic relationships. In spite of the importance of such studies, many aspects are still unknown either in relation to structural or functional phenomenon of the trophic relationships of arthropods living in the soil. This is very true especially among those groups of animals which dominate any soil ecosystem like collembola. Most studies exist on the aspects of ecology connected with nutrition biology of collembola in particular to litter decomposition and thereby formation of soil but very little on the feeding behaviour of these groups of animals in nature.

One of the earliest reports in relation to feeding biology of collembola was by Agrell (1941) who showed the occurrence of empty guts related to dry condition in the soil and litter in *Anurophorus laricus*. Hutchinson (1951) showed the effect of physico-chemical instability of the litter and humus microhabitats for the incorporation of fugitive species. The type of vegetation in a region, was reported to be indirectly affected and exerted by the influence of the microfloral composition in the soil (Bellinger, 1954). Periodic non-feeding phases associated with moulting in collembola population was well documented by Poole (1959). Certain microflora are reported to be present as gut symbionts in collembola having an important role in the digestion of plant material (Von Toyne, 1961). The distribution of collembola is directly proportional to the distribution of fungi on which they feed (Knight, 1961) and are greatly influenced by humidity conditions of the habitat (Poole, 1961). Individual preferences of certain plants by collembola species are also known (Dunger, 1962). Such populations when aggregated play at least a peripheral role in soil processes (Macfadyen, 1963), under culture experiments of feeding. It was shown by Sharma and Kevan (1963b : 1963c) that populations of collembola fail to reproduce on a diet lacking in plant

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material and revealed occasional cannibalistic behaviour. However, Christiansen (1964) showed food preferences had a wide range, and that *Bacillus* sp. in the gut of collembola was capable of digesting chitin, thereby, confirming the fact that collembola and micro-or macroflora are directly proportional. In any case the distinction between ingestion and assimilation was shown by Healey (1965), in that certain collembola species utilised only fats and carbohydrates in the fungal hypae without interfering with the reproductive structures of the fungus. Healey (1965) also showed that collembola species can survive upto eighteen months in a state of facultative diapause without feeding.

Knight and Angel (1967) showed that the average collembola spend an inactive or semiactive state for nearly 40-50% of their adult life. Von Torne (1967a ; 1967b) has shown the activity of the collembola gut-enzyme complement along with coprophagy to be responsible for the utilization of common resources. The bacterial contents of the soil and the migration of the collembola to higher densities of the former was shown to be reciprocal by Stebaeva (1967). The lack of breaking down cellulose in collembola was reported by Zinkler (1969) and the diminution of leaves after passing through the gut is the initial step of the decomposition cycle (Tikhomirov, 1969). The action of fungi on such materials could be immediate as they are known to adapt physiologically to a wide range of concentration of nitrogen (Levi and Cowling, 1969), for the growth and regulation of animal populations depended on the food quality (Watson, 1970). This is supported by the fact that the individuals of the same species differing in the gut contents from different habitats, is greater than those in the guts of individuals of different species in the same habitat (Gilmore and Raffensperger, 1970 ; Bodvarsson, 1970).

The nutritional differences between species of fungi with respect to feeding of collembola was shown by Mills and Sinha (1971) which was coupled with the infrequent feeding behaviour of collembola (De With and Joosse, 1971). This was supported by the fact that most collembola species are more or less non-specialized feeders (Petersen, 1971 ; Massoud, 1971 ; Luxton, 1972). Such low degree of specialization was associated with excess of food available (Anderson and Healey, 1972) and that scarcity of food was an important source of stability in reducing the amplitude of population fluctuations (Smith, 1972). Further, Jones (1972) showed the secretion of toxic substances from the root system in control of populations.

The importance of food available under field conditions was shown by Emlen (1973), as an adaptation to varied diet would only seem a selective advantage under laboratory conditions. A direct relationship between fauna and flora in agricultural tilled soil was shown by Kines and Sinha (1973). Moreover, at any one time the greater part of a population does not take part in the utilization of food resources (McMillan, 1975).

Work on Indian collembola and their feeding behaviour is very meagre (Singh, 1969). The aim of the present work was to take up some dominant species of collembola present in different abandoned Jhum fallows of N. E. India and to observe their feeding behaviour in the field. The gut contents of four species of collembola was correlated with one major group of microflora namely fungi of the soil. The studies were carried out seasonally for a period of one annual cycle to identify the selectiveness or non-selectiveness of the food (fungi) present in the soil.

MATERIAS AND METHODS

Details of extraction methods, have been given in an earlier paper on life history studies.

Immediately after collection of the species, the guts were teased out from five individuals. These guts were placed in dilution plate for culture and cut open and spread out on the media with the help of a spray of triple distilled water. Five plates were prepared for each species every month. The soil was taken from the two sites where these species occurred and a similar soil dilution plate method was prepared to isolate the fungi. 10 gm of soil from each site and replicate samples of five were placed in 100 ml of triple distilled water in a 250 ml Ehrlenmayer flask and blended for 1 minute for each replicate sample (5) from both the sites and a total of 10 plates were prepared every month. Final dilution of 1 to 10,000 was used for isolation. The media selected was Martin's rose ± Bengal Agar (Martin, 1950).

Such plates both for the gut contents of the collembola species and soil samples amounting to 20 (animals) and 10 soil replicates were incubated every month at 25 ± 1°C for 5 days. After this period the plates were removed, the fungi identified upto species wherever possible, their colonies counted and expressed as percentages. All this was carried out for a period of one year.

RESULTS

The present study was conducted on four of the dominant collembola species found in two abandoned jhum fallows, the youngest and oldest respectively. One common finding in both the sites from the top soil layers in these abandoned fallows, was that a total of 21 species of fungi were recorded, irrespective of the age of the fallow. Of these 21 species, when the total year was taken into consideration, it was seen that *Trichoderma viride*, Pers, ex. Gray was maximum in the soil of the youngest fallow (nearly 16%) followed by *Penicillium chrysogenum*, Thom. (15%), *Aspergillus niger*, Van Tiegham (14%) and *Fusarium* sp. (12%). All the others recorded less than 10% with *Penicillium nigricans*, Bainier, Thom. (9%) and least were *Cladosporium* sp., *Acremonium* sp. and *Verticillium* sp. all recording only 0.8% (Fig. 1).

A similar analysis of the soil in the oldest abandoned fallow revealed that the maximum was that of *Penicillium nigricans* (13%). All the others recorded were below 10% with only *Aspergillus niger* (nearly 10%). The least occurred species in this site were those of *Actinomucor* sp., *Verticillium* sp. and *Scopullariopsis* sp., all recording around 1.5% (Fig. 2)

It was seen that in the gut of *Seira indica*, the maximum occurrence was that of *Trichoderma viride* amounting to nearly 24% followed by *Fusarium* sp. with nearly 23%. Hence, these two species formed nearly 50% of those fungi found in the gut while the ones not recorded at all throughout the year, though present in the soil were *Cladosporium* sp., *Mucor hiemalis*, *Acremonium* sp., *Cunnighamella* sp., *Actinomucor* sp., and *Scopullariopsis* sp. Out of 21 species of fungi found in the soil, only 14 species were recorded in the gut of this species of collembola (Fig. 1).

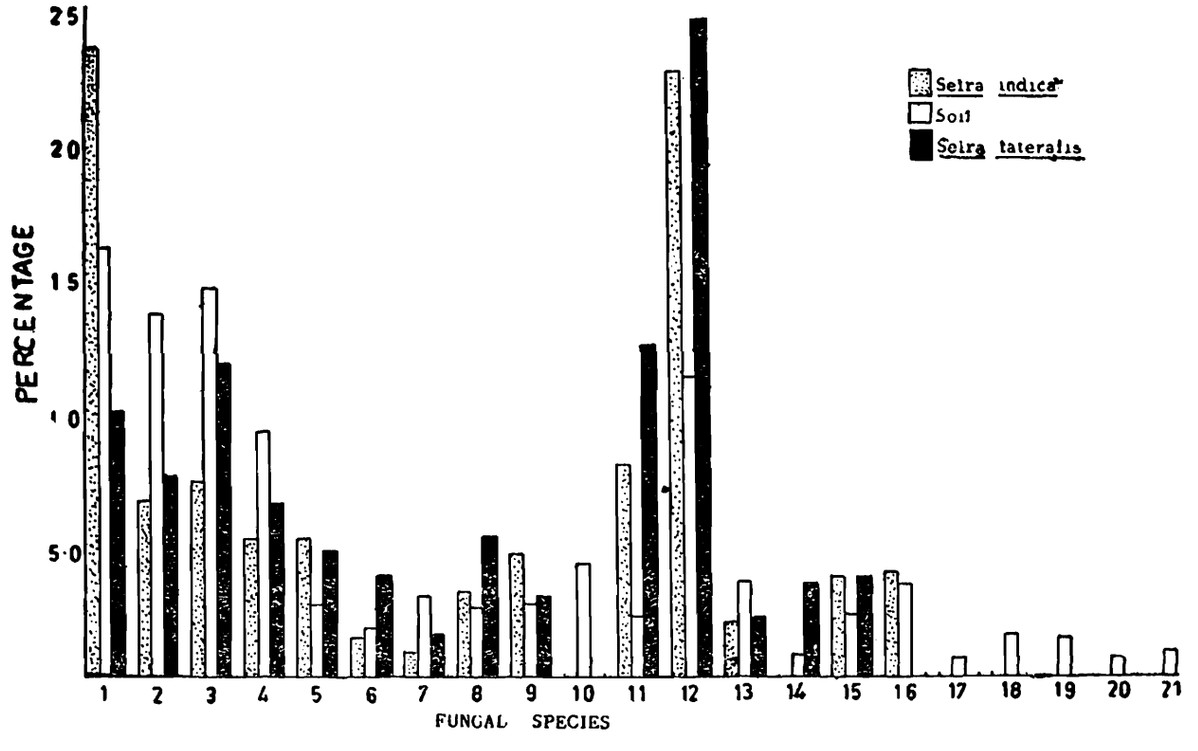

Fig. 1. Percentage occurrence of different species of fungi in the soil and two species of Collembola—for the entire study period.

In *Seira lateralis* it was seen that *Fusarium* sp. formed nearly 25% in the gut followed by *Alternaria alternata* and *Penicillium chrysogenum* with both around 12%. These three groups of fungi occupied nearly 50% of the total fungi in the gut. Again in this species, it was seen that seven fungi were absent viz. *Pythium* sp., *Mucor hiemalis*, *Acremonium* sp. *Cunnighamella* sp., *Actinomucor* sp., *Verticillium* sp. and *Scopullariopsis* sp. It was therefore observed in this species that again only 14 species of fungi were recorded in the gut, out of the 21 species available in soil (Fig. 1).

In the oldest abandoned fallow when a similar observation was made for the two dominant species of Collembola, it was seen that *Salina yosii*, recorded *Alternaria*

alternata as maximum in the gut (18%) followed by *Fusarium* sp. (14%). All the others recorded were less than 10% with only *Trichoderma viride* recording nearly 10%. Some fungal species were totally absent in the gut. They were *Mucor hiemalis*, *Acremonium* sp., *Cunnighamella* sp., *Actinomucor* sp., *Verticillium* sp. *Scopullariopsis* sp. Out of 21 species of fungi present in the soil only 15 were available in the gut of *Salina yosii* (Fig. 2).

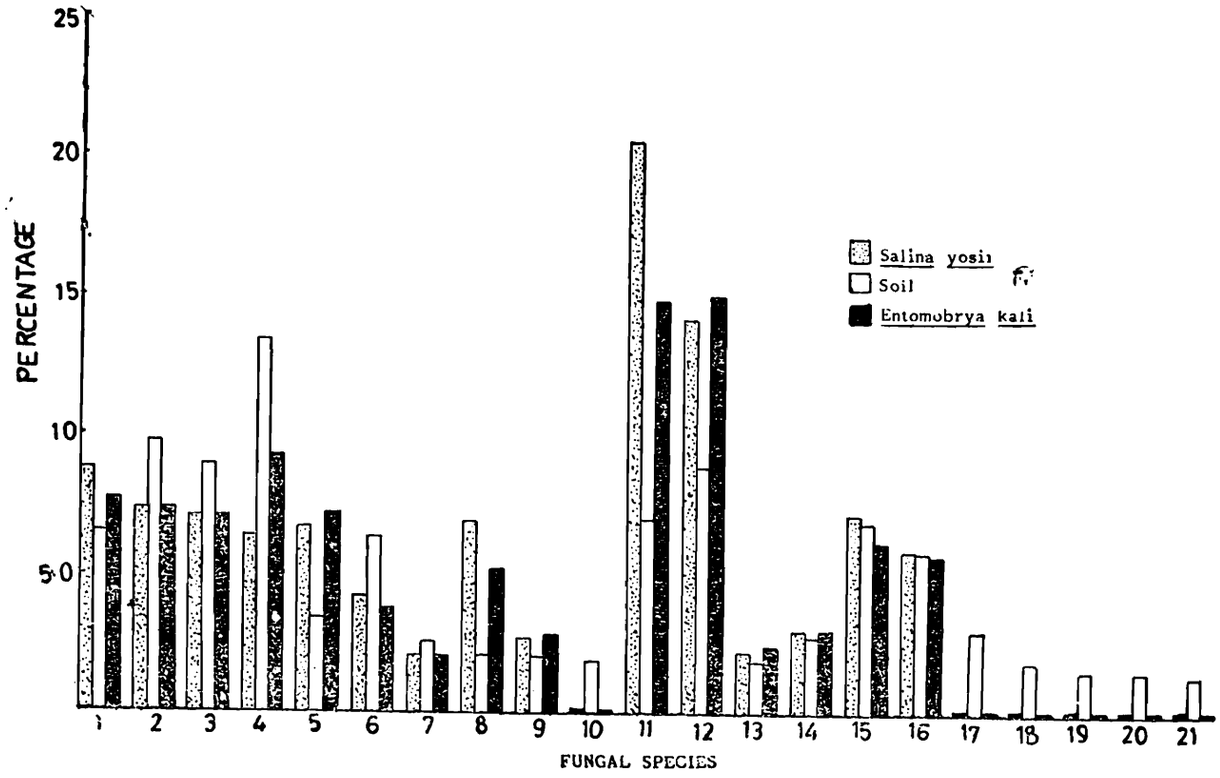

Fig. 2. Percentage occurrence of different species of fungi in the soil and two species of Collembola—for the entire service period.

In the fourth species *Entomobrya kali*, it was seen that *Alternaria alternata* and *Fusarium* sp. occupied nearly 15% each as maximum among the groups of fungi present in the gut. All the others were below 10% with only *Penicillium nigricans* showing 9.3%, being third in order of dominance. Like *Salina yosii* from the same site the same six groups of fungi were totally absent in the gut of three species also (Fig. 2).

In the youngest abandoned fallow the fungi isolated from the surface layers revealed that the dominant species of fungi had peaks in early spring which continued through summer and declined, once the monsoons set in (Table 1).

In the oldest fallow, the seasonal trend revealed that the two dominant fungal species, *Penicillium nigricans* and *Aspergillus niger* recorded peaks of abundance in August and July respectively, while the minimum was observed to be in the month of

TABLE 1. Monthly percentage occurrence of fungal species in the soils of the youngest and oldest abandoned jhum fallows.

Youngest abandoned jhum fallow.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
J	16.6	—	20.6	6.0	4.0	—	—	10.0	10.3	8.3	—	1.6	4.0	—	0.6	5.0	—	—	—	—	—
F	20.0	10.0	10.0	15.0	5.0	—	5.0	—	5.0	—	5.0	—	5.0	1.0	7.0	7.0	—	—	—	—	5.0
M	25.0	17.9	10.0	1.8	—	—	—	—	—	7.0	—	17.9	—	—	9.6	9.0	—	—	—	1.8	—
A	—	7.0	5.2	5.0	—	7.0	—	—	—	16.3	—	15.9	9.3	—	5.0	2.3	—	2.3	—	—	—
M	45.5	17.3	10.0	10.0	9.1	—	—	—	—	—	—	9.1	—	—	—	—	5.2	—	5.0	—	—
J	10.5	25.0	25.0	25.0	—	—	—	—	—	3.8	3.9	19.6	—	—	—	3.8	—	—	—	—	—
J	13.3	31.0	20.0	—	2.0	—	—	—	—	4.1	—	14.3	—	—	—	8.2	—	—	—	6.1	4.1
A	14.5	29.1	20.0	3.6	—	—	5.5	3.6	—	5.5	1.8	14.5	—	—	—	—	—	1.8	—	—	—
S	9.7	16.1	6.5	6.5	—	8.1	10.6	10.0	10.0	—	10.0	10.0	—	—	—	—	—	3.2	—	—	—
O	4.2	3.8	15.3	16.0	4.2	5.0	6.0	5.0	5.0	2.0	5.0	16.7	—	—	—	1.0	1.0	3.0	3.0	1.0	3.0
N	6.2	4.3	5.4	5.0	7.0	—	5.0	—	—	2.0	—	17.0	13.5	8.1	3.0	2.0	2.7	2.0	2.7	1.0	3.0
D	15.9	1.8	15.9	15.9	—	1.0	5.0	1.0	3.0	2.3	2.0	10.9	10.4	1.0	3.0	3.0	1.0	—	6.8	—	1.0

Oldest abandoned jhum fallow.

J	8.4	—	5.0	5.0	—	—	—	—	—	10.0	5.8	5.0	5.0	26.3	10.0	10.0	20.0	3.2	3.3	3.3	3.3
F	9.6	5.0	5.0	7.5	5.0	—	2.0	—	10.0	5.0	10.0	9.6	3.0	7.5	2.0	3.9	2.0	3.0	2.0	3.0	5.0
M	7.0	13.7	13.7	10.0	—	—	—	—	10.0	4.8	3.3	10.0	—	—	7.1	10.0	1.0	2.0	3.0	2.0	2.0
A	—	15.0	10.0	20.0	—	20.0	—	—	—	1.0	—	5.0	—	—	5.0	5.0	1.0	1.0	1.0	1.0	—
M	—	5.8	5.0	8.9	—	10.0	—	—	—	2.7	—	5.1	—	—	20.0	10.0	8.9	10.0	5.4	5.4	2.7
J	9.2	10.0	1.5	10.0	—	2.0	—	6.5	—	—	30.0	30.8	—	—	—	—	—	—	—	—	—
J	5.7	20.0	12.3	30.0	—	8.6	—	—	—	—	12.9	10.0	—	—	—	—	—	—	—	—	—
A	4.1	50.0	15.0	27.6	5.0	6.9	5.0	9.5	—	—	15.0	10.0	2.9	2.0	2.0	2.0	—	—	—	—	—
S	5.1	15.4	10.0	10.0	10.0	10.0	4.0	14.4	—	—	8.6	6.0	5.1	5.4	10.0	5.0	—	—	—	—	—
O	8.2	10.0	7.7	10.0	15.9	2.0	10.9	—	1.4	—	—	8.0	2.3	4.5	16.0	14.0	1.0	1.0	1.0	1.0	1.0
N	11.2	7.6	11.8	10.0	2.0	17.6	5.0	—	1.8	—	—	5.0	2.0	5.0	4.5	6.5	2.5	2.5	1.5	1.5	2.0
D	10.9	10.2	10.0	12.0	5.0	14.8	4.4	—	1.1	—	—	3.4	2.0	5.0	6.5	10.0	1.0	1.0	1.0	1.0	1.0

1. *Trichoderma viridae*, 2. *Aspergillus niger*, 3. *Penicillium chrysogenum*, 4. *Penicillum nigricans*, 5. *Mycogone* sp., 6. *Absidia spinosa*, 7. *Absidia* sp., 8. *Mucor recemosus*, 9. *Mucor circinelloides*, 10. *Mucor hiemalis*, 11. *Alternaria alternata*, 12. *Fusarium* sp. 13. *Cephalosporium* sp., 14. *Cladosporium* sp., 15. *Doratomyces* sp., 16. *Pythium* sp., 17. *Acremonium* sp., 18. *Cunninghamella* sp., 19. *Actinomucor* sp., 20. *Verticillium* sp., 21. *Scopullariopsis* sp.

TABLE 2. Monthly percentage occurrence of fungal species in the guts of *Seira indica* and *Seira lateralis*.

Seira indica

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
JAN	20.1	—	13.3	6.7	3.3	—	—	—	20.0	—	—	13.3	—	—	13.3
FEB	5.5	5.5	—	11.1	5.5	—	11.1	—	16.6	16.6	—	11.1	—	11.1	5.5
MAR	11.8	11.8	17.6	11.8	—	—	—	—	—	—	17.6	—	—	17.6	11.8
APR	—	10.0	20.0	10.0	—	20.0	—	—	—	—	20.0	—	—	10.0	10.0
MAY	33.3	—	—	—	22.2	—	—	—	—	—	44.4	—	—	—	—
JUN	25.0	—	—	—	—	—	—	—	—	37.5	37.5	—	—	—	—
JUL	50.0	—	—	—	—	—	—	—	—	—	50.0	—	—	—	—
AUG	7.1	14.3	21.4	7.1	—	—	—	21.4	—	28.5	—	—	—	—	—
SEP	33.3	16.7	8.3	8.3	—	—	—	16.0	—	—	16.7	—	—	—	—
OCT	21.4	21.4	7.1	7.1	21.4	—	—	—	—	—	21.4	—	—	—	—
NOV	50.0	—	—	—	—	—	—	—	—	—	50.0	—	—	—	—
DEC	25.0	—	—	—	—	18.8	—	—	18.8	12.5	12.5	—	—	6.3	6.3

Seira lateralis

JAN	9.1	—	18.2	9.1	—	—	—	—	—	—	27.3	18.2	—	18.2	—
FEB	9.1	4.5	—	9.1	9.1	—	9.1	—	18.2	13.5	—	9.1	13.6	4.5	—
MAR	15.0	10.0	20.0	10.0	—	—	—	—	—	—	20.0	—	15.0	10.0	—
APR	—	7.1	28.6	7.1	—	28.6	—	—	—	—	14.3	—	7.1	7.1	—
MAY	20.0	—	—	—	30.0	—	—	—	—	—	50.0	—	—	—	—
JUN	—	—	—	—	—	—	—	—	—	57.1	42.9	—	—	—	—
JUL	—	—	—	—	—	—	—	—	—	—	100.0	—	—	—	—
AUG	—	—	—	10.0	—	—	—	40.0	—	50.0	—	—	—	—	—
SEP	15.4	23.1	15.4	—	—	—	3.1	—	—	7.7	—	—	—	—	—
OCT	16.7	16.7	25.0	16.7	16.7	—	—	—	—	—	8.3	—	—	—	—
NOV	28.5	28.5	28.5	—	—	—	—	—	—	—	14.3	—	—	—	—
DEC	4.5	—	4.5	—	—	18.2	9.1	—	18.2	27.2	9.1	—	4.5	4.5	—

1. *Trichoderma viridae*, 2. *Aspergillus niger*, 3. *Penicillium chrysogenum*, 4. *Penicillium nigricans*, 5. *Mycogone* sp., 6. *Absidia spinosa*, 7. *Absidia* sp., 8. *Mucor recemosus*, 9. *Mucor circinelloides*, 10. *Alternaria alternata*, 11. *Fusarium* sp., 12. *Cephalosporium* sp., 13. *Cladosporium* sp., 14. *Doratomyces* sp., 15. *Pythium sp.*

TABLE 3. Monthly percentage occurrence of fungal species in the guts of *Salina yosii* and *Entomobrya kali*.

Salina yosii

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
JAN	11.8	—	17.6	17.6	—	—	—	—	—	5.9	11.8	11.8	5.9	—	17.6
FEB	9.1	6.1	3.0	9.1	9.1	—	6.1	—	15.2	9.1	—	9.1	9.1	9.1	6.1
MAR	19.0	14.3	19.0	4.8	—	—	—	—	—	—	9.5	—	—	19.0	14.3
APR	—	15.4	7.7	17.7	—	23.1	—	—	—	—	7.7	—	—	15.4	23.1
MAY	—	—	—	—	50.0	—	—	—	—	40.0	10.0	—	—	—	—
JUN	—	—	—	—	—	—	—	—	—	84.0	16.0	—	—	—	—
JUL	—	—	—	—	—	—	—	—	—	50.0	50.0	—	—	—	—
AUG	—	—	—	16.7	—	—	—	66.7	—	16.7	—	—	—	—	—
SEP	17.6	17.6	11.8	11.8	11.8	—	—	17.6	—	5.9	5.9	—	—	—	—
OCT	26.7	20.0	20.0	6.7	—	—	—	—	—	—	6.7	—	—	20.0	—
NOV	16.7	12.5	4.2	—	—	16.7	12.5	—	14.7	—	4.2	—	4.2	8.3	4.2
DEC	4.7	2.3	2.3	2.3	9.3	11.6	7.0	—	2.3	—	4.7	11.6	18.6	16.3	7.0

Entomobrya kali

JAN	2.5	—	16.7	20.8	—	—	—	—	—	8.3	8.3	8.3	8.3	—	16.7
FEB	7.3	7.3	4.9	9.8	9.8	—	4.9	—	14.6	7.3	—	9.8	12.2	4.9	7.3
MAR	14.3	9.5	19.0	9.5	—	—	—	—	—	—	14.3	—	—	19.0	14.3
APR	—	15.0	10.0	10.0	—	20.0	—	—	—	—	10.0	—	—	15.0	20.0
MAY	—	—	—	—	54.5	—	—	—	—	—	45.5	—	—	—	—
JUN	—	—	—	—	—	—	—	—	—	71.4	28.6	—	—	—	—
JUL	—	—	—	—	—	—	—	—	—	60.0	40.0	—	—	—	—
AUG	—	—	—	27.3	—	—	—	45.5	—	27.3	—	—	—	—	—
SEP	16.7	20.8	12.5	12.5	8.3	—	—	16.7	—	4.2	8.3	—	—	—	—
OCT	18.8	12.5	12.5	18.8	—	—	—	—	—	—	12.5	—	—	25.0	—
NOV	16.1	12.9	6.5	—	—	12.9	9.7	—	16.1	—	6.5	—	6.5	6.5	6.5
DEC	6.9	10.3	3.4	3.4	13.8	13.8	0.3	—	3.4	—	6.9	10.3	10.3	3.4	3.4

1. *Trichoderma viridae*, 2. *Aspergillus niger*, 3. *Penicillium chrysogenum*, 4. *Penicillium nigricans*, 5. *Mycogone* sp., 6. *Absidia spinosa*, 7. *Absidia* sp., 8. *Mucor recemosus*, 9. *Mucor circinelloides*, 10. *Alternaria alternata*, 11. *Fusarium* sp., 12. *Cephalosporium* sp., 13. *Cladosporium* sp., 14. *Doratomyces* sp., 15. *Pythium* sp.

January for both the species. It was also seen that there were five species which recorded at least 20% or more of the total relative abundance in one or more of the months (Table 1).

As in soil so also in the gut contents of *Seira indica* the two major species were *Trichoderma viride* and *Fusarium* sp. which showed maximum peaks in July (50%) and November (45%) respectively. All others were 20% or slightly more (Table 2).

In *Seira lateralis* it was seen that *Fusarium* sp., recorded 100% in the month of July and nil in the month of February, while *Alternaria alternata* showed a maximum of 57% in the month of June and *Penicillium chrysogenum* showed a maximum of 28.5% in the months of April and November. Again all others were around 20% (Table 2).

In *Salina yosii*, the soil fungi, *Fusarium* sp. and *Alternaria alternata* occurred 50% in the month of July, while *Trichoderma viride* recorded a maximum of nearly 27% in the month of October (Table 3).

In *Entomobrya kali*, the fungus *Alternaria alternata* recorded a peak of nearly 70% in the month of June with a slight drop to 60% in the month of July which reduced to less than half (28%) in the month of August. *Fusarium* sp., was maximum in the month of May (45%) while it dropped to nearly 30% (29.5%) in the month of June and again increased to 40% in July while *Penicillium nigricans* showed two peaks of abundance, one in August (21%) and the other in January (21%) (Table 3).

DISCUSSION

While analysing the gut contents of the four species of Collembola and correlating it with those in the soil from where these species were extracted, it seemed, that, seasonally there was no regularity between the soil fungal flora and the fungal flora in the gut of collembola. Among the dominant species of fungi from the youngest abandoned fallow and the oldest abandoned fallow there were however, significant differences in the seasonal abundance of the various fungal species.

When the gut contents of the collembola species *Seira indica* and *Seira lateralis* from the same site, was compared with the soil, it was seen that among the dominant fungal species, like *Trichoderma viride*, *Penicillium chrysogenum*, *Aspergillus niger* and *Fusarium* sp. which recorded peaks of abundance in the soil, they were also abundant in the guts of *Seira indica* and *Seira lateralis* around the same months except for the last which in *Seira lateralis* gut showed a contrasting increase when actually in the soil this was declining. One dominant species of fungus in the soil was *Penicillium nigricans*, which was not recorded in the guts of either of these two collembola species. However, fungal species like *Alternaria alternata*, *Absidia spinosa* and *Mucor recemosus* which were least recorded in the soil was found to be at least 23% or more in the guts of

both species. Moreover *Mucor circinelloides* recorded in *Seira indica* was replaced by *Mycogone* sp. in *Seira lateralis*.

A similar analysis of the soil fungi from the oldest abandoned fallow and the guts of the collembola species, revealed that only *Alternaria alternata* and *Fusarium* sp. when forming a peak in the soil was also maximum in the guts of both the species, while *Penicillium nigricans* and *Absidia* sp. had similar speaks both in soil and in the gut of *E. kali* only. They showed a different pattern in *S. yossi* and in fact the former fungal sp. always recorded below 20%, though revealed a peak similar to soil recording only 16%. *Doratomyces* sp. showed similar peaks of abundance between soil and *Salina yosii* gut contents but totally different for *Entomobrya kali* gut contents. *Aspergillus niger* recorded maximum in mid-monsoon, and had peaks of abundance in the guts of *Salina yosii* and *Entomobrya kali*, only in the autumn months. *Acremonium* sp. which did show more than 10% in the soil was totally absent in the guts of both the species. In addition to these, fungal species like *Trichoderma viride*, *Penicillium chrysogenum*, *Mucor recemosus* and *Pythium* sp., which occurred well below 10% in the soil, were present as peaks of 20% or more in the gut of *S. yosii*. Of these, the last two species were also present in the gut of *Entomobrya kali* while the former two were absent. *Mycogone* sp. similarly occurred in the gut of *E. kali* and not in the gut of *S. yosii*.

As a general occurrence of the various fungal species in the gut of the collembola irrespective of the area from where they were collected, it was seen that *Aspergillus niger*, *Fusarium* sp. *Absidia spinosa*, *Alternaria alternata* and *Mucor recemosus* occurred in the guts of all the four species of Collembola irrespective of whether they formed 10% or more in the soil from the two different sites. *Trichoderma viride* and *Penicillium chrysogenum* were seen to occur only in *S. indica*, *S. lateralis* and *Salina yosii* guts, while *Penicillium nigricans* in the gut of *Entomobrya kali* only. Species like *Doratomyces* sp. and *Pythium* sp. seemed to show a relation to the collembola from different sites in that they failed to occur in the guts of *S. indica* and *S. lateralis*, while present in *Salina yosii* and *E. kali*. Interestingly, enough, *Mycogone* sp. was found only in *S. lateralis* and *E. kali*, the former from the youngest abandoned fallow and the latter from the oldest abandoned fallow. *Mucor circinelloides* was a species which occurred only in the gut of *S. indica* and in no other collembola species.

It is seen that the four species of collembola were more or less non-specialised feeders (Petersen, 1971 ; Mcmillan, 1975). This low degree of specialization is probably attributed to the excess food available to these decomposers (Healey, 1972). In the present study, when particular fungal species becomes rare, there did not seem to be a distinct selective advantage in contrast to Emlen (1973). In all the four species of collembola undertaken there was no incidence at all of empty guts. This was probably because the region under consideration always had high humidity and rainfall above average in comparison to the rest of India. However, it has been seen that there was a high feeding activity immediately after the onset of monsoon (Joosse, 1976). It is

seen that there is a great synchronisation of total collembola population to the feeding behaviour, where the amplitude of population fluctuations increase in autumn (Smith, 1972 ; Joosse and Testerink, 1977). This, therefore primarily attributed to soil moisture condition more than anything else (Verhoef, 1977). Of the 10 or 11 species of fungi it was seen that more than 50% are common in the soil as also in the gut contents of two species from the same habitat. This is in concordance with several studies, that the gut contents of collembolan species living under similar conditions, show similarity (Poole, 1959 ; Gilmore and Raffensperger, 1970 ; Bodvarsson, 1970 ; McMillan and Healey, 1971). But this ability of such extensive numbers of detritus species not only co-existing but also utilising identical food resources, conflicts the general theory of ecological concepts, that related species sharing same habitats evolve food differentiation and hence the concept of ecological niche (De-Bach 1966 ; Slobodkin *et al.* 1967 ; Reynoldson and Davies, 1970).

Further, species of collembola are known to vary in their ability to digest particular components and also vary in the activity range of their own enzyme component (Von Torne, 1967a ; 1967b). In the present study, the micro habitat differences between species have been left undetected because of the complexity of the work. It seems that the low degree of food specificity in these species was due to an interaction, reducing competition pressure between the species which superficially utilise the rather uniform resources under moist soil conditions (Anderson and Healey, 1972 and Dowding, 1976).

Despite this fact, fungi among microflora are the most efficient penetrators of plant remains and within a limited period, nutrients get incorporated in microbial tissues, which represents not only production of equal or similar food resources but also a high quality of nutrition.

SUMMARY

Very little is known in India, regarding the structural and functional aspects of the trophic relationships of soil arthropods. The present study was undertaken in four dominant a species of collembola occurring in the soil of abandoned jhum fallows of N. E. India. Their feeding habits in relation to soil fungi was carried out for a period of one year. It was observed that all the collembola species undertaken for the study were not only non-selective feeders, but also did not restrict their feeding to only the dominant fungal species occurring in the soil that they inhabited.

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FIVE NEW SPECIES OF *COLAULUS* TOWNES FROM INDIAN SUBREGION
(Hymenoptera : Ichneumonidae)

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The genus *Colaulus* Townes is recorded from the first time from India and Nepal from material collected from the states of Assam, Himachal Pradesh, Karnataka, Maharastra, Tamil Nadu, Kerala, Uttar Pradesh and Nepal. This genus belongs to subtribe Goryphina, tribe Mesostenini of the subfamily Mesosteninae.

The genus is chiefly recognized by having evenly convex clypeus, its apical margin without median tooth ; mandibular teeth subequal ; occipital carina joining hypostonal carina before the base of mandible ; propodeal spiracles round to elliptic, first tergite about 3x as long as wide at apex, with a week lateral angulation at base, nervellus intercepted below the middle, brachiella present or absent, axillus vein parallel to anal margin of the hind wing.

Colaulus Townes can be recognized from its allied genera, viz., *Tricapus* Townes and *Pseudotricapus* Jonathan by the following key :

1. Genal carina weakly sinuate, joining hypostomal carina above base of mandible ; clypeus weakly convex, without apical median tooth ; mandible with its lower tooth shorter than upper tooth ... ... **Colaulus** Townes

— Genal carina strongly sinuate or curved, joining hypostomal carina at the base of mandible ; clypeus with a median apical tooth ; lower tooth of mandible more or less equal to or half as long as upper tooth 2

2. Mandible with its lower tooth half as long as upper tooth ; epomia absent ; sternaulus short, reaching about 0.4 the distance to middle coxa ; nervellus intercepted a little above its center ; brachiella reaching 0.7 the distance to wing margin ... ... **Tricapus** Townes

— Mandible with almost equal teeth ; epomia present ; sternaulus reaching 0.6 the distance to middle coxa ; nervellus intercepred at its lower 0.4 ; brachiella faintly present. ... ... **Pseudotricapus** Jonathan

Genus **Colaulus** Townes

1970. *Colaulus* Townes, *Mem. Amer. Ent. Inst.*, **12** ; 269.

Type species : *Colaulus carinatus* Townes, Original desingnation.

Body moderately slender. Head wider than long. Clypeus evenly convex, its apical margin arched or sometimes straight and impressed, without a median tooth

or irregularity. Mandibles stout, lower tooth slightly shorter than the upper tooth. Frons evenly arched, with a short to long median vertical carina. Occipital carina complete, joining hypostomal carina above the base of mandible. Epomia short to moderately long. Mesoscutum weakly to moderately convex, notauli short to long and deep reaching far beyond the middle. Mesopleurum with prepectal carina extending 0.5 or upto the base of subtegular ridge. Sternaulus short (0.4) to long. Juxtacoxal carina present. Both the transverse carinae of propodeum complete, spiracle round to short elliptic. First tergite slender, about 3.5x as long as wide at apex, tergite at base without a distinct lateral tooth, except for a weak angulation, petiolar area narrow and tubular. Postpetiole rectangular ; dorso-median carinae almost absent, dorso-lateral carinae extending from base to apex, ventro-lateral carinae absent except near the apex, tergite roundish in cross-section. Postpetiole 2.0x as long as wide, spiracles close to each other than to apex. Areolet of moderate size, higher than wide, pentagonal, 0.8x as high as the portion of second recurrent vein above bulla, intercubiti convergent, second recurrent curved. Nervulus interstitial or little based. Nervellus intercepted at its lower 0.4, mediella strongly arched, brachiella present or absent, axillus parallel to wing margin, Ovipositor long, about 0.9 to 1.3x as long as hind tibia, its tip long and pointed, lower valve with weak teeth.

Length : Female, 4.75-7 mm ; fore wing 3-6 mm ; ovipositor sheath 1.5-2.5 mm. Male, 4.5-5.0 mm ; fore wing 4.0-55 mm.

Type-species : *Colaulus carinatus* Townes.

This genus is confined to Oriental Region and widely distributed in India. The specimens have been collected from various localities of Southern and North-Eastern regions of India and Nepal. Townes (1970) described this genus based on a species from Philippines and Burma. Five new species viz., *C. lucidus*, *C. erugus*, *C. pnnctatus*, *C. septentrionalis* and *C. flavofaciatus* are described from India and Nepal. The species under this genus from Oriental Region can be distinguished by the following key :

Key to the Oriental species of COLAULUS

1. First, second and third abdominal tergites almost entirely, black. Species from Philippines and Burma. ... ... **carinatus** Townes

— First abdominal tergite almost entirely, second tergite broadly at apex and third tergite narrowly to broadly at apex yellowish-brown to reddish (not black). Species from India and Nepal 2

2. Thorax entirely yellowish-brown. Pronotal collar narrowly yellow. (Mesoscutum and scutellum smooth and shiny. Mesopleurum, metapleurum and propodeum largely smooth and shiny with minute scattered punctures)... 1. **lucidus**, sp. nov.

— Thorax not entirely yellow (yellowish-brown), atleast its mesoscutum and/or pronotum black ; pronotal collar with or without a yellow band 3

3. Face entirely black. Clypeus black or yellow. Hind tarsus entirely dark brown. 4

— Face and clypeus, yellow. Hind tarsus from apical 0.25 of 1st segment to 4th segment whitish. 5

4. Clypeus yellow. Frons with broad yellow orbital marks. Body largely with weak punctures and regosities. Lateral carina more or less confined to its base. Antennal segments 6th to 12th, whitish ... ... 2. **erugus** sp. nov.

— Clypeus and frons entirely black. Body largely densely punctate. Lateral carina of scutellum extending at its basal 0.25. Antannal segments 6th to 10th, whitish. ... ... 3. **punctatus**, sp. nov.

5. Face laterally black, in the middle yellow. Pronotum (except the collar) and mesopleurum, black. Face densely punctate. Pronotal collar above the base of fore coxa shallowly punctate. Brachiella in hind wing represented by a short stump ... ... 4. **septentrionalis**, sp. nov.

— Face laterally and in the middle yellow. Pronotum (except collar) and mesoplurum, deep yellow. Face rugoso-punctate. Pronotal collar above the base of fore coxa smooth and shiny. Brachiella in hind wing present. ... ... 5. **flavofaciatus**, sp. nov.

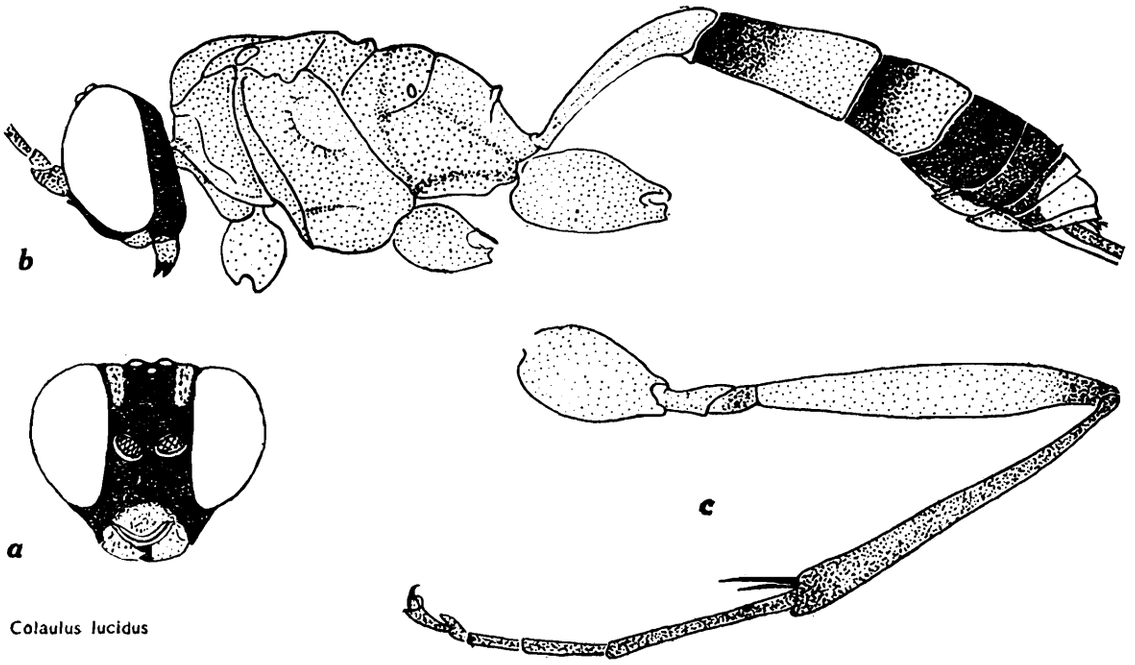
1. **Colaulus lucidus**, sp. nov.

(Fig. 1 : a, b, c)

This species is distinguished by having thorax entirely yellowish-brown ; pronotal collar yellow and body largely smooth and shiny.

Female : Body in general subpolished. Face finely and shallowly punctate all over. Clypeus sparsely and shallowly punctate. Malar space granulose, 0.7x the basal width of mandible. Frons largely smooth and shiny, with a few scattered punctures in the middle. Vertex and temple shiny, with minute sparse punctures, punctures on vertex not well defined. Pronotum with pronotal collar and upper margin broadly smooth and shiny, its posterior margin weakly rugose, epomia long extending up to upper margin. Mesoscutum, scutellum and metascutellum smooth and shiny. Lateral carina of scutellum more or less confined to its base. Mesopleurum, metaplurum and propodeum largely smooth and shiny, except for a few scattered shallow punctures on meso-and metapleurm and a few striation along the anterior margin of speculum. Propodeum apicad of apical carina rugose, apical carina of propodeum in the middle in broken line,

apophysis crest-like. First tergite smooth, second and third tergites strongly granulose, fourth and following tergites mat and subpolished. Brachiella vein present as a small stump. Other structures and wings as under generic description.



Figs 1. *Colaulus lucidus*, sp. nov. : a. head front view ; b. body side view ; c. hind leg.

Yellowish-brown. Antenna black with scape brown, 6th-12th flagellar segments white above. Head black except clypeus and mandible, brown ; mandibular teeth dark brown. Frons along the eye margin with two moderately wide and elongated orbital stripes, pronotal collar, subtegular ridge (faintly) and tegula, yellow (Fig. 1, a, b). Legs in general yellowish-brown, except middle and hind tarsus, hind tibia almost wholly and extreme apex of hind femur, dark brown (Fig. 1, c). Abdomen blackish-brown to black, except its first tergite wholly, second and third tergites broadly at apex (sometimes second and third tergites wholly) yellowish-brown. Fourth to sixth tergites black, except sixth tergite apico-medially, and seventh and eighth tergites almost wholly, white. Wings clear hyaline.

Male : Essentially similar to female in sculpture and colour, except as follows : Body largely smooth and shiny ; face with distinct punctures. Epomia short. Apical carina of propodeum indistinct. Second to seventh tergites mat and closely punctate.

10th-15th flagellar segments white above. Scape and clypeus, reddish-brown. All the tergites with broad apical yellowish-brown bands, the bands on apical tergites faint. Hind leg with trochanter largely, femur at apex, wholly of tibia, first and fifth tarsal segments, dark brown to blackish. Second to fourth hind tarsal segments white ; rest of colour similar to female.

Length : Female, 6.0 mm ; fore wing 4.5 mm ; ovipositor sheath 2.5 mm. Male, 5.0 mm ; fore wing 4.0 mm.

Holotype Female and *Allotype* Male, India : Tamil Nadu ; Oothu in Kodai Hills, 1200 m, 3.xii.1966, M. K. Kamath, Coll. No. K 146. *Paratypes* 5 Females. India : Tamil Nadu : Oothu in Kodai Hills, 1200 m, 4 F, 3-4.xii.1966, Colls J. K. Jonathan and M. K. Kamath, Coll. Nos. J 195,K 146 & 147. Kerala : Walayar Forest, 1 F, 8.xii.1966, J. K. Jonathan, Coll. No. 197 (Z. S. I. Calcutta and two paratypes in Gupta Collection, Florida).

Distribution : South India : Tamil Nadu and Kerala States.

2. **Colaulus erugus**, sp. nov.

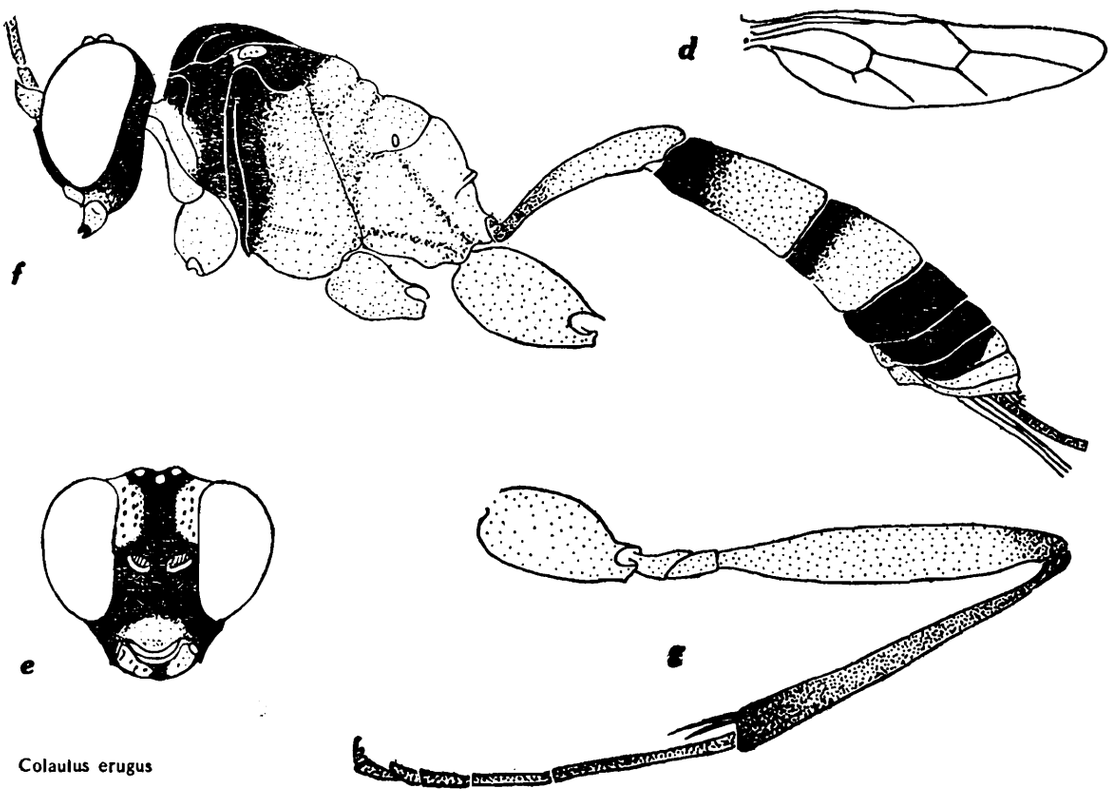
(Fig. 1 : d, e, f, g)

This species is characterized by having face entirely black ; clypeus yellowish or reddish-brown. Frons with yellow orbital marks. Antennal segments 6th to 12th whitish. Pronotum largely rugose in its lower 0·5 and lateral carina of scutellum confined to its base.

Female : Face subpolished, finely rugoso-punctate. Clypeus subpolished, sparsely and minutely punctate. Malar space granulose, 0.75x the basal width of mandible. Frons and Vertex smooth and shiny. Temple with minute scattered punctures. Pronotum coarsely striate in the lower half, upper half with fine oblique striations, extreme upper margin with indistinct punctures. Mesoscutum shiny, minutely and sparsely punctate. Scutellum and metascutellum largely smooth and shiny, except scutellum with sparse and minute punctures at base, lateral carina of scutellum more or less confined to its base. Mesopleurum shiny with fine and sparse punctures, coarsely striate above near subtegular ridge and speculum, prepectral carina extending up to the base of subtegular ridge. Metapleurum shiny, sparsely and shallowly punctate, juxtacoxal carina present. Propodeum subpolished, based of basal carina smooth, apicad of apical carina rugose, area between apical and basal carinae sparsely and shallowly punctate ; apical carina absent in the middle. First tergite smooth and shiny, second and third tergites densely and finely punctate at base, granulose towards the apex, following tergites mat and subpolished. Nervulus basad of basal vein by a distance greater than the width of the vein ; brachiella present as a short stump (Fig. 1d). Ovipositor long and its tip pointed.

Colour similar to *Colaulus lucidus*, sp. nov. except as follows : clypeus entirely yellow. Mesoscutum, pronotum (except the collar, yellow) and anterior half of

mesopleurum, black. First tergite at its basal 0.3 with brownish hue. Second and third tergites at their basal 0.33 blackish, apical 0.6 yellowish-brown (Fig. 1, e. f. g).



Figs 1. *Colaulus erugus*, sp. nov. : d. hind wing, ; e. head front view ; f. body side view ; g. hind leg.

Male : Essentially similar to female in sculpture and colour except as follows : Body more slender and polished, sculpture weak. Pronotal collar broadly yellow. First tergite wholly, second and third broadly, fourth and fifth narrowly at apex, yellowish-brown. Sixth tergite wholly blackish-brown. Seventh tergite yellow, except its extreme base blackish. Third and fourth segments of hind tarsus whitish-yellow.

Length : Female, 6.0 mm ; fore wing 4.5 mm ; ovipositor sheath 2.0 mm. Male, 5.0 mm ; fore wing 4.0 mm.

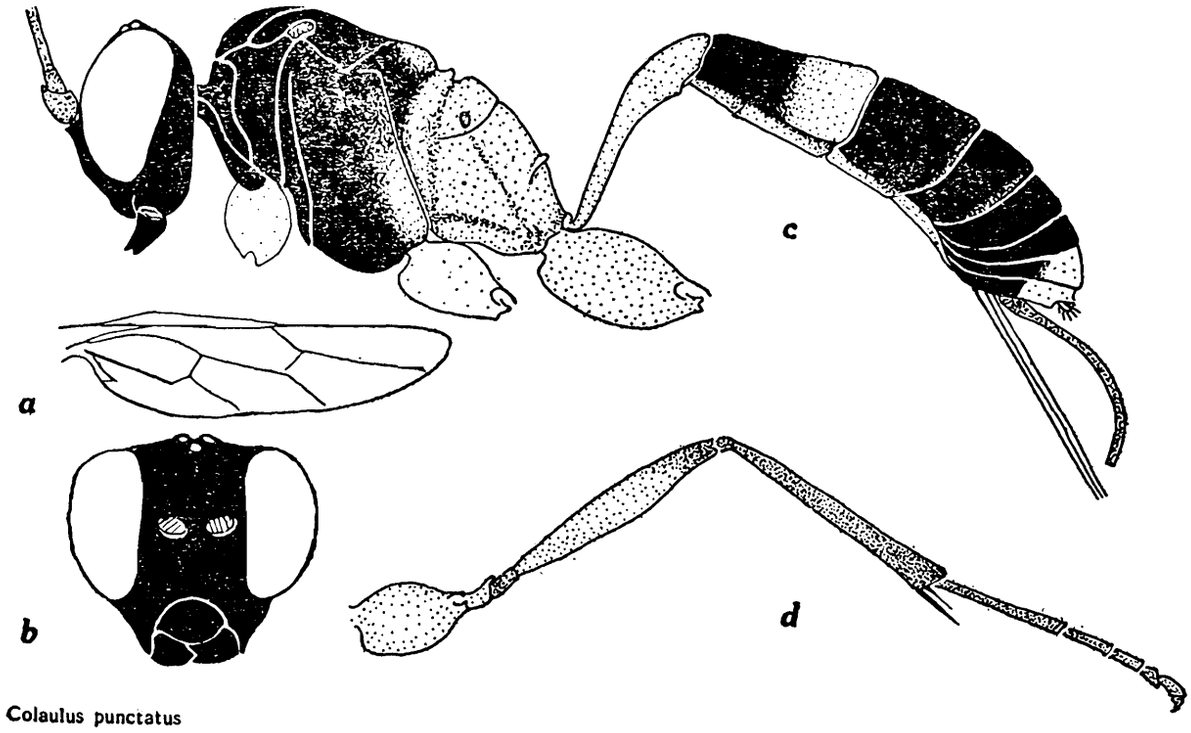
Holotype Female, India : Karnataka : Kottegehar, 665 m, 29.xi.1965, J. K. Jonathan, Coll. No. J 104. *Allotype* Male, India : Tamil Nadu : Yercaud, 1364 m. in Shevarey Hills, 22.xi.1966, M.K. Kamath, Coll. No. K. 138. *Paratypes* 1 Female, 1 Male. India : Karnataka : Marcara, 1 F, 1150 m, 19.xii.1965, M. K. Kamath, Coll. No. K 64 ; 1 M, same data as allotype (Z.S.I., Calcutta and one female paratype in Gupta Collection, Florida).

Distribution : India : Karnataka and Tamil Nadu States.

3. **Colaulus punctatus**, sp. nov.

(Fig. 2 : a, b, c, d)

This species is close to *Colaulus erugus*, sp. nov. by having face yellow and hind tarsus dark brown. It can be easily distinguished by having body densely punctate ; frons without orbital marks and antennal segments 6th to 10th whitish.



Figs 2. *Calauls* punctatus, sp. nov. : **a.** hind wing ; **b.** head front view ; **c.** body side view ; **d.** hind leg.

Female : Body subpolished. Face with moderately dense punctures, surface appears to be reticulo-punctate. Clypeus closely punctate at basal half, tending to be smooth and shiny towards the apex. Malar space strongly granulose, 0.83x the basal width of mandible. Frons and vertex with moderate size punctures. Pronotum moderately strongly punctate, punctures in the groove dense and with running striations. Mesoscutum closely punctate. Scutellum shiny with sparse small punctures, lateral carina of scutellum confined to its basal 0.25. Mesopleurum wholly with dense, moderately strong punctures, prepectal carina extending up to the base of subtegular ridge. Metapleurum densely punctate, surface appears to be reticulo-punctate, juxta-coxal carina present. Propodeum between basal carina and apex reticulo-punctate, basad of basal carina smooth and shiny, apical carina weak in the middle, lateral apophysis crest-like. First tergite smooth and shiny, with a few indistinct punctures. Second and third tergites strongly granulose, following tergites mat and subplished. Brachiella in hind wing absent (Fig. 2a).

Black. Antennal flagellum from extreme apex of 6th to 10th segment above white. Scape in front yellowish-brown. The following are reddish : mesopleurum along the

posterior margin, scutellum at apex, tegula, metascutellum, metapleurum, propodeum, first tergite, apical 0.4 of second tergite, extreme apical margins of third and fourth tergites. Seventh and eighth tergites dorsally white, abdomen ventrally reddish-brown (Fig. 2 : b, c). Fore leg with coxa and trochanter yellowish, rest deep yellow. Middle leg with coxa and trochanter, yellowish, femur deep yellow, tibia and tarsus brownish. Hind coxa, trochanter and femur reddish-brown, extreme apex of femur, tibia and tarsus wholly, dark brown (Fig. 2d). Wings clear hyaline.

Male : Unknown.

Length : Female, 4.75-6 5 mm ; fore wing 3-4.5 mm ; ovipositor sheath 1.5-2.2 mm.

Holotype : Female, India : Assam : Rangapara, Sonajuli Tea Estate, 25.iv.1966, J. K. Jonathan, Coll. No. J 137. *Paratypes* 5 Females. India : Assam : Rangapara, Sonajuli Tea Estate, 1F, 26.iv.1966, T. Chand, Coll. No. T207 ; 1F (abdomen damaged), 29.iv.1966, D. T. Tikar, Coll. No. T219 ; Tarajuli Tea Estate, 1F, 26.iv.1966, D. T. Tikar, Coll. No. T204. Kerala : Walayar Forest, 1F (damaged specimen), 14.xii.1966, J. K. Jonathan, Coll. No. J200. Nepal : Gorakna, 1F, 30.ix.1970, V. K. Gupta, Coll. No. 349 (Z.S.I., Calcutta and two paratypes in Gupta Collection, Florida)

Distribution : India ; Assam, Kerala, Nepal.

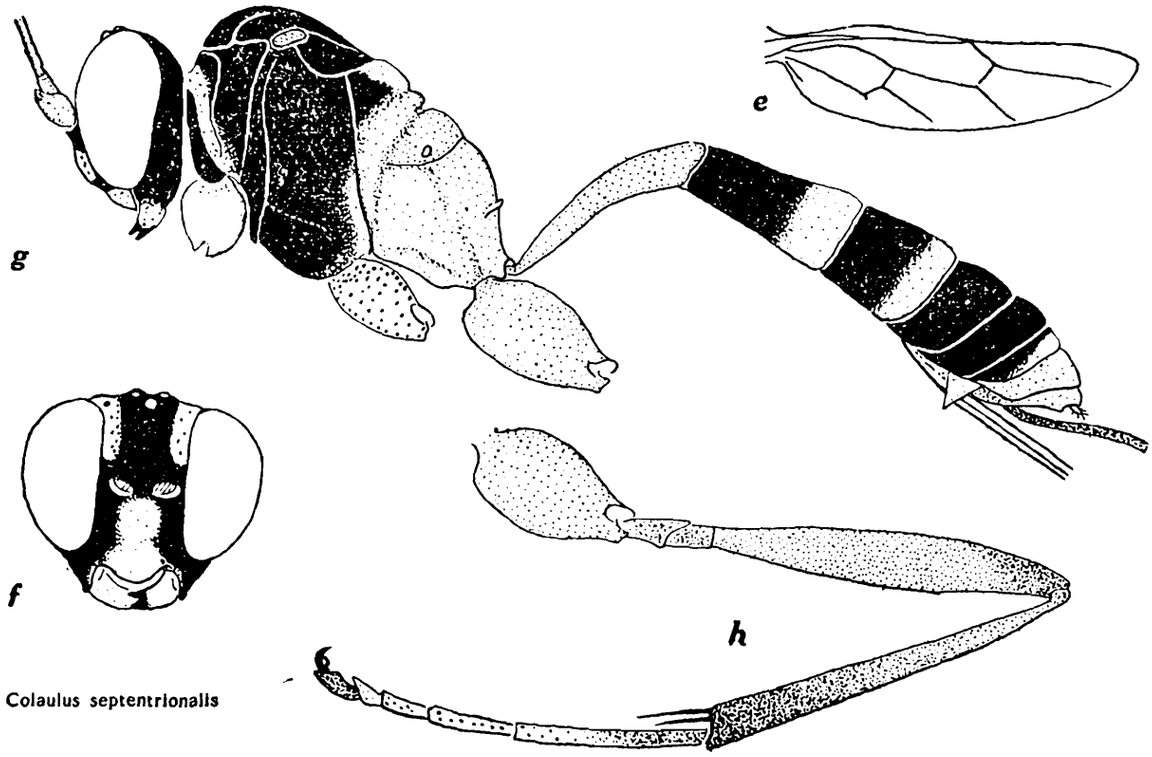
4. **Colaulus septentrionalis**, sp. nov.

(Fig. 2 : e, f, g, h)

This species is close to *Colaulus flavofaciatus*, sp. nov. in having face and clypeus yellow and hind tarsus largely whitish. It is distinguished by having face in the middle and clypeus wholly yellow. Pronotum and mesopleurum largely black. Face densely punctate. Pronotal collar above the base of fore coxa shallowly punctate.

Female : Face subpolished, densely granuloso-punctate. Clypeus subpolished sparsely and shallowly punctate. Malar space granulose, 0.7x the basal width of mandible. Frons sparsely and finely punctate, punctures weak along the eye margin. Vertex and temple subpolished, sparsely and finely punctate, punctures on vertex weak. Mandible punctate. Pronotum at its lower 0.5 coarsely trans-striate, upper 0.5 shiny with sparse fine punctures ; pronotal collar just above the base of fore caxa shallowly punctate. Epomia moderately long and strong. Mesoscutum and metascutellum shiny with sparse and indistinct punctures. Lateral carina of scutellum confined to its basal 0.2. Mesopleurum shiny with fine and sparse punctures, short but strong striae present at the anterior margin of speculum, prepectal carina extending up to the base of subtegular ridge. Metapleurum shiny, sparsely punctate above, closely punctate below, juxtacoxal carina present. Propodeum shiny, basad of basal carina with a few scattered shallow punctures, between basal and apical carinae sparsely punctate, apicad of apical

carina rugose ; apical carina complete, apophysis weak, low crest-like. First tergite shiny, its petiolar area smooth, postpetiole sparsely punctate. Second to fourth tergites with dense fine punctures, tergites apically appears to be granulose, following tergites mat and subpolished. Ovipositor and wings similar to *Colaulus erugus* (Fig. 2c).



Figs 2. *Calaulus septentrionalis*, sp. nov. : e. hind wing ; f. head front view ; g. body side view ; h. hind leg.

Black, Antennal flagellum from 6th-12th segments white ; scape and pedicle brown in front. Face in the middle, clypeus (mark on these two fused), mandible (except the teeth), orbital stripes on frons, pronotal collar, tegula, subtegular ridge faintly, scutellum (except at base, brownish), fore and middle coxae and their first trochanteral segments, apices of sixth to eight tergites, yellowish-white. Metapleurum, base of hind wing, metascutellum, mesopleurum along the pleural suture, propodeum, first tergite (except at base brownish) and hind coxae, red. Second and third tergites broadly at apex and legs in general, yellowish-brown. Apex of fore tarsus, middle tarsus almost wholly, hind tarsus with the basal 0.75 of first segment and fifth segment wholly, dark brown ; rest of hind tarsus whitish. Wings clear hyaline.

Male : Similar to female, except more polished, slender and weakly sculptured. Colour also similar to female except flagellum with 9th-16th segments white ; face and clypeus wholly and temple near the base of mandible, yellowish. Second tergite broadly at apex brown, following tergities blackish-brown. Seventh tergite except at base, broadly whitish.

Length : Female, 7-8 mm ; fore wing 5-5.5 mm ; ovipositor sheath 1.75 mm. Male, 7-7.5 mm ; fore wing 4.5-5.5 mm.

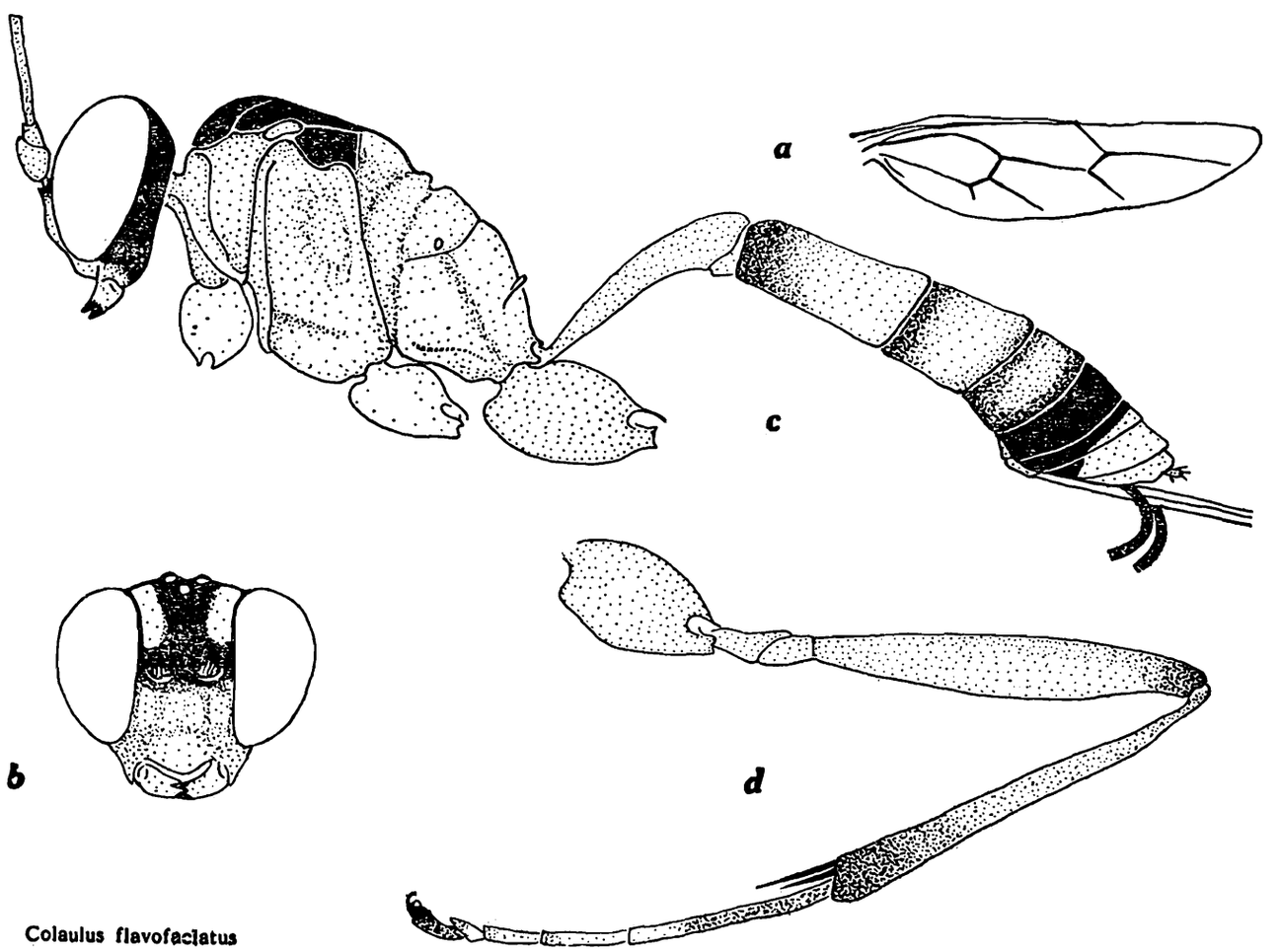
Holotype : Female and *Allotype* Male, India : Himachal Pradesh : Banikhet, 1524 m, 7.v.1971, D. Ram, Coll. No. DH 35. *Paratypes* 3 Females, 30 Males. 2 M, same, data as above. Manali, 1828 m, 12 M, 1F, 13.v.-2.vi. 1970, Colls. A. K. Gulati, D. Ram, M. K. Kamath, M. Gupta, V. K. Gupta, Colln. Nos. K 195, 200, 234, 235, 237, 252, 257, 260, 261 ; M 4, 19 ; 336. Nichar, 2400 m, 1 M, 8.vi.1972, Girish Chandra, Coll. No. G 8. Uttar Pradesh : Barkot, 1212m, 2 M, 16.v.1967, Colls. J. K. Jonathan & M. K. Kamath, Colln. Nos. J 223 & K 181 ; Chaubattia 200 m, in Kumaon Hills, 2 F, 9 M, 16.vi.1968, V. K. Gupta Coll. No. 321 (Gupta and Z.S.I., Calcutta.)

Distribution : India : Himachal Pradesh and Uttar Pradesh.

5. **Colaulus flavofaciatus**, sp. nov.

(Fig. 3 a, b, c, d)

This species is distinguished by having face in the middle and at sides, yellow. Face rugoso-punctate. Pronotal collar above the base of fore coxa smooth and shiny and brachiella present in hind wing.



Figs 3. *Calaulus flavofaciatus*, sp. nov. : a. hind wing ; b. head front view ; c. body side view ; d. hind leg.

Female : Body subpolished. Face largely weakly rugoso-punctate. Clypeus largely smooth and shiny, except minutely punctate along the clypeal groove. Malar space

granulose, 0.75x the basal width of mandible. Frons largely smooth and shiny. Vertex and temple shiny with sparse minute punctures. Pronotum above the base of fore coxa smooth and shiny, rest somewhat trans-rugoso-punctate. Mesoscutum sparsely and minutely punctate. Scutellum with indistinct punctures at base, lateral carina extending at it basal 0.4. Metascutellum smooth and shiny. Mesopleurum smooth and shiny except above minutely punctate. Prepectal carina extending up to the base of subtegular ridge. Metapleurum with sparse minute weak punctures ; juxtacoxal carina present. Propodeum with both the transverse carinae complete, smooth and shiny between apical carina and base ; apicad of apical carina rugose ; apophysis crest-like. First tergite smooth, second and third strongly granulose, fourth and following tergites mat and subpolished. Brachiella in hind wing present (Fig. 3a).

Body largely yellowish-brown. Antennae dark brown, with scape yellowish-brown. 6th to 12th flagellar segments white above. Face brownish. The following are yellow : the face with two elongate mark along the eye margin and a bilobed mark in the middle, clypeus wholly, mandibles (except the teeth), frons along the eye margin, pronotal collar below, tegula, fore and middle coxae, scutellum and metascutellum, mesoscutum black (Fig. 3b). Abdomen yellowish-brown, except its second and third tergites at base and fourth to sixth tergites wholly, dark brown. Extreme apex of sixth tergite and seventh and eighth tergites almost wholly, white (Fig. 3c). Legs yellowish-brown, except extreme apex of hind femur, tibia wholly, basal 0.8 of first segment and whole of 5th segment of hind tarsus, dark brown, rest of hind tarsus whitish (Fig. 3d). Wing clear hyaline.

Male : Unknown.

Length : Female 7 mm ; fore wing 4.5 mm ; ovipositor sheath 2.5 mm.

Holotype : Female, India : Kerala : Connanore, 8.xi.1970, M. K. Kamath, Coll. No. 296. (Z. S. I., Calcutta).

Distribution : India : Kerala.

SUMMARY

Five new species of *Colaulus* viz., *C. lucidus*, *C. erugus*, *C. punctatus*, *C. septentrianalis* and *C. flavofaciatus* are described from India. The genus *Colaulus* is new to India.

ACKNOWLEDGEMENTS

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Rec. zool. Surv. India, **92** (1-4) : 89-97, 1992

SOIL ACARINA AND COLLEMBOLA IN FOREST AND CULTIVATED LAND OF KHASI HILLS, MEGHALAYA.

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INTRODUCTION

During the last decade considerable work has been done on the Indian soil fauna, and quite a number of reports exist on the soil fauna of North-East India with particular reference to Meghalaya (Reddy & Alfred 1977, 1978a, 1978b ; Vatsauliya and Alfred 1980 ; Darlong & Alfred, 1982 ; Hattar & Alfred 1986 ; Paul & Alfred 1986). Most of these studies are confined to jhum cultivation and pine forest soils of Khasi Hills, Meghalaya, and as such there is hardly any work done on cultivated system from this region. The study was undertaken to compare the distribution and diversity of mesofauna with particular reference to Collembola and Acarina of pine forest soil and an adjacent cultivated land, for one annual cycle at four different soil depths.

MATERIALS AND METHODS

The study sites were located in Shillong at an altitude of 1500 m. The sites studied comprised of a pine forest (*Pinus kesiya* Royle) and an adjacent plot of cultivated land belonging to vegetable research station, Government of Meghalaya, Shillong. Seasonal vegetables were grown in the vegetable land. The usual type of tillage followed in the hills of North-East India was carried out and a rotational method of agronomic practices were followed. Both the sites have an area of 2.5 ha. of flat and undulating slopes. Although soil samples were taken out fortnightly intervals from September, 1981 to August, 1982, the results are presented as monthly averages. In both the systems soil samples consisted of 5 cm. sq. in surface area to a depth of 40 cms. divided into four depths of 10 cm. each. Five random cores of each soil layer from each system were collected by a rectangular iron cover (5×5×10 cm.) and extraction of soil fauna was done using modified Tullgren funnels (Macfadyen, 1953 ; Southwood, 1966). The period of extraction was 7-10 days at constant 40°C depending on the moisture content of soil samples. Similarly soil samples were also collected for analysing the physico-chemical parameters. The method of Walkey and and Black (1934) was followed for the analysis of the chemical factors of soil. The fauna were statistically analysed for their C. V., species diversity (Shannon Weiner) and species similarity (QS).

Results and Discussion

Analysis of Edaphic factors :

The soils of the Ecosystems studied were (a) pine forest—sandy loam in texture and brown in colour (b) cultivated land—sandy loam in texture and light brown in colour. Different factors were analysed by taking samples from four soil depths. The minimum and maximum values of soil factors analysed are given in Table 1. The contents of organic carbon, soil conductivity, phosphate and potassium were found to vary seasonally in both systems. The temperature, pH and moisture content was found to vary significantly. The humidity recorded was quite high.

Vertical Distribution pattern of Collembola :

The mean seasonal density of Collembola in pine forest and cultivated land as given in Fig. I for one annual cycle from September 1981 to August, 1982 reveals that in the upper 0-10 cm. soil depth in pine forest (Fig. IA) the Collembola were recorded maximum in November and minimum in December, and in the cultivated land maximum in February and minimum in October.

In the 10-20 cm. soil depth in pine forest (Fig. IB) they were maximum in January and minimum in August, and in cultivated land maximum in April and minimum in December.

In the 20-30 cm. and 30-40 cm. (Figs. IC & ID) soil depths their numbers were significantly low in both the systems but their numbers fluctuated in different months.

Altogether 11 species of Collembola viz. *Cryptopygus thermophelus, Isotoma (Desoria) trispinata, Dicranocentrus singularis, D. fraternus, Megalothorax minimus, Sphaeridea cf. cornuta, Entomobrya* spp. *Metaicoelura* spp. *Siera* spp. *Sminthurinus bimaculatus* and *Onychiurus* spp. were recorded in pine forest. In the cultivated land 6 species of Collembola viz. *Isotoma (Desoria) trispinata, Megalothorax minimus, Xenylla* spp. *Folsomides* spp., *Onychiurus* spp. and *Sphaeridae cf. cornuta* were recorded.

In the upper 0-10 cm. and 10-20 cm. soil depths, 4 species of Collembola viz. *Isotoma (Desoria) trispinata, Megalothorax minimus, Sphaerdea cf. cornuta* and *Onychiurus* spp. were common to both the systems as against 11 and 6 species in pine forest and cultivated land respectively. The species *Isotoma (Desoria) tripinata* was dominant in both the systems and its density being two times higher in the cultivated land in the 0-10 cm soil depth and reverse in the case of 10-20 cm soil layer.

In the 20-30 cm soil layer the no. of species sharply reduced to six in pine forest with marked reduction in their density and was found to be constant at six species in cultivated land. Out of the two species viz. *Megalothorax minimus* and *Sphaeridea of cornuta* being common to both the systems the latter species was dominant in both the systems.

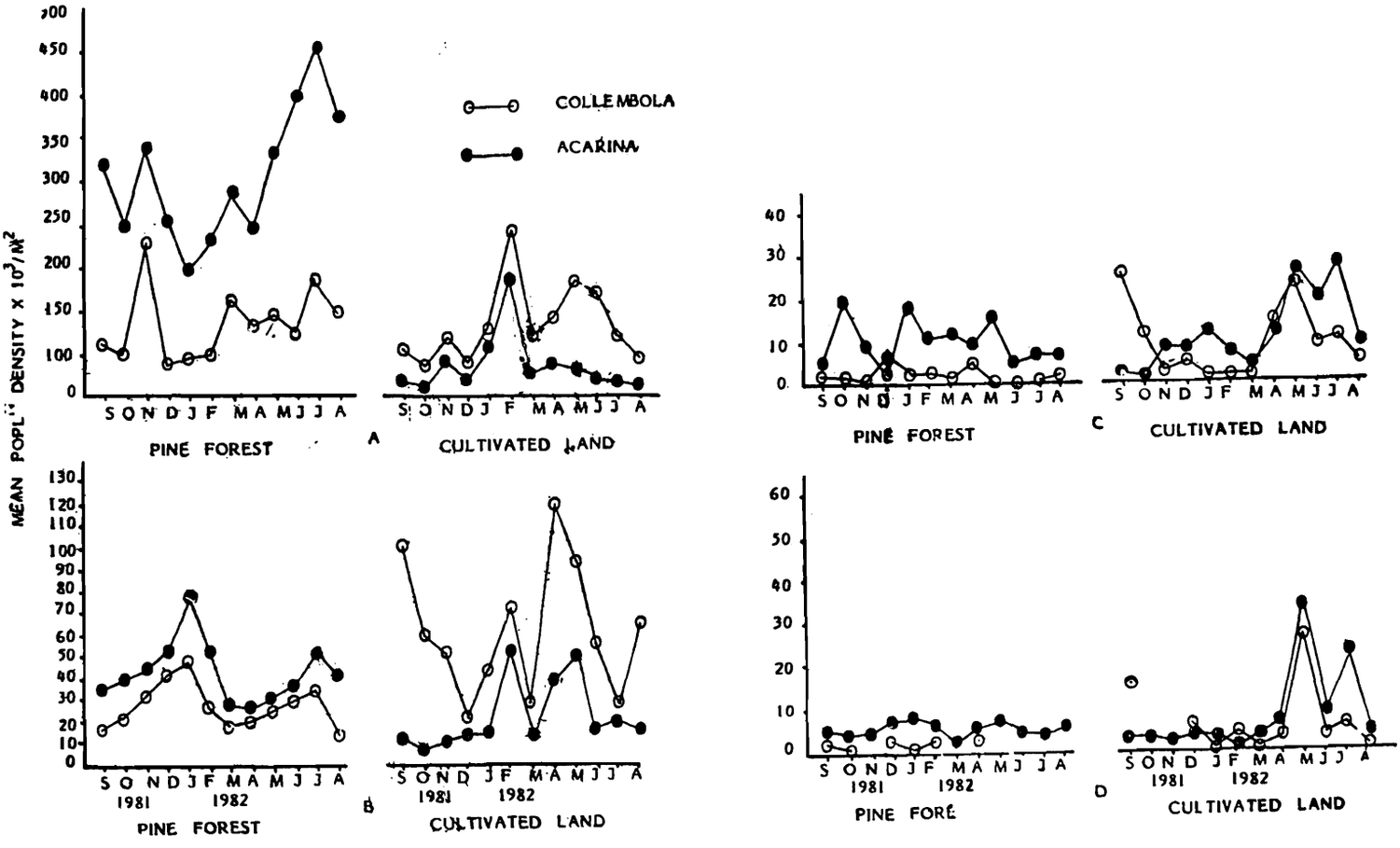
In the 30-40 cm soil layer in pine forest the no. of species further reduced to four as well as in cultivated land. In this layer two species viz. *Sphaeridea cf. cornuta* and *Onychiurus* spp. were common to both the systems, the former being domiuant in pine forest and *Xenylla* spp. in cultivated land. As seen in Table 2 for C. V. values (%) cultivation seems to have very little impact on Collembola as compared to the forest.

Vertical Distribution pattern of Acarina :

The mean seasonal density of Acarina in pine forest and cultivated land as given in Fig. I for one annual cycle from September 1981 to August 1982 reveals that in the upper 0-10 cm (Fig. IA) soil depth the Acarina were recorded maximum in July and minimum in December and in cultivated land maximum in February and minimum in October.

FIG - I.

SEASONAL POPN DENSITY OF COLLEMBOLA AND ACARINA AT 0-10 CM, 10-20 CM, 20-30 CM AND 30-40 CM SOIL DEPTHS.



In the 10-20 cm soil depth in pine forest (Fig. IB) they were maximum in February and May (two peaks) and minimum in October.

In the 20-30 cm and 30-40 cm soil depth (Fig. IC & D) their numbers were significantly low but their numbers fluctuated in different months.

Altogether 8 species of Acarina viz. *Epilohmannia* spp. *Galumna* spp. *Scheloribates albialatus*, *S. huancayensis*, *Parasitus divortus*, *Pseudoparasitus* spp. *Eremobelba* spp. and *Dolicheremaeus* spp. were recorded in pine forest. In the cultivated land 5 species of Acarina viz. *Scheloribates albialatus*, *Oppia* spp. *Rhysotritia ardua*, *Gamasodes assamensis* and *Parasitus divortus* were recorded.

In the upper 0-10 cm and 10-20 cm soil depth 2 species of Acarina viz. *Schelaribates albialatus* and *Parasitus divortus* were common to both the systems as against 8 and 5 species in pine forest and cultivated land respectively. The species *Scheloribates albialatus* was found to be dominant in both the systems.

In the 20-30 cm and 30-40 cm soil depths only one species namely *Parasitus divortus* was common to both the systems while *Scheloribates huancayensis* was dominant in 20-30 cm soil depth and *Epilohmannia* spp. in 30-40 cm soil depth in pine forest. In cultivated land *Parasitus divortus* was dominant in both these depths. As seen in Table 3 for C. V. values (%) for Acarina the values were always higher in the cultivated land than in pine forest indicating the disturbed nature of the former system.

Parameters affecting Mesofaunal Distribution and Diversity :

Soil temperature throughout the sampling period varied slightly depending on vegetative cover and soil depth. Generally higher relative humidity and vegetative cover increased the moisture content of the soil especially near the surface exposing the mesofauna to greater temperature and moisture fluctuations. Changes in soil depth coincide with similar changes in moisture, temperature, organic matter, quality and quantity, pore space and soil temperature (Wallwork, 1970 ; Mitchell, 1979). Fluctuation in these factors tended to decrease with depth as the physical environment became more stable. Within the soil environment various layers are produced which provide various micro-habitats able to support different species of Collembola and Acarina. The numbers of Collembola and Acarina greatly decreased with depth due to similar-drops in organic matter and pore space volume in pine forest but in cultivated land the reduction was less as compared to pine forest. It is the combination of many soil factors which might have contributed to the overall mesofaunal composition of both cultivated land and pine forest. In view of the present study it could be inferred that the collective influence of all the factors in controlling the population and vertical distribution of soil mesofauna especially Collembola and Acarina was more pronounced in both the systems studied.

In general the soil fauna of arable land is less abundant and diversified than the fauna of forested ecosystems (Edwards & Lofty 1969 ; Ghilarov, 1975). This is evident from data of cultivated land as compared with pine forest and the number of species recorded in each system. Similar sampling and extraction techniques were used in both the ecosystems ; the difference between them being due to litter

accumulation in pine forest which have a great impact on the abundance of many species of Acarina. An experiment performed by Karg (1967) showed the importance of litter layer that when it is removed from the forest site, the abundance and species number were reduced by more than 50% and the species composition became similar to that in the cultivated land, as is evident in our present study. The abundances reported in this paper are high for Acarina in pine forest as compared to cultivated land. The Collembola being in the reverse (cf. Hale, 1967). The Collembola seem to be less affected by cultivation than Acarina (Christiansen, 1964).

In the present investigation it was seen that interestingly enough the pine forest possessing higher number of species reveal their possible occupation of most ecological niches in a rather stabilised ecosystem where fluctuations of abiotic factors are most extreme. The reverse is in cultivated land where number of species decreased because of the catastrophes imposed on the system by ploughing, harrowing, manure, insecticides, application of fertilizers, cultivation and harvesting etc. Ploughing and harrowing generally decrease the abundance of soil animals (Tischler 1955 ; Sheals 1956 ; Ghilarov 1975 ; Edwards 1977). The direct negative effects of ploughing are partly due to abrasive damage to the animals and partly due to trapping of animals in the soil when it is inverted and the existing system of cracks and pores is destroyed. Since the cultivated land studied was subject to intensive ploughing and harrowing it could have possibly affected the mesofaunal composition as compared to pine forest. Secondary affects, e.g., drying of the uppermost part of the soil and removal of litter from the surface probably could affect the mesofaunal composition in cultivated land as compared to pine forest. Thus cultivated land harboured a depleted soil fauna because of frequency and type of cultivation and degree of plant cover and intensity of soil cultivation and the species diversity of Collembola and Acarina reduced as

TABLE 1. Minimum and Maximum Values of Soil Factors in Four Different Soil Depths in Pine Forest & Cultivated Land.

Ecosystem	Depths	Temp. °C	Moisture %	pH units	T.S.S. %	Org. Carbon Kg/ha	P. Kg/ha	K. Kg/ha
Pine Forest	0-10 cm	8.5-21.0	17.95-57.07	4.83-6.16	5.00-26.66	1.95-4.31	1.34-30.64	42.93-214.66
	10-20 cm	8.0-21.0	12.03-73.89	5.00-6.36	5.33-81.33	1.50-4.29	0.74-23.91	29.86-158.66
	20-30 cm	7.5-20.3	15.88-69.90	4.73-6.10	5.66-62.00	1.56-3.97	0.74-34.23	33.60-166.13
	30-40 cm	7.2-19.1	10.32-66.94	4.83-6.16	4.66-34.33	0.78-3.74	3.46-35.12	13.06-322.93
Cultivated Land	0-10 cm	9.0-22.0	12.86-71.23	5.75-6.67	10.53-48.26	1.37-2.41	1.95-32.25	45.19-258.23
	10-20 cm	8.8-19.9	16.92-80.26	5.81-6.54	12.45-53.56	1.15-2.15	1.76-28.39	50.53- 26.87
	20-30 cm	8.1-19.3	19.28-78.71	5.61-6.19	9.36-38.73	1.03-1.87	1.25-19.78	37.83-215.26
	30-40 cm	7.8-18.7	20.54-73.35	5.35-5.87	7.85-31.92	0.68-1.07	1 04-15.53	23.29-161.35

TABLE 2. Mean population densities of Collembola species and their co-efficient of Variance in pine forest & cultivated land.

Cultivated Land	0-10 cm			10-20 cm			20-30 cm			30-40 cm		
	Mean	±S.E.	C.V. (%)	Mean	±S.E.	C.V. (%)	Mean	±S.E.	C.V. (%)	Mean	±S.E.	C.V. (%)
1. *Isotoma (Desoria) trispinata*	83.75	11.01	44.55	33.50	5.52	57.07	0.83	0.27	113.02	—	—	—
2. *Megalothorax minimus*	9.83	1.80	63.45	6.00	0.80	46.06	1.15	0.59	178.00	—	—	—
3. *Onychiurus* spp.	16.75	2.27	47.01	6.67	1.35	70.37	1.83	0.43	81.97	2.08	0.96	159.45
4. *Sphaeridea cf cornuta*	3.08	0.50	56.23	1.92	0.40	71.60	3.33	0.99	103.64	1.00	0.46	156.52
5. *Xenylla* spp.	8.83	0.84	33.09	10.50	1.94	64.01	1.25	0.44	123.67	2.00	0.92	159.53
6. *Folsomides* spp.	6.75	0.66	34.07	3.33	0.43	65.04	1.58	0.58	128.00	0.92	0.31	117.57
Pine Forest												
1. *Isotoma (Desoria) trispinata*	39.66	6.18	54.00	9.33	1.41	52.60	—	—	—	—	—	—
2. *Megalothorax minimus*	5.83	0.87	52.19	1.42	0.43	105.85	0.17	0.11	227.82	—	—	—
3. *Onychiurus* spp.	10.08	1.49	51.22	1.92	0.67	120.46	—	—	—	0.17	0.11	227.82
4. *Sphaeridea cf cornuta*	5.52	1.05	69.43	4.58	0.75	57.06	1.00	0.23	80.00	0.67	0.22	115.61
5. *Dicranocentrus singularis*	11.08	1.93	60.44	2.08	0.40	66.44	0.25	0.13	178.88	—	—	—
6. *Dicranocentrus fraternus*	6.91	1.09	54.74	1.25	0.39	108.51	—	—	—	—	—	—
7. *Cryptopygus thermophelus*	20.00	3.46	70.48	4.08	0.51	43.77	0.33	0.14	148.45	—	—	—
8. *Entomobrya* spp.	5.33	0.98	63.70	0.50	0.19	134.16	—	—	—	—	—	—
9. *Siera* spp.	5.66	0.92	56.65	0.58	0.26	155.17	0.42	0.19	157.93	0.17	0.11	227.82
10. *Metacoelura* spp.	6.25	1.31	72.88	0.33	0.19	196.38	0.08	0.08	353.55	—	—	—
11. *Sminthurinus bimaculatus*	6.91	1.41	70.82	1.17	0.36	108.11	—	—	—	0.25	0.13	178.88

TABLE 3. Mean population densities of Acarina species and their co-efficient of Variance in pine forest & cultivated land.

Cultivated Land	0-10 cm			10-20 cm			20-30 cm			30-40 cm		
	Mean	±S.E.	C.V. (%)	Mean	±S.E.	C.V. (%)	Mean	±S.E.	C.V. (%)	Mean	±S.E.	C.V. (%)
1. *Scheloribates albialatus*	36.41	8.70	82.85	11.25	2.75	84.84	—	—	—	—	—	—
2. *Parasitus divortus*	13.67	2.51	63.70	4.25	0.91	74.48	5.58	1.67	103.81	4.33	1.94	154.89
3. *Rhysotritia ardua*	4.50	0.86	66.00	3.91	0.84	74.43	2.50	0.51	71.33	3.00	0.76	87.62
4. *Gamasodes assamensis*	3.67	1.16	109.16	0.58	0.19	115.65	2.17	0.64	101.69	0.33	0.19	196.38
5. *Oppia* spp.	6.58	1.45	76.29	2.33	0,59	88.47	1.25	0.41	113.70	0.83	0.34	144.07
Pine Forest												
1. *Scheloribates albialatus*	101.41	13.75	46.98	20.33	2.47	42.14	—	—	—	—	—	—
2. *Parasitus divortus*	36.91	3.59	33.40	9.00	1.08	41.57	3.75	0.65	60.28	1.50	0.43	100.44
3. *Epilohmannia* spp.	28.75	2.95	35.57	2.00	0.37	64.03	1.08	0.29	92.12	0.83	0.34	144.07
4. *Galumna* spp.	46.33	6.00	44.86	3.00	0.52	60.27	0.92	0.29	108.15	1.83	0.30	56.52
5. *Scheloribates hyancayensis*	25.91	3.96	52.95	3.33	0.58	60.58	3.17	0.69	75.84	—	—	—
6. *Psudoparasitus* spp.	16.25	1.89	40.40	3.00	0.90	104.45	—	—	—	1.58	0.29	63.29
7. *Eremobelba* spp.	25.00	2.91	40.39	1.58	0.64	141.52	1.00	0.25	84.85	—	—	—
8. *Dolicheremaeus* ssp.	24.50	2.90	39.56	2.17	0.61	97.86	—	—	—	—	—	—

TABLE 4. Q.S. Values of Collembola & Acarina between pine forest and adjacent cultivated land.

Mesofauna	0-10	10-20	20-30	30-40
Collembola	54.44	54.44	33.33	50.00
Acarina	30.77	30.77	11.11	12.5

compared to the forest system. The investigation also revealed that the abundance of soil mesofauna in cultivated land was higher in comparision to number of species as compared to pine forest.

However, eveness is indicative of phenomena in the reverse in that cultivated land reversal means more eveness than in the pine forest which could be attributed to cumulative influence of minor fluctuations in various abiotic factors which probably contribute a factorial complex thereby nullifying the effect of individual components.

The Q.S. value of Collembola between the two systems were much higher than that of Acarina (Table 4). Both the groups showed respective similarities atleast upto 20 cm depth, beyond which the values were much lower. However, at the extreme depth of 30-40 cm the Collembola tended to show a higher value of Q.S.

Summary

The present study deals with particular reference to Acarina (Mites) and Collembola (Springtails) and to their vertical distribution and diversity in Forest soil and an adjacent cultivated land.

The forest comprised of a sub-tropical pine and the cultivated land belonged to the local vegetable research station where seasonal vegetables were grown on a rotation basis.

Soil fauna was analysed from soils taken upto a depth of 40 cm. at intervals of 10 cm. each.

Results indicate higher density of Acarina and Collembola in forest and comparatively less in the case of cultivated land. Species richness is less in the arable system as compared to the forest soils.

The results are discussed in relation to certain physicochemical parameters and influence of agricultural practices on soil fauna.

Acknowledgements

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ASILIDAE (DIPTERA) FROM GOA, KARNATAKA AND TAMIL NADU

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Introduction

Since asilid fauna of Goa is poorly known, it was intensively surveyed by us in November 1989. On our way from Madras to Goa by road, localities near our camps in Tamil Nadu and Karnataka were also surveyed. The collections made during this survey and one specimen of *Clephydroneura wilcoxi* Joseph & Parui collected by Sri K. Ilango from Madras are reported in the paper. The arrangement of genera followed in this paper is according to 'A Review of the Asilidae (Diptera) from India' by Joseph & Parui (1990).

The types are deposited in the National Zoological Collection, Zoological Survey of India, Calcutta.

Genus **Lobus** Martin

1972. *Lobus* Martin, *J. Kansas ent. Soc.* **45** : 8.

Type species : *Leptogaster pallipes* Janssens ; original designation.

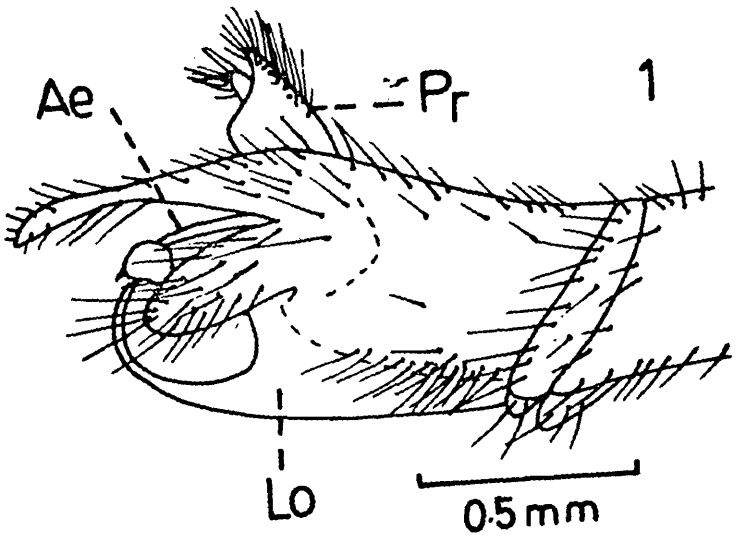
1. **Lobus bandipurensis** n. sp. (Fig. 1)

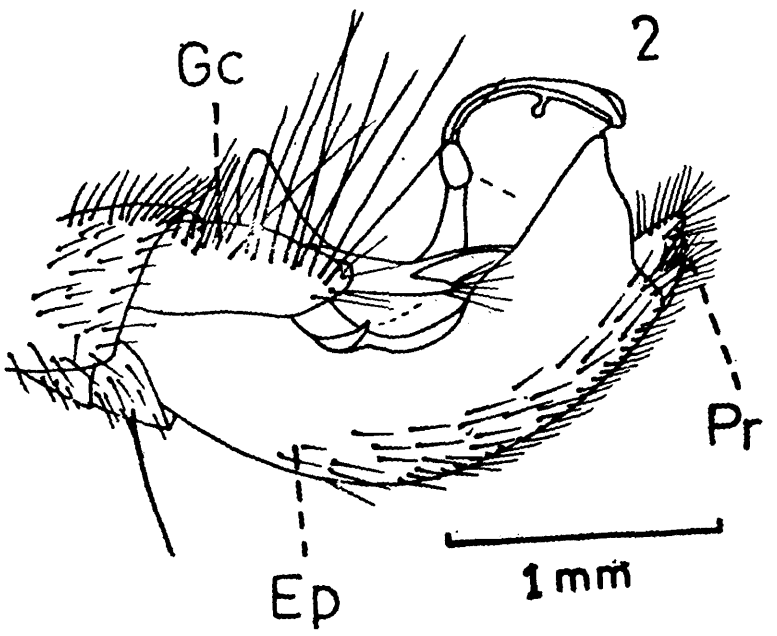
A slender black fly with black, pale yellow and yellowish-brown legs, and infuscated wings. Male : length 11 mm, wing 7 mm ; female : length 12 mm, wing 8 mm.

Male : *Head* black with sparse grey and greyish-yellow tomentum ; mystax white, postcranium with pale yellow setae, postgena with white setae. Antenna dark brown with black bristles on scape and pedicel, scape about two-thirds length of pedicel, first flagellomere elongate, style nearly as long as first flagellomere and gradually thickened distally. Palpus and proboscis black, former with black and latter with white setae.

Thorax black with greyish-yellow and grey tomentum ; scutum with a faint medio-longitudinal black stripe extending from anterior border to near hind border, the stripe anteriorly divided by a still fainter narrow, greyish-yellow stripe ; chaetotaxy :

1 notopleural, 1 postalar (weak), 1 supra-alar ; vestiture pale yellow, bristles black and pale yellow ; scutellar border with about 3 rows of pale yellow setae, disc with a few setae basally ; pleura with dense, greyish-white tomentum, anepisternum and katepisternum anteriorly bearing white setae. Haltere pale yellow, with stalk lighter coloured





Figs. 1 & 2. *Lobus bandipurensis* n. sp., lateral view of male genitalia.
Nusa shevaroyensis n. sp., lateral view of male genitalia.

Legs black, pale yellow and yellowish-brown ; coxa and trochanter black ; fore femur pale yellow with black apex, tibia pale yellow with black anteriorly and apically, basitarsus pale yellow for two-thirds distance from base and remained black, remaining tarsal segments black ; mid femur black with base narrowly pale yellow and subapex narrowly yellowish-brown, mid tibia similar to that of fore tibia but black colour occupies more area, tarsus similar to that of fore tarsus ; hind femur similar to that of mid femur but the median black area less extended, tibia less than one-fourth pale yellow basally and the rest black, tarsus similar to that of mid tarsus but basitarsus

pale yellow only for about one-third distance ; fore tibia and basitarsus ventrally and hind tibia and basitarsus posteroventrally with mat of golden yellow pubescence ; vestiture white and black, bristles black and pale yellow.

Wing infuscated.

Abdomen black, tergum 1 with a basal, transverse row of black and pale yellow bristles, and a few, long pale yellow setae laterally, vestiture white and black. Male genitalia (Fig. 1) yellowish-brown and black with white setae.

Female : Quite similar but with the following differences : postcranium and pleura of thorax predominantly greyish-yellow tomentose ; abdominal terga 4-7 with grey tomentum both on anterior and poterior borders. Female genitalia black with white setae, sternum 8 apically with a median, shallow depression, proctiger narrowed from middle to apex.

Holotype ♂, Reg. No. 7713/H6, Karnataka : Bandipur, 12.xi.1989, Coll. Joseph and Parui. *Paratype* ♀, Reg. No. 7714/H6, rest of details as in holotype.

Lobus bandipurensis n. sp. is similar to *L. martini* Joseph & Parui, in the presence of more than two rows of setae on the border of scutellum, but is recognised by its larger size and differences in the structural details of the male genitalia.

Genus **Nusa** Walker

1851. *Nusa* Walker, *Insecta Saundersiana*, **1** : 105.

Type species : *Nusa aequalis* Walker ; designated by Hermann (1912 : 243).

2. **Nusa shevaroyensis** n. sp. (Fig. 2)

A medium black species with grey and greyish-yellow tomentum, black legs, dark brown wings, and distinctive male genitalia. Male : length 13 mm, wing 7 mm.

Male : *Head* broader than thorax, black with sparse grey tomentum ; mystax white with a few black bristles below on either side, fronto-orbital setae and ocellar bristles black, postgena with dense white setae, postocular bristles consist of 3 long ones and a row of comparatively shorter ones. Antenna black, scape and pedicel bear white and black bristles, pedicel slightly shorter than scape, first flagellomere short. Palpus and proboscis black with white setae.

Thorax black, grey tomentose ; pronotum with a transverse row of black bristles medially and a few pale yellow setae laterally ; scutum with a mediolongitudinal black stripe extending from anterior border to slightly beyond transverse suture, the stripe dividing it absent, sides with two black, contiguous spots ; chaetotaxy : 2 notopleurals, 2 postalars, 3 supra-alars ; scutellum with hind border bearing a row of 8 bristles, disc

with sparse, short, black setae ; katatergite with a bunch of long, white, and two or three black, bristly setae. Haltere yellowish-brown.

Legs black, hind femur with 3 white bristles posteriorly, fore and mid tibiae with dense, elongate, white bristly setae, vestiture white and black, the former predominant in fore and mid legs and the latter in hind leg, bristles black and white, fore tibia and tarsal segments ventrally and hind tibia at apex ventrally and on tarsal segments ventrally with mat of golden yellow setae.

Wing dark brown ; R_5 and M_1 united well before the border.

Abdomen black, tergum 1 with three, tergum 2 with two, and terga from 3-5 with one white bristles laterally, vestiture pale yellow. Male genitalia (Fig. 2) black with black setae.

Holotype ♂, Reg. No. 7715/H6, Tamil Nadu : Dharmapuri District : Shevaroy Hills, 6.xi.1989, Coll. Joseph and Parui.

It is distinguished from all the other known Indian species by the distinctive male genitalia. According to our key (1987) to species of *Nusa* from India and adjoining countries it runs to couplet 4. Of the two species under it, *N. aequalis* Walker and *N. elva* (Walker), it is closer to the former from which it differs in the black scape and legs, dark brown wing and in the absence of lateral grey spots on abdomen. The male genitalia of *N. aequalis* Walker is not known to us for comparison.

Genus **Michotamia** Macquart

1838. *Michotamia* Macquart, *Dipt. exot.* **1** (2) : 75.

Type species : *Michotamia analis* Macquart, 1838 : 72 ; monotypic.

3. **Michotamia aurata** (Fabricius)

1794. *Asilus aurata* Fabricius, *Ent. Syst.* **4** : 387.

1975. *Michotamia aurata* : Oldroyd, *A Catalog of Diptera of Oriental Region*, **2** : 130.

Material examined : 3 ♀, Tamil Nadu : Dharmapuri Dist. : Nethalai, 5.xi.1989 ; 1 ♂, Karnataka : Uttar Kannad Dist. : Amod, 22.xi.1989 ; 5 ♂, 3 ♀, Goa : Vasco da Gama, 24.xi.1989 ; 1 ♀, Goa : Panaji, 25.xi.1989, all Coll. Joseph & Parui.

Distribution : This species has been recorded from Andhra Pradesh, Bihar, Delhi, Karnataka, Kerala, Madhya Pradesh, Orissa, Pondicherry, Rajasthan and West Bengal. Here it is recorded for the first time from Goa. The species was described from "East India".

4. **Michotamia fuscifemorata** Joseph & Parui

1984. *Michotamia fuscifemorata* Joseph & Parui, *Rec. zool. Surv. India*, Occ. Paper No. 66 : 26.

Material examined : 1 ♂, Karnataka : Bangalore. Bannerghata National Park, 9.xi.1989, Coll. Joseph & Parui.

Distribution : This species has been recorded from Andhra Pradesh, Karnataka and Kerala in India, and from Bangladesh and Nepal. Here it is recorded for the first time from Goa.

Genus **Stichopogon** Loew

1847. *Stichopogon* Loew, *Linn. Ent.* **2** : 499.

Type species : *Dasypogon elegantulus* Wiedemann, 1820 ; original designation.

5. **Stichopogon inaequalis** (Loew)

1847. *Dasypogon inaequalis* Loew, *Linn. Ent.* **2** : 505.

1975. *Stichopogon inaequalis* : *A Catalog of Diptera of the Oriental Region,* 2 : 129.

Material examined : 3♂, 6♀, Goa : Canacona : Palolen, 18.xi.1989 ; 4♂, 4♀, Goa : Vasco : Consaulin Beach, 24.xi.1989 ; 7♀, Goa : Panaji : Mirmar Beach, 25.xi.1989 ; 2♂, 6♀, Panaji : Donapala, 26.xi.1989 ; 3♂, 1♀, Panaji : Bambolim, 29.xi.1989, all Coll. Joseph & Parui.

Distribution ; It has been recorded from the following localities in India : Andaman Islands, Andhra Pradesh, Bihar, Maharashtra, Rajasthan and Tamil Nadu. Here it is recorded for the first time from Goa. The species was described from the Palaearctic Region.

6. **Stichopogon meridionalis** Oldroyd

1948. *Stichopogon meridionalis* Oldroyd, *Ent. Monthly Mag.* 84 : 261.

1990. *Stichopogon meridionalis* : Joseph & Parui, *Rec. zool. Surv. India,* Occ. Paper No. 113 : 42.

Material examined : 1♂, 8♀, Goa : Canacona : Palolen, 18.xi.1989 ; 6♂, 16♀, Goa : Margoa : Colva Beach, 21.xi.1989 ; 4♀, Goa : Vasco : Bogmalla Beach, 24.xi.1989 ; 3♂, 1♀, Goa : Panaji, 25.xi.1989 ; 4♂, 3♀, Panaji : Calangut Beach, 27.xi.1989 ; 5♀, Goa : Bambolim Beach, 29.xi.1989 ; 5♂, 2♀, Panaji, 29.xi.1989, all Coll. Joseph & Parui.

Distribution : It has been reported from the following localities in India : Andhra Pradesh, Gujarat, Karnataka, Kerala, Rajasthan, Tamil Nadu and West Bengal. It is recorded for the first time from Goa. The species was described from Tamil Nadu and Sri Lanka.

Genus **Clephydroneura** Becker

1925. *Clephydroneura* Becker, *Ent. Mitt.* **14** : 68.

Type species : *Asilus xanthopus* Wiedemann ; designated by Oldroyd (1938 ; 450).

7. **Clephydroneura nelsoni** Joseph & Parui

1979. *Clephydroneura nelsoni* Joseph & Parui, *Ent. Scand.* **10** (1) : 36.

Material examined : 4♂, 2♀, Karnataka : Bangalore : Lalbagh, 8.xi.1939, Coll. Joseph & Parui.

Distribution : The species has so far been recorded only from Tamil Nadu. Here it is recorded for the first time from Karnataka.

8. **Clephydroneura pulla** Oldroyd

1939. *Clephydroneura pulla* Oldroyd, *Ann. Mag. nat. Hist.* **11** (1) : 467.

1990. *Clephydroneura pulla* : Joseph & Parui, *Rec. zool. Surv. India*, Occ. Paper No. 113 : 51.

Material examined : 7♂, 1♀, Tamil Nadu : Dharmapuri Dist. : Hogennkal Forest, 5.xi.1989 ; 1♂, 3♀, Dharmapuri : Nallampatti, 5.xi.1989, all Coll. Joseph & Parui.

Distribution : The species was described from Andhra Pradesh, subsequently it has been recorded from Karnataka and Tamil Nadu.

9. **Clephydroneura wilcoxi** Joseph & Parui

1979. *Clephydroneura wilcoxi* Joseph & Parui, *Ent. Scand.* **10** : 35.

Material examined : 1♂, Tamil Nadu : Madras : Tharaipakkam, 2.vii.1989, Coll. K. Ilango ; 1♂, Karnataka : Bangalore : Lal Bagh, 8.xi.1989 ; 1♂, Goa : Mandavi, 28.xi.1989, both Coll. Joseph & Parui.

Distribution : The species has been reported from Andhra Pradesh, Karnataka and Tamil Nadu. Here it is recorded for the first time from Goa.

Genus **Machimus** Loew

1849. *Machimus* Loew, *Linn. Ent.* **4** : 1.

Type species : *Asilus chrystis* Meigen ; designated by Coquillett, 1910.

10. **Machimus parvus** Ricardo

1919. *Machimus parvus* Ricardo, *Ann. Mag. nat. Hist.* **9** (3) : 54.

1990. *Machimus parvus* : Joseph & Parui, *Rec. zool. Surv. India*, Occ. Paper No. 113 : 57.

Material examined : 9♂, 10♀, Karnataka : Bandipur, 12.xi.1989, Coll. Joseph & Parui.

Distribution : The species has so far been recorded from Kerala and Tamil Nadu. Here it is recorded for the first time from Karnataka.

Genus **Philodicus** Loew

1848. *Philodicus* Loew, *Linn. Ent.* 3 : 391.

Type species : *Asilus javanus* Wiedemann, 1819 : 4 ; original designation.

11. **Philodicus femoralis** Ricardo

1921. *Philodicus femoralis* Ricardo, *Ann. Mag. nat. Hist.* 8 (9) : 190.

1990. *Philodicus femoralis* : Joseph & Parui, *Rec. zool. Surv. India*, Occ. Paper No. 113 : 61.

Material examined : 3♂, 1♀, Tamil Nadu : Dharmapuri Dist. : Shevaroy Hills, 6.xi.1989 ; 1♂, Goa : Margao, 21.xi.1989 ; 8♂, 1♀, Goa : Vasco da Gama, 24.xi.1989, all Coll. Joseph & Parui.

Distribution : In India this species has been recorded from Assam, Arunachal Pradesh, Bihar, Goa, Gujarat, Himachal Pradesh, Karnataka, Kerala, Meghalaya, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. It was described from Burma.

12. **Philodicus javanus** (Wiedemann)

1819. *Asilus javanus* Wiedemann, *Zool. Mag.* (Wiedemann) 1 (3) : 4. (for detailed synonyms refer to Joseph & Parui, 1983 : 362).

1975. *Philodicus javanus* Oldroyd, *A Catalog of Diptera of the Oriental Region*, 2 : 149.

Material examined : 1♂, Tamil Nadu : Dharmapuri Dist. : Nathalai, 5.xi.1989, Coll. Joseph & Parui.

Distribution : It has been reported from Assam, Arunachal Pradesh, Bihar, Himachal Pradesh, Karnataka, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. The species was described from Goa.

13. **Philodicus pruthii** Bromley

1935. *Philodicus pruthii* Bromley, *Rec. Indian Mus.* 37 : 224.

1990. *Philodicus pruthii* : Joseph & Parui, *Rec. zool Surv. India*, Occ. Paper No. 113 : 62.

Material examined : 4♂, 4♀, Tamil Nadu : Dharmapuri Dist. : Hogenakkal Forest, 5.xi.1989 ; 1♀, Dharmapuri Dist. : Shevaroy Hills, 6.xi.1989, all Coll. Joseph & Parui.

Distribution : It is known from Andhra Pradesh, Karnataka, Kerala, Rajasthan and Tamil Nadu. The species was described from Tamil Nadu.

Genus **Promachus** Loew

1848. *Promachus* Loew, *Linn. Ent.* 3 : 390.

14. **Promachus duvaucelii** (Macquart)

1838. *Trupanea duvaucelii* Macquart, *Dipt. exot.* 1 (2) : 97.

1975. *Promachus duvaucelii* : Oldroyd, *A Catalog of Diptera of the Oriental Region*, 2 : 152.

Material examined : 1♂, Tamil Nadu : Dharmapuri Dist. : Hogenakkal Forest, 5.xi.1989 ; 1♂, 3♀, Dharmapuri Dist. : Shevaroy Hills, 6.xi.1989 ; 1♂, 3♀, Karnataka : Bandipur, 12.xi.1989 ; 3♂, 1♀, Karnataka : Chitradurga Dist. : 15.xi.1989 : 1♂, Goa : Panaji, 29.xi.1989, all Coll. Joseph & Parui.

Distribution : It is known from Andhra Pradesh, Delhi, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. It is recorded here for the first time from Goa.

Summary

The paper deals with 14 species of 8 genera from Goa, Karnataka and Tamil Nadu. Of these 2 species, *Lobus bandipurensis* and *Nusa shevaroyensis*, are new ; 6 species, *Michotamia aurata* (Fabricius), *M. fuscifemorata* Joseph & Parui, *Stichopogon inaequalis* (Loew), *S. meridionalis* Oldroyd, *Clephydroneura wilcoxi* Joseph & Parui and *Promachus duvaucelii* (Macquart), are recorded for the first time from Goa ; and yet *Clephydroneura nelsoni* Joseph and Parui and *Machimus parvus* Ricardo, are new reports from Karnataka.

Acknowledgements

We are indebted to Prof. M. S. Jairajpuri, Director, Zoological Survey of India, Calcutta, for the permission accorded to study the material and for his keen interest in this study. We also like to place on record our appreciation to Prof. A. G. Scarbrough, Towson State University, Towson, Maryland, U. S. A., for critically reading the manuscript and for offering valuable suggestions.

Abbreviations : Ae, aedeagus ; Ep, epandrium ; Go, gonocoxite ; Lo, lobus ; Pr, proctiger.

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Joseph, A. N. T. and Parui, P. 1987. A Revision of *Nusa* (Diptera : Asilidae) from India and adjoining countries. *Oriental Ins.* **21** : 133-146.

Josehp, A. N. T. and Parui, P. 1990. A Review of Asilidae (Diptera) from India. *Rec. zool. Surv. India*, Occ. Paper No. 113, pp. 1-122.

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FIVE NEW SPECIES OF SCIARID GNATS (DIPTERA : SCIARIDAE) FROM INDIA

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INTRODUCTION

The sciarid gnats are generally looked upon as the "problem children" of the order Diptera for their tiny size and apparently superficial homogenity. These flies often called dark winged fungus gnats usually prevail around the fungus and other decaying plants and animals. The knowledge of economic importance of the sciarid gnats is incomplete and superficial. According to Steffan (1966) sciarids cause considerable damage to green house plants and mushrooms. Adults are involved in carrying spores of various mushroom diseases (Ware, 1933) and hypopial stages of tyroglyphid mites (Thomas, 1942).

Studies on the Indian sciarid gnats though meagre, owe to Brunetti (1912, 1920) who first, recorded a large number of sciarids. Later, Steffan (1972 a, b) made revision of Oriental sciarids and redescribed some of the Indian species of Brunetti (1920). This paper contributes descriptions of six species under the genera *Epidapus* Haliday, *Lobosciara* Steffan, *Lycoriella* Frey, *Plastosciara* Berg, *Scythropochroa* Enderlein and *Trichosia* Winnertz.

MATERIAL AND METHODS

The sciarids of the present study were collected through operation of light traps in various localities in India. For better understanding, the specimens were mounted on microslides after the techniques of Wirth and Blanton (1959) as modified by Steffan (1966). The gross morphology and body colouration were observed on the insects mounted on paper points and preserved in small shell vials containing 70% alcohol in the laboratory.

The morphological terminologies used in the descriptions of species are based on Steffan (1966, '69) and Alam *et al.*, (1988).

Types and other material are at present kept with the senior author and will be deposited to the National Zoological Collections, Calcutta ; USNM Washington. The Natural History Meseum, London and Bishop Museum, Honolulu in due course.

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Systematic Account

1. **Epidapus nullusanalis** Alam & Das Gupta, n. sp.
(Figs. 1 A-F)

Male :

Head—Dark brown, subglobular. Length 0.24 (0.23–0.25, n=3) mm, Interfacetal hairs short and sparse, barely extending beyond outer curvature of facets. Eye bridge (Fig. 1A) moderately broad and contiguous, 2 facets long at junction. Median ocellus

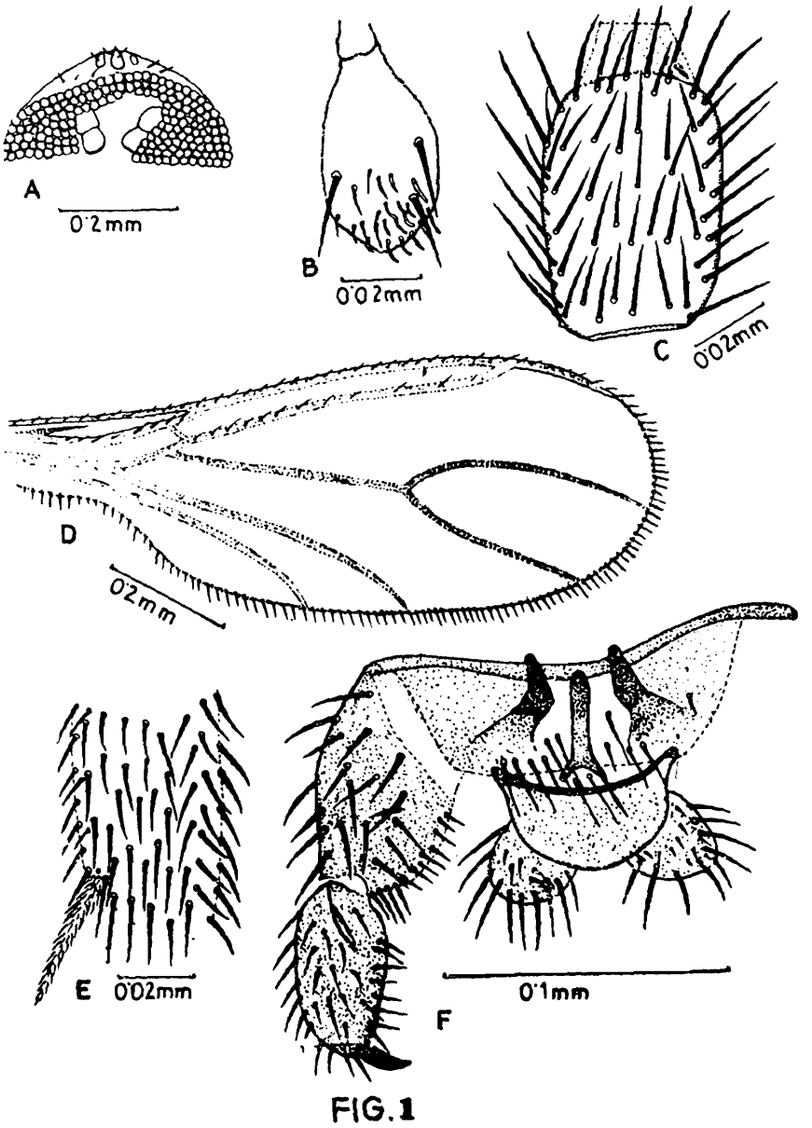

FIG. 1

Fig. 1A—F. *Edidapus nullusanalis* Alam & Das Gupta, n. sp. : A, eye bridge ; B, palpus, C, flagellomere 4 ; D, wing ; E, tibial comb and F. terminalia.

separated from eye bridge by about 1/2 width of ocellus, lateral ocelli little farther. Anterior vertex 0.18× length of head with 10-12 strong setae, posterior vertexal setae numerous and subequal to anterior vertexal setae. Prefrons with a median patch of

5-7 strong setae. Clypeus bare. Labrum short, triangular. Proboscis and labellum reduced. Palpus (Fig. 1 B) light brown, 1 segmented and ovoid with 3 strong setae and numerous large hyaline sensillae on dorsum. Antenna brown. Scape slightly broader in diameter than pedicel with 1 transverse row of 7 median setae ; pedicel with 1 row of shorter setae on distal 1/2 relatively longer and narrower ; neck distinct ; flagellar hairs almost straight about 2/3 width of flagellomeres ; flagellomere 4 (Fig. 1 C) 0.05 (0.04-0.05, n=3)mm. long about 1.6×longer than wide ; neck well developed about 1/3 length of flagellar joint.

Thorax—Brown. Acrostichals moderately developed and restricted to anterior 1/3 of scutum ; dorsocentrals subequal to acrostichals and extending the entire length of scutum ; supraalars strong, about 2×length of dorsocentrals. Scutellum with 2 long setae at posterior margin and several weak lateral setae scattered above the longer ones. Posterior pronotum with 3-4 short setae ; anterior pronotum with 5 well developed setae. Proepimeron broadly triangular, posterior epimeron of mesothorax about 1.8×longer than wide. Metanotal apodeme short, inflated distally.

Wing (Fig. 1D)—Brown, numerous dark microtrichia over the entire wing surface and many fine pale setae at posterior margin. Length 1.07 (1.05–1.09, n=3) mm ; breadth 0.4 (0.39–0.42, n=3) mm ; Costa, R_1 R_{4+5} with microtrichia posterior veins bare ; R_1 very short, joining costa considerably proximad of the base of M fork ; M fork symmetrical but M_1 slightly arcuate near base ; stem of CuA absent, CuA_1 arising from the basal point of bM distad of the base of CuA_2 ; anal veins totally absent. RM index 5.12 (5.0–5.25, n=3), CM 0.51 (0.5–0.52, n=3). Haltere light brown and club-shaped, setae restricted on the knob and disposed in a single uneven row.

Legs—Coxa and femur yellowish, remainder of segments yellowish brown. Fore leg : length of femur 0.28 mm ; tibia 0.31 mm ; basitarsomere 0.12 mm ; 2nd tarsomere 0.06 mm. Hind leg : femur 0.33 mm ; tibia 0.35 mm ; basitarsomere 0.15 mm ; 2nd tarsomere 0.08 mm. Fore tibial setae subequal ; tibial comb (Fig. 1E) without differentiated setae. Mid tibial setae also undifferentiated but hind tibial setae differentiated by slightly enlarged posterodorsals and few apicals. Tibial spurs 1 : 2 : 2, hind tibial spurs subequal in length to the diameter of tibial apex. Tarsal claws simple.

Abdomen—Tergum dark brown with moderately developed, sparse setae ; sternum brownish, setae subequal to tergal setae ; Sternum VIII with 1 posterior row of setae.

Terminalia (Fig. 1F)—tergum IX broad and quadrate with several long setae along the posterior margin, remainder of the surface bare. Dorsal apodeme highly developed, thumb-like, with dark sclerotization and extending to anterior margin of genital cavity. Ejaculatory apodeme long, rod-like, with 'V' shaped short fork. Aedeagus (Fig. 1F) with thin basal margin which is densely sclerotized, moderately to lightly

over remainder of surface. Tergum X bilobed, lobes somewhat rounded apically with long apical setae distinct from other short setae scattered over entire surface. Gonocoxites broadly joined, simple, and with scattered setae—those along dorsomesal surface short, weak and more in number ; mesoapical setae poorly developed. Gonostylus oblong, clothed with numerous strong setae and with dark strong terminal spur ; gonostylus about 0.7× length of gonocoxite and 1.86× longer than wide.

Female : Unknown.

Etymology : The name derives from the absence of anal vein of the wing.

Specimen examined : Holotype male (Type No. Ent. Ep 1 PCZM), Mazaffarpur, 16. V. 1983. Coll. S. K. Dasgupta. Paratypes : 4 males with data same as type.

Comments : This new species is very similar in general appearance to *F. johannseni* Shaw (1941) reported from North America but it is distinctly separated by the following chief characteristics : eye bridge with 2 facets long at junction, labellum greatly reduced, flagellomere 4 relatively wider, RM index (5.12) much higher, stem of CuA vein totally absent, anal veins invisible, greatly developed dorsal, and ejaculatory apodeme with short 'V' shaped terminal fork.

2. **Lobosciara spinipennis** (Sasakawa)

1962. *Bradysia spinipennis* Sasakawa **2** : 130.

Specimens examined : 2 males, Simla, 2. IV. 1975 ; Coll. S. Alam ; 2 males from Kalimpong, 26. V. 1978, 27. V. 1978 and 29. V. 1978, Coll. P. K. Chaudhuri.

Comments : The Indian forms of *L. spinipennis* (Sasakawa) studied now are almost identical to their counterparts described from Micronesia and Thailand except for few less setae on 1st and 2nd palpal segment and indistinct apical hook of ejaculatory apodeme.

3. **Lycoriella crassisetosa** Alam & Dasgupta, n.sp.
(Figs. 2. A-F)

Male :

Head—Brownish black, ovoid, and 0.43 (0.42 – 0.44, n = 3) mm. long. Interfacetal hairs as frequent as facets, extending at least 1 facet width beyond outer curvature of facets. Eye bridge (Fig. 2A) strikingly broad and contiguous, 4 facets long at junction, 5 facets elsewhere. Ocelli subequal, median ocellus with 2 strong bristles and separated from eye bridge by about width of ocellus. Anterior vertex with well developed scattered setae, 0.22×length of head ; posterior vertexal setae more in number, subequal to anterior vertexal setae. Prefrons with radially arranged 22-25 setae. Clypeus with 2 dorsomedian and 1 ventral setae. Labrum narrowly triangular, 1/5 length of head. Proboscis well developed, 0.3×length of head and subequal to the total width of labellar lobes. Palpus (Fig. 2B)—light brown, 3 segmented ; PP. 31 : 23 : 31 ; segment

1 club-shaped with numerous hyaline sensillae disposed in a distinct oval sensory pit, distal 1/2 with 6 dorsal setae ; segment 2 about 2/3 length of segment 1, with 6-7 setae ; segment 3 elongate, subequal to segment 1 but narrower with 9 setae of which 6 dorsolateral, 1 ventral, and 2 apicals. Antenna dark brown at proximal 2/3, yellowish brown at distal 1/3. Scape globose, broader in diameter than pedical with 2 rows of

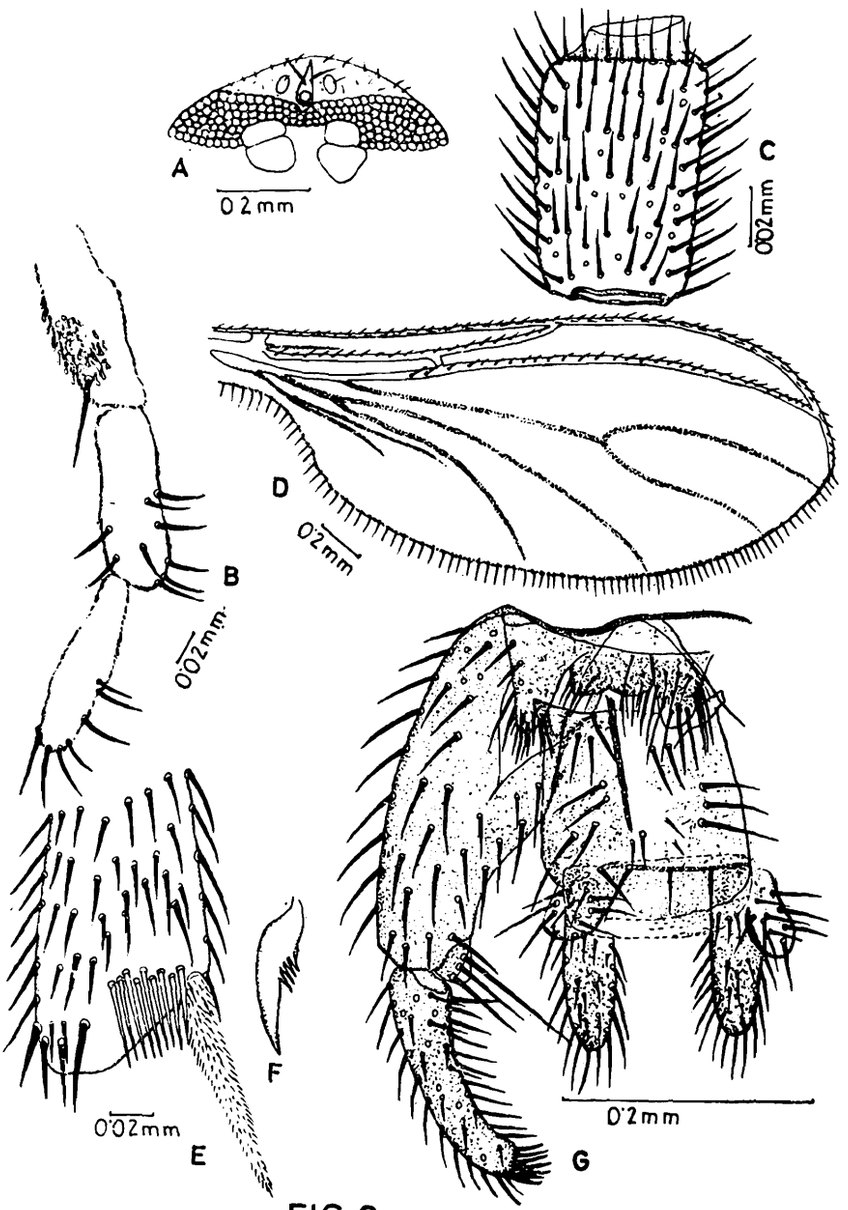

FIG. 2

Fig. 2A—F. *Lycoriella crassisetosa* Alam & Das Gupta, n. sp. : A, eye bridge ; B, palpus, C, flagellomere 4 ; D, wing ; E, tfbial comb and F, terminalia.

5-6 moderately developed setae ; pedicel with 9 strong setae scattered on distal 1/2. Flagellomeres elongate and darkly sclerotized with densely arranged setae, flagellar neck short ; flagellomere 4 (Fig. 2 C) 0.17 (0.15 – 0.18, n = 3) mm. long, about 2.4 × width ; neck 0.18 × length of flagellar joint ; flagellar hairs pale and short, about 1/3 diameter of flagellomeres.

Thorax—Orange brown. Acrostichals weak, irregularly biserial, restricted along 1/3 of scutum ; dorsocentrals anteriorly subequal to acrostichals, posteriorly longer setae ; supraalars with short and long setae, longest one about 2.5×longest dorsocentral. Scutellum with 4 long subapical and 6 8 medium-sized scattered setae. Posterior pronotum bare ; anterior pronotum with 6 setae. Proepisternum with 7-9 scattered setae subequal to apn. setae. Proepimeron moderately developed ; posterior mesoepimeron elongate, 2.3×longer than wide.

Wing (Fig. 2D)—Brownish, clothed with dark brown microtrichia and numerous fine setae along posterior margin. Length 2.81 (2.75–2.9, n=3) mm. breadth 0.91 (0.9–0.92, n=3) mm. Costa, R_1, R_{4+5} with macrotrichia, posterior veins bare ; R_1 joining costa a little before base of M fork which is symmetrical ; M_1 slightly arcuate near base ; stem of M and anal vein evanescent. RM index 1.72 (1.64–1.8, n=3), CM 0.65 (0.64–0.67, n=3), RM/bM 0.97 (0.88–1.02, n=3), st CuA/bM 0.28 (0.27–9.31, n=3). Haltere yellowish brown, knob with 1 row of 10-12 dorsal setae.

Legs—Coxa and femur bright, brownish yellow, other segments light brown. Fore leg : length of femur 0.67 mm ; tibia 0.84 mm ; basitarsomere 0.47 mm ; 2nd tarsomere 0.22 mm. Hind leg : femur 0.92 mm ; tibia 1.13 mm ; basitarsomere 0.58 mm ; 2nd tarsomere 0.23 mm. Fore tibial setae undifferentiated except for 4 slightly enlarged preapicals ; fore tibial comb (Fig. 2E) with an ovoid patch of dense setae, set in a shallow pit. Mid tibial setae largely subequal except for 6 stout and dark preapicals. Hind tibia with differentiated posterodorsal along distal 2/3, few scattered and little enlarged dorsal and apex with unilateral row of 16-18 dark stout setae. Tibial spurs : fore tibia with 1, mid tibia with 2 unequal, and hind tibia with 2 subequal spurs ; hind tibial spurs short, 0.85× longer than diameter of tibial apex. Tarsal claws simple.

Abdomen—Dusky brown ; tergal setae short, sparse and subequal to sternal setae ; sternum VIII with 1 row of setae along the apical margin. Terminalia (Fig. 2F)—Tergum IX trapezoidal and longer than wide, with moderate-sized scattered setae and distal margin with 6 long setae. Dorsal apodeme darkly sclerotized, proximally somewhat flattened, extending about 1/2 way into genital cavity. Ejaculatory apodeme long and strongly sclerotized with broad apical fork. Aedeagus (Fig. 2F) sub conical, basal margin dark, rest of the surface with moderate sclerotization. Tergum X bilobed, squared to slightly rounded at apex, clothed with minute setae and posteriorly several enlarged setae. Gonocoxites narrowly joined ventrally with scattered moderately developed setae ; mesal surface with weak short and dense ; mesoapically a long whip—like seta extending posteriorly about 2/3 length of gonostylus. Gonostylus elongate, terminating in a dark strong apical spur encircled by 3 apicomesal and 3 subapical spines ; 2 whip-like mesal setae proximad of apicomesal spines ; gonostylus about 2.7× longer than wide and 0.69×length of gonocoxite.

Female : Unknown.

Etymology : The name "crassisetosa" denotes the densely distributed setae in the flagellomere.

Specimens examined : Holotype male (Type No. Ent Ly I PCZM), Darjeeling, 20.XI. 1978. Coll. S. Alam. Paratypes : 3 males with data same as type.

Comments : The new species appears to be very similar to *L. caeser* (Johannsen) reported from Canada and South Georgia Is. and also to *L. agarici* Loudon (1978) described from New South Wales (Australia). However, it differs from the two in the following characteristics : flagellomere 4 darkly sclerotized and densely setigerous ; flagellar hairs distinctly shorter than the width of flagellomeres ; wing elongate and larger ; RM index lower (1.72), value of st CuA/bM less than 0.3, and a differently shaped gonostylus.

4. **Plastosciara alia** Alam & Dasgupta, n. sp.
(Figs. 3 A-F)

Male :

Head—Brown, sub-globular, and 0.41 (0.39–0.42, n=3) mm. long. Interfacetal hairs sparse, generally shorter, barely extending beyond outer curvature of facets. Eye bridge (Fig. 3 A) contiguous and broad, 4 facets long at junction, some places 5 facets long. Median ocellus almost touching edge of eye bridge, lateral ocelli a little farther. Anterior vertex 1/6 length of head with few scattered shorter setae ; posterior vertexal setae strong and numerous. Prefrons narrow with 3-4 strong ventral setae. Clypeus bare. Labrum moderately developed, apex somewhat blunt. Probosics relatively smaller. Labellum moderately developed. Palpus (Fig. 3 B) brown, 2-segmented ; segment 1 slightly swollen at distal 1/2 with numerous dorsal and lateral hyaline sensilae, 4 dorsolateral strong and long setae ; segment 2 ovoid, slightly shorter than 1, with 1 apical and 4 dorsolateral setae which are about 1/2 length of setae of the 1st segment. Antenna brownish yellow. Scape subequal to slightly broader in diameter than pedicel with 1 median transverse row of strong setae ; pedicel with scattered 6-8 moderately developed setae. Flagellomeres sub equal, long and with very short neck ; 4th flagellomere (Fig. 3, C) 0.09 (0.09-0.11, n=3) mm. long about 2.28×longer than wide ; neck about 1/6 length of flagellar joint ; flagellar hairs about 0.7×diameter of flagellomeres.

Thorax : Dark brown. Acrostichals weakly developed, extending slightly beyond posterior 1/2 of scutum ; dorsocentrals moderately developed ; supraalars very long. Scutellum well developed with 4-5 long posterior and 7-8 moderately developed median setae. Posterior pronotum bare ; anterior pronotum with 3 strong posterior setae. Proepisternum with 12 scattered setae subequal to apn. setae. Posterior epimeron of mesothorax well developed, about 1.5×longer than wide. Metanotal apodeme broad.

Wing : (Fig. 3 D)—Brown, entire wing surface clothed with microtrichia ; posterior margin with numerous fine setae. *Length* : 3.08 (2.85-3.35, n=3) mm ; breadth 1.16 (1.15-1.2, n=3) mm. Costa, R_1 R_{4+5}, and distal 2/3 of RM with macrotrichia, other veins bare ; ST M evanescent ; M fork symmetrical. RM index 0.75 (0.73-0.78, n=3), CM 0.63 (0.59-0.68, n=3), RM/bM 1.32 (1.28-1.35, n=3), at CuA/bM 0.65 (0.64-0.67, n=3). Haltere yellowish brown, stem elongated, knob with 1 irregular row of dorsal setae.

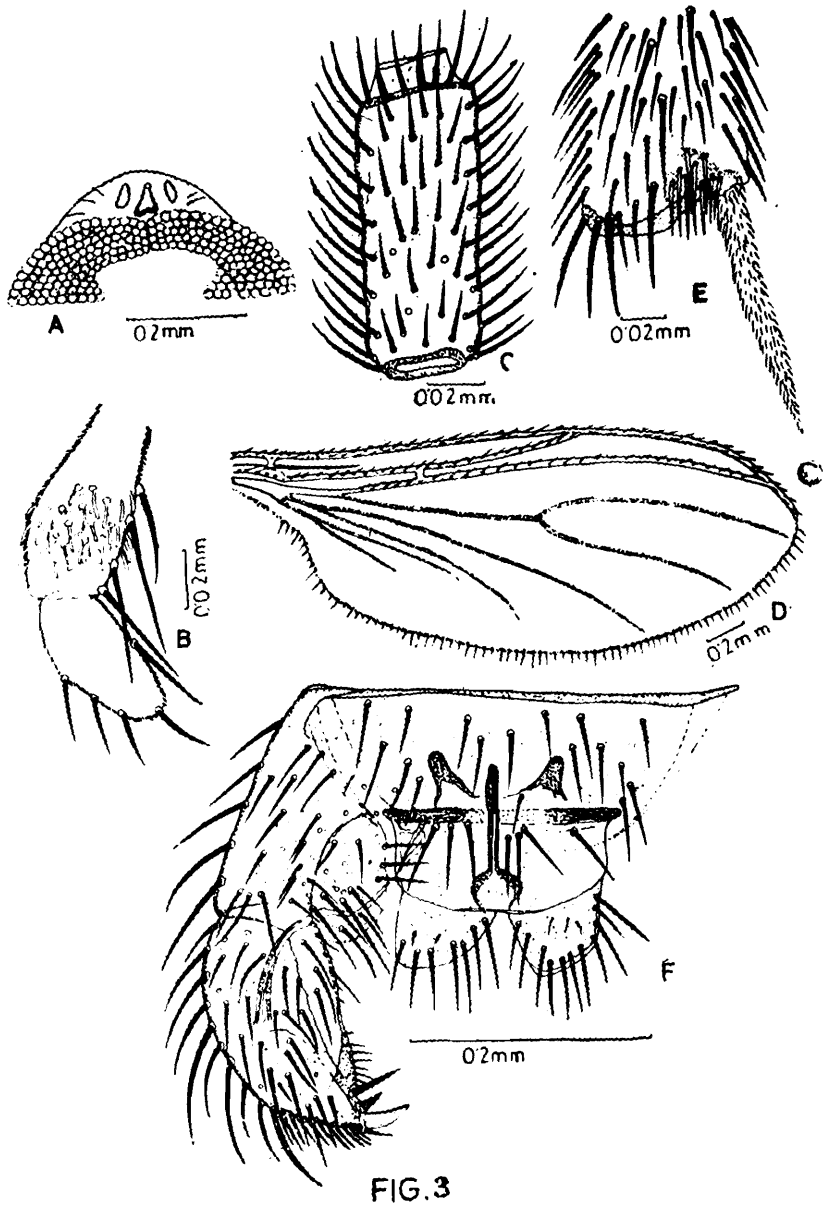

FIG.3

Fig. 3A—F. *Plastosciara alia* Alam & Das Gupta, n. sp. : A, eye bridge ; B, palpus ; C, flagellomere 4 ; D, wing ; E, tibial comb and F, terminalia.

Legs : Coxa and femur yellowish, rest of the segments dark brown. Fore leg : length of femur : 0.8 mm ; tibia 1.32 mm ; basitarsomere 1.0 ; 2nd tarsomere 0.39 mm. Hind leg : femur 1.36 mm ; tibia 1.88 mm ; basitarsomere 0.85 mm ; 2nd tarsomere 0.36 mm. Fore tibia with 3 distinctly enlarged dosal and 4 stout pre-apical setae ; fore tibial comb (Fig. 3E) composed of an ovoid patch of slightly differentiated setae

contiguous with other tibial setae. Mid tibia with several enlarged posterodorsal and dorsal setae, apex with 6 strong setae. Hind tibia with several enlarged posterodorsal along distal 1/3, slightly enlarged dorsal and posterior setae, apex with 6 enlarged setae. Tibial spurs 1 : 2 : 2 ; hind tibial spurs about 2.33× longer than diameter of tibial apex. Tarsal claws simple.

Abdomen—Brownish yellow ; tergal setae strong subequal to sternal setae.

Terminalia (Fig. 3F)—Tergum IX broadly semicircular with scattered long setae. Dorsal apodeme short and broad, inflated proximally, well sclerotized anteriorly, extending about 3/4 way into genital cavity. Ejaculatory apodeme long and narrow, moderately sclerotized, apical fork distinct. Aedeagus (Fig. 3 F) densely sclerotized along basolateral corners, lightly sclerotized on remainder. Tergum X bilobed, lobes slightly squared at apex, densely setigerous, several long setae along the apical margins. Gonocoxites broadly joined ventrally with triangular mid ventral lobe, clothed with many strong setae ; mesoapical setae slightly differentiated from other setae. Gonostylus acuminate distally with strong apical spur surrounded by 2-3 spines, outer margin with long and strong setae, rest of the surface clothed wirh moderately developed setae ; gonostylus about 1.84× longer than wide and 1.05× length of gonocoxite.

Female : Unknown.

Etymology : The name "*alia*" comes from characters of different nature.

Specimen examined : Holotype male (Type No. *Ent Pl. I. PCZM*), Darjeeling 15. VI. 1983. Coll. P. K. Chaudhuri. Paratypes : 4 males, North Bengal University campus, 4.V. 1981, Coll. S. K. Dasgupta.

Comments : This new species is separated from all other known species of *Plastosciara* by the following distinct features : RM index less than 1.0, basitarsomere of fore leg longer than fore femur, fore tibial comb ovoid with dense setae and differentiated from general tibial vestiture, hind tibial spurs distinctly longer than width of tibial apex, armature of gonostylus unique in having strong apical spur surrounded by fine spines.

5. **Scythropochroa subovopalpi** Alam & DasGupta, n. sp.

(Figs. 4 A-F)

Male :

Head—Black, subglobular. Length 0.42 (0.37 – 0.46, n=14) mm. Interfacetal hairs short and sparse, extending about 1/2 x height of facet. Eye bridge (Fig. 4A) moderately contiguous with 2 facets long at junction, becoming 3 facets long on next lateral row, facetal rows irregular. Ocelli subequal and equidistant from eye bridge by about 1/3 width of ocellus, median ocellus with 3-4 strong bristles. Anterior vertex apparently bare, 1/5 length of head ; posterior vertex with strong scattered setae. Prefrons with a

central patch of 12-16 strong setae. Clypeus bare. Labrum short, about 1/8 length of head. Proboscis and labellum reduced. Palpus (Fig. 4B) 1-segmented, almost oval, about 2.5 x longer than wide ; posterior 1/2 darkly sclerotized with numerous dorsal hyaline sensillae and 3-4 dorsolateral, 2 subapical, and 1-2 short anterior setae. Antenna blackish brown. Scape broader and slightly longer than pedicel with 10 strong setae arranged in irregular double rows at dorsomedian region ; pedicel globose

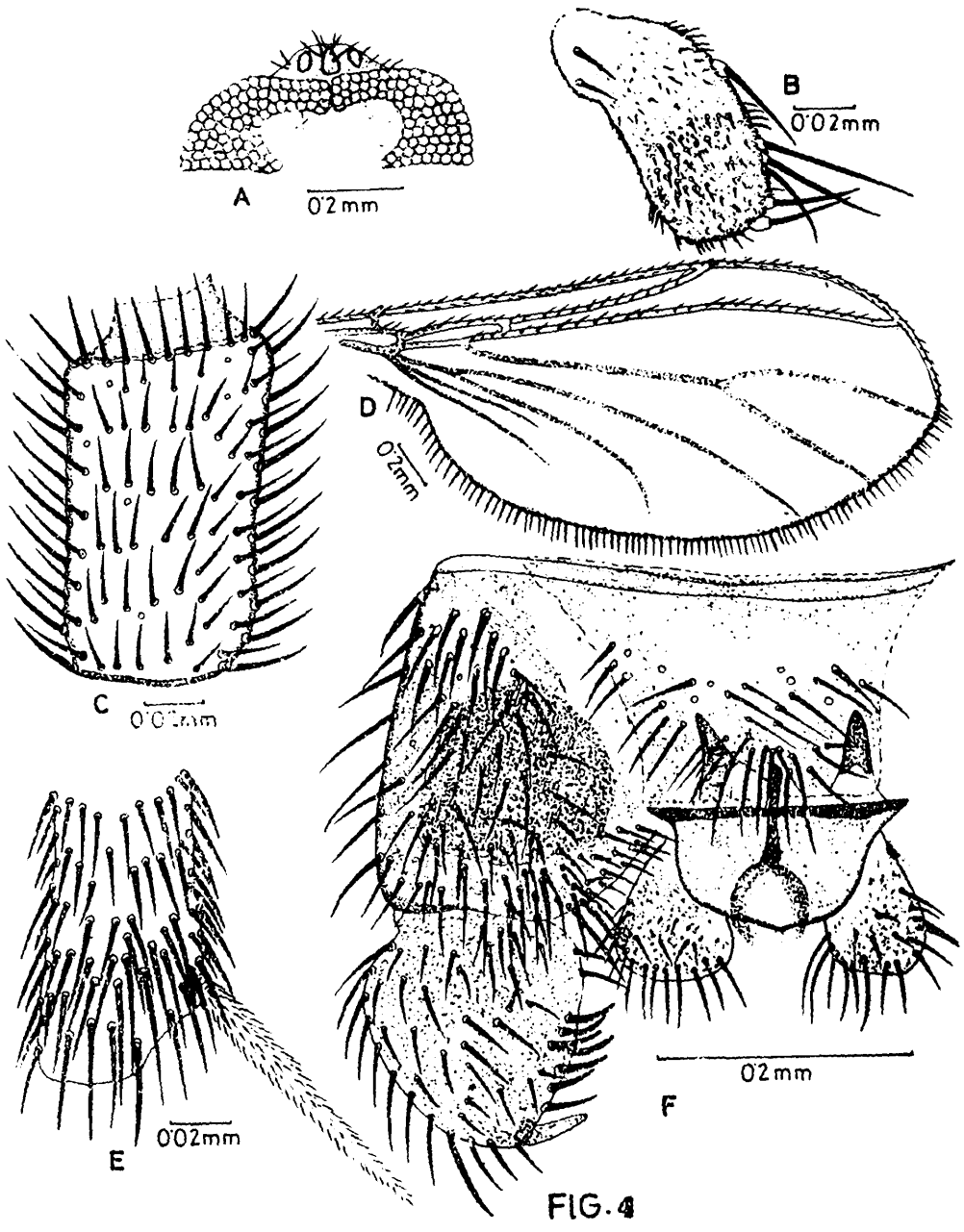

Fig. 4A—F. *Scythropochroa subovopalpi* Alam & Das Gupta, n. sp. : A, eye bridge ; B, palpus ; C, flagellomere 4 ; D, wing ; E, tibial comb and F, terminalia.

with 6 shorter setae arranged in a single row. Flagellomeres moderately long, apical segments narrower and longer ; flageller necks distinct ; flagellar hairs about 0.6 x of flagellomeres ; 4th flagellomere (Fig. 4C) 0.1 (0.09–0.12, n=14) mm. long, about diameter 1.78 x longer than wide ; neck 0.19 x length of flagellar joint.

Thorax—Blackish brown. Acrostichals moderately developed, restricted along 1/4 or slightly more of scutum; dorsocentrals well developed, posterior setae slightly longer; supraalars strong, longest one about 1.5 x largest dorsocentral. Scutellum well developed with 5-6 long setae posteriorly and 19-22 weak scattered setae ahead of longer ones. Posterior pronotum with 4 setae; anterior pronotum with 7-8 posterior setae. Proepisternum with 9 strong median setae. Proepimeron well developed; posterior epimeron of mesothorax broad, about 0.95 x longer than wide.

Wing (Fig. 4D)—Dark brown. Length 2.27 (2.1-2.4, n=14) mm; breadth 1.11 (1.0–1.22, n=14) mm. Entire wing surface clothed with microtrichia and posterior margin with numerous fine setae. Costa, R_1, R_{4+5} and RM with macrotrichia, other veins bare; R_1 joining costs oposite or slightly beyond the base of M fork. M fork symmetrical; all the veins distinct. RM index 1.04 (1.0–1.13, n=14), CM 0.73 (0.7–0.78, n=14), RM/bM 0.89 (0.78–1.08, n=14), St CuA/bM 1.02 (0.78–1.25, n=14). Haltere brown; mid-halteres subequal to slightly longer than haltere knob with 2-3 rows of dorsal setae disposed irregularly on the knob.

Legs—Coxa and femur brownish yellow, tibia and tarsal segments deep brown. Fore leg: length of femur 0.69 mm; tibia 1.07 mm; basitarsomere 0.58 mm, 2nd tarsomere 0.22 mm. Hind leg: femur 0.91 mm; tibia 1.28 mm; basitarsomere 0.58 mm; 2nd tarsomere 0.22 mm. Setae of fore and mid tibia largely subequal; fore tibial comb (Fig. 4E) composed of a large patch of slightly enlarged dark setae not separated from tibial vestiture by any bare area. Hind tibia with slightly enlarged posterodorsal setae along distal 1/2; apex with 6 enlarged setae. Tibial spurs 1 : 2 : 2; hind tibial spurs about 1.55 x longer than diameter of tibial apex. Tarsal claws simple.

Abdomen—Brownish black; tergal setae strong, evenly distributed; sternal setae subequal to slightly shorter than tergal setae; sternum VIII with 2-3 rows of posterior setae.

Terminalia (Fig. 4F)—Tergum IX almost quadrate with numerous strong setae at posterior 1/2. Tergum X bilobed, rounded to squared at apex, apical margin with several long setae distinct from other short setae. Dorsal apodeme moderately developed, distal 2/3 strongly sclerotized, little inflated proximally, extending about 1/2 or slightly less in way of genital cavity. Ejaculatory apodeme long rod-like, apical fork distinct 'U' shaped. Aedegus (Fig. 4F) a densely sclerotized along basal margin, lightly on remainder. Gonocoxites broadly joined ventrally with broad oval darkly sclerotized areas, entire surface clothed with strong dense setae; setae along dorsomesal surface more in number but short; mesoapical setae undifferentiated from nearby setae. Gonostylus subglobular clothed with numerous strong setae, terminating in a strong spur and a group of 7-9 inwardly directed mesal spines; gonostylus about 1.25 x longer than wide and 0.75 x length of gonocoxite.

Female: Unknown.

Etymology : The name "*subovopalpi*" is derieved from the nearly oval palpus.

Specimen examined : Holotype male (Type No. *Ent Scy I PCZM*), Ranchi, 12. VIII. 1967. Coll. S. K. DasGupta. Paratypes ; 5 males, Raniganj, 8. V. 1967 ; 4 males, Belpahari, 27. V. 1981, 28. V. 1981. Coll. P. K. Chaudhuri ; 4 males, Burdwan town, 17-18. VIII. 1979, Coll. P. K. Chaudhuri.

Comments : The present species is distinctly separated from other known Oriental and Micronesian species by almost-egg shaped palpus with different setal arrangements, RM index above 1.0, gonocoxites with darkly sclerotized areas, broader gonostylus with strong apical spur along with 7 or more recurved spines.

6. **Trichosia dolioflagellomera** Alam & DasGupta, n. sp.
(Figs. 5 A—K)

Male :

Head—Yellowish brown, subglobular to ovoid, and 0.43 mm. long. Interfacetal hairs sparse and short, rarely extending beyond outer curvature of facets. Eye bridge (Fig. 5A) broadly contiguous, 1-2 facets long at junction, rest of the eye bridge with 3 facets long, rows irregular. Median ocellus with 2 strong bristles separated from eye bridge by 1/2 width of ocellus, lateral ocelli slightly ahead. Anterior vertex 0.23x length of head with 7 short median and 8-9 moderately developed scattered setae ; posterior vertex with strong scattered setae. Prefrons with 18-21 scattered setae. Clypeus with 4 setae. Labrum subtriangular, 1/5 length of head. Proboscis about 0.3x length of head and subequal to the width of labellar lobes. Palpus (Fig. 5B) yellowish, 3—segmented. PP. 33 : 24 : 35 ; segment 1 slightly swollen midially with a patch of numerous dorsal hyaline sensillae and 10 setae ; segment 2 short, 0.65x length of segment 1, with 9 setae on distal 2/3 ; segment 3 elongate, little swollen at the region of distal 1/3, subequal to slightly longer than 1st segment, with 7 setae on distal 1/2. Antenna yellowish brown. Scape broader than pedicel with 1 row of 5 long median setae ; pedicel with 1 transverse row of 5-6 weaker setae, Flagellomeres cask shaped with indistinct neck ; flagellar hairs slightly shorter in length than the diameter of flagellomeres ; 4th flagellomere (Fig. 5C) 0.14 mm. long, 2.2x longer than wide.

Thorax—Yellowish brown with dark brown scutellum. Acrostichals moderately developed and disposed along anterior 3/4 ; dorsocentrals about 2x length of acrostichals ; supraalars slightly longer than dorsocentrals. Scutellum with 1 row of strong setae posteriorly and remainder of surface with weak scattered setae. Posterior pronotum with 5 setae ; anterior pronotum with 4-6 setae. Proepimeron 2 times longer than wide, posterior apex blunt ; anterior mesoepimeron slightly concave.

Wing (Fig. 5D)—Yellowish brown ; 2.0 mm long and 0.82 mm. wide ; entire wing membrane with densely arranged microtrichia and numerous scattered macrotrichia. Costa, R_1, R_{4+5}, stM. M_1 & M_2, CuA_1 & CuA_2 with macrotrichia ; M fork

symmetrical ; stM evanescent. RM index 0.94, CM 71, RM/bM 1.0 st CuA/bM 0.33. Haltere dark brown with club-shaped knob possessing 3 rows of dorsal setae.

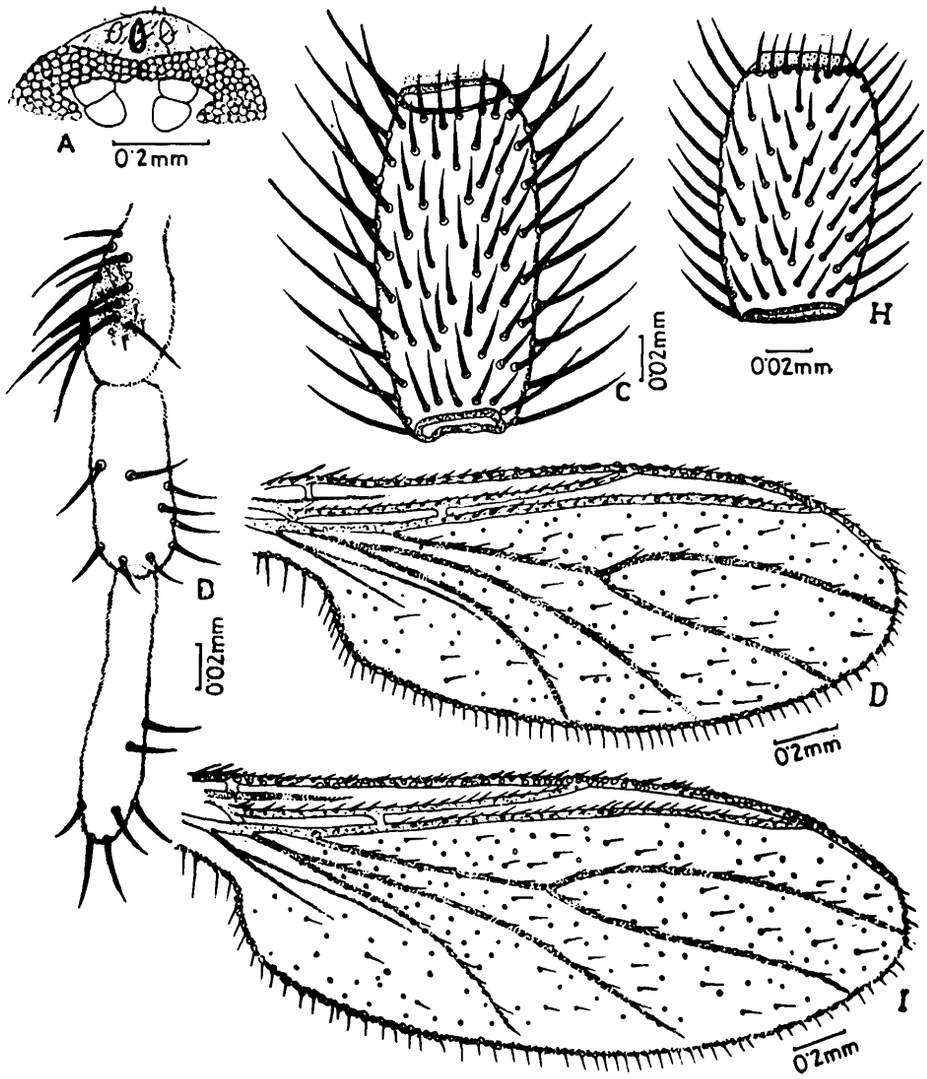

FIG.5

Figs. 5A, B, C, D, H, I : *Trichosia dolioflagellomera* Alam & Das Gupta, n. sp. : A, eye bridge ; B, palpus ; C, flagellamerr 4 ; D, wing ; H, flagellomere 4 ; I. wing.

Legs : Coxa and femur pale yellow, other segments hellowish brown. Fore leg : length of femur 0.6 mm ; tibia 0.86 mm ; basitarsomere 0.48 mm ; 2nd tarsomere 0.2 mm. Hind leg : femur 0.85 mm ; tibia 1.26 mm ; basitarsomere 0.53 mm ; 2nd tarsomere 0.22 mm. Fore tibia with few strong differentiated dorsal setae ; tibial comb (Fig. 5 E) with a patch of strong dark setae, not distinctly separated from general tibial vestiture ; 4 stout setae preapically. Mid tibia with differentiated dorsal, posterodorsal, ventral, and 8 preapical setae. Hind tibia with enlarged posterodorsal along median 1/2, scattered dorsal, ventral, and a row of strong preapical setae. Tibial spurs 1 : 2 : 2 ; hind tibial spurs 1.67 x longer than diameter of tibial apex. Tarsal claws simple.

Abdomen : Tergum brownish yellow with strong setae ; sternum pale yellow with weaker setae. *Terminalia* (Fig. 5 F)—Tergum IX trapezoidal with numerous long scattered setae. Dorsal apodeme well developed and thumb-like with moderate sclerotization, extending more than 1/2 way into genital cavity. Ejaculatory apodeme narrowed with broad apical fork. Aedeagus (Fig. 5 G) subtriangular and well sclerotized,

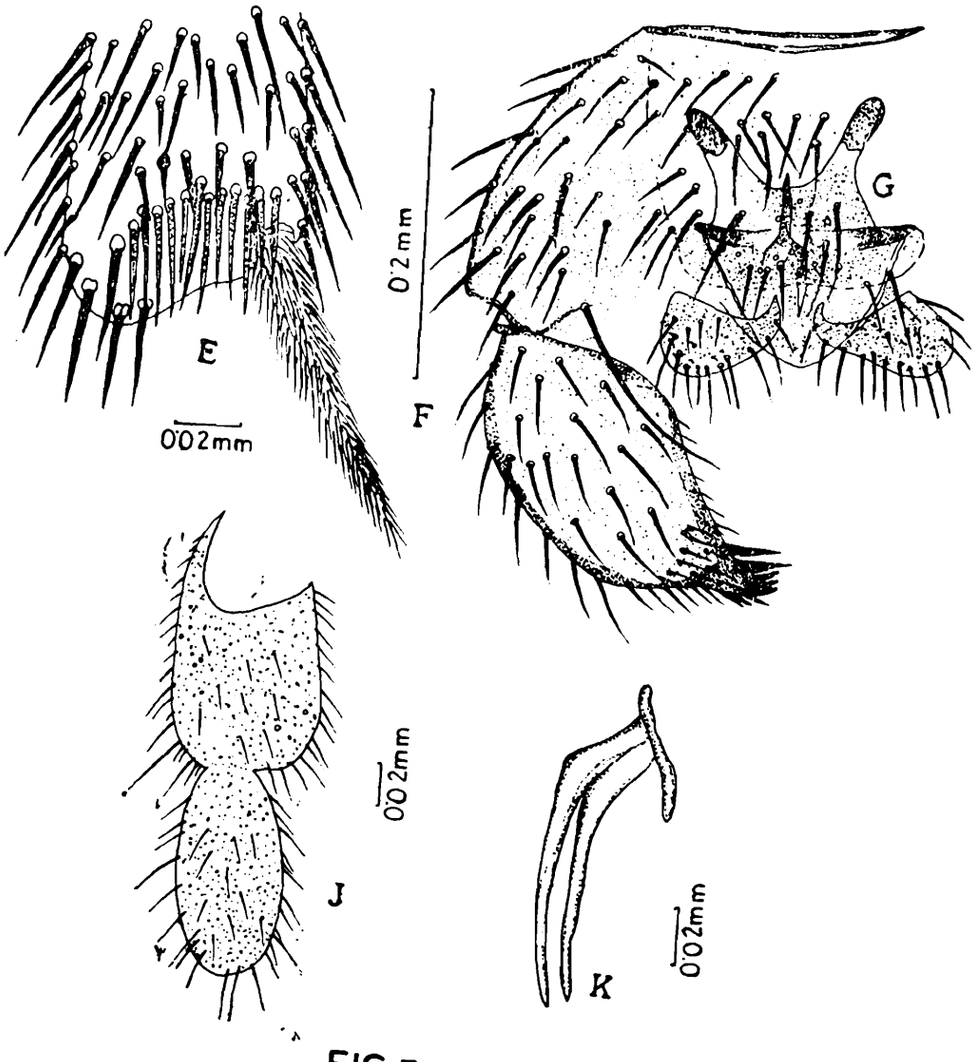

FIG.5

Figs. 5E, F, G, J, K ; E, tibial comb ; F, terminalia ; G, aedeagus of male ; J, cerci and K, vaginal furca of female.

dark at basal corners. Tergum X bilobed with long apical setae separated from other short setae. Gonocoxite simple with scattered setae ; 1 long whip-like seta to each gonocoxite, about 2/3 x length of gonostylus. Gonostylus cuneate ; apex with a patch of short spines separated from 2 long, stout spines mesoapically ; gonostylus 1.92 x longer than wide and 0.96 x length of gonocoxite.

Female :

Head—Blackish brown ; 0.47 (0.46-0.48 n=4) mm. long. Proboscis slightly longer than male. Flagellomere 4 (Fig. 5 H) about 0.7 x length of male, slightly

narrower. Palpus : PP. 45 : 33 : 47 ; segment 1 with 10, 2 with 12, and 3 with 10-13 setae.

Wing : (Fig. 5 I) greater than male ; length 2.77 (2.5-2.95, n=4) mm ; breadth 1.07 (0.98-1.12, n=4)mm ; macro and microtrichial distribution on the wing surface and veins strikingly similar to that of male. RM index 0.89 (0.82-0.94, n=4), CM as male, RM/bM 1.12(1.0-1.25 n=4), stCuA/bM 0.34 (0.33-0.35, n=4).

Legs—Fore leg : femur 0.79 mm ; tibia 1.08 mm ; basitarsomere 0.64 mm ; 2nd tarsomere 0.25 mm ; Hind leg : femur 1.11 mm ; tibia 1.64 mm ; basitarsomere 0.75mm ; 2nd tarsomere 0.28 mm. Fore tibial comb similar to male. Hind tibial spurs about 2 x longer than the diameter of tibial apex.

Abdomen : relatively longer than male. Terminalia : (Fig. 5 J) about 4 x length of hypogynal valves. Vaginal furca (Fig. 5 K) with narrowed stem ; arms anteriorly flattened and joining the stem near anterior 1/3.

Etymology : The name "*dolioflagellomera*" denotes the cask shaped flagellomere.

Specimen examined : Holotype male (Type No. Ent Tr 1 PCZM), Siliguri, 8.V.1973, Coll. S. K. Dasgupta. Allotype female, data same as holotype.

Paratypes : 4 females with data same as type.

Comments : This new species is somewhat allied to *T. ussurica* Mohrig and Antonowa (1978), described from U. S. S. R. and also to the Indian species *T. trilineata* (Brunetti 1912) but distinguishable features like cask-shaped flagellomeres with very indistinct neck, 10 setae on 1st palpal segment, cuneate gonostylus with short apical and long mesoapical spines, and differently shaped vaginal furca of female establishing it as a new species.

SUMMARY

Five species of Sciardid gnats, *Epidapus nullusanalis* n. sp., *Lycoriella crassisetosa* n. sp. *Plastosciara alia* n. sp., *Scythropochroa subovopalpi* n. sp., *Trichosia dolioflagellomera* n. sp. are described and one species, *Lobosciara spinipennia* (Sasakawa) is recorded in India.

ACKNOWLEDGEMENTS

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ASILIDAE (DIPTERA) FROM GUJARAT, INDIA

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INTRODUCTION

In August 1988 we, in collaboration with the Desert Regional Station, Zoological Survey of India, Jodhpur, surveyed Gujarat for asilids. Due to unprecedent rains during this period the robberflies were scarce. The paper reports the collection made during this period. The arrangement of genera followed is based on 'A Review of the Asilidae (Diptera) from India' by Joseph & Parui (1990).

The types are deposited in the National Zoological Collections, Zoological Survey of India, Calcutta.

Genus **Laxenecera** Macquart

1838. *Laxenecera* Macquart, *Dipt. exot.* **1** (2) : 77.

Type species : *Laxenecera albibarbis* Macquart ; designated by Hermann (1919 : 340).

1. **Laxenecera albibarbis** Macquart

1838. *Laxenecera albibarbis* Macquart, *Dipt. exot.* **1** (2) : 195.

1990. *Laxenecera albibarbis* : Joseph & Parui, *Rec. zool. Surv. India*, Occ. Paper No. 113 : 16.

Material examined : 2♂, Gujarat : Rajkot Dist. : Rajkot, 29.viii.1988 ; 1♂, 3♀, Baroda Dist. : Baroda, 29.viii.1988, all Coll. A. N. T. Joseph.

Distribution : It is already recorded from Andaman, Bihar, Gujarat, Himachal Pradesh, Maharashtra, Rajasthan, Uttar Pradesh and West Bengal.

2. **Laxenecera flavibarbis** Macquart

1838. *Laxenecera flavibarbis* Macquart, *Dipt. exot.* **1** (2) : 194.

1990. *Laxenecera flavibarbis* : Joseph & Parui, *Rec. zool. Surv. India*, Occ. Paper No. 113 : 16.

Material examined : 2♀, Gujarat : Baroda Dist. : Pipae, 29.viii.1988 ; 2♂, Baroda Dist. : Baroda, 29.viii.1988, all Coll. A. N. T. Joseph.

Distribution : It is already reported from Bihar, Goa, Gujarat, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal.

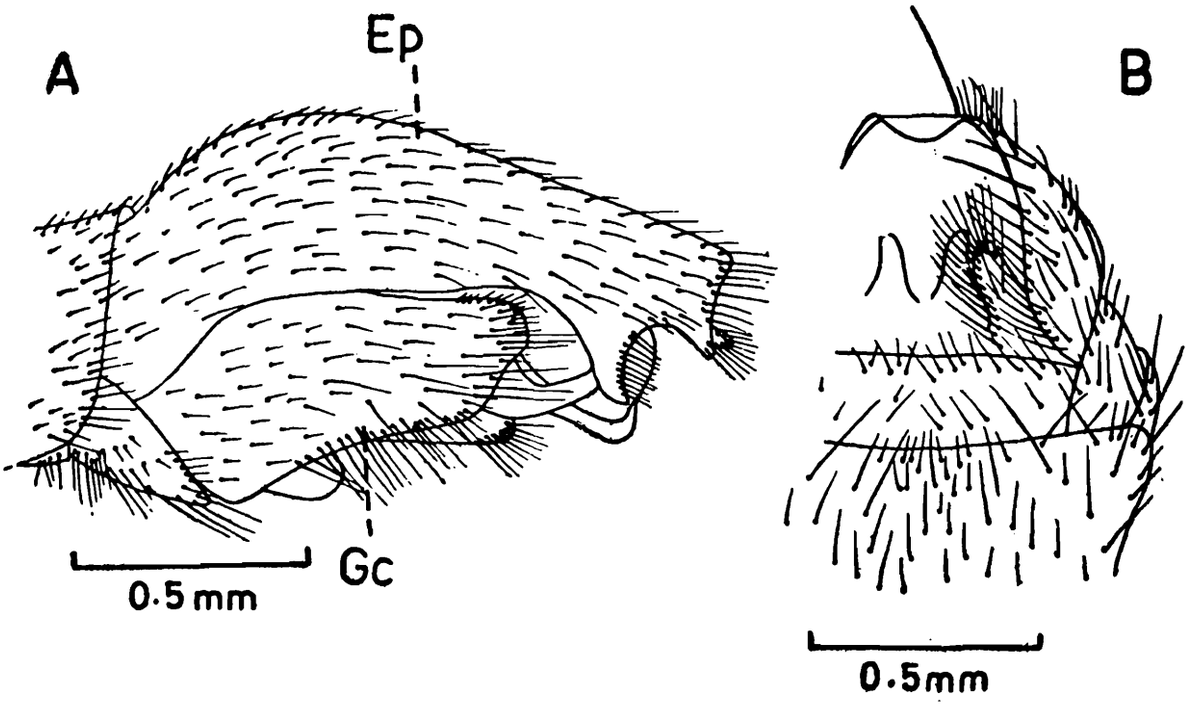
Genus **Nusa** Walker

1851. *Nusa* Walker, *Insecta Saundersiana*, **1** : 105.

Type species : *Nusa aequalis* Walker ; designated by Hermann (1912 : 243).

3. **Nusa bhargavai** n. sp. (Fig)

A medium to rather large, black species with grey tomentum, black legs and dark brown wings. *Male* : length 14-17 mm, wing 8-9 mm ; female : length 13 mm, wing 10 mm.



Nusa bhargavai n. sp.
A, lateral view of male genitalia ; B, ventral view of female genitalia.

Male : *Head* broader than thorax, black with dense grey tomentum ; mystax white with a few black bristles, fronto-orbital bristles and ocellar bristles black, postocular bristles with one or two pairs of pale yellow bristles or wholly black, postcranium with sparse, white setae, postgena with white setae. Antenna black with distal half of first flagellomere orange, scape and pedicel bear black and white bristles, pedicel from two-thirds to subequal to the length of scape, scape more than half to two-thirds length of 1st flagellomere, the latter short. Palpus and proboscis black with white setae.

Thorax black, grey tementose ; pronotum with a median transverse row of black bristles, laterally with white setae ; scutum devoid of mediolongitudinal stripe ;

chaetotaxy : 2 notopleurals, 3 (+1 weak) postalars, 4 supra-alars, 1 additional bristle anterior to notopleurals ; vestiture black with a few white setae on humeri, bristles black or black and pale yellow ; scutellum with 10 black or black and pale yellow bristles on border, disc with black setae ; katatergite with elongate pale yellow and white bristly setae. Haltere yellowish-brown to dark brown.

Legs black, fore tibia anteroventrally and tarsus ventrally with mat of golden yellow setae, bristles black and white, vestiture black.

Wing dark brown ; R_5 and M_1 united well before the border.

Abdomen black, terga laterally and posteriorly with light grey tomentum which gradually decrease from anterior to posterior terga, terga 1-5 with 1 to 5 white bristles, vestiture black and white. Male genitalia (Fig. A) black, epandrium distinctive.

Female ; Similar to males but with the following differences : mystax wholly white, fronto-orbital bristles white, postocular bristles white with 2 black bristles, antennal scape and pedicel with bristles wholly white ; chaetotaxy : about 10 setae in place of supra-alars ; scutellar bristles and setae white, haltere pale yellow ; abdominal terga posteriorly and laterally yellowish-brown. Genitalia [Fig. B) figured.

Holotype ♂, Reg. No. 7709/H6, Gujarat : Junagadh Dist., : Veraval : Kukusvada, 15.viii.1988, Coll. A. N. T. Joseph. *Paratypes* 2♂, Reg. No. 7710/H6 and 7711/H6, Veraval : Garakmandi, 16.viii.1988 ; 1♀, Reg. No. 7712/H6, Rajkot Dist. : Rajkot, 21.viii.1988, all Coll. A. N. T. Joseph and P. Parui.

It is similar to *Nusa formio* Walker differing from which in the following : black species including wholly black legs, dark brown wings and differences in the shape of male genitalia, especially epandrium and gonocoxite. It is named in honour of Sri R. N. Bhargava, our colleague who helped us to complete the survey of robberflies from Gujarat successfully.

4. **Nusa elva** (Walker)

1849. *Asilus elva* Walker, *List Dipt. Colln. Br. Mus.* 2 : 445.

1975. *Nusa elva* : Oldroyd, *A Catalog of Diptera of the Oriental Region* 2 : 115.

Material examined : 1♂, Gujarat : Junagadh Dist. : near Sidhakar, 12.viii.1988 ; 1♀, Junagadh Dist. : Veraval Dari, 15.viii.1988 ; 2♂, Rajkot Dist. : Targharia, 21.viii.1988, all Coll. A. N. T. Joseph.

Distribution : It is recorded for the first time from Gujarat. The other recorded localities are "Bengal" and Assam.

Genus **Michotamia** Macquart

1838. *Michotamia* Macquart, *Dipt. exot.* 1 (2) : 75.

Type species : *Michotamia analis* Macquart, 1838 : 72 ; monotypic.

5. **Michotamia aurata** (Fabricius)

1794. *Asilus aurata* Fabricius, *Ent. Syst.* **4** : 387.

1975. *Michotamia aurata* : Oldroyd, *A Catalog of Diptera of the Oriental Region* **2** : 130.

Material examined : 1♂, 1♀, Gujarat : Baroda Dist. : Baroda, 29.viii.1988, all Coll. A. N. T. Joseph.

Distribution : Although it is widely distributed in India, it is recorded here for the first time from Gujarat.

Genus **Ommatius** Wiedemann

1821. *Ommatius* Wiedemann, *Dipt. exot.* **1** : 213.

Type species : *Asilus marginellus* Fabricius ; designated by Coquillett (1910 : 579).

6. **Ommatius indicus** Joseph & Parui

1983. *Ommatius indicus* Joseph & Parui, *Ent. Scand.* **14** (1) : 86.

Material examined : 4♂, 7♀, Gujarat : Gandhi Nagar : Indrora Nature Park, 28.viii.1988, Coll. A. N. T. Joseph.

Distribution : It is recorded for the first time from Gujarat. The other already recorded localities are Andhra Pradesh, Karnataka, Kerala and Tamil Nadu.

7. **Ommatius ponti** Joseph & Parui

1984. *Ommatius ponti* Joseph & Parui, *Oriental Ins.* **18** : 58.

Material examined : 2♂, 4♀, Gujarat : Junagadh Dist. : Veraval, 15.viii.1988 : Coll. A. N. T. Joseph.

Distribution : This is the first record of the species from Gujarat. It was earlier recorded from Rajasthan and Uttar Pradesh. Its type locality is Pakistan.

Genus **Stichopogon** Loew

1847. *Stichopogon* Loew, *Linn. Ent.* **2** : 499.

Type species : *Dasypogon elegantulus* Wiedemann, 1820 ; original designation.

8. **Stichopogon inaequalis** (Loew)

1847. *Dasypogon inaequalis* Loew, *Linn. Ent.* **2** : 505.

1975. *Stichopogon inaequalis* Oldroyd, *A Catalog of Diptera of the Oriental Region*, **2** : 129.

Material examined : 3♀, Gujarat : Mahesana Dist. : Taranga Hills, 9.viii.1988 ; 5♂, 8♀, Gandhinagar Dist. : Indrora Nature Park, 28.viii.1988 ; 1♂, Ahmedabad Dist. : Vastrapur, 31.viii.1988, all Coll. A. N. T. Joseph.

Distribution : In India the species has been reported from Andaman, Andhra Pradesh, Bihar, Maharashtra, Rajasthan and Tamil Nadu. It is the first record from Gujarat.

9. **Stichopogon tomentosus** Oldroyd

1948. *Stichopogon tomentosus* Oldroyd, *Entomologist's mon. Mag.* **84** : 263.

1990. *Stichopogon tomentosus* : Joseph & Parui, *Rec. zool. Surv. India*, Occ. Paper No. 113 : 42.

Material examined : 1 ♂, 4 ♀, Gujarat : Baroda Dist. : Pipae, 29.viii.1988, Coll. A. N. T. Joseph.

Distribution : The species is recorded here for the first time from Gujarat. The earlier recorded localities are Andaman, Bihar, Karnataka and Rajasthan.

Genus **Astochia** Becker

1913. *Astochia* Becker, *Ann. Mus. Zool. Acad.*, St. Peters-bourgh **17** : 538.

Type species : *Astochia metatarsata* Becker ; monotypic.

10. **Astochia pseudoguptai** Joseph & Parui

1987. *Astochia pseudoguptai* Joseph & Parui, *Bull. zool. Surv. India* 8 (1-3) : 100.

Material examined : 6 ♂, 3 ♀, Gujarat : Junagadh Dist. : near Sidokar, 12.viii.1988 ; 3 ♂, 1 ♀, Junagadh Dist. : Medhal River bridge, 15.viii.1988, all Coll. A. N. T. Joseph.

Distribution : This species is recorded earlier from Rajasthan and Sikkim. It is the first report from Gujarat.

Genus **Clephydroneura** Becker

1925. *Clephydroneura* Becker, *Ent. Mitt.* **14** : 68.

Type species ; *Asilus xanthopus* Wiedemann ; designated by Oldroyd (1938 : 450).

11. **Clephydroneura pulla** Oldroyd

1938. *Clephydroneura pulla* Oldroyd, *Ann. Mag. nat. Hist.* (11) **1** : 467.

1990. *Clephydroneura pulla* : Joseph & Parui, *Rec. zool. Surv. India*, Occ. Paper No. 113 : 51.

Material examined : 2 ♂, 6 ♀, Gujarat : Gandhi Nagar : Indroro Nature Park, 28.viii.1988, 2 ♂, Gandhi Nagar, Sharita Garden, 30.viii.1988, all Coll. A. N. T. Joseph.

Distribution : The species is known to occur in Andhra Pradesh, Karnataka and Tamil Nadu. It is recorded for the first time from Gujarat.

Genus **Philodicus** Loew

1848. *Philodicus* Loew, *Linn. Ent.* **3** : 391.

Type species : *Asilus javanus* Wiedemann, 1819 : 4 ; original designation.

12. **Philodicus ceylanicus** Schiner

1868. *Philodicus ceylanicus* Schiner, in *Reise der Osterreichischen Fregatte Novara, Dipt.* : 179.

1990. *Philodicus ceylanicus* : Joseph & Parui, *Rec. zool. Surv. India,* Occ. Paper No. 113 : 61.

Material examined : 2♂, 1♀, Gujarat : Junagadh Dist. : Veraval Dari, 15.viii.1988. 2♂, 3♀, Jamnagar Dist. : Dharol, 18.viii.1988 ; 1♂, 3♀, Jamnagar Dist. : Dwarka, 19.viii.1988 ; 3♂, 1♀, Rajkot Dist. : Targhoria, 21.viii.1988 ; 3♂, 2♀, Rajkot Dist. : 23.viii.1988, all Coll. A. N. T. Joseph.

Distribution : Earlier recorded localities are Andaman, Kerala, Pondicherry, Tamil Nadu and West Bengal. It is recorded for the first time from Gujarat.

13. **Philodicus femoralis** Ricardo

1921. *Philodicus femoralis* Ricardo, *Ann. Mag. nat. Hist.* (9) 8 : 190.

1990. *Philodicus femoralis* : Joseph & Parui, *Rec. zool. Surv. India,* Occ. Paper No. 113 : 61.

Material examined : 1♂, 3♀, Gujarat : Junagadh Dist. : Veraval Dari, 15.viii.1988, Coll. A. N. T. Joseph.

Distribution : It is the first report of the species from Gujarat. Earlier recorded localities are Arunachal Pradesh, Bihar, Goa, Kerala, Meghalaya, Orissa, Rajasthan and West Bengal.

Genus **Promachus** Loew

1848. *Promachus* Loew, *Linn. Ent.* 3 : 390.

Type species : ***Asilus maculatus*** Fabricius ; designated by Coquillett (1910 : 595).

14. **Promachus duvaucelii** (Macquart)

1838. *Trupanea duvaucelii* Macquart, *Dipt. exot.* 1 (2) : 97.

1975. *Promachus duvaucelii* : Oldroyd, *A Catalog of Diptera of the Oriental Region* 2 : 152.

Material examined : 1♀, Gujarat : Junagadh Dist. : Veraval, 15.viii.1988 ; 1♂, 1♀, Rajkot Dist. : Rajkot, 21.viii.1988 ; 6♂, 3♀, Rajkot Dist. : Bedi, 23.viii.1988 ; 9♂, 4♀, Surendranagar Dist. : Kotaria, 24.viii.1988 ; 1♂, 2♀, Surendranagar Dist. : Mandal, 25.viii.1988 ; 1♂, Ahmedabad Dist. : Nal Sarovar Birds Sanctuary, 26.viii.1988 ; 12♂, 6♀, Gandhinagar : Indrora Nature Park, 28.viii.1988 ; 3♂, 6♀, Baroda Dist. : Pipae, 29.viii.1988 ; 5♂, 3♀, Baroda Dist. : Baroda, 29.viii.1988 ; 9♂, 6♀, Gandhinagar : Sharita Garden, 30.viii.1988, all Coll. A. N. T. Joseph.

Distribution : It has already been recorded from Andhra Pradesh, Delhi, Gujarat, Madhya Pradesh, Punjab, Rajasthan, Uttar Pradesh and West Bengal.

SUMMARY

The paper deals with fourteen species of asilids from Gujarat, of which one, *Nusa bhargavai*, is a new species and ten species, *Nusa elva* (Walker), *Stichopogon inaequalis* (Loew), *S. tomentosus* Oldroyd, *Michotamia aurata* (Fabricius), *Ommatius indicus* Joseph & Parui, *O. ponti* Joseph & Parui, *Astochia pseudoguptai* Joseph & Parui, *Clephydroneura pulla* Oldroyd, *Philodicus ceylanicus* Schiner and *P. femoralis* Ricardo, are reported for the first time from Gujarat.

ACKNOWLEDGEMENTS

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Abbreviations : Ep, epandrium ; Gc, gonocoxite.

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FLAGELLATE SYMBIOTES (PROTOZOA) OF XYLOPHAGOUS TERMITES FROM NORTHERN BIHAR

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Introduction

Taxonomic studies on the flagellate symbiotes of Indian termites are inadequate and restricted only to a few states of eastern and western parts of the country (*see* Das, 1983). The northern part of India which covers a large area and comprises a large number of states remains almost unexplored excepting one publication of Tiwari (1988) who reported the occurrence of six species of termite flagellates from Uttar Pradesh. However, Simmons (*loc. cit.* Kirby, 1932) studied some 'Behar termites' which as he found were not infected by any protozoa. In view of this the present author undertook several surveys in the districts of Bhagalpur, Chhapra (Saran), Darbhanga, Dumka, Gopalganj, Madhubani, Monghyr, Muzaffarpur, Purnea, Saharsa, Sahibganj, Samastipur, Vaishali, and West Champaran in the northern part of Bihar during 1983-1984 and 1986 and collected 27 species of termite flagellates from 5 species of termite hosts. These flagellates are being dealt with in the present communication.

Material and Methods

During the course of this study large number of termites were examined from different localities. The termites examined were collected from different habitats, specially from the living and dried trees and agricultural plants. Sometimes collection of host termites were also made from timber depots, logs, cemented brick built walls, plywoods and pitch boards. Attempts were made to obtain their different castes, especially the soldiers for proper identification of termites as without soldiers identification of termites is not possible.

To obtain flagellate symbiotes of termites, the entire gut of the worker caste was removed and gut contents were emptied on clean slide containing a drop of 0.5 per cent saline. Generally 67 per cent lock's solution was applied in which the protozoa are less deformed and remain active for a long period. The study is based on the material obtained from living termites. As fixative Schaudinn's fluid was used. The materials so fixed were mostly stained in Heidenhain's iron haematoxylin and some times Eosin was used as a counter stain and mounted in DPX. The dilute Lugol's iodine was occasionally used to detect in the ingested wood particles inside the protozoans specimens examined under microscope. The morphometric measurements of flagellates

on permanent mount were taken with the help of ocular micrometer. The drawings were made with the aid of Camera Lucida (Prism type).

Systematic List of Flagellates

Order : OXYMONADIDA

Family : Oxymonadidae

1. *Oxymonas bosei* Das
2. *O. grandis* Cleveland

Order : TRICHOMONADIDA

Family : Devescovinidae

3. *Caduceia kalshoveni* Kirby
4. *Devescovina glabra* Grassi
5. *D. lemniscata* Kirby
6. *Foaina reflexa* Kirby
7. *F. solita* Kirby
8. *Macrotrichmonas pulchra* Grassi

Family : Calonymphidae

9. *Stephanonympha minuta* Das and Choudhury
10. *S. pyriformis* Das and Choudhury
11. *S. silvestrii* Janicki

Order : HYPERMASTIGIDA

Family : Holomastigotidae

12. *Holomastigotoides bengalensis* Chakravarty and Banerjee
13. *H. campanula* (De Mello)
14. *H. emersoni* Das
15. *H. hollandei* Das
16. *H. magnus* Uttangi
17. *H. ogivalis* De Mello
18. *H. ovalis* Uttangi
19. *H. rayi* Karandikar and Vittal

20. *H. reniformis* De Mello
21. *H. sphaeroidalis* De Mello

Family : SPIROTRICHONYMPHIDAE

22. *Spirotrichonympha bhadreshwarensis* Tiwari
23. *S. froilanoi* Karandikar and Vittal
24. *S. roonwali* Das

Family : EUCOMONYMPHIDAE

25. *Pseudotrichonympha cardiformis* Karandikar and Vittal
26. *P. indica* Chakravarty and Banerjee
27. *P. subapicalis* Karandikar and Vittal

HOST—SYMBIOTE LIST

Host	Flagellates
1. *Cryptotermis havilandi* (Sjosted) :	1. *Oxymonas bosei* Das
	2. *O. grandis* Cleveland
	3. *Devescovina glabra* Grassi
	4. *D. lemmiscata* Kirby
	5. *Foaina solita* Kirby
	6. *Stephanonympha minuta* Das and Choudhury.
2. *Glyptotermes caudomunitus* Kemner	1. *Macrotrichomonus pulchra* Grassi
3. *Neotermes bosei* Snyder	1. *Caduceia kalshoveni* Kirby
	2. *Foaina reflexa* Kirby
	3. *Stephanonympha pyriformis* Das and Choudhury
4. *Coptotermes heimi* (Wasmann)	1. *Holomastigotoides bengalensis* Chakravarty and Banerjee
	2. *H. campanula* (De Mello)
	3. *H. emersoni* Das
	4. *H. magnus* Uttangi
	5. *H. ogivalis* De Mello

Host	Flagellates
	6. *H. reniformis* De Mello
	7. *H. sphaeroidalis* De Mello
	8. *Spirotrichonympha bhadreshwarensis* Tiwari
	9. *S. roonwali* Das
5. *Heterotermes indicola* (Wasmann)	1. *Holomastigotoides hollandei* Das
	2. *H. ovalis* Uttangi
	3. *H. rayi* Karandikar and Vittal
	4. *Pseudotrichonympha cardiformis* Karandikar and Vittal
	5. *Spirotrichonympha froilanai* Karandikar and Vittal

Key to families, genera and species

1. Mastigont system with limited flagella 17
   Mastigont system with numerous flagella 2
2. Flagella arranged in spiral rows 3
   Flagella not arranged in spiral rows — Family Eucomonymphidae (Genus *Pseudotrichonympha*) ... 15
3. Spiral rows of flagella numerous — Family *Holomastigotidae* (Genus Holomastigotoides) ... 4
   Spiral rows of flagella limited — Family Spirotrichonymphidae (Genus *Spirotrichoympha*) ... 13
4. Prenuclear zone present 5
   Prenuclear zone absent ... *H. campanula*
5. Prenuclear zone occurs as narro strip over the nucleus ... *H. magnus*
   Prenuclear zone not occurs as narrow strip over the nucleus 6
6. Body elliptical with nipple like anterior end ... *H. bengalensis*
   Body elliptical without nipple like anterior end 7
7. Non-stereociliac flagella occupying the posterior one fifth of the body ... *H. rayi*
   Non-stereociliac flagella not occupying the posterior on fifth of the body ... 8

8.	Axostyle present	...	... 9
	Axostyle absent	...	*H. ovalis*
9.	Apical pit present	...	*H. hollandei*
	Apical pit absent	...	... 10
10.	Nucleus round	...	... 11
	Nucleus not round	...	... 12
11.	Body spherical	...	*H. sphaeroidalis*
	Body club-shaped	...	*H. emersoni*
12.	Body inverted cup-shaped	...	*H. ogivalis*
	Body reniform	...	*H. reniformis*
13.	Body cone-shaped	...	*S. froilanoi*
	Body not cone-shaped	...	... 14
14.	Posterior extremity drawn out into a cone	...	*S. roonwali*
	Posterior extremity not drawn out into a cone	...	*S. bhadreshwarensis*
15.	Campanula subapical in position	...	*P. subapicalis*
	Campanula not subapical in position	...	... 16
16.	Body heart shaped	...	*P. cardiformis*
	Body elongated	...	*P. indiaca*

17. Mastigont having two to four flagella always associated with an axostyle, parabasal body present 18

No such mastigont system present, parabasal body absent ... Family : Oxymonadidae (Genus : **Oxymonas**)...26

18. Nucleus single — Family : Devescovinidae...19

Nucleus multiple — Family : Calonymphidae (Genus : **Stephanonympha**)...24

19. Trailing flagellum longer than the body 20

Trailing flagellum shorter than the body — Genus : **Caduceia** (*C. kalshoveni*).

20. Cresta very much enlarged with internal membrane — Genus : **Macrotrichomonas** ... (*M. pulchra*)

Cresta without much enlargement and without internal membrane ... 21.

21. Trailing flagellum $1-1\frac{1}{2}$ times of the body length ... Genus **Devescovina**...22

Trailing flagellum more than two times of the body length — Genus **Foaina** ...23

22. Cytoplasm contains group of deep staining granules posterior to the nucleus, trailing flagellum card-like ... *D. glabra*

Cytoplasm not containing such granules, trailing flagellum band-shaped ... *D. lemniscata*

23. Parabasal body with U-shaped bend ... *F. reflexa*

Parabasal body without such bend ... *F. solita*

24. Body pyriform with bluntly pointed anterior end ... *S. pyriformis*

Body not pyriform without bluntly pointed end 25

25. Eight to twelve nuclei in a single spiral rows ... *S. minuta*

Numerous nuclei in two to three spiral rows ... *S. silvestrii*

26. Body broadly ovoidal with stiletto-shaped axostyle ... *O. bosei*

Body ellipsoidal with scimitar-shaped axostyle ... *O. grandis*

Abreviations Used

b=body width, cam=campanula length, cr=cresta length, f_1=first type of flagella, f_2=second type of flagella, f_3=third type of flagella, l=body length, nb=nuclear width, nl=nuclear length, rst=rostrum length, tf=trailing flagellum.

Systematic Accounts

Order : OXYMONADIDA

Family : Oxymonadidae

1. **Oxymonas bosei** Das

(Fig. 1)

1974. *Oxymonas bosei* Das, *Acta Protozool*, 12 : 337.

Material examined : 2 exs, Sonepure, Chhapra Dist., Bihar ; 7.xii.1984, Coll. D. N. Tiwari.

Diagnosis : Body broadly ovoidal, rostellum extending up to 1.5 times length of body ; axostyle stiletto-shaped, projecting slightly below the nucleus and hanging freely in cytoplasm ; blepharoplast two in number and located near shoulder of rostellum ; nucleus elliptical containing one ovoidal karyosome at center and numerous fine granules mostly concentrated to peripheral zone ; endoplasm containing fragments of wood particles.

Measurements : l=125–172 (150) μm ; b=34–45.5 (41.2)μm ; nl=8.7–13.6 (11.9) μm ; nb=4.6–8.5 (6.6)μm ; l : b=2.8–5(3.7) ; l : nl=9.1–17.5 (13).

Present host : *Cryptotermes havilandi* (Sjöstedt).

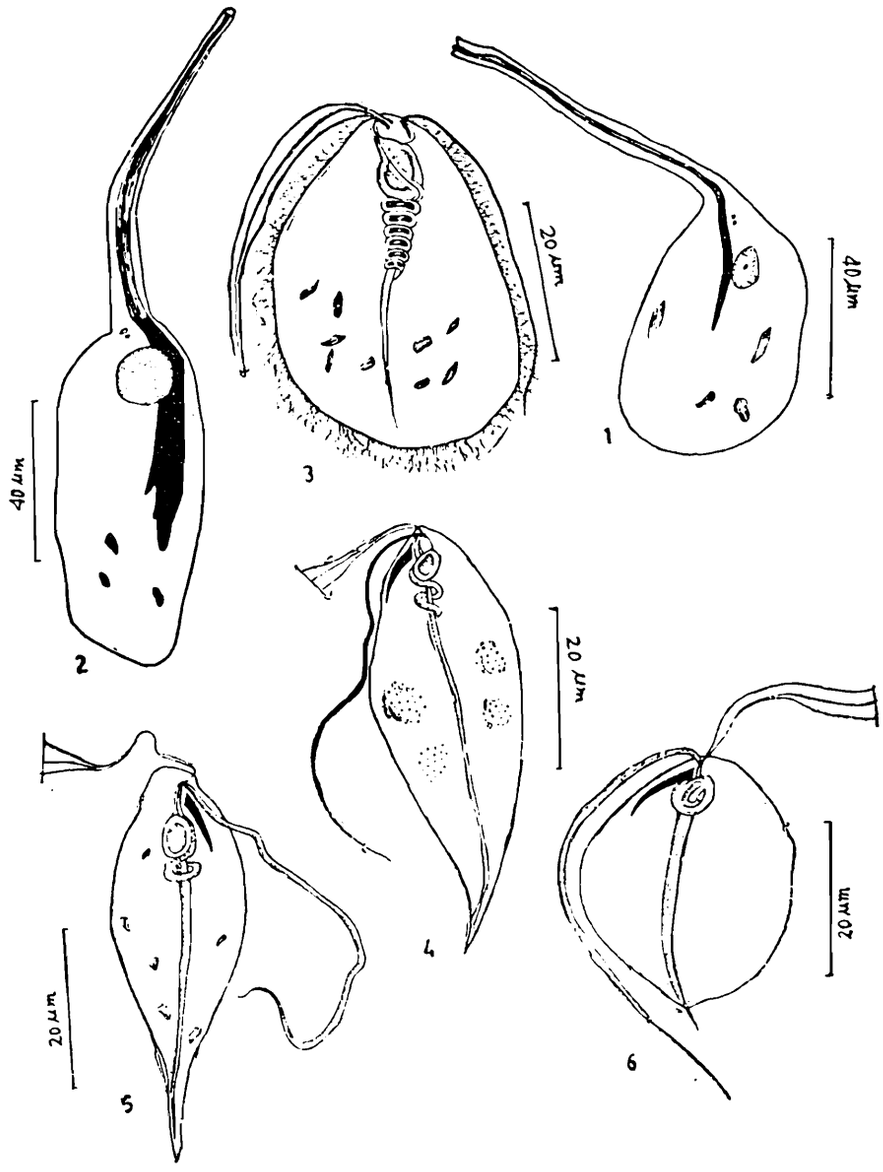
Distribution : India ; Bihar (Present record), West Bengal.

2. **Oxymonas grandis** Cleveland

(Fig. 2)

1935. *Oxymonas grandis* Cleveland, *Biol. Bull.* **69** : 54.

Material examined : 2 exs., Jhanjharpur, Madhubani Dist., Bihar ; 21.i.1986, Coll. D. N. Tiwari.



Figs. 1. *Oxymonas bosei* Das
2. *Oxymonus grandis* Cleveland
3. *Caduceia kalshoveni* Kirby
4. *Devescovina glabra* Grassi
5. *Devescovina lemniscata* Kirby
6. *Feaina reflexa* Kirby

Diagnosis : Body ellipsoidal, size of rostellum varies depending upon attaching or motile phase, axostyle scimitar-shaped, nucleus ovoidal, situated posterior to shoulder of axostyle, karyosome absent, chromatin granules of various sizes ; endoplasm containing fragments of wood particles.

Measurements : l=87.5–224 (182.8)μm ; b=38.5–49(43.2)μm ; nl=17.5–24.5 (20.1)μm ; nb=10.5–17.5 (14.8)μm ; 1 : b=2.3–5.3 (4.1) ; 1 : nl=5–10.6 (8.9).

Present host : *Cryptotermes havilandi* Sjöstedt).

Distribution : India : Bihar (present record), West Bengal.

Order : TRICHOMONADIDA

Family : DEVESCOVINIDAE

3. **Caduceia kalshoveni** Kirby

(Fig. 3)

1942. *Caduceia kalshoveni* Kirby, *Univ. Calif. Publs Zool.*, **45** : 108.

Material examined : 3 exs., Borio, Dumka dist., Bihar ; 23.xi.1983, Coll. D. N. Tiwari.

Diagnosis : Body more or less round ; slender ring present at anterior part of body. Posterior roots of anterior flagella ends with large irregular granules and connected by a fine fibril to blepharoplast group of several closely approximated granules. Cresta, trailing flagellum, parabasal body and anterior flagella connected with blepharoplast. Trailing flagellum long, slender, cord-like and shorter than body. Cresta very small ; parabasal body coiled lightly around the trunk of axostyle ; parabasal turn ranging from 5-9 in number. Chromatin sheild absent ; nucleus oval ; endoplasm containing numerous granules and indigested wood particles ; smaller sphirochaetes densely distributed on entire body surface.

Measurements : 1=36–52.5(42.6) μm, b=24–45(30.9) μm, nl=6.7–7.5(7.3) μm, nb=5.2–6(5.8) μm, tf=34.5–45(36.3) μm, 1 ; b=1.1–1.7(1.4), 1 : nl=4.8–7(5.8).

Present host : *Neotermes bosei* Snyder.

Disiribution : India : Bihar (Present record).

Remarks : It is the first record of this species from Indian termite.

4. **Devescovina glabra** Grassi

(Fig. 4)

1917. *Devescovina glabra* Grassi, *Atti Accad. Naz. Lincei Memorie*, Ser, 5, **12** : 334.

Material examined : 4 exs., Jhanjharpur, Madhubani Dist., Bihar ; 21.i. 1986, Coll. D. N. Tiwari.

Diagnosis : Body elongated with pointed posterior end. Trailing flagellum cord-shaped. Cresta small measuring 7.2–8 (7.8) μm with posteromedial edge larger than anteromedial edge. Parabasal body takeing two turns round axostyle ; straight with stout aterior and filamentous posterior end. Nucleus oval in shape ; cytoplasm

containing groups of deep staining granules posterior to nucleus which is characteristic of the species.

Measurements : 1=48–64(56.8) μm, b=16–25.6(20) μm, 1 : b=2.3–3.5(2.9), nl=4–4.8(4.2) μm, nb=2.4–3.2(3) μm, tf=60.8–70.4 (62.8) μm.

Present host : *Cryptotermis havilandi* (Sjöstedt).

Distribution : India : Bihar (Present record), West Bengal.

Remarks : *Neotermes bosei* Snyder is new host record for *D. glabra* from the Indian subcontinent.

5. **Devescovina lemniscata** Kirby

(Fig. 5)

1926. *Devescovina lemniscata* Kirby, *Univ. Calif. Publs. Zool.* **29** : 103.

Material examined : 5 exs., Kharagpur, Monghyr Dist., Bihar ; 23.xi.1984, Coll. D. N. Tiwari.

Diagnosis : Body pyriform with pointed posterior end ; trailing flagellum band or ribbon-like. Cresta with broad proximal and pointed distal end ; parabasal body takes 1–1½ turns around the axostyle ; nucleus ellipsoidal ; endoplasm containing smaller wood particles.

Measurements : 1=43.2–51.2(48) μm, b=17.6–19.2(18.8) μm, 1 : b=2.5 : 1 ; nl=5.6–7.2(6.2) μm, nb=3.2–4.8 (4) μm, tf=56–72(66.8) μm, cr=9.6–12(11.2) μm.

Present host : *Cryptotermes havilandi* (Sjöstedt).

Distribution : India : Bihar (Present record), West Bengal.

6. **Foaina reflexa** Kirby

(Fig. 6)

1942. *Foaina reflexa* Kirby, *Univ. Calif. Publs Zool.*, **45** : 206.

Material examined : 4 exs., Borio, Dumka Dist., Bihar, 23.xi.1983, Coll. D. N. Tiwari.

Diagnosis : Species moderate to large ; anterior flagella three in number and equal in length ; trailing flagellum ribbon-like exceeding twice of body length ; cresta long but narrow ; parabasal body with U-shaped bend ; axostyle very stout and projecting out towards posterior end to a short distance ; nucleus more or less oval.

Measurements : 1=24–43.2(33.6) μm, b=16–32(24.4) μm, 1 : b=1.2–1.5(1.3), nl=4.8–6.4(5.4) μm, nb=4–4.8(4.2) μm, tf=60-85(72) μm, cr=13.6–16(14.6) μm.

Present host : *Neotermes bosei* Snyder.

Distribution : India : Bihar (Present record), West Bengal.

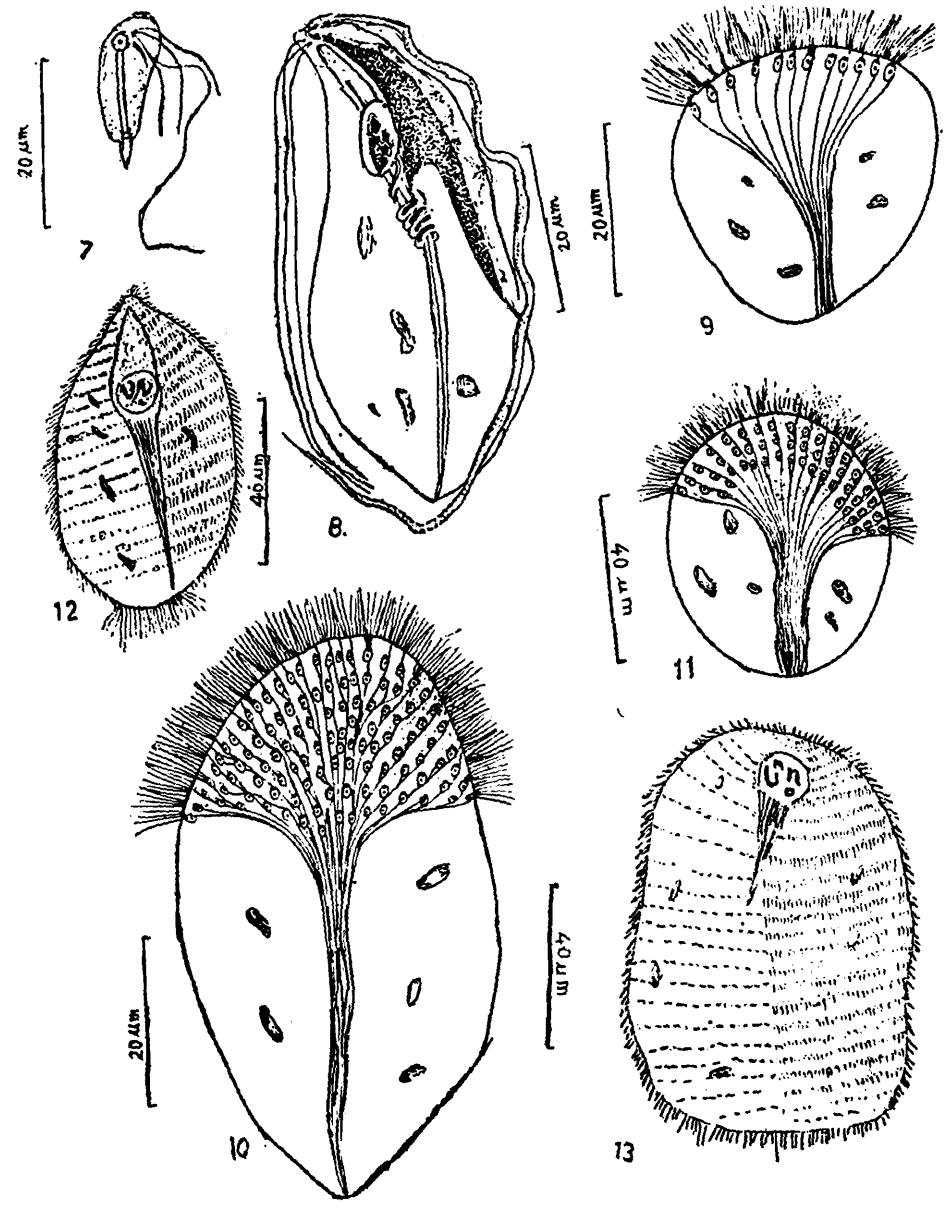
Remarks : *Neotermes bosei* Snyder is the new host record for *Foaina refexa* Kirby.

7. **Foaina solita** Kirby

(Fig. 7)

1942. *Foaina solita* Kirby, *Univ. Calif. Publs Zool.* **45** : 182.

Material examined : 2 exs, Katra, Muzaffarpur Dist., Bihar, 27.xi.1984, Coll. D. N. Tiwari.



Figs. 7. *Foaina solita* Kirby
8. *Macrotrichomonas pulchra* Grassi
9. *Stephanonympha minuta* Das and Choudhury
10. *Stephanonympha pyriformis* Das and Choudhury
11. *Stephanonympha silvestrii* Janicki
12. *Holomastigotoides bengalensis* Chakrabarty and Banerjee
13. *Holomastigotoides campanula* (De Mello)

Diagnosis : Anterior flagella three in number, cord-like traling flagellum with narrow cresta. A conspicuous clear area anterolateral to anterior end of capitulum

which is a prominent feature of *F. nana*, is characteristically absent in present species. Parabasal body short and restricted to dorsal side of nucleus ; axostyle moderately stout without enlarged rounded cusp ; nuleus more or less round.

Measurements : 1=8–16 (11.1)μm, b=3.2–8 (5.4)μm, 1 : b=2.–2.5 (2.1), nl=1.9–3.2 (2.6)μm, nb=1.5–2.4 (1.9)μm, tf=19.4–32μm, cr=3–4.5 (3.7)μm.

Present host : *Cryptotermes havilandi* (Sjöstedt).

Distribution : India : Bihar (Present record), West Bengal.

8. **Macrotrichomonas pulchra** Crassi

(Fig. 8)

1917. *Macrotrichomonas pulchra Grassi, Atti. Accad. naj. Lincei Memorie Ser.* 5, **12** : 334.

Material examined : 2 exs., Borio, Dumka Dist., Bihar, 23.xi.83, Coll. D. N. Tiwari.

Diagnosis : Body more or less spindle-shaped ; anterior flagella three in number ; trailing flagellum band-shaped ; cresta and trailing flagellum and separately a short distance from central granules. Cresta large and inner part of cresta uniformly dense and outer part undulted. Parabasal body coiled, 4-5 times around axostyle ; parabasal filament extending along a short distance beyond anteromedial edge. Axostyle tapering posteriorly without filamentous end or cusp but with bluntly pointed end and in some specimens projecting out to a short distcnce. Nucleus elipsoidal with densely distributed chromatin grunules. A clear space between nuclear membrane and chromatin granules present ; endoplasm containing wood particles of various sizes ; spirochaetes absent on body surface.

Measurements : 1=57.6–73.6 (63.3)μm, b=22.8–33.6 (31.6)μm, nl=8.8–10.4 (9.7)μm, nb=6–8.8 (7.2)μm, cr=27.2–48 (42.2)μm, tf=70–115μm, 1 : b=1.8–2.1 (2), 1 : nl=6.1–7 (6.4).

Present host : *Glyptotermes caudomunitus* Kemner.

Distribution : India : Bihar (Present record).

Remarks : This is the first record of *Macrotrichomonas pulchra* from termite host, *Glyptotermes caudomunitus* from Indian subcontinent.

Family : CALONYMPHIDAE

9. **Stephanonympha minuta** Das and Choudhury

(Fig. 9)

1972. *Stephanonympha minuta* Das and Choudhury, *Proc. zool. Soc. Calcutta*, **25** : 26.

Material examined : 2 exs., Bettiah, West Champaran Dist., Bihar, 23.i.1986, Coll. D. N. Tiwari.

Diagnosis : Body oval with broad anterior and bluntly pointed posterior end; nuclei in single spiral series, 8-12 in number and and oval in shape situated near anterior end of the body ; each nucleus possessing deeply stained chromatin granules and large round blepharoplast. Adjacent to nucleus there is small parabasal body connected with blapharoplast by means of a parabasal thread. An axial filament arising from posterior portion of each blapharoplast and running towads posterior portion of body in form of an axial bundle. Axial bundle reaching up to posterior end of body ; endoplasm containing small pieces of wood particles.

Measurements : 1=36–40 (37.8)μm, b=30–36 (32)μm, 1 : b=1.1–1.2 (1.1).

Preseut host : *Cryptotermes havilandi* (Sjöstedt).

Distribution : India : Bihar (Present record), West Bengal.

Remarks : *Stephanonympha minuna* Das and Choudhury is recorded from a new host *Cryptotermes havilandi* (Sjöstedt).

10. **Stephanonympha pyriformis** Das and Choudhury

(Fig. 10)

1972. *Stephanonympha pyriformis* Das and Choudhury, *Proc. zool. Socr. Calcutta*, **25** : 27.

Material examined : 3 exs., Birpur, Saharsa Dist., Bihar, 2.xii.1983, Coll. D. N. Tiwari.

Diagnosis : Body pyriform with bluntly pointed posterior end. Nuclei ovoidal and arranged in 6-8 spiral series, occupying one third portion of anterior end of body ; each nucleus having a round blepharoplast at its anterior end and an ovoidal small parabasal body adjacent to it. Four flagella arising from each blepharplast ; blepharoplast connected with parabasal body through a fibril and sending an axial filament over nucleus towards posterior end forming an axial bundle ; axial bundle ultimately extending to posterior extremity of body. Endoplasm containing large number of small piecies of wood particles.

Measurements : 1=64–83.2 (73)μm, b=38–52.8 (49.6)μm, 1 : b=1.3–1.5 (1.4).

Present host : *Neotermes bosei* Snyder.

Distribution : India : Bihar (Present record), West Bengal.

Remarks : *Stephanonympha pyriformis* Das and Choudhury is the new host tecord from *Neotermes bosei* Synder,

11. **Stephanonympha silvestrii** Janicki

(Fig. 11)

1911. *Stephanympha silvestrii* Janicki, *Biol. Zbl.*, **31**: 325.

Material examined : 4 exs., Kharagpur, Monghyr Dist., Bihar, 23.xi.1984, Coll. D. N. Tiwari.

Diognosis : Body more or less round in shape. Nuclei fusiform in shape containing distinct chromatin granules, two to three spiral series of nuclei occupying anterior portion of body. Blepharoplast situated at anterior of nucleus. Parabasal body small and four flagella arising from each blepharoplast. Axial filaments also extending downwards from blepharoplast to form axial bundle like that of *S. pyriformis* and *S. minuta*. Endoplasm containing wood particles.

Measurements : 1=48–80 (61)μm, b=36–68 (52)μm.

Present host : *Cryptotermes havilandi* (Sjöstedt)

Distribution : India : Bihar (Present record), West Bengal.

Order : HYPERMASTIGIDA

Family : HOLOMASTIGOTIDAE

12. **Holomastigotoides bengalensis** Chakravarty and Banerjee

(Fig. 12)

1956. *Holomastigotoides bengalensis* Chakravarty and Banerjee, *Proc. zool. Soc., Calcutta,* 9 : 36.

Material examined : 3 exs., Lalitpur, Saharsa Dist., Bihar, 3.xii.1983, Coll. D. N. Tiwari.

Diagnosis : Body more or less oval but sometimes elliptical with anterior part gradually pointed resembling a nipple while posterior end rounded. Flagella of two types, shorter ones covering major portion of body in dexiotropic manner leaving a posterior portion glabrous and chmpletely devoid of flagellar band ; larger flagella occupying posteriormost portion of body. Axostyle narrow, well developed reaching posterior extremity of body. Nucleus lying anteriorly and oval in shape ; prenuclear zone granulated with conical area around anterior end of nucleus.

Measurements : 1=67.5–105.2 (69.8)μm, b=41.2–70.5 (43.1)μm, nl=10.4–13 (12.1)μm, nb=8.5–11.5 (9.3)μm, 1 : b=1.5–1.8 (1.6), 1 : nl=5–9.5 (5.7).

Present host : *Coptotermes heimi* (Wasmann).

Distribution : India : Bihar (Present record), Uttar Pradesh, West Bengal.

13. **Holomastigotoides campanula** (De Mello)

(Fig. 13)

1921. *Leidya campanula* De Mello, *Argu. indo-port. med. Hist. nat.,* 1 : 179.

Material examined : 3 exs., Mirzacheuki, Sahibganj Dist., Bihar, 20.xi.1983, Coll. D. N. Tiwari.

Diagnosis : Body looking typically like bell-jar without apical knob ; anterior portion of body usually convex while posterior one may be flat or bulging. Body

covering with two types of flagella, the shorter one arranged all over body in dexiotropic rows while longer ones set thickly on posterior surface. Nucleus more or less oval situated near anterior part of body. Axostyle fibrous. Prenuclear zone absent.

Measurements : 1=36.8–105(73.9)μm, b=35.2–80(62.4)μm, nl=4.8–9.6(7.6)μm, nb=6.4–8(7.2)μm, 1 : b 1.1–1.3(1.2) ; 1 : nl=9.

Present host : *Coptotermes heimi* (Wasmann).

Distribution : India : Bihar (Present record), Diu, West Bengal.

14. **Holomastigotoides emersoni** Das

(Fig. 14)

1976. *Holomastigotoides emersoni* Das, *Acta protozool.* 15 : 105.

Material examined : 2 exs., Pratapganj, Saharsa Dist., Bihar, 5.xii.1983, Coll. D. N. Tiwari.

Diagnosis : Body club-shaped with maximum width in posterior half and considerably elevated at anterior end forming a nipple-like structure ; posterior end of body broadly rounded. Flagella of two types, shorter one distributed all over body dexiotropically while longer ones occupying posterior end of body. Axostyle poorly developed. Prenuclear zone distinct, dense and homogemous.

Measurements : 1=76.5–110.4(93.4)μm, b=28.9–47.6(38.2)μm, nl=6.8–10.2 (8.5)μm, nb=6.2–10.2(8.2)μm, 1 : b=1.9–2.5 (1.7), 1 : nl=10.9–15 (12.9).

Present host : *Coptotermes heimi* (Wasmann).

Distribution : India : Bihar (Present record), West Bengal.

15. **Holomastigotoides hollandei** Das

(Fig. 15)

1976. *Holomastigotoides hollandi* Das, *Acta Protozool,* **15** : 103.

Material examined : 2 exs., Saharsa district town, Sharsa Dist., Bihar, 29.xi.1983, Coll. D. N. Tiwari.

Diagnosis : Body more or less round in shape, finger like elevation at anterior end well developed, bearing an apical pit occasionally. Two types of flagella present, first type smaller and covering whole body while second type nonstereociliac, larger and confined to posterior portion of body. Prenuclear zone clearly visible, nucleus containing chromatin granules in dense patches, dispersed irregularly inside nucleus. Axostyle fibrous and well developed reaching up to posterior part of body. Endoplasm sometimes containing bigger size of wood particles.

Measuremeants : 1=55–76.8 (70.9)μm, b=50.2–64 (57.1)μm, nl=6.8–10.4 (8)μm, nb=6–9.6 (7)μm, 1 : b=1.2–1.3 (1.2), 1 : nl=6.6–8 (7.3).

Present host : *Heterotermes indicola* (Wasmann).

Distributian : India : Bihar (Present record), West Bengal.

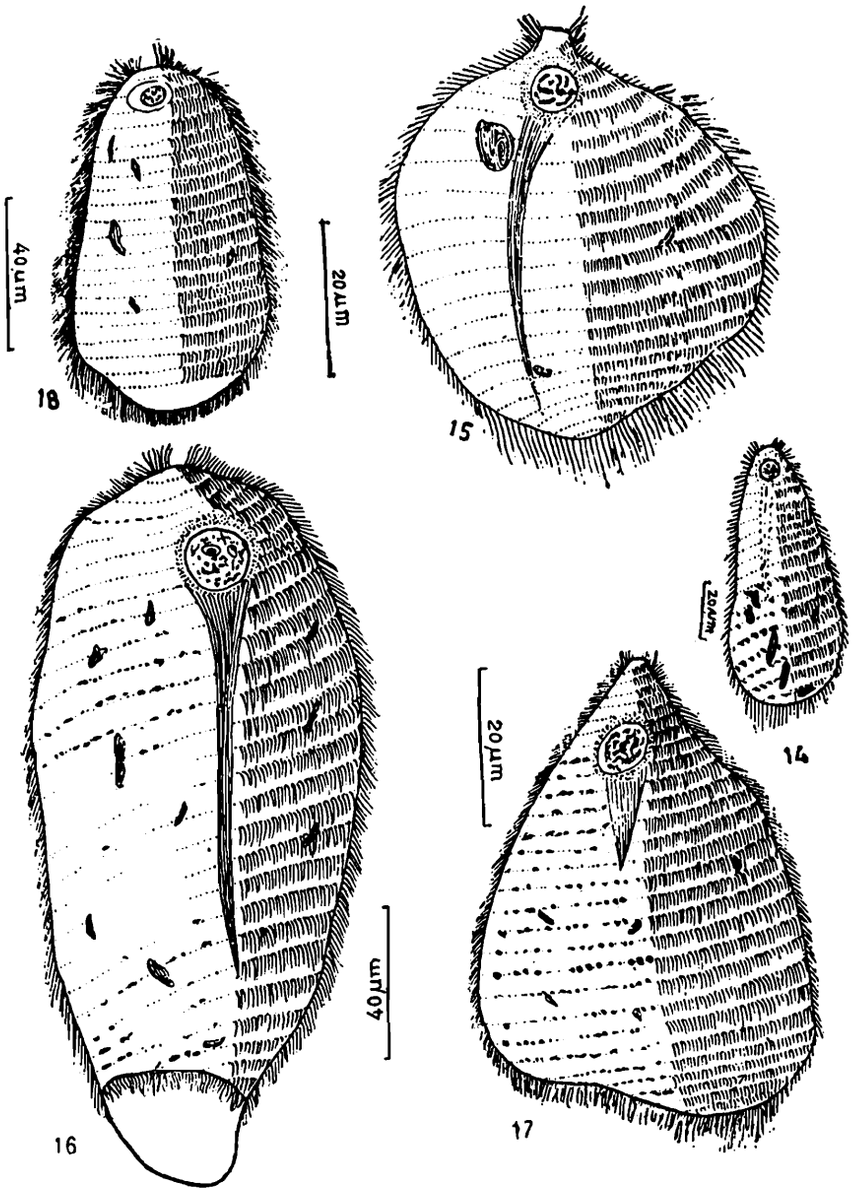
Remarks : *Heterotermes indicola* (Wasmann) is new host record for this flagellate.

16. **Holomastigotoides magnus** Uttangi

(Fig. 16)

1962. *Holomastigotoides magnus* Uttangi, *J. Karnatak univ.* **7** : 188.

Material examined : 3 exs., Banmankhi, Purnea Dist., Bihar, 30.xi.1983, coll. D. N. Tiwari.



Figs. 14. *Holomastigotoides emersoni* Das
15. *Holomastigotoides hollandei* Das
16. *Holomastigotoides magnus* Uttangi
17. *Holomastigotoides ogivalis* De Mello
18. *Holomastigotoides ovalis* Uttangi

Diagnosis : Body ovoidal, broadly rounded anteriorly and blunt towards posterior

end ; length of flagella uniform all over the body, but posterior smaller glabrous region completely devoid of any flagella. Nucleus round and situated near anterior end of the body. Chromatin granules deeply stained. Axostyle fibrous, distinct and reaching slightly beyond middle region of body. Narrow striped prenuclear zone, distinct in permanent preparation over the nucleus.

Measurements : 1=176.3–220 (190.6)μm, b=94.3–114.8 (104.5)μm, nl=16.4–20.5 (18.9)μm, 1 : b=1.7–1.8 (1.7), 1 : nl=8.6–10 (9.3).

Present host : *Coptotermes heimi* (Wasmann).

Distribution : India : Bihar (Present record), Gujarat, West Bengal.

17. **Holomastigotoides ogivalis** De Mello

(Fig, 17)

1937. *Holomastigotoides ogivalis* De Mello, *C. R. XII Intern. zool. Lisbonne* : **2** : 1373.

Material examined : 4 exs., Hathua, Gopalganj. Dist., Bihar, 31.1.1986, Coll. D. N. Tiwari.

Diagnosis : Body resembles the form of an inverted cup with a blunt finger-like elevation at anterior end. Body covered with two types of flagella, shorter flagella occupying whole of body in dexiotropic rows while longer ones situated densely on posterior surface. Nucleus ovoid and carries a distinct prenuclear zone. Axostyle distinct.

Measurements : 1=60.5–94 (80.7)μm, b=40.5–56.2 (48.3)μm, nl=8.2–12.7 (11.6)μm, nb=6.1–9.5 (9)μm, 1 : b=1.2–1.8 (1.6), 1 : nl (6.2–9 (6.9).

Present host : *Coptotermes heimi* (Wasmann).

Distribution : India : Bihar (Present record), Daman, Uttar Pradesh, West Bengal.

18. **Holomastigotoides ovalis** Uttangi

(Fig. 18)

1962. *Holomastigotoides ovalis* Uttangi, *J. Karnatak univ. Sci.* **7** : 185.

Material examined : 1 exs., Mehrauna, Siwan Dist., Bihar, 12.xii.1984, Coll. D. N. Tiwari.

Diagnosis : Body oval, with anterior end narrowly round and posterior broadly round. Posterior portion of body glabrous and devoid of any flagellar band, Flagella longer arranged in dexiotropic rows and cover whole of body while posterior glabrous portion bearing stereocilia. Nucleus oval situated at anterior pole of body. Chromatin granules homogenous mass surrounded by halo. Prenuclear zone and axostyle absent.

Measurements : 1=102 μm, b=63 μm, nl=8.2 μm, nb=6.5 μm, 1 : b=1.6, 1 : nl= 13.5.

Present host : *Heterotermes indicola* (Wasmann).

Distribution : India : Bihar (Present record), Gujarat, West Bengal.

19. **Holomastigotoides rayi** Karandikar and Vittal

(Fig. 19)

1954. *Holomastigotoides rayi* Karandikar and Vittal, *J. Univ. Bombay*, **23B** : 18.

Material examined : 3 exs., Manigachhi, Darbahanga Dist., Bihar, 16.xii.1984, coll. D. N. Tiwari.

Diagnosis : Body oval with apical pit clearly visible at anterior end. Body covered with two types of flagella, smaller flagella covering the whole of body in dexiotropic spirals, longer flagella covering one-fifth of posterior end of body. Present author could not trace any stereocilie at its posterior end. Nucleus ovoidal. Axostyle not distinct and reaching up to middle of body. Prenuclear zone distinct.

Measurements : l=77–90.2(84.9) μm, b=41.5–52.5(49) μm, nl=10.5–12.3(11.6) μm, nb=8.2–10.5(9.1) μm, l : b=1.4–1.8(1.6), l : nl=6.3–8.3(7.3).

Present host : *Heterotermes indicola* (Wasmann).

Distribution : India : Bihar (present record), Maharashtra, West Bengal.

Remarks : *Holomastigotoides rayi* is recorded here from a new host *Heterotermes indicola*.

20. **Holomastigotoides reniformis** De Mello

(Fig. 20)

1937. *Holomastigotoides reniformis* De Mello, *C. R. XII Congr. Intern. Zool. Lisbonne*, 2 : 1373.

Material examined : 1 ex., Mehrauna, Siwan Dist., Bihar, 12.xii.1984, Coll. D. N. Tiwari.

Diagnosis : Body reniform, flagella of one type covering whole of body dexiotropically. Nucleus oval. Axostyle short and reaching slightly below nucleus. Prenuclear zone distinct and granular. Endoplasm containing fibres of wood particle.

Measurements : l=110.2 μm, b=36 μm, nl=5 μm, nb=4.2 μm, l : b=3, l : nl=22.

Present host : *Coptotermes heimi* (Wasmann).

Distribution : India : Bihar (Present record), Goa.

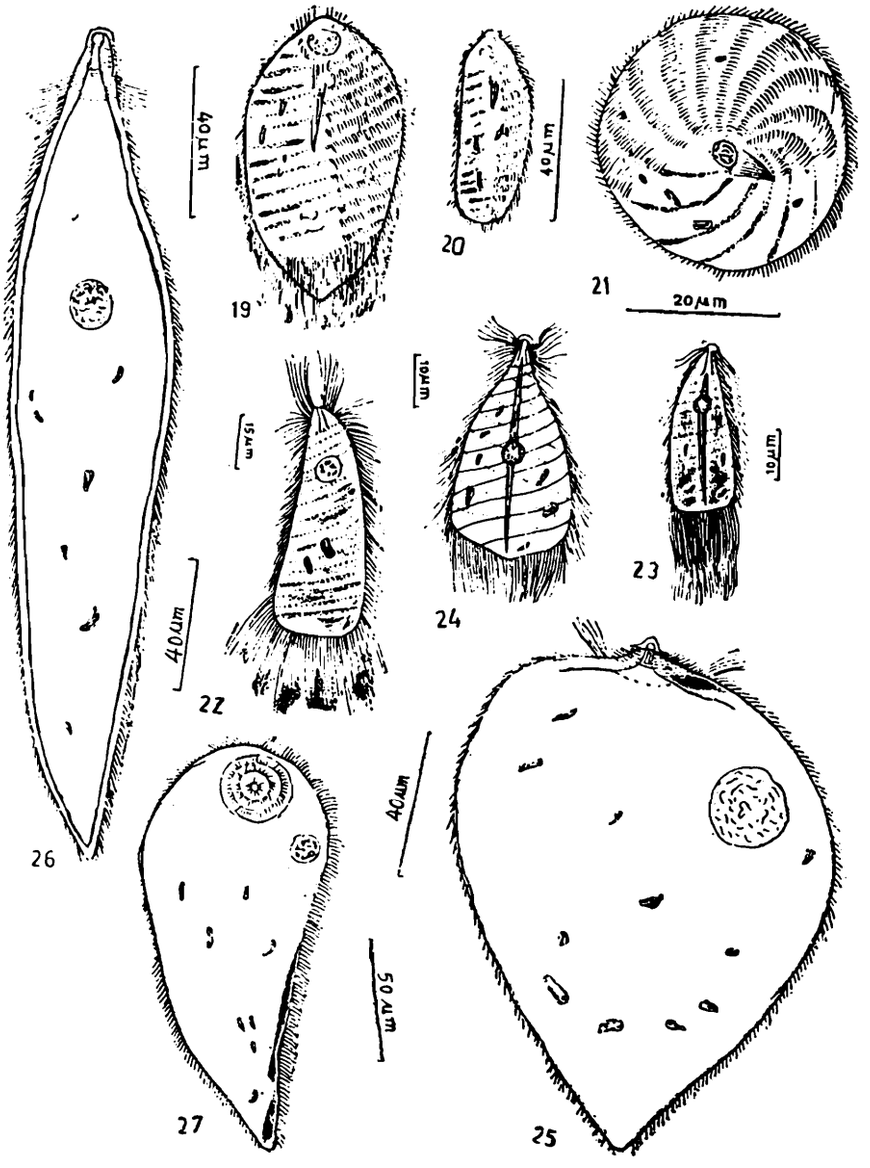
21. **Holomastigotoides sphaeroidalis** De Mello

(Fig. 21)

1937 *Holomastigotoides sphaeroidalis* De Mello, *C. R. XII. Cong, Intern. Zool. Lisbonne*, 2 : 1373.

Material examined : 4 exs., Nathnagar, Bhagalpur Dist., Bihar, 22.xi.1983, Coll. D. N. Tiwari.

Diagnosis : Body spherical as indicated by its name. One type of flagella covering body dexiotropically, Nucleus round situated near anterior end from which flagellar bands seems to derive. Axostyle distinct, broad and abruptly pointed. Prenuclear zone distinct.



Figs. 19. *Holomastigotoides rayi* Karandikar and Vittal
20. *Holomastigotoides reniformis* De Mello
21. *Holomastigotoides sphaeroidalis* De Mello
22. *Spirotrichonympha bhadreshwarensis* Tiwari
23. *Spirotrichonympha froilanoi* Karandikar and Vittal
24. *Spirotrichonympha roonwali* Das
25. *Pseudotrichonympha cardiformis* Karandikar and Vittal
26. *Pseudotriehonympha indica* Chakraborty and Banerjee
27. *Pseudotrichonympha subapicalis* Karandikar and Vittal

Measurements : 1×b=31.8 µm×31.8 µm, nl×nb=4.5 µm×4.5 µm.

Present host : *Coptotermes heimi* (Wasmann).

Distribution : India : Bihar (present record), Daman, Karnataka, Uttar Pradesh, West Bengal.

Family : SPIROTRICHONYMPHIDAE

22. **Spirotrichonympha bhadreshwarensis** Tiwari

(Fig. 22)

1977. *Spirotrichonympha bhadreshwarensis* Tiwari, *Curr. Sci.*, **46** : 232.

Material examined : 1 ex., Birpur, Saharsa Dist., Bihar, 2.xii.1983, Coll. D. N. Tiwari.

Diagnosis : Body more or less pear-shaped with pointed anterior and slightly compressed posterior end, a short tuble originating at anterior end but not reaching to nucleus. Body covered with spiral bands in dexiotropic rows ; a little portion of posterior end of body devoid of flagellar band. Two types of flagella covering the body ; shorter one covering whole of body while longer flagella covering posterior portion. Nucleus spherical with scattered chromatin granules and located in anterior third of body. Axostyle absent.

Measurements ; 1=50.4 μm, b=27.3 μm, nl=6.7 μm, nb=6.7μm, 1 : b=1.8, 1 : nl=7.7.

Present host : *Coptotermes heimi* (Wasmann).

Distribution : India : Bihar (present record), West Bengal.

23. **Spirotrichonympha froilanoi** Karandikar & Vittal

(Fig. 23)

1954. *Spirotrichonympha froilanoi* Karandikar & Vittal, *J. Univ. Bombay*, **23B** : 20.

Material examined : 4 exs., Dumka district town, Dumka dist., Bihar, 20.xi.1983. Coll. D. N. Tiwari.

Diagnosis : Body cone-shaped with anterior portion narrowed to a blunt end and posterior portion broader, body covered with two types of flagella, shorter ones covering whole body dexiotropically excepting posterior flat portion which is thickly studded with a bunch of very long flagella which appears to come out like a tuft bristles in a brush. Nucleus more or less round and located in anterior third of body. A distinct thick cord-like axostyle present but not protruding outside the posterior end of the body.

Measurements : 1=19.2–51.2(32.5) μm, b=14.4–33.6(22.1) μm, nl=3.2–6.4(4.8) μm, nb=2.4–5.6(4.4) μm, 1 : b=1.3–1.6(1.4), 1 : nl=4–11.5(7.6).

Present host : *Heterotermes indicola* (Wasmann).

Distribution : India : Bihar (present record), Karnataka, Uttar Pradesh, West Bengal.

24. **Spirotrichonympha roonwali** Das

(Fig. 24)

1976. *Spirotrichonympha roonwali* Das, *Acta Protozool*, **15** : 116.

Material examined : 3 exs., Godda, Dumka Dist., Bihar, 20.xi.1983., Coll. D. N. Tiwari.

Diagnosis : Body pyriform and bearing uperculum at anterior end and with broad posterior end drawn out in a cone at its centre. Nucleus more or less round. Prenuclear zone dense and conical. Four flagellar bands arising from centroblepharoplast and turned round body dexiotropically. These bands containing numerous basal granules, giving rise to one type of flagella. Axotyle thin and fibrous and extending beyond middle region of body.

Measurements : l=32–48(38.4) μm, b=17.6–27.2(21.2) μm, nl=4.8–5.6(5) μm, nb=3.2–4.6(3.6) μm, l : b=1.7–2(1.8), l : nl=5.5–8.5(6.8).

Present host : *Coptotermes heimi* (Wasmann).

Distribution : India : Bihar (present record), West Bengal.

Family : EUCOMONYMPHIDAE

25. **Pseudotrichonympha cardiformis** Karandikar and Vittal

(Fig. 25)

1954. *Pseudotrichonympha cardiformis* Karandikar and Vittal, *J. Univ. Bombay*, **23B** : 2.

Material examined : 3 exs., Birpur, Saharsa, Dist., Bihar, 2.xii.1983, Coll. D. N. Tiwari.

Diagnosis : Body typically heart-shaped, anterior part consisting of campanula and middle portion of campanula known as rostral tube, measuring 8 μm ; tube bearing more or less transparent hemispherical apical cap, campanular surface covered by three types of flagella, distinguishable from one another by their length and location. First type of flagella shortest, immobile and strictly confined to rostral tube ; second type of flagella longest and arranged below first one in a thick circular band ; third type of flagella arranged in longitudinal rows in a leotropic manner. These flagella covering companula and rest of body except short glabrous end of posterior extremity of body. Nucleus spherical and situated in the middle region of body. Endoplasm containing fragements wood and sphaerita-like microorganism.

Measurements : l=105–181.2 (118.1)μm, b=82.2–130.3 (91.8)μm, nl=22.5–37.5 (25.6)μm, nb=20.33.7 (25.6)μm, l : b=1.2–2 (1.2), l : nl=7–8.5 (7.8), cam=14–18.6 (18)um, f_1=6-8um, f_2=17-20um, f_3=8-13.5um.

Present host : *Heterotermes indicola* (Wasmann).

Distribution : India : Bihar (Present record), Karnataka, Uttar Pradesh, West Bengal.

26. **Pseudotrichonympha indica** Chakravarty and Banerjee

(Fig. 26)

1956. *Pseudotrichonympha indica* Chakravarty and Banerjee, *Proc. zool. Soc. Calcutta.*, 9 : 42.

Material examined : 5 exs., Pratapganj, Saharsa Dist., Bihar, 5.xii.1983, Coll. D. N. Tiwari.

Diagnosis : Body elongated broader in middle. Rostral tube measuring 3.8-7 um with apical cap. Campanular surface covered with three types of flagella, distinguishable from another in length and location as described in *P. indicu*. Nucleus more or less circular and located in middle of body. Chromatin granules distributed irregularly. Endoplasm containing fragments of wood.

Measurements : l=217–301 (169.9)um, b=42–55 (49)um, nl=15.7–21 (18.8)um, nb=14–17.5 (16.1)um, l : b=3.8–7.1 (5.5), l : nl=11.3–17.2 (13.9), cam=10.5–14 (11.8)um, f1=8.2–13.3 um, f2=16.4–20.5 um, f3=6.1–10.5 um.

Present host : *Coptotermes heimi* (Wasmann).

Distribution : India : Bihar (present record), Uttar Pradesh, West Bengal.

27. **Pseudotrichonympha subapicalis** Karandikar and Vittal

(Fig. 27)

1954. *Pseudotrichonympha subapicalis* Karandikar and Vittal, *J. Univ. Bombay*, 23B : 8.

Material examined : 4 exs., Manigachhi, Darbhanga Dist., Bihar, 26.xi.1983, Coll. D. N. Tiwari.

Diagnosis : Body generally rounded and swallen anteriorly and gradually tapering posteriorly to a blunt end. Campanula situated almost in middle towards anterior portion of body in subapical position. Campanular region seen in the form of two circular areas situated one within other ; outer circle representing peripheral margin of campanula, middle circle representing rim along which arranged second series of flagella like eye lashes. Inner circle having tiny aperture in centre. In some specimens campanular region observed in its longitudinal axis. Body entirely covered with third series of flagella excepting a short posterior portion. Nucleus spherical and usually found towards anterior region of the body. Endoplasm containing wood particle of various sizes.

Measuremeuts : 1=172.5–205 (181) μm, b=70–90 (87.5) μm, nl=15–19.5 (18.1) μm, nb=15–19.5 (18.1) μm, 1 : b=2–3.8 (2), 1 : nl=8.6–11.5 (10), cam=18.5 μm, f1=6–8 μm, f2=18–20 μm, f3=8–9 μm.

Present host : *Coptotermes heimi* (Wasmann).

Distribution : India : Bihar (present record), Karnataka, West Bengal.

Summary

1. Twenty seven species of flagellate symbiotes representing six families and nine genera have been reported from Northern Bihar.
2. *Glyptotermes caudomunitus* has been searched for the first time for its flagellate symbiotes from India.
3. All the species of the flagellate symbiotes under the study are new record from Northern Bihar.

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ASILIDAE (DIPTERA) FROM UTTAR PRADESH, INDIA

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INTRODUCTION

During May—June 1989 Dr. M. S. Shishodia and Sri P. Parui surveyed Western and Northern Uttar Pradesh for grasshoppers and robberflies. The asilids collected by this party and from time to time by other colleagues : Dr. R. K. Varshney, Dr. S. K. Gupta, and Dr. R. K. Ghosh, from the Zoological Survey of India, Calcutta, are reported in this paper. The generic arrangement followed is according to 'A Review of Asilidae (Diptera) from India' by Joseph and Parui (1990).

The types are deposited in the National Zoological Collections, Zoological Survey of India, Calcutta.

Genus **Michotamia** Macquart

1838. *Michotamia* Macquart, *Dipt. exot.* **1** (2) : 75.

Type species : *Michotamia analis* Macquart, 1838 : 72 ; monotypic.

1. **Michotamia aurata** (Fabricius)

1794. *Asilus aurata* Fabricius, *Ent. Syst.* **4** : 387.

1975. *Michotamia aurata* : Oldroyd, *A Catalog of Diptera of the Oriental Region* **2** : 130.

Material examined : 2 ♀, Uttar Pradesh : Ghaziabad Dist. : Ragunathpur, 5.vi.1989, Coll. M. S. Shishodia.

Distribution : The species has been recorded from Andhra Pradesh, Bihar, Delhi, Goa, Karnataka, Kerala, Madhya Pradesh, Orissa, Pondicherry, Rajasthan and West Bengal. Here it is recorded for the first time from Uttar Pradesh.

Genus **Ommatius** Wiedemann

1821. *Ommatius* Wiedemann, *Dipt. exot.* **1** : 213.

Type species : *Asilus marginellus* Fabricius ; designated by Coquillett (1910 : 579).

2. **Ommatius shishodiai** n. sp. (Fig.)

A small black species with black and yellowish-brown legs, wings entirely hyaline or only anterior border yellow, and a clavate abdomen. Male : length 4-6 mm, wing 3-4 mm ; female : length 5-6 mm, wing 4-5 mm.

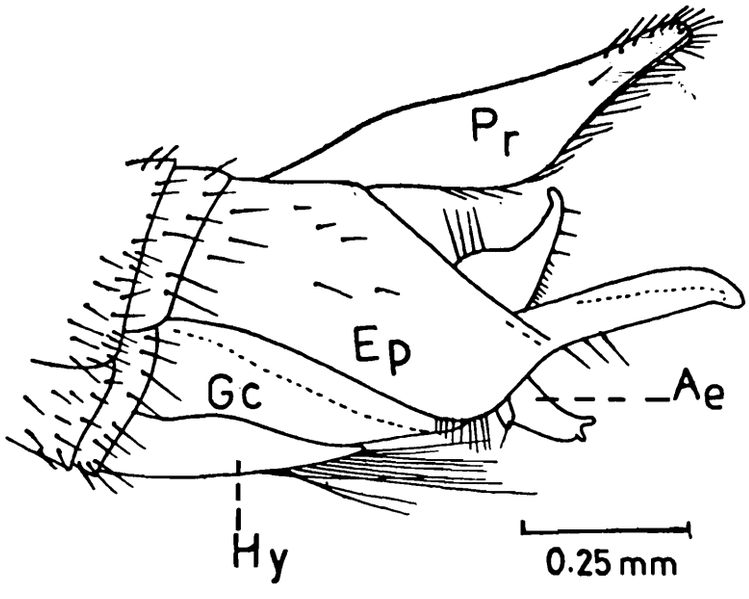

Fig. 1. Lateral view of male genitalia of *Ommatius shishodiai* n. sp.

Male : *Head* black, grey tomentose ; mystax wholly white or white with one or more upper bristles being black ; fronto-orbital setae white, ocellar bristles white or white and black, postocular bristles white, postocciput almost bare, postgena with a few white setae. Antenna black, scape and pedicel with black or black and white bristles, length of scape variable from half to subequal to the length of pedicel, first flagellomere slightly longer than pedicel. Palpus and proboscis black with white setae.

Thorax black, sparsely grey tomentose ; pronotum with a pair of pale yellow bristles and sparse white setae ; scutum with the mediolongitudinal stripe usually indistinct, sometimes faintly discernible ; chaetotaxy : 2 notopleurals, 1 postalar, 2 supra-alars, 2 (rarely 3) dorsocentrals ; vestiture almost absent, bristles white and black ; scutellum inflated with shallow subapical groove, scutellar border with 2 short bristles, disc with scarce white setae ; katatergite with a few elongate, bristly white setae. Haltere pale yellow or yellowish-brown.

Legs largely black and yellowish-brown, sometimes the latter colour lighter, pale yellow ; coxa and trochanter black ; femur black except hind femur narrowly yellowish-brown at base, in a few examples fore and mid femora black dorsally and pale yellow ventrally with increased yellow area at base of hind femur ; tibia usually pale yellew with black apex, the extent of colour variable, basitarsus yellowish-brown with its apex and remaining segments black, hind basitarsus often more extensively black ; vestiture white and black, latter predominant, bristles black, femur ventrally with bristly white setae, which in hind femur form ventral and posteroventral rows.

Wing hyaline, or hyaline with anterior border yellow tinged.

Abdomen weakly clavate, black with hind border of each tergum narrowly pale yellow, tergum 1 laterally with a cluster of long, white setae, tergum 2 with similar but fewer bristles, vestiture otherwise white or black or both intermingled. Male genitalia (Fig.) black and yellowish-brown, setae white and black.

Female : Similar with the following differences : upper side of mystax usually with more black bristles, ocellar bristles usually wholly black ; chaetotaxy : 2-3 dorsocentrals ; legs more extensively yellowish-brown. Genitalia black, proctiger lighter coloured with dense grey tomentum and apex obtuse, sternum 8 truncate at apex, on either side with an elongate, bristly seta.

Holotype ♂, Reg. 7716/H6, Uttar Pradesh : Bulandshahr : Gulawthi, 2.vi.1989, Coll. M. S. Shishodia. *Paratypes* 1 ♀, Reg. No. 7717/H6. 4.v.1989, rest of details as in holotype ; 2 ♂, 3 ♀, Rsg. No. 7718/H6 to 7722/H6, 26.v.1989, rest of data as in holotype ; 11 ♂, 3 ♀, Reg. No. 7723/H6, remaining data as in holotype.

Ommatius andamanensis Joseph and Parui, *O. nilgiriensis* Joseph and Parui and *O. shishodiai* n. sp. are closely similar, all of which can be separated by the details of male genetalia. Furthermore *O. shishodiai* n. sp. has black femur. It is named in honour of our esteemed colleague Dr M. S. Shishodia, who has helped us in our several field trips.

Genus **Stichopogon** Loew

1847. *Stichopogon* Loew, *Linn. Ent.* 2 : 499.

Type species : *Dasypogon elegantulus* Wiedemann, 1820 ; original designation.

3. **Stichopogon inaequalis** (Loew)

1847. *Dasypogon inaequalis* Loew, *Linn. Ent.* 2 : 505.

1975. *Stichopogon inaequalis* : Oldroyd, *A Catalog of Diptera of the Oriental Region*, 2 : 129.

Material examined : 1 ♀, Uttar Pradesh : Balanshahr Dist. : Gulawthi, 2.v.1989, Coll. M. S. Shishodia.

Distribution : It has already been reported from Andaman Islands, Andhra Pradesh, Bihar, Goa, Maharashtra, Rajasthan and Tamil Nadu. Here it is reported for the first time from Uttar Pradesh.

4. **Stichopogon meridionalls** Oldroyd

1948. *Stichopogon meridionalis* Oldroyd, *Entomologist's mon. Mag.* 84 : 261.

1990. *Stichopogon meridionalis* : Joseph & Parui, *Rec. zool. Surv. India*, Occ. Paper No. 113 : 42.

Material examined : 1 ♂, 2 ♀, Uttar Pradesh : Meerut Dist. : Baghpet, 23.v.1989 ;

2♂, 1♀, Meerut Dist. : Modi Nagar, 24.v.1989 ; 3♀, Bulandshahr Dist. : Bulandshahr : Gulawthi, 2.vi.1989, all Coll. M. S. Shishodia.

Distribution : It is already recorded from Andhra Pradesh, Gujarat, Karnataka, Kerala, Rajasthan, Tamil Nadu and West Bengal. It is the first report of the species from Uttar Pradesh.

5. **Stichopogon tomentosus** Oldroyd

1948. *Stichopogon tomentosus* Oldroyd, *Entomologist's mon. Mag.* **84** : 263.

1990. *Stichopogon tomentosus* : Joseph & Parui, *Rec. zool. Surv. India*, Occ. Paper No. 113 : 42.

Material examined : 2♂, 2♀, Uttar Pradesh : Meerut Dist. : Baghpet, 23.v.1989, Coll. M. S. Shisodia.

Distribution : It has been recorded from Andaman Islands, Bihar, Karnataka, Rajasthan and West Bengal. Here it is recorded for the first time from Uttar Pradesh.

Genus **Clephydroneura** Becker

1925. *Clephydroneura* Becker, *Ent. Mitt.* **14** : 68.

Type species : *Asilus xanthopus* Wiedemann ; designated by Oldroyd (1938 : 450).

6. **Clephydroneura nelsoni** Joseph & Parui

1979. *Clephydroneura nelsoni* Joseph & Parui, *Ent. Scand.* **10** (1) : 33.

Material examined : 4♂, 1♀, Uttar Pradesh : Ghaziabad Dist. : Raghunathpur, 5.vi.1989, Coll. M. S. Shishodia.

Distribution : It has been reported from Bangalore and Tamil Nadu. Here it is recorded for the first time from Uttar Pradesh.

Genus **Machimus** Loew

1849. *Machimus* Loew, *Linn. Ent.* **4** : 1.

Type spacies : *Asilus chrystis* Meigen : designated by Coquillett (1910).

7. **Machimus anglaris** (Ricardo)

1922. *Tolmerus angularis* Ricardo, *Ann. Mag. nat. Hit.* (9) **10** : 64.

1975. *Machimus angularis* : Oldroyd, *A Catalog of Diptera of the Oriental Region*, 2 : 144.

Material examined : 1♂, Uttar Pradesh : Mussorie, 24.ix.1989, Coll. R. K. Ghosh.

Distribution : It has been recorded from Himachal Pradesh, Uttar Pradesh and West Bengal.

8. **Machimus indicus** Joseph & Parui

1986. *Machimus indicus* Joseph & Parui, *Rec. zool. Surv. India*, Occ. Paper No. 96 : 27.

Material examined : 4♂, 2♀, Uttar Pradesh : Mussorie Municipal Garden, 2000 m. 3.vii.1978, Coll. R. K. Varshney and party ; 1♂, Uttar Paadesh : Uttar Kashi Dist. : Nakwi, 2.xi.1989, Coll. S. K. Gupta.

Distribution : The species was described from Uttar Pradesh.

9. **Machimus subgenitalis** Bromley

1939. *Machimus subgenitalis* Bromley, *Rec. Indian Mus.* **37** : 221.

1983. *Machimus subgenitalis* : Joseph & Parui, *Oriental Ins.* **17** : 356.

Material examined : 1♂, Uttar Pradesh : Uttar Kashi, 3.xi.1989, Coll. S. K. Gupta.

Distribution : It has been reported only from Himachal Pradesh and West Bengal. Here it is reported for the first time from Uttar Pradesh.

Genus **Philodicus** Loew

1848. *Philodicus* Loew, *Linn. Ent.* **3** : 391.

Type species : *Asilus javanus* Wiedemann, 9 ; original designation.

10. **Philodicus femoralis** Ricardo

1921. *Philodicus femoralis* Ricardo, *Ann. Mag. nat. Hist.* (9) 8 : 190.

1990. *Philodicus femoralis* : Joseph & Parui, *Rec. zool. Surv. India*, Occ. Paper No. 113 : 61.

Material examined : 2♂, Uttar Pradesh : Meerut Dist. : Pratappur, 2.vi.1989 ; 2♂, Meerut Dist., 23.vi.1989 ; 1♂, 1♀, Meerut Dist. : Baghpet, 25.vi.1989 ; 4♂, 3♀, Bulandshahr Dist. : Sikandrabad, 31.v.1989 ; 2♂, 3♀, Bulandshahr Dist. : Khurja, 1.vi.1989 ; 2♂, 3♀, Ghaziabad Dist. : Raghunathpur, 5.vi.1989 ; Ghaziabad Dist. : Raghunathpur, 5.vi.1989 ; 2♂, Ghaziabad Dist. : Salarpur Kalan, 6.vi.1989 ; 7♂, 2♀, Ghaziabad Dist. : Noida, 1.vi.1989, all Coll. M. S. Shishodia.

Distribution : It is a widely distributed species. It has been recorded from Assam, Arunachal Pradesh, Bihar, Goa, Gujarat, Himachal Pradesh, Karnataka, Kerala, Meghalaya, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal.

11. **Philodicus javanus** (Wiedemann)

1819. *Asilus javanus* Wiedemann, *Zool. Mag.* (Wied.) **1** (3) : 4.

1975. *Philodicus javanus* Oldroyd, *A Catalog of Diptera of the Oriental Region*, **2** : 149.

Material examined : 1♂, Uttar Pradesh : Uttar Kashi Dist. ; Nakuri, 2.xi.1989, Coll. S. K. Gupta.

Distribution : It has been reported from Assam, Arunachal Pradesh, Bihar, Himachal Pradesh, Karnataka, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal.

Genus **Trichomachimus** Engel

1933. *Trichomachimus* Engel, *Ark. zool.* A, **25** (22) : 10.

Type species : *Machimus pubescens* Ricardo ; original designation.

12. **Trichomachimus pubescens** (Ricardo)

1922. *Machimus pubescens* Ricardo, *Ann. Mag. nat. Hist.* (9) **10** : 67.

1975. *Trichomachimus pubescens* : *A Catalog of Diptera of the Oriental Region*, **2** : 156.

Material examined : 1 ♂, Uttar Pradesh : Uttar Kashi Dist. : Nakuri, 2.xi.1989, Coll. S. K. Gupta.

Distribution : It has been recorded from Arunachal Pradesh, Sikkim and West Bengal. Here it is reported for the first time from Uttar Pradesh.

Summary

Twelve species of asilids are reported from Uttar Pradesh. Of these one, *Ommatius shishodiai*, is a new species, and seven species, *Stichopogon inaequalis* Loew, *S. meridionalis* Oldroyd, *S. tomentosus* Oldroyd, *Michotamia aurata* Fabricius, *Clephydroneura nelsoni* Joseph & Parui, *Machimus subgenitalis* Bromley and *Trichomachimus pubescens* (Ricardo), are new records to Uttar Pradesh.

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We are grateful to Prof. M. S. Jairajpuri, Director, Zoological Survey of India, Calcutta, for according permission to study the material. We like top place on record our appreciation to our colleagues, Dr. R. K. Varshney, Dr. S. K. Gupta, Dr. M. S. Shishodia and Dr. R. K. Ghosh for collecting the robberflies described in this paper. We are indebted to Prof. A. G. Scarbrough, Towson State University, Towson, Maryland, U. S. A., for critically going through the manuscript.

Abbreviations

Ae, aedeagues ; Ep, epandrium ; Gc, gonocoxite ; Hy, hypandrium ; Pr, proctiger

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Joseph, A. N. T. and Parui, P. 1989. On some Asilidae (Diptera) from India present in the Smithsonian Institution II. *Oriental Ins.* **23** : 193-203.

Rec. zool. Surv. India, **92** (1-4) : 161-172, 1992

STUDIES ON LONGICORN BEETLES (COLEOPTERA : CERAMBYCIDAE) FROM INDIA PART 1. ON INDIAN SPECIES OF *APOMECYNA* LATREILIE WITH A KEY TO INDIAN GENERA OF TRIBE APOMECYNINI

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Inroduction

Beetles of the family Cerambycidae, commonly known as longicorn beetles, are very important economically as many of these insects are injurious to living trees as well as to timber.

After the publication of Gahan's monographic work (1906) in the Fauna of British India series no comprehensive work on the taxonomy of Indian Cerambycidae has been published. Stebbing (1914), Beeson and Bhatia (1939) and Beeson (1941) have contributed on the biolology and life history of many important species by taxonomic informations are still scattered in various journals published from all over the world in different languages. This is especially true for the subfamily Lamiinae which includes majority of the longicorn beetles and was not included in Gahan's fauna volume.

In the present paper, descriptions, geographical distribution, additional locality data and biological informations wherever available on all the species known from Indian region of the genus *Apomecyna* have been provided. A key to the genera of tribe Apomecynini known from Indian region and another key to the Indian species of the genus *Apomecyna* have been included.

Tribe **Apomecynini Lacordaire** 1872

The tribe Apomecynini is one of the 30 tribes of subfamily Lamiinae known from India and can be characterised as follows : Small to moderate in size, long to very long in form. Tarsal claws divergent. Metasternum not very short. First antennal segment never very short (non very long as in Agapanthini). Ciatrix usually absent. Middle tibiae with dorsal furrow. Middle coxal cavities open or closed.

Out of the 123 genera known from Asia-Australian region 19 genera have been recorded from Indian region. These can be separated by the following key :

Kay to the Indian Genera of Tribe Apomecynini

1(4) Pronotum with lateral spine.

2(3) Upper surface sparsely covered with hair ... *Nicomioides* Breuning

*Present address : Jhargram Raj College, Jhargram-721507.

3(2) Upper surface without hair ... *Metamecyna* Breuning

4(1) Pronotum without lateral spine.

5(6) 3rd antennal segment very short, not more than twice long as the 2nd ... *Eunidia* Erichson

6(5) 3rd antennal segment never so small.

7(8) Metasternum short ... *Tuberculosybra* Breuning

8(7) Metasternum not so short.

9(30) Head retracted.

10(13) 5th antennal segment with brush of hairs.

11(12) 3rd antennal segment with brush of hairs ... *Estigmenidia* Gahan

12(11) 3rd antennal segment without brush of hairs ... *Pemptolasius* Gahan

13(10) 5th antennal segment without brush of hair.

14(15) Eyes subdivided ... *Ropica* Pascoe

15(14) Eyes emarginate.

16(23) 3rd antennal segment at best as long as the 4th.

17(18) Entire upper surface sparsely covered with hair ... *Orcesia* Pascoe

18(17) Upper surface without hairy covering.

19(22) Middle coxal cavities closed.

20(21) Prosternal process extending between coxae ... *Parepilyata* Breuning

21(20) Prosternal process not extending between coxae (sternal small) ... *Sybra* Pascoe

22(19) Middle coxal cavities open ... *Neosybra* Breuning

23(16) 3rd antennal segment longer than the 4th.

24(25) Frons trapezoidal ... *Mimeepilista* Breuning

25(24) Frons rectangular.

26(25) Pronotum transverse.

27(28) Antenna extends upto the middle of the body ... *Diaxenes* Waterhouse

28(27) Antennae as long as or a little shorter than body ... *Praenethomimus* Breuning

29(26) Pronotum as long as broad ... *Hyagnis* Pascoe

30(9) Head not retracted.

31(33) Middle coxal cavities closed.

32(33) Elytra in apical 4th with tubercle or hairy stripe ... *Atimura* Pascoe

33(32) Elytra without those mentioned above ... *Cornallis* Thomson

34(37) Middle coxal cavities open.

35(36) 3rd antennal segment markedly shorter than 4th ... *Mycerinopsis* Thomson

36(35) 3rd antennal segment at best a little shorter than 4th ... *Apomecyna* Latreille

Genus **Apomecyna** Latyeille

The genus *Apomecyna* may be recognised as follows : Very elongated, cylindrical. Antennae thick, shorter than body, lower surface not fringed. First segment short and thick. 3rd segment as long as or rather longer than 4th, much longer than first, fifth and rest are shorter. Antennal tubercle are broadly separated from each other, little produced. Eyes coarsely facetted, strongly emarginate, ventral lobe transverse. Frons broader than high. Pronotum transverse to longer than broad, convex, trilobed, rounded laterally, with two fine transverse groove, one anteriorly and another at base. Elytra very long, convex, rather broader than pronotum. Head not retracted. Prosternal process narrow, lower than the coxae uniformly rounded. Mesosternal process sloping towards apex. Metasternum of normal length. Mesocoxal cavities open. Legs little long. Femur clavate. Middle tibiae emarginate preapically.

The genus *Apomecyna* was erected by Latreille in 1829. The type species of the genus is *Apomecyna histrio* described by Fabricius from Tranquebar in South India. Aurivillius (1922) in Coleopterorum Catalogus recorded 6 species, namely *A. alboguttata* Megerle, *A. cretacea* Hope, *A. histrio* (F.), *A. leucosticta* Hope, *A. neglecta* Pascoe and *A. saltator* (F.) from Indian region. Breuning (1938) added two more species, *A. fallaciosa* from North West India and *A. ceylonica* from Ceylon. In the collection of Zoological Survey of India, there is a specimen of *A. proba* Newmannn from India, thus bringing the number of species known from Indian region to nine. Breuning (1964), however, in his revision of tribe Apomecynini of Asiatic and Australian region placed *A. alboguttata*, *A. neglecta* and *A. proba* under the synonymy of *A. histrio*, *A. saltator* and *A. cretacea* respectively, thus bringing the valid species of the genus *Apomecyna* Latreille known from Indian region to six. These species can be separated by the following key :

Key to the Indian species of **Apomecyna**

1(2) Pronotum with continuous narrow yellowish middorsal line ... ... *A. leucosticta* (Hope)

2(1) Pronotum without such line. ... ...

3(4) Elytra rounded apically ... ... *A. ceylonica* Breuning

4(3) Elytra truncated or emarginate apically. ... ...

5(6) Pronotum as long as broad in the middle ... *A. cretacea* (Hope)

6(5) Pronotum transverse. ... ...

7(8) 5th and rest antennal segment together shorter than 3rd and 4th together ... ... *A. histrio* (F.)

8(7) 5th and rest together longer than 3rd and 4th together. ...

9(10) 5th and rest together much longer than 3rd and 4th ... *A. fallaciosa* Breuning

10(9) 5th and rest together not so longer than 3rd and 4th ... *A. saltator* (F.)

1. **Apomecyna histrio** (Fabricius)

1792. *Lamia histrio* Fabricius, *Ent. Syst.* p. 288.

1802. *Saperda alboguttata* Megerle, *Cat. Ins. Append, Nov.* no. 473, p. 10.

1840. *Apomecyna histrio* Castelnau, *Hist. Nat. Col.* II, p. 40.

1868. *Apomecyna quadrifasciata* Thomson, *physis*, II, p. 59.

1918. *Apomecyna maculaticollis* Pic, *Mél. exot. ent.* XXVIII, p. 6.

Size small to medium (7-12mm in length), shape cylindrical. (Fig. 1). Upper surface dark brown, covered with pale reddish brown hair. Pronotal disc with one white post median longitudinal mark and usually with one or two smaller white mark on lateral side of mid-dorsal line. Elytra covered with yellowish white patches, number of patches variable, arranged in four transverse bands, one irregular post basal, 2nd obliquely laterally rising premedian 3rd irregular post median and last small preapical. One small round whitish patch at the side of each abdominal segment. Third abdominal segment at base and 2/3rd of 4th abdominal segment pale, 3rd and 4th antennal segment apically and rest of the segments dark brown. Antennae hardly extending upto middle of the elytra, extremely finely punctured, 3rd segment longer than 4th, 5th and rest taken together not longer than the combined length of 3rd and 4th. Ventral optical lobe twice as long as gena. Head and pronotum coarsely punctured. pronotum transverse. Scutellum semicircular. Elytra parallel, obliquely truncated apically, rather closely but finely punctured in longitudinal rows ; punctures finer towards apex. Me sutural striae. Mesosternal process gradually slopping towards apex. Metasternum convex and smooth in the middle, punctured at the sides. Femora closely and finely punctured.

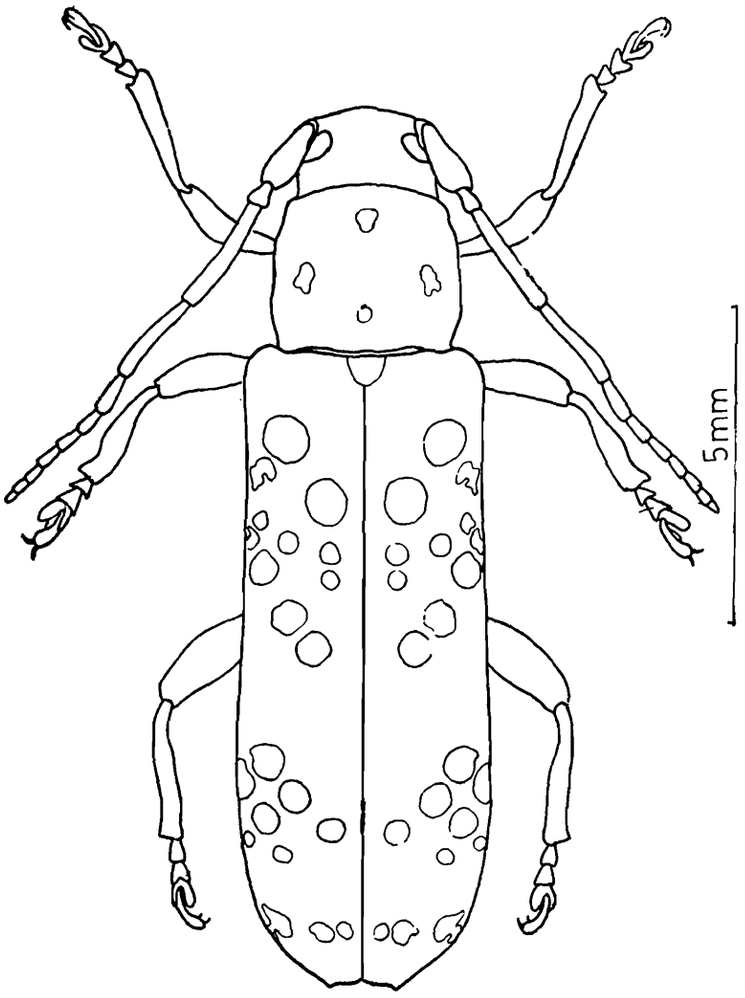
Length 7-12 mm ; Breadth 2-3.5 mm.

Material examined : Cochin State, Paramoikulam, 16-24.ix.1914, F. H. Gravely Coll., 2 ex. ; Andaman Islands, dated Nil, Coll. Nil—1 ex. ; Calcutta, dated Nil, Coll—Nil—1 ex.

Distribution : INDIA : Andaman, West Bengal and Kerala ; East ASIA, JaPAN PHILLIPINE, SUNDA ISLAND, MALAKKA to QUEENSLAND.

Remark : The species was described by Fabricius from a specimen from Tranquebar, India. In the specimen under study there are only three distinct patches

of white spots, the prebasal patch is confluent with the patches of the premedian region to form a broad band. The basal portion of the fourth antennal segment is



Text-fig. 1

Fig. 1. *Apomecyna histrio* (F.)

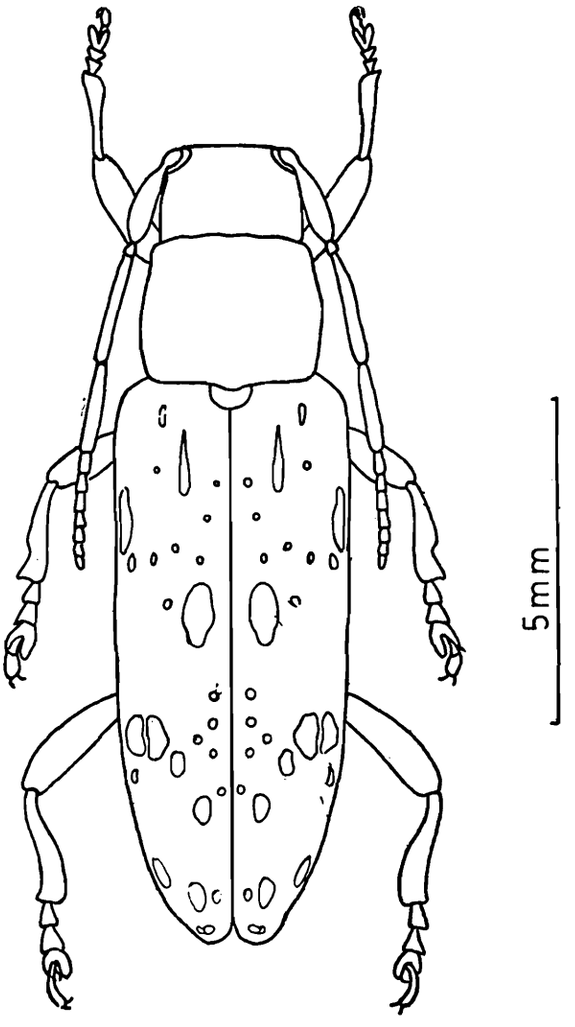
distinctly patchy covered with white pubescence while the other segments are dark brown. Pronotal disc have two distinct median spots, one anteriorly and the other basally while there is no post median longitudinal mark.

Biology : *A. histrio* has been recorded in *Tinospora cordifolia* and its life cycle has been described by Lefroy (1910). The larva lives in the living stem of the creeper making irregular tunnels. Beetles of the variety *cretacea* emerged from a climber collected in the Andamans between April and July (Beeson, 1941).

2. Apomeeyna cretacea (Hope)

1831. *Callidium cretaceum* Hope, *Gray Zool. Misc.*, p. 28.
1938. *Apomecyna multinotata* var., *laosensis* Pic, *Bull. Soc. ent. Fr.* xliii, p. 124.
1842. *Apomecyna proba* Newman, **1** : 299.
1964. *Apomecyna cretacea* m. *proba* Breuning *Ent. Abhan* **30** : 20, 24.

The present species resembles *A. histrio* but upper surface of body covered with large punctures, pronotum as long as broad, apical margin of elytra obliquely truncated (Fig. 2).



Text-fig. 2

Fig. 2. *Apomecyna cretacea* (Hope)

Size medium (11-18 mm in length), Shape elongated. Reddish brown, upper surface covered with pale yellowish pubescence. Pronotum without continuous longitudinal marking, pale white patches at sides. White patches in elytra arranged in ill defined transverse bands.

Length 11-18mm ; breadth 3.3-5.5mm.

Material Examined : INDIA, Tirap, Power House, Khonsa, 4.xi.1971. 800m. At light, G. S. Arora Coll. 1 ex ; Calcutta, Tollygunge, 23.iv.1950, A. P. Kapur, Coll. 1 ex.

Distribution : The species is distributed from India to Phillipine.

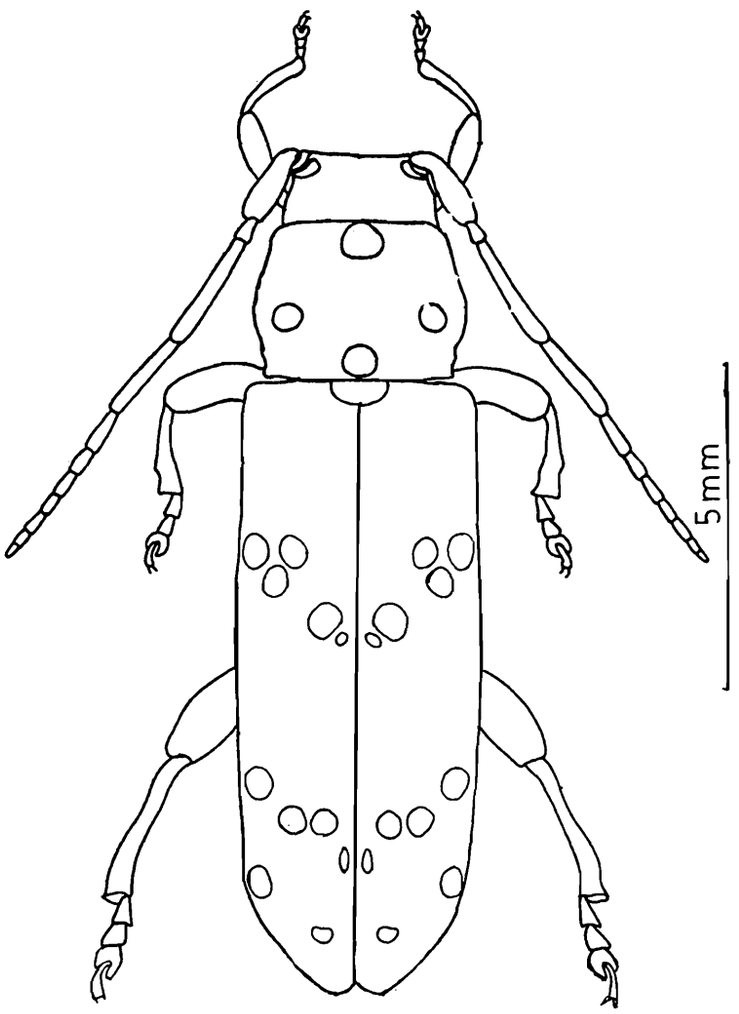
Remark : *A. proba* and *A. cretacea* (Breuning, 1964). The morphs *proba* occurs in Indian region and the present description has been mainly based on this morph.

Hope (1831) described this species from Nepal. The fourth antennal segment is paler at the basal 2/3rd and covered with white pubescence in the specimen examined.

3. **Apomecyna ceylonica** Breuning

1938. *Apomecyna ceylonica* Breuning, *Nov. Ent. fasc.* viii, p. 51.

Similar to *A. histrio* F. but little broader, 1st antennal segment not punctured, head feebly, pronotum little closely punctured. Apical margin of elytra rounded, upper surface of body rather pale yellowish brown, sometimes no white mark on pronotum, the whole apical 3rd of elytra covered densely with whitish patch (Fig. 3).



Text-fig. 3

Fig. 3. *Apomecyna ceylonica* Breuning

Length 12 mm ; breadth 4 mm.

Material Examined : CEYLON, Kandy, Date—Nil, 1 ex.

Distribution : CEYLON : Waddawa, Kandy.

Remarks : Breuning described the species from Ceylon : Waddawa (Museum Stockholm). Post basal markings absent and ventral lobe of eyes is less than twice the length of gena in the specimen studied.

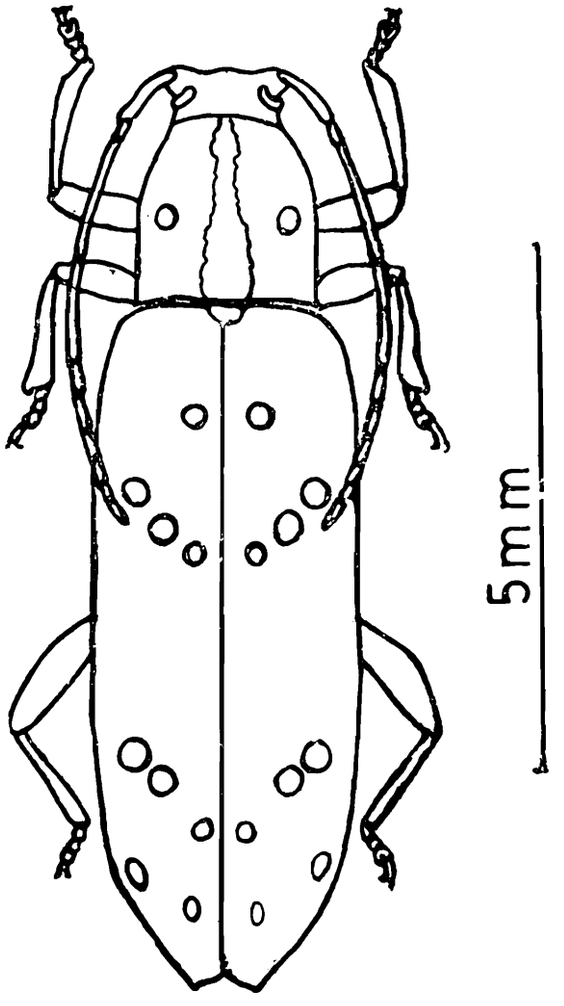
In the specimen under study pronotum have to mediin white spots and two laterally. The elytra have two distinct white patches, the premedian rising obliquely and the apical third composed of whitish spots.

4. **Apomechyna leucosticta** (Hope)

1831. *Callidium leucostictum* Hope, *Gray Zool. Misc.* p. 28.

1925. *Apomecyna lyteomaculata* Pic, *Mel. exot. ent.*, lxviii, p. 64.

Size small to medium (9-12 mm in length), shape strongly elongated (Fig. 4) Reddish, extremely finely covered with yellowish hairs. Pronotum with very narrow



Text-fig. 4

Fig. 4. *Ampomecyna leucosticta* (Hope)

ochraceous yellow longitudinal middle band. Scutellum ochraceous yellow. Each elytron with some ochraceous yellow rounded patches, one or two post basal, a few forming strongly laterally ascending premedian band, some forming laterally inclining

postmedian band another forming a preapical transverse band. One ochraceous small mark on sides of each abdominal segment.

Head and pronotum closely and strongly punctured. Antennae hardly reaching middle of elytra, 3rd and 4th antennal segment taken together a little longer than 5th and rest taken together. Apical margin hardly truncated, closely and strongly punctured. Metasternal disc convex and smooth and finely covered with yellowish pubescence in the middle, gradually sloping at sides and covered larger hairs and moderatly strong punctures. Femora moderately strongly punctured, punctures stronger towards apex.

Length 9-12 mm ; breadth 2-3 mm.

Material examined : Pashok, alt. 2000 ft. Darjeeling Dist., Himalayas, —vi.1916, L. C. Hartless, Coll.—1 ex ; Ukhrul, Manipur, 6400 ft., Lat. 25 N, Long. 94-95, Date—Nil, Revd. W. Pettigrew. Coll. 1 ex.

Distribution : INDIA : W. Bengal (Darjeeling), Sikkim, Meghalaya (Shillong), Manipur ; BHUTAN, BURMA and LAOS.

Remark : The description drawn from specimens of Manipur and the species can be easily distinguished by its elongated shape, prothorax as long as broad, pronotum with longitudinal narrow middorsal ochraceous yellow line and elytra with ochraceous yellowish patches. The material examined have the apical margin of the elytra obliquely truncated and the other tip is projected into a feeble spine.

5. **Apomecyna saltator** (Fabricius)

1781. *Lamia saltator* Fabricius, *Mant. Ins.* 1, p. 141.

1865. *Apomecyna neglecta* Pascoe, *Trans. ent. Soc. Lond.*, (3) iii, p. 152.

1868. *Apomecyna pertigera* Thomson, *Physis*, ii, p. 160.

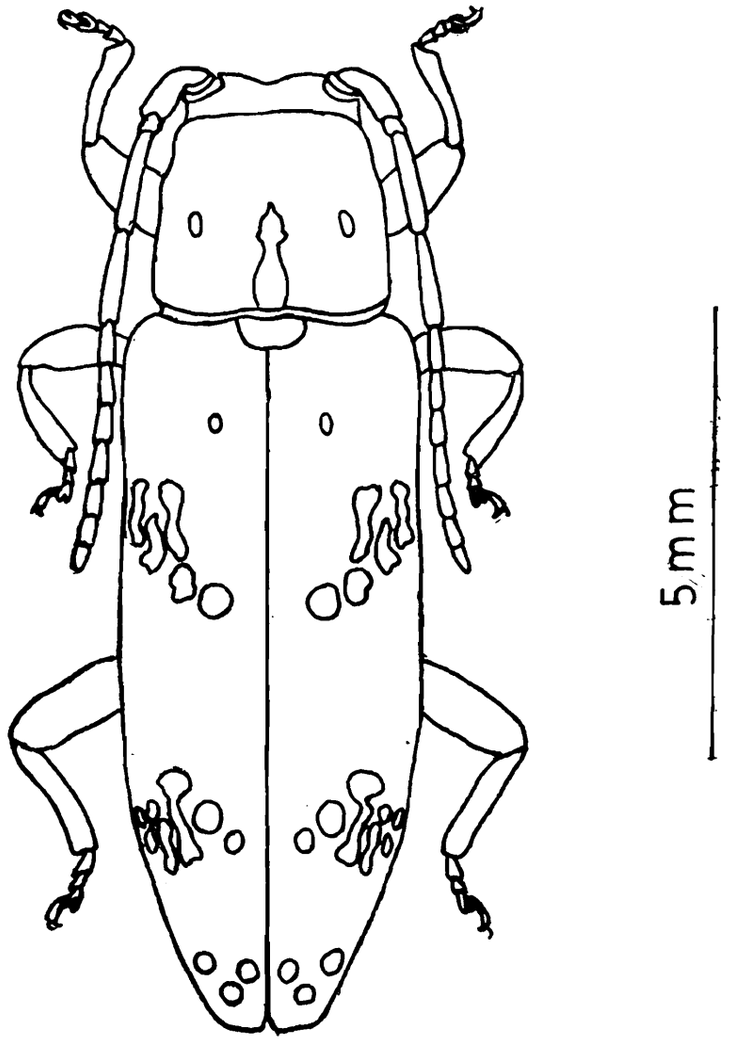
1918. *Apomecyna multinotata* Pic, *Mel. exot. ent.* xxviii, p. 5.

1942. *Apomecyna excavaticeps* Gressitt, *Lingn. Nat. Hist. Serv. Mus.* Spec. Publ., 8, p. 25.

Size small to medium (8-14 mm in length), shape cylindrical (Fig. 5). Dark, brown, covered with pale reddish brown pubescence. Pronotum with feely marked longitudinal post median band and some ill defined white lateral patches. Elytra with white patches forming one laterally ascending premedian transverse band, and another broedly oblique postmedian and other narrow preapical transverse band. Antennae pale reddish brown, the 4th segment in basal 3/4th whitish.

Antennae hardly extending upto middle of the eytra, a little thick. 5th and rest antennal segment together a little longer than 3rd and 4th taken together, 3rd a little longer than 4th. Ventral optical lobe twice as long as gena. Head and pronotum rather closely and finely punctured. Pronotum transverse. Scutellum semicircular. Apical margin of elytra feebly truncated, lateral margin rounded, rather closely and finely punctured.

Material examined : Andaman Island, Dated—Nil, Coll.—Nill, 2 exs ; Calcutta, At light, Date—Nil, F. H. Gravely, Coll—1 ex ; Pashok, alt. 3590 ft. Darjeeling dist., E. Himalayas, —vi.1916, L. C. Hartless Coll.—1 ex. ; Pashok, alt. 3500 ft. Darjeeling dist. E. Himalayas, 26.v—14.iv.1916, F. H. Gravely, Coll.—2 ex ; Calcutta, Behala 21.vi.1968, R. K. Kacker Coll. 1 ex ; Darjeeling dist, Singla, 1500 ft, May 1918, Carmichael Coll., 5 exs ; Maldah, Date—Nil, Coll—Nil, 1 ex ; Sureil, 5000 ft, Darjeeling dist, E. Himalayas, 11—31.x.1917, N. Annandale, F. H. Gravely Coll. 1 ex ; Peradeniya, Ceylon, Date—Nil ; Coll.—Nil, 2 exs.



Text-fig 5

Fig. 5. *Apomecyna saltator* (F.)

Distribution : INDIA, SINGAPORE and TAIWAN ISLAND.

Remark : Fabricius described the species without any definite locality data. The specimen under study agrees fully with the above description.

Biology : *A. saltator* has been recorded in *Coccinia indica*, *Cucurbita moschaeta*, *Lagenaria vulgaris*, *Luffa acutangula*, *L. aegyptiea*. The life history is recorded by Lefroy

(1910) (under the name of *Apomecyna pertigera*). The beetle feeds on and lays eggs in the stems of living pumpkin and the larva tunnels along the pith and surrounding tissues. The life cycle is 35-45 days in the hot weather with 3 or 4 generations in a year. Emergence from dry climbers of the overwintered generation occurs from May to September.

6. **Apomecyna fallaciosa** Breuning

1938. *Apomecyna fallaciosa* Breuning, *Novit. Ent. fasc.* viii., p. 50.

Similar to *A. saltator* F., but the 5th and rest antennal segment together much longer than 3rd and 4th together, apical margin of elytra strongly truncated. Elytra without preapical markings, anterior markings, irregularly united at elytral disc, one obliquely inclined towards the lateral side premedian and another wavy postmedian.

Length 11 mm ; breadth 3 mm.

Material examined : Not examined.

Distribution : Breuning described the species on specimen from Northwest India (British Museum)—U. P. (Museum, Dehradun).

Summary

The present paper deals with 6 species of *Apomecyna* Lacordaire known from India. Detailed descriptions with illustrated figures, synonymic references, geographical distribution and biological informations are furnished. A key to the 19 Indian genera of the tribe and keys to the species of the genus *Apomecyna* known from India are also provided.

Acknowledgement

The present authors are grateful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta, for laboratory facilities and to Dr. M. Cox, British Museum, Natural History for his comment on certain species.

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Rec. zool. Surv. India, **92** (1-4) : 173-175, 1992

A RARE NEW SPIDER *LUTICA* MARX (ARANEAE : ZODARIIDAE) FROM INDIA

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INTRODUCTION

The spiders of the family Zodariidae are very little known from India. The genus *Lutica* was established by Marx (1891) with *Lutica maculata* Marx as a type species from California. Tikader and Patel (1975) reported this genus for the first time from India and described one new species. Tikader and Malhotra (1976) described one more species from India. While examining the spider collections made by one of us (TSR) from Costal Andhra Pradesh, we came across a new species of the genus *Lutica*, which is described and illustrated in details here. This is the third species which is making a total of three species from India.

The type specimens will in due course be deposited in the National Collections of Zoological Survey of India, Calcutta.

Lutica kovvurensis sp. nov.

(Fig. 1, a-h)

General : Cephalothorax and legs reddish brown, abdomen dark brown. Total length 3.80 mm. Carapace 2.12 mm long, 1.55 mm wide ; abdomen 2.12 mm long, 1.66 mm wide.

Cephalothorax : Longer than wide, cephalic region slightly high with rounded margin and provided with light brown patches. Thoracic region provided with a thin sharp fovea. Eyes pearly white except anterior medians. Anterior row very slightly procurved (straight as seen from the front), anterior medians conspicuously larger than the others and encircled by dark brown patches. Posterior row strongly procurved, posterior medians widely separated from each other and closer to adjacent laterals, laterals contiguous as in Fig. 1a. Sternum heart shaped, pointed behind and clothed with fine hairs. Labium and maxillae longer than wide, distal ends provided with thin scopulae. Sternum, labium and maxiliae as in Fig. 1b. Chelicerae short and stout. Legs long, moderately strong, clothed with fine hairs. Leg formula 4 1 3 2.

Male : It is similar to the female but smaller in size. Total length 2.66 mm. Male palp as in Fig. 1e, f and g.

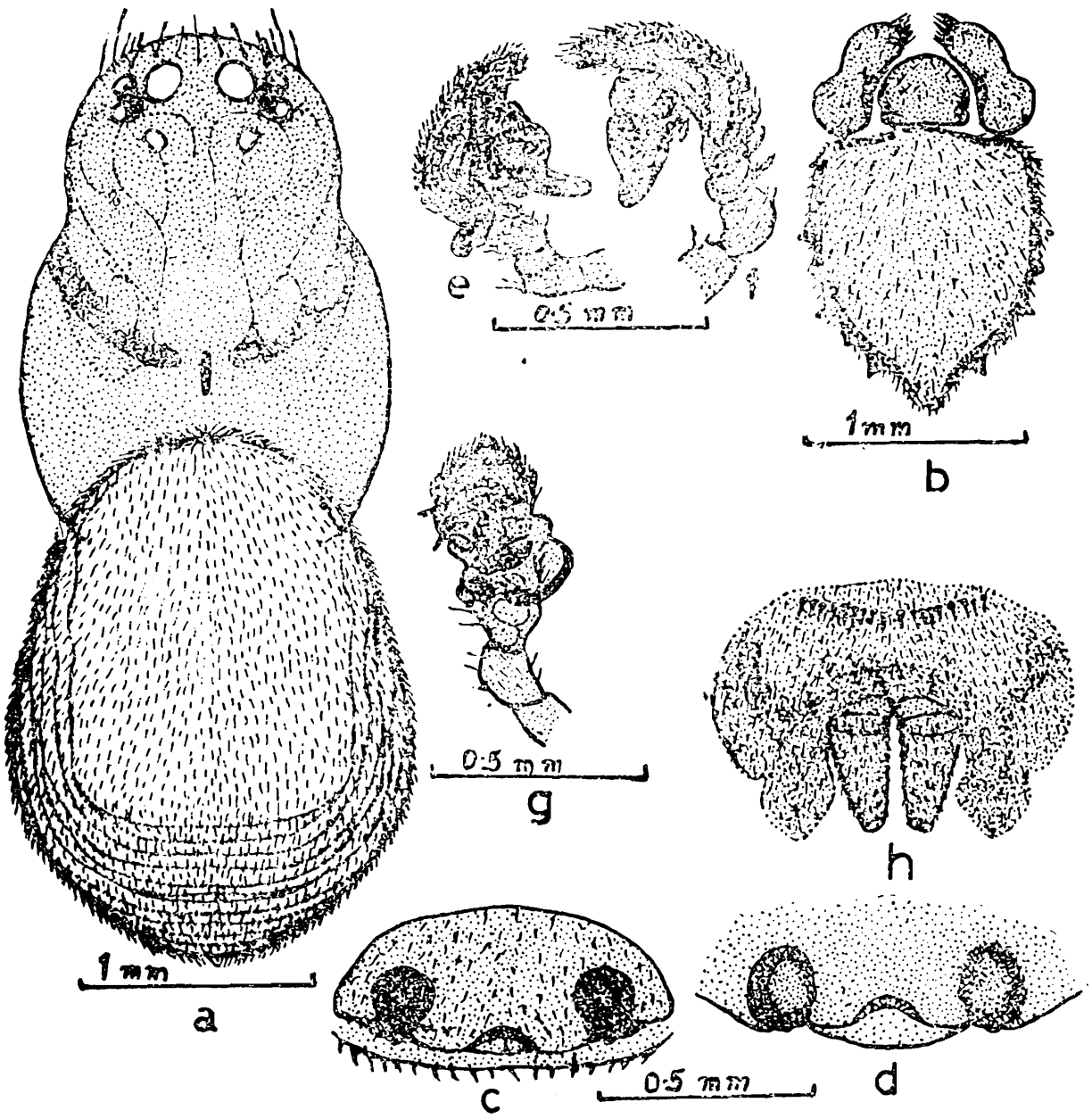

Fig. 1. a-h ; *Lutica kovvurensis* sp. nov.
- a. Dorsal view of female (legs omitted),
- b. Sternum, labium and maxillae,
- c. Epigyne,
- d. Internal genitalia,
- e. Right male palp—outer view,
- f. Right male palp—inner view,
- g. Right male palp—ventral view,
- h. Spinnerets.

Abdomen : Nearly globular, longer than wide, strongly overlapping on cephalothorax in front. Dorsal side uniform deep brown in colour, clothed with fine hairs and pubescence. Dorsum of abdomen posterolaterally provided with thin corrugations as

in Fig. 1a. Ventral side uniformly pale in colour. The anterior pair of spinnerets are conspicuously long and other two pairs properly developed as in Fig. 1h. Epigyne and internal genitalia as in Fig. 1c and d.

Holotype : One female, *allotype*, one male in spirit.

Type-locality : Kovvur, Dist. West Godavari, Costal Andhra Pradesh, India, 5-ix-1985. Coll. T. S. Reddy.

Diagnosis : This species resembles to *Lutica bengalensis* Tikader and Patel but it is separated as follows : (i) Thoracic region provided with thin sharp fovia but in *L. bengalensis* thoracic region provided with a pit and no distinct fovia present. (ii) Dorsum of abdomen posterolaterally provided with thin corrugations but in *L. bengalensis* no such corrugations present. (iii) Epigyne and internal genitalia are also structurally different.

SUMMARY

A new spider species *Lutica kovvurensis* sp. nov. (Zodariidae) is described in details and illustrated here from West Godavari District of Andhra Pradesh, India.

ACKNOWLEDGEMENTS

The authors are grateful to Prof. K. B. Tipnis, Principal, Sir P. P. Institute of Science, Bhavnagar University, Bhavnagar for providing the laboratory facilities.

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Rec. zool. Surv. India, 92 (1-4) : 177-192, 1992

REPORT ON THE ICHTHYOFAUNA OF KANYAKUMARI DISTRICT, TAMIL NADU

T. J. INDRA
Zoological Survey of India, Madras

INTRODUCTION

During the years 1988-89, Zoological Survey of India, Southern Regional Station, Madras, carried out two extensive surveys of Kanyakumari District, Tamil Nadu, under the District Survey scheme, by Dr. K. V. Lakshminarayana, Scientist 'SE' and Dr. Koshy Mathew, Scientist 'SD'. Kanyakumari District is the southernmost district of Tamil Nadu and Indian Mainland. The district has a rich share of ponds, rivers and reservoirs. Fishes were collected from various habitats like ponds, streams, rivers and reservoirs.

A total of 630 specimens were collected and identified, and belong to 7 orders, 15 families and 42 species. Most of the specimens were registered and the register number are given in bracket.

As there is neither a comprehensive account on the freshwater fish fauna of this district available in the district Gazetteer, nor is the work of Singh (1976) complete, the present study may be of use to improve our knowledge on the Ichthyofauna of Kanyakumari district. An interesting colour variety of *Puntius filamentosus* (Val.) was noted in this district.

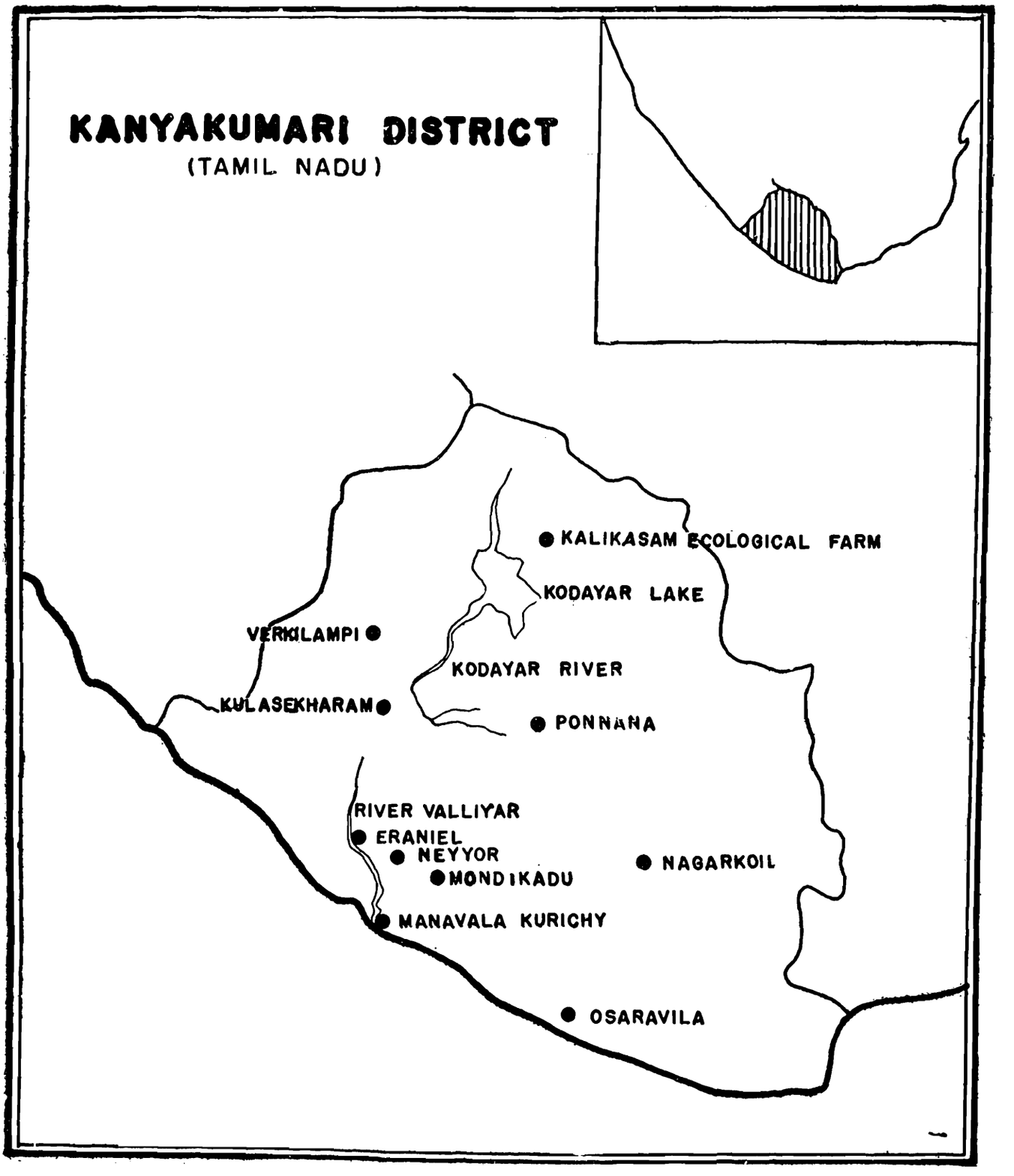
List of Species

Super Order : ELOPOMORPHA
I Order : ELOPIFORMES
Family : MEGALOPIDAE

1. *Megalops cyprinoides* (Broussonet) ... 12 exs.

Super Order : OSTARIOPHYSI
II Order : CYPRINIFORMES
Family : CYPRINIDAE
Subfamily : CULTRINAE

2. *Salmostoma bacaila* (Ham.) ... 10 exs.
3. *Salmostoma clupeoides* (Bloch) ... 4 exs.


KANYAKUMARI DISTRICT
(TAMIL NADU)
KALIKASAM ECOLOGICAL FARM
KODAYAR LAKE
VERKILAMPI
KODAYAR RIVER
KULASEKHARAM
PONNANA
RIVER VALLIYAR
ERANIEL
NEYYOR
NAGARKOIL
MONDIKADU
MANAVALA KURICHY
OSARAVILA

Subfamily : RASBORINAE

4.	*Amblypharyngodon microlepis* (Bleeker)	...	57 exs.
5.	*Danio (D.) aequipinnatus* (Mc Cll,)	...	15 exs.
6.	*Esomus barbatus* (Jerdon)	...	15 exs.
7.	*Rasbora (R.) daniconicus* (Ham.)	...	45 exs.

Subfamily : CYPRININAE

8.	*Puntius amphibius* (Val.)	...	5 exs.
9.	*Puntius chola* (Ham.)	...	1 ex.
10.	*Puntius dorsolis* (Jerdon)	...	14 exs.
11.	*Puntius melanampyx melanampyx* (Day)	...	65 exs.
12.	*Puntius filamentosus* (Val.)	...	30 exs.
13.	*Puntius sarana subnasutus* (Val.)	...	4 exs.
14.	*Puntius sophore* (Ham.)	...	8 exs.
15.	*Puntius vittatus* (Day)	...	34 exs.
16.	*Tor khudree malabaricus* (Jerdon)	...	7 exs.

Subfamily : GARRINAE

17.	*Garra mullya* (Sykes)	...	5 exs.

Family : HOMALOPTERIDAE

Subfamily : NOEMACHEILINAE

18.	*Noemacheilus triangularis* (Day)	...	14 exs.

Family : COBITIDAE

Subfamily : COBITINAE

19.	*Lepidocephalus thermalis* (Val.)	...	55 exs.

Order : SILURIFROMES

Family : BAGRIDAE

20.	*Mystus armatus* (Day)	...	1 ex.
21.	*Mystus montanus* (Jerdon)	...	21 exs.
22.	*Mystus oculatus* (Val.)	...	3 exs.
23.	*Mystus xittatus* (Bloch)	...	1 ex.

Family : HETEROPNEUSTIDAE

24. *Heteropneustes fossilis* (Bloch) ... 1 ex.

Order : ATHERINIFORMES

Family : CYPRINODONTIDAE

25. *Aplocheilus blochii* (Arnold) ... 16 exs.
26. *Aplocheilus lineatus* (Val.) ... 9 exs.

Family : POECILIDAE

27. *Gambusia affinis patruelis* (Baird & Girard) ... 15 exs.

Order : CHANNIFORMES

Family : CHANNIDAE

28. *Channa orientalis* (Schneider) ... 21 exs.
29. *Channa punctatus* (Bloch) ... 1 exs.

Order : PERCIFORMES

Family : CHANDIDAE

30. *Ambassis commersonii* Val. ... 7 exs.

Family : CICHLIDAE

31. *Etroplus maculatus* (Bloch) ... 43 exs.
32. *Etroplus suratensis* (Bloch) ... 12 exs.
33. *Oreochromis mossambica* (Peters) ... 33 exs.

Family : MUGILIDAE

34. *Liza parsia* (Ham.) ... 1 ex.
35. *Mugil cephalus* Linnaeus ... 1 ex.

Family : GOBIIDAE

36. *Awaous grammepomus* (Blkr.) ... 3 exs.
37. *Glossogobius biocellatus* (Val.) ... 1 ex.
38. *Glossogobius giuris* (Ham.) ... 3 exs.
39. *Oligolepis acutipennis* (C. & V.) ... 2 exs.
40. *Stigmatogobius javanicus* (Blkr.) ... 7 exs.

Family : BELONTIDAE

41. *Macropodus cupanus* Val. ... 22 exs.

Order : MASTACEMBELIFORMES

Family : MASTACEMBELIDAE

42. *Mastacembelus guntheri* Day ... 4 exs.

Megalops cyprinoides (Broussonet)

1782. *Clupea cyprinoides* Broussonet, *Ichthyol.*, pl. 9

Type locality : Gceans between the Tropics.

Material : 12 exs., 90-110 mm. SL., Puthurkayal at Mondikadu, 21 km. West of Nagarkoil., 9.10.89, (F. 2880).

Distribution : Indo-West Pacific. A coastal pelagic species, ascending rivers.

Salmostoma bacaila (Hamilton)

1822. *Cyprinus bacaila* Hamilton, *Fish Ganges*, p. 265, 384, pl. 8., fig. 76

Type locality : Rivers of Gangetic Provinces.

Material : 5 exs., 73-93 mm. SL., Velliyakulam pond, Manavalakurichy village., 17.7.89 (F. 2647) ; 3 exs. 85-95 mm. SL., Thengaramkulam, 16 Km. West of Nagarkoil., 18.8.89, (F. 2665) ; 2 exs., 77-85 mm. SL., Periyakulam Reservoir., 25.8.89, (F. 2677).

Distribution : Throughout India, Pakistan and Bangladesh.

Salmostoma clupeoides (Bloch)

1795. *Cyprinus clupeoides* Bloch, *Naturg. Ausland. Fische*, **12**, p. 49, pl. 408, fig. 2.

Type locality : Tranquebar).

Material : 4 exs., 92-100 mm. SL., Puthurkayal, Mondikadu, 21 km. West of Nagarkoil., 9.10.89 ; (F. 2882).

Distribution : Narmada, Tapi, Krishna, Godavary and Cauvery river systems. Recorded from Nasik, Deolali and Jabalpur.

Amblypharyngodon microlepis (Bleeker)

1853. *Leuciscus microlepis* Bleeker, *Verh. batav. Genoot. Kunst. Wet.*, 25, p. 41.

Type locality : River Hooghly.

Material : 7 exs., 48-65 mm. SL., Velliyakulum pond, Manavalakurichy., 17.7.89 (F. 2651) ; 32 exs., 41-71 mm. SL., Thengaramkulum, 16 Km. West of Nagarkoil.,

18.8.89 (F. 2660) ; 16 exs., 72-77 mm. SL., Therpakulam pond near Verkilampi. ; 7.10.89 (Fig. 2887) ; 2 exs., 62-70 mm. SL., Puthurkayal at Mondikadu, 21 Km. West of Nagarkoil., 9.10.89 (F. 2881).

Distribution : Throughout India, except Western India.

Danio D. aequpinnatus (Mc Clelland)

1839. *Perilampus aequipinnatus* Mc Clelland, *Asiatic Researchers*, **19**, p. 393.

Type locality : Assam.

Material : 4 exs., 21-55 mm. SL., Kalikasam Ecological farm., 25.3.88 (F. 1374) ; 4 exs., 45-60 mm. SL., Ponnana, on way to Kulasekharam., 26.3.88 ; 4 exs., 17-28 mm. SL., Molayar River., 28.3.88 ; 2 exs., 30-31 mm. SL., Lower Kodayar 17.3.89 (F. 2476) ; 1 ex., 20 mm., SL., Thengaramkulam pond, 16 Km. West of Nagarkoil., 18.8.89 (F. 2667).

Distribution : Eastern Himalaya, Meghalaya, Deccan, Nepal, Bangladesh, Burma, Thailand and Sri Lanka.

Esomus baratus (Jerdon)

1949. *Leuciscus barbatus* Jerdon, *J. Lit. Sic.*, **15**, p. 322.

Type locality : Rivers and tanks all over Mysore, Karnataka.

Material : 10 exs., 44-70 mm. SL., Thengaramkulam, 16 Km. West of Nagarkoil., 18.8.89 (F. 2666) ; 2 exs., 59-64 mm. SL., Periyakulam Reservoir near Manavalakurichy., 20.9.89 (F. 2883) ; 3 exs., 76-85 mm. SL., Therpakulam pond near Verkilampi (F. 2886).

Distribution : Confined to Southern India.

Rasbora (R.) daniconius (Hamilton)

1822. *Cyprinus daniconius* Hamilton, *Fish Ganges*, p. 327, p. 15, fig. 89.

Type locality : Rivers of Southern Bengal.

Material : 4 exs., 18-72 mm. SL., Kalikasam Ecological farm., 25.3.88 (F. 1375) ; 1 ex., 50 mm. SL., Vaalathivayal on Paraliyar road., 26.3.88 (F. 1656) ; 5 exs., 26-51 mm. SL., Ponnana on way to Kulasekharam., 26.3.88 ; 7 exs., 15-26 mm. SL., Mylar Odai, Kodayar river., 28.3.88 ; 10 exs., 16-30 mm. SL., Lower Kodayar, 17.3.89 (F. 2479) ; 2 exs., 61-65 mm. SL., Velliyakulam pond, Manavalakurichy village, Nagarkoil., 17.7.89 (F. 2649) ; 6 exs., 46-89 mm. SL., Thengaramkulam, 16 Km., West of Periyakulam Reservoir., 25.8.89 (F. 2656) ; 10 exs., 80-87 mm. SL., Therpakulam pond near Verkilampi., 7.10.89 (F. 2888).

Distribution : Throughout India, Pakistan, Bangladesh, Sri Lanka, Burma and Malayan Archipelago.

Puntius amphibius (Valenciennes)

1842. *Capoeta amphibia* Valenciennes, *Hist. Nat. Poiss.*, **16**, p. 282, 478.

Type locality : Bombay.

Material ; 2 exs., 75-85 mm. SL., Therpakulum pond near Verkilampi. 7.10.89 (F. 2884) ; 1 ex., 59 mm. SL., Paruthikulam pond near Eraniel., 8.10.89 (F. 2867) ; 1 ex., 72 mm. SL., Pazamkulam pond at Karunyal road in Monday Market, Neyyor., 9.10.89 (F. 3531) ; 1 ex., 43 mm. SL., Thengaramkulam, 16 Km. West of Nagarkoil., 18.8.89 (F. 2658).

Distribution : Freshwaters of Uttar Pradesh, Madhya Pradesh, Orissa and South India, Sri Lanka.

Puntius chola (Hamilton)

1822. *Cyprinus chola* Hamilton, *Fish Ganges*, p. 312, 313.

Type locality : North-eastern parts of Bengal.

Material : 1 ex., 65 mm. SL., Velliyakulam pond, Manavalakurichy village, Nagarkoil., 17.7.89 (F. 2648).

Distribution : Throughout India. Pakistan, Bangladesh, Burma and Sri Lanka.

Puntius dorsalis (Jerdon)

1849. *Systomus dorsalis* Jerdon, *Madras J. Lit. & Sci.* p. 314, 316.

Type locality : Tanks and rivers in the neighbourhood of Madras.

Material ; 1 ex., 21 mm. SL., Thothykadu., 15.3.89 (F. 2450) ; 13 exs., 43-110 mm. SL., Paruthikulam pond near Eraniel., 8.10.89 (F. 2869).

Distribution : Rivers of Krishna, Cauvery, Coleroon in South India.

Puntius melanampyx melanampyx (Day)

1865. *Labeo melanampyx* Day, *Proc. zool. Soc. London*, p. 298.

Type locality ; Wynaad.

Material : 44 exs., 10-41 mm. SL., Kalikasam Ecological Farm., 25.3.88 (F. 1376) ; 12 exs., 15-52 mm. SL., Ponnana on Kulasekharam Road, 26.3.88 (F. 1650) ; 7 exs., 15-25 mm. SL., Mylar Odai, Kodayar River., 28.3.88 ; 1 ex., 16 mm. SL., on way to Kodayar Power House., 30.3.88 (F. 1654) ; 1 ex., 20 mm. SL., Lower Kodayar., 17.3.89 (F. 2481).

Distribution ; Wynaad, Nilgiris, Travancore range of Hills and Cauvery river.

Puntius filamentosus (Valenciennes)
(Plate I, fig. 1 & 2)

1844. *Leuciscus filamentosus* Valenciennes, *Hist. Nat. Poiss.*, 17., p, 96, pl. 492.

Type locality : Alleppey, Kerala.

Material : 6 exs., 75-85 mm. SL., Periyakulam Reservoir., 25.8.89 **(F. 2672)**; 24 exs., 54-85 mm. SL. Periyakulam Reservoir, 20.9.89 (F. 2881).

Distribution : From Canara down the West coast and along the base of Nilgiris and Travancore Hills. Sri Lanka.

Remarks : The present material collected from Periyakulam Reservoir, Kanyakumari, differ from *Puntius filamentosus* in having a very long black blotch on the caudal penduncle and in the absence of black and red cross bars on the caudal fin, instead there is a thick red band on the caudal and anal fins. This may be a colour variety of *P. filamentosus* (Val.) since all other morphometric characters are identical with the typical *P. filamentosus*.

Puntius sarana subnasutus (Valenciennes)

1865. *Cyclochelichthys pinnauratus* Day, *Proc. zool. Soc. London*, p. 300. *Fish Malabar*. p. 209, pl. 15, fig. 2.

Type locality : Wynaad.

Material : 4 exs., 77-100 mm. SL., Paruthikulam near Eraniel., 8.10.89 (F. 2868).

Distribution : River systems in Andhra Pradesh, Karnataka, Tamil Nadu and Kerala.

Puntius sophore (Hamilton)

1822. *Cyprinus sophore* Hamilton, *Fish Ganges*, p. 310, 319 ; pl. 19.

Type locality : Ponds of Bengal.

Material : 1 ex., 44 mm. SL., Nagarkoil—Kanyakumari Road., 24.3.88 (F. 1646); 2 exs., 21-25 mm. SL., Chanengodu near Kulasekharam., 29.3.88 (F. 1554); 3 exs., 40-67 mm. SL., Thengaramkulum, 16 Km. West of Nagarkoil., 18.8.89 (F. 2657) ; 1 ex., 58 mm. SL., Periyakulam Reservoir., 20.9.89 (F. 2882).

Distribution : Throughout India, Pakistan, Bangladesh and Sri Lanka.

Puntius vittatus Day
(Plate I, fig. 3)

1865. *Puntius vittatus* Day, *Proc. zool. Soc. London*, p. 303.

Type locality : Madras.

Material : 8 exs. 18-32 mm. SL., Thothykadu,, 15.3.89 (F. 2448) ; 8 exs., 30-41 mm.

SL., Velliyakulam pond, Manavalakurichy, 17.7.89 ; 12 exs., 31-37 mm. SL., Thengaramkulam, 16 Km. West of Nagarkoil., 18.8.89 (F. 2659) ; 2 exs., 46-48 mm. SL., Therpakulam near Verkilampi, 7.10.89 (F. 2885) ; 4 exs., 24-40 mm. SL., Pazamkulam pond at Karunyal Road in Monday Market , 9.10.89 (F. 3532).

Distribution : Karnataka, Kerala, Tamil Nadu, Goa, Kutch and Rajasthan. Sri Lanka and Pakistan.

Remarks : In the description of this species Day (1889) has clearly mentioned about a black blotch on the dorsal fin but in the figure of the species the marking is not clearly seen. So a better photograph of the same species is given in the paper for the benefit of future workers.

Tor khudree malabaricus (Jerdon)

1848. *Barbus malabaricus* Jerdon, *Madras J. Lit. & Sci.*, **15**, p. 312.

Type locality : Mountain streams of Malabar.

Material : 7 exs., 23-44 mm. SL., Kalikasam Ecological Farm., 25.3.88 (F. 2974) ;

Distribution : Rivers of Western Ghats, Godavary, Krishna, Cauvery and their tributaries.

Garra mullya (Sykes)

1841. *Chondrostoma mullya* Sykes, *Trans. zool. Soc. London*, **2**, p. 359, pl. 62, fig. 3.

Type locality : Poona waters.

Material : 5 exs., 33-44 mm. SL., Kalikasam Ecological farm., 25.3.88 (F. 2975).

Distribution : Throughout India except Assam and Himalaya.

Noemacheilus triangularis Day

1865. *Nemacheilus triangularis* Day, *Proc. zool. Soc. London*, p. 295.

Type locality : Mundakayam, Travancore.

Material : 5 exs., 24-45 mm. SL., Kalikasam Ecological farm., 25.3.88 (F. 1540) ; 8 exs., 28-46 mm. SL., on way to Kodayar power house., 30.3.88 (F. 1652) ; 1 ex., 28 mm. SL., Lower Kodayar., 17.3.89 (F. 2480).

Distribution : Peninsular India, Western Ghats, Kallar, Pamba, Periyar and Bharathapuzha drainages.

Lepidocephalus thesmalis (Valenciennes)

1846. *Cobitis thermalis* Valenciennes, *Hist., nat. Poiss.*, **17**, p. 78.

Type locality : Ceylon.

Material : 1 exs., 29 mm. SL., Nagarkoil—Kanyakumari Road., 24.3.88 (F. 1647) ; 9 exs., 26-45 mm. SL., Vaalathi Vayal on Paraliyar Road., 26.3.88 ; 13 exs., 21-41 mm. SL., Chanengodu near Kulasekharam., 29.3.88 (F. 1551) ; 7 exs., 21-25 mm. SL., Osaravila., 14.3.89 (F. 2475) ; 2 exs., 25-31 mm. SL., Payamaram ; 15.3.89 (F. 2470) ; 16 exs., 20-30 mm. SL., Thothykadu., 15.3.89 (F. 2455) ; 1 ex., 33 mm. SL., Kalikasam Ecological Farm,, 25.3.88 (F. 1541) ; 4 exs., 35-54 mm. SL., Periyakulam Reservoir., 25.8.89 (F. 2671) ; 2 exs., 39-40 mm. SL., Paruthikulam pond near Eraniel., 8.10.89 (F. 2872).

Distribution : Southern Karnataka, Kerala and Tamil Nadu, Sri Lanka.

Mystus armatus (Day)

1865. *Hypselobagrus armatus* Day, *Proc. zool. Soc. London.*, p. 289.

Type locality : Malabar.

Material : 1 ex., 80 mm. SL., Chanengodu near Kulasekharam., 29.3.88 (F. 1555).

Distribution : Wynaad, Cauvery river in Southern India.

Mystus montanus (Jerdon)

1849. *Bagrus montanus* Jerdon, *Madras J. Lit. & Sci.* **15** (2) ; p. 338.

Type locality : Manantody river, Wynaad.

Material : 2 exs., 40-48 mm. SL., Lower Kodayar ; 17.3.89 (F. 2482) ; 1 ex., Thengaramkulam, 16 Km. West of Nagarkoil., 18.8.89 (F. 2664) ; 18 exs., 30-55 mm. SL., Periyakulam Reservoir., 25.8.89 (F. 2676).

Distribution : Manantody river, Wynaad, Cauvery headwaters in Southern India.

Mystus oculatus (Valenciennes)

1839. *Bagrus oculatus* Valenciennes, *Hist. Nat. Poiss.*, **14**, p. 424.

Type locality : Malabar.

Material : 1 ex., 45 mm. SL., Thengaramkulam, 16 Km. West of Nagarkoil., 18.3.89 (F. 2663) ; 2 exs., 43-50 mm. SL., Paruthikulam pond near Eraniel., 8.10.89 (F. 2875).

Distribution : Malabar, Kerala and Coimbatore.

Mystus vittatus (Bloch)

1797. *Silurus vittatus* Bloch, *Ichthyl. Hist. Nat.*, **11**, p. 40, pl. 371, fig. 2.

Type locality : Tranquebar, South India.

Material : 1 ex., 114 mm. SL., Paruthikulam pond near Eraniel., 8.10.89 (F. 2876).

Distribution : Throughout India, Pakistan, Burma, Thailand, Bangladesh and Sri Lanka.

Heteropneustes fossilis (Bloch)

1794. *Silurus fossilis* Bloch, *Naturg. Ausland. Fische.*, p. 46, pl. 370, fig. 2.

Type locality : Tranquebar.

Material : 1 ex., 155 mm. SL., Thengaramkulam, 16 Km. West of Nagarkoil., 18.8.89 (F. 2653) ; 2 exs., 135-140 mm. SL., Therpakulam near Verkilampi., 7.10.89 (F. 2883).

Distribution : Throughout India, Pakistan, Bangladesh, Burma, Sri Lanka and Siam.

Aplocheilus blochii (Arnold)

1911. *Haplochilus panchax* var. *blochii* Arnold, *Wschr.*-u. *Terrarienk*, **8**, p. 672.

Type locality : Rivers and Tanks of Madras city.

Material : 2 exs., 16-18 mm. SL., Payamaram., 15.3.89 (F. 2468) ; 7 exs., 20-29 mm. SL., Thengaramkulam pond, 16 Km. West of Nagarkoil., 18.8.89 (F. 2661) ; 7 exs., 17-25 mm. SL., Pazamkulam pond at Karunyal Road., 9.10.89 (F. 3533).

Distribution : Fresh and brackishwaters of Kutch, Ahmedabad and Madras. Pakistan and Sri Lanka.

Aplocheilus lineatus Valenciennes)

1846. *Panchax lineatum* Valenciennes, *Hist. nat. Poiss.*, **18**, p. 381.

Type locality : Bombay.

Material : 6 exs., 17-39 mm. SL., Ponnana on Kulasekharam Road., 26.3.88 (F. 1651) ; 3 exs., 21-37 mm. SL., Chanengodu near Kulasekharam., 29.3.88 (F. 1552).

Distribution : Fresh and brakishwaters along the coast of Bombay, Wynaad, Malabar, Coorg, Madras and Andhra Pradesh. Sri Lanka.

Gambusia affinis patruelis (Baird & Girard)

1853. *Heterandia patruelis* Baird, and *Girard, Proc. Acad. nat. Sci. Philad.*, **6**, p. 390.

Type locality : Rio Sabinal, Texas.

Material : 15 exs., 15-28 mm. SL., on way to Kodayar power house., 30.3.88 (F. 1653).

Distribution : Throughout India. Pakistan, Burma, Bangladesh and Sri Lanka.

Channa orientalis (Schneider)

1801. *Channa orientalis* Schneider, *Syst. Ichth.*, p. 496, pl. 90, fig. 2.

Type locality : Not given.

Material : 5 exs., 40-47 mm. SL., Vaalathi Vayal on Paraliyar Road, 26.3.88 (F. 1655) ; 6 exs., 45-55 mm. SL., Chanengodu., 29.3.88 (F. 1553) ; 1 ex., 76 mm. SL., payamaram., 15.3.89 (F. 2472) ; 4 exs., 15-70 mm. SL., Thothykadu., 15.3.89 (F. 2454) ; 5 exs., 60-80 mm. SL., Periyakulam Reservoir., 25.8.89 (F. 2673).

Distribution : Throughout India. Pakistan, Afghanistan, Bangladesh, Sri Lanka, Burma, Thailand, Malaysia and Viet-Nam.

Channa punctatus (Bloch)

1793. *Ophiocephalus punctatus* Bloch *Naturg. Ausland. Fische.*, 2. 139, pl. 358.

Type locality : Coromandal coast.

Material : 1 ex., 50 mm. SL., Pazakulam pond at Karunyal Road., 9.10.89 (F. 3534).

Distribution : Freshwaters of India. Pakistan, Burma, Sri Lanka, China and Malasiya.

Ambassis commersonii Cuvier

1828. *Ambassis commersonii* Cuvier, *Hist. nat. Poiss.*, 2, p. 176, pl. 25.

Type locality : Bourbon, Pondicherry., Mahe.

Material : 7 exs., 44-89 mm. SL., River Valliyar near Manavalakurichy Village., 20.9.89, (F. 2878).

Distribution : Indo-west Pacific. Often ascending rivers.

Etroplus maculatus (Bloch)

1785. *Chaetodon maculatus* Bloch, *Syst. Ichth.*, pl. 427, fig. 2.

Type locality : Not given.

Material : 4 exs, 17-18 mm. SL., Nagarkoil-Kanyakumari Road., 24.3.88 (F. 1649) ; 1 ex., 16 mm. SL., Thothykadu., 15.3.89 (F. 2452) ; 2 exs., 28-29 mm. SL., Payamaram., 15.3.89 (F. 2467) ; 2 exs., 58-64 mm. SL.. Thengaramkulam, Nagarkoil., 18.8.89 (F. 2655) ; 21 exs., 20-51 mm. SL., Periyakulam Reservoir., 25.8.89 (F. 2669) ; 2 exs., 41-45 mm. SL., Periyakulam Reservoir., 20.9.89 (F. 2884) ; 11 exs., 40-49 mm. SL., Puthurkayal at Mondikadu 21 Km. West of Nagarkoil., 9.10.89 (F. 2877).

Distribution : Tamil Nadu, Kerala and S. Kanara, Sri Lanka.

Etroplus suratensis (Bloch)

1763. *Chaetodon suratensis* Bloch, *Syst., Ichth.*, pl. 217.

Type locality : Surat.

Material : 1 ex., 35 mm. SL., Payamaram., 15.3.89 (F. 2466) ; 4 exs., 40-81 mm. SL., Periyakulam Peservoir., 25.8.89 (F. 2668) ; 3 exs., 55-85 mm. SL., River Valliyar near Manavalakurichy., 20.9.89 (F. 2827) ; 4 exs., 53-70 mm. SL., Puthurkayal at Mondikadu., 9.10.89 (F. 2878).

Distribution : Fresh and brackish waters of Orissa, Tamil Nadu and Kerala. Sri Lanka.

Oreochromis mossambica (Peters)

1852. *Chromis mossambica* Peters, *Monatsb. Akad. Wise. Berlin*, p. 681.

Type locality : Zambesi River.

Material : 15 exs , 12.5-26 mm. SL., Nagarkoil-Kanyakumari Road, 24.3.88 (F. 1648) ; 6 exs., 25-35 mm. SL., Thengaramkulam, 16 Km. West of Nagarkoil., 18.8.89 (F. 2662) ; 8 exs., 35-62 mm. SL., Periyakulam Reservoir., 25.8.89 (F. 2670) ; 1 ex., 78 mm. SL., Paruthikulam pond near Eraniel., 8.10.89 (F. 2874) ; 3 exs., 60-80 mm. SL., Puthurkayal at Mondikadu., 9.10.89 (F. 2879).

Distribution : Eastern Africa to Natal. Widely introduced in India and Pakistan.

Liza parsia (Hamilton)

1822. *Mugil parsia* Hamilton, *Fish Ganges*, p. 215, 380, pl. 17, fig. 71.

Type locality : Fresh water river of Bengal.

Material : 1 exs., 35 mm. SL., River Valliyar near Manavalakurichy village, 20.9.89 (F. 2880).

Distribution ; Coasts of Bombay, Malabar, Kerala and West Bengal. Pakistan. Bangladesh, Burma, Sri Lanka and Philippines.

Mugil cephalus Linnaeus

1758. *Mugil cephalus* Linnaeus, *Syst. Nat.*, 1 ed., **10**, p. 316.

Type locality : European Ocean.

Material : 1 ex., 54 mm. SL., River Valliyar near Manavalakurichy village., 20.9.89 (F. 2879).

Distribution : Throughout Southern India. Pakistan, Burma, Sri Lanka, and China.

Awaous grammepomus (Bleeker)

1849. *Gobius melanocephalus* Bleeker, *Verh. Bat. Gen.*, **22**, p. 23.

Type locality : Not given.

Material : 3 exs., 63-80 mm. SL., Periyakulam Reservoir., 25.8.89 (F. 2678).

Distribution : India. Philippines and Indo-Australian Archipelago.

Glossogobius biocellatus (Valenciennes)

1837. *Glossogobius biocellatus* Cuvier and Valenciennes, *Hist. nat. Poiss.*, **12**, p. 73.

Type locality : Not given.

Material : 1 ex., 61 mm. Sl., River Valliyar near Manavalakurichy Village., 20.9.89 (F. 2825).

Distribution : India. Philippines and Indo-Australian Archipelago.

Glossogobius giuris (Hamilton)

1822. *Gobius giuris* Hamilton, *Fish Ganges*, p. 51, 336, pl. 33, fig. 15.

Type locality : Ponds and fresh waters of Gangetic Provinces.

Material : 2 exs., 91-160 mm. SL., Thengaramkulam, 16 Km. West of Nagarkoil., 18.8.89 (F. 2654) ; 1 ex., 75 mm. SL., Paruthikulam pond near Eraniel., 8.10.89, (F. 2873).

Distribution : Throughout India, both fresh and estuarine waters

Oligolepis acutipennis (Cuv. & Val.)

1837. *Gobius acutipennis* Cuvier & Valenbiennes, *Hist. nat. Poiss.*, 12, p. 80.

Type locality : Malabar.

Material : 2 exs., 57-68 mm. SL., River Valliyar near Manavalakurichy Village., 20.9.89, (F. 2826).

Distribution : From India to Indo-Australian Archipelago and Philippines.

Stigmatogobius javanicus (Bleeker)

1856. *Gobius javanicus* Bleeker, *Nat. Tijds, Ned. Ind.* **11**, p. 88.

Type locality : Not given.

Material : 7 exs., 44-89 mm. SL., River Valliyar near Manavalakurichy. 20.9.89, (F. 2830 (A).

Distribution : India. Philippines, Indo-Australian Archipelago and Queensland.

Macropodus cupanus Valenciennes

1831. *Macropodus cupanus* Valenciennes, *Hist. nat. Poiss.*, 7, p. 357.

Type locality : Pondicherry.

Material : 2 exs., 30-32 mm. SL., Payamaram., 15.3.89 (F. 2473) ; 12 exs., 14-27 mm. SL., Thothykadu., 15.3.89 (F. 2453) ; 8 exs., 31-45 mm. SL., Pazamkulam pond at Karunyal Road in Monday Market, Neyyor., 9.10.89 (F. 3529).

Distribution : Ditches, paddy fields and shallow waters along the coasts of India. Pakistan and Sri Lanka.

Mastocembelus guntheri Day

1865. *Mastacembelus guentheri* Day, *Proc. zool. Soc. London*, p. 37.

Type locality : Malabar.

Material : 1 ex., 44 mm. SL., Mylarodai, Kodayar, 28.3.88 ; 1 ex., 72 mm. SL., Lower Kodayar., 17.3.89 (F. 2458) ; 2 exs,, 52-65 mm. SL., Pazamkulam pond at Karunyal Road at Monday Market, Neyyor., 9.10.89 (F. 3535).

Distribution : Malabar coast and Kanyakumari District.

DISCUSSION

Forty two species including 33 primary freshwater fishes are reported for the first time from Kanyakumari District. Earlier report on fishes of Kanyakumari district is found in a small hand book by Singh (1976) wherein 19 primary freshwater species are reported and of these 11 species are not represented in the present collection. Several North Indian species have been inadvertently included in the list *viz.* *Haplocheilus panchax* (=*Aplocheilus panchax* (Ham.), *Discognathus lamta* (=*Garra lamta* (Ham.), *Barbus chrysopoma* (=*Puntius sarana spilurus* (Gunther), *Barbus puntio* (=*puntius puntio* (Ham.)) and *Chela sardinella* (=*Salmostoma sardinella* (Val.)). Also for certain other species nomenculatural changes have to be incorporated for ex. *Aplocheilus melastigma* (=*Oryzias melanostigma* (Mc. Cl.)), *Barbus tor* (=*Tor khudree malabaricus* (Jerdon)), *Rasbora argentea* (=*Chela acinaces* (Val.)) and *Chela clupeoides* (=*Salmostoma clupeoides* (Bleeker)) (Jayaram, 1981). This report is an upto-date one on the Ichthyofauna of the district.

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PLATE-I

Fig. 1

Fig. 2

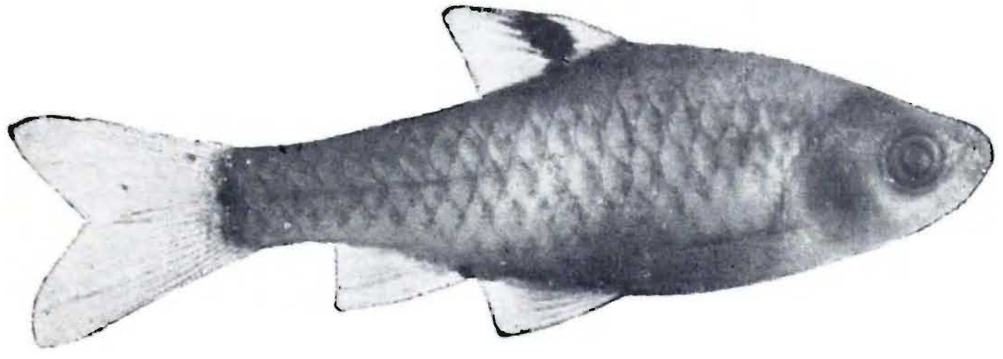

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Fig. (1) *Puntius filamentosus* (Val.). A colour variety collected from Kanyakumari district.

(2) *Puntius Filamentosus* (Val.). A specimen showing the original colour pattern of the species.

(3) *Puntius vittatus* (Day.). A figure clearly showing the blotch on the dorsal fin.

Rec. zool. Surv. India, 92 (1-4) : 193-209, 1992

FISHES OF KALAKAD WILDLIFE SANCTUARY, TIRUNELVELI DISTRICT, TAMIL NADU, INDIA, WITH A REDESCRIPTION OF *HORALABIOSA JOSHUAI* SILAS

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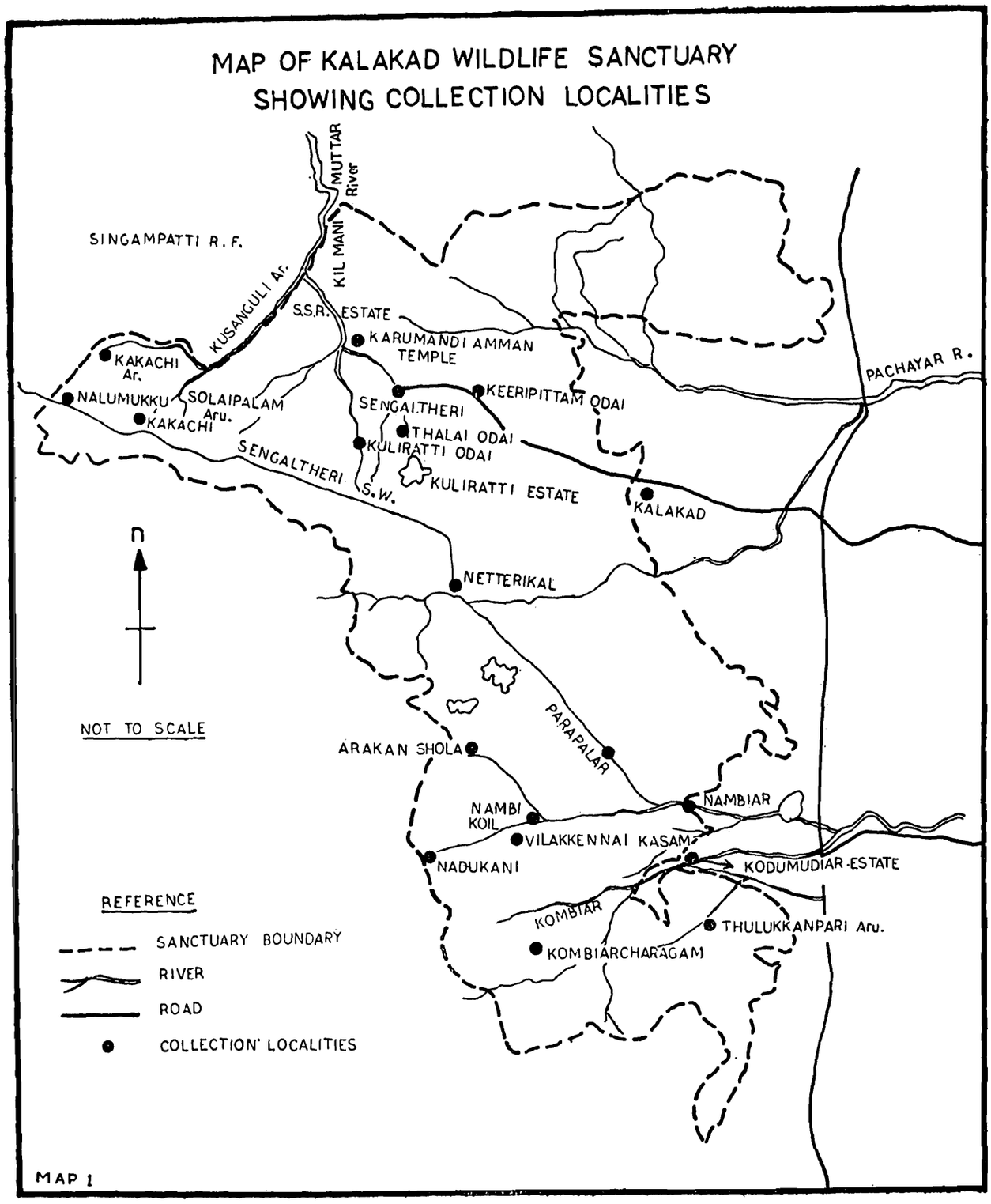
Introduction

Faunistic tours were conducted for the first time by the Southern Regional Station of the Zoological Survey of India, Madras, to Kalakad Wildlife Sanctuary during 1984 through 1987. Earlier reports of fishes from Tirunelveli District includes those of Silas (1953). He described 9 species from the head-waters of the Tambraparni River which drains the eastern face of the "Singampatty hill range" and from the Tambraparni watershed, Tirunelveli District. Of these, two were new to science viz. *Horalabiosa joshuai* gen. et sp. nov. and *Puntius arulius tambraparni* sub sp. nov. The present collection from the little explored Kalakad Wildlife Sanctuary (which includes the "Singampatty hill range" also), Tirunelveli District comprises of 19 species including one new species *Garra kalakadensis* Rema Devi (in press). The rich collection of different size groups of *Horalabiosa joshuai* Silas from different drainages and altitudes has facilitated its redescription. *Esomus thermoicos* (Val.) known from Ceylon is reported here along with 12 other species including the hill stream fish *Bhavania australis* (Jerdon). Colour variation in *Aplocheilus lineatus* (Val.) is also reported herein. In the systematic account of the species are included the first reference, material examined, length range in mm SL, date of collection, altitude in metres, register no., systematic remarks and distribution.

Physiography of The Kalakad Sanctuary

The Kalakad Wildlife Sanctuary is located in Nanguneri Taluk, Tirunelveli District of Tamil Nadu and lies between latitudes 8°25'N and 8°35'N and longitudes 77°25'E and 77°35'E. The sanctuary comprises the whole of the Kalakad Reserve Forests. The hills are covered with dry deciduous forest on the lower slopes and evergreen (shola type) forests on the upper reaches, traversed by rivers and mountain streams. Across the eastern slope of the sanctuary, the rivers Kodumudiar, Nambiar, Netterikal and Pachayar flow eastwards. The Kilmanimuthar with its tributaties, the Kulirattiar and Kusanguliar traverse the western aspect of the sanctuary. The highest peak is the Kalakad peak (1775 m) and the other noteworthy peaks are Velimalai (1011 m), Kakachi (1233 m), Netterikal (1350 m), Kuliratti (1396 m) and Thiruvannamalai peak (1378 m).


MAP OF KALAKAD WILDLIFE SANCTUARY
SHOWING COLLECTION LOCALITIES
MUTTAR River
KIL MANI
SINGAMPATTI R.F.
KUSANGULI Ar.
S.S.R. ESTATE
KARUMANDI AMMAN TEMPLE
KAKACHI Ar.
NALUMUKKU
SOLAIPALAM Aru.
KAKACHI
SENGALTHERI
KEERIPITTAM ODAI
THALAI ODAI
KULIRATTI ODAI
SENGALTHERI S.W.
KULIRATTI ESTATE
PACHAYAR R.
KALAKAD
N
NETTERIKAL
NOT TO SCALE
PARAPALAR
ARAKAN SHOLA
NAMBI KOIL
NAMBIAR
VILAKKENNAI KASAM
NADUKANI
KODUMUDIAR ESTATE
KOMBIAR
THULUKKANPARI Aru.
KOMBIARCHARAGAM
REFERENCE
SANCTUARY BOUNDARY
RIVER
ROAD
COLLECTION LOCALITIES
MAP 1

SYSTEMATIC ACCOUNT

1. **Danio aequipinnatus** (McClelland)

1839. *Perilampus aequipinnatus* McClelland, *Ind. Cyp.* p. 393, pl. 60, fig. 1.

Type locality : Assam.

Material : 268 exs., 9.0-72.0 mm SL, 190 m-1320 m. (9 exs., F. 637, Nalumuku Kakachi Rd., 1140 m, 6.9.85 ; 150 exs., F. 639, Kakachi, 1320 m, 7.9.85 ; 14 exs., F. 635, between kakachi and Nalumuku solaipalam aru, 9.9.85 ; 13 exs., F. 638, along solaipalam aru, Nallankadu, 1120 m, 11.9.85 ; 3 exs., Pachayar near Thalaiaru, 190 m, 12.2.86 ; 15 exs., F. 654, Karikaran Thondu, Pachayar, 200 m, 13.2.86 ; 17 exs., F. 663, along the course of Nambiar upto Nambikoil, 190 m-350 m, 21.8.86 ; 4 exs., F. 666, along the course of Nambiar upto Nambikoil, 190-350 m, 21.8.1986 ; 35 exs., F. 704, Vilakkennai kasam, 300 m, 8.1.87 and 8 exs., F. 683, alcng Nambiar on way to Nambikoil, 260 m, 9.1.87).

Diagnostic features : D 2/10-11 ; A 3/13-16 ; L l 34-36, complete ; predorsal scales 17 ; fresh specimens orange in colour with bluish bands.

Distribution : India : Eastern Himalaya, Meghalaya and Deccan ; Nepal ; Bangladesh ; Myanmar ; Tenasserim provinces ; Thailand ; Sri Lanka.

2. **Esomus thermoicos** (Valenciennes)

(Plate 1, Fig. 1)

1842. *Nuria thermoicos* Cuvier and Valenciennes, *Hist. Nat. Poiss.*, XVI, p. 238.

Type locality : Sri Lanka.

Material : 10 exs., 35.0-37.0 mm SL, F. 3528, Karungal kasam, 250 m, 10.1.87.

Description : D 2/6 ; A 3/5 ; P 1/10-11 ; V 1/7 ; C 1/17/1 ; lateral line 33-34 (pored upto 30-32 scales) ; predorsal 18-20 ; preventral 21-22 ; rostral barbel extends upto posterior margin of eye ; maxillary barbel extends almost upto pectoral tip and in one specimen, 36.0 mm SL, it extends beyond ventral origin. Head 3.58 (3.40-3.70), depth of body 4.68 (4.36-5.18), predorsal distance 1.48 (1.42-1.56), postdorsal distance 2.86 (2.71-3.11), preventral distance 1.86 (1.80-1.94), preanal distance 1.40 (1.36-1.45), height of dorsal 5.46 (5.08-5.84), length of pectoral 3.57 (3.44-3.71), length of pelvic 6.94 (6.12-7.35), length of anal 5.15 (4.76-5.81), length of caudal peduncle 4.85 (4.59-5.34), height of caudal peduncle 10.10 (9.31-11.71), length of rostral barbel 10.51 (9.68-12.80) and length of maxillary barbel 2.38 (2.0-2.65) in standard length. Height of head 1.64 (1.54-1.74), snout 3.93 (3.73-4.06), eye diameter 4.23 (3.77-4.95) and interorbital width 2.86 (2.67-3.05) in head length ; width of body 1.69 (1.54-1.86) in depth of body ; postdorsal distance 1.93 (1.73-2.19) in predorsal distance. Sides with a black band ; abdomen dark in colour.

Affinities and distribution :

Esomus danrica thermoicos (Val.) is known only from Sri Lanka (Deraniyagala, 1952). Silas (1952) considers this a subspecies of *E. barbatus* (Jerdon), a peninsular form which lacks the lateral band. The material in the present collection answers to the description of *E. thermoicos* (Val.) mainly in the characteristic lateral band and in the predorsal row of scales (17 in *E. barbatus*).

3. **Rasbora daniconius** (Hamilton)

(Plate 1, Fig. 2)

1822. *Cyprinus daniconius* Hamilton, *Fish Ganges*, p. 327, pl. 15, fig. 89.

Type locality : Rivers of South Bengal.

Material : 86 exs., 17.0-84.0 mm SL, 100-350 m. (8 exs., F. 642 and F. 647, Keeripittam odai, 100 m, 9.2.86 ; 5 exs., F. 656, Pachayar near Thalaiaru, 190 m, 12.2.86 ; 1 ex., F. 655, Karikaran thondu, Pachayar, 200 m, 13.2.86 ; 11 exs., F. 664 and F. 665, along the course of Nambiar upto Nambikoil, 190-350 m, 21.8.86 ; 5 exs., F. 668, Thulukkan parai aru, 300 m, 23.8.86 ; 7 exs., stream near Kodumudiar estate, 200 m, 26.8.86 ; 12 exs., F. 684 and F. 690, along Nambiar on the way to Nambikoil, 260 m, 9.1.87 ; 4 exs., F. 691, Thulukkan parai, 240 m, 12.1.87 ; 27 exs., F. 681, Kombiar charagam, Thakkaru, 210 m, 13.1.87 and 6 exs. F. 682, Nambiar on the way to Nambikoil, 190-250 m, 14.1.87.)

Remarks : Lateral line with 33 pored scales ; predorsal scales 14 ; L. tr 5/2-2½ ; head length 3.55 (3.33-3.70), body depth 4.0 (3.82-4.13), predorsal distance 1.80 (1.75-1.87) and postdorsal distance 2.15 (2.1-2.2) in standard length ; postdorsal in predorsal distance 1.19 (1.16-1.26). Body with a bold lateral band from tip of snout to the fork of the caudal fin, a dark streak on mid dorsal surface, the first few scales along the lateral line have dark bases.

Distribution : Throughout India ; Pakistan ; Nepal ; Bangladesh ; Sri Lanka ; Myanmar ; Malay Archipelago and Zanzibar.

4. **Rasbora caverii** (Jerdon)

(Plate 1, Fig. 3)

1848. *Leuciscus caverii* Jerdon, *Madras J. Lit. & Sci.*, 15, p. 320.

Type locality : Cauvery river, Coorg State.

Material : 10 exs., 21.0-61.0 mm SL, 150-250 m. (9 exs., 21.0-61.0 mm, F. 687, Karungal kasam, 250 m, 10.1.87 and 1 ex., F. 698, stream near Kodamadi estate, 150 m, 15.1.87)

Remarks : Of these specimens the largest 60.0 mm SL has a short dorsal-hypural distance as characteristic of *R. caverii*. In the juveniles this character is found to be

subject to variation and these specimens differ very little from *R. daniconius*. The predorsal scales are more in number 16 (14 in daniconius). Lateral line with 33-35 pored scales ; lateral transverse 6/1½/2-2 ; head length 3.86 (3.57-4.14), body depth 4.62 (4.33-5.16), predorsal distance 1.75 (1.70-1.79), postdorsal distance 2.23 (2.09-2.41) in standard length ; postdorsal 1.28 (1.25-1.42) in predorsal. The lateral band is less faint and narrower and there are no faint stripes above and below this as in *daniconius*. These specimens differ from *daniconius* chiefly in the more number of predorsal scales and in its body depth.

Distribution : India : Southern India, notably Karnataka especially the Cauvery basin ; Sri Lanka.

5. **Puntius bimaculatus** (Bleeker)

(Plate 1, Fig. 4)

1864. *Gnathopogon bimaculatus* Bleekeer, *Verh. Nat. Holl. Maatsch. Haarlem* (2), xx, p. 17.

Type locality : Sri Lanka.

1868. *Puntius (Capoeta) puckelli* Day, *Proc. Zool. Soc. London,* : 197.

Type locality : Bangalore.

Material : 10 exs., 25.0-35.0 mm SL, 100-260 m. (2 exs., F. 3513, Keeripittam odai, 100 m, 9.2.86 ; 2 exs., F. 3512, along Nambiar on the way to Nambikoil, 260 m, 9.1.87 and 6 exs., F. 3510, stream near Kodamadi estate, 150 m, 15.1.87.

Remarks : D 3/7 ; P 1/12-14 ; V 1/6-7 ; C 1/17/1 ; L1 23-26 ; L tr 4-5/3-3½/2 ; predorsal scales 8-9½/2. A spot in dorsal base from the 3rd to the 7th branched rays and one on caudal base. These specimens agree in most details to *P. puckelli* Day. A note on *P. bimaculatus* (Blkr.) (=*P. puckelli* Day) from Javadi hills is published elsewhere.

Distribution : Peninsular India, Sri Lanka.

6. **Puntius chola** (Hamilton)

1822. *Cyprinus chola* Hamilton, *Fish Ganges*, p. 312, 389.

Type locality : North-Eastern parts of Bengal.

Material : 5 exs., 39.0-45.0 mm SL, F. 3511, Stream near Kodamadi estate, 150 m. 15.1.87.

Remarks : Suborbital sensory canal pores radiating from eye in short rows are observed also in these specimens.

Distribution : Throughout India ; Pakistan ; Bangladesh ; Myanmar ; Sri Lanka.

7. **Puntius dorsalis** (Jerdon)

(Plate 1, Fig. 5)

1849. *Systomus dorsalis* Jerdon, *Madras J. Lit. & Sci.*, pp. 314, 316.

Type locality : Madras.

Material : 94 exs., 13.0-52.0 mm SL. 100-1100 m. (3 exs., F. 628. stream near Nalumuku estate, 1100 m, 4.9.85 ; 16 exs., F. 629, Nalumuku estate, 1100 m, 11.9.85 ; 14 exs., F. 641, Keeripittam odai, 100 m, 9.2.86 ; 2 exs., Poochithondu odai, Mudalliruppan bridge, 10.2.86 ; 6 exs., Pachayar near Thalaiar, 190 m, 12.2.86 ; 39 exs., F. 662, Aruval theeti odai, 185 m, 14.2.86 and 14 exs., F. 697, stream near Kodamadi estate, 150 m. 15.1.86).

Remarks : These specimens conform to *P. dorsalis* (Jerdon) in most of its meristic and morphometric characters and in the general body colouration. However, it differs in the presence of articulated dorsal and the dark spot before caudal base, characters attributable to young ones (Hora, 1936). Another feature observed in these specimens from Kalakad is the presence of numerous vertical sensory canal pores radiating from eye.

Distribution : South India, Rajasthan ; Sri Lanka.

8. **Puntius sarana subnasutus** (Valenciennes)

1865. *Cyclochelichthys pinnauratus* Day, *Proc. Zool. Soc. London*, p. 300 ; *Fish Malabar*, p. 209, pl. 15, fig. 2.

Type locality : Wynaad.

Material : 2 exs., 54.0 mm and 123.0 mm SL. F. 685 and F. 699. along Nambiar on the way to Nambikoil, 260 m, 9.1.87.

Distribution : India : Peninsular India, South of Krishna river, Goa ; Sri Lanka.

9. **Puntius ticto punctatus** (Day)

1822. *Cyprinus ticto* Hamilton, *Fish Ganges*, pp. 314. 389, pl. 8, fig. 87.

Type locality : Southeastern parts of Bengal.

Material : 1 ex., 39.0 mm. SL. F. 660, Pachayar near Thalaiyaru, 190 m, 12.2.86.

Diagnostic features : D 3/8 ; P 1/13 ; V 1/7/1 ; A 3/5 ; L l 25-26 ; L tr $5/3^{1}/2$; predorsal scales 9 ; a black spot below lateral line behind opercle on the 3rd scale, a diffused black ocellus on caudal peduncle ; each scale on body with a black base ; the lateral line is complete.

Distribution : Peninsular India.

10. **Horalabiosa joshuai** Silas

(Plate 2, Figs. 1 & 2)

1953. *Horalabiosa joshuai* Silas, *Rec. Ind. Mus.*, 51 : 28-33.

Type locality : Headwaters of Tambraparni river, Tirunelveli.

Material : 598 exs., 12.0-90.0 mm SL, 730-1330 m. (28 exs., F. 585, Sengaltheri east, 900 m, 19.8.84 ; 17 exs., F. 612, Sengaltheri west, 730 m, 20.8.84 ; 6 exs., F. 590, arround Sengaltheri, 980 m, 21.8.84 ; 11 exs., F. 597, Sengaltheri south east in Kuliratti odai ; 22.8.84 ; 20 exs., F. 596, Sengaltheri east, Thalai odai ; 850 m, 23.8.84 ; 50 exs., F. 599, Sengaltheri south east, 870 m, 24.8.84 ; 31 exs., F. 588, Sengaltheri to Kakachi path, 1200 m, 25.8.84 ; 8 exs., F. 602, Karumandi Amman temple, Sengaltheri, 970 m, 26.8.84 ; 12 exs., F.601, Thalaiodai, Sengaltheri east, 850 m, 19.11.84 ; 15 exs., F. 607, rocky pool in front of Karumandi Amman temple, 1000 m, 20.11.84 ; 11 exs., F. 604, Karumandi Amman temple, west of Sengaltheri rest house, 970 m, 24.11.84 ; 8 exs., F. 608, east of Sengaltheri along the course of Pachayar, 840 m, 25.11.84 ; 7 exs., F. 616, Kilmanimutharu, 740 m, 28.2.85 ; 14 exs., F. 617 & F. 623, Pachayar, 840 m, 2.3.85 ; 8 exs., F. 622, way to Netterikkal, 1330 m, 3.3.85 ; 23 exs., F. 621, Pachayar, 890 m, 4.3.85 ; 19 exs., F. 619, Pachayar, 890 m, 6.3.85 ; 36 exs., F. 632, way to Kakachi from Nalumuku, 1200 m, 5.9.85 ; 32 exs., Nalumuku kakachi road, 1140 m, 6.9.85 ; 147 exs., F. 634, along Solaipalam aru, stream, on the way to kakachi from Nalumuku, 1130 m, 8.9.85 ; 26 exs., F. 626, way to kakachi from Nalumuku, 1080 m, 9.9.85 ; 13 exs., F. 625, nullah near 10 acres tea estate, 1030 m, 10.9.85 ; 11 exs., F. 630, stream near Nalumuku estate, 1100 m, 11.9.85 ; 8 exs., F. 627, along Solaipalam aru, Nallankadu, 1120 m, 11.9.85 ; 1 ex., F. 651, Poochi thondu odai, Mudaliruppan bridge, 10.2.86 ; 12 exs., F. 650, Thalaiodai, 810 m, 11.2.86 ; 17 exs., F. 703, Pachayar, east of Sengaltheri, 850 m, 25.4.87 ; 6 exs., Sengaltheri to Kuliratti aru, 890-900 m, 26.4.87 ; and 1 ex., Nature trail to Karumandi Amman temple, 900-980 m. 27.4.87).

Redescription : D 3/7-8 ; P 1/12-14 ; V 1/6-7/1 ; A 2-3/5 ; C 19 ; L l 32-35 ; predorsal scales 10-12 ; L tr 4-4½ and 2½-3½. Body moderately elongate ; dorsal profile convex to slightly compressed, its greatest height below the commencement of the dorsal fin 5.81 (5.08-7.22) in total length, 4.45 (3.92-5.56) in standard length ; head small, rounded anteriorly, somewhat depressed, its length 4.59 (4.00-5.08) in total length, 3.53 (3.09-3.92) in standard length ; height of head 1.59 (1.27-1.76), width of head 1.41 (1.23-1.70), eye diameter 4.42 (3.40-5.75), interorbital width 2.35 (1.50-2.77), snout 2.70 (2.39-3.17) in length of head ; eye in snout 1.65 (1.27-2.28), in interorbital 1.88 (1.37-2.63) ; eye is of moderate size but comparatively larger and anterior in position in young specimens, with increase in length of fish the eye becomes proportionately smaller and is placed more or less in the centre. Well developed rostral groove is present separating the upper lip from the rostrum ; lips are moderate to well developed, thick and fleshy at the angles where they are continuous and minutely

papillated ; post labial groove is interrupted in the middle ; post labial callous pad extends to almost half the distance between the anterior end of the lower jaw and the isthmus. Length of pad 3.54 (2.92-4.57), width of mental pad 4.57 (3.60-5.81) in head length ; width of callous pad 1.30 (0.83-1.75) in its own length. In fishes from higher altitudes the pad is thickened along its anterior end into a hood-like structure (in fishes above 35.0 mm SL), in lower altitudes this structure is observed in fishes of greater length range only. However in some fishes collected in Sengaltheri east, Thalaiodai, 850 m. the hood-like structure was not well developed even in the largest specimen collected i. e. 50.0 mm. SL. Incidently specimens collected from this locality answers exactly to the description given by Silas (1953), the maximum length of the fish collected and studied by him was 65.0 mm TL. Anteriorly the callous pad is confluent with the lower lip at the symphysis while posteriorly its margin is slightly lobed and somewhat free ; the surface of the fleshy pad is minutely and sparcely papillated.

The rostral and maxillary barbels are well developed, the former is equal to or a little less than diameter of eye, does not reach the anterior border of the eye, while the latter is much longer than the diameter of eye and extends to beyond the posterior margin of eye. Scales are of moderate size ; sensory canal pores well developed in fishes found in lower altitudes.

Height of dorsal 1.01 (0.83-1.19), anal 1.26 (0.75-1.63) in body depth ; base of dorsal 7.39 (6.38-9.43), base of anal 12.86 (10.0-17.90) in standard length ; length of pectoral 4.02 (3.42-5.10), pelvic 4.75 (4.09-6.00), predorsal distance 1.94 (1.75-2.09) in SL ; postdorsal in predorsal distance 1.00 (0.93-1.15). Length of body cavity 1.95 (1.74-2.23) in SL. distance from vent to anal fin 3.99 (2.50-5.99) in the distance between pelvic to anal fin ; height of caudal peduncle 1.24 (0.92-1.60) in its length ; air bladder 3.56 (3.27-3.81) and length of intestine 1.07 (0.83-1.33) in TL in six specimens measured from an altitude of 730 m.

Distribution : India, Western Ghats of Tirunelveli District.

Discussion : Silas (1953) described a new genus and species, *Horalabiosa joshuai* from the Western Ghats of Tirunelveli District, Madras State, at a general elevation of 4000 above sea level, from the head-waters of the Tambraparni river at Singampatty, which drains the eastern face of this hill range. This is characterized by the presence of a post-labial callous structure in the mental region which is minutely and sparcely papillated. Silas (*op. cit.*) while remarking on the resemblance of this genus *Horalabiosa* to *Garra* observed that the main differences were in the nature of the rostrum (a rostral groove is present in the former), the mental region and the gut length/body length ratio. His description was based on 13 specimens (27.0-49.0 mm SL). The present collections from Kalakad Wildlife Sanctuary collected from different drainages and altitudes which flow into the Tambraparni river constitutes several specimens ranging from 12.0-90.0 mm SL some of which exhibit a few variations. Hence it is felt

desirable to redescribe the species. Of the different fish genera found in the headwaters of Kalakad, *Horalabiosa* is the most well established.

Marked differences in the general shape and certain other characters were observed in specimens collected from higher altitudes ; the typical and most commonly found form has an arched back (Fig. 1, Plate 2) whereas in specimens collected from Sengaltheri east which answer to the original description, the dorsal profile is almost straight and in some specimens collected from the same locality the back is slightly flexed inwards and mouth widely opened, which may be the result of contortion in the fish on death. A striking difference is seen in the nature of the callous pad in the mental region between populations collected from Sengaltheri to Kakkachi path, at an altitude of 1200 m. The callous pad is longer than broad in young forms and in the adults it is more or less squarish. The major differences observed in specimens from Sengaltheri east are the slightly smaller head, subterminal mouth, less muscular and less well developed pectoral and pelvic fins, shortened predorsal distance and the straight or slightly arched dorsal contour, compared to the specimens collected from other regions and altitudes which has a longer head, subterminal mouth with snout projecting beyond this on ventral side, the encapsulated callous pad, well developed and highly muscular fan-shaped and longer paired fins and convex dorsal profile.

To ascertain whether any specific differences between this and other populations, samples collected from 3 different altitudes and drainages were compared. For this study 22 morphometric characters were measured (no variation was observed in meristic characters) and statistically analysed following Snedecor (1961). The variance ratio test was employed to compare the means of two samples from normal population and the students t-Distribution was done to study the significance in variation.

The 26 body proportions studied were : head width, height of head, length and width of callous pad, eye diameter, interorbital width and snout length in relation to head length ; body depth, head length, length of pectoral and pelvic fins, predorsal distance, distance from pectoral base to anus, base of dorsal and anal fins in relation to SL ; length to width ratio of callous pad ; length of snout and interorbital width in relation to eye ; height of dorsal and anal fins in relation to body depth ; the distance from anus to anal fin in the distance between pelvic to anal fins ; height of caudal peduncle in relation to its length ; predorsal/postdorsal ratio and length of caudal fin in total length.

Comparative study of the samples collected from different altitudes and localities revealed that specimens collected from Sengaltheri east showed some differences to specimens collected from Pachaiyar and specimens from between Sengaltheri and Kakachi and Sengaltheri west, in the nature of the callous pad, snout length, eye diameter, length of paired fins, height of dorsal and in the length of the body cavity.

In order to find out whether any specific differences existed between populations from different altitudes the students t-Distribution was employed and differences were observed in 4 characters as in Table 2. Fishes collected from 1200 m (Sample A) showed significant difference from samples from 850 m (Sample C) in the length of body cavity (distance from pectoral base to anal) and in the position of anus in relation to pelvic and anal fin. Samples from 890 m (sample B) showed an intermediate character. From this it could be deduced that probably life in higher altitudes has brought about certain adaptive changes as in the better developed paired fins and the position of the anus being shifted towards the anal fin, probably to provide greater ventral surface for adhesion to the substratum.

From Table 1 it is seen that populations from 900 m also show greater similarity to those from 850 m. This could be possible since specimens from 900 m and 850 m were collected from Sengaltheri east ; on the other hand populations from Sengaltheri west, Pachaiyar and those from Sengaltheri to Kakachi path showed greater affinity to one another inspite of altitudinal difference.

From this study it could be concluded that though slight altitudinal variations were observed, greater differences were observed between those from different drainages, and the phenetic differences could be attributed to the differences in ecological conditions of the different water bodies and segregation of population for a long period of time. While redescribing *Horalabiosa* the mean of all these samples have been taken into account to include the wide range in the morphometic characters.

Subfamily : Garrinae

11. **Garra kalakadensis** Rema Devi

Garra kalakadensis Rema Devi, *Rec. Zool. Surv.*, 8 pp., pl. 1, figs. 2., Table 1, (in press).

Type locality : Kalakad Wildlife Sanctuary, Tirunelveli Dt.

Material : 642 exs., 17.0-77.0 mm, 190-1000 m. (38 exs., F. 584, Sengaltheri east, 900 m, 19.8.84 ; 1 ex., F. 586, Sengaltheri south west, 850 m, 20.8.84 ; 36 exs., F. 595, Sengaltheri east, Kulliratti odai, 850 m, 22.8.84 ; 11 exs., F. 611, Sengaltheri east, Thalaiodai, 850 m, 23.8.84 ; 9 exs., F. 592, in front of Karumandi Amman temple, 970 m, 26.8.84 ; 26 exs., F. 594, Sengaltheri west, 730 m, 20.9.84 ; 6 exs., F. 605, Sengaltheri east, Thalai odai, 850 m, 19.11.84 ; 7 exs., F. 606, Karumandi Amman temple, 1000 m, 20.11.84 ; 17 exs., F. 603, Karumandi Amman temple, west of Sengaltheri guest house, 970 m, 24.11.84 ; 23 exs., F. 624, Pachayar, 840 m, 2.3.85 ; 5 exs., F. 633, way to Kakachi from Nalumuku Solaipalam aru, 1080 m, 9.9.85 ; 11 exs., F. 631, stream near Nalumuku Estate, 1100 m, 11.9.85 ; 154 exs., F. 643, Keeripittam odai, 4 km from Sengaltheri road, 100 m, 9.2.86 ; 38 exs., F. 648, Thalai odai, 810 m, 11.2.86 ; 4 exs., along the course of Nambiar upto Nambikoil, 190-350 m, 21.8.86 ; 1 ex., Kombiaru, Thakkaru charagam,

TABLE 1. Comparison of morphometric characters of populations of *Horalabiosa joshuai* Sailas from different altitudes and drainages.

Altitude : Locality :	1200 m Between Sengal-theri and Kakachi	900 m Sengal-theri east	890 m Pachayar	850 m Sengal-theri east, Thalai-odai	730 m Sengal-theri west
Characters					
TL/body depth	6.00	5.63	5.84	5.70	5.86
SL/body depth	4.55	4.31	4.47	4.42	4.50
TL/head length	4.67	4.61	4.66	4.31	4.71
SL/head length	3.55	3.53	3.58	3.35	3.63
Head length/head width	1.33	1.43	1.34	1.46	1.50
Head length/height of head	1.62	1.57	1.64	1.57	1.56
Head length/length of mental pad	3.55	3.41	3.82	3.29	3.63
Head length/width of mental pad	4.62	4.43	4.30	4.70	4.80
Length of mental pad/width of mental pad	1.31	1.31	1.14	1.44	1.32
Head length/eye diameter	4.60	4.24	4.66	4.35	4.27
Head length/interorbital width	2.16	2.32	2.43	2.35	2.50
Head length/length of snout	2.66	2.79	2.54	2.76	2.75
Length of snout/eye diameter	1.73	1.52	1.84	1.57	1.57
Interorbital width/eye diameter	2.06	1.83	1.92	1.85	1.72
SL/length of pectoral fin	3.86	4.01	3.87	4.30	4.06
SL/length of pelvic fin	4.53	4.66	4.69	5.03	4.84
Body depth/height of dorsal fin	0.99	1.03	0.99	1 06	0.98
Body depth/length of anal fin	1.23	1.26	1.18	1.33	1.30
SL/base of dorsal fin	7.32	7.17	7.40	7.79	7.28
SL/base of anal fin	12.94	11.75	14.10	12.89	12.61
SL/predorsal distance	1.96	1.88	1.93	1.92	2.00
Predorsal dist./postdorsal dist.	1.04	1.01	1.01	1.01	0.96
SL/dist. from pectoral base to anus	1.82	2.06	1.96	2.09	1.82
Dist. from pelvic base to anal fin/dist. from anus to anal fin	4.31	4.29	4.08	3.30	3.97
Length of caudal peduncle/height of caudal peduncle	1.36	1.16	1.26	1.20	1.20
TL/length of caudal fin	4.17	4.28	4.27	4.51	4.34

TABLE 2. Comparison of certain morphometric characters of *Horalabiosa joshuai* from three different altitudes using students t-Distribution test.

	A and B d. f. 28	B and C d. f. 28	A and C d. f. 18
Characters			
SL/distance from pectoral fin base to anus	1.4270 not significant	1.1971 not significant	2.0252 significant at 1%
Pelvic to anal fin/ anus to anal fin	0.7190 not significant	2.4385 significant at 5%	3.186 significant at 1%
SL/length of pectoral fin	0.0589 not significant	2.1457 significant at 5%	1.7484 significant at 10%
SL/length of pelvic fin	0.8639 not significant	1.6030 not significant	1.9366 significant at 10%

290 m, 22.8.86 ; 4 exs., Thulukkan parai aru, 300 m, 23.8.86 ; 26 exs., F. 854, Thodathi odai, 390 m, 25.8.86 ; 5 exs., along Nambiar, on the way to Nambikoil, 190-350 m 9.1.87 ; 40 exs., Thulukkanparai, 240 m, 12.1.87 ; 8 exs., Thalai odai, 810 m, 23.4.87 ; 28 exs., F. 856, Karumandi Amman temple, 980 m, 24.4.87 ; 145 exs., F. 852, Pachayar, east of Sengaltheri, 850 m, 25.4.87 ; 1 ex., F. 851, east of Sengaltheri, Pachayar, 850 m, 25.4.87 ; 5 exs., 900-980 m, nature trail to Karumandi Amman temple, 26.4.87).

Holotype : 77.0 mm SL, Reg. No. FF2664 (of the Indian Museum, National type collections of freshwater fishes, Calcutta), Pachayar, east of Sengaltheri, Kalakad Wildlife Sanctuary, Tirunelveli District, Tamil Nadu, 850 m, 25.4.87, Coll. Dr. M. Vasanth.

Relationship : *Garra kalakadensis* differs from the widely distrubuted *G. mullya* (Sykes) in several characters viz. the marked difference in the position of vent which is near to anal fin in the former while in the latter it is well in advance of the anal fin, the mental disc is well developed, head length longer and body slender whereas in *G. mullya* the body is deeper, head shorter and mental disc restricted to the anterior third of the head. The two differ in colour pattern also. *G. kalakadensis* shows some resemblance to *G. lamta* (Ham.) in the presence of well developed lateral tubercular area (secondary sexual character) in the snout, the well developed mental disc and the slender form. However in *G. lamta* (Ham.) the vent is very close to the anal fin, the pectoral fin is shorter and the air bladder is much reduced (Menon, 1864).

12. **Garra mullya** (Sykes)

1841. *Chondrostoma mullya* Sykes, *Trans. Zool. Soc. London*, 2, p. 359, pl. 62, fig. 3.

1864. *Garra mullya*, Menon, *Mem. Indian Mus.*, 14 (4), p. 212.

Type locality : Poona waterways.

Material : 55 exs., 18.0-63.0 mm, 100-1120 m, (2 exs., F. 613, Sengaltheri west, 730 m, 20.8.84 ; 4 exs., F. 589, around Sengaltheri, 980 m, 21.8.84 ; 3 exs., Sengaltheri south east, Kuliratti odai, 850 m, 22.8.84 ; 7 exs., Sengaltheri east, Thalaiodai, 850 m, 23.8.84 ; 6 exs., F. 615, Karumandi Amman temple, Sengaltheri, 470 m, 26.8.84 ; 2 exs., F. 610, Thalai odai, Sengaltheri east, 850 m, 19.11.84 ; 8 exs., F. 587, way to S. S. R. Estate, Sengaltheri west, 21.11.84 ; 5 exs., Pachayar, 840 m, 2.3.85 ; 4 exs., F. 640, along Solaipalam aru, Nallankadu, 1120 m, 11.9.85 ; 1 ex., F. 646, Keeripittam odai, 4 km from Sengaltheri, 100 m ; 4 exs., Poochithondu odai, Mudaliruppan bridge, 10.2.86 ; 5 exs., Parapalar near Pachayar, 240 m, 15.2.86 ; 4 exs., Aruval theeti odai, 185 m, 14.2.86).

Remarks : Occasionally *G. mullya* and *G. kalakadensis* were collected from the same locality. *G. mullya* can be segregated on the basis of the vent being positioned at a greater distance from the anal fin and the mental disc being smaller, less well developed and restricted to the anterior third of the head.

Distribution : Throught India except Assam and Himalaya.

Family : HOMALOPTERIDAE

Subfamily : HOMALOPTERINAE

13. **Bhavania australis** (Jerdon)

1848. *Platycara australis* Jerdon, Madras J. Lit. Sci., 15, p. 333.

Type locality : Waltair.

1987. *Bhavania australis*, Menon, *Fauna India*, Cobitoidea : Homalopteridae. p. 234-236, pl. 9. figs. 5 & 6.

Material : 1 ex., 40.0 mm SL, F. 593, Sengaltheri east, Thalaiodai, 850 m, 23.8.84.

Diagnostic features : D. 2/8 ; P. 7/10 ; V. 2/7 ; A. 2/5 ; C. 19 ; Ll. more than 70 scales, complete ; gill openings small and restricted to above base of pectoral ; 2 pairs of rostral and one pair of maxillary barbels ; behind lower central portion of lip there are two prominent papillae.

Distribution ; India : Western Ghats : Karnataka, Tamil Nadu (Nilgiris, Kalakad, Tiruneveli Dt.) and Kerala.

Subfamily : NOEMACHEILINAE

14. **Noemacheilus triangularis triangularis** Day

1865. *Nemacheilus triangularis* Day, *Proc. Zool. Soc.* p. 295 and Fish India, p. 619, pl. CLIII, fig. 10.

Type locality : Travancore Hills.

1987. *Noemacheilus triangularis triangularis*, Menon, *Fauna India*, Cobitoidea : Homalopteridae, p. 168, pl. 11 figs. 4, 5 & 8.

Material : 42 exs., 29.0-60.0 mm, 153-730 m. (25 exs., F. 930, Karikaran thondu, 13.2.86 ; 5 exs., Pachayar, 12.2.86 ; 2 exs., F. 614, Sengaltheri west, 730 m, 20.8.84 ; 6 exs., F. 694, Vilakkennai kasam, west of Nambikoil, 300 m, 8.1.87 ; 1 ex., F. 686, Thulukkan parai, 240 m, 12.1.87 ; 1 ex., F. 701, Namibiar, on the way to Nambikoil, 190-250 m, 14.1.87 ; 1 ex., F. 693, along Nambiar, 260 m, 9.1.87 ; 1 ex., F. 689, stream near Kodamadi estate, 150 m, 15.1.87).

Remarks : D. 3/7-8 ; P. 10-11 ; A. 3/5 ; C. 1/17/1 ; Showing a slight extension of range in the fin formula than that given by Menon (1987). Barbels are well developed, the outer rostral reaching the anterior, middle or posterior border of eye ; maxillary reaches the posterior border of eye. Body slender being 14.99 (11.65-20.0) percent of SL ; distance from anus to anal fin 20.65 (19.18-22.86) percent or 4.86 (4.37-5.21) times in the distance from pelvic to anal fin as typical of the subspecies *N. triangularis triangularis* (Menon, op. cit.).

Distribution : Peninsular India : Western Ghats, Kallar, Pamba, Periyar, Bharathapuzha drainages and Kalakad, Tirunelveli.

Family : COBITIDAE

Subfamily : COBITINAE

15. **Lepidocephalus thermalis** (Valenciennes)

1846. *Cobitis thermalis* Valenciennes, *Hist. Nat. Poiss.*, 17, p. 78.

Type locality : Sri Lanka.

Material : 27 exs., 19.0-39.0 mm, 150-260 m. (11 exs., Keeripittam odai, 9.2.86 ; 1 ex., F. 692, along Nambiar on the way to Nambikoil, 260 m. 9.1.87 ; 1 ex., F. 700, Nambiar, on the way to Nambikoil, 190–250 m, 14.1.87 ; 10 exs., F. 688, stream near Kodamadi Estate, 150 m, 15.1.87 ; 4 exs., stream near Kodumudi aru Estate, 200 m, 26.8.87).

Distribution : India : South India south of Krishna, Karnataka, Kerala, Tamil Nadu ; Sri Lanka.

Order : SILURIFORMES

Family : BAGRIDAE

16. **Mystus montanus** (Jerdon)

1849. *Bagrus montanus* Jerdon, *Madras J. Lit. & Sci.*, 15 (2), p. 338.

Type locality : Manantody river, Wynaad.

1954. *Mystus* (*Mystus*) *montanus*, Jayaram, *Rec. Indian Mus.*, 51 (4), p. 533.

Material : 10 exs., 43.0-77.0 mm SL. 150-190 m. (2 exs., F. 653, Pachayar near Thalaiaru, 190 m, 12.2.86 ; 2 exs., F. 661, Aruval theeti odai, 185 m, 14.2.86 ; 6 exs., F. 703, stream near Kodamadi estate, 150 m. 15.1.87).

Distribution : Kerala state : Wynaad range of hills, Tamil Nadu : Cauvery head-waters, Kalakad (Tirunelveli Dt.), Madhya Pradesh, Hoshangabad Dt., Assam.

17. **Mystus vittatus** (Bloch)

1797. *Silurus vittatus* Bloch, *Ichthyol. Hist. Nat.*, p. 40, pl. 371, fig. 2.

Type locality : Trancebar.

1954. *Mystus* (*Mystus*) *vittatus*, Jayaram, *Rec, Indian Mus.*, 51 (4), p. 534.

Material : 1 ex., 63.0 mm SL. F. 644, Keeripittam odai, 4 km on Sengaltheri road, 100 m, 9.2.86.

Distribution : Throughout India ; Pakistan ; Myanmar ; Thailand ; Bangladesh ; Sri Lanka.

Superorder : ATHERINOMORPHA

Order : ATHERINIFORMES

Family : CYPRINODONTIDAE

18. **Aplocheilus lineatus** (Valenciennes)

(Plate 2, Figs. 3 & 4)

1846. *Panchax lineatus* Valenciennes, *Hist. Nat. Poiss.*, 18, p. 381.

Type locality : Bombay.

1849. *Aplocheilus rubrostigma* Jerdon, *Madras Jour. L. S.* XV, p. 331.

Material : 24 exs., 12.0-46.0 mm, 150-200 m. (9 exs., F. 652, Pachayar near Thalaiaru, 190 m, 12.2.86 ; 8 exs., F. 699, stream near Kodumudiar Estate, 200 m, 26.8.86 ; 1 ex , F. 705, stream near Kodumudiaru Estate, 200 m, 26 8.86 ; 5 exs., F. 695, stream near Kodamadi Estate, 150 m, 15.1.87 ; 1 ex., stream near Kodumudi aru Estate, 200 m, 26.8.87).

Remarks : D 8 ; A 16-19 ; L l 29-30 (upto caudal base) ; predorsal scales 24-25. Each scale bordered with black ; 8-10 vertical bands on sides, absent on the upper one third of the body, but almost encircling caudal peduncle ; dorsal with a dark spot on the middle of its base followed above by rows of spots ; anal and caudal fins spotted in radiating rows, pectoral and pelvic fins not spotted ; in larger specimens dorsal blotch extends throughout its base and the bands along the sides disappear or are less prominent and merge with the dark ground colour. Live specimens are irridescent green, eyes are deep green and black and caudal tinged yellow ; in caudal fin three central rays are prolonged ; second branch of second ray of pelvic fin greatly prolonged.

In *A. rubrostigma* of Jerdon the bands are absent and the anal ray count is 17-18. In typical *A. lineatus* the lateral band is of specific nature and the anal ray count is 15-17. In the present collection the colour variation observed in *A. lineatus* (lateral bands merging with the ground colour in larger male specimens) and the range in anal count substantiates that *A. rubrostigma* is a synonym of *A. lineatus*.

Distribution : Peninsular India ; Sri Lanka.

Superorder : ACANTHOPTERIGII

Order : CHANNIFORMES

Family : CHANNIDAE

19. **Channa orientalis** (Schneider)

1801. *Channa orientalis* Schneider, *Syst. Ichth.*, p. 496, pl. 90, fig. 2.

Material : 26 exs., 23.0-70.0 mm. 150-350 m. (2 exs., Keeripittam odai, Sengaltheri, 100 m, 9.2. 86 ; 9 exs., Keeripittam odai, Sengaltheri, 100 m. 9.2.86 ; 1 ex., Pachayar near Thalaiaru, 190 m, 12.2.86 ; 7 exs., F. 667, along the course of Nambiar upto Nambikoil, 190-350 m, 21.8.86 ; 3 exs., F. 706, stream near Kodumudi aru Estate, 200 m, 26.8.86 ; 2 exs., F. 707, along Nambiar, on the way to Nambikoil, 190-350 m, 9.1.87 ; 1 ex., F. 696, Kombiar charagam, Thakkaru, 210 m, 13.1.87 ; 1 ex., stream near Kodamadi Estate, 150 m, 15.1.87).

Distribution : Throughout India ; Nepal ; Sri Lanka ; Bangladesh ; Myanmar ; Pakistan.

SUMMARY

A collection of fishes from Kalakad Wildlife Sanctuary, Western Ghats, Tirunelveli District, Tamil Nadu, India is reported. Eight faunistic surveys were conducted by the Southern Regional Station, Z. S. I., Madras from 1984 to 1987. Nineteen species are reported here including *Garra kalakadensis*, described by me earlier. *Horalabiosa joshuai*

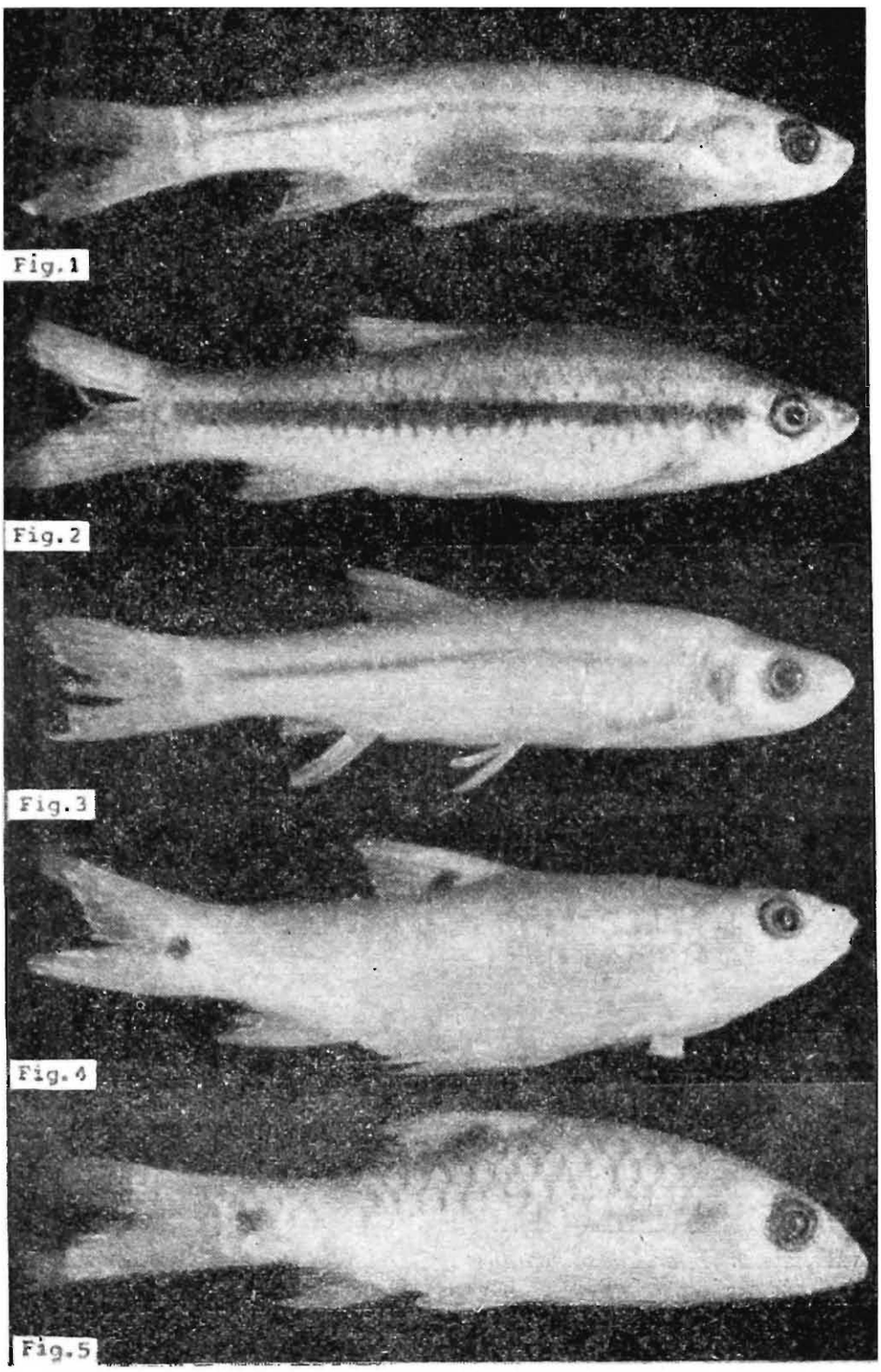


PLATE-1

PLATE 1

Fig. 1. Lateral view of *Esomus thermoicos* (Val.), 35.0 mm SL.
Fig. 2. Lateral view of *Rasbora daniconius* (Ham.), 75.0 mm SL.
Fig. 3. Lateral view of *Rasbora caverii* (Jerdon), 60.0 mm SL.
Fig. 4. Lateral view of *Puntius bimaculatus* (Blks.), 35.0 mm SL.
Fig. 5. Lateral view of *Puntius dorsalis* (Jerdon), 43.0 mm SL.

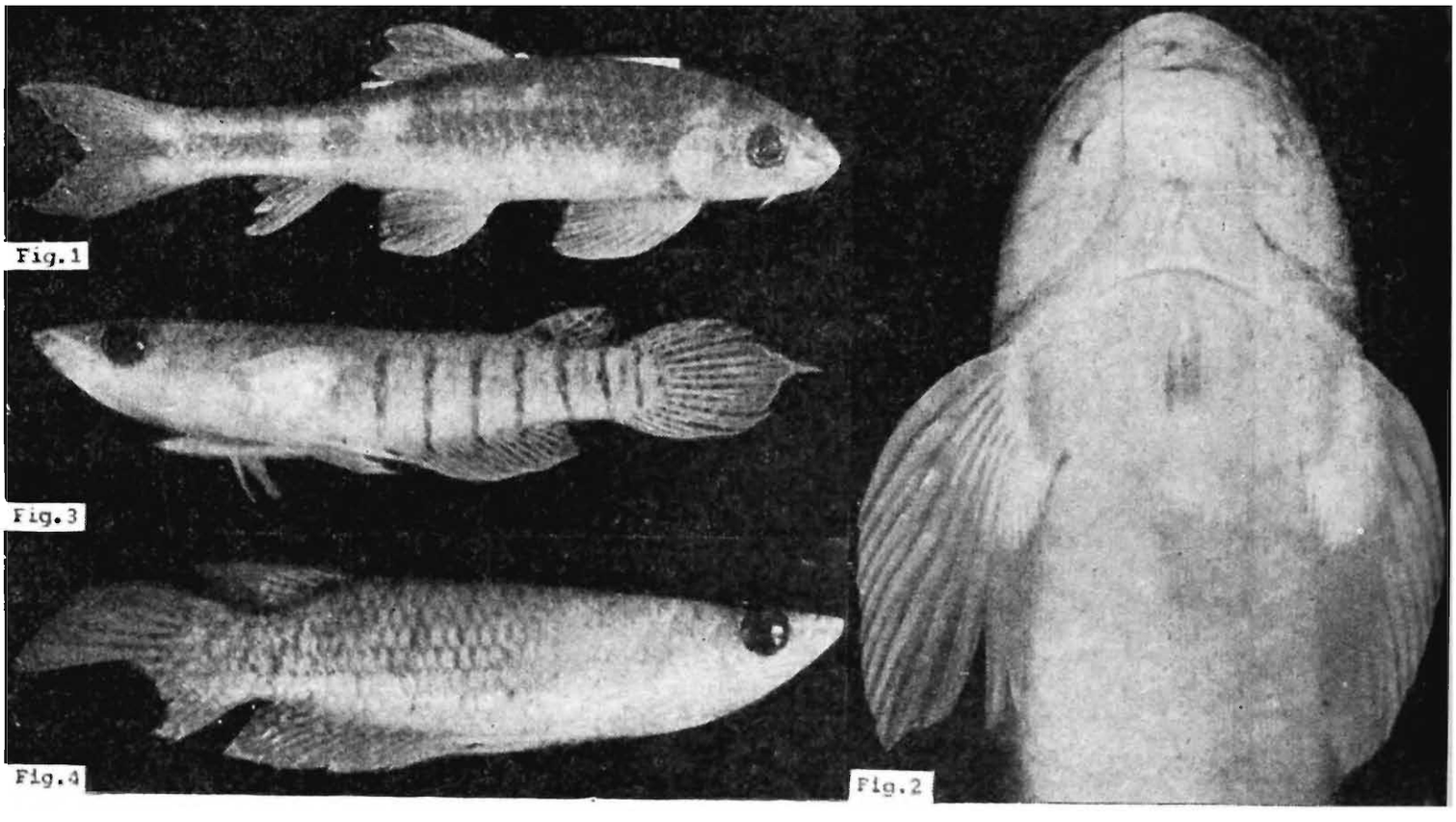


PLATE-2

PLATE 2

Fig. 1. Lateral view of *Horalabiosa joshuai* Silas, 75.0 mm SL.

Fig. 2. Lateral view of *Horalabiosa joshuai* Silas, 90.0 mm SL.

Fig. 3. Lateral view of *Aplocheilus lineatus* (Val.), 55.0 mm SL.

Fig. 4. Lateral view of *Aplocheilus lineatus* (V.), without bonds, 59.0 mm SL.

Silas is redescribed. *Esomus thermoicos* (Valenciennes), a Sri Lankan species is reported for the first time from the Indian Peninsula.

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Rec. zool. Surv. India, **92** (1-4) : 211-224, 1992

FIXATION OF THE CONCEPT OF *PARONELLA* SCHÖTT, 1893 [COLLEMBOLA : ENTOMOBRYIDAE]

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The genus *Paronella* was established by SCHÖTT in 1893 from Cameroons, Africa. *P. fusca* became the type-species of the genus by monotypy [again fixed by Börner, 1903]. The genus was placed on the Official List of Generic Names by the International Commission of Zoology in 1958.

The genus at the present moment is the most heterogeneous one and its condition is like the contents of a trash-can. Various species belonging to the widely different genera like *Callyntrura* (Börner, 1906, 1913 ; Imms, 1912 ; Carpenter, 1917, 1924 ; Kinoshita, 1917 ; Folsom, 1924 ; Handschin, 1929 ; Womersley, 1934a ; Uchida, 1938, 1944, 1958 ; Absolon and Kseneman, 1942 ; Denis, 1948 ; Roonwal *et. al*, 1951 ; Baijal, 1955 ; Fernando, 1957 ; Salmon, 1964) ; *Microparonella* (Salmon, 1964) ; *Dicranocentruga* (Börner, 1903 ; Schött, 1903, 1927 ; Wahlgren, 1908 ; Philiptschenko, 1926 ; Handschin, 1924, 1929 ; Denis, 1925, 1931, 1933 ; Womersley, 1934b ; Marlier, 1945 ; Delamare Deboutteville, 1947, 1950a, b, 1951a, b, 1952 ; Paclt, 1959 ; Salmon, 1956, 1964) ; *Pseudoparonella* (Schäffer, 1898, Schött, 1901, 1903, 1917 ; Handschin, 1925 ; Denis, 1933, 1948 ; Womersley, 1937 ; Yosii, 1960) ; *Paronana* (Carpenter, 1924) ; *Trichorypha* (Schött, 1903, 1927 ; Denis, 1933 ; Womersley, 1934a, 1939 ; *Lepidonella* (Schäffer, 1898 ; Schött, 1903 ; Handschin, 1925, 1926, 1928 ; Denis, 1933, 1948) and *Bromacanthus* (Börner, 1903) were either described or transferred to the genus *Paronella* by the workers as mentioned within parentheses against each genus, SALMON (1964) listed 58 species and sub-species belonging to the above-mentioned genera under the genus *Paronella*.

SCHÖTT'S (1893) diagnosis of the genus *Paronella* and the description of *Paronella fusca* were extremely vague and insufficient. He diagnosed the genus on the basis of certain secondary characters and overlooked many important characters of generic importance. Thus diagnostic characters, available from SCHÖTT'S (1893) diagnosis are as follows : (a) antennal length and its colour pattern, (b) nature of body facies, (c) nature of scales clothing body. Such inadequate diagnosis led the latter workers to place the species of widely different genera, as mentioned above, in the genus *Paronella*. Such additions of heterogeneous species belonging to widely different genera by the subsequent workers from almost all the zoogeographical regions let SCHÖTT (1903, 1927) to widen the concept of the genus *Paronella* and thus the placed the species

of *Lepidonella* (*annulicornis*), *Dicranocentruga* (*nigromaculata, penicillata*), *Trichorypha* (*atrofasciata*), *Callyntrura* (*lineata, feae, sumatrana, longicornis, florensis*) and *Dicranocentroides* (*plumicornis*) in his genus *Paronella*. It is to be noted that most of the earlier workers including SCHÖTT relied primarily on the characters like the stout dentes and plump mucrones while placing such heterogeneous species-groups in the genus *Paronella*. SALMON (1964), relying on such poor diagnosis of *Paronella*, synonymised widely different genera like *Microparonella* Carpenter, 1916 and *Callyntrura* Börner, 1906 with *Paronella*. SCHÖTT'S synonmisation of *Trichorypha with Paronella* was also accepted by the subsequent workers, as mentioned above. Present study reveals that these genera have more differences than resemblances to *Paronella*. DENIS (1925) remarked *Paronella* Schött as a heterogeneous one involving species of the most diverse countries like Africa, India, Malayasia, and Australia. BÖRNER (1906), however, understood the difference existing between *Paronella* and species having six teethed mucrones and dentes not heavily clothed dorsally with scales and devoid of spines. He (Börner, 1906), therefore, erected a sub-genus of *Paronella viz.*, *Callyntrura* with the type-species *anopla* from Java possessing such characters. However, the same author (BÖRNER, 1906, 1913) described two new species from Java having the same characters as that of *Callyntrura* under *Paronella*. HANDSCHIN (1925) splitted such heterogeneous species of *Paronella* into four genera mainly on the basis of number of mucronal teeth and presence or absence of dental scale appendage. SCHÖTT (1925) accepted HANDSCHIN'S proposition and remarked that "the difference between *Paronella* s.str. and *Aphysa*, however, appear a bit too vague to adhere to strictly in future if decided only by the number of mucronal teeth". HANDSCHIN'S (1925) splitting of *Paronella* primarily on the basis of the number of mucronal teeth brought many widely different species belonging to widely different genera together. Thus we note in the literature HANDSCHIN'S hesitation with the species like *Paronella dahli* Schäffer [*Pseudoparonella* (*Lawrenceana*) *dahli* n.comb.] and *Paronella picta* Schäffer (=*Lepidonella picta* n.comb.) with longer antennae in placing them in the genus *Paronella* on the basis of number of mucronal teeth. HANDSCHIN (*loc. cit.*), therefore, putforward a queer hypothesis for justifying his action of splitting the genus *Paronella* on the basis of number of mucronal teeth. He conceived that with the complexities of mucronal structure, lengthening of antennae as well as obliteration of dental spines occur and opined that his hypothesis needs verification by examination of concerned forms i.e. *Paronella picta* and *Paronella dahli*. The present investigation proved, as mentioned above, that the former belongs to *Lepidonella* Yossi and the latter to *Pseudoparonella* (*Lawrenceana*) and the hypothesis of HANDSCHIN (1925) is not tenable. DENIS (1933) accepted and followed HANDSCHIN'S (1925) splitting of the genus *Paronella*, but he doubted whether such separation actually would indicate the natural affinities of diverse species. In a key to the species of *Paronella*, Denis (1933), however, included species of distantly related genera like *Pesudoparonella* (*Lawrenceana*) *dahli* (Schäffer), *Lepidonella picta* (Schäffer), *Pseudoparonella* (*Lawrenceana*) *dahli tamarensis*

(Schött) n.comb., *Trichorypha atrofasciata* Schött and the other species to be placed under *Diranocentruga*. Nevertheless, DENIS (1933) could realise the difference between *Paronella* Schött, 1893 and *Aphysa* Handschin, 1925, although not fully, which is indicated by the fact that he felt that *Paronella flava* Carpenter, 1928 [=*Callyntrura* (*Callyntrura*) *flava* n.comb.] better resembles to *Aphysa*. He also sensed the difference between the species of *Paronella* and *Paronella picta* Schäffer, 1898 (=*Lepidonella picta*) which has 3 mucronal teeth. He, therefore, commented that the latter species needs further investigations as regards the number of its mucronal teeth.

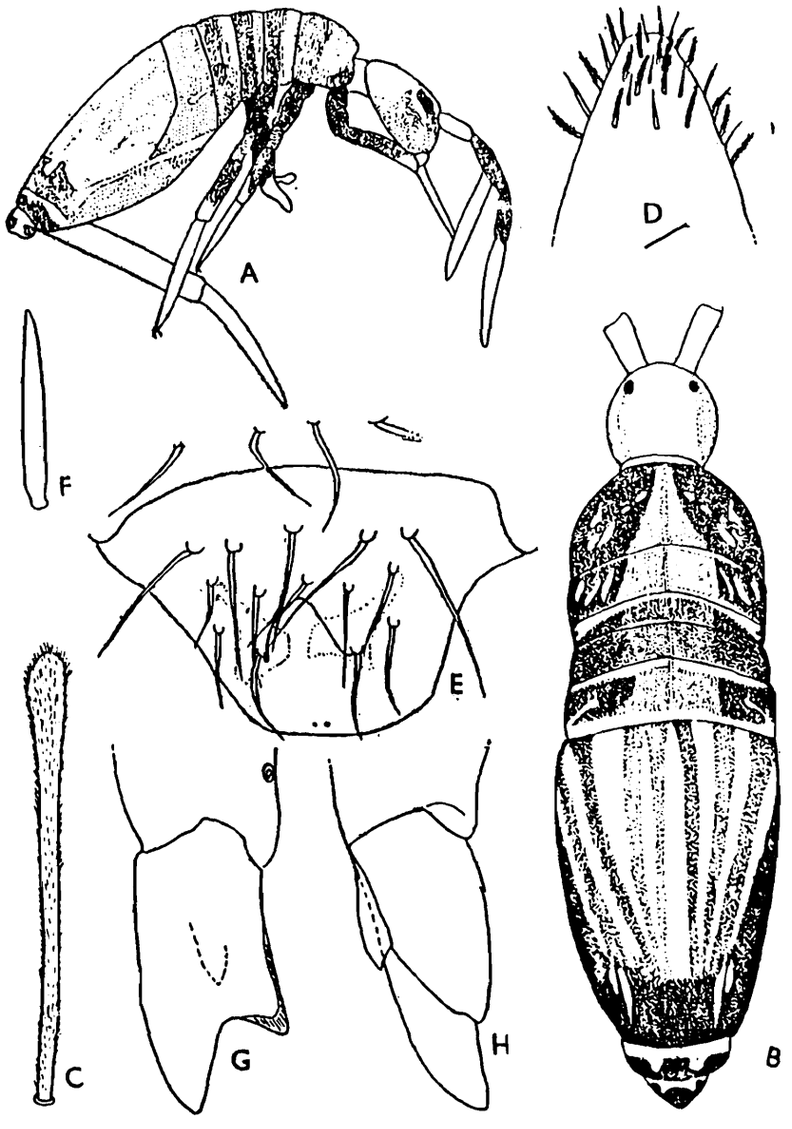


Fig. 1. A, Proffle (lateral), B, Profile (dorsal) showing pigmentation ; C, spathulate seta from the end of Abd. IV ; D, apex of Ant. IV ; E, labral chaetotaxy ; F, a tibiotarsal spine ; G, H, mucrones.

The above review of the genus *Paronella* is given from the existing literature as well as thorough investigations of the type-specimens and other collections of various species to point out its ubiquitous and heterogeneous nature involving several composite

generic groups. In view of such generic confusion in relation to *Paronella*, the investigator felt pertinent to consolidate the actual concept of the genus *Paronella*. The author had an access to the original slide preparations of SCHÖTT (1893) and 3 syntypes of *Paronella fusca* preserved in spirit, in superb condition. The present investigation proves that *paronella fusca* SCHÖTT (1893) is the unique species to be

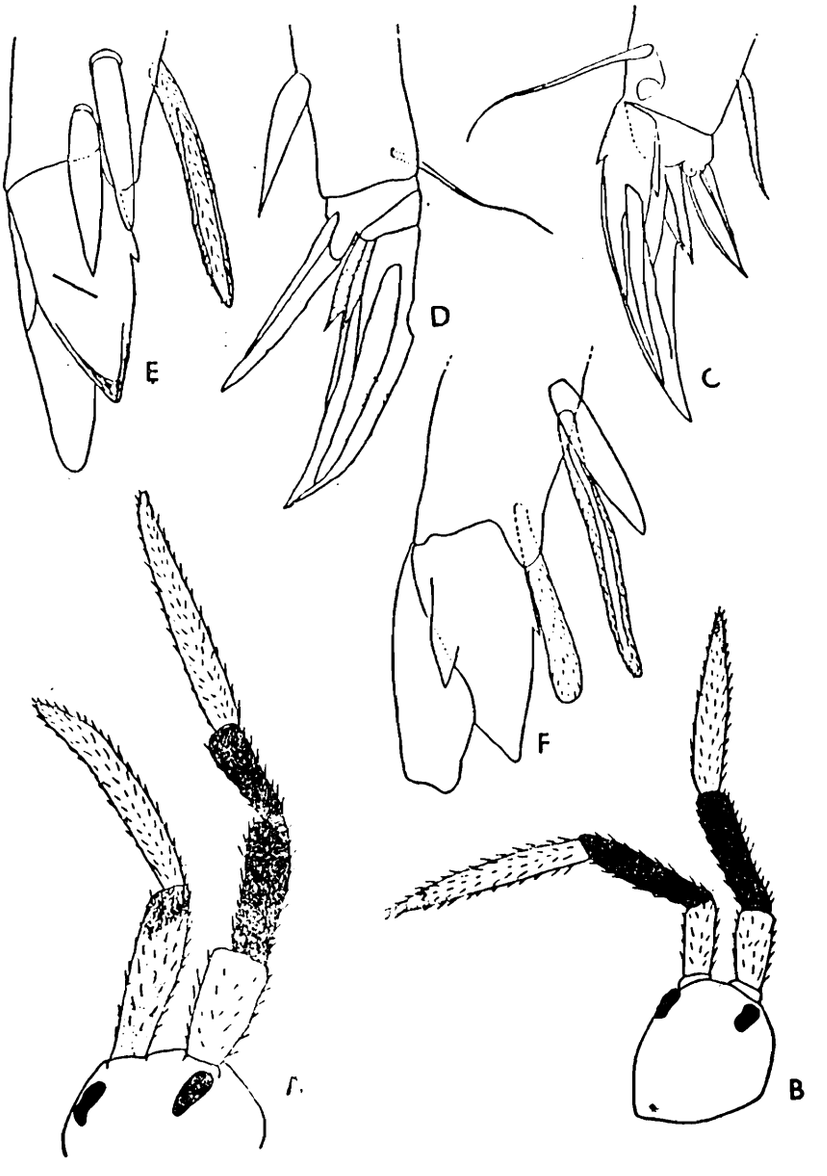


Fig. 2. A, B, anomaly in the segmentation of antennae ; C, footcomplex of leg I ; D, footcomplex of leg II ; E, F, mucrodens.

included in the genus *Paronella* as it does not share any of its principal character with any species, now known under the genus *Paronella*. The principal characters of *Paronella fusca* are given in the diagnosis of the genus. However, a few of such characters, possessed by the type-species *Paronella fusca*, are as follows—body like *Entomobrya* (Fig. 1, A ; PL. I, A) ; presence and nature of extra ocular structure (E. O. S) (MITRA, 1972) ; both manubrium and dentes are armed with two strong rows of nontransiting spines (Fig. 3, D, E, F ; PL. I, C, D) ; body devoid of flexed macrochaetae

(achaetoic body) ; anterior face of ventral tube anteriorly with 7+7 macrochaetae (Fig. 3, C) ; long, setaceous tenent hair ; ungues large with paired inner basal teeth enlarged, distal unpaired tooth reduced, vestigial or absent (Fig. 2, C, D) ; body clothed with round and oval scales (typical scales), no scales with acuminate apices occur (Fig. 4 ; PL. I, B). Such unique combination of characters is possessed only by the type-species *Paronella fusca*. Thus the *Paronella*, the long heterogeneous genus, is represented by its type-species only.

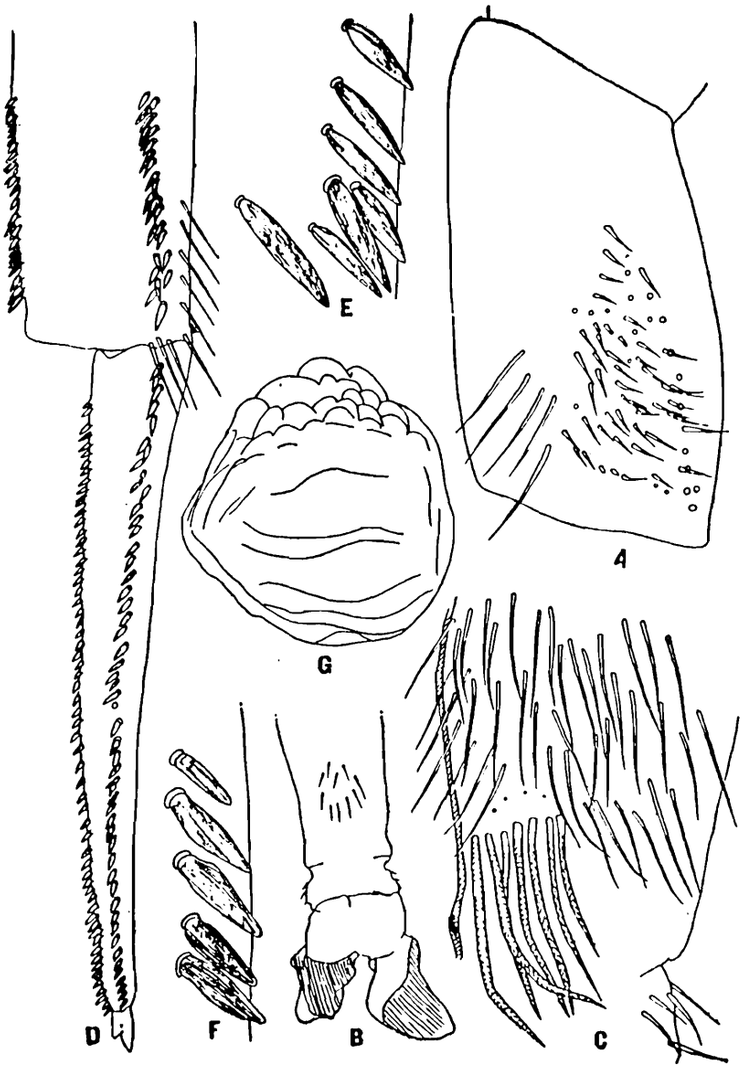


Fig. 3. A, trochanteral organ ; B, ventral tube ; C, chaetotaxy of the anterior face of ventral tube ; D, distal portion of manubrium with dentes (left) showing nontransitional spines ; E, manubrial spines ; F. dental spines ; G, male genital field.

Redifinition : Body facies like *Entomobrya* ; antennae shorter than half the length of body ; frontal spines absent, apex of Ant. IV wiihout a distinct sense-knob ; prelabral setae 4, long, slender, smooth, labral setae, 5, 5, 4, smooth, long and slender ; labral margin without distinct ledges or tubercles, sometime 2 minute tubercles visible ;

ocelli 8+8, G and H vestigial and appear nonfunctional, extra ocular structure well developed, 4 lobed, outer lobe is drawn into a slender process (MITRA, 1972) ; ungues and unguiculi large ; lanceolate, nondentate, fore unguiculi shorter than the mid and hind ones ; unguis with inner paired basal teeth considerably enlarged, distal unpaired tooth vestigially developed or totally absent, external basolateral teeth well developed ;

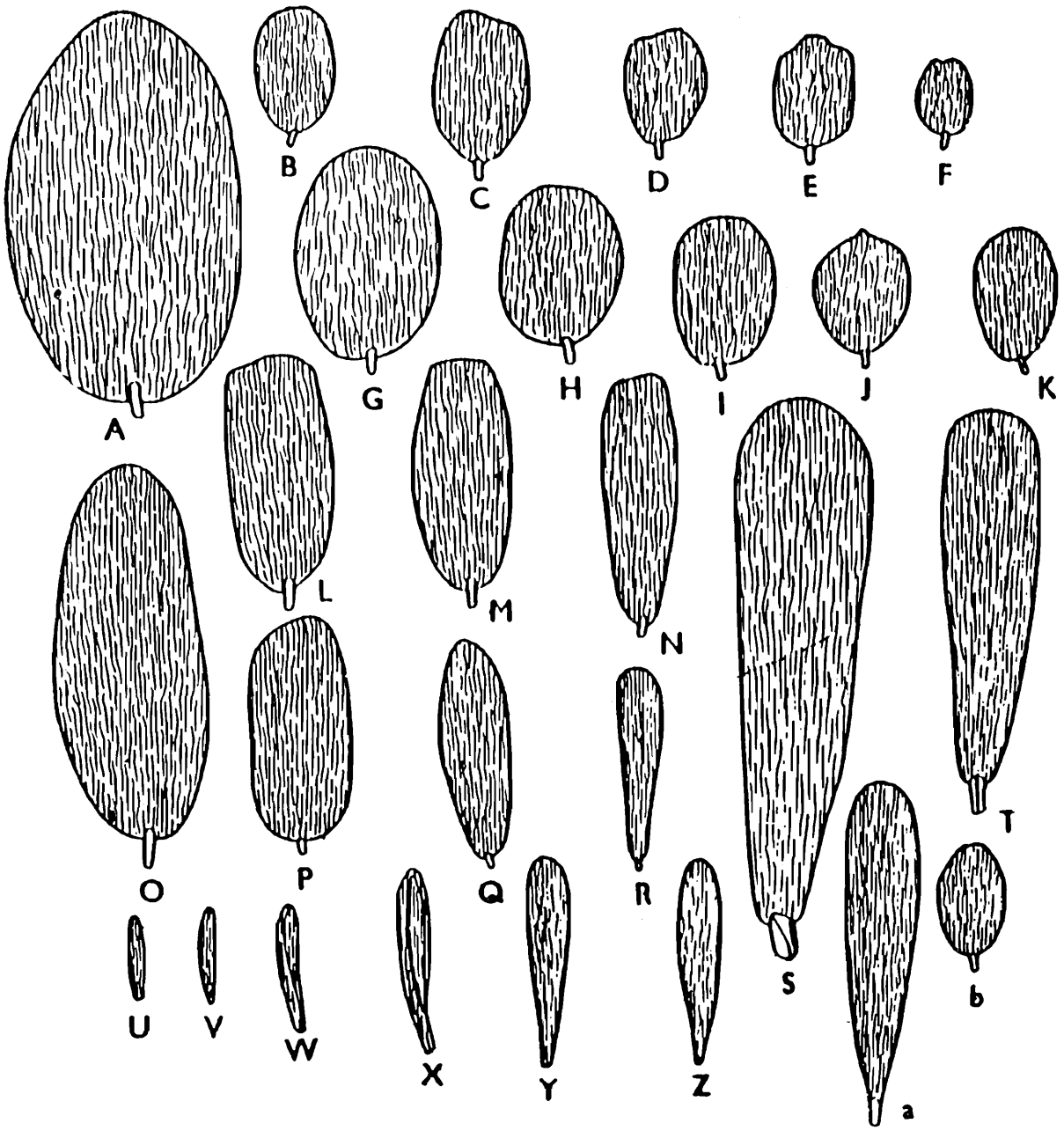
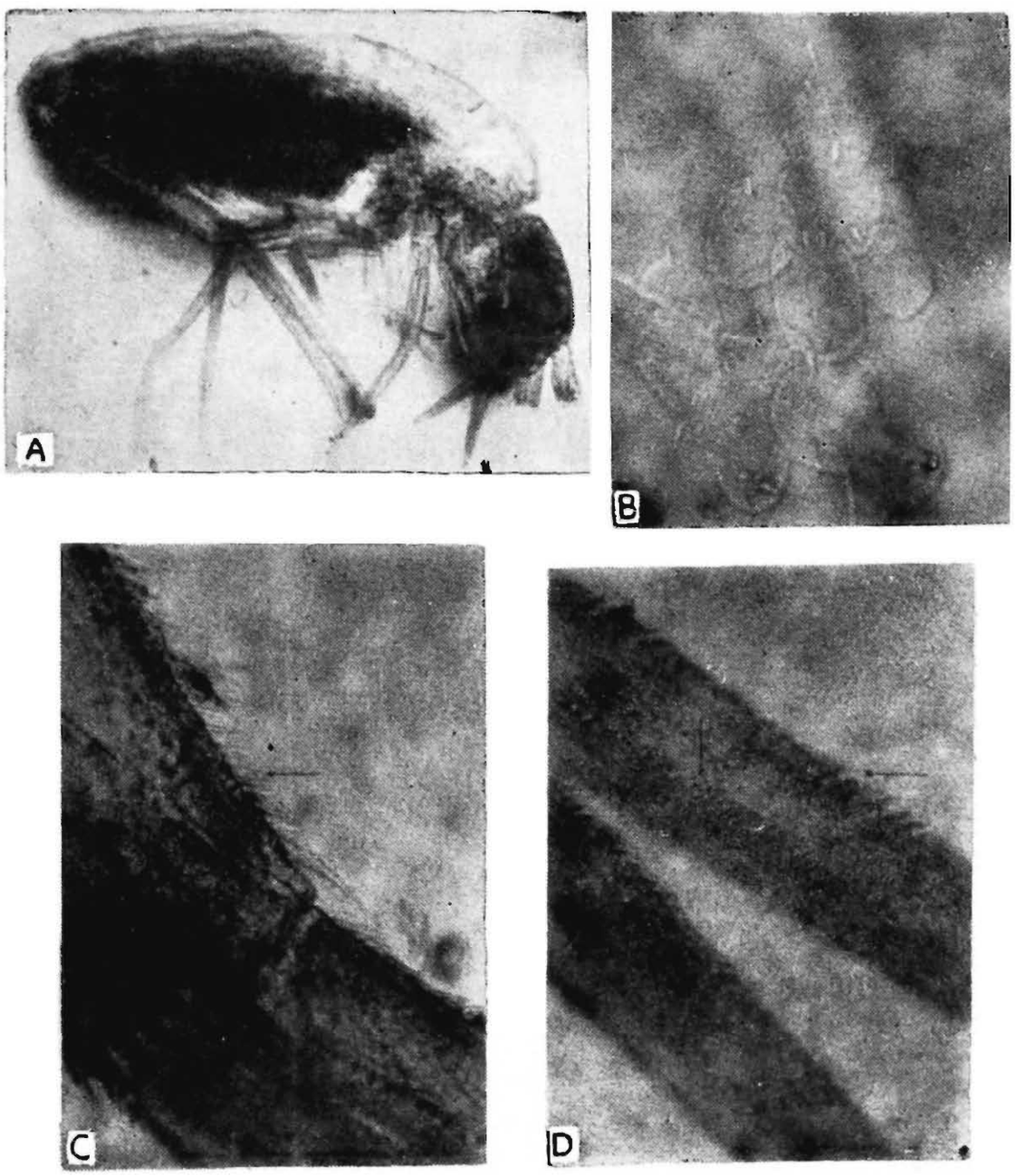


Fig. 4. Typical scales in Paronellini. A-Q, scales from body ; R-Z, scales from dentes ; a, b, scales from dorsal region of manubrium.

tenent hair setaceous ; trochanteral organ well developed ; tibiotarsi with strong spiniform setae ; ventral tube well developed, with protrusible vesicles everted, anterior face anteriorly with 7+7 macrochaetae, coarsely ciliated, general surface of anterior and posterior faces with long, slender setae (Fig. 3) ; manubrium upto three-fourth of its length distally and dentes all along its length with two rows of nontransiting, nonciliated



Paronella fusca Schött : A, lactotype, selected (in Swedish Museum National History, Stockholm) ; B, typical scales from body (from a paralectotype) ; C, distal portion of manubrium showing presence of distinct spines ; D, distal portion of dentes showing to rows of nontransitional spines.

and highly developed dark apines ; mucro large, plump with 3-4 teeth ; apical tooth round or truncated ; dental scale appendage and dental spiny appendage absent ; body clothed with large round, oval and elongate typical scales, scales mostly hyaline, distinctly pedicellate ; body devoid of any flexed macrochaetae (achaetoic body).

Type-species : *Paronella fusca* Schött, 1893, by monotypy [Also fixed by Börner (1903)].

DESCRIPTION OF THE TYPE-SPECIES

Paronella fusca Schött, 1893

1893. *Paronella fusca* Schött, *Bih. Tillk. Svenska. Akad. Handl.*, **19** (2) : 1-23 ; Schött, 1903, *Redögorelse für Allmänna Läroverken I Linköping. Eksö och Vadstena, Underläsaret* 1902-1903, pp. III-IV ; Schött, 1927, *Medd. Linköpings högre allm. läroverks redögorelse*, pp. 1-39 ; Denis, 1933, *Boll. Lab. Zool. Portici*, **27** : 222-322.

Material : On slides (original preparations of Schött)—Slide No. 1248, labelled as "*Paronella fusca* H. S. Kamerun. Furca". Slide No. 1249, labelled as "*Paronella fusca* Schött Tjall". Slide No. 1250, labelled as "*Paronella fusca* Schött. Ogen-Tjall". Slide No. 1251, labelled as "*Paronella fusca* H. S. Kamerun. Furcula Tydl. tagg-ruder". Slide No. 1252, labelled as *Paronella fusca* H. S. Kamerun. Extromiteter o furka". Slide No. 1253, labelled as "*Paronella fusca* H. S. Kamerun. Tajall und.....". Slide No. 1254, labelled as "*Paronella fusca* H. S. Kmerun. Furca. Tydl. mucro nos o manubrialtaggar".

In alcohol—1 vial containing 3 syntypes, labelled as "*Paronella fusca*. Schött. Kamerun, Bonge. Colleg. Y. Sjöstedt, Determ. H. Schött".

Above materials were studied from the Swedish Museum Natural History, Stockholm, Sweden.

Colouration (Fig. I, A, B ; PL. 1, A) : Males distinct from females in darker colour pattern and larger, bulky body facies ; ground colour of body and appendages pale yellow to brown ; Ths. II, III, Abds. I, II, III with darker blue pigment laterally and paler medially, Abd. IV laterally and posteriorly with intense dark blue-black pigment, faint brown to violet strands descend from the anterior margin of Abd. IV and unite with the patches posteriorly, such strands very faint and not visible in 1 syntype ; Abd. V with a characteristic patch with two symmetrical notches, one one either side, Abd. VI with characteristic dark blue-black pigment dorsally and laterally ; females always lightly pigmented in contrast to males, coxae and trochanter well pigmented in males, femora pigmented proximally upto half of its length, tibiotarsi nonpigmented ; ventral tube with dark blue-black pigment ; Ants. II, III with dark violet pigment, Ants. I and IV nonpigmented in individuals with 4-segmented antennae, in others with 3-segmented antennae, Ant. II. with very deep violet pigment, in individuals with 2-segmented antennae first segment violet distally (Fig. 2, A, B) ; head with dirty brown pigment on genae and anteriorly to each ocellar field.

Clothing : Clothed mainly with typical scales (Fig. 4 ; PL. 1, B) and some stiff, dark, nonflexed setae ; flexed macrochaetae totally absent, frontal spines absent ; a few short, dark brown setae present at antennal bases and anteriorly on frons ; antennae clothed with ciliated microchaetae, interspersed occasionally with certain outstanding feeble acuminate setae on Ants. I, II ; Ant. IV in addition to ciliated microchaetae, with apparently smooth erect microchaetae ; lasiotrichia present as 2, 3, 2 on Abds. II,

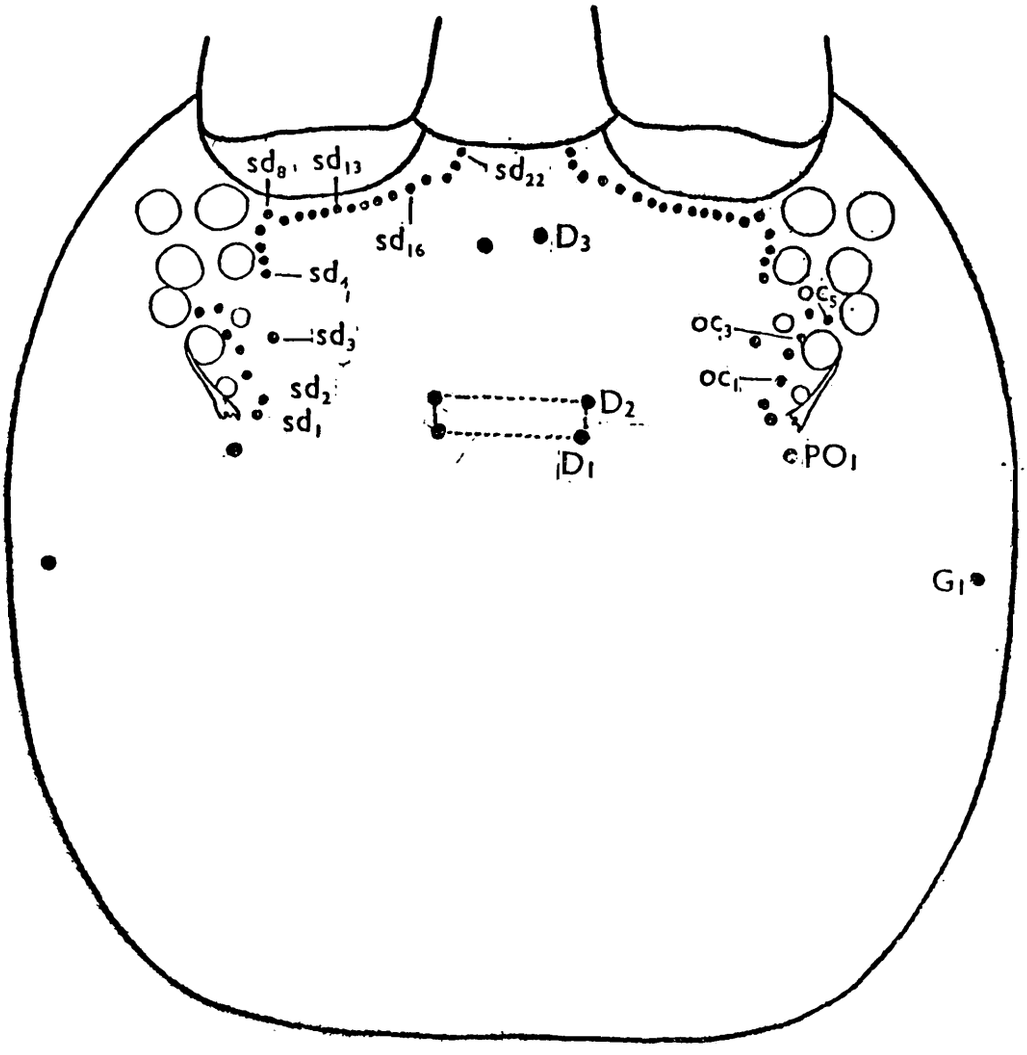


Fig. 5. Cephalic chaetotaxy.

III and IV, respectively ; Abds. V, VI with acuminate microchaetae ; Abd. VI ventrally on each side with a cluster of long, ciliated, spathulate setae (Fig. I, C) ; tibiotarsi in addition to usual acuminate ciliated setae, with 8-10 strong spiniform setae on inner margin and 3 distally on the antero-medial region of tibiotarsi (Fig. 1, F) ; furcula densely clothed dorsally with longer claviform scales, setae scarce ; manubrium dorsally with scales, scales on its lateral margin calviform, laterally and distally certain long acuminate setae occur ; dentes dorsally with very long calviform scales, setae almost lacking on dentes.

Chaetotaxy : Chaetotaxically, the genus is interesting in the absence of flexed macrochaetae on body.

Head : Vertex devoid of any setae and scales ; dorsal region represented by D_{1-3}, distance between D_1 and D_2 on each side closely approximated and their joining forms a narrow rectangle, right D_5 located slightly above the left ; subdorsal satae *c.* 22, extremely variable in number and nature ; ocular region with 5 microchaetae (oc_{1-5})

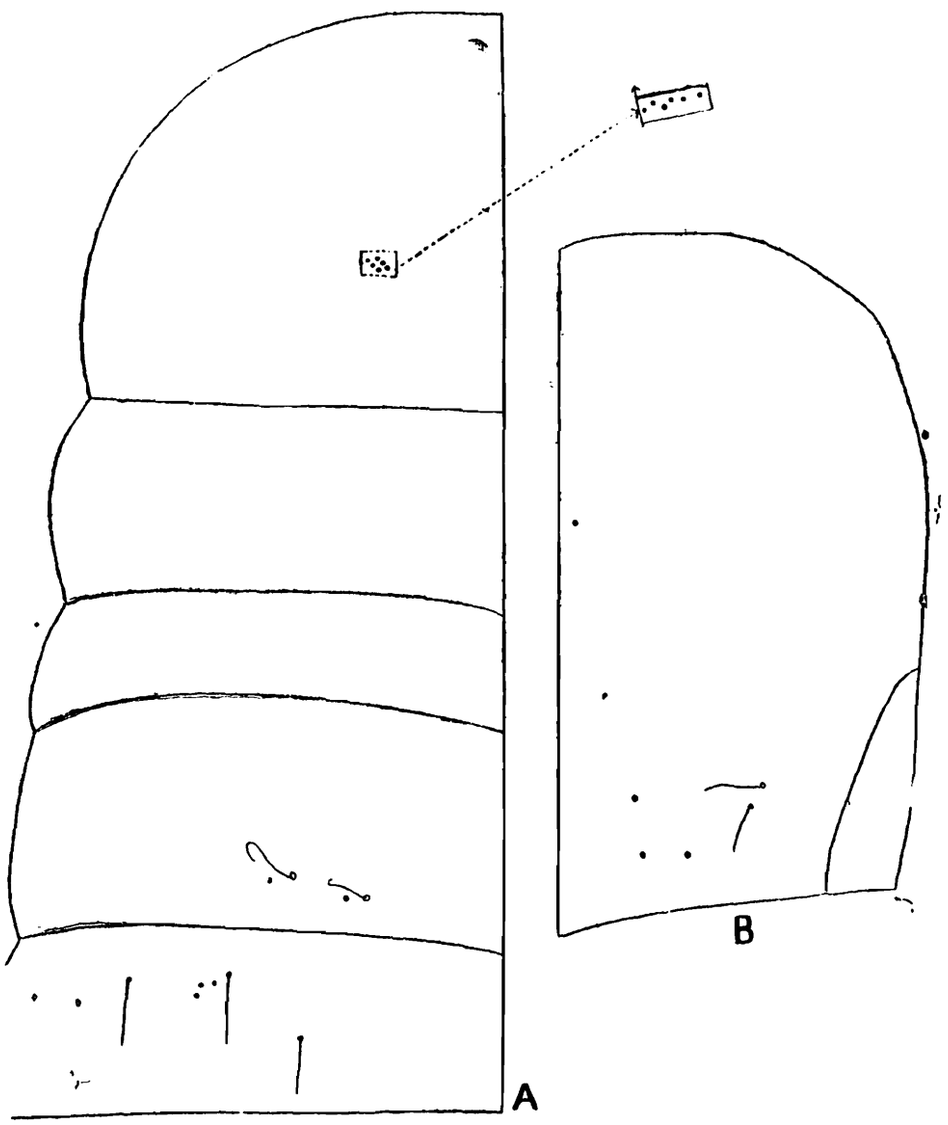


Fig. 6. Chaetotaxy of body ; A, Ths. II, III and abds. I-III ; B, Abd, IV.

on each side ; parietal region without setae ; postocular region with a single macrochaeta (PO_1) on each side ; occipital and cervical regions without macrochaetae ; area genalis represented by a single macrochaeta (G_1) on each side, a characteristic feature of *Paronella* (Fig. 5).

Body : Th. II medially with 6 short, stiff and localised setae, arrangement asymmetrical ; Th. III and Abd. I without any setae ; Abd. II with 2 setae on each side in

close proximity of lasiotrichia Abd. III with 8 setae on either side ; no distinct transverse row of setae occurs in the anteromedial region of Abd. IV, general surface of the segment with 6 setae on either side (Fig. 6).

Head: 2 dark pigmented ocellar patches, one on each side of the headcapsule, each containing 3 ocelli, G and H reduced and appear nonfunctional : frontal spines absent ; much anomaly and asymmetry observed in the number of annennal segments, e. g. 1 syntype with right antenna four segmented (9 : 16 : 11 : 24) and left two segmented (17 : 28.5) (Fig. 2, A) ; in other both right and left antennae 3 segmented (8 : 6 : 21) (Fig. 2, B) ; the relative length index of segments of the third syntype with both 3 segmented antennae, right, 14 : 25 : 38 and left, 14 : 23.5 : 36 ; antennae characteristically shorter in length and can be compared with the antennae of *Entomobrya* (Fig. 1, A) ; ratio of head diagonal/Ant. I varies from 8-17/22-26 ; Ant. IV apically without distinct sense-knob, 4 smooth setae present ; prelabral setae 4, apparently smooth, labral setae 5, 5, 4, smooth ; anterior margin of labrum with two small tubercles which may be absent, median intrusion of labrum in the form of an inverted "U" ; mandible with 4 apical teeth and a well developed molar plate, maxillae with semicircular fringed lamellae.

Thorax : Relative length index of Ths. II ; III=16 : 9 ; legs all similar, each with 10 stout strong spiny setae on inner lateral margin, and 3 anteromedially ; tenent hair long, setaceous, present on all legs ; tibiotarsal lobes not distinct ; unguis large, slightly curved, inner margin with enlarged paired basal teeth ganulate, medial and distal teeth absent, seldom a vestige of medial tooth observed at two-thirds of the inner margin, external basolateral teeth well developed ; unguiculus large, lanceolate, nondentate, inner margin, sometime with irregular deepenings (Fig. 2, C, D) ; trochanteral organ well developed with *c.* 71 short spines arranged Abds. I : II : III : IV : V : VI=6 : 8 : 9 : 45 : 5 : 3 ; manubrium : dens=40 : 41 ; lightly pigmented. Length : 3 mm. Lectotype is mounted on a slide (Pl. I, A) and paralecthtypes in spirit and on slides, reposited in the Swedish Museum Natural History, Stockholm, Sweden.

Type-locality : Bonge, Cameroons ('Kamerun' of Schött), Africa.

Comparisions : The genus is represented by the type-species only. Variations in the number of antennal segments do not cause any change in other morphological features and such variations are infra-specific ones.

Interlationships : The genus *Paronella* phylogenetically is closest to *Dicranocentruga* and *Campylothorax* in the possession of extra ocular structure. Absence of any prominent hump on metathorax and multilobular extra ocular structure in *Paronella* and *Dicranocentruga* indicate their closest relationship. The genus exhibts characteristics of cave dwelling forms in the presence of reasonably enlarged paired inner ungual teeth, setaceous tenent hairs and absence of unpaired distal tooth in most examples. It appears from the structure of foot complex of *P. fusca* that it is adapted to live on wet clay.

Christiansen (1965) indicated such foot complex to be a characteristic feature of the forms living on wet clay in cave. However, the presence of pigmentation on body, well developed ocelli together with the complex extra ocular structure do not indicate it to be a full-fledged troglobiont. Characteristics of stage 2 in cave adaptation as indicated by Christiansen (1961) quite agree with the foot complex of *Paronella fusca* and at any rate it possesses at least some of those troglophilic adaptative characters. In the species of *Dicranocentruga*, however, the unpaired inner distal ungual tooth and tenent hair are normal like that of non-cavernicolous forms. Such differences in foot complex indicate the distinct differences in behavioural and ecological adaptations existing between *Paronella fusca* and the species of its related genus *Dicranocentruga*.

Distribution : The genus is known so far from the Cameroons, West Africa,. Uptil now the type-species is known from its type-locality only. BARRA (1969) described a new species, *viz.*, *Paronella* (*Paronella*) *purpurea* from Gabon which as some of its features suggest, may be a member of *Paronella* s. str. Further investigation on the type material of this species, not presently available for examination, is required to ascertain its actual identity.

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SUMMARY

In this study, the concept of *Paronella* Schött, 1893 is fixed and precised on the basis of the examination of the syntypes of the type-species, *Paronella fusca* Schött and other species known under *Paronella* so far. Lectotype of *P. fusca* is selcted from the syntypes examined. It is noted that *Paronella*, a long heterogeneous genus, is represented by the type-species only.

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FAUNA OF CONSERVATION AREAS : FAUNA OF SANJAY GANDHI NATIONAL PARK, BOMBAY (VERTEBRATES)

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INTRODUCTION

Among the four National Parks in the State of Maharashtra, Sanjay Gandhi National Park is a beautifully preserved green oasis within the confines of Bombay metropolis. The park exhibits an amazing diversity of terrain-beginning at just 30 meters above sea level, to almost 500 m and displays coastal, dry and mixed deciduous, and typical western ghat plateau habitats. It boasts of two big lakes and 2000 years old Kanheri caves.

Due to its proximity to Bombay city, a lot of people have visited, studied and written about this Park, but unfortunately this information is all scattered and most of it deals with the bird fauna, as indeed it is a bird watcher's paradise (Abdulali 1981, Naik 1986, Monga 1986, Singh & Yazdani 1988). In this paper we have tried to present as a consolidated work, the vertebrate fauna of this Park after an intensive survey from 1987 to 1989 under the special conservation area survey programme of the Zoological Survey of India. The groups were worked out as per the following : Pisces (GMY & DFS) ; Amphibia, Reptilia (DFS & MSP) ; Aves (DFS) & Mammalia (MSP).

The Park

(Fig. 1 & 1A)

Sanjay Gandhi National Park (previously known as Krishnagiri Upawan and later as Borivli National Park) is situated about 25 kms north from the heart of Bombay city and is only 8 kms from the shores of the Arabian Sea. It lies between 72' 53° & 72' 50° east longitude and 19' 88° & 19' 21° north latitude. The southern boundary of the park is formed by the shore of Vihar lake, on the east by the townships of Bhandup, Mulund and Thane and on the west by Goregaon, Malad, Kandivli and Borivli. The northern boundary extends beyond Bassein creek and includes the Nagla forest block. The park covers an area of 96.40km^2, out of which the recreational sector alone takes up 5.06km^2 area. The park terrain is semi-mountaneous, the level ground being between Tulsi and Vihar lakes, the lower westerly reaches of Krishnagiri Upawan and the northern end of Chenna forest. These hills are regarded as the outer spurs of the Sahyadris (western ghats). The major sources of water in the park are Tulsi and Vihar lakes, Dahisar and Rewat nallas. Tulsi and Vihar have a combined

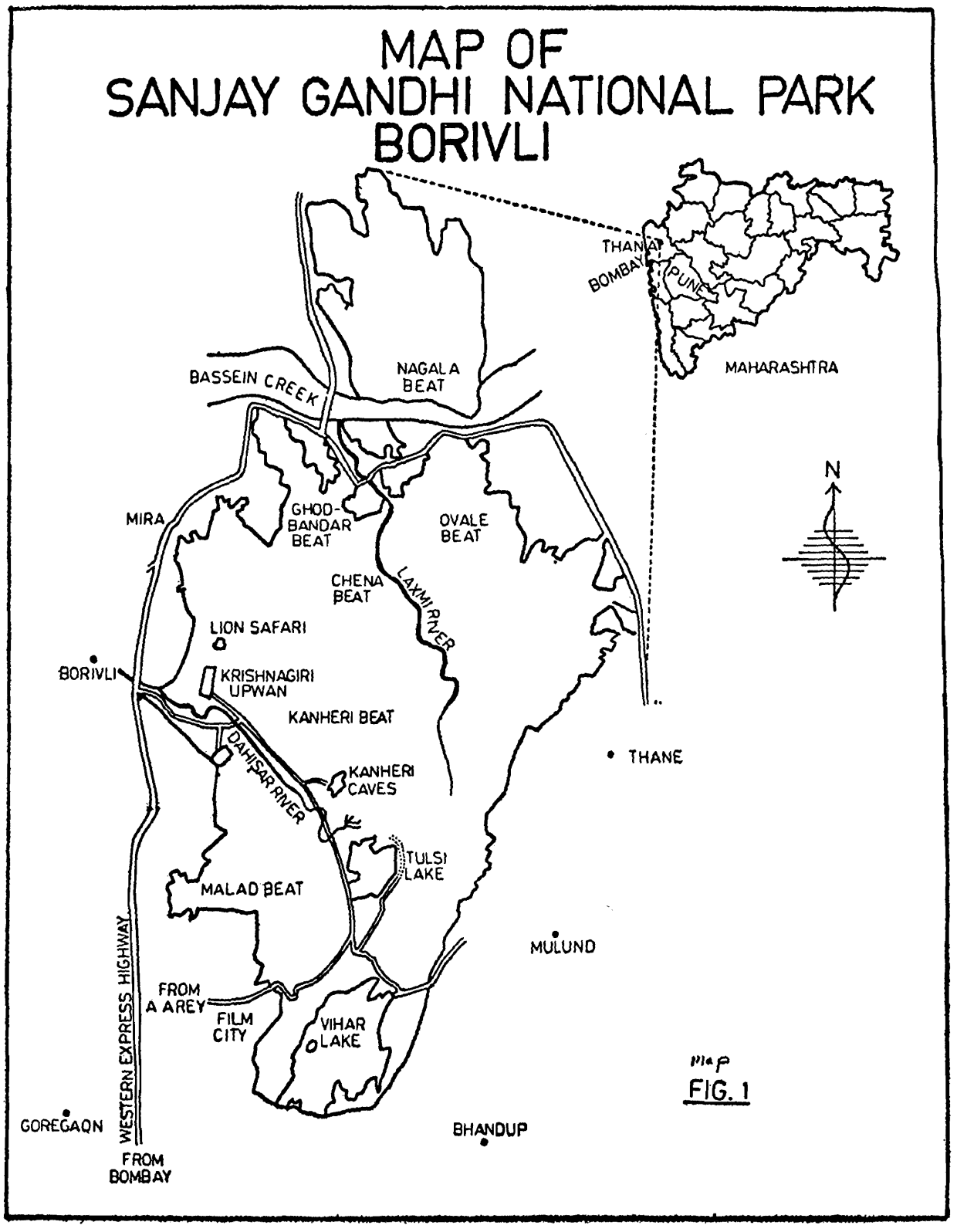
MAP OF
SANJAY GANDHI NATIONAL PARK
BORIVLI
THANA
BOMBAY
PUNE
MAHARASHTRA
BASSEIN CREEK
NAGALA BEAT
N
MIRA
GHOD-BANDAR BEAT
OVALE BEAT
CHENA BEAT
LAXMI RIVER
LION SAFARI
BORIVLI
KRISHNAGIRI UPWAN
KANHERI BEAT
DAHISAR RIVER
KANHERI CAVES
THANE
TULSI LAKE
MALAD BEAT
MULUND
FROM A AREY
FILM CITY
VIHAR LAKE
WESTERN EXPRESS HIGHWAY
GOREGAON
FROM BOMBAY
BHANDUP
Map
FIG. 1

Fig. 1

water spread area of about 8.62km^2 and are a source of drinking water supply to Bombay city (Fig. 4-III).

Dahisar river, which originates from Tulsi lake, flows through the forest of Magathana village and joins Manori creek (near Dahisar village) which finally meets Arabian sea. The catchment area of Dahisar river extends to over 2023.500 ha. Numerous small nallas join this river during its course through the park. Rewat nalla originates near Avaghade hill (SW of Yeur village) and flows northwards, finally joining Bassein creek. This nalla is locally known as Laxmi river, while near its origin it is known as 'Vaghacha khonda'. The catchment area of this nalla extends to over 2225.850 ha.

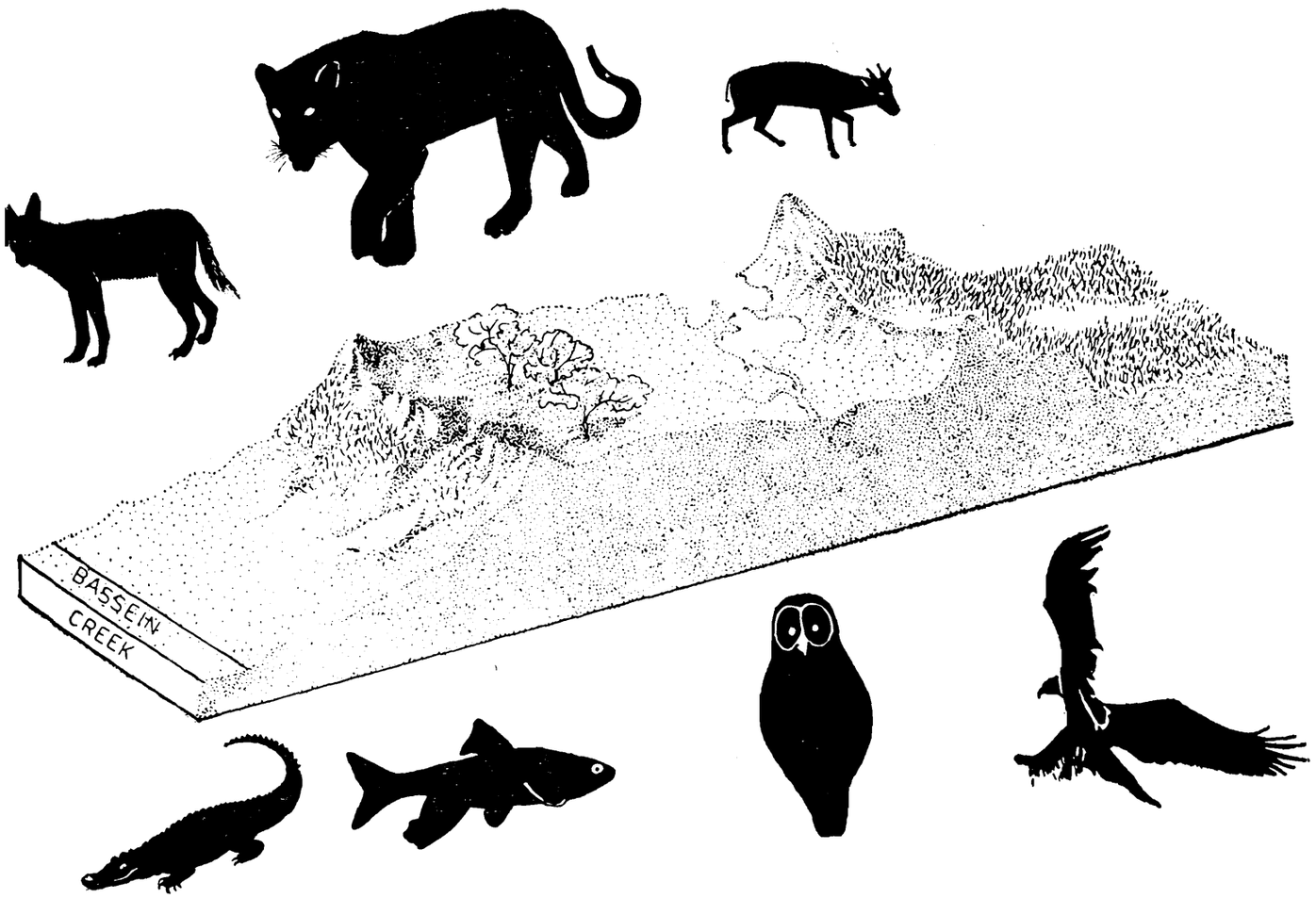

Fig. 1A

SGNP is one of the most highly visited national parks in the country. Over 30 lakh people visit it every year. Most of them visit the Krishnagiri Upawan sector which comprises the recreation zone. A mini train, nature trails, lion safari, lawns, paddle boating (on an artificially made lake on Dahisar river) are added attractions.

Another tourist spot is the historic Kanheri caves (numbering over hundred) built by Budhist monks almost 2000 years ago. This site is looked after by the Aracheological Survey of India. The caves are arranged in several viharas or monasteries, solitary cells for hermits, lecture halls and temples. Outside the caves are small tanks for water, separate for each cell, and couches carved out of rock, may be, for the monks to recline on.

The Forest

Due to its proximity to the coast, numerous water courses and hilly terrain, the flora too presents a very diverse picture, ranging from dry & moist deciduous to semi-evergreen to open scrub to halophytes. The principal types are ; *Tectona grandis* (Teak) *Terminalia tomentosa* (Ain), *Bombax malabaricum* (red silk cotton), *Adina cordifolia* (Kadamba), *Dendrocalamus strictus* (Bamboo), *Butea monosperma* (Flame of the forest), *Pterocarpus marsupium* (Bibla).

The Fauna

Studies have revealed that the Park is very rich in fauna. 30 spp. of Pisces, 7 spp. of Amphibia, 23 of Reptilia, 64 of Aves & 48 spp. of Mammalia have been observed and recorded (Appendix I).

(A) *Fishes*

30 species of fishes (freshwater & marine) were recorded from the Park. The freshwater sources are Tulsi & Vihar lakes, Dahisar & Rewat rivers. Numerous small tributaries join these rivers during their course through the park. As the rivers are of a short length, indigenous fish fauna includes rather small sized varieties like *Puntius*, *Rasbora*, *Garra* etc. A hill stream Cyprinid, *Parapsilorhynchus tentaculatus* was found in seasonal streams flowing down the Kanheri caves from an altitude of about 486 MSL. In summer, these fishes are seen in water filled stone cisterns along the caves.

(B) *Amphibia*

Most of the common species occurring elsewhere in India are represented here. *Rana breviceps*, the Indian burrowing frog, is found in the Kanheri caves area during early monsoon months. The common tree frog *Polypedates maculatus*, is quite commonly seen during the monsoon.

(C) *Reptilia*

The outstanding feature of the reptilian fauna of the Park is the occurrence of Crocodile, *Crocodilus palustris*, in Tulsi lake. The Indian Python & Cobra are also found in the forested areas of the Park.

(D) *Birds*

The bird fauna of the Park is rich and diverse. 64 spp. have been reported and an attempt made to give their status. The species composition is typical of the Konkan region.

(E) *Mammals*

48 spp. of mammals were observed in the Park. The fauna is typical of the Sahyadri region with a predominance of spotted deer, leopard, etc.

A good variety of bat species have been observed. It is interesting to note that the bats inhabit only a few (2-3) caves out of about a hundred caves in Kanheri.

Another interesting feature is the presence of both Bonnet & Rhesus monkeys in the Park.

A large number of domestic dogs have been seen near the MAFCO factory area. Their behaviour is almost like the wild ones and have started hunting and attacking in packs.

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Appendix I

Class : Pisces
Subclass : Teleostomi
Order : CYPRINIFORMES
Family : Cyprinidae

1. **Salmostoma clupeoides** (Bloch)

1895. *Cyprinus clupeoides* Bloch, *Auslandische Fische*, Berline 12, p. 49, pl. 408, fig. 20.

Type locality : Tranquebar.

2. **Danio aequipinnatus** (McClelland)

1839. *Perilampus aequipinnatus* McClelland, *Asiatic Res.* Calcutta, 19, p. 3 pl. 60, Fig. 1.

Type locality : Assam.

3. **Rasbora daniconius** (Hamilton)

1822. *Cyprinus daniconius* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 327, 329, pl. 15, fig. 89.

Type locality : Rivers of Southern Bengal.

4. **Puntius ticto** (Hamilton)

1822. *Cyprinus ticto* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 314, 389, pl. 8, fig. 87.

Type locality : South-east part of Bengal.

5. **Catla catla** (Ham)

1822. *Cyprinus catla* Hamilton, *Fish Ganges*, pp. 287, 387, pl. 13, fig. 81.

Type locality : In the rivers and tanks of Bengal.

6. **Cirrhinus mrigala** (Ham)

1822. *Cyprinus mrigala* Hamilton, *Fish Ganges*, pp. 279, 386, pl. 6, fig. 79.

Type locality : Ponds and freshwater rivers of the Gangetic provinces.

7. **Labeo calbasu** (Ham)

1822. *Cyprinus calbasu* Hamilton. *Fish Ganges*, pp. 297, 387, pl. 2, fig. 83.

Type locality : Rivers and ponds of Bengal and in the western provinces.

8. **Labeo rohita** (Ham)

1822. *Cyprinus rohita* Hamilton, *Fish. Ganges*, pp. 301, 388, pl. 36, fig. 85.

Type locality : Freshwater rivers of the Gangetic provinces.

9. **Parapsilorhynchus tentaculatus** Annandale

1919. *Parapsilorhynchus tentaculatus* Annandale, *Rec. Indian Mus.* Calcutta, 16 (1), p. 128, pl. 1, Figs. 4, 4a, pl. 3, fig. 2.

Type locality : Khandala, Maharashtra State.

10. **Garra mullya** (Sykes)

1841. *Chondrostoma mullya* Sykes. *Trans. Zool. Soc.* London, 2, p. 359, pl. 62 fig. 3.

Type locality : Poona.

Order : SILURIFORMES

Family : BAGRIDAE

11. **Aorichthys aor** (Hamilton)

1822. *Pimelodus aor* Hamilton, *Fishes of Ganges* pp 205, 379, pl. 20. fig. 68.

Type locality : Rivers of Bengal and upper parts of Gangetic estuaries.

12. **Mystus menoda trachacanthus** (Val)

1839. *Bagrus trachanthus* Valenciennes, *Hist. Nat. Poiss.* 14, p. 419.

Type locality : Bengal.

Family : HETEROPNEUSTIDAE

13. **Heteropneustes fossilis** (Bloch)

1794. *Silurus fossilis* Bloch, *Auslandische fische*, Berlin, 6, p. 370, fig. 2.

Type locality : Tranquebar.

Order : ATHERINIFORMES

Family : CYPRINODONTIDAE

14. **Aplocheilus lineatus** (Val)

1846. *Panchax lineatum* Val. *Hist. Nat. Poissons*, Paris, 18, p. 381.

Type locality : Bombay.

Order : CHANNIFORMES

Family : CHANNIDAE

15. **Channa punctatus** (Bloch)

1793. *Ophiocephalus punctatus* Bloch, *Auslandische Fische*, Berlin, 6, p. 139 pl. 358.

Type locality : Malabar.

Order : PERCIFORMES

Family : CICHLIDAE

16. **Tilapia mossambica** (Peters)

1852. *Chromis mossambicus* Peters, *Monatsb. Akad. Wiss.*, Berlin, p. 681.

Type locality : Zambesi river, South Africa.

Family : ANABANTIDAE

17. **Anabas testudineus** (Bloch)

1792. *Anabas testudineus* Bloch, *Naturg. Ausland. Fisches*, 6, p. 121, pl. 322.

Type locality : Japan, East Indies.

Family : GOBIIDAE

18. **Glossogobius giuris giuris** (Ham)

1822. *Gobius giuris* Hamilton, *Fishes of Ganges*, pp. 51, 366, pl. 33, fig. 15.

Type locality : Ponds and freshwater rivers of Gangetic provinces.

Prominent marine fishes of Bassein Creek

Order : CLUPEIFORMES

Family : CLUPEIDAE

19. **Hilsa toli** (Val)

Alausa toli Valenciennes *H. N. Poiss*, XX, p. 435.

Family : ENGRAULIDAE

20. **Coilia dussumieri** Val

Coilia dussumieri Val. *H. N. Poiss.* XXI, p. 81, pl. 610.

Order : SILURIFORMES

Family : ARIIDAE

21. **Arius caelatus** Valenciennes

1840. *Arius caelatus* Valenciennes, *H. N. Poiss.* 15, pp. 66.

Type locality : Bombay.

22. **Arius sona** (Ham)

1822. *Pimelodus sona* Hamilton, *Fishes of Ganges* pp 172, 376.

Type locality : Estuaries of Bengal.

Order : MYCTOPHIFORMES

Family : HARPADONTIDAE

23. **Harpadon nehereus** (Ham)

1822. *Osmerus nehereus* Hamilton, *Fishes of Ganges* : 209.

Type locality : Mouth of Ganges.

Order : PERCIFORMES

Family : TERAPONIDAE

24. **Terapon jarbua** (Forsskal)

1775. *Sciaema jarbua* Forsskal, *Descript. Animalium*, 50.

Type locality : Djedda Red sea.

Family : SCIAENIDAE

25. **Johnius belangeri** (Cuvier)

1830. *Corvina belangerii* Cauvier, *H. N. Poiss.* 5, 120.

Type locality : Pondicherry.

26. **Johnius elongatus** Mohan

1976. *Johnius elongatus* Mohan, *Matsya* (1) : 19, fig. 1.

Type locality : Veraval, Gujarat.

27. **Kathala axillaris** (Cuvier)

1830. *Corvina axillaris* Cuvier, *H. N. Poiss.* 5 : 113.

Type locality : Malabar.

Family : MUGILIDAE

28. **Valamugil spiegleri** (Bleeker)

1858. *Mugil spiegleri* Bleeker, *Nat. Tijdschr. Ned-Indie*, **16** : 279.

Type locality : Java.

Family : GOBIIDAE

29. **Boleopthalmus boddarti** (Pallas)

Gobius boddaerti Pallas, spic viii, pl. 11, pl. 2, fig. 4, 5.

30. **Boleopthalmus dussumieri** Val

Boleopthalmus dussumieri Val. *H. N. Poiss*, xii, p. 207, pl. 354.

Class : AMPHIBIA

Order : SALIENTIA

Family : BUFONIDAE

1. **Bufo melanostictus** Schn. Common Indian Toad

1799. *Bufo melanostictus* Sch. *Hist. Amph. Jena*, I. 216.

Family : MICROHYLIDAE

2. **Ramanella montana** (Jerdon) Jerdon's Ramanella

Family : RANIDAE

3. **Rana cyanophlyctis** Schn. Skipper frog

1799. *Rana cyanophlyctis* Schneider, *Hist. Amph. Jena*, I, 137.

4. **Rana tigerina** Daudin Indian Bull frog

1803. *Rana tigrina* Daudin, *Hist. Rain. Gren. Crap.* ; 64, pl. 20.

5. **Rana limnocharis** Weigmann Indian Cricket frog

1835. *Rana limnocharia* Weigmann, *N. Acta Ac. Leop. Carol.* **17** (1) : 255.

6. **Rana breviceps** Sch. Indian Burrowing Frog

1799. *Rana breviceps* Schneider, *Hist. Amph. Jena*, 1, p. 140.

7. **Blypedates maculatus** (Gray) Common tree frog

Class : REPTILIA

Order : LORICATA

Family : CROCODILIDAE

1. **Crocodylus palustris** Lesson Indian marsh crocodile

Crocodylus palustris Lesson, *Belang. Voy. Ind. Or. Zool.*, 305, Ganges.

Order : TESTUDINES

Family : EMYDIDAE

2. **Melanochelys trijuga** (Schweigger) Pond tortoise

1814. *Emys trijuga* Schweigger *Prodr. Monog. Chel.*, 41, Java.

Order : SQUAMATA

Suborder : SAURIA

Family : GEKKONIDAE

3. **Hemidactylus brooki** Gray Spotted Indian house Gecko

1845. *Hemidactylus brooki* Gray, *Cat. Liz. Brit. Mus.*, : 153, Borneo.

4. **Hemidactylus maculatus** Dumeril & Bibron Rock Gecko

1836. *Hemidactylus maculatus* Dumeril & Bibron, *Exp. Gen.* iii : 358, India (Bombay).

Family : AGAMIDAE

5. **Sitana ponticeriana** Cuvier Fan-throated Lizard

6. **Calotes versicolor** (Daudin) Indian garden lizard

1802. *Agama versicolor* Daudin, *Hist. Nat. Rept.* iii : 395. India.

Family : VARANIDAE

7. **Varanus bengalensis** (Daudin) Indian monitor

1758. *Lacerta bengalensis* Linn. *Syst. Nat.* ed x : 201, India.

Family : SCINCIDAE

8. **Mabuya carinata** (Sch.) Common or Brahminy skink

1801. *Scincus carinatus* Schneider, *Hist. Amph.* **2** : 183.

Suborder : SERPENTES

Family : TYPHLOPIDAE

9. **Ramphotyphlops braminus** (Daudin) Common worm snake

1803. *Eryx braminus* Daudin, *Hist. Nat. Rept.* vii : 279.

Family : BOIDAE

10. **Python molurus** (Linn.) Indian Python

1758. *Coluber molurus* Linnaeus, *Syst. Nat. ed.* 10th : 225, India.

11. **Eryx conicus** (Schn.) Russell's earth Boa

1796. In Russell, *Ind. Serp.* **1** : 5, Madras.

12. **Erxy johni** (Russell) John's earth Boa

1801. *Boa, johnii* Russell *Ind. Serp.* ii : 18 & 20, pls. xvi & xvii.

Family : DIPSADIDAE

13. **Oligodon taeniolatus** (Jerdon) Russell's or variegated Kukri snake

1853. *Coronella taeniolata* Jerdon, *J. Astat. Soc.* Bengal, xxii, p. 528.

Family : NATRICIDAE

14. **Xenochrophis piscator** (Sch.) Checkered keelback

1799. *Hydrus piscator* Schnoider, *Hist. Amph.* 1, p. 247 : East Indies.

Family : COLUBRIDAE

15. **Elaphe helena** (Daudin) Trinket snake

1796. In Russell, *Ind. Serp.*, i. 37, pl. 32. Vizagapatam.

16. **Ptyas mucosus** (Linn.) Dhaman or common rat snake

1758. *Coluber mucosus* Linnaeus *Mus. Ad. Prid.*, I : 37, pl. 23, India.

17. **Argyrogena fasciolatus** (Shaw) Banded Racer

1796. In Russell, *Ind. Serp.* **1** : 26, pl. xxi, India.

18. **Dendrelaphis tristis** (Daudin) Common Indian Bronze back or Tree snake

1803. *Coluber tristis* Daudin, *Hist. Nat. Rept. vi* : 430.

19. **Lycodon aulicus** (Linn.) Common wolf snake

1754. *Coluber aulicus* Linnaeus, *Mus. Addph. Frider*, I : 29, pl. xii, fig. 2.

20. **Ahaetulla nasuta** (Lacepede) Common green whip snake

1789. *Coluber nasutus* Lacepede, *Hist. Nat. Serp.* i, p. 100 & ii, p. 277. Pl. 4, fig. 2. Ceylon.

Family : ELAPIDAE

21. **Bungarus caeruleus** (Sch.) Common Indian Krait

1801. *Pseudoboa caerulea* Schneider, *Hist. Amph.*, ii : 284, Vizag.

22. **Naja naja** (Linn.) Indian Cobra

1758. *Coluber naja* Linnaeus, *Syst. Nat.* ed. 10th : 221, India.

Family : VIPERIDAE

23. **Vipera russelli** (Shaw) Russell's Viper

1799. *Coluber russelli* Shaw *Nat. Misc.* vii, pl. 291.

Class : AVES

Order : PODICIPEDIFORMES

Family : PODICEPEDIDAE

1. **Podiceps ruficollis capensis** Salvadori Little Grebe

1884. *Podiceps capensis* Salvadori, *Amm. Mus. Civ. Genova* : (2) I : 252 : Shoa, Africa.

Status : Common, resident.

Order : PELECANIFORMES

Family : PHALACROCORACIDAE

2. **Phalacrocorax niger** (Viellot) Little Cormorant

1817. *Hydrocorax niger* Viellot, *Nouv. Dict. Hist. Nat.* : 8 : 88 : East Indies, Bengal.

Status : Common, resident.

3. **Anhinga rufa melanogaster** Pennant Darter

1769. *Anhinga melanogaster* Pennant, *Indian Zool.* : 13 : 12, Ceylon.

Status : Common, resident.

Order : CICONIIFORMES

Family : ARDEIDAE

4. Ardeola grayii grayii (Sykes) Pond Heron

1832, *Ardea grayii* Sykes. *Proc. Zool. Soc. Landon* : 158.

Status : Common, resident.

5. Bubulcus ibis coromandus (Boddaert) Cattle Egret

1783. *Cancroma coromanda* Boddaert, *Table Pl. enlum* : 54.

Status : Common, resident.

Family : CICONIIDAE

6. Egretta garzetta garzetta (Linn.) Little Egret

1766. *Ardea garzetta* Linnaeus, *Syst. Net. ed. 12,* **1** : 237.

Status : Common, resident.

7. Anastomus oscitaus (Boddaert) Openbill Stork

1783. *Ardea oscitaus* Boddaert *Table Pl. enlum.* : **55** : Pondicherry.

Status : Common, resident.

Order : ANSERIFORMES

Family : ANATIDAE

8. Anas crecca crecca Linn. Common Teel

1758. *Anas crecca* Linnaeus *Syst. Nat.* ed. 10, **1** : 26 : Sweden.

Status : Common, resident.

Order : FALCONIFORMES

Family : ACCIPITRIDAE

9. Elanus caeruleus vociferus (Latham) Blackwinged kite

1790. *Falco vociferus* Latham, *Index. Orn.* : **1** : 46 : Coromandal coast, India.

Status : Resident, commonly seen throughout the Park.

10. Milvus migrans govinda Sykes Pariah kite

1832. *Milvus govinda* Sykes, *Proc. Zool. Soc. London* : **81** : Dukhum.

Status : Resident, seen commonly.

11. **Haliastur indicus indus** (Boddaert) Brahmani kite

1783. *Falco indus* Boddaert, *Table Pl. enlum.* : **25** : Pondicherry.

Status : Resident. Common.

12. **Accipiter badius dussumieri** (Temminck) Indian Shikra

1824. *Falco dussumieri* Temminck, *Pl. Col. Livr.* : **52** : Bengal, India.

Status : Common.

13. **Gyps bengalensis** (Gmelin) Indian Whitnbacked Vulture

1788. *Vulture bengalensis* Gmelin, *Syst. Nat.* : **1** (1) : 245 : Bengal.

Status : Resident. Seen near MAFCO factory.

14. **Circus macrourus** (S. G. Gmelin) Pale Harrier

1770. *Falco macrourus* S. G. Gmelin *Reise d. Russl. th.* : **1** : 48 : Voronezh, Southern Rnssia.

Status : Resident. Near Tulsi lake.

15. **Spilornis cheela melanotis** (Jerdon) Lesser Crested Serpent Eagle

1844. *Buteo melanotis* Jerdon, *Madras Jour. Lit. Sci.* : **13** : 166 : at the foot of the Nilgiri.

Status : Resident. Occassional. Tulsi lake area.

16. **Circus aeruginosus aeruginosus** (Linn.) Marsh Harriar

1758. *Falco aeruginosus* Linnaeus, *Syst. Nat.* ed. 10, **1** : 91 : Europe, restricted type locality, Sweden.

Status : Occassionally seen in forested areas.

Order : GALLIFORMES

Family : PHASIANIDAE

17. **Pavo cristatus** Linn. Indian Peafowl

1758. *Pavo cristatus* Linnaeus, *Syst. Nat.* ed. 10, **1** : 156 : India.

Status : Resident. Common.

18. **Gallus gallus murghi** Robinson & Kloss Red jungle fowl

1920. *Gallus ferroginous murohi* Robinson & Kloss, *Rec. Indian, Mus.* : **19** : 14 : Chirula, Gaya Dist., Bihar.

Status : Resident, quite common.

19. **Gallus sonneratti** Temminck Grey Junglefowl

1813. *Gallus sonneratii* Temminck, *Fig. et Gall.* : **2** : 246 : Eastern Ghats near Madras.

Status : Resident. Common.

Order : GRUIFORMES

Family : TURNICIDAE

20. Turnix suscitator taigoor (Sykes) Common Bustard-Quail

1832. *Hemipodius taigoor* Sykes, *Proc. Zool. Soc., London* : 155 : Dukhun.

Status : Resident. Occassionally seen.

Family : RALLIDAE

21. Amaurornis phoenicurus chinensis (Boddaert) White breasted water hen

1783. *Fulica chinensis* Loddaert *Table Pl. enlum* : 54 : China.

Status : Resident. Common.

22. Porphyrio p. poliocephalus (Latham) Indian Purple Moorhan

1801. *Gallinula poliocephala* Latham, *Index Orn. Suppl.* : 68 : India.

Status : Resident. Common.

23. Fulica atra Linn. Coot

1758. *Fulica atra* Linnaeus *Syst. Nat.* ed. 10, **1** : 152 : Europe.

Status : Resident. Common.

Order : CHARADRIIFORMES

Family : JACANIDAE

24. Hydrophasianus chirurgus (Scopoli) Pheasant tailed Jacana

1786. *Tringa chirurgus* Scopoli, *Dal. Flor. et Faun. Insusbr. fasc.* : **2** : 92.

Status : Resident. Occassional.

25. Metopidius indicus (Latham) Bronze-winged Jacana

1790. *Parra indica* Latham, *Index Orn.* : **2** : 765 : India.

Status : Resident. Common.

Family : RECURVIROSTRIDAE

26. Himantopus himantopus (Linn.) Blackwinged stilt

1758. *Charadrius himantopus* Linnaeus *Syst. Nat.* ed. 10, **1** : 151 : Southern Europe.

Status : Resident. Common.

27. Burhinus oedicnemus indicus (Salvadori) Stone curlew

1865. *Oedicnemus indicus* Salvadori, *Atti Soc. Ital. Sci. Nat. milano* : 8 : 381 : India.

Status : Occassionally seen.

Order : COLUMBIFORMES

Family : COLUMBIDAE

28. **Streptopelia chinensis suratensis** (Gmelin) Spotted Dove

1789. *Columba suratensis* Gmelin, *Syst. Nat.* **1** (2) : 778 : Surat, Gulf of Cambay, India.

Status : Resident. Common.

29. **Streptopelia decaocto decaocto** (Frivaldszky) Ring Dove

Status : resident.

Order : PSITTACIFORMES

Family : PSITTACIDAE

30. **Psittacula krameri manillensis** (Bech.) Rose ringed Parakeet

1800. *Psittacula manillensis* Bechstein, *Stubenvogel, 2nd Gotha ed.* : 612 : Phillippines.

Status : Resident.

Order : CUCULIFORMES

31. **Eudynamys scolopacea scolopacea** (Linn.) Koel

1758. *Cuculus scolopaceaus* Linnaeus, *Syst. Nat.* ed. 10, **1** : 111 : Malabar.

Status : Resident. Common.

32. **Cantropus sinensis sinensis** (Stephens) Crow-phaesant

1815. *Polophilus sinensis* Stephens in Shaw's *Genl. Zool.* : **9** (1) : 51 : China.

Status : Resident. Common.

Order : STRIGIFORMES

Family : STRIGIDAE

33. **Tyto alba startens** Hartert Indian Barn Owl

1929. *Tyto alba startens* Hartert, *Nov. Zool.* : 35 : 98 : Cachar.

Status : Occassionally seen.

34. **Bubo bubo bengalensis** (Franklin) Great Horned Owl

1831. *Otus bengalensis* Franklin, *Proc. Zool. Soc. London* : 115 : Ganges.

Status : Uncommon.

Order : CAPRIMULGIFORMES

Family : CAPRIMULGIDAE

35. **Caprimulgus indicus indicus** Latham Indian Jungle Nightjar

1790. *Caprimulgus indicus* Latham, *Index Orn.* : **2** : 588 : India.

Status : Resident. Common.

Order : APODIFORMES

Family : APODIDAE

36. Cypsiurus parvus batasiensis (J. E. Gray) Palm Swift

1829. *Cyp.* (*Selus*) *batasiensis* J. E. Gray in Griffith's *Anim. Kingdom* : **7** : 60 : India, restricted to Calcutta.

Status : Uncommon.

Order : CORACIIFORMES

Family : ALCEDINIDAE

37. Ceryle rudis leucomelanura Reichenbach Pied Kingfisher

1851. *Ceryle leucomelanura Reichenbach, Handb. Spec. Orn.* : **21** : Ceylon.

Status : Resident. Common.

38. Alcedo atthis bengalensis Gmelin Common Kingfisher

1788. *Alcedo bengalensis* Gmelin, *Syst. Nat.*, **1** (1) : 450 : Bengal.

Status : Resident. Common.

39. Halcyon smyrensis fusca (Boddaert) White breasted Kingfisher

1783. *Alcedo fusca* Boddaert, *Table Pl. enlum* : **54** : Malabar Coast.

Status : Resident. Common.

Family : MEROPIDAE

40. Merops orientalis orientalis Latham Green Bee-eater

1790. *Merops orientalis* Latham, *Index Orn. Suppl.* xxxiii ; Ind.

Status : Resident. Common.

Family : UPUPIDAE

41. Upupa epops ceylonensis Reichenbach Indian Hoopoe

1853. *Upupa ceylonensis* Reichenbach, *Handb. Spec. Orn., Scansoriae* : 320 : Ceylon.

Status : Resident. Common.

Family : BUCEROTIDAE

42. Tockus birostris (Scopoli) Common Grey Hornbill

1786. *Buceros birostris* Scopoli, *Del. Flor. et Faun. Insnbr. fasc* : 2 : 87 ; Cormandel, India.

Status : Resident. Common.

Order : PICIFORMES

Family : CAPITONIDAE

43. **Megalaima zeylanica inornata** Walden Green Barbet

1870. *Megalaima inornata* Walden, *Ann. Mag. Nat. Hist.*, 5 (4) : 219 : Malabar.

Status : Resident. Common.

Family : PICIDAE

44. **Micropternus brachyurus jerdonii** (Malherbe) Rufous Woodpecker

1849. *Phaiopicus jerdonii* Malherbe, *Rev. et. Mag. Zool.* : **1** (2) : 535 : Indian Peninsula restricted to Travancore.

Status : Resident.

45. **Dinopium benghalense tehminae** (Whistler & Kinnear) Goldenbacked Woodpecker

1934. *Brachypternus benghalensis tehminae* Whistler & Kinnear, *Jour. Bombay nat. Hist. Soc.* **37** : 293 : Rajampura, 1350 ft., Panthalam Hills Travancore.

Status : Resident.

46. **Picoides mahrattensis mahrattensis** (Latham) Yellow fronted pied woodpecker

1801. *Picus mahrattensis* Latham, *Index Orn. Suppl.*, xxxi ; Mahratta Country, India.

Status : Occassionally seen.

Order : PASSERIFORMES

Family : ORIOLIDAE

47. **Oriolus oriolus kundoo** Sykes Golden Oriole

1832. *Oriolus kundoo* Sykes, *Proc. Zool. Soc. London* : 187 : Dukhun.

Status : Local migrant.

Family : DICRURIDAE

48. **Dicrurus paradiscus grandis** (Gould) Racket-tailed Drongo

1836. *Edolins grandis* Gould, *Proc. Zool. Soc. London* : 5 : Nepal.

Status : Occassionally seen.

49. **Dicrurus leucophaeus longicaudatus** Hay Grey or Ashy Drongo

1845. *Dicrurus lougicaudatus* Lord Arthur Hay in Jerdon, 1845, *Madras Jour. Lit. Sci.* : **13** : 121 : *nom. nud.*

Status : Migrant. Common.

Family ; STURNIDAE

50. **Acridotheres tristis tristis** (Linn.) Myna

1766. *Paradisea tristis* Linnaeus, *Syst. Nat.* ed. : **12**, 1 : 167 : Calcutta.

Status : Resident. Common.

Family : CORVIDAE

51. **Corvus splendens splendens** Vieillot House Crow

1817. *Corvus splendens* Vieillot, *Nouv. Dict. d' Hist. Nat.* : 8 : 44 : Ben.

Status : Resident, Common.

52. **Corvus macrorhynchos culminatus** Sykes Jungle Crow

1832. *Corvus culminatus* Sykes, *Proc. Zool. Soc. London* : 96 : Dukhun : Poona.

Status : Resident. Common.

53. **Pycnonotus cafer cafer** (Linn.) Redvented Bulbul

1766. *Turdus cafer* Linnaeus, *Syst. Nat. ed.* : **12**, 1 : 295 : Pondicherry.

Status : Resident. Common.

54. **Pycnonotus jocosus fuscicaudatus** (Gould) Redwhiskered Bulbul

1866. *Otocompsa fuscicaudatus* Gould, *Proc. Zool. Soc. London* : **3** : 664.

Status : Resident. Common.

Family : MUSCICAPIDAE

55. **Pellorneum ruficeps ruficeps** Swainson Spotted Babbler

1332. *Pellorneum ruficeps* Swainson, *Fauna Boreoli-Americana* : 487 ; Ind.

Status : Resident in flocks.

56. **Terpsiphone paradisi paradisi** (Linn.) Paradise Flycatcher

1758. *Corvus paradisi* Linnaeus, *Syst. Nat. ed.* 10, **1** : 107 : India.

Status : Occassional, migrant.

57. **Savicoloides fulicata intermedia** Whistler & Kinner Indian Robin

1932. *Savicoloides fulicata intermedia* Whistler & Kinnear, *Jour. Bom. Nat. Hist. Soc.* : 36 : 73 ; Rahuri, Rahuri, Ahmednagar.

Status : Common.

58. **Prinia sociates sociates** Sykes Ashy wren-warbler

1832. *Prinia sociates* Sykes, *Proc. Zool. Soc. London* : 89 : Dukhun.

Status : Resident. Common.

Family : PARIDAS

59. **Parus major stupae** Koelz Grey Tit

1939. *Parus major stupae* Koelz *Proc. Biol. Soc. Washington* : 52 : 61 : Sanchi, Bhopal.

Status : Resident, occassionally seen.

Family : MOTACILLIDAE

60. **Motacilla caspica caspica** (Gmelin) Grey Wagtail

1774. *Parus caspicus* Gmelin, *Reise d. Russ* : 5 : pl. 20 : Fig. 2 : 104 : Southern Shore of Caspican Sea.

Status : Resident. Common.

Family : NECTARINIIDAE

61. **Nectarinia asiatica asiatica** (Latham) Purple Sunbird

1790. *Carthia asiatica* Latham, *Index Orn.* : 1 : 288 : India=Gurgaon.

Status : Resident. Common.

62. **Ploceus phillipinus phillippinus** (Linn.) Indian Baya

1766. *Loxia phillippinu* Linnaeus, *Syst. Nat. ed.* 12, 1 : 305 : Ceylon.

Status : Resident. Common.

Family : ZOSTEROPIDAE

63. **Passer domesticus indicus** Jardine & Selby House Sparrow

1835. *Passer indicus* Jardine & Selby *III. Orn.* 3 : pl. 118 : India, restricted to Bangalore.

Status : Resident. Common.

Family : Emberizidae

64. **Melophus lathami saboristatus** (Gray) Crested Bunting

1831. *Emberiza lathami* Gray, *Zool. Misc.* : 1 : 2 : Canton, Kwangtung.

Status : Resident, occassionally seen.

Class : MAMMALIA

Order : INSECTIVORA

1. **Suncus murinus** (Lin.) House Shrew

1766. *Sorex murinus* Linnaeus, *Syst. Nat. 12th ed.*, 1 : 74 : Java.

Status : Common.

2. **Suncus stoliczkanus** (Anderson)

1877. *Crocidura* (*Pachyura*) *stoliczkanus* Anderson, *J. Asiat. Soc. Bengal*, **46** : 270 : Bombay, India.

Status : Occassional.

Order : CHIROPTERA

Suborder : MEGACHIROPTERA

Family : PTEROPIDAE

3. **Rousettus leschenaulti** (Desmarest) Fruit bat

1820. *Pteropus leschenaulti* Desmarest, *Encycl. Meth. Mamm.*, **1** : 110 : Pondicherry, India.

Status : Commonly seen in Kanheri cave No. 1.

4. **Pteropus giganteus** (Brunnich) Flying fox

1782. *Vespertilio gigantea* Brunnich, *Dyrenes Historie*, **1** : 45 : Bengal, India.

Status : Common.

5. **Cynopterus sphinx** Vahl. Short-nosed fruit bat

1797. *Vespertilio sphinx* Vahl., *Skr. Nat. Selak. Copenhagen*, **4**, 1 : 123 : Tranquebar, Madras, India.

Status : Common.

Suborder : MICROCHIROPTERA

Family : EMBALLONURIDAE

6. **Taphozous melanopogon** Temminck Black bearded tomb bat

1841. *Taphozous melanopogon* Temminck, *Mon. Mamm.*, **2** : 287 : Bante, West Java.

Status : Commonly seen in Kanheri caves.

Family : MEGADERMATIDAE

7. **Megaderma spasma** (Lin.) Malay false Vampire bat

1758. *Vespertilio spasma* Linnaeus, *Syst. Nat. 10th* ed., **1** : Celebes.

Status : Commonly seen in Kanheri areas.

8. **Megaderma lyra** Geoffroy Indian false Vampire

1810. *Megaderma lyra* E. Geoffroy, *Ann. Mus. H. N. Paris*, **15** : 190 : India.

Status : Common.

Family : RHINOLOPHIDAE

9. **Rhinolophus rouxi** Temminck Horse shoe bat

1835. *Rhinolophus rouxi* Temminck, *Mon. Mamm.*, **2** : 306 ; Pondicherry and Calcutta, India.

Status : Reported by Brosset (1962) from Kanheri area.

10. **Rhinolophus lepidus** Blyth

1844. *Rhinolophus lepidus* Blyth, *J. Asiat. Soc. Bengal*, **13** : 486 ; Calcutta.

Status : Reported by Brosset (1962) from Kanheri area.

11. **Hipposidorus speoris** (Schneider) Schneider's leaf-nosed bat

1800. *Vespertilio speoris* Schneider, in Schreber's Saugeth, pl. 59 b : Tranqueber.

Status : Occassional.

12. **Hipposidorus bicolor** (Temminck) Leaf-nosed bat

1834. *Rhinolophus bicolor* Temminck, *Tijdschr. Natuur. Gasch.*, **1.** i : 19, pl. 1, fig. 3 : Anjer Coast, Java.

Status : Reported by Brosset (1962) from Vihar lake area.

13. **Hipposidorus galeritus** Cantor Cantor's leaf-nosed bat

1846. *Hipposidorus galeritus* Cantor, *J. Asiat. Soc. Bengal*, **15** : 183 : Penang, Malay States.

Status : Reported by Brosset (1962) from Kanheri.

Family : VESPERTILIONIDAE

Subfamily : VESPERTILIONINAE

14. **Pipistrellus mimus** Wroughton Indian pygmy pipistrelle

1899. *Pipistrellus mimus* wroughton, *J. B. N. H. S.*, **12** : 722 : Mheskatri, Dangs, Surat Dist., India.

Status : Common.

Subfamily : KERIVOULINAE

15. **Kerivoula picta** (Pallas) Painted bat

1767. *Vespertilio pictus* Pallas, *Spic. Zool.*, **3** : 7 : Peninsular India.

Status : Reported by Brosset (1962) from Borivali.

Order : PRIMATE

Family : CERCOPITHECIDAE

16. **Macaca radiata** (Geoffroy) Bonnet macaque

1812. *Cercocebus radiatus* E. Geoffroy, *Ann. Mus. H. N., Paris*, **19** : 98 : India.

Status : Common. Troops were sighted mostly near Kanheri area.

17. **Macaca mulatta** (Zimmerman) Rhesus macaque

1780. *Cercopithecus mulatta* Zimmerman, *Geogr. Gesch. Mensch*, **2** : 195 : India.

Status : Introduced. One small troop (size : 5-6) near deserted forest rest house on the side of Tulsi Lake was sighted. It is situated a few kms. away from Kanheri caves.

18. **Presbytis entellus** (Dufresne) Langur

1787. *Simia entellis* Dufresne, *Bull. Soc. Philmon*, **1**, 7 : 49 : Bengal in India.

Status : Common.

Order : CARNIVORA

Family : CANIDAE

19. **Canis aureus** Linn. Jackal

1758. *Canis aureus* Linnaeus, *Syst. Nat.* 10th ed., **1** : 40 : Province of Lar. Persia.

Status : Occassional.

20. **Vulpes bengalensis** (Shaw) Indian or Bengal fox

1800. *Canis bengalensis* Shaw, *Genl. Zool.*, **1**, 2 : 330 Bengal.

Status : Occasional.

Family : VIVERRIDAE

21. **Viverricula indica** Desmarest Small Indian Civet

1817. *Viverra indica* Dasmarest, *Nouv. Dict. N. H.*, **7** : 170.

Status : Common.

22. **Paradoxurus hermaphroditus** (Pallas) Toddy Cat

1777. *Viverra hermaphrodita* Pallas, *Schreber, Saiigeth.*, **36** : 426 : India.

Status : Common.

Family : HERPESTIDAE

23. **Herpestes edwardsi** (Geoffroy) Common Mongoose

1837. *Ichneumon edwardsi* (Geoffroy) *De' Scr. Egypts*, 2 : 139 : East Indies" (Madras, Pocock, 1933).

Status : Common.

Family : HYAENIDAE

24. **Hyaena hyaena** (Linn.) Striped Hyaena

1758. *Canis hyaena* Linnaeus, *Syst. Nat. 10th* ed. : 1: 40 : Benna Mountaine Laristan, South Persia.

Status : Common.

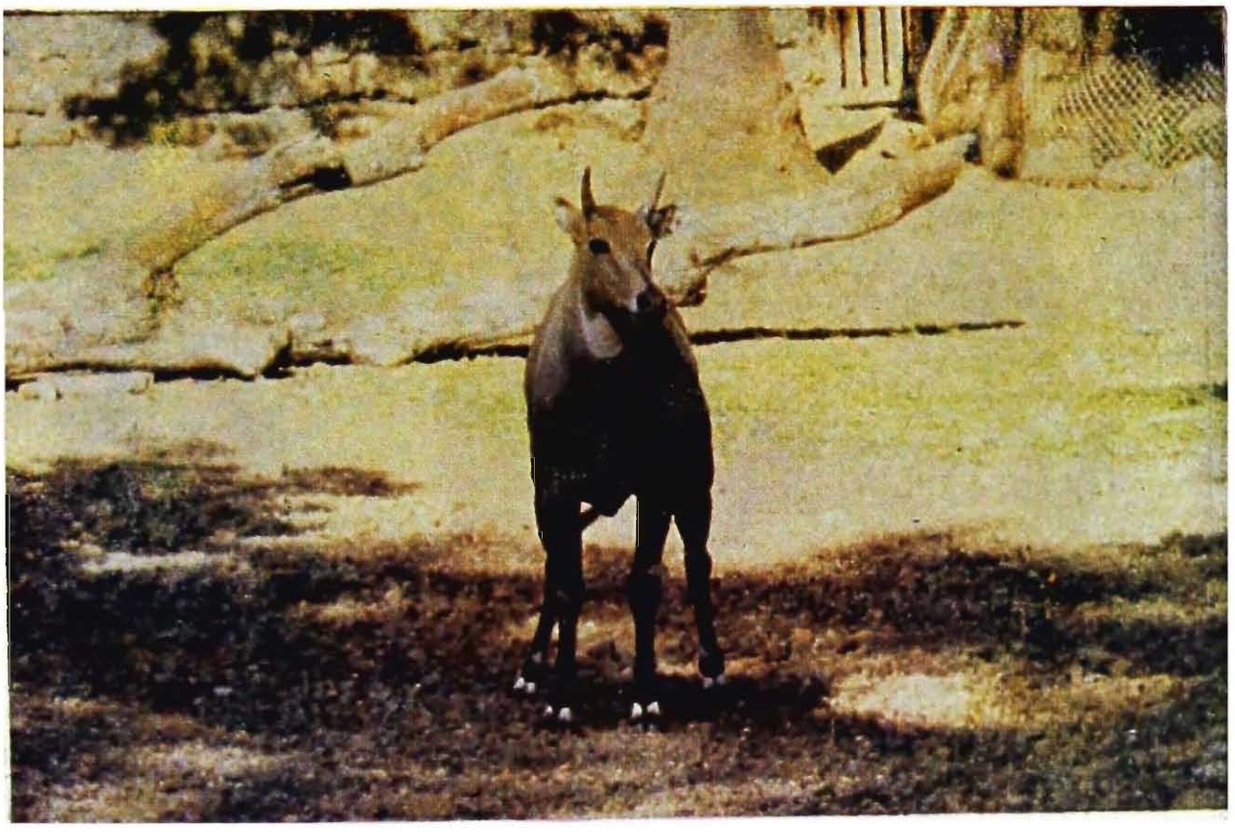
Family : Felidae

25. **Felis chaus** Guldenstaedt Jungle Cat

1776. *Felis chaus* Guldenstaedt, *Nov. Com. Acad. Petroo.*, **20** : 483 : Terek River, north of Caucasus.

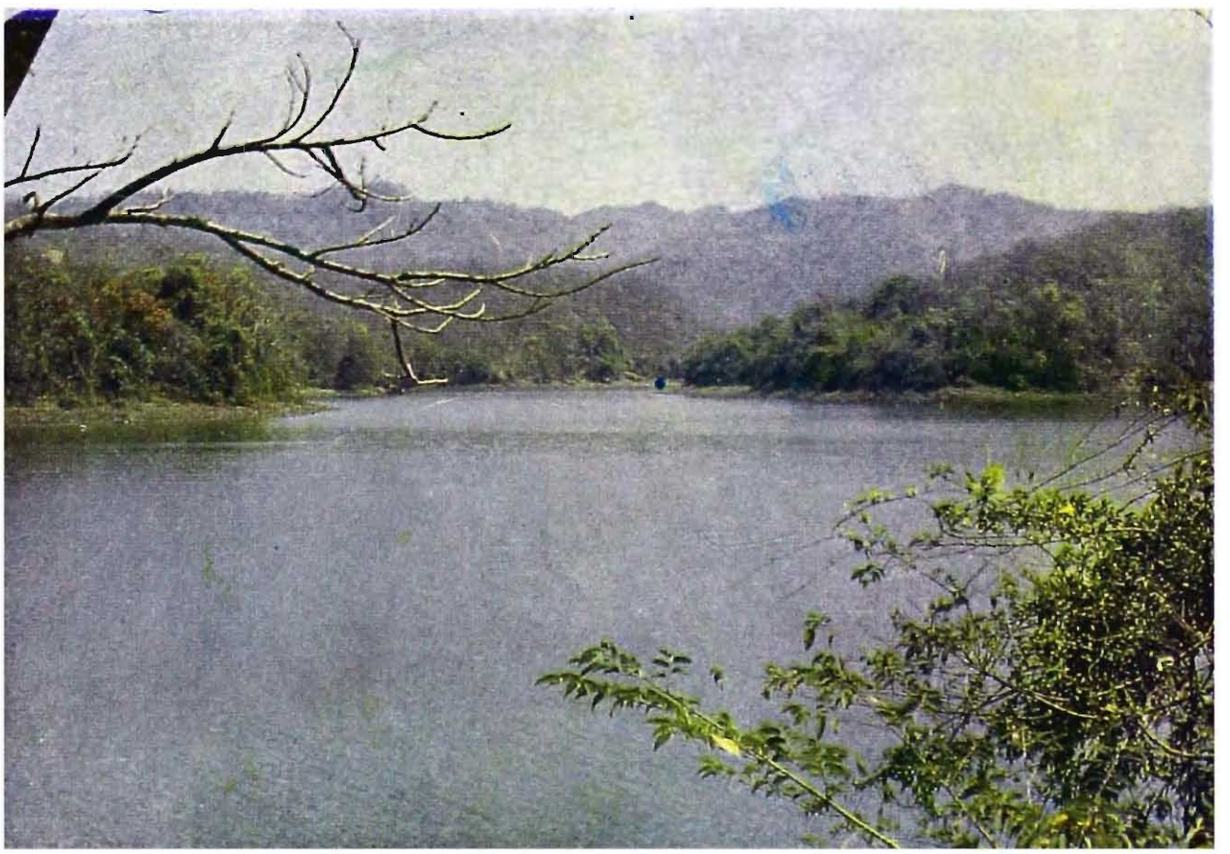
Status : Common.

1 Spotted deer in the recreation zone.

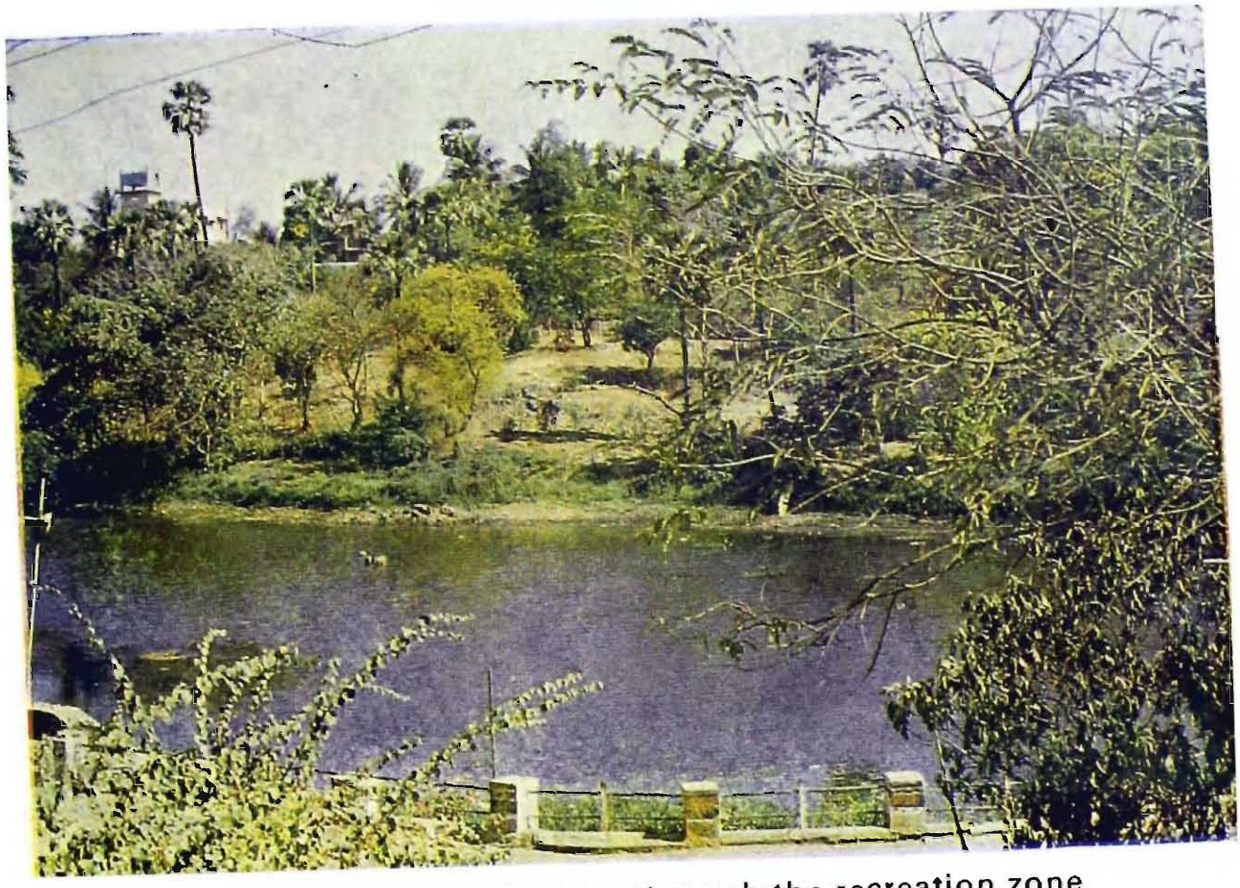


2. Blue bull kept in the recreation zone.

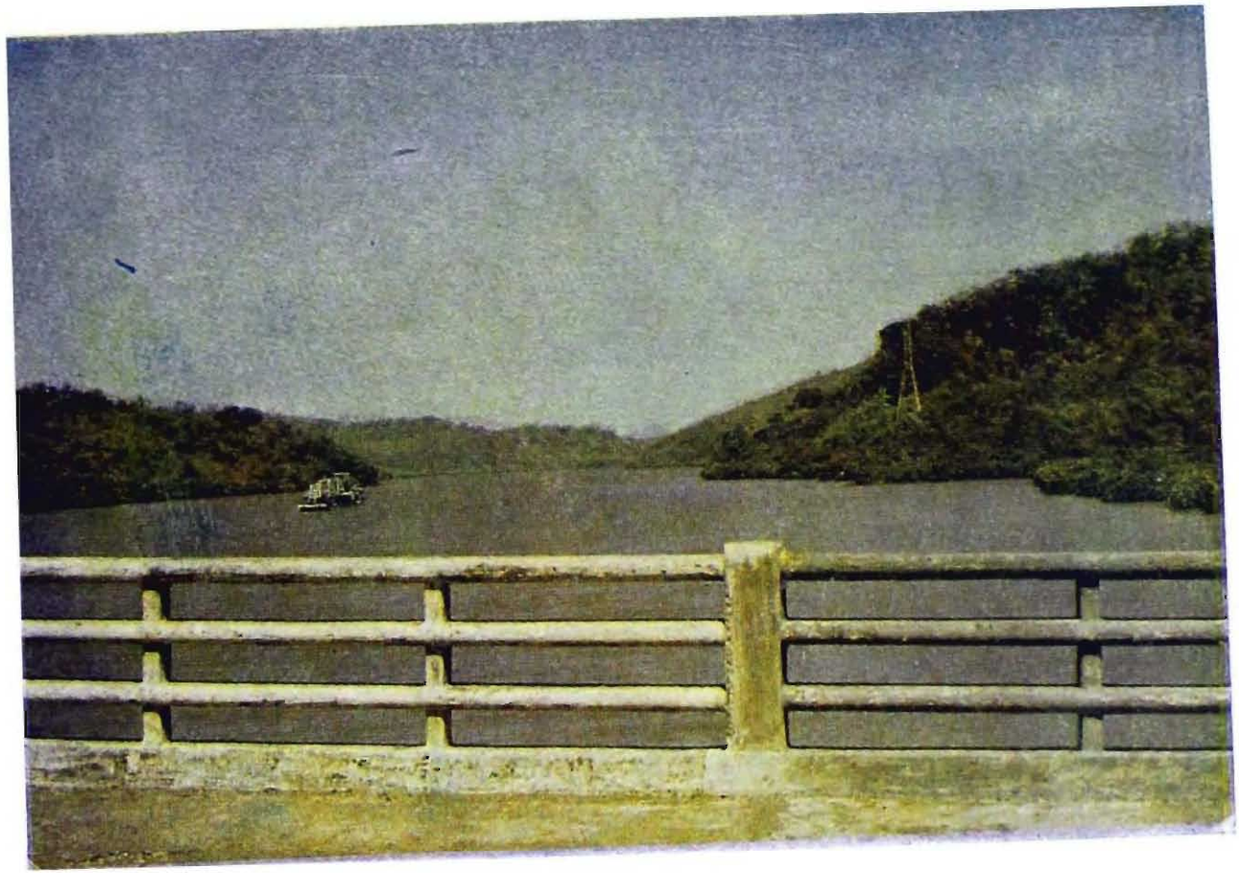
3. Baby crocodile caught from Tulsi lake and kept in an enclosure.



4. Tulsi lake.



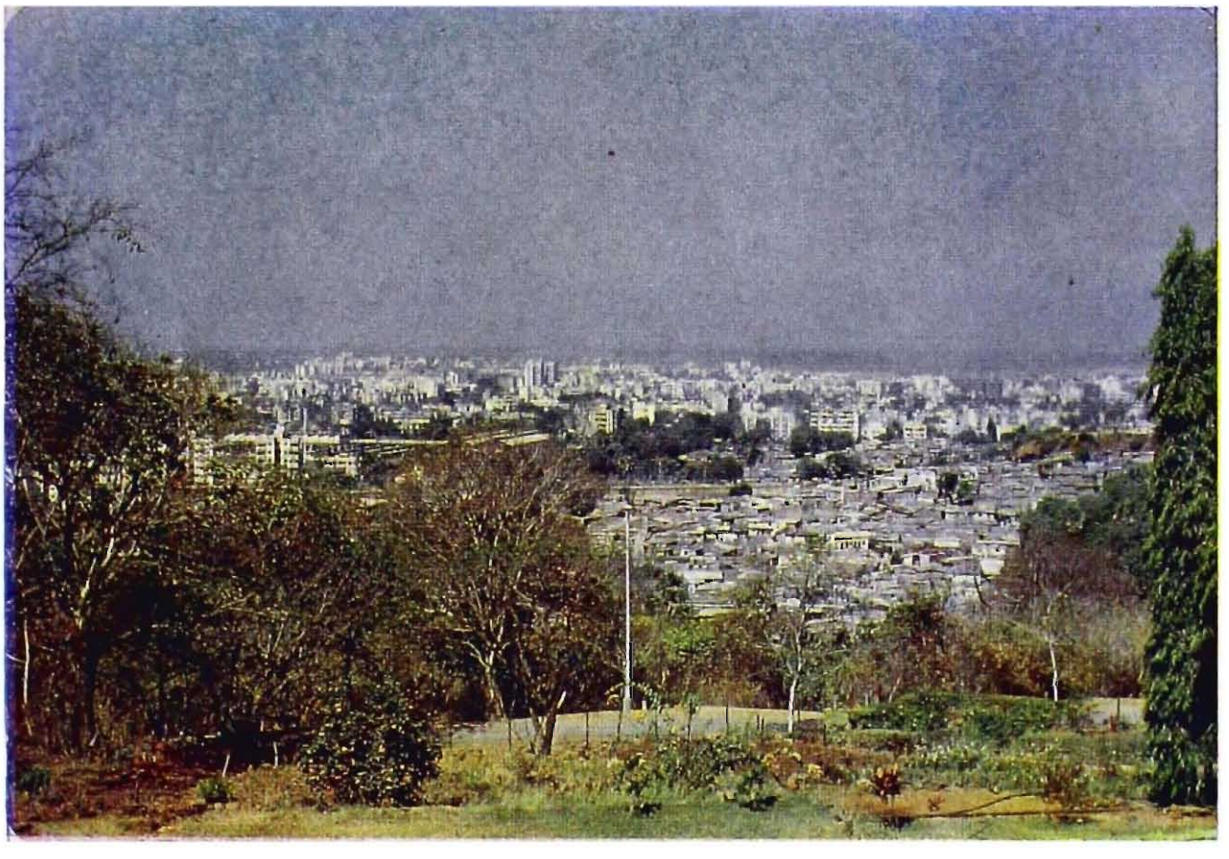
5. Dahisar river flowing through the recreation zone.



6. Bassein creek which divides the park into two.

7-8. Glimpses of the forest.

9. Historic Kanheri caves.



10. Slum adjoining the Park. Bombay city can be seen in the background.

11. Litter left behind by visitors.

26. **Panthera pardus** (Linn) Leopard or Panther

1758. *Felis pardus* Linnaeus, *Syst. Nat., 10th* ed. : **1** : 41 : Egypt.

Status : Common. As per the forest official report, there are about twenty leopards moving in the entire S. G. N. P. area.

27. **Panthera tigris** (Linn) Tiger

1758. *Felis tigris* Linnaeus, *Syst. Nat., 10th* ed. **1** : 41 : Bengal.

Status : Reported earlier but currently absent.

Order : ARTIODACTYLA

Family : SUIDAE

28. **Sus scrofa** Linn. Indian wild boar

1758. *Sus scrofa* Linnaeus, *Syst. Nat., 10th* ed. : **1** : 49 : Germany.

Status : Common.

Family : TRAGULIDAE

29. **Tragulus (Moschiola) meminna** (Erxl.) Mouse deer

1777. *Moschus meminna* Erxleben, *Syst. Regn. Anim. Mamm.*, : 322 : Ceylon.

Status : Occassional.

30. **Muntiacus muntjack** (Zimmer) Indian muntjack or Barking deer

1780. *Cervus muntjack* Zimmerman, *Geogr. Gesch.*. **2** : 131 : Java.

Status : Common.

31. **Axis axis** (Erxleben) Chital or Spotted deer

1777. *Cervus axis* Erxleben, *Syst. Regn. Anim.*, : 312 : Bank of Ganges, India.

Status : Common. A small herd of spotted deers was sighted near Tulsi lake.

32. **Cervus unicolor** Kerr Sambar

1792. *Cervus axis unicolor* Kerr, *Anim. Kingd.*, 300 : Ceylon.

Status : Common. Hoof mark of sambar was found near Tulsi lake.

Family : BOVIDAE

33. **Tetracerus quadricornis** (blainvilla) Chowsingha or Four horned antelope

1816. *Cercophorus* (*Cervicapra*) *quadrincornis* Blainville, *Bull. Soc. Philoml., Paris* : 75 : 78 : Plains of Peninsular India.

Status : Introduced. About five four horned antelopes have been reported to be released in the National Park area by forest authorities.

34. **Boselaphus tragocamelus** (Pallas) Nilgai or Blue bull

1766. *Antilope tragocamelus* Pallas, *Misc. Zool.*, 5 : Plains of Peninsular India.

Status : A small herd of bull has been reported to be released in the National Park by the forest authorities.

Order : LAGOMORPHA

Family : LEPORIDAE

35. **Lepus nigricollis** Cuvier Black-naped or Indian hare

1823. *Lepus nigricollis* F. Cuvier, *Dict. Sci. Nat.* : **26** : 307 : Madras.

Status ; Common.

Order : RODENTIA

Family : SCIURIDAE

36. **Funambulus pennanti** Wroughton Five striped palm squirrel

1905. *Funambulus pennanti* Wroughton, *J. B. N. H. S.*, **16** : 411 : 411 : Mandvi Taluka, Surat Dist., Gujrat, India.

Status : Common.

37. **Funambulus tristriatus** (Waterhouse) Jungle striped squirrel

1837. *Sciurus tristriatus* Waterhouse, *Charlasworth's Mag. nat. Hist.*, **1** : 496.

Status : Commonly found in the forested areas of core zone.

Family : HYSTRICIDAE

38. **Hystrix indica** Kerr Indian Porcupine

1792. *Hystrix oristata* var *indica* Kerr, *Anim. Kingd.* : 213 : India.

Status : Common.

Family : MURIDAE

Subfamily : GERBILLINAE

39. **Tatera indica indica** (Hardwicke) Indian gerbil Antelope rat

1807. *Dipus indicus* Harwicke, *Trans. Linn. Soc., London,* : 8 : 279 : Northern India.

Status : Occassionally found in agricultural zone beyond creek.

Subfamily : MURINAE

40. **Vandeleuria oleracea** (Benett) Long-tailed tree mouse

1832. *Mus oleracea* Benett, *PZS*, 121 : Deccan, India.

Status : Occassional.

41. **Rattus blanfordi** (Thomas) White-tailed wood rat

1888. *Mus blanfordi* Thomas, *Ann. Mag. N. H.*, 7 : 24 : Madras, India.

Status : Occassional.

42. **Rattus rattus rufescens** (Gray) House rat

1837. *Mus rufescens* Gray, *Ann. Mag. N. H.*, **1** : 585 ; Dharwar, India.

Status : Common.

43. **Rattus norvegicus** (Berkenhout) Norvey rat

1769. *Mus norvegicus* Berkenhout, *Outlines N. H. Gt. Britain & Ireland*, **1** : 5 Great Britain.

Status : Spread from Bombay harbour after plague epidemic. Found mostly near residential areas of Borivali East.

44. **Mus musculas castaneus** (Waterhouse) House mouse

1843. *Mus castaneus* Waterhouse, *Ann. Mag. N. H.*, **12** : 134 : Philippine Island.

Status : Common.

45. **Mus booduga** (Gray) Indian Pigmy field mouse

1837. *Leggada booduga* Gray, *Charlesworth's Mag. N. H.*, **1** : 586 : Southern Mahratta, India.

Status : Commonly found in agricultural zone beyond creek.

46. **Golunda ellioti** Gray Indian bush rat

1837. *Golunda ellioti* Gray, *Charlesworth's Mag. N. H.*, **1** : 586 ; Dharwar, India.

Status : Occassional.

47. **Bandicota bengalensis kok (lordi)** (Gray) Lesser bandicoot rat or Indian mole rat

1837. *Mus kok* Gray, *Charlesworth's Mag. N. H.*, **1** 585 : Dharwar, India.

Status : Common.

48. **Bandicota indica indica (malabarica)** (Bech.) Large bandicoot

1800. *Mus indicus* Bechstain, *Veber Viert Thiere*, **2** : 497 : Pondicherry, India.

Status : Common.

Rec. zool. Surv. India, **92** (1-4) : 253-264, 1992

NOTES ON A COLLECTION OF GRASSHOPPERS (ORTHOPTERA : ACRIDIDAE) FROM BIHAR STATE, INDIA

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Introduction

The grasshopper fauna of Bihar State is meagrely known, there being no consolidated account. Kirby (1914) in his Fauna of British India recorded only four species especially from Pusa (Bihar), containing three new species : *Phlaeoba cinctalis* which is now considered a synonymy of *Ceracris deflorata* Brunner, 1883 ; gen. et sp. nov. *Lefrova acutipennis* and *Aswatthamanus cylindricus* both of which are now merged with the unique genus, *Mesopsis* Bolivar, 1906, as the species, *M. cylindricus* (Kirby, 1914). In the same year Bolivar (1914) also described a unique new species, *Perella insignis*, again from Pusa, which remains unrecorded till then. Uvarov (1921) recorded 16 species from Pusa of which 4 species were also reported from Ghapra. Of these species, *Aulacobothrus bolivari* was described from Chapra. *Pusana laevis*, *P. rugulosa* and *Tristria pulvinate* from Pusa ; *Hygracris palustria* from Pusa, Waini and Darbhanga and three species of the genus *Paraconophyma* from Pusa collection, but from uncertain localities. The same author in 1927 again reported three species from Chota Nagpur and in 1937 described *Tropidopola* (*Longicornis*) *indica* from Pusa (also from Kaira, Gujarat).

After Uvarov (op. cit.) there had been no substantial contribution barring a report of grasshoppers from Chota Nagpur by Tandan and Shishodia (1976) in which they recorded 22 species but without detailed localities or any other data.

As a result of these studies not more than 44 species of grasshoppers were known from the entire Bihar State (vide Appendix I), of which 24 species were recorded from Chota Nagpur alone. The present contribution comprising of 36 species from Chota Nagpur collection made by the author and old collections of Patna Regional Station enhances the number of species known so far from Bihar to 62, with 19 additional new records.

A large number of species from Bihar are common with West Bengal fauna studied by Bhowmik (1986) ; for latest reference of these species Bhowmik (op. cit) may be consulted. Current references have been given only in restricted and required cases only.

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Systematic Account

Order : ORTHOPTERA

Family : Acrididae

1. **Acridia exaltata** Linn. 1758

Material examined : 1♂ ; Kodarma, Hazaribagh ; 5-11-86. 3♀ and 1♀ mymph ; Kabar lake ; 25-28.8.89 ; H. K. Bhowmik coll.

Remarks : It is a common species. During Oct.-Nov. its population becomes rare, but it persists throughout the winter and also breeds round the year.

2. **Phlaeoba infumata** Brunner, 1893

Material : 5♂, 3♀ ; Netarhat, Bihar ; 12.2.1971 ; Bhola Nath coll.

Remarks : This is rather an uncommon species of the genus in Indian fauna. All the specimens were collected in February.

3. **Phlaeoba panteli** Bolivar, 1902

Material : 1♀ ; Bhadu vill. Bukhari, Kabar lake ; 25.8.89 ; H. K. Bhowmik coll. 1♂ ; Sitamarhi, Sonauli ; 16.3.88 ; Y. Chaturvedi coll.

Remarks : Through the species is quite wide spread and is known from Tamilnadu, Bihar (Pusa), West Bengal and Afganistan, it is not common in Bihar.

4. **Ceracris deflorata** (Brunner, 1893)

(Plate 1 Fig. 1)

Material : 10♂, 5♀ ; Betla, Palamu ; 8-9.9.87 ; H. K. Bhowmik coll. 1♀ ; Maroma 13.9.87 ; H. K, Bhowmik coll. Manipur : 1♂ ; Morea ; 25.11.83 ; B. C. Saha coll.

Remarks : The species is already known from Pusa and Chapra and as well as from Manipur (India) and Burma, here it is recorded from Chota Nagpur where it is found in abundance. The present lots of specimens were collected from deep, dumpy places, bordering natural water resources in the localities. The present specimens, however, are slightly bigger in size.

Measurements : Body ♂ 21-22, ♀ 30-31 ; antenna ♂ 14-16, ♀ 11-12 ; head ♂ 3-3.5, ♀ 4-4.5 ; prozona ♂ 2.25-2.5, ♀ 3-3.25 ; metazona ♂ 1.75-2, ♀ 2.5-2.75 ; tegmen ♂ 19-20, ♀ 25-26 ; post-femur ♂ 13-14, ♀ 17-18 ; post. tibia ♂ 10-11, ♀ 16-17.

*5. **Truxalis nasuta** (Linn, 1758)

Material : 1♀ ; Kodarma, Hazaribagh, 5.11.86. 1♂ ; Jogadishpur, Deoghar ; 19.10.86.

Remarks : It is a cosmopolitan species. But from India it was so far recorded from only Bilaspur, Madhya Pradesh and Surat (Gujarat). It is a new record from the State of Bihar.

*6. **Aulacobothrus luteipes** (Walk, 1871)

Material : 2 ♀ ; Giridhi ; 22.10.86. 3 ♂ ; Hazaribagh town ; 3.11.86.

Remarks : A common species found throughout India. But it seems not to have been recorded earlier from the Bihar State.

7. **Leva indica** (Bol. 1902)

Material : 4 ♀ ; Madhuban ; 26.10.86. 1 ♂ ; Kodarma, Hazaribagh ; 6.11.86

Remarks : More or less a common species of India, found almost throughout the length and breadth of the country.

8. **Aiolophus thalassinus tamulus** (Fabr.. 1798)

Material : 1 ♀ ; Madhuban, Giridhi ; 26.10.86. 3 ♀ ; Baikthpur, Patna ; 21.7.67 ; T. Vazirani coll. 1 ♀ ; Jogipur, Patna ; 16.8.66 ; B. Nandi Coll. 1 ♂ ; Kankarbagh, Patna ; 24.7.68 ; B. Nandi Coll. 2 ♂, 2 ♀ ; Maner, Bihar ; 30.11.74 ; R. K. Varshney coll. 1 ♀ ; Chhatarpur ; 29.1.71 ; T. Venkateswarlu coll. 1 ♂ ; Munachali, Patna ; 10.2.70 ; B. Nandi coll.

Remarks : This subspecies is very common in Bihar and is cosmopolitan in distribution.

9. **Gastrimargus africanus africanus** (Saussure, 1888)

Material : 1 ♀ ; Madhuban, Giridih ; 26.10.86. 1 ♂ ; Goshipur ; 17.10.86. 1 ♂ ; Laxhimpur, Munger ; 8.9.89 and 1 ♀ ; Dighal Pahar ; 20.8.1989. 4 ♂ ; Gariapani ; 16.9.89 ; All by H. K. Bhowmik Coll.

Remarks ; A very common subspecies of India and of Africa.

10. **Trilophidia annulata** (Thunberg, 1815)

Material : 11 exs ; Jaimangla gham, Forest near Kaber Lake, 27.8.1989.

*11. **Clonacris sila** Rehn, 1944

(Plate 1 Figs. 2)

1944. *Clonacris siln* Rehn, *Proc. Acad. nat. Sci. Philad*, **96** : 58-66.

Material : 1 ♂ and nymph ; Netarhat, Palamau dist ; 16.9.87 ; H. K. Bhowmik coll. 1 ♀ ; Kolebira, Gumla dist ; 22.9.87 ; H. K. Bhowmik coll.

Remarks : The species was described from Tamilnadu from both sexes and lately, after 42 years, has been recorded by me from Joshipur and Harishankar, Orissa State (in press, *Rec. Zool. Surv. India*) and provided with short notes on its description, measurements, key, etc. The availability of nymphal stage (19mm) is recorded herewith for the first time, indicating its breeding period just after rains. The specimens were found in almost cleared ground, barring a few dried up leaves, but under the canopy of big trees.

*12. **Pternoseirta bimaculata** (Thunberg, 1815)

Material : 6♂, 2♀ ; Giridih ; 22.10.86.

Remarks ; Described from Sri Lanka, the species is recorded recently from West Bengal (Bhowmik, 1986) and now from Bihar for the first time.

13. **Acrotylus humbertianus** Saussure, 1884

Material : 1♂ ; Giridih ; 22.10.86. 1♂, 1♀ ; Dumri ; 29.10.86.

Remarks ; A common species of India.

14. **Morphacris fasciata sulcata** (Thunberg, 1815)

Material : 1♀ ; Dumri ; 29.10.86. 1♂, 1♀ ; Hazaribagh town ; 1.11.86. 1♀ ; Sherghati, Gaya dist ; T. Venkateshwarlu Coll.

Remarks : This subspecies is found almost throughout India.

*15. **Sphingonotus balteatus balteatus** (Serville, 1839)

(Plate 1 Fig. 4)

1839. *Oedipoda balteata Serville*, Ins. *Orth.* 734.

Material : 1♂ ; Hazaribagh town ; 1.11.86 ; H. K. Bhowmik coll.

Remarks : This subspecies was known so far from Bombay (t. c.), Gujarat (Perim Island, Gulf of Cambay) and Arabia (Aden).

The specimens (14-15 mm) differ in coloration of posterior tibiae, they are bright dark brownish instead of blue. The band in wing is light brownish. The species is recorded from Bihar for the first time.

*16. **Sphingonotus orissaensis** Jago and Bhowmik

Material : Numerous examples of both sexes.

Remarks : The species is described from Orissa (in press, *Rec. Zool. Surv. India*). Examples of both sexes of the species were also collected by me from the nearby hill top of Chanabati, Bihar. The hillock was barren barring small grasses in crevices.

The species was seen basking in direct sunlight. It appears to be abundant both in Orissa and Bihar in identical habitats.

17. **Oedaleus abruptus** (Thunberg, 1815)

Material : 2♂, 1♀ ; Madhuban ; 27.10.66.

Remarks : A very easily available species.

*18. **Locusta migratoroides** Reiche & Fairmaire, 1847

Material : 1♂, 1♀ ; Baikallpur ; 6.4.1968 ; T. Venkateswarlu party coll. 1♂ ; Bagali Diar ; 15.4.1967 ; K. K. Mahajan coll.

Remarks : General colour reddish brown ; head with a very pale line behind eyes. Pronotum granulated, constricted in middle ; the sole carinae in pronotum though clear but not very distinct and definitely angulated behind. Tegmina mottled are reticulated with brown, more so in ♀ compared to male. Wing clearly byaline. Posterior femora rather long, not much thickened basad and uniformly tapering.

Though the species belongs to a noted and renowned genus, its population seems very limited now. The present specimens are, however, smaller in size.

Measurements : Body ♂37, ♀39-40 ; antenna ♂12, ♀14-15 ; head ♂3.25, ♀4-4.5 ; prozona ♂4, ♀4.5-5, metazona ♂5, ♀5.5-6, tegmen ♂36, ♀40-45 ; post. femur ♂18, ♀22-25 ; post. tibia ♂19, ♀19-24.

*19. **Eucoptacra praemorsa** (Stal, 1860)

Material : 5♀ ; Madhuban ; 26.10.86. 1♂, 1♀ ; Hazaribagh town ; 3.11.86.

Remarks : A very common species. But it is here newly recorded from Bihar.

*20. **Epistaurus sinetyi** (Bolivar, 1902)

Material : 1 ♀ ; Dhumri, Deoghar ; 30.10.86.

Remarks : The species was known so far from Tamilnadu, West Bengal and Sri Lanka. It is a new record from Bihar.

*21. **Coptacra punctoria** (Walker, 1870)

1870. *Acridium punctorium* Walker, *Cat. Derm Salt. Br. Mus.*, **4** : 630.

Material : 1♀ ; Netarhat, Palamau dist. ; 15.9.87 ; H. K. Bhowmik coll.

Remarks : Bhowmik (in press) has redescribed the species, in detail, from collections of material from Orissa and Andhra Pradesh (Araku Valley), with the description of male for the first time. It is a new record from Bihar.

*22. **Pachyacris violascens** (Walker, 1870)

Material : 1 ♀ ; Maner, Bihar ; 30.11.74 ; R. K. Varshney coll.

Remarks : The specimen (55 mm) seems to be discoloured, even the colouration of its wings does not give any indication of its pale violet tinge. The tegmen has big oblique patches of brownish tinge. Posterior tibia with 6 external and 7 internal yellowish-red tipped spines, the inner spines are stouter and longer than external ones.

The species was described from Sri Lanka and is now reported from Orissa (Bhowmik, 1983) and Himachal Pradesh (Bhowmik and Halder, 1983). It is, however, a new record from Bihar.

23. **Pachyacris vinosa** (Walker, 1870)

Material : 2 ♀ ; Madhuban, Giridih ; 27.10.86. 1 ♂, 1 ♀ ; Kolebira, Gumla dist. ; 21.9.87. 4 ♂, 5 ♀ ; Dighal Pahar, Santal Pargana ; 19-20.9.89. 4 ♂, 3 ♀ ; Kharagpur (Munger dist.) ; 7.9.89 ; All H. K. Bhowmik coll.

Remarks : This interesting species is rather common in India (Bhowmik, 1986).

24. **Cyrtacanthacris tatarica** (Linn. 1758)

Material : 1 ♂, 1 ♀ ; Dhumri, Giridih 29.10.86. 1 ♂, 1 ♀ ; Dighal Pahar ; 20.9.89. H. K. Bhowmik Coll.

Remarks : A very common species found in agricultural fields, especially in paddy fields.

25. **Chondracris rosea** (de Geer, 1773)

Material ; 2 ♂ ; Jagadishpur forest, Deoghar ; 19.10.86. 3 ♂, 6 ♀ ; Digal Pahar, Santal Parganas, 19-20.9.1989 ; H. K. Bhowmik Coll.

Remarks : A wide spread species in north eastern states of India. In Digal Pahar, the species was noticed in abundance along with *Pachyacris vinosa* in the shining bushes.

26. **Catantops innotabilis** (Walkar, 1870)

Material : 3 ♀ ; Madhuban, Deoghar, 16.10.86. 1 ♂, 1 ♀ ; Giridih ; 22.10.86. 3 ♂, 2 ♀ ; Dighal Pahar ; 20.9.1989 ; All H. K. Bhowmik coll.

Remarks ; A very common species in the Indian Fauna.

*27. **Stenocatantops splendens** (Thunberg, 1815)

Material : 1 ♀ ; Madhuban, Giridih ; 22.10.86.

Remarks ; It is rather a rare species. It is here newly recorded from Bihar.

*28. **Xenocatantops jagabandhui** Bhowmik, 1985

1985. *Xenocatantops jagabandhui* Bhowmik, *Bull. Zool. Surv. India*, **7** (2-3) : 295.

Material : 1 ♀ ; Dhumri, Giridih ; 29.10.86 ; H. K. Bhowmik & S. Sur coll ; 1 ♀ ; Kolibera, Gumla, 22.9.87.

Remarks : The species was described from Himachal Pradesh, and Orissa, in India. The present locality is a new extension of its distributional range.

+29. **Cataloipus elegans** (Walker, 1870)

1870. *Heteracris elegans* Walker, *Cat. Derm Salt. Br. Mus.*, **4** : 662-663.

Material : 2♂, 2♀ ; Dumri, Giridih, Bihar ; 29.10.1986 ; H. K. Bhowmik and S. Sur coll.

Remarks : Uvarov (1921) synonymised *H. elegans* Walk. with *C. cognatus* Walk. mentioning, inter alia, Kirby's (1914) fig. 139, in which figure the tegmen is shown to be longer than the abdomen. But the same author (1921, P. 139) while pointing out differences of *C. cognatus* from *C. oberthiiri* Bol. narrates that in the former the tegmina are shorter specially in ♀ ♀ where it scarcely reach the apex of abdomen.

The specimens before me tally nicely with the description of *H. elegans*, as given in Kirby's fauna. Uvarov (op. cit.) puts maximum emphasis, for specific identity of *C. cognatus*, on the structure of prosternal tuberale which is somewhat distinctly narrowed at extremity, in both sexes. But in the present lot of material the same structure is tongue-shaped, almost identical to that of *C. indicus* Uvarow, 1942 or *C. zuluensis* Sjöstedt, 1929. Whereas the male cercus is also similar to those species. However, the present material, unlike *C. indicus*, lacks any depression, or median carinicula of pronotum and have tegmina shorter than abdomen in ♀, but almost as long as in ♂ but in either sex never surpass post. femoral spex. In size as measurements given below, the specimens, especially females are larger than all the related species : *C. indicus* (♂ 38, ♀ 52), *C. cognatus* (♂ 33-35, ♀ 46-50) or *C. zuluensis* (under which *C. cognatus* is now a synonymy—Sjöstedt, 1929) (♂ 32). The male subgenital plate big, supersede abdominal end and distinctly biforked.

The specimens thus exhibit an admixture of features of related species with propensity to *elegans* so demanding further review of its identity.

Measurements : Body ♂ 34-35, ♀ 63-64 ; antenna ♂ 13-14, ♀ 18-18.5 ; head ♂ 4.5-5, ♀ 6.5-6.75 ; prozona ♂ 4-4.25, ♀ 6-6.25, metazona ♂ 2.5-2.75, ♀ 4.25-4.5 ; tegmen ♂ 23-24, ♀ 38-39 ; post. femur ♂ 21-22, ♀ 35-35.5 ; post. tibia ♂ 20-20.5, ♀ 31-33.5 ; male subgenital plate 2-2.5.

Note : The size of ♂ is almost same as *indicus* or *cognatus*, but the ♀ is, of course, larger than related species.

*30. **Heteracris pulcher** (Bolivar, 1902)

(Plate 1, Fig. 3)

Material : 1 ♀ ; Dhumri, Giridih ; 29.10.86. 4♂, 5 ♀ ; Bhadu vill. Bukhari, Kaber Lake ; 25.8.89 ; H. K. Bhowmik coll.

Remarks : A rare species recorded so far from Tamilnadu, West Bengal and Sri Lanka. It is being recorded here for the first time from Bihar. In Kaber Lake these examples were found on the bank of a canal, under direct sun light. The embankment was covered with wild bushes, one side of which was bushy along with paddy fields. A large numbers of them were seen basking in the sun.

The specimens agree with the redescription of the species given by Bhowmik (1986).

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

Material : 2♂, 1 ♀ ; Dhumri, Deoghar ; 29.10.86. 2 ♀ ; Laxhmipur, Munger ; 8.9.89 and 2 ♀ ; Gariapani, Santhal parganas ; 16.9.89. 1♂ ; Bogati Diar ; 15.4.67 ; K. K. Mahajan (Patna Insect Survey) ; 1 ♀ nymph ; Bogampur ; 12.7.67 ; T. Venkateswarlu and party.

Remarks ; It is one of the commonst sub-species of the genus in India.

*32. **Eyprepocnemis rosea** Uvarov, 1942

1942. *Eyprepccnemis roseus* Uvarov, *Ann. Mag. nat. Hist.*, 9 (11) : 597, fig. 4 R.

1958. *Eyprepocnemis rosea* : Dirsh, *Proc. R. ent. Soc. Lond.*, (8) : 27 (3-4) : 42, fig. 7 : Bhowmik and Halder, 1983. *Ree. Zool. Surv. India*, 81 : 185-186, figs. 21-22.

Material : 1♂ ; Kolebire, Gumla dist, 22.9.87 ; H. K. Bhowmik coll, 1 ♀ ; Betla, Palamau dist ; 8.9.87 ; H. K. Bhowmik coll. 5♂, 3 ♀ ; Madhuban, Giridih ; 27.10.86. 1 ♀ ; Bhimbandh, Munger ; 6.9.89 ; H. K. Bhowmik coll.

Remarks : This interesting species was recorded so far from scattered areas—Shillong, Dehra Dun and abundantly throughout Himachal Pradesh. It is recorded here for the first time from Bihar State.

*33. **Choroedocus robustus** (Serville, 1839)

(Plate II, Fig. 5)

Material : 1 ♀ ; S. F. R. I. lab ; 25.11.1967, K. K. Mahajan coll. 1 ♀ ; Hyrocalekar, From—Patna ; 17.8.1967 ; K. K. Mahajan coll. 1 ♀ ; Dighal Pahar, Santhal Pargana ; 20.9.89 ; H. K. Bhowmik coll.

Remarks : The species was recorded previously from eaatern India (eastern Himalayas, Calcutta) ; its availability in Bihar is a new record. The present specimens, however, tally exactly with the descriptions and measurements given by Bhowmik (1986).

*34. **Choroedocus illustris** (Walker, 1870)

(Plate II, Figs. 6-7)

Material : 5♂, 3♀ ; Netar Hat, Palamau, Bihar ; 16.9.87 H. K. Bhowmik coll. 1♂ ; Betla, Palamau ; 8.9.87. H. K. Bhowmik coll. 1♂, 1♀, Kolebira, Gumla dist ; 21.9.87 ; H. K. Bhowmik coll.

Remarks : The species was described from South India. But now it is abundantly found in Himachal Pradesh (Bhowmik and Halder, 1983). Its availability in North-eastern India is, therefore, very interesting and indicates its wide distribution.

The species seems to be a "forest dweller". In Chota Nagpur it was noticed in plenty in a slope, in jungle, directly under sun shine.

Measurements : Length of body ♂ 32-33, ♀ 55-57 ; antenna ♂ 14-15, ♀ 21-22 ; tegmen ♂ 25-27, ♀ 45-47 ; post. femur ♂ 25-26, ♀ 35-37 ; pronotum ♂ 6-7, ♀ 10-11 ; male cercus 6-7.

*35. **Eupreponotus punctatus** Singh, 1978

(Plate II, Fig. 9)

Material ; 6♂ and a ♀ nymph ; Netarhat, Palamau dist. ; 16.987 ; H. K. Bhowmik and S. Sur coll.

Remarks : Singh (1978) has described the species from Dehra Dun (U. P.) material. The present material appears to be identical to his material.

The availability of a nymph during September indicates that its generation starts after rainy season.

The specimens were collected from a shaircase of a hillock which was under direct sun-light.

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Appendix

List of grasshoppers known from Bihar

1. *Acrida exaltata* Linn., 1758
2. *Ceracris deflorata* Br. 1893
   (=*Phlaeoba cintalis* Kirby, 1914)
3. *C. nigricornis nigricornis* (Walk. 1870)
4. *Gonista sagitta* (Uv. 1932)
5. *Perella insignis* Bol. 1914
6. *Phlaeoba infumata* Br. 1893

7. *P. panteli* Bol. 1902
8. *Truxalis indica* Bol. 1902
+9. *T. nasuta* (Linn. 1758)
*10. *Aulacobothrus bolivari* Uv. 1921
+11. *A. luteipes* (Walk. 1871)
12. *Leva indica* (Bol. 1909)
13. *L. cruciate* (Bol. 1914)
14. *Mesopsis cylindricus* Kirby, 1914
(= *Aswatthamanus* Kirby, 1914)
(= *Lefroya acutipennis* Kirby, 1914)
15. *Oedalaus abruptus* (Thunberg, 1815)
+16. *Locusta migratoroides* Reiche & Fairmaire, 1847
17. *O. senegalensis* (Krauss, 1877)
+18. *Pternoscirta bimaculata* (Thunberg, 1815)
19. *Morphacris fasciata sulcata* (Thunberg, 1815)
20. *Gastrimargus af. africanus* (Sauss, 1888)
21. *Aiolopus th. thalassinus* (Fabr. 1781)
22. *Acrotylus humbertianus*, Sauss. 1884
23. *Chlaebora marshalli* (Henry, 1933)
*24. *Pusana laevis* (Uv. 1921)
*25. *P. rugulosa* (Uv. 1921)
+26. *Shingonotus balteatus balteatus* (Serville, 1839)
+27. *Spingonotus orissaensis* Jago and Bhowmik (in press)
+28. *Clonacris sila* Rehn, 1944
29. *Trilophidia ahnulata* (Thunberg, 1815)
30. *Spathosternum pr. prasiniferum* (Walk, 1871)
31. *Hieroglyphus annulicornis* (Shikari, 1910)
32. *H. banian* (Fabr. 1798)
33. *H. oryzivorus* Carl, 1916
*34. *Hygracris palustris* Uvarov, 1921
35. *Oxya velox* (Fabr. 1787)
36. *O. hyla hyla* Sarviile, 1831
37. *O. fuscovittata* (Marschall 1836)

+38. *Eucoptacra praemorsa* (Stal, 1860)
+39. *Epistaurus sinetyi* (Bolivar, 1902)
+40. *Coptacra punctoria* (Walk. 1870)
41. *Pachyacris vinosa* (Walk, 1870)
+42. *P. violascens* (Walk. 1870)
43. *Anacridium flavescens* (Fabr. 1773)
44. *Chondracris rosea* (De Geer, 1773)
45. *Cyrtacanthacris tatarica* (Linn. 1758)
46. *Tristria pulvinata* (Uv. 1921)
**47. *Tropidopola (longicornis) indica* Uv., 1937
48. *Catantops innotabilis* (Walk. 1870)
+49. *Stenocatantops slendens* (Th., 1815)
+50. *Xenocatantops jagabandhui* Bhowmik, 1985
51. *Paraconophyma polita* Uv. 1921
52. *P. punctata* Uv. 1921.
53. *P. scabra* (Walker, 1870)
+54. *Catantcipus elegans* (Walker, 1870)
55. *Caloptenopsis glaucopsis* (Walk. 1870)
56. *Acorypha glaucopsis* (Walker)
+57. *Eyprepocnemis rosea* Uvarov, 1942
58. *E. alacris alacris* (Servile, 1839)
+59. *Heteracris pulcher* (Bolivar, 1902)
+60. *Choroedocus* illustris (Walk. 1870)
+61. *C. robustus* (Serville, 1839)
+62. *Eupreponotus punctatus* Singh, 1978

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* Denotes type locality
** Type locality jointly with other areas
+ New records in this communication

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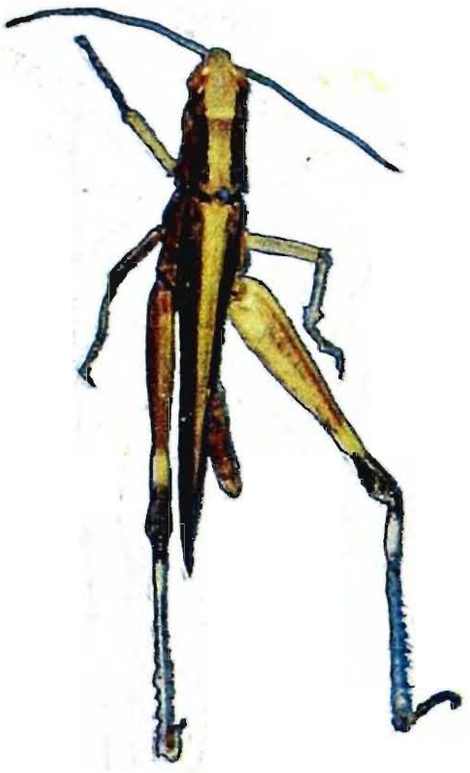
PLATE 1



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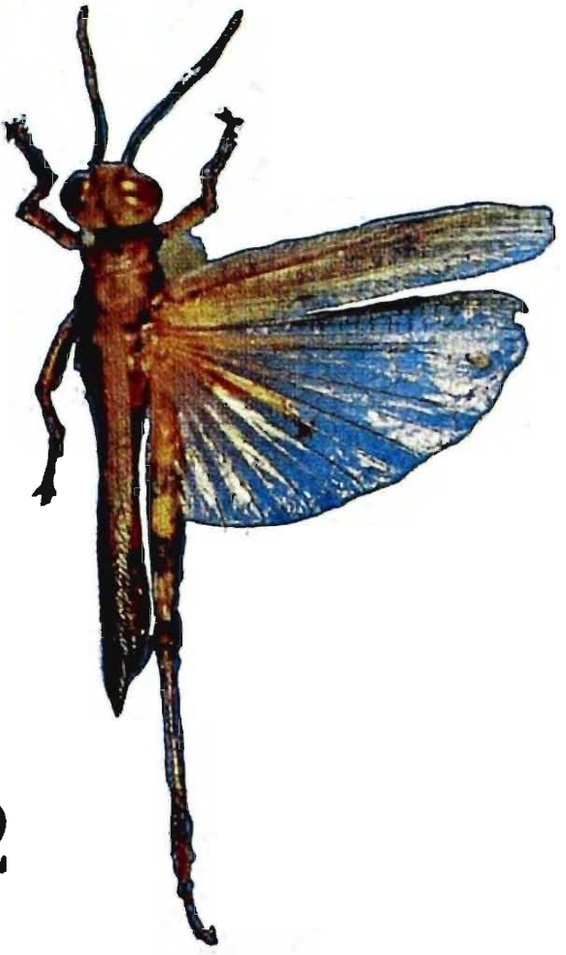

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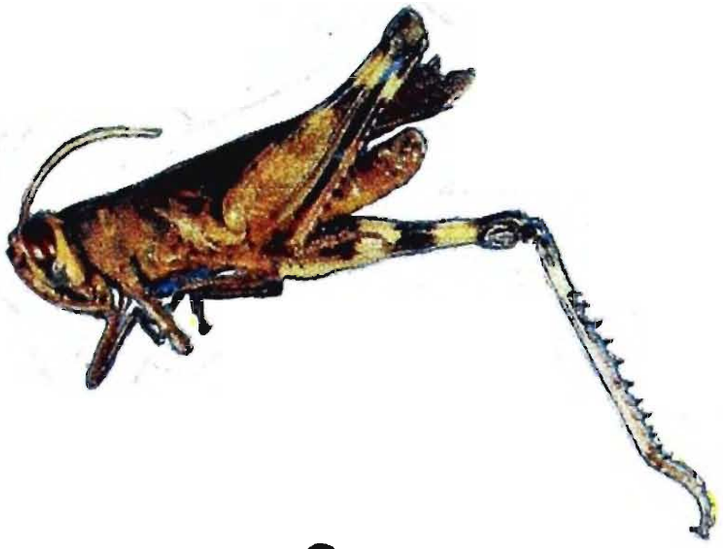

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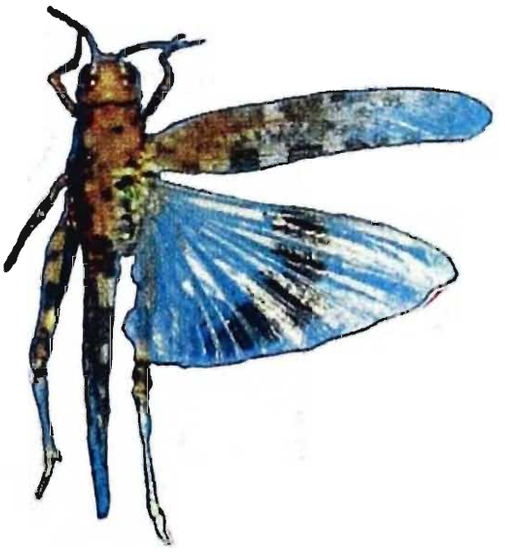

4

Profile of

Figs. 1. *Ceracris deflorata* (Female) 30 mm. 2. *Clonacris sila* (Male) 22 mm.
3. *Heteracris pulcher* (Male) 27 mm. 4. *Sphingonotus baiteatus balteatus* (Male) 14 mm.

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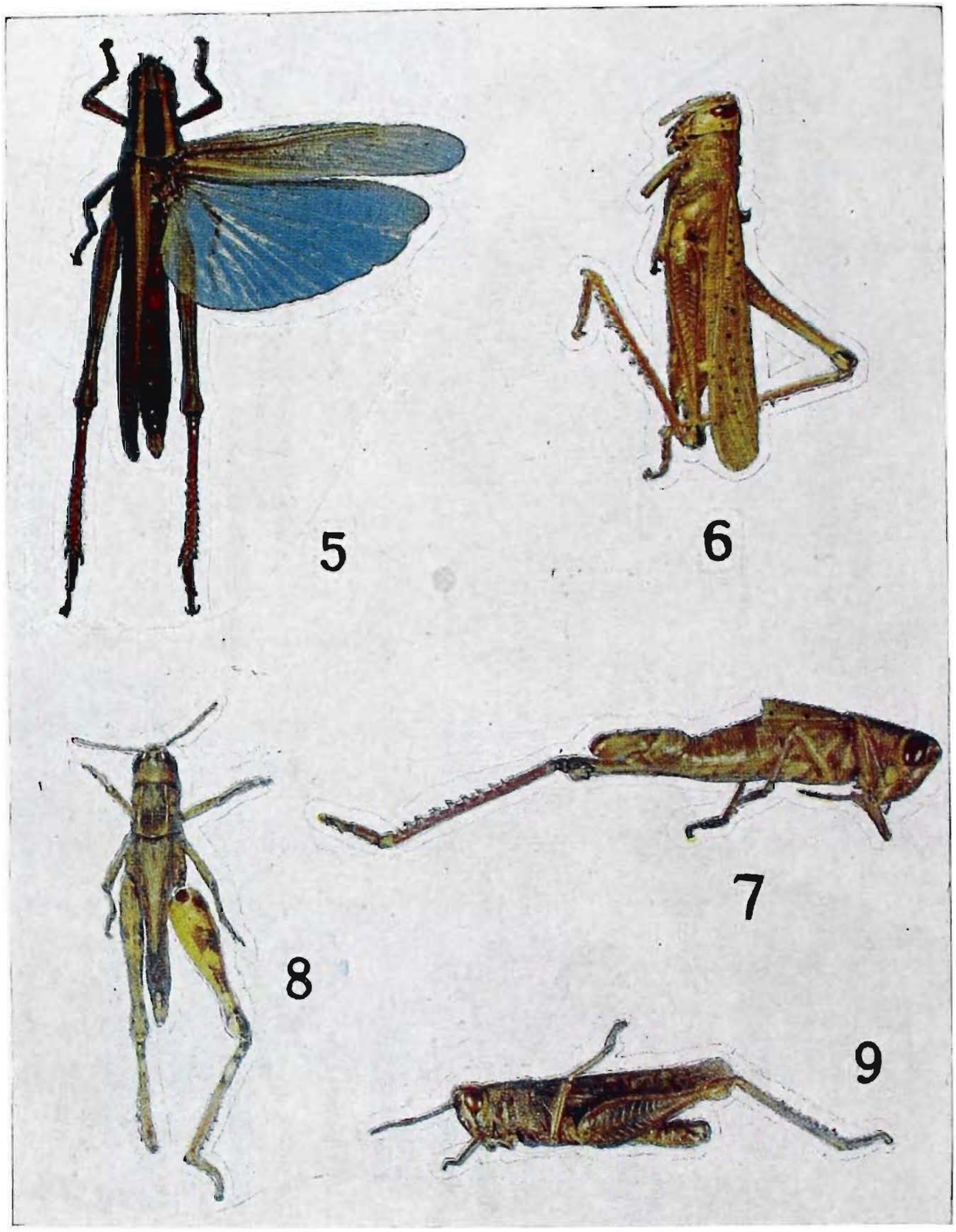
PLATE 2



Profile of

Figs. 5. *Choroedocus robustus* (Female) 68 mm. 6. *Choroeducus Illustris* (Female) 56 mm. 7. *Choroeducus illustris* (Male) (Note Male Cercus) 32 mm. 8. *Eyprepocnemis rosea* (Male) 13 mm. 9. *Eupreponotus punctatus* (Male) 23mm.

Rec. zool. Surv. India, **92** (1-4) : 265-284, 1992

CONCEPT OF *PSEUDOPARONELLA* HANDSCHIN, 1925 (COLLEMBOLA : ENTOMOBRYIDAE : PARONELLINAE)

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Zoological Survey of India
Berhampur, Orissa.

INTRODUCTION

HANDSCHIN (1925) splitted the genus *Paronella* Schött (1893), into four genera *viz.*, *Paronella* Schött (1893), *Pseudoparonella* n. g., *Aphysa* n. g. and *Microphysa* n. g. He diagnosed *Pseudoparonella* and fixed *Paronella appendiculata* Schött, 1917 as the type-species of his new genus. In the same paper, he redescribed *Paronella setigera* Börner, 1906 as a *new comb. viz.*, *Pseudoparonella setigera* and described a new species, *Pseudoparonell incerta.*

The main diagnostic characters, used by HANDSCHIN (1925) to differentiate his new genus *Pseudoparonella* from other related genera, were as follows : (1) Antennae usually short, scarcely attaining body length, Ant. IV annulated. (2) Body with larger rounded scales. (3) Mucro short, 2-teethed. (4) Dentes upto tip with spines.

Although, HANDSCHIN (1925) fixed *P. appendiculata* as the type-species of his new genus, he somewhat hesitated in fixing the above-mentioned species of Schött (*P. appendiculata*) as the type-species because of the incongruity in certain characters, specially in the shape of scales and longer antennae in *P. appendiculata* and *P. queenslandica.* It will be worthwhile to quote the following few lines, which will clearly express HANDSCHIN'S (1925) hesitations : "Als Typus fasse ich SCHÖTT'S *Paronella appendiculata* auf. Allerdings treten bei dieser Art 'bewimperte, lanzettliche an beiden Enden zugespitzte Schuppen' auf." (*Treubia*, Vol. VI, p. 254). HANDSCHIN (1925) tried to justify this difference in the shape of scales and length of antennae by attributing such difference to the developmental phases, thus to quote : "Mit der Längenzunahme der Mucronen zeigt sich auch eine Verlängerung der Antennen (*queenslandica* SCHÖTT.) doch bleibt der allgemeine Bauplan vollständig gewahrt". Examination of the lectotypes and a series of paralectotypes of *P. appendiculata* and *P. queenslandica* proves that the diagnosis given by HANDSCHIN (1925) does not agree at all with the characters actually possessed by these species (i.e., *P. appendiculata* and *P. queenslandica*) and his diagnosis of *Pseudoparonella* was actually derived from the species like *P. setigera* and *P. incerta* which he had examined at the time of describing his new genus. In fact, examination of the holotype and representative collections of *P. incerta* and *P. setigera* proves that the former should be included in *Lepidonella* Yosii (1960) and

the latter in *Bromacanthus* Schött (1925). Thus, it is now apparent that *P. appendiculata* and *P. queenslandica* are widely different from the two cited species and they belong to two widely different tribes *viz.*, Callyntrurini (*appendiculata, queenslandica*) and Bromacanthini (*incerta. setigera*). *Paronella* with the type-species *P. fusca* Schött is widely different from the species like *P. appendiculata* and *P. queenslandica* and other

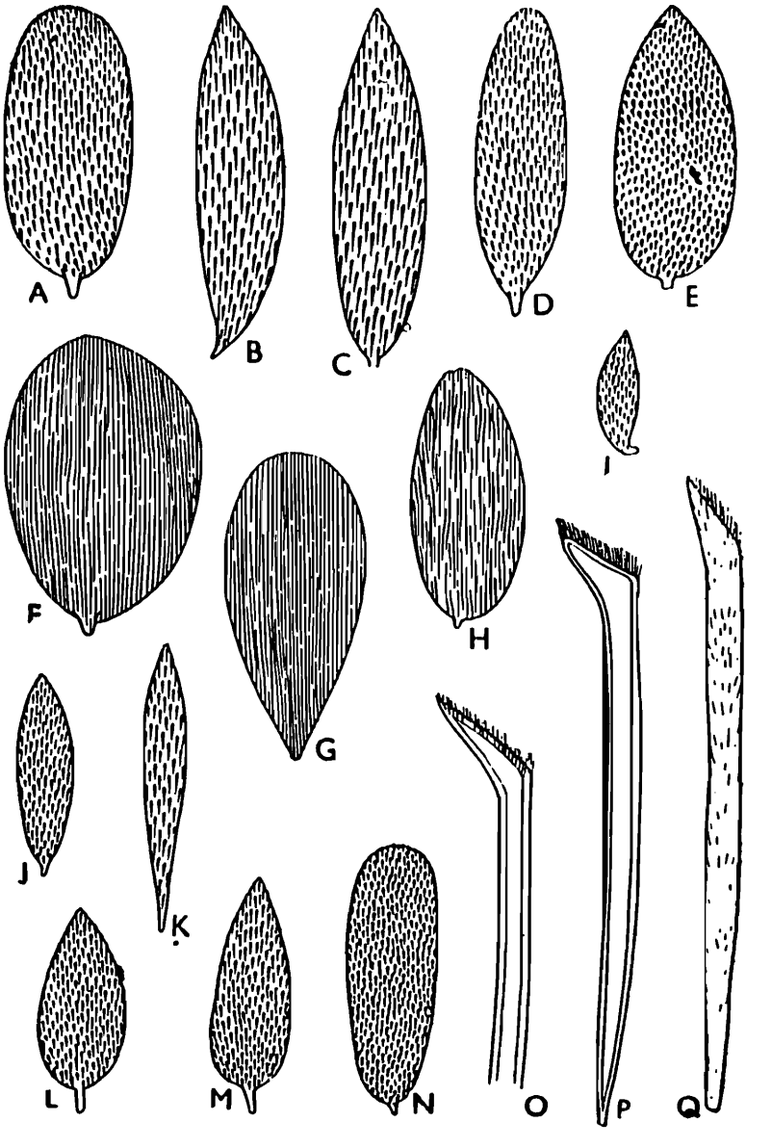

Fig. 1. Pseudoscales and flexed macrochaetae in *Pseudoparonella* and *Lawrenceana*. *Pseudoparonella* (*Lawrenceana*) *queenslandica* (Schött). A, D, I, L, M-Scales from Ths. II, III and Abd. IV ; O, apex of a flexed macrochacte from thorax ; Q, a flexed macrochaeta from head (from Lectotype and Paralectotype) ; *Pseudoparonella* (*Pseudoparonella*) *appendiculata* (Schött). B, C, E, F, G, H, J, N—Scales from thorax and abdomen (from the specimen of Belgrave, Vicroria, det. Womersly) ; K, a scale from Abd. II (from Lectotype) ; P, a flexed macrochaeta from thorax (from Lectotype).

species of the genus in (1) Achaetoic condition of its body ; (2) presence of distinct simple spines on manubrium and dentes, (3) presence of extra ocular structure, (4) nature of scales clothing body and (5) nature of mucronal structure. Evidently the

species having the characters of *P. appendiculata* and *P. queenslandica* should be included in a separate genus under Callyntrurini as the characters possessed by them neither agree with the charcters of *Paronella* nor with those of *P. setigera* and *P. incerta*. Some of such oustanding characters are as follows : (i) presence of transitional pseudoscales mostly of lanceolate shape of. *Dicranocentroides* (*vs.* true or typical scales in *B. setigera* n. comb., *L. incerta* n. comb. and *P. fusca*) [Figs. 1-3, 5 ; PL-I, E, F] ; (ii) presence of

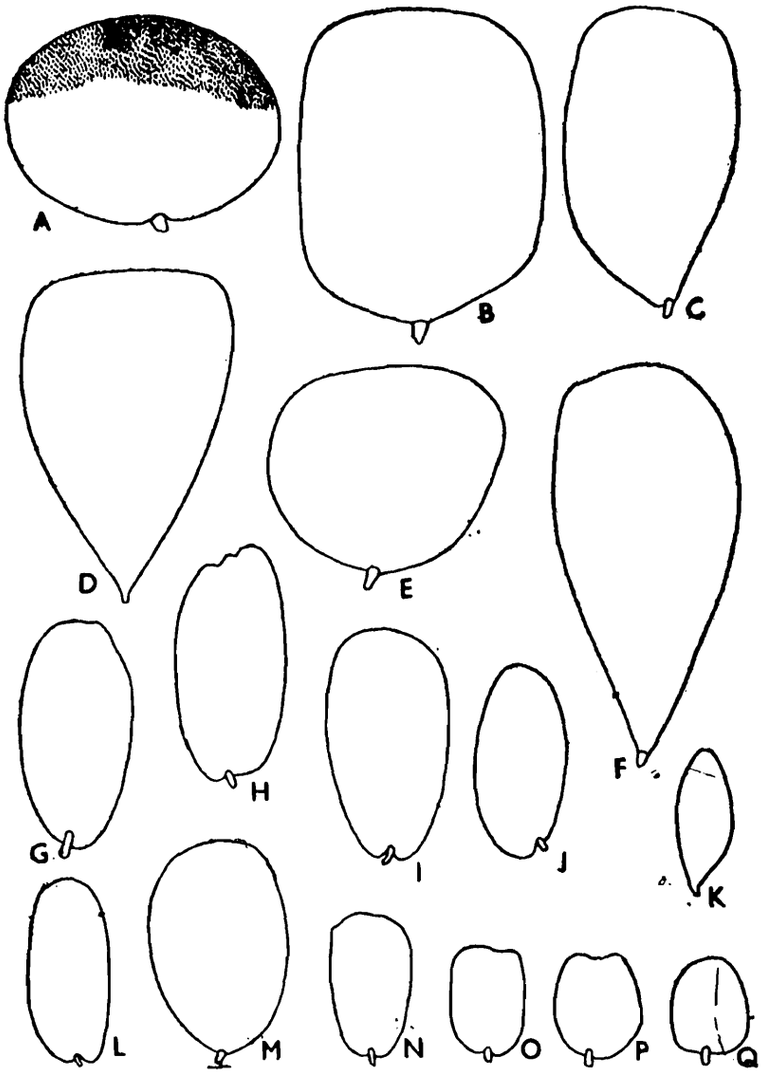

Fig. 2. Typical scales in Bromacanthini A-E, G-N, P, Q—from body ; F, O, from manubrium.

obliquely truncated flexed macrochaetae (brush setae) (*vs.* achaetoic body in B. *setigera*, *L. incerta* and *P. fusca*) ; (iii) dental spines absent (*vs.* dental apines always present in *B. setigera*, *L. incerta* and *P. fusca*) ; (iv) arrangement of ocelli always in 2 longitudinal parallel rows (*vs.* circular arrangement of ocelli with ocellus B located more or less centrally in each ocellar field in *B. setigera* and *L. incerta*). The name *Pseudoparonella* Handschin (1925), however, is to be retained as the oldest available name for the *appendiculata* and *queenslandica* groups of species with the type-species *P. appendiculata*,

fixed by HANDISCHIN (1925) [Articale 68(a)]. The present investigation further reveals that the species listed by PROF. SALMON (1964) under *Pseudoparonella* Handschin (1925) either belongs to the genus *Microparonella* Carpenter, 1916 (*doveri* Carpenter, 1932), *Bromacanthus* Schött, 1925 (*orientalis* Handischin, 1930 ; *setigera*

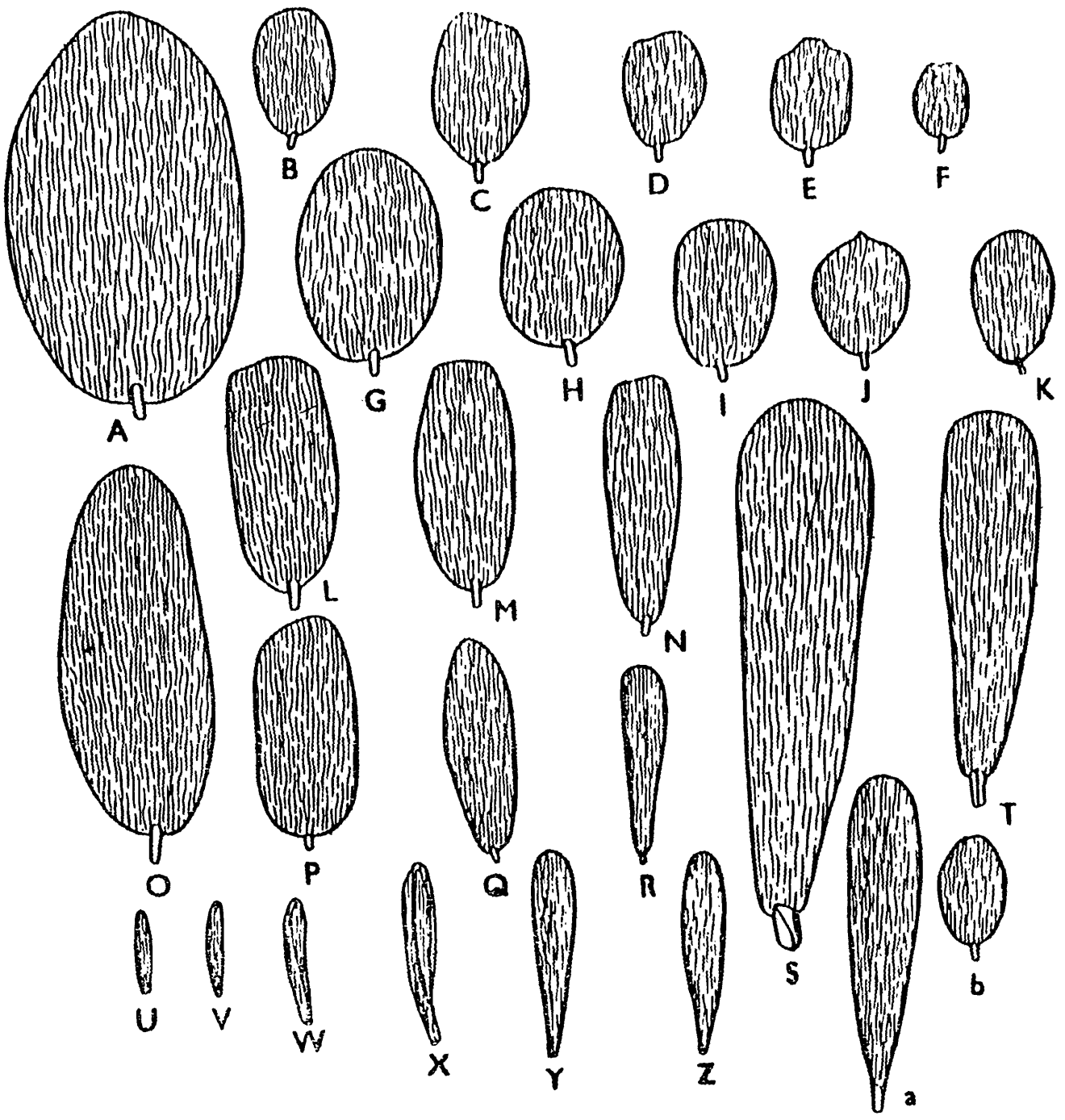

Fig. 3. Typical scales in Paronellini. A-Q, scales from body ; R-Z, scales from dentes ; a, b, scales from dorsal region of manubrium.

Börner, 1906), *Lepidonella* Yosii, 1960 (*incerta* Handschin, 1925 ; *nigrofasciata* Handschin, 1928 ; *papuanus* Womersley, 1937) or *Pseudoparonella* Handschin, 1925 (*halophila* Womersley, 1934 ; *novaecaledonine* Yosii, 1960 ; *shibtai* Yosii, 1960). However, his main list of species does not include the species like *Paronella appendiculata* Schött

(1917) which HANDSCHIN (1925) specifically and definitely fixed as the type-species of *Pseudoparonella*. Thus the present concept of the genus *Pseudoparonella* is based on four composite generic groups *viz.*, *Bromacanthus*, *Lepidonella*, *Microparonella* and *Pseudoparonella*. A thorough redefinition of *Pseudoparonella* Handschin (1925) on the basis of its type-species and others is, therefore, imperative and given below.

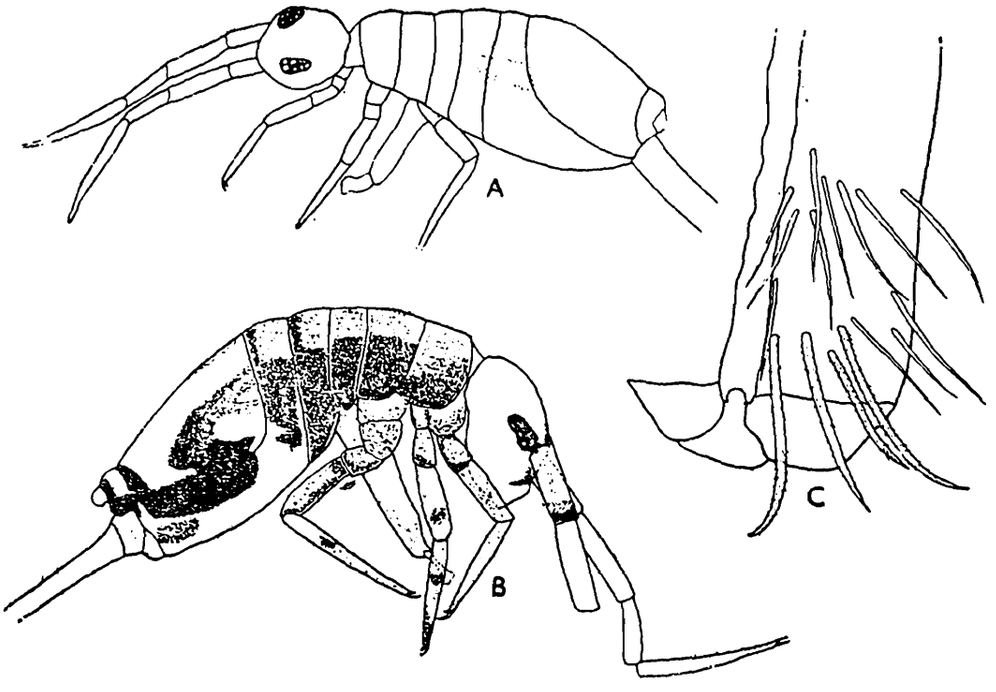

Fig. 4. Profile of *Pseudoparonella* (*Pseudoparonella*) *appendiculata* (Schötta). A, Paralectotype (Juvenile, slide No. 4175, labelled as lectotype, now amended as paralectotype); B, Lectotype (Slide No. 4177, labelled as paratype, now amended as Lectotype); C, chaetotaxy of anterior face of ventral tube.

WOMERSLEY (1939) erected the genus *Paronana* with the type-species *Paronella bidenticulata* Carpenter, 1925. The material on which WOMERSLEY'S observations were based was a single specimen from Belgrave, Victoria, South Australia. The diagnostic characters given by WOMERSLEY (1939) are (i) body scaled and (ii) two scale-like lobes at apex of dentes. In the detailed description of the species WOMERSLY (1939) mentioned : "The apical dental lobes figured by CARPENTER are broken off but the scars are distinctly visible" (p. 212). However, in his figure (Fig. 64 M. ; p. 210), he actually depicted two sockets, one located apically and another dorsally to dentes. The present author examined that specimen of Belgrave, Victoria (Repository : South Australian Museum, Adelaide) in which it is observed that the dental scale-like lobe is totally absent and the scars of dental "scale-like lobes" mentioned by WOMERSLEY (1939) are the sockets of dental spiny appendages of *Pseudoparonella*. Simultaneously, the examination of the lectotype of *Paronella bidenticulata*

Carpenter, 1925 (Repository : Manchester Univeasity Museum, England) reveals that the species is without scales on body and with a distinct dental scale appendage. It is thus evident that *Paronana bidenticulara*, WOMERSLY, 1939 from Victoria, S. A. has no relation with *Paronella bidenticulata* Carpenter, 1925 from New Zealand, and that the specimen of Belgrave is a member of the genus *Pseudoparonella*. Therefore, WOMERSLEY'S diagnosis of *Paronana* corresponds to *Pseudoparonella* (MITRA, 1990).

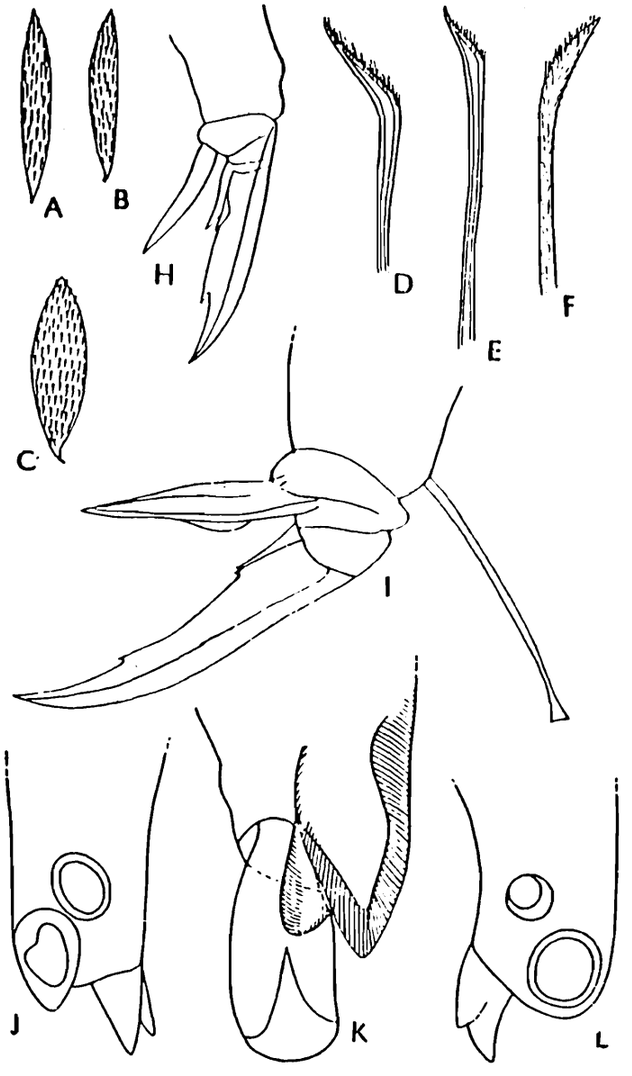

Fig. 5. Details of *Pseudoparonella* (*Pseudoparonella*) *appendiculata* (Schött). A, B, C, scales from body ; D, E, F, G, flexed macrochaetae from thorax ; H, footcomplex from leg II, I, footcomplex from leg III ; J, K, L, mucrodens in different views [All illustrations from the lectotype and Paralectotypes].

The species of *Pseudoparonella* Handschin (1925) can be distinctly subdivided into two sub-genera *viz.*, *Pseudoparonella* (for *appendiculata* group of species) and *Lawrenceana* (New sub-genus) (for *queenslandica*—group of species) on the basis of striking

morphological and chaetotaxic characters which are indicated in the diagnosis of each sub-genus.

I. TAXONOMIC ACCOUNT

Pseudoparonella Handischin, 1925

1925. *Pseudoparonella* Handschin, *Treubia*, **6** : 225-270 ; *Paronana* s. str. Womersley, 1939, *Primitive Insects of South Australia, Adelaide*, pp. 322.

Redifinition : Antennae subequal or longer than body ; frontal spines absent ; prelabral setae 4, smooth, labral setae, 5, 5, 4, smooth ; anterior face of ventral tube anteriorly with 4+4 macrochaetae ; dental spines absent ; dental scale appendage absent, dental spiny appendages present ; mucrones demarcated or nondemarcated from dentes, apicallyor sub-apically located, with 2-3 teeth ; femoral organ absent ; body clothed with pseudoscales and flexed macrochaetae ; scales on body comparable to the scales of *Dicranocentroides*, scales may be with secondarily rounded apices but mostly with sharp apices (lanceolate) ; flexed macrochaetae involves ciliated, obliquely truncated ones (brush setae) and also setae with blunt apices (Fig. 1).

Type-species : *Paronella appendiculata* Schött, 1917, fixed by Handschin, 1925.

Sub-genus : **Pseudoparonella** Handschin, 1925 (New Status)

1925. *Pseudoparonella* Handschin, *Treubia*, **6** : 225-270 ; *Paronana* s. str. Womersly, 1939, *Primitive Insects of South Australia, Adelaide*, pp. 322.

Redifinition : Antennae shorter or subequal to the length of body ; mucrones small, usually not distinctly demarcated from dentes, sub-spically located, with 2 teeth ; 2 large dental spiny appendages present dorsally near base of mucrones, one of such appendages located apically on dentes.

Type-species : *Paronella appendiculata* Schött, 1917.

DESCRIPTION OF THE TYPE-SPECIES

Pseudoparonella (Pseudoparonella) appendiculata (Schött) 1917

1917. *Paronella appendiculata* Schött, *Ark, Zool.*, **11** (8) : 60 ; Salmon, 1964b, *Bull. Roy. Soc., N. Z.*, (7) **2** : 145-644.

1925. *Pseudoparonella appendiculata* Handschin, *Treubia*, **6** : 225-270 ; Womersly, 1934b, *Trans. Proc. Roy. Soc. Sth, Austr.*, **58** : 86-138 ; Womersely, 1939, *Primitive Insects of South Australia, Adelaide*, pp. 322.

1934. *Pseudoparonella halophila* Womersly, *Trans. Proc. Roy. Soc. Sth. Austr.*, **58** : 86-138 ; Womersly, 1939, *Primitive Insects of South Australia, Adelaide*, pp. 322 ? Synonym.

1936. *Pseudoparonella bidenticulata* Womersley, *Trans. Roy. Soc., N. Z.*, **66** : 316-326 New Synonymy.

1939. *Paronana bidenticulata* Womersly, *ibid.*, New Synonymy.

Material : *Pseudoparonella* (*Pseudoparonella*) *appendiculata*—on slides : Slide No. 4175, labelled as "*Paronella appendiculata* Schött, 1917. Lectotype. Malanda, North Queensland. E. Mjöberg. Jan. 1912." Slide No. 4176, labelled as "*Paronella appendiculata* Schött, 1917. Paratype. Cedar Creek, Queensland. E. Mjöberg. April, 1913." Slide No. 4177, labelled as "*Paronella appendiculata* Schött, 1917. Paratype. Cedar Creek, Queensland. E. Mjöberg. Jan. 1912." Slide No. 1237, labelled as *Paronella appendiculata* n. sp., Alkali. Australien. H. Schött." Slide No. 1238, labelled as "*Paronella appendiculata*. Harbeklad. H. Schött." In spirit : Vial No. 1, 1 ex., labelled as "*Paronella appendiculata* n. sp. Cedar Creek, Queensland. Mjöberg, mars." Vial No. 2, 1 ex., labelled as "*Paronella appendiculata* n. sp. Atherton, Queensland. Mjöberg, Jan." Vial No. 3, 1 ex., labelled as "*Paronella Queenslandica* n. sp. Malanda, Queensland. Mjöberg. Vial No. 4, 1 ex., labelled as "*Paronella appendiculata* n. sp. Malanda, Queensland. Mjöberg." All from the Swedish Museum Natural History, Stockholm. 1 ex., mounted on a slide, labelled as "*Pseudoparonella bidenticulata* Carp. Loc. Belgrave, Vic. 1/38. DWT. Det. H. Womersley", from South Australian Museum, Adelaide.

Colouration : Usually dark pigmented ; lighter forms with faint, violet pigment laterally on Abd. IV and on tergal margins, such pale colour pattern usually exhibited by juveniles with shorter antennae (Paratype, Slide No. 4176 and Lectotype, Slide No. 4175) [Fig. 4, B ; Pl. IA] ; in the darkest forms, the tergal margins of Ths. II, III, Abds. I, II, III deep violet and entire segments with lighter violet pigment ; Abds. III and IV laterally with dark and posteriorly with light violet pigment ; certain longitudinal violet strands descend from the anteromedial region of Abd. IV ; Abd. II with violet pigment ; Ant. I distally and Ant. II proximally with faint violet pigment ; Ant. III proximally and Ant. IV distally little darker ; precoxae, coxae and proximal part of femora dark violet in pigmented forms (Fig. 4, B Pl. I, A) ; femora distally and tibiotarsi with violet suffusion ; head laterally with irregular violet patches and bases of antennae with dark violet pigment.

Clothing : Body clothed with scales and setae ; scales exhibit different integraded shapes and sizes between small lanceolate to oval elongate ones, each usually with a short basal stalk, scales in general comparable with the scales of *Dicranocentroides* (Fig. 5 ; Pl. I, E, F ; Pl. II, B, C) ; ciliated, flexed macrochaetae both obliquely truncated and acuminate, obliquely truncated setae narrow or broad with obliquely truncated apices blunt or drawn into a fine apical process, located on head, Ths. II, III, Abds. I, II, III ; acuminate macrochaetae usually found on head, Abds. IV, V and VI ; antennae with acuminate microchaetae, occasionally with certain outstanding microchaetae on Ants. I, II ; Ant. IV, in addition to such setae, with certain erect, apparently smooth setae, legs clothed with long, delicate setae, tibiotarsi on inner lateral margin with certain stiff setae ; furcula clothed with acuminate, long and short setae.

CHAETOTAXY

Head : Vertex with V_0+V_{1-6}, all macrochaetae, V_1, V_2 arranged in a trapezoid fashion with V_0 located medially on the line joining V_1-V_1 ; dorsal region with 7 macrochaetae (D_{1-7}), arrangement of which characteristic for the sub-genus ; subdorsal region represented by 8 setae of which SD_4 and SD_{6-8}, usually macrochaetae ; ocular region with 5 microchaetae (oc_{1-5}), arrangement of which characteristic ; postocular region on each side with a single macrochaeta (PO_1) ; parietal region medially

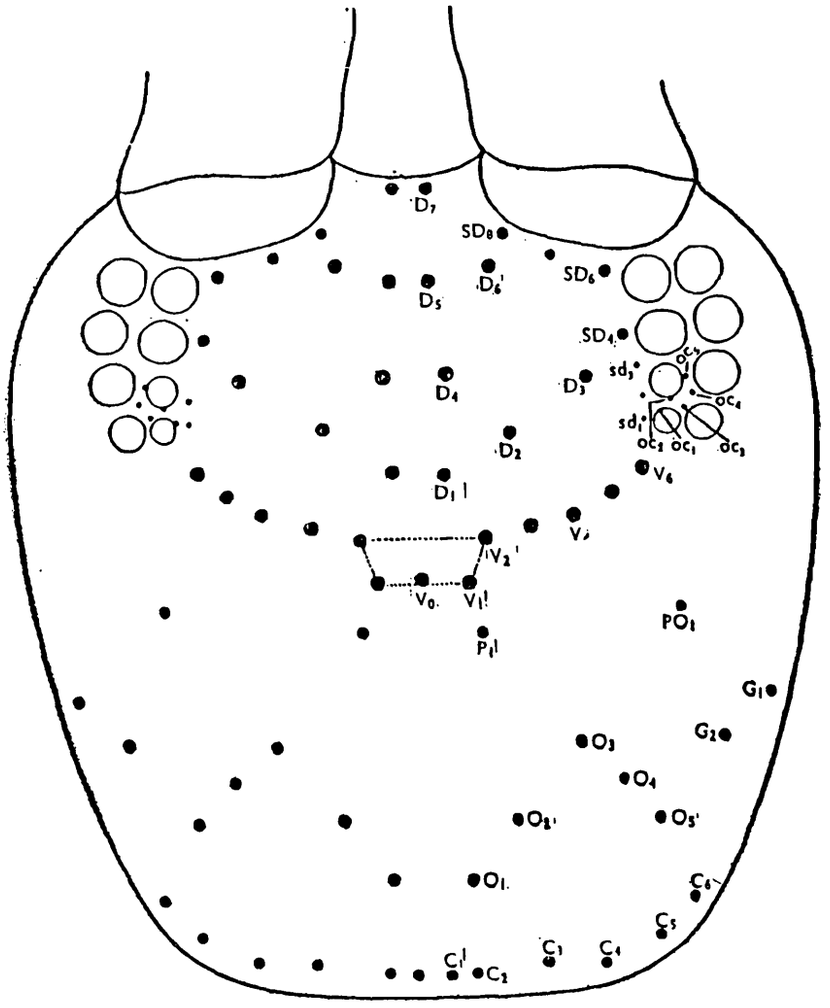

Fig. 6. Cephalic chaetotaxy of *Pseudoparonella* (*Pseudoparonella*) *appendiculata* (Schött).

represented by 1+1 macrochaeta (P_1+P_1) ; postocular region on each side with a single macrochaeta (PO_1) ; occipital region has 5 macrochaetae on each side (0_{1-5}), arrangement characteristic ; cervical region represented by 6 macrochaetae on each side (C_{1-6}) ; Genal region with 2 macrochaetae on each side (G_{1-2}) [Fig, 6].

Body : Usually with lesser number of macrochaetae on tergites than its nearest alley, *Lawrenceana*, (New subgenus). Thus, Ths. II (11-17), III (12-20) ; Abds. I (3-5), II (4-5), III (10) and Abd. IV anteromedially on each side with transverse row of 8 macrochaetae (Fig. 7).

Head : Almost circular in outline from above ; frontal spines absent ; ocelli 8+8, G and H smaller than the rest ; antennal length much variable, it may be shorter or subequal to the total length of head and body, the relative length index of Ants. I : II : III : IV may be (a) 12 : 24 : 17 : 40 ; (b) 17 : 30 : 20 : 48 or (c) 28 : 43 : 26 : 62 ; head diagonal/Ant. I=11/5, constant in most of the specimens examined ; prelabral setae, 4, smooth, labral setae, 5, 5, 4 smooth ; Ant. IV apically with a prominent sense-knob guarded with 3-4 smooth setae.

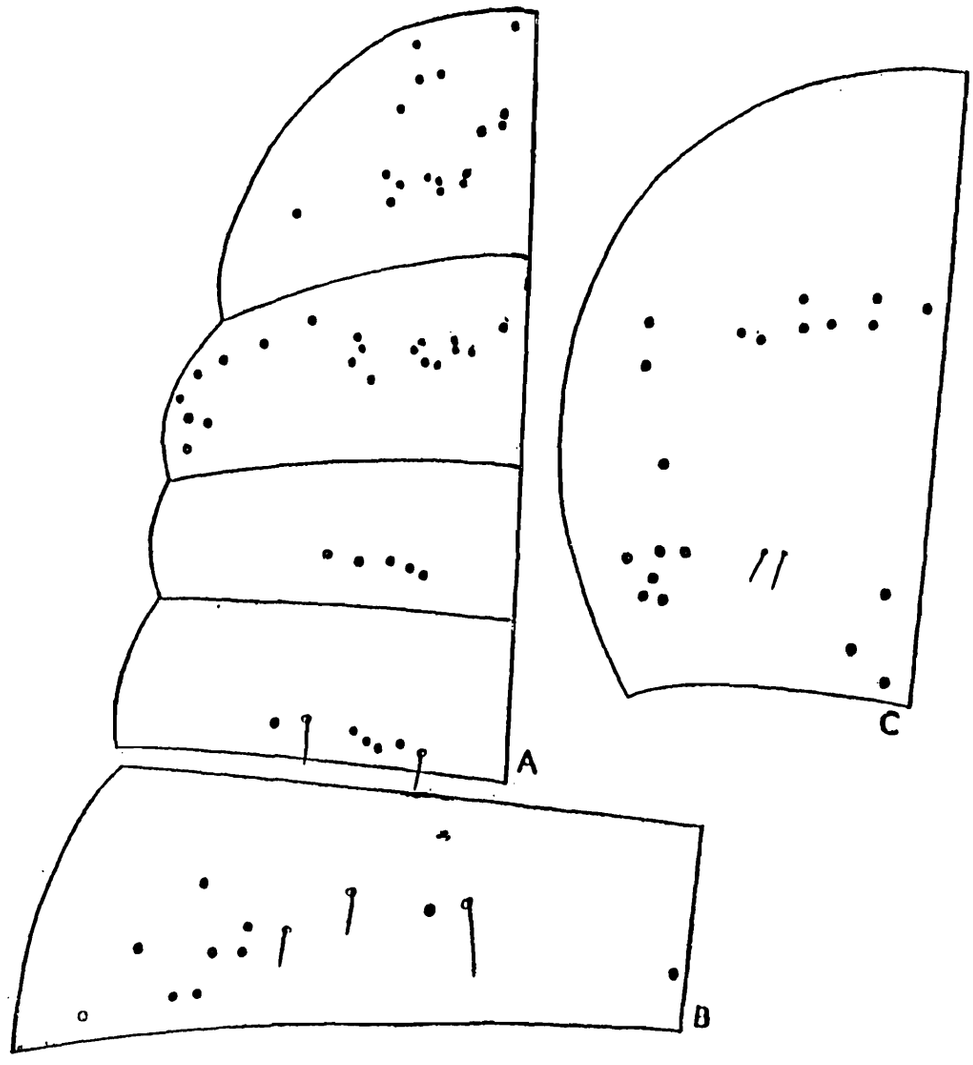

Fig. 7. Body chaetotaxy of *Pseudoparonella* (*Pseudoparonella*) *appendiculata* (Schött).

Thorax : Relative length index of Ths. II III=19 : 13 ; tibiotarsi feebly divided distally ; unguis with paired inner basal teeth and single distal unpaired tooth, external basolateral teeth reduced ; teeth more pronounced on hind legs than fore and mid-legs ; fore-unguiculi more of truncate-type, mid- and hind-unguiculi almost of lanceolate type (Fig. 5, H, I) ; all nondentate ; tenent hair slender, clavate ; trochanteral organ not seen.

Abdomen : Relative length index of Abds. I : II : III : IV : V+VI=16 : 17 : 15 : 75 : 11 ; ventral tube long with protrusible vesicles retracted in most of the examples ;

anterior face of ventral tube anteriorly with 4+4 ciliated macrochaetae arranged on each side of the ventral groove, microchaetae clothe rest of the anterior and posterior faces (Fig. 4, C) ; rami of retinaculum each with 4 teeth, corpus with a median seta ; relative length index of manubrium : mucrodens=37 : 51 ; mucro bidentate, sub-apically attached on dentes, length of mucrones variable (Fig. 5, J, K, L) ; dentes apically with a large spiny appendage followed by another smaller one as evident from its socket.

Length (excluding appendages) : 0.92-2 mm.

Type-specimens : Lectotype and 6 paralectotypes on slides and 4 in spirit are reposited in the Swedish Museum Natural History, Stockholm. Lectotype examined (Plate No. Pl. I, C) is a juvenile one and it is not known as to who designated the lectotype of the species. Present investigator, therefore, amends the previous selection and selects the syntype (Slide No. 4177) [Pl. I, A ; Fig. 4, B] as the lectotype. This is an adult specimen and corresponds well with the original description of the species. Although Slide Nos. 1237 and 1138 and the specimens in spirit bear the labels having identical data as that of the lectotype and paralectotypes, however, they do not bear any type-label. There is no doubt that these slides and specimens belong to the type-series which Schött (1917) had examined. The present investigator, therefore, considers other specimens on slides and in spirit as paralectotypes.

Type-locality : The specimens of *Pseudoparonella* (*Pseudoparonella*) *appendiculata* were collected by E. Mjöberg from various localities of Queensland, Australia. The present investigator, therefore, selects "Malanda", North Queensland, Australia, as the type-locality of the species which is the locality of the lectotype.

Comparisons : The species can be characterised by the number of setae on body which is fairly constant. Further, the species can be recognised by its colour pattern. WOMERSLEY (1934) described *P.* (*Pseudoparonella*) *halophila* from West Australia which was discriminated from *P.* (*Pseudoparonella*) *appendiculata* on the basis of the absence of pigmented patches and its shorter antennae. However, such nonpigmented forms (usually juvenile ones) are present in the material of *P.* (*Pseudoparonella*) *appendiculata* studied and in all possibility WOMERSLEY'S *P. halophila* is a juvenile of *P.* (*Pseudoparonella*) *appendiculata*. Examination of the single specimen from Belgrave, Victoria, South Australia, on which WOMERSLEY (1936) based the description of *Pseudoparonella bidenticulata* and subsequently in 1939 based the redescription of *Paronana bidenticulata* (Carpenter), proves it to be a good example of *P.* (*Pseudoparonella*) *appendiculata*. So called "scars" of "dental lobes", mentioned and depicted by WOMERSLEY are nothing but the sockets of two dental spiny appendages. Yosii (1960) also apprehended this erroneous conception of WOMERSLEY

Interrelationships : The sub-genus is close to *Lawrenceana* but differs from it in the mucro being located sub-apically on dentes and in the presence of an apical dental

spiny appendage. Further, the nature of mucrones, which are not clearly demarcated from dentes, is also a characteristic feature of the sub-genus. Chaetotaxically, the sub-genus is also distinct and usually has less number of setae on head and body than *Lawrenceana*. Similarity in the nature of mucronal end of *Pseudoparonella* and *Bromacanthus* is an analogous character. The sub-genus has some affinity with *Dicranocentroides* in the absence of frontal spines and in the presence of simple prelabral setae. However, it is distinct from it in the presence of conspicuous dental spiny appendages, absence of dental spines and in having small, bidentate mucrones, not clearly demarcated from dentes. Further, *Pseudoparonella* lacks tuft of outstanding macrochaetae on antennal segments, that is found in the species of *Dicranocentroides*.

Distribution : The members of the sub-genus are distributed in the oceanic islands of the Australian Region and also in the main territory of Australia. They have not been recorded so far from the oceanic islands of the Oriental Region and New Zealand. Besides the type-species, *P.* (*P.*) *halophila* Womersley, 1934 from Western Australia (where the type-species also occurs) and *P.* (*P.*) *shibtai* Yosii, 1960 are to be included in the subgenus *Pseudoparonella*.

Subgenus : **Lawrenceana*** (New Subgenus)

Diagnosis : Antennae longer than body ; mucrones comparatively large, well demarcated from dentes, apically attached, with 2-3 teeth [rarely a fourth vestigial tooth found in *P. bougainvilleae* (Yosii, 1960) n. comb.] ; 2 dental spiny appendages located sub-apically and dorsall near base of each mucrone, no apical dental spiny appendage occurs ; represents larger species.

Type-species : *Paronella queenslandica* Schött, 1917, now designated.

Description of the Type-Species

Pseudoparonella (Lawrenceana) queenslandica (Schött) 1917

1917. *Paronelta queenslandica* Schött, *Ark. Zool.*, **11** (8) : 60 ; Salmon, 1964b, *Bull. Roy. Soc., N. Z.*, (7) **2** : 145-644.

1939. *Pseudoparonella queenslandica* Womersly, *Primitive Insects of South Australia, Adelaide*, pp. 322 ; Yosii, 1960b, *Bull. Osaka Mus. Nat. Hist.*, **12** : 9-38.

Material : *Pseudoparonella* (*Lawrenceana*) *queenslandica* (Schött) : On slides—Slide No. 1284, labelled as "*Paronella queenslandica* Schött, 1917. Cedar Creek, Queensland. E. Mjöberg. Best. H. Schött." Slide No. 1285, labelled as "*Paronella queenslandica* Schött, 1917. Paratype." Slide No. 1286, labelled as "*Paronella queenslandica* Schött,

*Named after Mr. P. N. Lawrence, British Museum (Natural History), London in recognition of his contributions on Collembola.

1917, Paratype. Cedar Creek. Queensland. E. Mjöberg. Jan. 1913". Slide No. 1287, labelled as "*Paronella queenslandica* ; Australien ; Detaljer ; H. Schött." Slide No. 1289, labelled as "*Paronella queenslandica* n. sp. austr. E. Mjöberg. Best." Slide No. 1290, labelled as "*Paronella queenslandica* n. sp. austr. E. Mjöberg. Best. H. Schött (Furcula)".

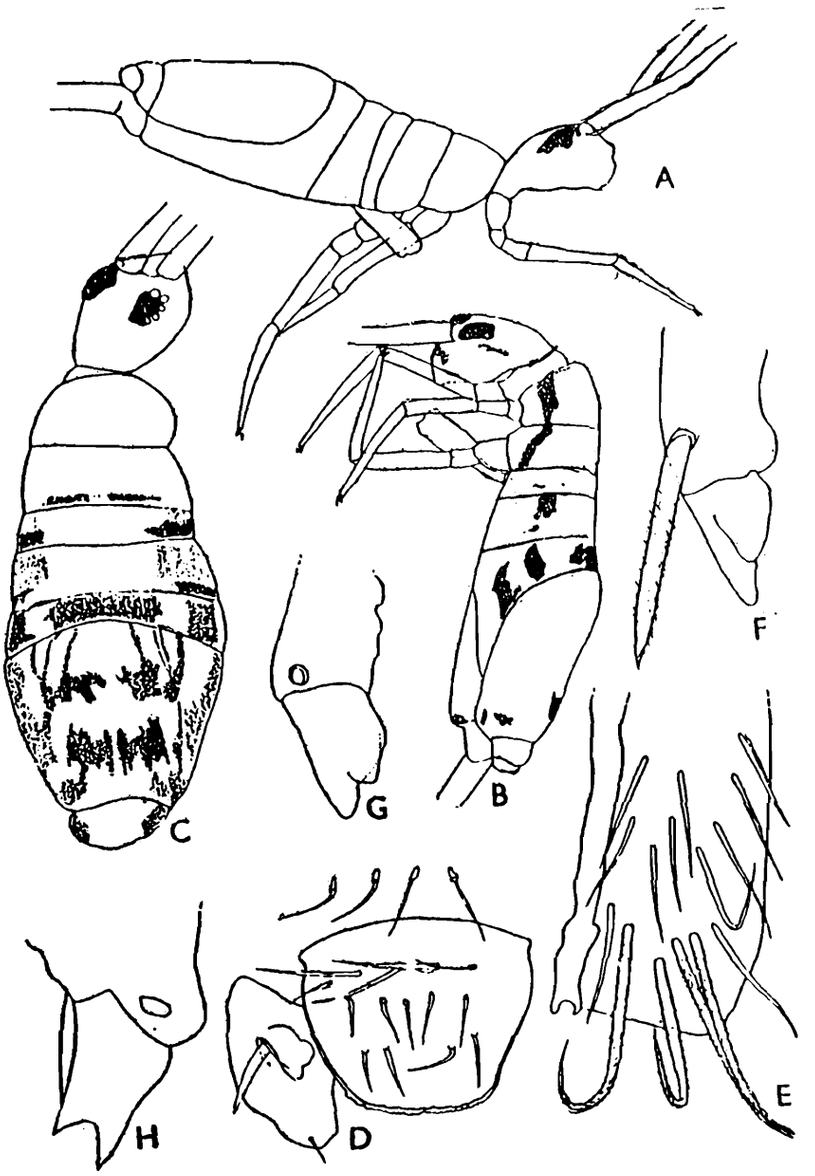

Fig. 8. *Pseudoparanella* (*Lawrenceana*) *queenslandica* (Schött). A, Paralectotype (in alcohol) showing of pigmented platehes ; B, Paralectotype (in alcohol) showing presence of pigmented patches ; C, a dark pigmented paralectotype mounted on slide No. 1288 ; D, labral chaetotaxy and half of labium ; E, chaetotaxy of the anterior face of ventral tube ; F-H, mucrones (single d. sp. a. shown) [All from the swedish museum of Natural History, Stockholm].

Slide No. 1291, labelled as "*Paronella queenslandica* n. sp. austr. E. Mjöberg's. Best. H. Schött." Slide No. 1292, labelled as "*Paronella queenslandica* n. sp. Austral." Slide No. 1293, labelled as "*Paronella queenslandica*. Australien gaffel. H. S." Slide No. 1294, labelled as "*Paronella queenslandica* n. sp. austr. E. Mjöberg Best. H. Schött." Slide No.

4178, labelled as "*Paronella queenslandica* Schöttt, 1917. Lectotype, Logan village, Sth. Queensland. E. Mjöberg. Oct. 1912." In spirit—vial No. 1, 10 exs., labelled as "*Paronella queenslandica* n. sp. Malanda, Queensland. Mjöberg." Vial No. 2, 1 ex., labelled as "*Paronella queenslandica* n. sp. Atherton, Queensland, Mjöberg, April." Vial No. 3, 1 ex., labelled as "*Paronella queenslandica* n. sp. Evelyne, Queensland, Mjöberg." Vial No. 4, 1 ex., labelled as *Paronella queenslandica* n. sp. Mt. Tambourine, Queensland. Mjöberg." Vial No. 5, 3 exs., labelled as "*Paronella queenslandica* n. sp. Bellenden Ker, Queensland, Mjöberg, Majo" (another label, written in pencil reads as Bellenden Ker, 4000 ft. ht., maj, 29/3). Vial No. 6, 6 exs., labelled as "*Paronella queenslandica* n. sp. Bellenden Ker, Queensland, Mjöberg, maj." Vial No. 7, 29 exs., labelled as "*Paronella queenslandica* n. sp. Cedar Creek, Queensland, Mjöberg, mars." Vial No. 8, 14 exs., labelled as "*Paronella queenslandica* n. sp. Atherton, Queensland, Mjöberg, april." Vial No. 9, 1 ex., labelled as *Paronella queenslandica* n. sp. Herberton." Vial No. 10, 10 exs., labelled as "*Paronella queenslandica* n. sp. Atherton, Queensland, Mjöberg." Vial No. 11, 7 exs., labelled as "*Paronella queenslandica* n. sp. Logan Village, Queensland, Mjöberg." Vial No. 12, 1 ex. labelled as "*Paronella queenslandica* n. sp. Bellenden Ker, Queensland, Mjöberg, maj." Vial No. 13, 6 exs., labelled as "*Paronella qaeenslandica* n. sp. Cedar Creek, Queensl., Mjöberg, Okt."

Colouration : Ground colour of body pale yellow with veriable violet to blue pigment ; three distinct forms can be discerned : (a) without any trace of pigment on body, this form mostly common in the lectotype and paralectotypes examined (Fig. 8, A ; Pl. I, D) ; (b) with purple pigment along the margins of meso and metaterga, sometime on lateral margins of Abd. I, laterally and dorsomedially on Abds. II, III and also posteromedially and laterally on Abd. IV in the form of small blotches (Fig. 8, B) ; (c) Forms with dark blue-black pigment in the form of a narrow transverse band posteriorly on Th. II, along tergal margins of Abds. I-IV ; Abd. III, medially with a broad transverse band, on Abd. IV three longitudinal strands of the same pigment descend from its anterior margin which unite posteriorly with a dark pigmented patch on either side, transverse band present posteriorly on Abd. IV, Abds. V and VI medially nonpigmented (Fig. 8, C) ; antennal bases in all the forms usually with dark pigmented patches ; pigmentation of legs and antennae variable ; furcula nonpigmented.

Clothing : Body clothed with scales and flexed macrochaetae ; macrochaetae mostly obliquely truncated, ciliated type found on head, Ths. II, III, Abds. I, II, III ; acuminate macrochaetae abundant dorsomedially on Abd. IV, Abds. V and VI ; Ants. I, II and legs with certain prominent macrochaetae ; furcula clothed with both macro and microchaetae of acuminate type, rarely with some feeble spine-like setae ; scales mostly elongate, occasionally with secondarily rounded apices but mostly acuminate (lanceolate) ; scales present on antennae, head and on Abds. IV, V, VI usually of

lanceolate type (Fig. 1), while those present dorsomedially on Ths. II, III, Abds. I, II, III with secondarily rounded apices ; scales present laterally on these segments, always with acuminate apices (Fig. 1 ; Pl. I. E. F ; Pl. II, A).

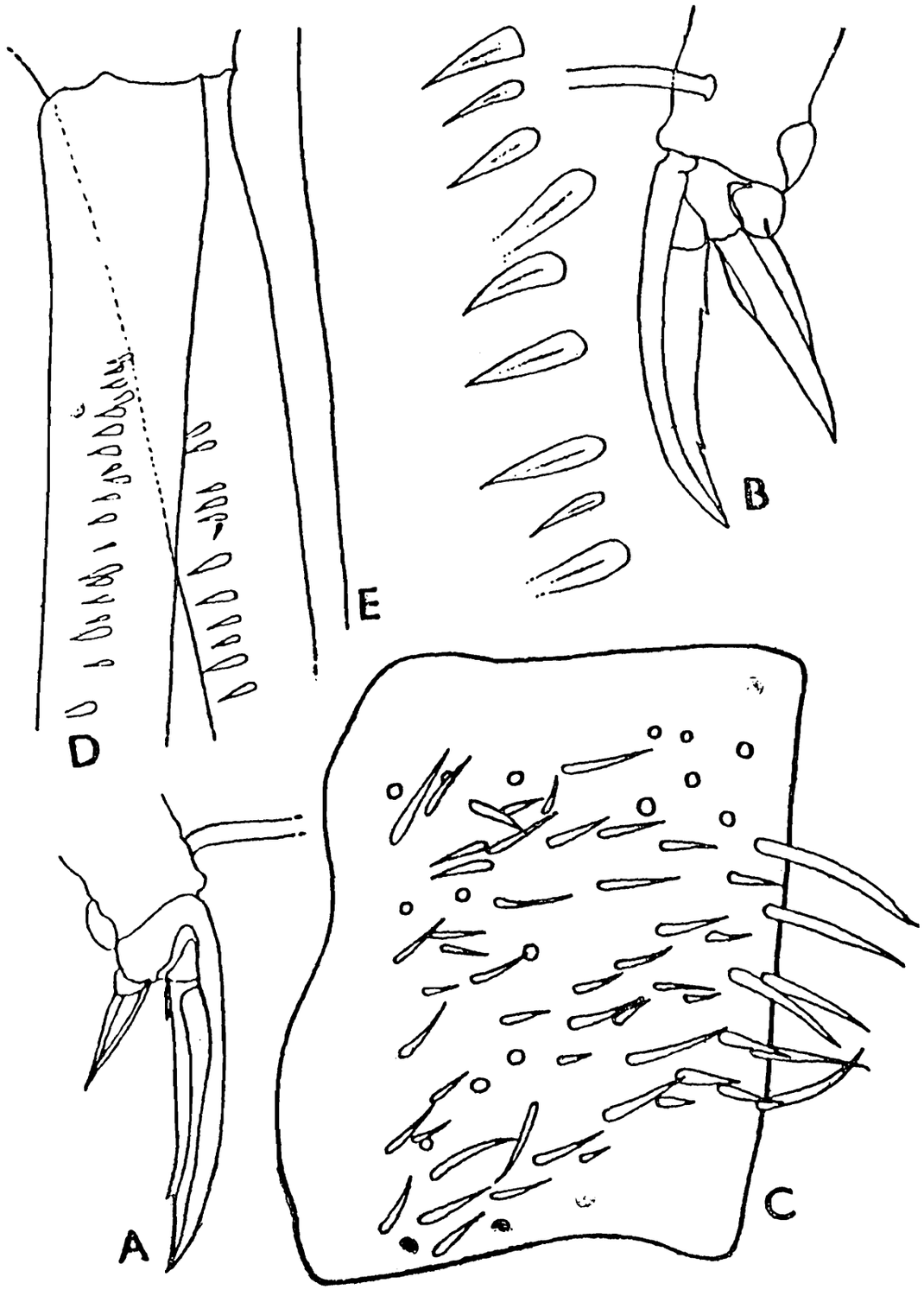

Fig. 9. *Pseudoparonella* (*Lawrenceana*) *queenslandica* (Schött). A, footcomplex of leg I (from a paralectotype) ; B, footcomplex from leg III (from a paralectotype) : C, trochanteral organ ; D, an exceptional row of strong setae, observed in only one paralectotype (Slide No. 1288, Swedish Museum Natural History, Stockholm) ; E, same, a few spiny setae enlarge.

CHAETOTAXY

Head : Vertex with V_0+V_{1-7}, all of which macrochaetae, arrangement of V_0, V_1, V_2 like the sub-genus *Pseudoparonella* ; dorsal region with 5 macrochaetae (D_{1-5}) ; subdorsal region represented by 17 setae of which SD_4, SD_5, SD_{10-17} macrochaetae ; ocular region represented by 5 microchaetae (oc_{1-5}) ; postocular region represented by a single macrochaetae on each side (PO_1) ; parietal region without any setae ; occipital region with 6 macrochaetae on each side (O_{1-6}) ; cervical region with 4 macrochaetae on each side (C_{1-4}) ; genal region represented by 2 macrochaetae on each side (G_{1-2}), insertion of which quite characteristic for the sub-genus (Fig. 10).

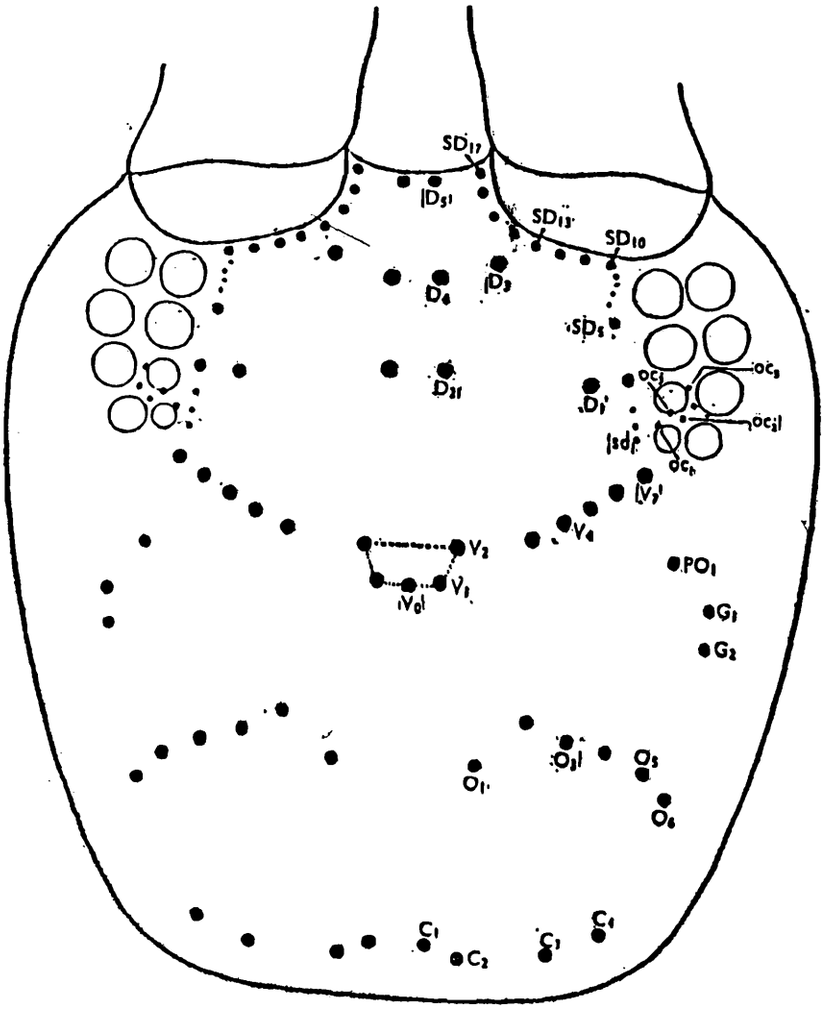

Fig. 10. Cephalic chaetotaxy of *Pseudoparonella* (*Lawrenceana*) *queenslandica* (Schött).

Body : Usually with relatively more macrochaetae on each tergite than *Pseudoparonella*, range of macrochaetae on each segment as follows : Ths. II (12-18), III (15-21) ; Abds. I (5-12), II (4-8), III (4-7) ; Abd. IV anteromedially with transverse rows of 13-16 macrochaetae on either side (Fig. 11).

Head : Pear-shaped, dorsally ; frontal spines absent ; 8 ocelli on each side in dark pigmented patches, ocelli G and H smaller than the rest ; antennae longer than

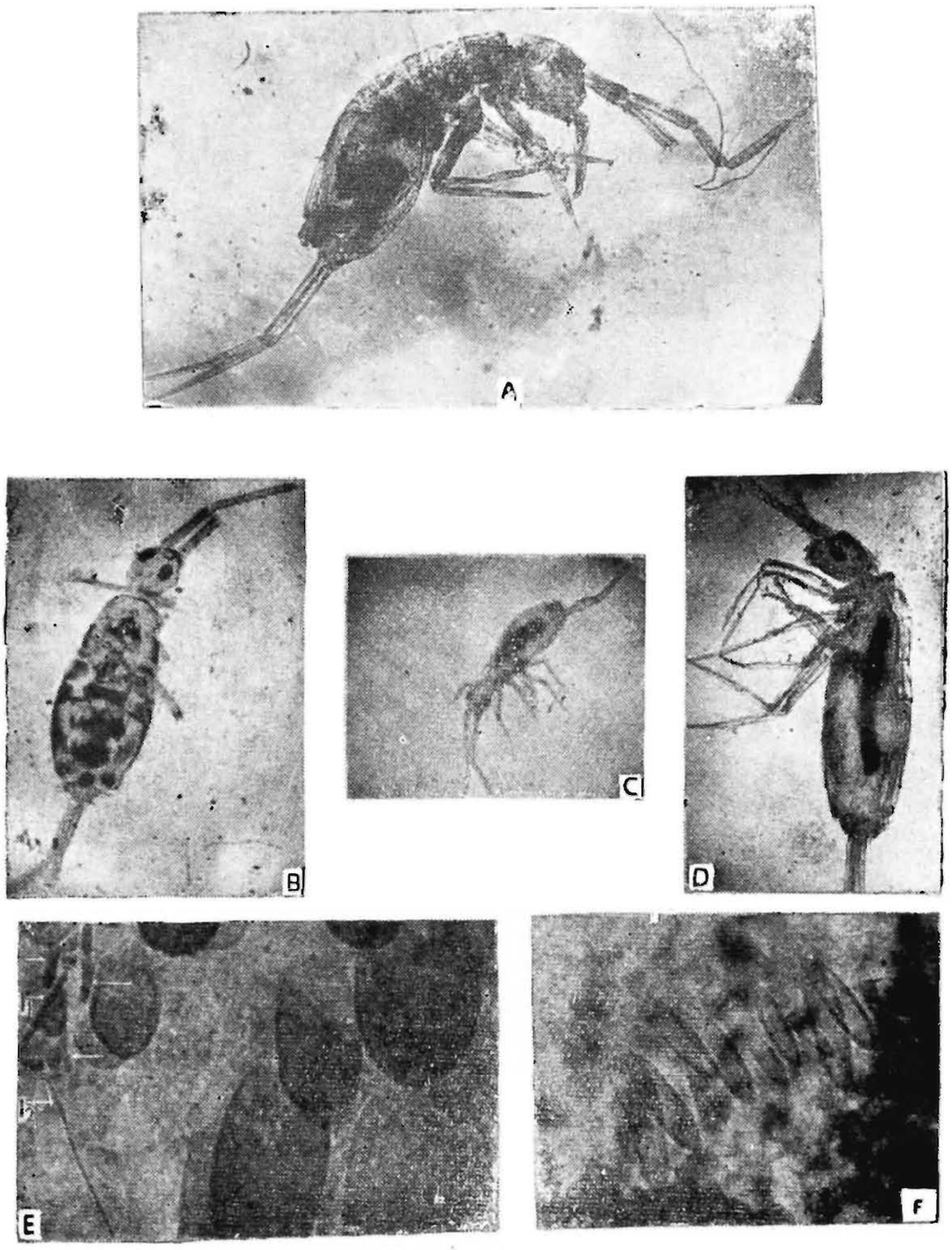

Plate I. *Pseudoparonella* (*Pseudoparonella*) *appendiculata* (Schött). A, Paralectotype, now designated as lectotype (Slide No. 4177, Swedish Museum Natural History, Stockholm) ; C, labelled as lectotype (Juvenile) [now amended and designated as paralectotype, slide No. 4175, Swedish Museum Natural History, Stockholm].

Pseudoparonella (*Lawrenceana*) *queenslandica* (Schött), B, Paralectotype (Slide No. 1291, Swedish Museum Natural History, Stockholm) ; D, Lectotype (Slide No. 4178, Swedish Museum Natural History, Stockholm) ; F, Psedoscales from Abd. III.

Lepidonella incerta (Handschin), n. comb. E. Typical scales and accessory scales near huse of lasiotrichia (1_1 and 1_2) from Abd. IV.

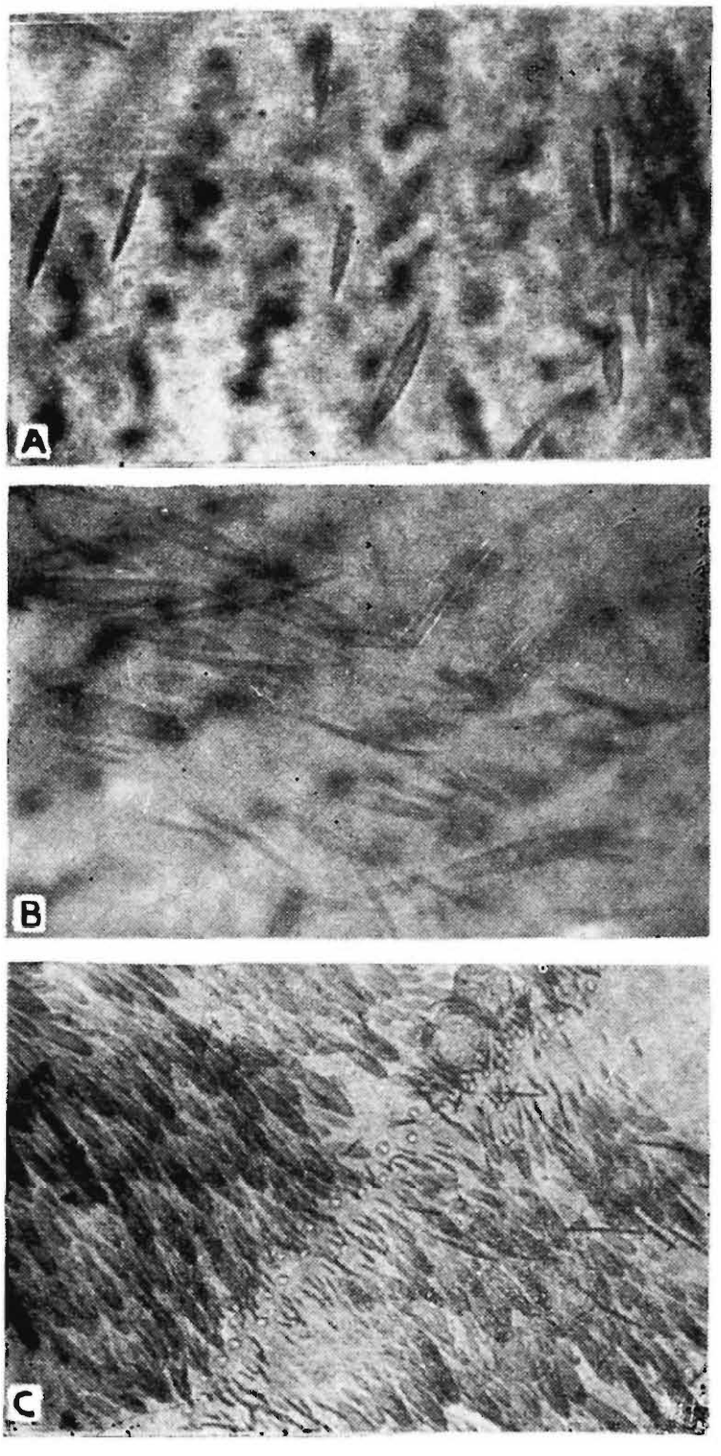

Plate II. A, Pseudoscales from Abd. IV of *Pseudoparonella* (*Lawrenceana*) *queenslandica* (Schött) ; B, Pseudoscales from Abd. IV of *Pseudoparonella* (*Pseudoparonella*) *appendiculata* (Schött) ; C, Pseudoscales and scale-primordia from Abd. IV in *Dicranocentroides flavescens* Yosii.

the total length of body and outstretched furca ; number of antennal segments and their ratio variable, individuals with 3 segmented antennae frequent, relative length index of Ants. I : II : III+IV=*c.* 31 : 43 : 79 and Ants. I : II : III : IV=*c.* 30 : 39 : 78 : 76 ; Ant. IV secondarily annulated, apically with a consipcuous sense-knob guarded

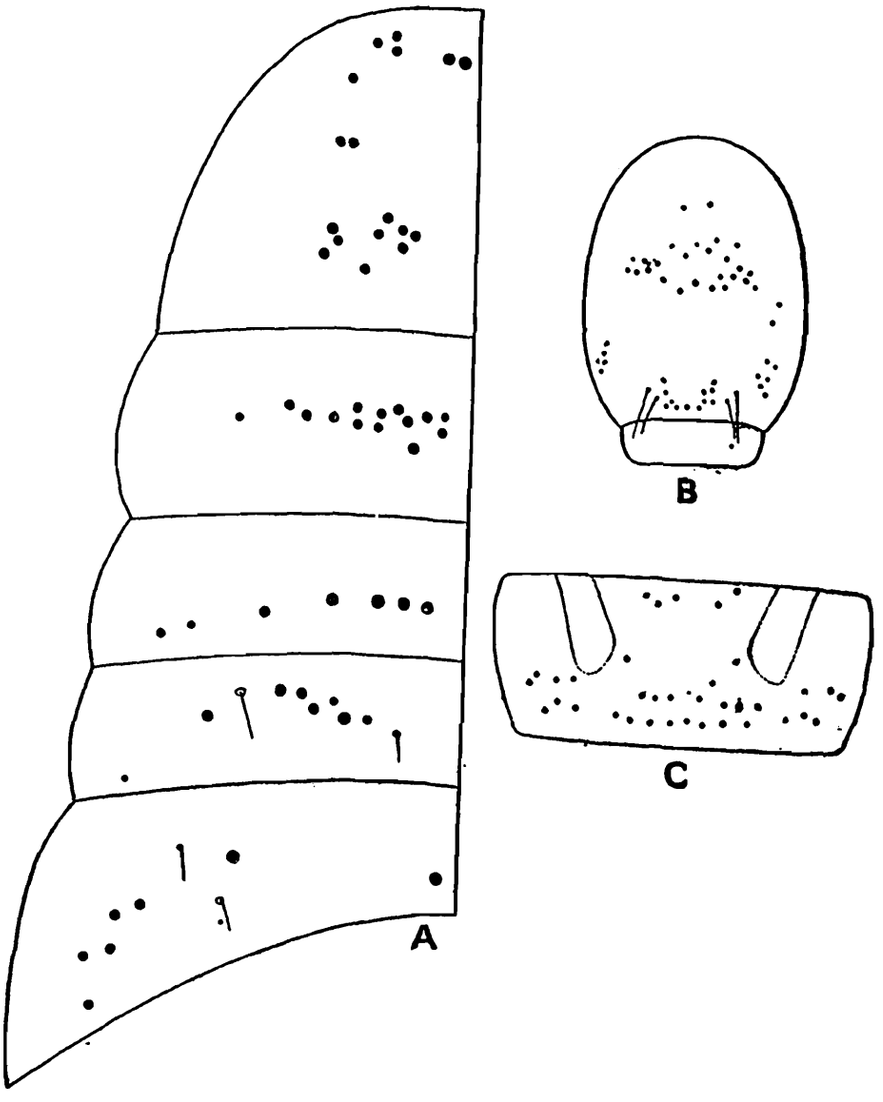

Fig. 11. Body chaetotaxy of *Pseudoparonella* (*Lawrenceana*) *queenslandica* (Schött).

with some erect smooth setae ; prelabral and labral setae slender, prelabral setae 4, smooth, labral setae 5, 5, 4, smooth, no ledges or tubercules observed near anterior margin of labrum, border of anterior margin irregular ; labium medially on each side with a stout spine-like seta (Fig. 8, D).

Thorax : Relative length index of Ths. II : III=11 : 8 ; tibiotarsi usually divided distally ; fore unguiculi relatively small, lanceolate, paired inner basal teeth of fore unguis usually feebly developed ; mid and hind unguiculi large, lanceolate, nondentate, paired inner basal ungual teeth well developed on mid and hind ungues, in addition, an unpaired tooth ocurs at the three-fourth distally on inner margin of all ungues,

external basolateral teeth present; tenent hair well developed, clavate; tibiotarsal lobes overhanging the base of unguiculi well developed (Fig. 9, A, B); trochanteral organ well developed with *c.* 68 spines (Fig. 9, C).

Abdomen: Relative length index of Abds. I : II : III : IV : V : VI=5 : 6 : 5 : 4 : 29 : 4 : 2; ventral tube long, anterior face anteriorly with 4+4 macrochaetae, rest of the surface with numerous microchaetae, posterior face with many microchaetae interspersed with certain long feeble setae rami of retinaculum each with 4 teeth, corpus with a median seta; furcula long, relative length index of manubrium : mucrodens= 21.6 : 28; mucro apically located on dentes, usually distinctly demarcated, bidentate; presence of 2 dental spiny appendages ascertained, in most examples, from the two large sockets, located dorsally above the base of each mucrone; a row of delicate spine like setae was observed in one paralectotype (Slide No. 1291) (Fig. 9, D, E).

Length (excluding appendages): 2-3.5 mm.

Type-specimens: All the specimens of the species (mentioned above under material) belong to the type-series as evident from the date available from the labels of the specimens. However, excluding lectotype (Slide No. 4178), only two other slides Slide Nos. 1285 and 1286) are labelled as "Paratypes". It is, however, not known as to who selected and designated the lectotype. The lectotype and paralectotypes are preserved in the Swedish Museum Natural History, Stockholm, Sweden.

Type-locality: The specimens of *Pseudoporonella* (*Lawrenceana*) *queenslandica* were were collected by E. Mjöberg from several localities of Queensland, Australia. The present investigator takes this opportunity to select "Logan village", South Queensland, Australia, as the type-locality of the species, which happens to be the locality of the lectotype.

Comparisons: The species exhibits considerable colur variations although such variants do not differ significantly from each other in important morphological charcters. Certain colour variants come close to a few species which were described by subsequent workers as new to science. The type-species can be easily discriminated from others by its bidentate mucrones and chaetotaxy of body.

Interrelationships: *Lawrenceana* apparently appears close to *Parachaetoceras* in the nature of mucrones which are bidentate and apically located on dentes but distinctly differs from it in the absence of dental apines, simple nature of prelabral setae and in the absence of dark, stiff outstanding macrochaetae on antennae and appendages. It resembles and differs from *Dicranocentroides* in the characters as mentioned under the interrelationships of the sub-genus *Pseudoparonella*.

Distribution: Species belonging to the sub-genus *Lawrenceana* are chiefly distributed in the oceanic islands of the Australian Region. Only one species (type-species) is so

far known from the main territory of Australia. From the present state of knowledge, they appear to be absent in the Oriental Region and New Zealand. Besides the type-species following species are to be included in this subgenus : *P.* (*L.*) *dahli* (Schäffer, 1893), n. comb. from Bismarck Archipelago and New Guinea ; *P.* (*L.*) *dahli tamarensis* (Schött, 1901), n. comb. from New Guinea ; *P.* (*L.*) *cheesmani* (Womersley, 1937), n. comb. from New Guinea ; *P.* (*L.*) *bougainvilleae* (Yosii, 1960) from Solmon and Bougainville Islands ; *P.* (*L.*) *queenslandica flavotruncata* Yosii, 1960 from Caledonia and *P.* (*L.*) *novaecaledoniae* Yosii, 1960 also from New Caledonia.

ACKNOWLEDGEMENTS

I am thankful to the authorities of the South Australian Museum, Adelaide and Swedish Museum of Natural History, Stockholm for permitting me to study the type-specimens and other collections, dealt with in this investigation.

Thanks are also due to the Director, Zoological Survey of India, for providing facilities for this study.

SUMMARY

The concept of *Pseudoparonella* Handschin, 1925, a heterogeneous genus from the Oriental Region, is redefined and precised on the basis of the examination of the type-specimens and other collections of the species, assigned to this genus at different times by various workers in the past.

It is seen that *Pseudoparonella sensu* Handschin is a member of Callyntrurini and two subgenera under *Pseudoparonella* are now recognised in this investigation.

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POLYDACTYLUS KONADAENSIS A NEW THREADFIN FISH FROM INDIA WITH A KEY TO SPECIES OF THE POLYNEMIDAE OF INDIA

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INTRODUCTION

In pursuance of the approved programme of work, a coastal survey has been conducted in the Kakinada-Gopalpur sector, East coast of India during which two adult specimens of the family Polynemidae belonging to the genus *Polydactylus* have been collected from the inshore water near Konada (18.0°N, 83.6°E), north of Visakhapatnam, Andhra Pradesh by shore seining. These specimens differ from all the so far known species of the genus (Day, 1878 ; Weber and de Beaufort, 1922 ; Munro, 1955 ; Misra, 1959 ; Hida, 1967 ; Kagwade, 1970 ; Anonymous, 1974 ; Girija Kumari *el al.* 1983-84 ; Menon and Babu Rao, 1984 ; Talwar and Kacker, 1984 ; Talwar and Jhingran, 1991). They are described here as a new species under the name *Polydactylus konadaensis*. The present description of a new species most probably pertains to an endemic stock since it shows close similarities to *P. sexfilis* (Val.) and dissimilarities possibly due to adaptation.

SYSTEMATIC ACCOUNT

Polydactylus konadaensis sp. nov.

(Plate 1)

Material and methods : Two adult females collected by shore seining, preserved in formaldehyde.

Diagnosis : A *Polydactylus* attaining a standard length of 105.5 mm ; 6 filamentous pectoral rays of which upper 5 extending beyond the tip of pelvic fin ; all upper pectoral rays simple ; no air bladder and pyloric caecae 16 in number.

Range : Konada, Andhra Pradesh, India.

Description : Br. st. vii ; D1. VIII ; D2. I.12 ; A. III. 11 ; P. 15+6 ; V. I.5 ; C. 17 ; L.1. 49 ; L. tr. 5/10 ; g.r. 18+21. Height 3.2-3.3 in S.1., 4.3-4.4 in T.1. Head about 3.25 in S.1., 4.3-4.4 in T.1. Eyes about 4.0 in head, 0.8-0.9 apart and 2.2-2.3 in post-orbital part of head. Inter-orbital space convex. Snout short, 1.3 in eye. Maxillary scaly, 1.8-1.9 in head. Head covered with scales to the end of snout. Anterior and posterior nostrils close together, close to eye. Preoperculum coarsely serrated, lower denticulations stonger. Angle of preoperculum produced and rounded.

Upper lip absent, lower lip well developed but not continuous at symphysis. Narrow bands of villiform teeth on jaws, palatines and vomer. Lateral line more or less straight, a short spine at the beginning of it. Origin of first dorsal in between pectoral and ventral, above the 6th lateral line scale. First dorsal spine minute ; second one stronger but shorter (1.5) than the third spine, 1.2 to 1.4 in post-orbital part of head but equal or more than the eye and snout together. Third spine almost 2/3 of body depth. Origin of second dorsal before that of anal. Spine of second dorsal more than 2/3 of second spine of first dorsal, longer than the longest anal spine. First anal spine minute. Free border of second dorsal is a bit falcate and of anal almost straight. Caudal 3.8-4.0 in T.l., deeply forked with pointed lobes. Pectoral fins inserted low on body, upper part of its base well below midline of body. Pectoral as long as head without snout, all rays of upper part of pectoral simple. Free pectoral filaments, except the last one, extending beyond the tip of ventral and the longest reaching anal. Ventral equal or shorter than post-orbital part of head, 1.8-2.0 in head. Distance between origin of anal and ventral lesser than head. Least depth of caudal peduncle almost 2/3 of its length and almost half of the head length. Dorsal, anal and caudal scaly. Body covered with moderate size ctenoid scales. Pyloric caecae 16 in number. No air bladder.

Colour : Golden, pectoral black, pelvic dark in the middle, first dorsal uniformly pigmented black, anal dusky, dorsals and caudal with black margins. No black blotch at the beginning of lateral line. Formalin preserved specimens yellow, brownish above.

Detailed measurements of the holotype and paratype are given in Table 1.

Holotype : ZSI/MBS-F-631, ♀, S. l. 105.5 mm ; Konada, Andhra Pradesh ; shore seine ; S. Krishnan and S. S. Mishra ; 07 iii 1992.

Paratype : ZSI/MBS-F-632, ♀, S. l. 96.0 mm ; other data similar to holotype.

Relationships : Some of the meristic characters of the species under description in relation to the other existing species with simple upper pectoral rays and six free filamentous pectoral rays known from the Indo-west Pacific region are presented in Table 2.

Some of the pectoral rays are branched in *P. sextarius* (Bloch and Schneider) and *P. xanthonemus* (Val.) where as in *P. konadaensis* sp. nov. all pectoral rays are simple. In *P. hexanemus* (C. & V.), *P. kuru* (Bleeker), *P. pfeifferi* (Bleeker) and *P. sexfilis* (Val.) also all the upper pectoral rays are unbranched. In *hexanemus*, the pectoral is longer than head while the species under description has pectoral shorter than head. In *kuru*, lateral line scale count is more (62-68) whereas in *konadaensis* it is less (49). Due to the presence of smaller eye, shorter caudal lobe, more upper pectoral rays and absence of air bladder it differs from *pfeifferi* which has not been reported in the Indian waters so far.

Because of the presence of a more or less comparable number of spines, fin rays, branchiostegal rays and transverse scales ; upper part of pectoral having unbranched rays ; golden body colour, black pectoral and pelvic being dark at the middle, *konadaensis* is comparable to *sexfilis* but variations like (i) higher number of scale in the lateral line (49) ; (ii) lesser height (4.3.) ; (iii) shorter caudal fin (3.8-4.0) ; (iv) bigger eye (4.0) ; (v) incomparably lesser number of pyloric caecae (16) ; (vi) presence of dusky anal fin without black margin ; (vii) upper five of free filamentous rays extending beyond pelvic fin tip (2 in *sexfilis*) ; (viii) absence of air bladder warrant erection of a

Table 1. Measurements of the Holotype and Paratype (in mm)

Characters		Holotype	Paratype
1. Total length	...	142.5	128.0
2. Standard length	...	105.5	96.0
3. Body depth	...	32.5	29.2
4. Head length	...	32.2	29.5
5. Snout length	...	6.2	5.5
6. Eye diameter	...	8.0	7.5
7. Inter-orbital width	...	7.0	6.0
8. Post-orbital length	...	18.0	16.5
9. Least depth of caudal peduncle	...	15.0	14.0
10. Length of caudal peduncle	...	22.0	20.0
11. Length of 2nd dorsal fin base	...	19.8	18.0
12. Length of anal fin base	...	21.5	19.0
13. Length of caudal lobe	...	37.0	32.0
14. Length of pectoral fin	...	26.5	23.5
15. Length of pelvic fin	...	16.5	16.5
16. Anal-ventral interspace	...	24.5	23.0
17. Length of maxillary	...	17.0	16.0
18. Length of 2nd spine of 1st dorsal	...	13.0	13.0
19. Length of 3rd spine of 1st dorsal	...	19.5	19.5
20. Length of the spine of 2nd dorsal	...	9.4	9.0
21. Length of the longest (3rd) anal spine	...	8.0	8.0

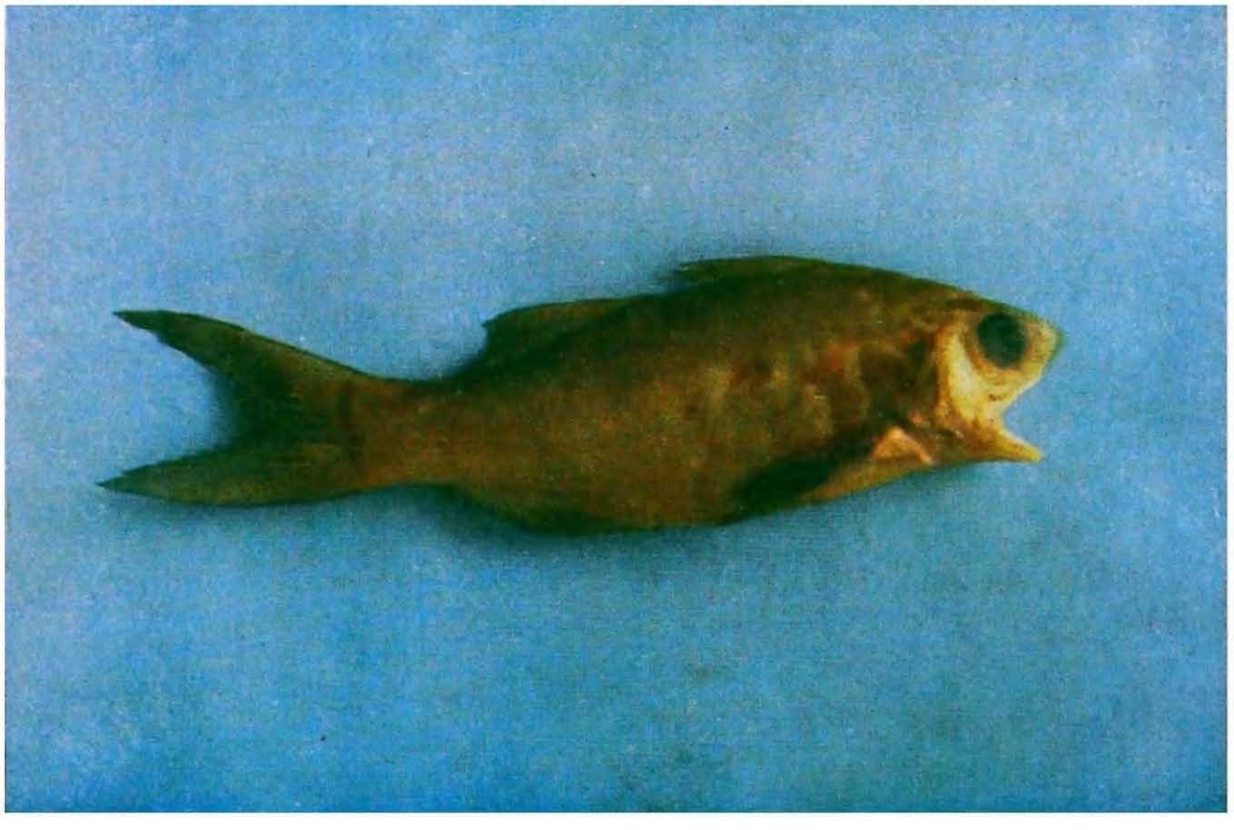
Table 2. Comparison of fin ray and scale counts, measurement ratios and other characters in five species of *Polydactylus*.

Sl. No.	Characters	*konadaensis*	*sexfilis*	*pfeifferi*	*kuru*	*hexanemus*
1.	Soft dorsal rays	12	12-13	11-12	13	12
2.	Anal rays	11	11-12	11	11	11
3.	Simple rays of upper pectoral	15	15	12-14	15-16	13-14
4.	Lateral line scales	49	46	48-50	62-68	47-48
5.	Transverse scales	5/10	5/10	5/10	6/10	5/10
6.	T. l/depth	4.3-4.4	4.5	4.4	4.7-4.8	3.2-4.2
7.	S. l/depth	3.2-3.3	3.3	3.2	3.4-3.5	—
8.	T. l/head	4.3-4.4	4.3	4.5-5.0	4.3-4.7	3.8-4.9
9.	S. l/head	3.25	3.2	3.3	3.0-3.5	—
10.	T. l/caudal	3.8-4.0	3.5	3.7	3.3-3.7	>3.3
11.	Head/eye	4.0	4.5	3.0-3.3	3.2-3.7	3.8
12.	Head/maxillary	1.8-1.9	—	1.75-2.0	2.1-2.3	—
13.	Pectorals	<head	<head	<head	<head	>head
14.	Interorbital space	convex	—	flat	convex	—
15.	Air bladder	absent	present	present	present	?
16.	Pyloric caecae	16	numerous	?	?	?
17.	Free pectoral rays	5 extending beyond ventral fin ; longest close to anal	2 extending to ventral fin tip	longest reaching well on anal	first surpassing ventral tip	longest (4th) reaching to caudal base
18.	Anal fin colour	dusky ; margin not black	free margin black	dusky	hyaline	?

new taxon at the species level. Quite interestingly Day (1878, 1898) found a large air vessel in *sexfilis* and recorded that Cuv. & Val. (1831) reported the absence of it. Gunther (1860) similarly observed that *sexfilis* does not have air bladder but Kagwade (1970) reported the presence of a large air bladder.

MISHRA & KRISHNAN

Plate 1



Polydactylus *Konadaensis* sp. nov.

In order to accommodate *P. sheridani* (Macleay) reported by Girija Kumari *et al* (1983-84) and *P. konadaensis* sp. nov. a revised working key for the identification of Indian species of polynemids is given below. It is clear that Talwar and Kacker (1984) have mistaken *sexfilis* for *kuru*.

Key to species of the Polynemidae of India

1 (a) Lower lip absent except towards the rictus (mouth corners) ; teeth extending on exterior part of jaws ; free pectoral filaments 4. ... ... *Eleutheronema tetradactylum*

(b) Lower lip well developed extending far forward except at the symphysis ; no teeth on exterior part of jaws ; 5 to 7 free pectoral filaments. ... 2

2 (a) Pectoral inserted high on body, upper part of its base in level with middline of body or higher ; without a sharp pectoral fold extending down from lower part of base of pectoral fin to cover bases of one or more pectoral filaments ; free pectoral filaments 7, very long, extending beyond caudal fin tip. ... 12

(b) Pectoral inserted low on body, upper part of its base well below midline of body ; a sharp fold of skin projecting downward or forward from lower end of base of pectoral fin and covering base of one or more of pectoral filaments ; free pectoral filaments 5 to 7, rather short. ... 3

3 (a) Pectoral fin with 5 free filamentous rays. ... 4

(b) Pectoral fin with more than 5 filamentous rays. ... 7

4 (a) A distinct dusky blotch present at the beginning of lateral line above the pectoral fin ; scales on lateral series 47 to 50. ... *Polydactylus microstoma*

(b) No dusky shoulder blotch ; scales on lateral series 60 to 75. ... 5

5 (a) Eyes large, 3.8 to 4.0 in head length ; caudal lobe not prolonged into filament ; body with dark narrow stripes along scale rows ; upper pectoral rays simple. ... *Polydactylus plebius*

(b) Eyes small, about 7 times in head length ; caudal lobes prolonged into filaments ; no stripes along scale rows. ... 6

6 (a) Upper pectoral rays simple ; pelvic-anal interspace nearly equal to head. ... *Polydactylus sheridani*

(b) Upper pectoral rays mostly branched ; pelvic-anal inter-space more than head. ... *Polydactylus indicus*

7 (a) Pectoral fin with 6 free filamentous rays. ... 8

(b) Pectoral fin with 7 free filamentous rays which are short extending to anal fin. ... *Polydactylus heptadactylus*

8 (a) Upper pectoral rays mostly branched. ... 9

(b) Upper pectoral rays simple, unbranched. ... 10

9 (a) A large black blotch at the beginning of lateral line ; free pectoral filamentous rays extending to the tip of pelvic fin. ... *Polydactylus sextarius*

(b) No black blotch at the beginning of lateral line ; free pectoral filamentous rays extending beyond tip of the pelvic fin. ... *Polydactylus xanthonemus*

10 (a) Lateral line scales above 60 ; body silvery with narrow brown lines along scale rows ; none of the free pectoral filamentous rays reaching to the pelvic fin tip. ... *Polydactylus kuru*

(b) Lateral line scales 50 or less ; body golden in colour. ... 11

11 (a) Eye 4.5 times in head length ; caudal 3.5 times in total length ; anal fin with black margin ; upper 2 pectoral filamentous rays reaching to tip of pelvic fin or extending beyond. ... *Polydactylus sexfilis*

(b) Eye 4.0 times in head length ; caudal 4.0 times in total length ; anal fin dusky, without black margin ; upper 5 free filamentous pectoral rays extending beyond tip of the pelvic fin, the longest reaching annal fin. ... *Polydactylus konadaensis*

12 (a) 3 upper pectoral filamentous rays extending far beyond caudal fin tip. ... *Polynemus paradiseus*

(b) 2 upper pectoral filamentous rays extending far beyond caudal fin tip, the third reaching only to the tip of the caudal fin. ... *Polynemus longipectoralis*

Summary

A new species of polynemid fish *Polydactylus konadaensis* collected from Konada, Andhra Pradesh is described. A working key for the polynemid fishes of the Indian waters is provided.

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ON THE SPECIES *CAPRITERMES FLETCHERI* HOLMGREN & HOLMGREN AND *EUTERMES INCOLA* WASMANN (ISOPTERA : TERMITIDAE : TERMITINAE) : THEIR STATUS, DESCRIPTIONS, ETC.

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INTRODUCTION

Holmgren and Holmgren (1917) described the species *Capritermes fletcheri* from material which on examination has been found to belong to two differsnt genera viz. *Dicuspiditermes* Krishna and *Pseudocapritermes* Kemner as we know them today. The material was from three different localities such as Puthupadi Forest (Malabar, Kerala), Anamalai Hills (Tamil Nadu) and Bababudin Hills (Karnataka). A detailed study of all the type material of the species (*C. fletcheri*) available and that of other related species as well as of a large undetermined collection of these two genera has revealed that *Capritermes fletcheri* Holmgren and Holmgren actually belongs to the genus *Pseudocapritermes*. It is also seen that the species *P. fontanellus* Mathur and Thapa, *P. goanicus* Chatterjee and Thakur and *P. roonwali* Verma are its junior synonyms. The species *Dicuspiditermes fletcheri* (Holmgren and Holmgren) as has been referred to in recent literatures, is in fact *D. incola* (Wasmann). The details of the study are given here in this paper.

ABBREVIATIONS USED

FRI, Forest Research Institute, Dehra Dun ; IARI, Indian Agricultural Research Institute, New Delhi ; Im, imago ; NHM, Natural History Museum, Masstricht ; S, soldier ; W, worker ; ZSI, Zoological Survey of India, Calcutta.

MATERIAL EXAMINED

A. *In Zoologicol Survey of India (ZSI)*

1. A vial with one S and 6 W (damaged, head separated from body) labelled *Capritermes fletcheri*, Anamalai Hills, coll. Fletcher, 22.i.1912, ex "colony and dead log", also with two separate lables of "cotype" and "det. Nils Holmgren". Redet. G. Bose (1984) as *Procapritermes fontanellus* Mathur and Thapa. This is the same collection as (2) of "*Capritermes fletcheri* n. sp." vide Holmgren and Holmgren, 1917, page 169. Now determined (O. B. Chhotani, 1992) as *Pseudocapritermes fletcheri* (Holmgren and Holmgren) and soldier designated 'Lectotype'.

2. A vial with one S and one W (damaged) of *Capritermes fletcheri*, Bababudin Hills, Mysore State, *T. B. Fletcher* coll., 12.xi.1912, ex "galleries and chambers 2-10" below soil at roots of coffee" also with a loose lable of "cotype". This meterial was received by FRI from IARI and one S and one W from FRI was donated to ZSI. This material is same as (3) of *Capritermes fletcheri* n. sp. "vide Holmgren and Holmgrem, 1917, p. 169. Now determined (O. B. Chhotani, 1992) as *Dicuspiditermes incola* (Wasmann).

3. A vial with 4 S and 4 W, labelled as *Capritermes incola* Wasmann, Bababudin Hills. Mysore State, coll. Flecher, with a loose label of "det Nils Holmgren". This is the same material as (3) of *Capritermes incola Wasm.* vide Holmgren and Holmgren, 1917, p. 170. Now determined (O. B. Chhotani, 1992) *Dicuspiditermes incola* (Wasmann).

4. Several vials with S and W, det. G. Bose (1984) as *Procapritermes fontanellus* Mathur and Thapa, now det. *Pseudocapritermes fletcheri* (H. & H.) ; and as *Dicuspiditermes fletcheri* (Holmgren and Holmgren) now det. *D. incola* (Wasm). Also several undetermined collections of S and W of *Pseudocapritermes* from Karnataka, Tamil Nadu and Kerala states and of *Dicuspiditermes* from Maharashtra, Tamil Nadu, Kerala and Karnataka (one with imagoes only). These are now determined as *Pseudocapritermes fletcheri* (Holmgren and Holmgren) and *Dicuspiditermes incola* (Wasmann).

5. Paratypes of *Pseudocapritermes fontanellus* Mathur and Thapa and of *P. goanicus* Chatterjee and Thakur and holotype of *P. roowali* Verma. Now det. *P. fletcheri* (Holmgren and Holmgren).

B. *In Indian Agricultural Research Institute, New Delhi (IARI)*

A vial with 7 W having three labels : 1. "Malabar Dt., Puthupadi Forest, under rotting bamboo, Y. R. coll., 22.I.13". 2. "Fletcher coll. AAD Malabar". 3. "*Capritermes sp.*" These are surely syntypes of *Capritermes fletcheri* Holmgren and Holmgren though not labelled as such the data tallies with No. (1) of *Capritermes fletcheri* n. sp." vide Holmgren and Holmgren, 1917, p. 169. Now det. *Pseudocapritermes fletcheri* (Holmgren and Holmgren).

C. *In Wasmann Collection at Natural History Museum, Masstricht (Holland)*

Three dealate imagoes (paratypes ? of *Eutermes incola* Wasmann) on one pin with two labels : (1) "Colombo Redeman" and (2) "b. Termes Redemani". These specimens are same as those of "Case V : Ceylon, Colombo, collected by A. Redemann ("bei *Termes Redemanni*"), determined by E. Wasmann (winged, dealated). In the collection on indication, same colony as Holotype *incola*, labeled van Boven, 1967". This is as given by van Boven (1969) in the list of types in Wasmann Collection, but there is no label by van Boven on the specimens.

One S and one W (paratype of *Capritermes longicornis* Wasmann), on one pin, with three labels : 1. Khandala (Bombay). 2. Assmuth *30*, Bombay. 3. *Capritermes longicornis* Wasm. The third label is in red ink.

OBSERVATIONS AND RESULTS

A. On *Capritermes fletcheri* Holmgren and Holmgren :

While studying the *Capritermes*—complex genera of the Indian Region it was noticed that the material from which Holmgren and Holmgren (1917) described the species *Capritermes fletcheri* came from three localities viz. Puthupadi Forest (Malabar, Kerala), Anamalai Hills (Tamil Nadu) and Bababudin Hills (Karnataka). These on study have been found to belong to two different genera i.e. *Dicuspiditermes* Krishna and *Pseudocapritermes* Kemner as we know today.

Since the original material of the species belongs to two genera and while going through the description of Holmgren and Holmgren (1917) it was observed that their description and measurements of the soldier of the species *Capritermes fletcheri* were actually based on the Anamalai Hills and Puthupadi Forest material and not on the Bababudin Hills specimens. In the description, the authors mention "Fontanelle punctiform. Labrum long, considerably longer than broad, deeply incised anteriorly. "Mandibles shorter than head. Antennae 14-jointed, third joint almost as long as second, fourth shorter than third" All these are the characters of *Pseudocapritermes* soldier, as such the species *Capritermes fletcheri* Holmgren and Holmgren is transferred to the genus *Pseudocapritermes* and that the Anamalai Hills and Puthupadi Forest specimens taken as the syntypes of *Pseudocapritermes fletcheri* (Holmgren and Holmgren) and the soldier from the Anamalai Hills collection in the ZSI is designated as the Lectotype. The third or the Bababudin Hills collection soldiers, besides being larger in size than the measurements given by the authors, have been seen to have (i) deeply incurved anterior margin of the labrum with short processes (serrations) on antero-lateral margin, (ii) the mandibles almost as long as head and (iii) the antero-lateral corners of head produced into pointed cusps. These are the characters of *Dicuspiditermes* and there is no such mention of these characters in the authors' description of the species.

Evidently the authors had the Anamalai Hills and Puthupadi Forest specimens before them while drawing up the description of *C. fletcheri*. Moreover it may be mentioned that Holmgren and Holmgren (1917, p. 170) had another collection from Bababudin Hills which was included under *Capritermes incola* (Wasm.). It was very probably an inadvertent mistake that the collection taken as syntypes of *Capritermes fletcheri* from Bababudin Hills was referred under this species.

On comparison of the paratypes of *Pseudocapritermes fontanellus* Mathur and Thapa and the now designated lectotype of *P. fletcheri* (Holmgren and Holmgren), it has been

found that *P. fontanellus* is synonymous with *P. fletcheri*. Also on examination of other collections of presently determined *P. fletcheri* it was observed that the characters on the basis of which the species *Pseudocapritermes goanicus* was described by Thakur and Chatterjee (1969) fall within the range of variations of the species *P. fletcheri* (Holmgren and Holmgren). Thakur and Chatterjee (1969) separate *P. goanicus* soldier from that of *fontanellus* (now a synonym of *fletcheri*) for having comparatively smaller fontanelle gland, for second segment of antenna subequal to third vs longer than third and different head indices. The variation in the size of fontanelle gland (Fig. 2) is shown in the figures of soldier head from two different collections from Periyar Lake (Kerala) and Mercara (Karnataka). The measurements also fall within the range of variation (Table 1). The species *P. goanicus* Thakur and Chatterjee (1969), therefore, is relegated to the synonymy of *Pseudocapritermes fletcheri* (Holmgren and Holmgren). The characters on the basis of which the species *P. roonwali* is separated by Verma (1985) also fall in the range of variations of *P. fletcheri*, and as such *roonwali* is also relegated to the synonymy of *P. fletcheri* (Holmgren and Holmgren).

B. On *Eutermes incola* Wasmann :

The syntypes of *Capritermes fletcheri* Holmgren and Holmgren (1917) from Bababudin Hills (Karnataka) so determined by them and it being a larger collection got distributed to various museums in the course of time. These actually belong to the genus *Dicuspiditermes* Krishna and thus created some confusion in literature in respect of the identity of the species *fletcheri*. It is because of this that Krishna (1965, 1968) and Bose (1984) refer the species *fletcheri* to *Dicuspiditermes* whereas it actually is a *Pseudocapritermes* as discussed above.

On examination of the paratypes of *Eutermes incola* Wasmann [=*Dicuspiditermes incola* (Wasmann)] and *Capritermes longicornis* Wasmann (synonym of *incola* vide Holmgren, 1913 and Snyder, 1949), received from the Natural History Museum, Masstricht (Holland), it has been found that the Bababudin Hills syntypes of *Capritermes fletcheri* could not be separated from the paratype soldier of *Capritermes longicornis* Wasmann. As such, it was either a misidentification by Holmgren and Holmgren (1917) or the so named 'cotypes' by them were inadvertently placed under *Capritermes fletcheri* as mentioned above.

The collections so determined as *Dicuspiditermes fletcheri* by Bose (1984) and present in ZSI were re-determined as *D. incola* (Wasmann) (=*Eutermes incola* Wasmann). The paratypes of *Dicuspiditermes pername* Thakur and Chatterjee were also examined and redetermined as *D. incola* (Wasmann), therefore, the name *pername* is treated here as junior synonym of *incola*.

Due to all this confusion in the literature in respect of the species *Pseudocapritermes fletcheri* (Holmgren and Holmgren) and *Dicuspiditermes incola* (Wasmann), the species

are redescribed, giving detailed synonymies with their measurements and figures from the type material of the species, to clear the position.

REDESCRIPTION OF THE SPECIES

PSEUDOCAPRITERMES FLETCHERI (HOLMGREN AND HOLMGREN) AND DICUSPIDITERMES INCOLA (WASMANN)

Pseudocapritermes fletcheri (Holmgren and Holmgren)

Synonyms : *Pseudocapritermes fontanellus* Mathur and Thapa (1961), *P. goanicus* Thakur and Chatterjee (1969) and *P. roonwali* Verma (1985)]

(Figs. 1-3 ; Table 1)

1917. *Capritermes fletcheri* Holmgren, K. and Holmgren, N. *Mem. Dept. Agric. India*, **5** : 169.

S. W. Syntypes in ZSI, FRI, IARI, AMNH and probably in Holmgren collection, Naturhist, Riksmuseet, Stockholm, Type-localities. Puthupadi Forest (Malabar, Kerala), Anamalai Hills (Tamil Nadu) and Babadudin Hills (Karnataka). S from Anamalai Hills in ZSI now designated Lectotype and type-locality restricted to Anamalai Hills (Tamil Nadu).

1949. *Capritermes fletcheri* ; Snyder T. E. *Smiths. misc. Colls.*, **112** : 193. (Partim).

1953. *Capritermes fletcheri* ; Rattan Lal and Menon, R. D. *Cat. Indian Insects*, pt. 27 : 47. (Partim).

1958. *Capritermes fletcheri* ; Ahmed, M. *Biologia*, Lahore, **4** : 190.

1961. *Pseudocapritermes fontanellus* Mathur, R. N. and Thapa, R. S. *J. Timber Dry. Pres. Assoc.*, **7** : 3-7.

S. and W. Holotype : S in FRI. Type-locality : Top slip (Tamil Nadu). New synonymy.

1968. *Procapritermes fontanellus* ; Krishna, K. *Bull. Am. Mus. nat. Hist.*, **135** (Art. 5) : 303.

1969. *Pseudocapritermes goanicus* Thakur, M. L. and Chatterjee, P. N. *Orient. Ins.*, **3** (2) : 189-192.

S. and W. Holotype : S in FRI. Type-locality : About 1 km from Moleum Rest House towards Belgaon side, Moleum Forest Range, South Goa Forest Division, Goa, India. New synonymy.

1969. *Pseudocapritermes fontanellus* ; Thakur, M. L. and Chatterjee, P. N. *Orient. Ins.*, **3** (2) : 191.

1970. *Pseudocapritermes fontanellus* ; Roonwal, M. L. In : *Biology of Termites* (Eds. Krishna, K. and Weesner, F. M.) : 354.

1975. *Pseudocapritermes goanicus* ; Sen-Sarma, P. K. et al. *Wood Destroying Termites of India* (Final Tech. Rep. PL 480 Proj. No. A7-FS-58) : 2, 63.

1978. *Procapritermes fontanellus* ; Roonwal, M. L. *Z. ang. Ent.*, **85** : 19.

1981. *Pseudocapritermes fontanellus* ; Ahmad, M. *Pakistan J. Zool.*, **13** (1-2) : 20.

1981. *Pseudocapritermes goanicus* ; Ahmad, M. *Pakistan J. Zool.*, **13** (1-2) : 20.

1984. *Procapritermes fontanellus* ; Bose, G. *Occ. Pap. Rec. zool. Surv. India*, No. 49 : 155-157.

1984. *Procapritermes goanicus* ; Bose, G. *Occ. Pap. Rec. zool. Surv. India*, No. 49 : 155, 157-158.

1985. *Pseudocapritermes roonwali* Verma, S. C. *Indian J. For.*, **8** (3) : 179-180.

Holotype S in ZSI. Type-locality : Kottavasal, Kerala, India. New synonymy.

IMAGO : Unknown.

SOLDIER (Figs. 1 & 2 ; Table 1) : Head-capsule yellowish, fontanelle gland area creamy white ; antennae, legs and body creamish ; left mandible blackish, right reddish black. Head fairly and body densely hairy. Total body-length 4.00-5.50 mm.

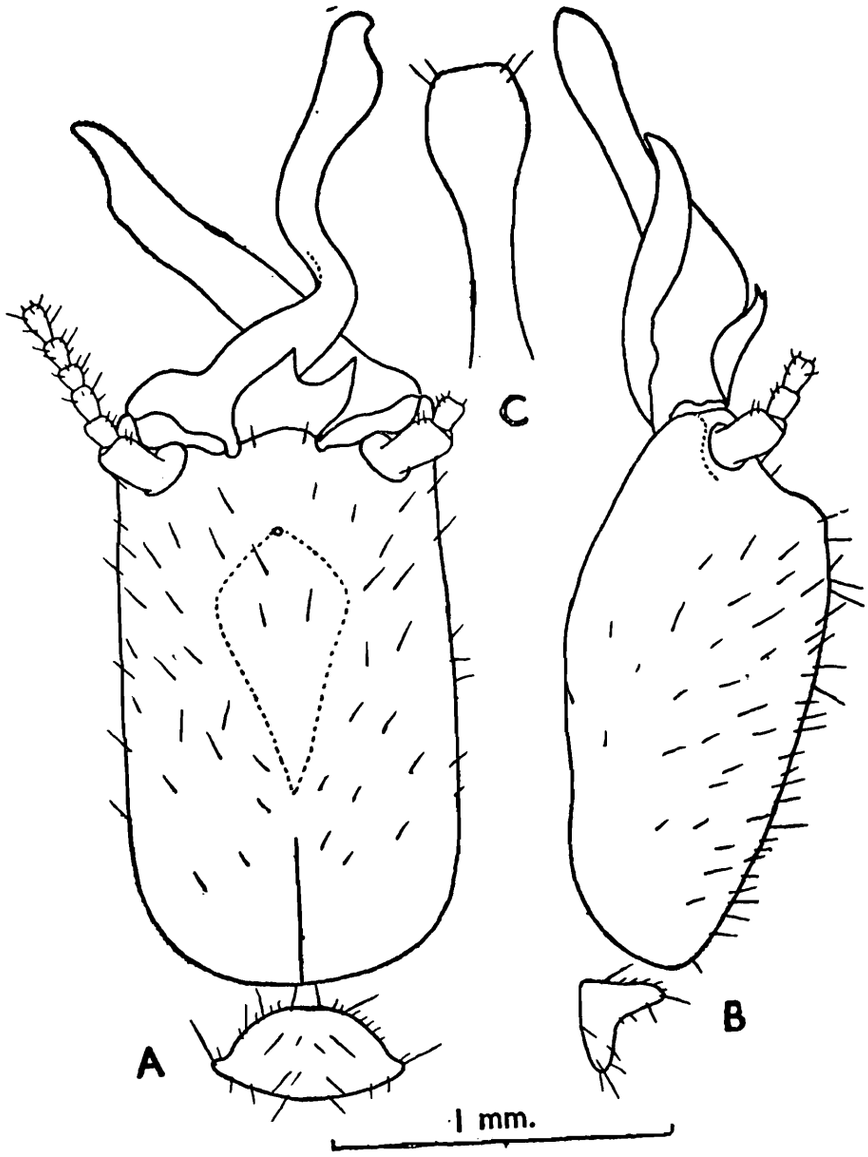

Fig. 1. *Pseudocapritermes fletcheri* (Holmgren and Holmgren). Lectotype soldier. Anamalai Hills, coll. Fletcher, 22.i.1912. A. Head and pronotum, dorsal view. B. Same, side view. C. Postmentum.

Head-capsule subrectangular, sides substraight ; width a little more than 3/4 of length to base of mandibles (length to base of mandibles 1.40-1.80, max. width 0.90-1.03 mm. index width/length 0.75-0.85) ; with a weak frontal projection ; sharply inclined in front at frons and weakly inclining behind ; median suture present, extending from posterior margin to about 1/3-1/2 of head-length. Fontanelle small, situated below frontal projection ; fontanelle gland variable in size (Fig. 2). Antennae with 14 segments ; segment 3 generally shorter than 2, club-like ; 4 generally shortest ;

sometimes segments 2 and 3 subequal, 4 a little shorter than 3. Labrum asymmetrical, sides convex ; anterior margin deeply incurved; antero-lateral corners projecting in front. Mandibles asymmetrical, subequal, shorter than head. Left mandible strongly twisted and with an incurved beak-like tip ; portion below tip strongly convex and swollen on inner margin and very broad at twist. Right mandible blade-like, with a

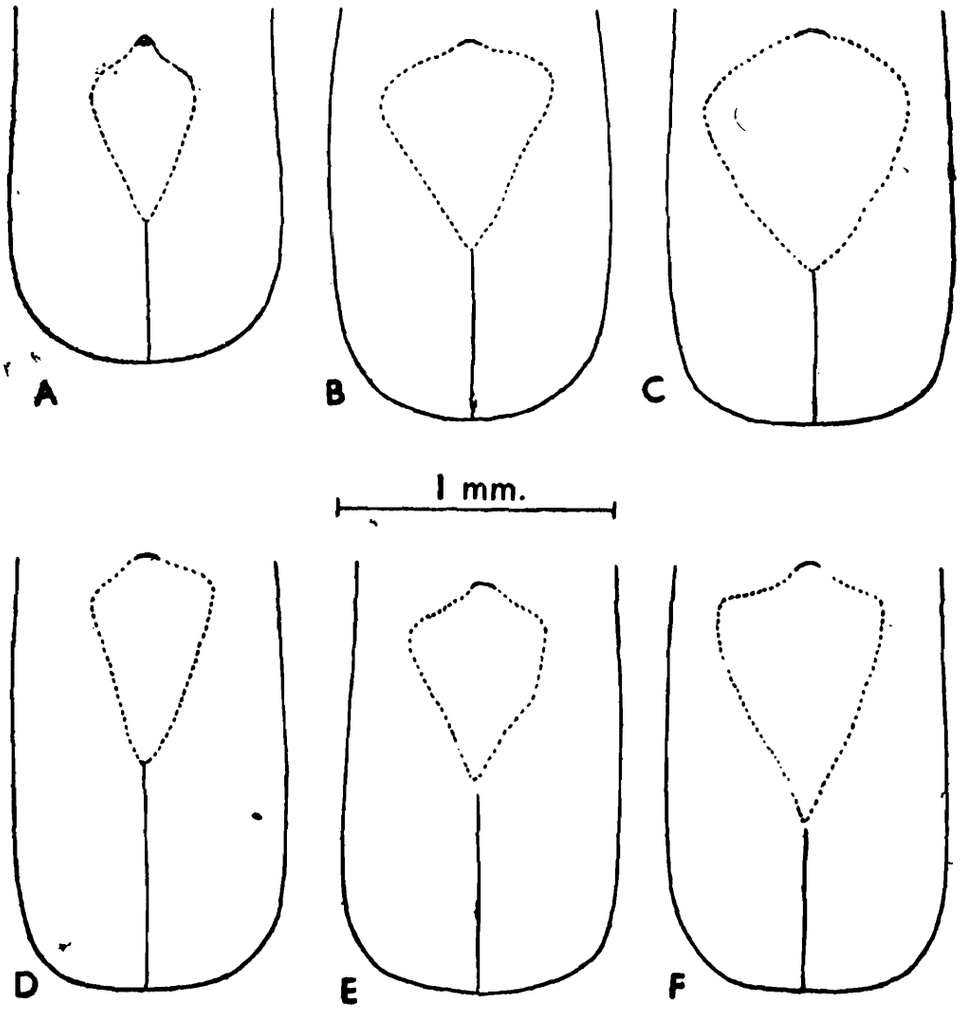

Fig. 2. *Pseudocapritermes fletcheri* (Holmgren and Holmgren). Variation in size of fontanelle gland in soldier. A-C. From specimens from Kuttikanam, Peermade (Kerala, India), coll. O. B. Chhotani, 3.iii.1969. D-F. From specimens from Mercara (Karnataka, India), coll. O. B. Chhotani, 20.xi.1962.

long incurved apical part ; outer margin weakly incurved in anterior half and inner margin near middle. Postmentum club-shaped ; waist lying below mid-point. Pronotum strongly saddle-shaped ; anterior and posterior margins faintly emarginate. Legs thin, long, hairy ; apical tibial spurs 3 : 2 : 2, dorsal spur on foretibia small ; tarsi 4-jointed. Abdomen elongate, hairy ; cerci 2-jointed ; styli absent.

WORKER (Fig. 3 ; Table 1) : Head, antennae and labrum pale yellow. Densely hairy. Total body-length 3.25-4.00 mm.

Head-capsule subcircular ; sides weakly narrowed behind ; broader than long. Fontanelle plate oval to subcircular. Antennae with 13-14 segments ; segment 3 in 13 segmented antennae sub-dividing ; in 14-segmented ones 3 and 4 short, 3 slightly longer than 4. Postclypeus swollen, less than half as long as wide, hairy ; medially divided. Labrum dome-shaped, hairy. Mandibles each with an apical and two marginals ; apical much larger than 1st marginal and angle between two wide. Left

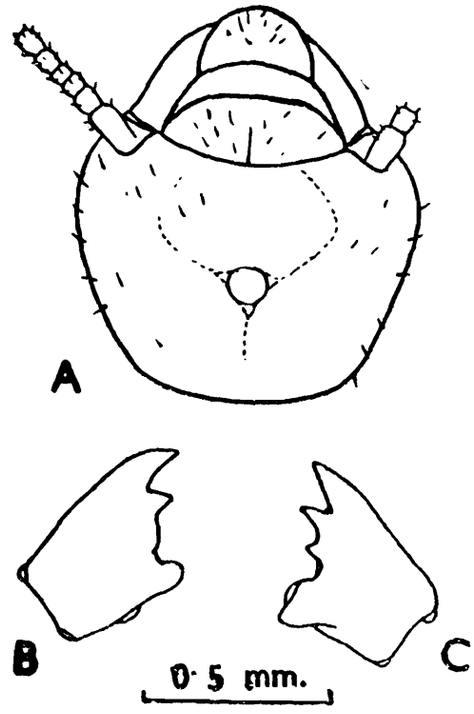

Fig. 3. *Pseudocapritermes fletcheri* (Holmgren and Holmgren). Letctomorphotype worker. Anamalai Hills, coll. Fletcher, 22.i.1912. A. Head, dorsal view. B. Left mandible, C. Right mandible

mandible with 2nd marginal rudimentary and separated from 1st by a long posterior margin of 1st ; molar projection extending up to about the level of 1st marginal ; index i. e. distance between apical and 1st marginal/distance between 1st and 2nd marginals c 0.80. Right mandible with 1st marginal having posterior margin slightly longer than anterior margin ; 2nd marginal small, with a long weakly incurved posterior margin ; molar plate longer than posterior margin of 2nd marginal. Pronotum strongly saddle-shaped ; anterior margin weakly notched. Legs short, hairy ; foretibia slightly swollen ; apical tibial spurs 3 : 2 : 2 ; tarsi 4-jointed.

Type-specimens : The soldier ex syntypes of *Capritermes fletcheri* Holmgren and Holmgren from Anamalai Hills, present in ZSI, is designated here as 'Lectotype' and workers as paralectotypes ; both in separate vials with ZSI Registration Nos. 3320/H 11 and 3321/H 11 respectively, deposited in National Zoological Collections, ZSI, Calcutta. The workers from Puthupadi Forest (syntypes), present in IARI, are also designated as paralectotypes and are deposited there.

TABLE 1. Measurements (in mm), etc. of *Pseudocapritermes fletcheri* Holmgren and Holmgren.

	Range (20 exs)	Lectotype soldier (Anamalai Hills, T. B. Fletcher, 22.i.1912) Det. N. Holmgren *Capritermes fletcheri*
SOLDIER		
Total body-length c	4.00-5.50	5.40
Length of head with mandibles	2.50-3.00	2.70
Length of head to base of mandibles	1.40-1.80	1.65
Occipito-fontanellus distance	1.20-1.48	1.43
Max. width of head	0.90-1.03	0.95
Height of head	0.75-0.85	0.80
Head index width/length to base of mandibles	0.572-0.645	0.575
Length of labrum	0.25-0.33	0.25
Width of labrum	0.20-0.25	0.23
Length of mandibles ; Left	1.10-1.35	1.30
Right	1.15-1.35	1.30
Mandible-head index (length of left mandible/ head-length to base of mandibles	0.750-0.819	0.788
Length of postmentum	0.70-0.88	0 88
Max. width of postmentum	0.28-0.33	0.33
Width of postmentum at waist	0.10-0.15	0.13
Length of pronotum	0.25-0.28	0.27
Max. width of pronotum	0.55-0.60	0.55
WORKER	Range (10 exs)	Paralectotype (2 exs)
Total body-length c	3.25-4.00	4.00
Length of head to tip of labrum	1.05-1.18	1.13-1.17
Length of head to base of mandibles	0.60-0.78	0.70-0.78
Max. width of head	0.75-0.88	0.88
Length of postclypeus	0.16-0.18	0.18
Width of postclypeus	0.45-0.50	0.50
Length of pronotum	0.13-0.20	0.13-0.15
Max. width of pronotum	0.40-0.55	0.50

Type-locality and distribution : Type-locality : Anamalai Hills, Tamil Nadu, India. Distribution : INDIA : Tamil Nadu, Kerala, Karnataka and Goa states.

Dicuspiditermes incola (Wasmann)

[Synonyms : *Capritermes longicornis* Wasmann and *Dicuspiditermes pername* Thakur and Chatterjee]

(Figs. 4 and 5 ; Tables 2 and 3)

1893. *Eutermes incola* Wasmann, E. *Wien Ent. Zeit.*, **12** (7) : 242.

1902. *Capritermes incola* ; Wasmann, E. *Zool. Jahrb. Syst.*, **17** (1) : 126, 128.

190` *Capritermes longicornis* Wasmann, E. *Zool. Jahrb. Syst.*, **17** (1) : 126-128.

1904. *Termes (Eutermes) incola* ; Desneux, J. *Genera Insect.*, Fasc. **25** : 43.

1904. *Termes (Eutermes) longicornis* ; Desneux, J. *Genera Insect.*, Fasc. **25** : 43.

1909. *Eutermes longicornis* ; Lefroy, H. M. *Indian Insect Life.* Vol. 1 : 120.

1912. *Capritermes incola* ; Holmgren, N. *J. Bombay nat. Hist. Soc.*, **21** (3) : 792-793.

1913. *Capritermes incola* ; Holmgren, N. *K. Svenska Vetensk-Akad. Handl.*, **50** (2) : 252.

1913. *Capritermes incola* ; Green, E. *Spol. Zeyl.*, **9** (22) : 13.

1914. *Capritermes incola* ; Bugnion E. *Bull. Mus. Hist. nat. Paris*, **20** (4) : 184-202.

1914. *Capritermes incola* ; Silvestri, F. *Rec. Indian Mus.*, **8** : 435.

1917. *Capritermes incola* ; Holmgren, K. and Holmgren N. *Mem. Dept. Agric. India*, **5** : 170.

1917. *Capritermes fletcheri* Holmgren K. and Holmgren, N. *Mem. Dept. Agric. India*, **5** : 169. (Partim, specimen from Bababudin Hills only are *incola*).

1922. *Capritermes longirostris* ; Silvestri, F. *Rec. Indian Mus.*, **24** : 537.

Silvestri refers to *C. longirostris* Wasm. in comparing his species *gravelyi* and also described his var. *cornutella* under *Capritermes longirostris* Wasm ; whereas Wasmann described *C. longicornis* and not *longirostris*, it is evidently an inadvertent mistake.

1922. *Capritermes incola* ; Hegh, E. *Les Termites* : 48.

1925. *Capritermes incola* ; John, O. Treubia, **6** (3-4) : 418.

1934. *Capritermes longicornis* ; Marghabandhu, V. *J. Bombay nat. Hist. Soc.*, **37** (3) : 711.

1949. *Capritermes fletcheri* ; Snyder, T. E. *Smiths. misc. Colls.*, **112** : 193 (Partim).

1949. *Capritermes incola* ; Synder, T. E. *Smiths. misc. Colls.*, **112** : 104.

1953. *Capritermes incola* ; Rattan Lal and Menon, R. D. *Cat. Indian Ins.*, Pt. 27 : 47-48. See for synonymy.

1958. *Capritermes incola* ; Ahmad, M. *Biologia*, Lahore, **4** : 184-185, 190.

1962. *Capritermes incola* ; Mathur, R. N. and Thapa, R. S. *Indian For. Leafl.*, No. 167 : 109.

1962. *Capritermes fletcheri* ; Mathur, R. N. and Thapa, R. S. *Indian For. Leafl.*, No. 167 : 108.

1965. *Dicuspiditermes fletcheri* ; Krishna, K. *Am. Mus. Novit.*, No. 2210 : 17.

1965. *Dicuspiditermes incola* ; Krishna, K. *Am. Mus. Novit.*, No. 2210 : 18.

1968. *Dicuspiditermes fletcheri* ; Krishna, K. *Bull. Am. Mus. nat. Hist.*, **138** (Art. 5) : 290.

1968. *Dicuspiditermes incola* ; Krishna, K. *Bull. Am. Mus. nat. Hist.* **138** (Art. 5) : 290.

1970. *Dicuspiditermes incola* ; Roonwal, M. L. In : *Biology of Termites* Vol. 2 (Eds. Krishna, K. and Weesner, F. M.) : 353.

1971. *Dicuspiditermes pername* Thakur and Chatterjee, *Zool. Anz.*, **187** : 77-87, New synonym.

1975. *Dicuspiditermes incola* ; Sen-Sarma, P. K. *Rec.*, et al. *Wood Destroying Termites of India* (Final Tech. Rep. PL 480 Proj. No. A-7-FS-58) : 2, 63.

1977. *Dicuspiditermes pername* ; Chhotani, *Occ. Pap. zool. Surv. India, No.* 9 : 33.

1978. *Dicuspiditermes incola* ; Roonwal, M. L. *Zeit. ang. Ent.*, 85 : 19.

1979. *Dicuspiditermes incola* ; Roonwal, M. L. *Termite Life and Termite Control in Tropical South Asia* : 135.

1984. *Dicuspiditermes fletcheri* ; Bose, G. *Occ. Pap. Rec. zool. Surv. India,* No. 49 : 144-146.

1984. *Dicuspiditermes pername* ; Bose, G. *Occ. Pap. Rec. zool. Surv. India,* No. 49 : 144, 149-150.

IMAGO (Fig. 4 ; Table 2) : Paratypes examined. Head-capsule dark brown ; post-clypeus yellowish brown ; antennae pale brown ; pronotum brown ; legs brownish

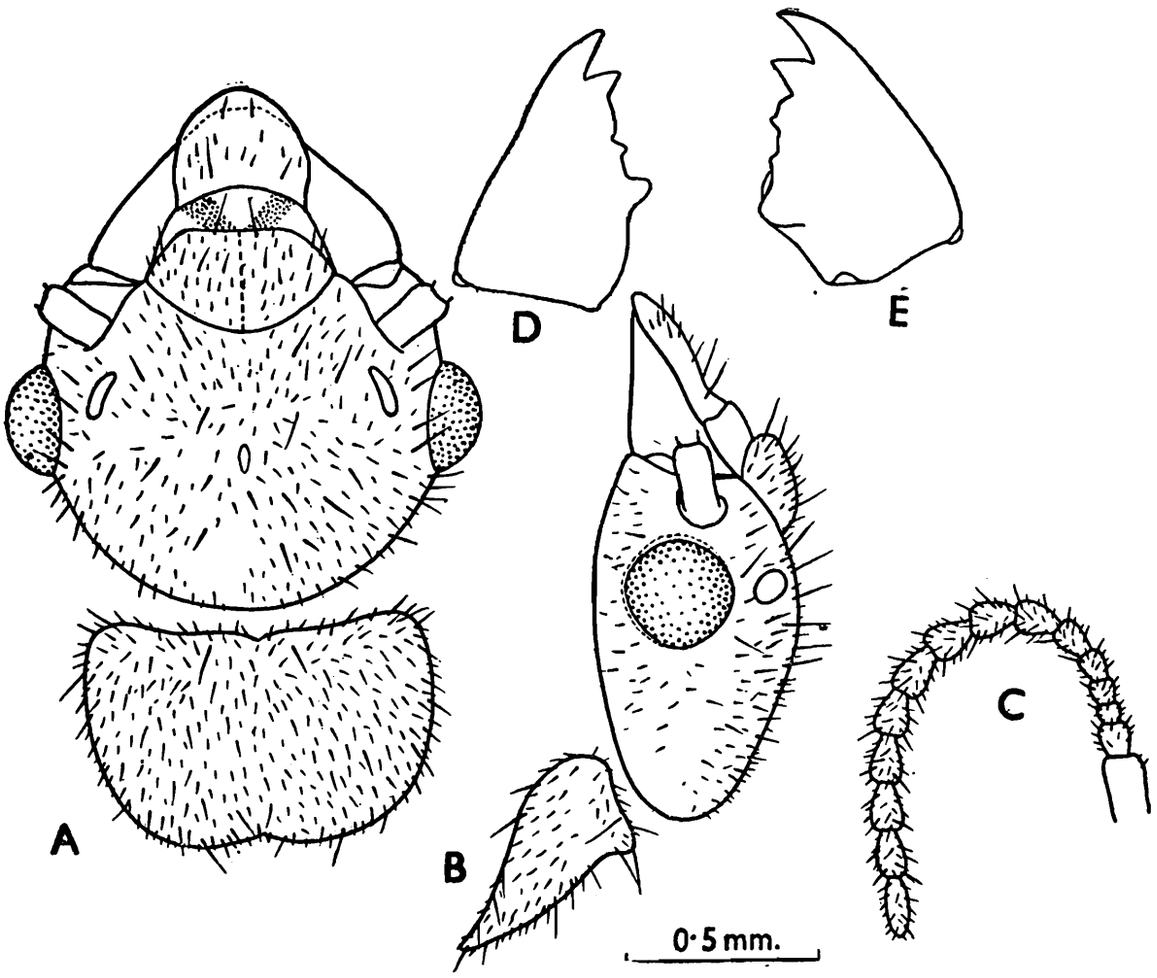

Fig. 4. *Dicuspiditermes incola* (Wasmann). Paratype Imago. Colombo, Sri Lanka, coll. A. Redemann. A. Head and pronotum, dorsal view. B. Same, side view. C. Left antenna. Drawings from 2nd specimen of the three specimens on one pin, present in Natural History Museum, Maastricht (Holland). D. and E. Left and right mandibles from a specimen from Virajpet near Mysore, India.

yellow ; wings pale brown ; abdomen brown above and a little paler below. Head and body covered with a thick coat of short hairs and several long hairs. Total body-length without wings c 5.60-8.5, with wings 12.50-14.20 mm.

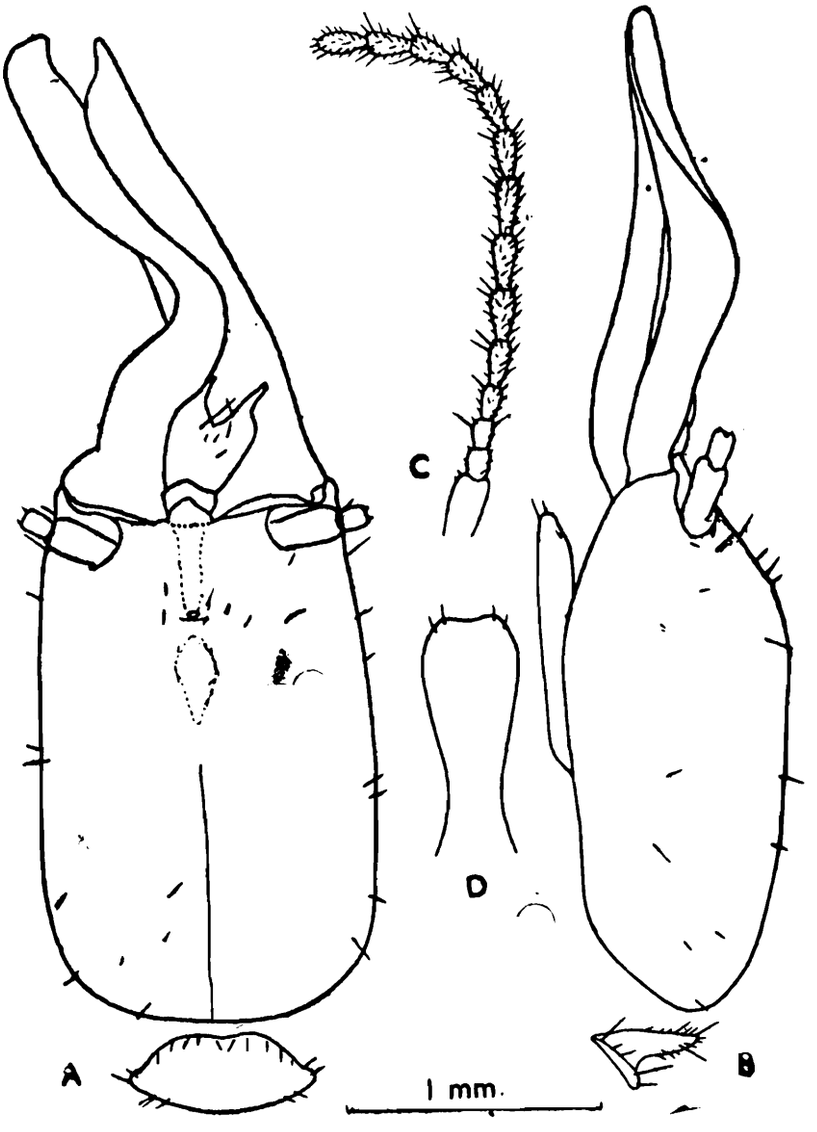

Fig. 5. *Dicuspiditermes incola* (Wasmann). Paratype soldier of *Capritermes longicornis* Wasmann, Khandala (Bombay), coll. Assmuth, present in Natural History Museum, Maastricht (Holland). A. Head and pronotum, dorsal view. B. Same, side view, C. Right antenna. D. Postmentum.

Head-capsule subcircular, with eyes broader than long (width with eyes 1.25-1.38, length to base of mandibles 0.88-1.00 mm) ; Y-suture absent. Fontanelle plate translucent, long and narrow (length 0.075-0.10 mm). Eyes round, fairly well projected ; equidistant from lower margin and antennae. Ocelli broadly oval ; situated at half to about their long diameter from eyes. Antennae with 14-15 segments ; segment 3

shortest ; in 14-segmented antennae segments 4 and 5 subqual and in 15-segmented ones 5 slightly shorter than 4. Postclypeus swollen, hairy ; length about half of width ; divided into 2 halves by a faint groove. Mandibles each with an apical and two marginals ; size of teeth as in figure. Pronotum flat but slightly raised at anterior margin when viewed in lateral view ; narrower than head, width 0.88-1.10 mm ; anterior margin weakly incurved and with a median notch ; posterior margin rounded with a prominent median notch. Legs elongate, hairy, fairly strong ; apical tibial spurs 3 : 2 : 2 ; tarsi 4-jointed. Wing pale brown, hairy along margins and scantily hairy on membrane ; microsculpture consists of papillae on margins and micrasters on membrane. Forewing : Costa thick, along anterior margin ; subcosta short, meeting costa just outside scale ; radius running along costa-subcosta and as thick as that ; media thin, arising separately from scale, running medially and with 3-4 branches near distal end ; cubitus with 8-10 branches to posterior margin. Hindwing venation as in forewing except subcosta wanting and media arising from radius outside scale and with 2-3 branches. Abdomen elongate, densely hairy ; cerci 2-jointed.

TABLE 2. Measurements (in mm), etc. of imagoes of *Discuspiditermes incola* (Wasmann).

	Range 8 exs (including 3 dealate paratypes)
Total body-length with wings c	12.5-14.20
Total body-length without wings c	5.60-8.50
Length of head to tip of labrum	1.35-1.57
Length of head to base of mandibles	0.88-1.00
Max. width of head with eyes	1.25-1.31
Max. height of head	0.53-0.62
Occipito-fontanelle distance	0.33-0.38
Max. diameter of eye	0.30-0.33
Min. diameter of eye	0.26-0.30
Eye-lateral margin of head distance	0.05-0.10
Max. diameter of ocellus	0.13-0.18
Min. diameter of ocellus	0.10-0.15
Min. eye-ocellus distance	0.08-0.13
Min. ocellus-antennal distance	0.13
Length of postclypeus	0.25-0.30
Width of postclypeus	0.50-0.60
Length of pronotum	0.58-0.63
Max. width of pronotum	0.88-1.10
Length of forewing with scale	10.3-11.20
Length of hindwing with scale	10.00-11.00

TABLE 3. Measurements (in mm), etc. of soldier and worker of *Dicuspiditermes incola* (Wasmann) and syntype of *Capritermes fletcheri* Holmgren and Holmgren and paratype of *Capritermes longicornis* Wasmann.

	Range	Paratypes of *C. longicornis*	Bababudin syntypes of *C. fletcheri*
	(20 exs)	(1 ex)	(1 ex)
SOLDIER			
Total body-length c	5.50-8.50	5.50	6.80
Length of head with mandibles	3.90-4.40	3.90	4.40
Length of head to base of mandibles	2.08-2.45	2.08	2.30
Occipito-fontanelle distance	1.70-2.10	1.70	1.90
Max. width of head	1.33-1.50	1.33	1.375
Head index (width/length to base of mandibles	0,589-0.652	0.638	0.598
Height of head	0.90-1.0	0.90	0.95
Length of labrum	0.40-0.63	0.40	0.50
Width of labrum	0.30-0.40	0.30	0.35
Length of mandibles : Left	1.85-2.20	1.85	2.075
Right	1.87-2.15	1.87	2.075
Mandible-head length index (left mandible-length/head-length to base of mandibles)	0.844-0.933	0.889	0.902
Length of postmentum	1.00-1.20	1.00	1.05
Max. width of postmentum	0.33-0.43	0.33	0.425
Width of postmentum at waist	0.18-0.22	0.18	0.18
Length of pronotum	0.25-0.35	0.25	0.35
Max. width of pronotum	0.75-0.88	0.75	0.80
WORKER	(10 exs)	(1 ex)	(1 ex)
Total body-length c	3.60-5.50	3.60	5.50
Length of head to tip of labrum	1.33-1.40	1.375	1.375
Length of head to base of mandibles	0.85-0.93	0.875	0.875
Max. width of head	1.05-1.13	1.05	1.125
Length of postclypeus	0.26-0.28	0.28	0.275
Width of postclypeus	0.50-0.55	0.55	0.525
Length of pronotum	0.25-0.30	—	0.30
Max. width of pronotum	0.50-0.60	—	0.55

SOLDIER (Figs. 5-6, Table 3) : Paratype of *Capritermes longicornis* Wasmann from Khandala examined. Head-capsule yellowish (fresh specimens) to yellowish brown (older specimens) ; antennae yellowish brown to pale brown ; labrum translucent, very weakly chitinised medially ; left mandible blackish brown, right reddish brown ; legs and body creamy white to pale yellow. Head and body fairly pilose. Total body-length c 5.5-8.5 mm.

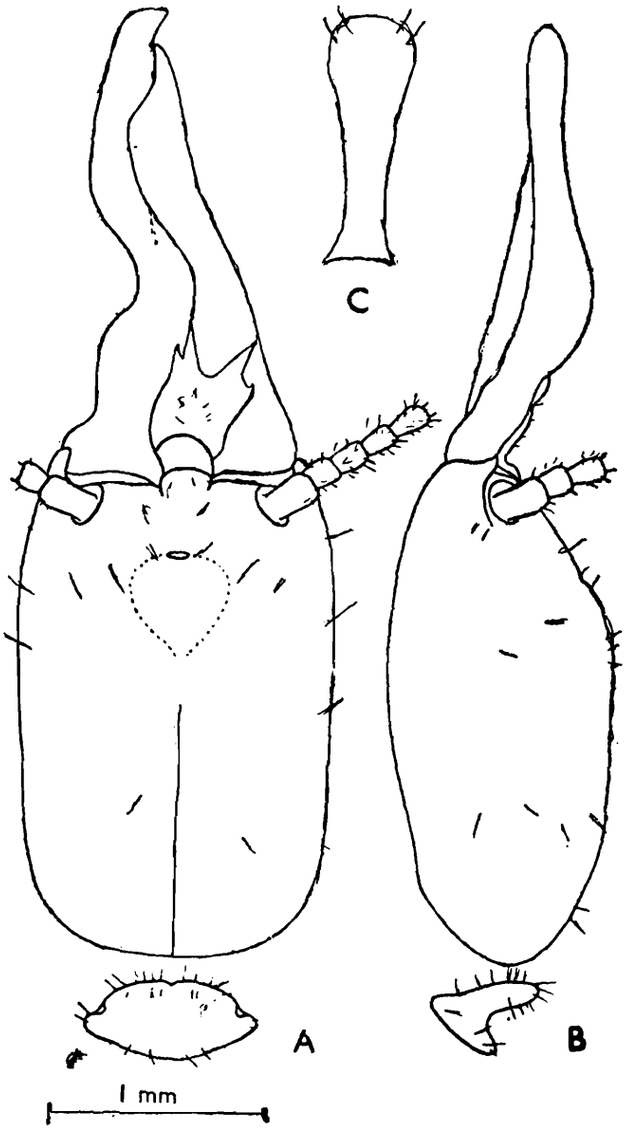

Fig. 6. *Dicuspiditermes incola* (Wasmann). Syntype soldier of *Capritermes fletcheri* Holmgren and Holmgren. Bababudin Hills, coll. T. B. Fletcher, 12.xi.1912. ex "galleries and chambers 2-10" below soil at roots of coffee. A. Head and pronotum, dorsal view. B. Same, side view. C. Postmentum.

Head-capsule subrectangular, sides substraight or slightly converging in front ; antero-lateral corners projected in front as cusps ; width more than half of length (index max. width/length to base of mandibles 0.570-0.638) ; median suture extending upto half of head-length from posterior margin ; frons inclined at 45° angle. Fontanelle

transverse, situated anteriorly; with a minute, brownish tube leading into a small fontanelle gland. Antennae with 14 segments; segments 2, 3 and 4 subequal, 3 sometimes longer than 2 or 4 and 4 sometimes slightly shorter than 3. Labrum asymmetrical, deeply incurved at anterior margin; antero-lateral corners produced into long needle-like processes; antero-lateral margins with 1 or 2 tooth-like projections or serrations at base of lateral processes. Mandibles asymmetrical, only a little shorter than head

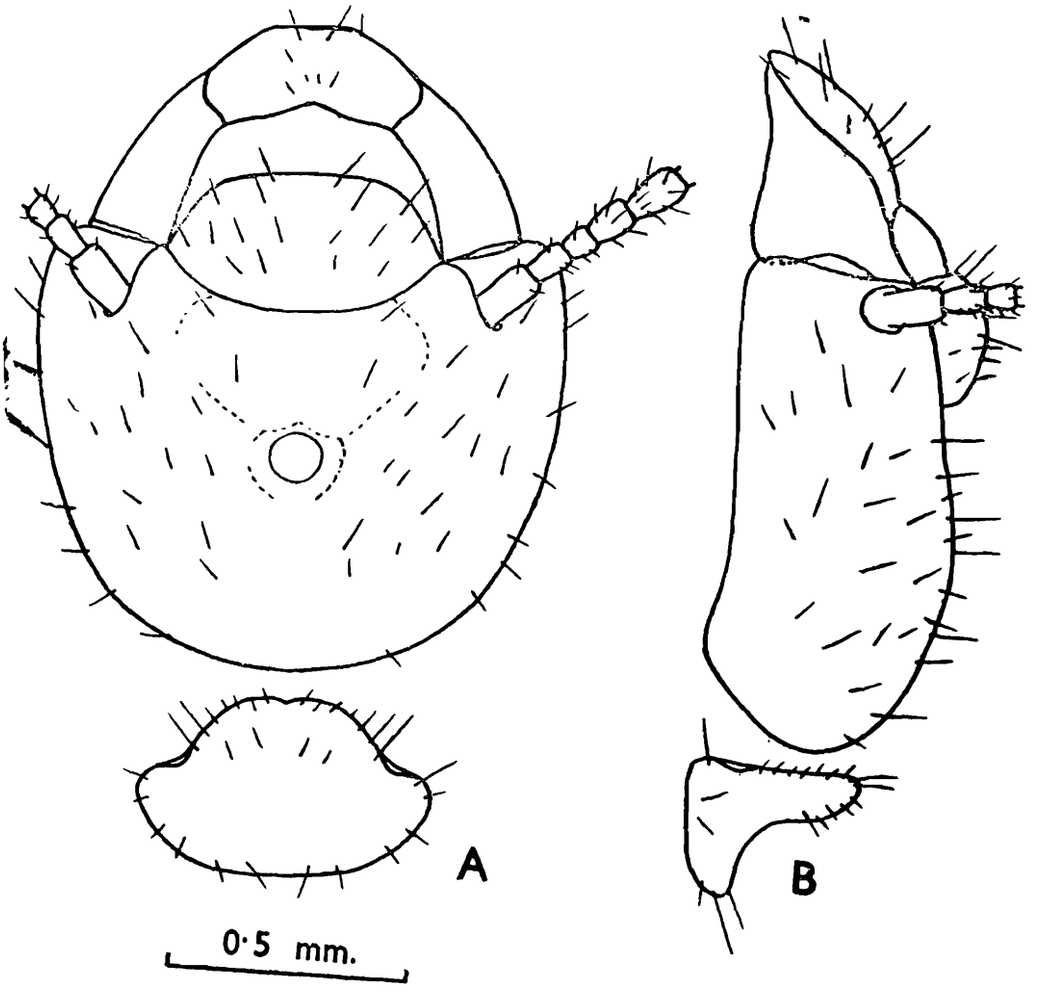

Fig. 7. *Dicuspiditermes incola* (Wasmann). Syntype worker of *Capritermes fletcheri* Holmgren and Holmgren. Data same as in fig. 6. A. Head and pronotum, dorsal view. B. Same, side view.

(index left mandible length/head-length to base of mandibles 0.844-0.933). Left mandible twisted at middle and with a prominent beak-like tip (sometimes tip worn-out; portion below tip swollen on inner margin. Right mandible subequal to or slightly shorter than left mandible; blade-like with a weakly incurved inner and outer margins; strongly incurved at apical portion and with a long pointed apex. Postmentum club-like, about half or little less than half of head-length; waist long and narrow, minimum width lying below middle. Pronotum strongly saddle-shaped, anterior margin weakly notched. Legs thin, long, hairy; apical tibial spurs 3 : 2 : 2; tarsi 4-jointed. Abdomen elongate; cerci 2-jointed; styli absent.

WORKER (Fig. 7, Table 3) : Head, antennae and postclypeus creamish to yellowish ; legs and thorax a little paler ; abdomen transparent with greyish intestinal contents showing through. Head and body fairly pilose. Total body-length 3.60-5.50 mm.

Head-capsule subcircular, wider than length to base of mandibles ; slightly depressed in region of fontanelle. Fontanelle plate oval to round, 0.10-0.17 mm in diameter. Antennae with 14 segments ; segment 3 slightly shorter than 2 and 4 slightly shorter than 3. Postclypeus swollen, hairy ; length about half or a little more than half of width. Mandibles typically *Dicuspiditermes* type. Pronotum and abdomen as in soldier ; legs also as in soldier but shorter.

Type-specimens : Type (=Holotype) and paratype in "Wasmann Collection" at Natural History Museum, Maastricht (Holland). Of *Capritermes longicornis* : Type and paratypes in "Wasmann Collection" as above. Of *Dicuspiditermes pername* : Holotype S in FRI and paratype S and W in FRI and ZSI.

Type-locality and Distribution : Type-locality : Sri Lanka : Colombo. Distribution : Sri Lanka and India (Maharashtra, Karnataka, Tamil Nadu and Kerala states).

SUMMARY

The species *Capritermes fletcheri* Holmgren and Holmgren has been found to belong to genus *Pseudocapritermes* Kemner and the species *P. fontanellus* Mathur and Thapa, *P. goanicus* Chatterjee and Thakur and *P. roonwali* Verma are its junior synonyms.

The species *Dicuspiditermes fletcheri* (Holmgren and Holmgren) as referred to in recent literature is actually *D. incola* (Wasmann).

The two species viz. *Pseudocapritermes fletcheri* (Holmgren and Holmgren) and *Dicuspiditermes incola* (Wasmann) are described in detail giving their complete synonymies. The types of all the relevant species were examined.

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Rec. zool. Surv. India, **92** (1-4) : 311-346, 1992

CHECK LIST OF INDIAN RHYACOPHILIDAE (TRICHOPTERA)

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Introduction

Linnaeus (1758) while erecting the Order Neuroptera included in it the Trichopterans also along with other groups. Trichoptera continued to be considered for a longtime in the heterogenous assesblage of order Neuroptera. It was Kirby who designated Trichoptera as a separate Order in 1813 and the view was supported by MacLachlan (1880). Kolenati (1848) subdivided the order into two main subdivisions, namely, Inaequipalpia and Aequipalpia, on the basis of relative number of joints in the maxillary palpi in male and female. MacLachlan (1880), Ulmer (1907), and Martynov (1924) divided the order into two suborders, the Annulipalpia and Integrepalpia, partly on the basis of the form and habits of the larvae and partly on the structures in the adult insects. Weaver (1983) classified Annulipalpia into two infraorders, Curvipalpia and Spicipalpia and included the super-family Rhyacophiloides in Spicipalpia. This classification of Weaver (*loc. cit.*) has been followed in the present paper. Under the superfamily Rhyacophiloidea, four families namely, Rhyacophilidae, Goeridae, Brachycentridae and Oeconesidae, were considered by Weaver. However in this check-list the authors are dealing with the family Rhyacophilidae only from India. Higler (1992) published a check-list of Indian Trichoptera but it is merely a listing of species with distribution. He has neither given references of the genera and species nor the type repository and type locality which are the most important items of a check-list. Therefore the authors feel the necessity for the publication of the present check-list on the family Rhyacophilidae.

Trichopteran fauna is not sufficiently known from India. The fauna belonging to the family Rhyacophilidae is known through the works of Betten (1909), Martynov (1930, 1935), Schmid (1959, 1970), Schmid & Botosaneanu (1966) and Kimmins (1964). Altogether 177 species and 10 subspecies in 2 genera are known from India of which the majority of the species are known from Eastern and Western Himalays. So, the scope eventually remains to work out the group from Peninsular and Insular parts of India.

The records of distribution mentioned are based on the material present in the National Zoological Collections of Zoological Survey of India and on the published informations. For type specimens, the informations related to the locality wherever known, the states as well as the type repository have been included. Institutions of

type repository have been shown in abbreviated forms which may be explained as follows :

BMNH—British Museum (Natural History), London.

CRB—Centre de recherches Biosystematiques, Ottawa, Canada.

MCZ—Museum of Comparative Zoology, Harvard University, Cambridge.

ZSI—Zoological Survey of India, Calcutta.

SM—Stockholm Museum.

Zool. Mus.—Zool. Meseum (Leningrad).

Literature references of genera and species, and distribution of each species have been included. In this connection, it may be mentioned that in the type localies of several species the locality 'Kameng' was shown 'Assam' as well as 'Khashi Hills', which was then under Assam, by Schmid. These have been corrected and shown as 'Kameng' under Arunachal Pradesh and 'Khasi Hills' under Meghalaya.

Family : RHYACOPHILIDAE

Genus **Rhyacophila** Pictet

1834. *Rhyacophila* Pictet, Rech. *Phrygan.*, p. 181.

1. **Rhyacophila alticola** Kimmins

1953. *Rhyacophila alticola* Kimmins, *Ark. Zool. Stockholm* (*N. S.*), **4** : 544.

1992. *Rhyacophila alticola*, Higler, *Oriental Insects*, **26** : 68.

Type locality : Tibet.

Type Repository : Holotype & Paratype : BMNH (London).

Distribution : India (Sikkim) ; Tibet.

2. **Rhyacophila anatina** Morton

1900. *Rhyacophila anatina* Morton, *Trans. ent. Soc. Lond.*, p. 6, pl. 1, Figs. 17-18.

Type locality : Khasi Hills (Meghalaya).

Type Repository : Holotype & Paratype : BMNH (London).

Distribution : India (Meghalaya and Sikkim).

3. **Rhyacophila ancestralis** Martynov

1935. *Rhyacophila ancestralis* Martynov, *Rec. Indian Mus.*, **37** : 93-95, Figs. 1, a, d.

Type locality : Khasi Hills (Meghalaya).

Type Repository : Holotype : ZSI (Calcutta).

Distribution ; India (Meghalaya).

4. **Rhyacophila angden** Schmid

1970. *Rhyacophila angden* Schmid, *Mem. ent.* Soc. *Can.*, No. 66 : 183.

Type locality : Sikkim.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Sikkim).

5. **Rhyacophila assimilis** Kimmins

1953. *Rhyacophila assimilis* Kimmins, *Ark. Zool. Stockholm* (*N. S.*) **4** : 553.

Type locality : North East Burma.

Type Repoitory : Holotype and Allotype : SM ; Paratypes : BMNH (London).

Distribution : India (Manipur), Burma.

6. **Rhyacophiia aureomaculata** Schmid

1970. *Rhyacophila aureomaculata* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 184.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratypes ; BMNH (London) and ZSI (Calcutta).

Distribution : India (Arunachal Pradesh).

7. **Rhyacophila aureostigma** Schmid

1970. *Rhyacophila aureostigma* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 184.

Type locality : West Bengal.

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (Sikkim and West Bengal).

8. **Rhyacophila bhotia** Schmid

1970. *Rhyacophila bhotia* Schmid, *Mem. ent. Soc. Can.*, no. 66 : 137.

Type locality : Dobalgaon (Tehri Garhwal ; Uttar Pradesh).

Type Repository : Holotype and Allotype CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (Uttar Pradesh).

9. **Rhyacophila bhuchanadhara** Schmid

1970. *Rhyacophila bhuchanadhara* Schmid, *Mem. ent. Soc., Can.*, No. 66 : 210.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype and Allotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

10. **Rhyacophila bicolor** Kimmins

1953. *Rhyacophila bicolor* Kimmins, *Ark. Zool. Stockholm* (*N. S.*), **4** : 532-534.

Type locality : North East Burma.

Type Repository : Holotype and Allotype : SM ; Paratype ; BMNH (London).

Distribution : India (Manipur). Burma.

11. **Rhyacophila bidens** Kimmins

1970. *Rhyacophila bidens* Kimmins, *Ark. Zool. Stockholm* (*N. S.*) **4** : 521.

Type locality : Burma.

Type Repository : Holotype : SM ; Paratypes : SM and BMNH (London).

Distribution : India (Sikkim, Manipur, Arunachal Pradesh and Uttar Pradesh) ; Burma.

12. **Rhyacophila chakungpa** Schmid

1970. *Rhyacophila chakungpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 161.

Type lacality : Sikkim.

Type Repository ; Holotype and Allotype : CRB (Canada).

Distribution : India (Sikkim).

13. **Rhyacophila chamolungpa** Schmid

1970. *Rhyacophila chamolungpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 180.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

14. **Rhyacophila changpa** Schmid

1970. *Rhyacophila changpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 217.

Type locality : Sikkim.

Type Repository : Holotype and Allotype CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (Sikkim).

15. **Rhyacophila chandzo** Schmid

1970. *Rhyacophila chandzo* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 154.

Type locality: Arunachal Pradesh (Kameng).

Type Repository : Holotype : CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (Arunachal Pradesh).

16. **Rhyacophila chayulpa chayulpa** Schmid

1970. *Rhyacophila chayulpa chayulpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 190.

Type locality : Sikkim.

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (Sikkim).

16a. **Rhyacophila chayulpa ringmo** Schmid

1970. *Rhyacophila chayulpa ringmo* Schmid, *Mem. ent. Scc. Can.*, No. 66 : 190.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (Arunachal Pradesh).

16b. **Rhyacophila chayulpa tsetangpa** Schmid

1970. *Rhyacophila chayulpa tsetangpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 191.

Type locality : Pauri Garhwal.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Uttar Pradesh).

17. **Rhyacophila chematangpa** Schmid

1970. *Rhyacophila chematangpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 171.

Type locality : Sikkim.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Sikkim).

18. **Rhyacophila chembo** Schmid

1970. *Rhyacophila chembo* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 185.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Arunachal Pradesh).

18a. **Rhyacophila chembo lartsepa** Schmid

1970. *Rhyacophila chembo lartsepa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 185.

Type locality : Pauri Garhwal.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Uttar Pradesh).

19. **Rhyacophila chenmo** Schmid

1970. *Rhyacophila chenmo* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 152.

Type locality : Manipur.

Type Repository : Holotype and Allotype : CRB (Canada).

Distribution : India (Manipur).

20. **Rhyacophila chimdro** Schmid

1970. *Rhyacophila chimdro* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 172.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype and Allotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

21. **Rhyacophila chomoyuma** Schmid

1970. *Rhyacophila chomoyuma* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 162.

Type locality : Manipur.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI, (Calcutta).

Distribution : India (Manipur).

22. **Rhyacophila choprai** Martynov

1935. *Rhyacophila choprai* Martynov, *Rec. Indian Mus.*, **37** : 97-98.

Type locality : Mussorie.

Type Repository : Holotype : ZSI (Calcutta).

Distribution : India (Uttar Pradesh).

23. **Rhyacophila chugalungpa** Schmid

1970. *Rhyacophila chugalungpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 172.

Type locality : Sikkim.

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Sikkim).

24. **Rhyacophila chulukpa** Schmid

1970. *Rhyacophila chulukpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 192.

Type locality : West Bengal.

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Sikkim & West Bengal).

25. **Rhyacophila chumikpa** Schmid

1970. *Rhyacophila chumikpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 186.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada). ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Arunachal Pradesh).

26. **Rhycophila chungse** Schmid

1970, *Rhyacophila chungse* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 152.

Type locality : Manipur.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : ZSI (Calcutta).

Distribution : India (Manipur and Arunachal Pradesh).

27. **Rhyacophila churongpa** Schmid

1970. *Rhyacophila churongpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 176.

Type locality : Saran.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Uttar Pradesh).

28. **Rhyacophila curvata** Morton

1900. *Rhyacophila curvata* Morton, *Trans. ent. Soc. Lond.*, pt. 1, p. 5, pl. 1, Figs. 12-14.

Type locality : Meghalaya (Khasi Hills).

Type Repository : Holotype : BMNH (London).

Distribution : India (Meghalaya, Sikkim, Manipur & Mizoram).

29. **Rhyacophila dafla** Schmid

1970. *Rhyacophila dafla* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 189.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

30. **Rhyacophila dakshi** Schmid

1970. *Rhyacophila dakshi* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 186.

Type locality : West Bengal.

Type Repository : Holotype : CRB (Canada).

Distribution : India (West Bengal & Sikkim) ; Nepal.

31. **Rhyacophila dgaldanpa** Schmid

1970. *Rhyacophila dgaldanpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 220.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Arunachal Pradesh).

32. **Rhyacophila dikkaravasini** Schmid

1970. *Rhyacophila dikkaravasini* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 196.

Type locality : Madras.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Tamil Nadu).

33. **Rhyacophila dilatata** Martynov

1935. *Rhyacophila dilatata* Martynov, *Rec. Indian Mus.*, **37** : 96-97, Figs. 3 a-c.

Type locality : Simla Hills.

Type Repository : Holotype : ZSI (Calcutta).

Distribution : India (Himachal Pradesh, Uttar Pradesh).

34. **Rhyacophila dirangpa** Schmid

1970. *Rhyacophila dirangpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 199.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

35. **Rhyacophila dolingpa** Schmid

1970. *Rhyacophila dolingpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 181.

Type locality : Meghalaya (United Jaintia and Khasi Hills).

Type Repository : Hollotype & Allotype : CRB (Canada) ; Paratypes : ZSI (Calcutta).

Distribution : India (Meghalaya).

36. **Rhyacophila dongkyapa** Schmid

1970. *Rhyacophila dongkyapa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 138.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Arunachal Pradesh, Sikkim & Manipur).

37. **Rhyacophila dongre** Schmid

1970. *Rhyacophila dongre* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 191.

Type locality : Sikkim.

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Sikkim).

38. **Rhyacophila dorje** Schmid

1970. *Rhyacophila dorje* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 144.

Type locality : Madras.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Tamil Nadu).

39. **Rhyacophila drokpa drokpa** Schmid

1970. *Rhyacophila drokpa drokpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 220.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Arunachal Pradesh and Manipur).

39a. **Rhyacophila drokpa gurla** Schmid

1970. *Rhyacophila drokpa gurla* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 221.

Type locality : Pouri Garhwal.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratype : ZSI (Calcutta).

Distribution : India (Uttar Pradesh).

39b. **Rhyacophila drokpa nyenpa** Schmid

1970. *Rhyacophila drokpa nyenpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 221.

Type locality : Sikkim.

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Sikkim).

40. **Rhyacophila drosampa** Schmid

1970. *Rhyacophila drosampa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 162.

Type locality : Meghalaya (United Jaintia and Khasi Hills).

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : ZSI (Calcutta).

Distribution : India (Meghalaya).

41. **Rhyacophila drotangpa** Schmid

1970. *Rhyacophila drotangpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 138.

Type locality : Sikkim.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Sikkim).

42. **Rhyacophila extensa** Martynov

1928. *Rhyacophila extensa* Martynov., *Ann. Mus. Zool. Acad.*, Leningrad, **28** : 493.

1931. *Rhyacophila carletoni* Banks, *Psyche*, **38** : No. 1. p. 69, Fig. 7.

1970. *Rhyacophila extensa*, Schmid, *Mem. ent. Soc. Can.*, No. 66 : 133.

1992. *Rhyacophila extensa*, Higler, *Oriental Insects*, **26** : 70.

Type locality : Turkestan.

Type Repository : Holotype ; MCZ.

Distribution : India (Himachal Pradesh and North India), Turkestan.

43. **Rhyacophila fletcheri** (Kimmins)

1952. *Rhyacophila fletcheri* Kimmins, *Ann. Mag. Nat. Hist. Lond.*, (12) **5** : 356.

1970. *Rhyacophila fletcheri*, Schmid, *Mem. ent. Soc. Can.*, No. 66 : 203.

Type locality : Sikkim.

Type Repository : Holotype : CRB (Canada) ; Paratypes : BMNH (London).

Distribution : India (Sikkim and Arunachal Pradesh).

44. **Rhyacophila gelukpa** Schmid

1970. *Rhyacophila gelukpa* Schmid, *Mem. ent. Soc. Can.*, 66 : 214.

Type locality : Sikkim.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Sikkim and Arunachal Pradesh).

45. **Rhyacophila gyaldzen** Schmid

1970. *Rhyacophila gyaldzen* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 144.

Type locality : Meghalaya, (United Jaintia and Khasi Hills).

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratype : ZSI (Calcutta).

Distribution : India (Meghalaya and Manipur).

46. **Rhyacophila gyamo** Schmid

1970. *Rhyacophila gyamo* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 180.

Type locality : Manipur.

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratype : ZSI (Calcutta).

Distribution : India (Manipur).

47. **Rhyacophila gyaspa** Schmid

1970. *Rhyacophila gyaspa* Scimid, *Mem. ent. Soc. Can.*, No. 66 : 200.

Type locality : West Bengal.

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (West Bengal).

48. **Rhyacophila gyelbu** Schmid

1970. *Rhyacophila gyelbu* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 187.

Type locality : Manipur.

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (Manipur and Sikkim).

49. **Rhyacophila hingstoni** Martynov

1930. *Rhyacophila hingstoni* Martynov, *Fauna of China and Eastern Tibet*, p. 67-69.

Type locality : Tibet.

Type Repository : Holotype and Paratype : BMNH (London) ; Paratype : Zool. Mus. (Leningard).

Distribution : India (Sikkim) ; Nepal and Tibet.

50. **Rhyacophila hobsoni** Martynov

1930. *Rhyacophila hobsoni* Martynov, *Fauna of China and Eastern Tibet*, p. 69.

Type locality : Tibet.

Type Repository : Holotype : BMNH (London).

Distribution : India (Sikkim and Uttar Pradesh) ; Tibet.

51. **Rhyacophila hydaspica** Schmid

1959. *Rhyacophila hydaspica* Schmid, *Tijdschr, ent.*, **102** : 237.

Type locality : Himalaya.

Type Repository : Holotype : CRB (Canada).

Distribution : Indou Kouch, Tout 1' Himalaya.

52. **Rhyacophila inconspicua** Morton

1900. *Rhyacophila inconspicua* Morton, *Trans. ent. Soc. Lond.*, p. 7, pl. 1, Fig. 21.

Type locality : Meghalaya (Khasi Hills).

Type Repository : Holotype : BMNH (London).

Distribution : India (Meghalaya).

53. **Rhyacophila jayadurga** Schmid

1970. *Rhyacophila jayadurga* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 196.

Type locality : Madras.

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratype : ZSI (Calcutta).

Distribution : India (Tamil Nadu).

54. **Rhyacophila kadampa** Schmid

1970. *Rhyacophila kadampa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 139.

Type locality : Manipur.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Manipur).

55. **Rhyacophila kadaphes** Schmid

1959. *Rhyacophila kadaphes* Schmid, *Tijdscher. ent.*, **102** : 235.

Type locality : Karakoram.

Type Repository : Holotype : CRB (Canada).

Distribution ; India (Uttar Pradesh), Indou-Kouch, Karakoram, Pakistan.

56. **Rhyacophila kagyupa** Schmid

1970. *Rhyacophila kagyupa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 197.

Type locality : Arunaehal Pradesh (Kameng).

Type Repository ; Holotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

57. **Rhyacophila kando** Schmid

1970. *Rhyacophila kando* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 206.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta)

Distribution : India (Arunachal Pradesh, Sikkim and Uttar Pradesh).

57a. **Rhyacophila kando rengma** Schmid

1970. *Rhyacophila kando rengma* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 207.

Type locality : Manipur.

Type Repository : Holotype and Allotype : CRB (Canada).

Distribution ; India (Manipur).

58. **Rhyacophila kangjongps** Schmid

1970. *Rhyacophila kangjongɣa* Schmid, *Mem. ent. Soc. Can.* No. 66 : 163.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratype : ZSI (Calcutta).

Distribution : India (Arunachal Pradesh).

59. **Rhyacophila kanichka** Schmid

1959. *Rhyacophila kanichka* Schmid, *Tijdschr. ent.*, **102** : 233.

Type locality : Himalaya.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Uttar Pradesh) ; Pakistan.

60. **Rhyacophila karpa** Schmid

1970. *Rhyacophila karpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 204.

Type locality : Meghalaya (United Jaintia and Khasi Hills).

Type Repository : Holotype : CRB (Canada).

Distribution : India (Meghalaya and Arunachal Pradesh).

61. **Rhyacophila kashongpa** Schmid

1970. *Rhyacophila kashongpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 148.

Type locality : Manipur.

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution ; India (Manipur).

62. **Rhyacophila kawachenpa** Schmid

1970. *Rhyacophila kawachenpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 163.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (Arunachal Pradesh).

63. **Rhyacophila kedara** Schmid

1970. *Rhyacophila kedara* Schmid, *Mem. ent. Soc. Can.*, No. 66 ; 170.

Type locality : Kedarnath.

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (Uttar Pradesh).

64. **Rhyacophila khamakhya** Schmid

1970. *Rhyacophila khamakhya* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 197.

Type locality : Madras.

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratype ; ZSI (Calcutta).

Distribution : India (Tamil Nadu).

65. **Rhyacophila khasiorum** Schmid

1970. *Rhyacophila khasiorum* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 187.

Type locality : Manipur.

Type Repository : Holotype and Allotype : CRB (Canada) : Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (Uttar Pradesh, Sikkim, Arunachal Pradesh, Meghalaya and Manipur).

66. **Rhyacophila khimbarpa** Schmid

1970. *Rhyacophila khimbarpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 188.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype : CRB (Canada) ; Paratypes ; BMNH (London) and ZSI (Calcutta).

Distribution : India (Arunachal Pradesh).

67. **Rhyacophila khiympa** Schmid

1970. *Rhyacophila khiympa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 170-171.

Type locality : Sikkim.

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratype : ZSI (Calcutta).

Distribution ; India (Sikkim).

68. **Rhyacophila kubra** Schmid

1970. *Rhyacophila kubra* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 178.

Type locality : Sikkim.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Sikkim).

69. **Rhyacophila kunma** Schmid

1970. *Rhyacophila kunma* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 154.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution ; India (Arunachal Pradesh).

70. **Rhyacophila kusang** Schmid

1970. *Rhyacophila kusang* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 145.

Type locality : Meghalaya (United Jaintia and Khasi Hills).

Type Repository : Holotype : CRB (Canada).

Distribution : India (Meghalaya).

71. **Rhyacophila kyadongpa** Schmid

1970. *Rhyacophila kyadongpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 221.

Type locality : Sikkim.

Type Reposi ory : Holotype & Allotype : CRB (Canada).

Distribution : India (Sikkim).

72. **Rhyacophila kyimdongpa** Schmid

1970. *Rhyacophila kyimdongpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 176.

Type locality : Meghalaya (United Jaintia & Khasi Hills).

Type Repository : Holotype : CRB (Canada).

Distribution : India (Meghalaya).

73. **Rhyacophila kyungpa** Schmid

1970. *Rhyacophila kyungpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 173.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

74. **Rhyacophila langdarma** Schmid

1970. *Rhyacophila langdarma* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 164.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

75. **Rhyacophila laptsapa** Schmid

1970. *Rhyacophila laptsapa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 200.

Type locality : Sikkim.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Sikkim).

76. **Rhyacophila lepcha** Schmid

1970. *Rhyacophila lepcha* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 193.

Type locality : Sikkim.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Sikkim).

77. **Rhyacophila lhabu** Schmid

1970. *Rhyacophila lhabu* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 164.

Type locality : Manipur.

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Manipur).

78. **Rhyacophila lhadzongpa** Schmid

1970. *Rhyacophila lhadzongpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 140.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Arunachal Pradesh).

79. **Rhyacophila lhakpa** Schmid

1970. *Rhyacophila lhakpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 174.

Type locality : Hanuman Chatti (Pauri Garhwal).

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratype : ZSI (Calcutta).

Distribution : India (Uttar Pradesh).

80. **Rhyacophila lhopa** Schmid

1970. *Rhyacophila lhopa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 197.

Type locality : Madras.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratype : ZSI (Calcutta).

Distribution : India (Tamil Nadu).

81. **Rhyacophila lobsang** Schmid

1970. *Rhyacophila lobsang* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 146.

Type locality : Madras.

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Tamil Nadu).

82. **Rhyacophila lonpo** Schmid

1970. *Rhyacophila lonpo* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 201.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

83. **Rhyacophila maitripa** Schmid

1970. *Rhyacophila maitripa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 211.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Arunachal Pradesh).

84. **Rhyacophila manipuri** Schmid

1970. *Rhyacophila manipuri* Schmid, *Mem. ent. Soc. Can.*, No. 66 ; 140.

Type locality : Manipur.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes ; BMNH (London) & ZSI (Calcutta).

Distribution : India (Manipur).

85. **Rhyacophila manlungpa** Schmid

1970. *Rhyacophila manlungpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 155.

Type locality : Arunachal Pradesh (Kameng).

Type Repository ; Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Arunachal Pradesh).

86. **Rhyacophila marpa** Schmid

1970. *Rhyacophila marpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 177,

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

87. **Rhyacophila milarepa** Schmid

1970. *Rhyacophila milarepa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 193.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

88. **Rhyacophila mishmica** Kimmins

1953. *Rhyacophila mishmica* Kimmins, *Ark. Zool. Stockholm* (*N. S.*), **4** ; 516-518.

Type locality : Assam.

Type Repository : Holotype, Allotype & Paratype : BMNH (London).

Distribution : India (Assam and Arunachal Pradesh).

89. **Rhyacophila monyulpa** Schmid

1970. *Rhyacophila monyulpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 165.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

90. **Rhyacophila mortoni** Kimmins

1953. *Rhyacophila mortoni* Kimmins, *Ark. Zool. Stockholm* (*N. S.*), **4** : 526-527.

Type locality : Meghalaya (Khasi Hills).

Type Repository : Holotype, Allotype & Paratype : BMNH (London) ; Paratype : (Indian Mus.), ZSI, (Calcutta).

Distribution : India (Meghalaya).

91. **Rhyacophila muktepa** Schmid

1970. *Rhyacophila muktepa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 188.

Type locality : Meghalaya (United Jaintia and Khasi Hills).

Type Repository : Holotype : CRB (Canada), Paratype : ZSI (Calcutta).

Distribution : India (Meghalaya and Manipur).

92. **Rhyacophila nobochepa** Schmid

1970. *Rhyacophila nobochepa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 178.

Type locality : West Bengal.

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (West Bengal, Sikkim and Arunachal Pradesh).

93. **Rhyacophila naga** Schmid

1970. *Rhyacophila naga* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 155.

Type locality : Manipur.

Type Repository : Holotype and AIlotype : CRB (Canada) ; Paratypes ; BMNH (London) and ZSI (Calcutta).

Distribution : India (Manipur).

94. **Rhyacophila nagongpa** Schmid

1970. *Rhyacophila nagongpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 140.

Type locality : Meghalaya (United Jaintia and Khasi Hills).

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (Meghalaya).

95. **Rhyacophila nakpo** Schmid

1970. *Rhycaophila nakpo* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 165.

Type locality : Manipur.

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (Manipur).

96. **Rhyacophila namgyal** Schmid

1970. *Rhyacophila namgyal* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 146.

Type locality : Meghalaya (United Jaintia and Khasi Hills).

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratype : ZSI (Calcutta).

Distribution : India (Meghalaya).

97. **Rhyacophila narayani** Schmid

1970. *Rhyacophila narayani* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 198.

Type locality : Kerala.

Type Repository : Holotype ; CRB (Canada).

Distribution : India (Kerala).

98. **Rhyacophila naviculata** Morton

1900. *Rhyacophila naviculata* Morton, *Trans. ent. Soc. Lond.*, p. 6, pl. 1, Figs. 19-20.

Type locality : Trichinopolly.

Type Repository : Holotype : BMNH (London).

Distribution : India (Tamil Nadu).

99. **Rhyacophila netongpa** Schmid

1970. *Rhyacophila netongpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 194.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

100. **Rhyacophila ngawang** Schmid

1970. *Rhyacophila ngawang* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 147.

Type locality : Meghalaya (United Jaintia & Khasi Hills).

Type Repository : Holotype : CRB (Canada).

Distribution : India (Meghalaya).

101. **Rhyacophila ngorpa** Schmid

1970. *Rhyacophila ngorpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 215.

Type locality : West Bengal.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (West Bengal and Sikkim).

102. **Rhyacophila ngulpa** Schmid

1970. *Rhyacophila ngulpa* Schmid, *Mem. ent. Soc. Can* , No. 66 : 171.

Type locality : Pouri Garhwal.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Uttar Pradesh).

103. **Rhyacophila norbu** Schmid

1970. *Rhyacophila norbu* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 147.

Type locality : Meghalaya (United Jaintia & Khasi Hills).

Type Repository : Holotype : CRB (Canada) ; Paratype : BMNH (London).

Distribution : India (Meghalaya).

104. **Rhyacophila nyamangpa** Schmid

1970. *Rhyacophila nyamangpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 1947.

Type locality : Sikkim.

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Sikkim).

105. **Rhyacophila nyelungpa** Schmid

1970. *Rhyacophila nyelungpa* Schmid. *Mem. ent. Soc. Can.*, No. 66 : 183.

Type locality : Meghalaya (United Jaintia & Khasi Hills).

Type Repository : Holotype : CRB (Canada).

Distribution : India (Meghalaya).

106. **Rhyacophila nyerongpa** Schmid

1970. *Rhyacophila nyerongpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 204.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

107. **Rhyacophila nyerpa** Schmid

1970. *Rhyacophila nyerpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 156.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

108. **Rhyacophila nyukmadongpa** Schmid

1970. *Rhyacophila nyukmadongpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 166.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

109. **Rhyacophila obscura** Martynov

1927. *Rhyacophila obscura* Martynov., *Ann. Mus. Zool. Acad. Sci. USSR.*, **28** : 163, pl. vii, figs. 1-4.

Type locality : Turkestan, Taschkent.

Type Repository : Holotype : BMNH (London).

Distribution : India (Punjab, Himachal Pradesh and Uttar Pradesh), Turkestan.

110. **Rhyacophila parva parva** Kimmins

1953. *Rhyacophila parva* Kimmins, *Ark. Zool. Stockholm* (*N. S.*), **4** : 536.

1970. *Rhyacophila parva parva*, Schmid; *Mem. ent. Soc. Can.*, No. 66 : 173.

Type locality : Meghalaya (Khasi Hills).

Type Repository : Holotype & Paratype : BMNH (London).

Distribution : India (Meghalaya).

110a. **Rhyacophila parva mukpo** Schmid

1970. *Rhyacophila parva mukpo* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 174.

Type locality : Manipur.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Manipur).

111. **Rhyacophila paurava** Schmid

1959. *Rhyacophila paurava* Schmid, *Tijdschr. ent.*, **102** : 237.

Type locality : Himalaya.

Type Repository : Holotype : CRB (Canada).

Distribution : India, Uttar Pradesh (Garhwal). Pakistan.

112. **Rhyacophila pemba** Schmid

1970. *Rhyacophila pemba* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 147.

Type locality : Meghalaya (United Jaintia & Khasi Hills).

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (Meghalaya and Manipur).

113. **Rhyacophila poba** Schmid

1970. *Rhyacophila poba* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 218.

Type locality : Sikkim.

Type Repository : Holotype : CRB (Canada) ; Paratypes : BMNH (London) and ZSI (Calcutta).

Distribution : India (Sikkim).

114. **Rhyacophila polha** Schmid

1970. *Rhyacophila polha* Schmid, *Mem. ent. Soc. Can.*, No. : 66 ; 166.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype and Allotype : CRB (Canada) ; Paratype : ZSI (Calcutta).

Distribution : India (Arunachal Pradesh).

115. **Rhyacophila procliva** Kimmins

1953. *Rhyacophila pracliva* Kimmins, *Ark. Zool. Stockholm* (*N. S.*), **4** ; 542-544.

Type locality : N. E. Burma.

Type Repository : Holotype, Allotype and Paratype : S. M. ; Paratype : BMNH (London).

Distribut on : India (Arunachal Pradesh and Manipur). Birmanie Septentrional

116. **Rhyacophila putata** Kimmins

1953. *Rhyacophila putata* Kimmins, *Ark. Zool. Stockholm* (*N. S.*), **4** : 512.

Type locality : Meghalaya (Shillong).

Type Repository : Holotype : BMNH (London).

Distribution : India (Meghalaya).

116a. **Rhyacophila putata temba** Schmid

1970. *Rhyacophila putata temba* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 167.

Type locality : Manipur.

Type Repository : Holotype and Allotype : CRB (Canada).

Distribution : India (Manipur).

117. **Rhyacophila rhombica** Martynov

1935. *Rhyacophila rhombica* Martynov, *Rec. Indian Mus.*, **37** : 98-99, Figs. 5 a-b.

Type locality : Darjeeling.

Type Repository : Holotype : ZSI (Calcutta).

Distribution : India (West Bengal).

118. **Rhyacophila rongpa** Schmid

1970. *Rhyacophila rongpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 222.

Type locality : Manipur.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Manipur, Sikkim & Arunachal Pradesh).

119. **Rhyacophila sakyapa** Schmid

1970. *Rhyacophila sakyapa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 153.

Type locality : Pouri Garhwal.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratype : ZSI (Calcutta).

Distribution : India (Uttar Pradesh).

120. **Rhyacophila sanglungpa** Schmid

1970. *Rhyacophila sanglungpa* Schmid., *Mem. ent. Soc. Can* , No. 66 : 202.

Type locality : Sikkim.

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Sikkim).

121. **Rhyacophila scissa** Morton

1900. *Rhyacophila scissa* Morton, *Trans. ent. Soc. Lond.*, p. 5, pl. 1, Figs. 15, 16.

Type locality : Meghalaya (Khasi Hills).

Type Repository : Holotype : BMNH (London).

Distribution : India (Meghalaya, Uttar Pradesh, Sikkim & Arunachal Pradesh).

121a. **Rhyacophila scissa niyampa** Schmid

1970. *Rhyacophila scissa niyampa* Schmid, *Mem. ent. Soc. Can.*, No. 66 ; 150.

Type locality : Manipur.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Manipur).

122. **Rhyacophila scissoides** Kimmins

1953. *Rhyacophila scissoides* Kimmins, *Ark. Zool. Stockholm* (*N. S.*), **4** : 520.

Type locality : Meghalaya (Khasi Hills).

Type Repository : Holotype & Paratypes : BMNH (London).

Distribution : India (Punjab, Himachal Pradesh, Sikkim, Uttar Pradesh, Meghalaya and Mizoram).

123. **Rhyacophila scotina** Kimmins

1953. *Rhyacophila scotina* Kimmins, *Ark. Zool. Stockholm* (*N. S.*), **4** : 513-514.

Type locality : Meghalaya (Cherrapunji).

Type Repository : Holotype : BMNH (London).

Distribution : India (Meghalaya).

124. **Rhyacophila senggepa** Schmid

1970. *Rhyacophila senggepa* Schmid, *Mem. ent. Soc. Can.*, No. 167.

Type locality : Meghalaya (United Khasi & Jaintia Hills).

Type Repository : Holotype : CRB (Canada).

Distribution : India (Meghalaya).

125. **Rhyacophila shakangpa** Schmid

1970. *Rhyacophila shakangpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 198.

Type locality : Chhana (Almora).

Type Repository : Holotype : CRB (Canada) ; Paratypes : ZSI (Calcutta).

Distribution : India (Uttar Pradesh).

126. **Rhyacophila sherchokpa** Schmid

1970. *Rhyacophila sherchokpa* Schmid, *Mem. ent. Soc., Can.*, No. 66 : 208.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Arunachal Pradesh).

127. **Rhyacophila sherpa** Schmid

1970. *Rhyacophila sherpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 156.

Type locality : Sikkim.

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Sikkim).

128. **Rhyacophila shingripa** Schmid

1970. *Rhyacophila shingripa* Schmid, *Mem. ent. Soc. Can* , No. 66 : 179.

Type locality : Sikkim.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Sikkim).

129. **Rhyacophila sikungpa** Schmid

1970. *Rhyacophila sikungpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 167.

Type locality : Pauri Garhwal.

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Uttar Pradesh).

130. **Rhyacophila similis** Martynov.

1935. *Rhyacophila similis* Martynov, *Rec. Indian Mus.*, **37** : 99.

Type locality : Garhwal.

Type Repository : Holotype : ZSI (Calcutta)

Distribution : India (Uttar Pradesh).

131. **Rhyacophila spinalis** Martynov

1930. *Rhyacophila spinalis* Martynov, *Proc. Zool. Soc. Lond.*, : 69.

1992. *Rhyacophila spinalis*, Higler, *Oriental Insects*, **26** : 72.

Type locality : Tibet.

Type Repository : Holotype : BMNH (London).

Distribution : India (Uttar Pradesh, Sikkim, Arunachal Pradesh).

132. **Rhyacophila stenostyla** Martynov

1930. *Rhyacophila stenostyla* Martynov, *Fauna of China and Eastern Tibet*, : 70-71.

Type locality : Tibet.

Type Repository : Holotype : BMNH (London).

Distribution : India (Sikkim and Uttar Pradesh). Nepal, Tibet.

133. **Rhyacophila sumdopa** Schmid

1970. *Rhyacophila sumdopa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 168.

Type locality : Holotype and Allotype : CRB (Canada).

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Manipur).

134. **Rhyacophila tarkiya** Schmid

1970. *Rhyacophila tarkiya* Schmid, *Mem. ent.* Soc. *Can.*, No. 66 : 194.

Type locality : Sikkim.

Type Repository : Holotype and Allotype : CRB (Canada).

Distribution : India (Sikkim).

135. **Rhyacophila tashepa** Schmid

1970. *Rhyacophila tashepa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 143.

Type locality : Sikkim.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Sikkim).

136. **Rhyacophila tashidingpa** Schmid

1970. *Rhyacophila tashidingpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 195.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype : CRB (Canada) ; Paratype : ZSI (Calcutta).

Distribution : India (Calcutta, Sikkim & Arunachal Pradesh).

137. **Rhyacophila tecta** Morton

1900. *Rhyacophila tecta* Morton, *Trans. ent. Soc. Lond.*, p. 4, pl. 1, Figs. 8-9.

Type locality : Meghalaya (Khasi Hills).

Type Repository : Holotype : BMNH (London).

Distribution : India (Meghalaya and Arunachal Pradesh) ; Birmanie Septentrionale.

138. **Rhyacophila tengyelingpa** Schmid

1970. *Rhyacophila tengyelingpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 173.

Type locality : Sikkim.

Type Repository : Holotype & Allotype CRB (Canada) ; Paratype ; ZSI (Calcutta).

Distribution : India (Sikkim).

139. **Rhyacophila tolungpa** Schmid

1970. *Rhyacophila tolungpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 182.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Arunachal Pradesh).

140. **Rhyacophila trashipa** Schmid

1970. *Rhyacophila trashipa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 212.

Type locality : Manipur.

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Manipur).

141. **Rhyacophila trulungpa** Schmid

1970. *Rhyacophila trulungpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 202.

Type locality : Pouri Garhwal.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Uttar Pradesh).

142. **Rhyacophila tsering** Schmid

1970. *Rhyacophila tsering* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 148.

Type locality : Kerala.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Kerala).

143. **Rhyacophila tshiringpa** Schmid

1970. *Rhyacophila tshiringpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 157.

Type locality : Sikkim.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratype ZSI (Calcutta).

Distribution : India (Sikkim).

144. **Rhyacophila tshogpa** Schmid

1970. *Rhyacophila tshogpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 ; 213,

Type locality : Sikkim.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Sikkim).

145. **Rhyacophila tsiudmerpo** Schmid

1970. *Rhyacophila tsiudmerpo* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 169.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Arunachal Pradesh).

146. **Rhyacophila tsona** Schmid

1970. *Rhyacophila tsona* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 192.

Type locality : Manipur.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Manipur).

147. **Rhyacophila tsongkhapa** Schmid

1970. *Rhyacophila tsongkhapa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 219.

Type locality : Sikkim.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Sikkim).

148. **Rhyacophila tungkorpa** Schmid

1970. *Rhyacophila tungkorpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 175.

Type locality : Sikkim.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Sikkim).

149. **Rhyacophila tungpa** Schmid

1970. *Rhyacophila tungpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 179.

Type locality : Jungle Chatti.

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratype ; ZSI (Calcutta).

Distribution : India (Uttar Pradesh).

150. **Rhyaeophila ugyenpa** Schmid

1970. *Rhyacophila ugyenpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 204.

Type locality : Meghalaya (United Jaintia & Khasi Hills).

Type Repository : Holotype : CRB (Canada).

Distribution : India (Meghalaya).

151. **Rhyacophila wangpo** Schmid

1970. *Rhyacophila wangpo* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 143.

Type locality : West Bengal.

Type Repository : Holotype : CRB (Canada).

Distribution : India (West Bengal).

152. **Rhyacophila yarlungpa** Schmid

1970. *Rhyacophila yarlungpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 182.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype : CRB (Canada) ; Paratype : ZSI (Crlcutta).

Distribution : India (Arunachal Pradesh & Sikkim) ; Nepal.

153. **Rhyacophila yigronga** Schmid

1970. *Rhyacophila yigrongpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 141.

Type locality : Sikkim.

Type Repository : Holotype : CRB (Canada) : Paratype : ZSI (Calcutta).

Distribution : India (Sikkim).

154. **Rhyacophila yipung** Schmid

1970. *Rhyacophila yipung* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 142.

Type locality : Manipur.

Type Repository : Holotype : CRB (Canada) ; Paratype : ZSI (Calcutta).

Distribution : India (Manipur).

155. **Rhyacophila yishepa** Schmid

1970. *Rhyacophila yishepa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 177.

Type locality : Sikkim.

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Sikkim).

156. **Rhyacophila yonggyapa** Schmid

1970. *Rhyacophila yonggyapa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 203.

Type locality : Manipur.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Manipur).

157. **Rhyacophila yullha** Schmid

1970. *Rhyacophila yullha* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 195.

Type locality : Sikkim.

Type Repository : Holotype & Allotype : CRB (Canada).

Distribution : India (Sikkim).

158. **Rhyacophila zhungpa** Schmid

1970. *Rhyacophila zhungpa* Schmid, *Mem. ent. Soc. Can.*, No. 66 : 199.

Type locality : Arunachal Pradesh (Kameng).

Type Repository : Holotype & Allotype : CRB (Canada) ; Paratypes : BMNH (London) & ZSI (Calcutta).

Distribution : India (Arunachal Pradesh & Uttar Pradesh).

Genus **Himalopsyche** Banks

1940. *Himalopsyche* Banks, *Proc. U. S. Nat. Mus.*, **88** : No. 3079 : 197.

159. **Himalopsyche amitava** Schmid & Botsoneanu

1966. *Himalopsyche amitava* Schmid & Botsoneanu, *Ann. ent. Soc. Queb.*, **11** : 148.

Type locality : Sikkim.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Sikkim).

160. **Himalopsyche angnorbui** Schmid

1963. *Himalopsyche angnorbui* Schmid, *Bonn. Zool. Beitr.*, **14** : 208.

1992. *Himalopsyche angnorbui*, Higler, *Oriental Insects*, **26** : 68.

Type locality : Garhwal.

Type Repository : Holotype & Paratype : CRB (Canada) ; Paratype : ZSI (Calcutta).

Distribution : India (Uttar Pradesh).

160a. **Himalopsyche angnorbui sherpa** Schmid

1963. *Himalopsyche angnorbui sherpa* Schmid, *Bonn. Zool. Beitr.* **14** : 208.

Type locality : Himalayas.

Type Repository : Holotype ; CRB (Canada).

Distribution : India (Uttar Pradesh).

161. **Himalopsyche bhagirathi** Schmid

1968. *Himalopsyche bhagirathi* Schmid, *Bonn. Zool. Beitr.*, **14** : 209.

Type locality : Himalayas.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Uttar Pradesh).

162. **Himalopsyche biansata** Kimmins

1952. *Himalopsyche biansata* Kimmins, *Ann. Mag. nat. Hist. Soc.*, (12) **5** : 351.

1992. *Himalopsyche biansata* Higler, *Oriental Insects*, **26** : 68.

Type locality : Tibet.

Type Repository : Holotype : BMNH (London).

Distribution : India (Sikkim) ; Tibet.

163. **Himalopsyche digitata** (Martynov)

1935. *Rhyacophila digitata* Martynov, *Rec. Indian Mus.*, **37** : 102-103, figs. 8a-c.

1922. *Himalopsyche digitata*, Higler, *Oriental Insects*, **26** : 68.

Type locality : Darjeeling.

Type Repository : ZSI (Calcutta).

Distribution : India (West Bengal, Uttar Pradesh, Sikkim and Arunachal Pradesh).

164. **Himalopsyche dolmasampa** Schmid

1963. *Himalopsyche dolmasampa* Schmid, *Bonn. Zool. Beitr.*, **14** : 212.

Type locality : Himalayas.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Uttar Pradesh).

165. **Himalopsyche gyamo** Schmid

1963. *Himalopsyche gyamo* Schmid, *Bonn. Zool. Beitr.*, **14** ; 228.

Type locality ; Himalayas.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Uttar Pradesh and Sikkim).

166. **Himalopsyche hierophylax** Schmid & Botosaneanu

1966. *Himalopsyche hierophylax* Schmid & Botosaneanu, *Ann. ent. Soc. Queb.*, **11** : 150.

Type locality : Uttar Pradesh.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Uttar Pradesh).

167. **Himalopsyche horai** (Martynov)

1935. *Rhyacophila pallida* Martynov, *Rec. Indian Mus.*, **37** : 100-102, figs. 7a-c.

1992. *Himalopsyche horai*, Higler, *Oriental Insects*, **26** : 68.

Type locality : Dalhousie.

Type Repository : Holotype : ZSI (Calcutta).

Distribution : India (Himachal Pradesh, Uttar Pradesh, Sikkim and Arunachal Pradesh).

168. **Himalopsyche lanceolata** (Morton)

1900. *Rhyacophila lanceolata* Morton, *Trans. ent. Soc. Lond.*, p. 2, pl. 1, fig. 1-4.

1952. *Himalopsyche lanceolata*, Kimmins, *Ann. Mag., nat. Hist.*, London, **5** (12) : 356.

Type locality : Meghalaya (Khasi Hills).

Type Repository : Holotype & Paratype : BMNH (London).

Distribution : India (Meghalaya and Manipur).

169. **Himalopsyche lepcha** Schmid

1963. *Himalopsyche lepcha* Schmid, *Bonn. Zool. Beitr.*, **14** : 222.

Type locality : Himalayas.

Type Repository : Holotype : CRB (Canada) ; Paratypes : ZSI (Calcutta).

Distribution ; India (Uttar Pradesh, Sikkim & West Bengal).

170. **Himalopsyche lungma** Schmid

1963. *Himalopsyche lungma* Schmid, *Bonn. Zool. Beitr.*, **14** : 217.

Type locality : Himalayas.

Type Repository : Holotype : CRB (Canada) ; Paratype : ZSI (Calcutta).

Distribution : India (Uttar Pradesh).

171. **Himalopsyche maitreya** Schmid

1963. *Himalopsyche maitreya* Schmid, *Bonn. Zool. Beitr.*, **14** : 220.

Type locality : Himalayas.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Uttar Pradesh).

172. **Himalopsyche malenanda** Schmid

1963. *Himalopsyche malenanda* Schmid, *Bonn. Zool. Beitr.*, **14** : 210.

Type locality : Himalayas.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Uttar Pradesh, Sikkim and Arunachal Pradesh).

173. **Himalopsyche phedogensis** Kimmins

1952. *Himalopsyche phedogensis* Kimmins, *Ann. Mag. nat. Hist. Soc.*, (12) **5** : 356.

Type locality : Sikkim.

Type Repository : Holotype & Allotype : BMNH (London).

Distribution : India (Sikkim).

174. **Himalopsyche tibetana** (Martynov)

1930. *Rhyacophila tibetana* Martynov, *Proc. zool. Soc. Lond.*, : 65.

1992. *Himalopsyche tibetana*, Higler, *Oriental Insects*, **26** : 68.

Type locality : Tibet.

Type Repostory : Holotype & Paratype : Zool. Mus. (Leningrad).

Distribution : India (Uttar Pradesh and Sikkim) ; Tibet.

175. **Himalopsyche todma** Schmid

1963. *Himalopsyche todma*, Schmid, *Bonn. Zool. Beitr.*, **14** : 215.

Type locality ; Himalayas.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Uttar Pradesh).

176. **Himalopsyche yatrawalla** Schmid & Botosaneanu

1966. *Himalopsyche yatrawalla* Schmid & Botosaneanu, *Ann. ent. Soc. Queb.*, **11** : 143.

Type locality : Uttar Pradesh.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Uttar Pradesh).

177. **Himalopsyche yongma** Schmid

1968. *Himalopsyche yongma* Schmid, *Bonn. Zool. Beitr.*, **14** : 217.

Type locality : Sikkim.

Type Repository : Holotype : CRB (Canada).

Distribution : India (Sikkim).

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Rec. zool. Surv. India, **92** (1-4) : 347-348, 1992

REPORT ON THE OCCURRENCE OF *RATTUS RATTUS WROUGHTONI* HINTON, 1918 (MAMMALIA : RODENTIA : MURIDAE), IN MADHYA PRADESH, INDIA

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While studying a small collection of rodents, collected during the recent survey trip to Balaghat and Mandla districts of Madhya Pradesh in 1991, I came across a number of specimens of *Rattus rattus wroughtoni* Hinton, 1918. Further, while examining the collection of this taxon present in the National Zoological Collection, some more specimens from Shahdol, Sidhi and Rewa districts of Madhya Pradesh collected and identified by late Dr. M. L. Roonwal, were traced out, but, which were not recorded by him.

According to authoritative literature (Ellerman and Morrison-Scott 1951 and Ellerman 1961) the distributional range of *Rattus rattus wroughtoni* Hinton, 1918 is restricted to southern peninsular India only. Therefore, the present material of this taxon from Madhya Pradesh constitutes its first authentic record from that state and eventually extends its distribution much further north and north-eastwards.

The present study reveals that two of the white-bellied forms of *Rattus rattus*, viz. *Rattus rattus narbadae* and *Rattus rattus wroughtoni* occur in Madhya Pradesh, out of which *Rattus rattus narbadae* is restricted to the West and *Rattus rattus wroughtoni* to the east of 80°E longitude.

Further, during the course of collection trip to Balaghat and Mandla districts of Madhya Pradesh, *Rattus rattus wroughtoni* Hinton and *Rattus rattus rufescens* (Gray) were trapped at the same spot both inside the kitchen as well as in the forests. However, out of 21 specimens of both the forms, no intergrades were found. This supports the view of Tiwari *et al.* (1971) that *Rattus rufescens* is a full species and not a subspecies of *Rattus rattus*.

The details of the specimens are given below. All measurements (in millimetres) are taken after Ellerman (1961).

Material : Madhya Pradesh : Balaghat district : 3 ♂, 2 ♀, 1 sub ad ♀ : Mukki, 21-26 Jan 1991, R. K. Ghose coll. ; 2 ♂ : Supkhar, 28, 29 Jan 1991, R. K. Ghose coll. Mandla district : 3 ♂, 3 ♀ : Kanha, 15-19 Jan 1991, R. K. Ghose coll. ; 4 ♂ : Motinala, 1, 2 Feb

1991, R. K. Ghose coll. Shahdol district : 2♂ : Baiohari, *c* 74 Km SE of Rewa, 15 Apr 1947, M. L. Roonwal coll. Sidhi district : 1♂, 2♀ : Jhuko, *c* 134 Km E of Rewa, 31 Mar—2 Apr 1947, M. L. Roonwal coll. Rewa district : 1 sub ad ♀ : Waidan, *c* 106 Km E of Rewa, 22 Mar 1947, M. L. Roonwal coll.

Measurements : External : 12♂ : Head and body 145-182 (169.5) ; tail 175-230 (196.8) ; hind-foot 30.5-34 (31.9) ; ear 20-25 (22.4). 6♀ : Head and body 137-178 (155.3) ; tail 155-217 (193.5) ; hind-foot 29-32 (30.8) ; ear 21-23.5 (22.1).

Cranial : 5♂ : Occipitonasal 40.5-41.7 (41.0) ; palate 21.3-22.9 (21.8) ; anterior palatal forimina 7.1-7.7 (7.4) ; nasal 13.8-15.0 (14.3) ; upper toothrow 6.0-6.6 (6.3) ; bulla 7.4-7.7 (7.5). 3♀ : occipitonasal 39.1-41.6 (40.7) ; palate 21.1-22.3 (21.8) ; anterior palatal foramina 7.1-7.4 (7.2) ; nasal 13.4-14.5 (13.9) ; upper toothrow 6.2-6.6 (6.4) ; bulla 7.2-7.3 (7.3).

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Tiwari, K. K., Ghose, R. K. and Chakraborty, S. 1971. Notes on a collection of small mammals from Western Ghats with remarks on the status of *Rattus rufescens* (Gray) and *Bandicota indica malabarica* (Shaw). *J. Bombay nat. Hist. Soc.*, **68** : 378-384.

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POPULATION CENSUS OF RHESUS MACAQUE AND HANUMAN LANGUR IN INDIA—A STATUS SURVEY REPORT

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INTRODUCTION

In the past excessive demand for monkeys, particularly of rhesus macaque, for biomedical and pharmaceutical research and other experimentation, have put a heavy strain on their population in nature in India. The rhesus macaque is and will continue to be the standard laboratory model for various scientific investigations. To meet this demand, large number of rhesus were being trapped and exported to other countries in the past. The past reports of the monthly statistics of Foreign Trade of India indicate that a good number of monkeys of Indian origin, particularly the rhesus, were exported to different countries. However, since 1978 there has been a total ban on the export of monkeys from India.

The fear expressed in many circles that our non-human primate populations are on the decline due to combinations of various factors, including export, generated the necessity for ascertaining the current population status of Indian non-human primates particularly the rhesus macaque and hanuman langur. To evaluate the status of non-human primates in the country, a survey of different states was undertaken just after the ban on export of monkeys was imposed. Field studies of non-human primates have been conducted from time to time in limited areas but a large scale population census of monkeys occupying different ecological niches of almost the entire country has never been undertaken. Southwick *et al* (1960 to 1983) have conducted population studies of rhesus macaque in northern India, particularly Uttar Pradesh, but they have not attempted to cover the entire range of distribution of rhesus in India, nor have they surveyed langur populations.

In India non-human primates occupy a large diversity of habitats ranging from dense forest in montane region to open land and human habitations. Under the present survey the parts of central, western, northern and some states of north eastern India were surveyed. A similar concurrent project was undertaken by Dr. G.U. Kurup of

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the Zoological Survey of India in southern India, viz, in Andhra Pradesh, Karnataka, Tamil Nadu and Kerala (Kurup, 1984).

Among all the primates, the rhesus macaque (*Macaca mulatta*) and hanuman langur (*Presbytis entellus*) have wide distribution in India. While the hanuman langur occurs throughout Indian sub-continent excluding some parts of the north eastern India, the rhesus macaque, though wide ranging in northern India and further east and south east, is replaced by bonnet macaque (*Macaca raidata*) in South India (Fig. 1). All the other species of monkeys have localised distribution in India. The present survey covered nearly entire distributional range of rhesus macaque in India, except some states in north eastern India.

Sampling Areas

Field work on this project involved a very large area in the northern, eastern, central and western India (nearly 2.67 million sq. km.) and it was physically impossible to cover the entire territory. Therefore, it was decided to undertake sample surveys of randomly selected areas of each state using the method of probability proportional to area. Care was taken that the study areas so selected from each state were representative of each type of ecolngical niche inhabited by non-human primates.

Areas of each geographical district within a division were cumulated and if 'T' be the total area of the division of 'n' small digits, then 'T' was multiplied with such highest multiple (m) that the product did not exceed 'n' digits. From the statistical table of biological agricultural and medical research (Fishers and Yeats) a random number 'R' was selected from random numbers table of 'n' digits. If the number 'R' was greater than 'T' then the remainder was taken after dividing 'R' by 'T' otherwise 'R' was taken as it was. This was referred to the cumulated column and the district was identified to which it corresponded. Using the above procedure, the districts that were selected from the different states for census were Baramula and Punch of Jammu and Kashmir state ; Bilaspur and Sirmur of Himachal Pradesh ; Ambala and Mohendragarh of Haryana ; Delhi ; Almora, Uttarkahsi, Pilibhit, Muzzafarnagar, Pratapgarh, Mirzapur, Etawah, Jhansi and Lalitpur, Unnao, Mathura and Deoria of of Uttar Pradesh ; Hoshiarpur, Sangrur and Amritsar of Punjab ; Bikaner, Ajmer, Udaipur, Jaipur, Sawai Madhopur and Jhalawar of Rajasthan ; Jhabua, Gwalior, Sidhi, Mandla, Raigarh, Betul and Bastar of Madhya Pradesh ; Vadodara and Junagarh of Gujarat ; Bhagalpur, Sahabad, Champaran and Singhbhum of Bihar ; Puri, Bolangir, Sundargarh of Orissa ; Midnapore, West Dinajpur and Darjeeling of West Bengal ; South district of Tripura ; South district of Manipur ; Jalgaon and Yeotmal of Maharashtra ; Adilabad, East Godawari and Vishakapatnam of Andhra Pradesh. Among the states in north-eastern India Assam, Arunachal Pradesh, Meghalaya, Mizoram and Nagaland could not be covered due to logistic reasons.

METHODS

After choosing the sampling units different census techniques were applied according to the nature of terrain involved. In the flat plains of the Indo-gangetic valley studded with villages, towns and cities and criss-crossed by network of roadways, the census areas were combed by using roads for locating and counting of the monkey groups. Roadside transects in 5 sq km grids were selected in open areas. Additionally, censuses were conducted in such habitats as villages, towns, cities, railway stations, temples, bazars, forests, hills and factories within the sampling areas. In forests, transects along roads, stream beds, game tracts and fire lines were used to locate monkey groups and, if sighted, they were counted and if visibility was poor their vocalisation and/or other sounds created by their activity were utilised for detection of monkey groups. In the hilly terrain it was not easy to use the same sighting and counting techniques that were applied in the flat plains and often the point method was used for census. This essentially consists of climbing the highest point on a hill or hillock to scan the surrounding areas to locate monkey groups if any, and if sighted, to trace and count them. This method was particularly used in some hilly tracts in Bihar, Tripura, Manipur and Uttar Pradesh. The roadside groups were classified as those which were exclusively occupying the trees and depended for their food and shelter entirely on the trees lining the sides of the road, and were away from the villages, towns, cities and forests.

Having located monkey groups, the exact locality and the animals sighted were recorded alongwith their habitats and other relevant data. In each group the individuals were counted and the number of each age category, i.e. adult males, adult females, juveniles and infants were recorded. In addition to actual sighting and locating monkeys, and through auditory signals, information regarding the distribution of monkeys was also obtained from local people.

METHODS FOR ESTIMATION OF POPULATION

The estimate of population was made by applying the formula $N = ni/fi$, where 'N' was estimated population, 'n' was the number of animals in the 'i' th division and 'fi' was the corresponding sampling fraction as follows :

$$\text{Sampling fraction (fi)} = \frac{\text{Total sampled area of the district surveyed}}{\text{Total area of the division}}$$

Where authentic proof of the presence of monkeys was found the reports of the local people about these groups were also taken into consideration for the purpose of estimation of population. In such cases the average group size of the monkeys that were observed in the area was taken as the group size of the group reported by the local people.

EXTERNAL CHARACTERS OF RHESUS MACAQUE AND HANUMAN LANGUR

Rhesus Macaque : A medium-sized macaque with hind quarters of the body brighter (orange-red hue) than fore quarters ; short tail, less than half the length of head and body, uniformly haired ; head-body length measures 455-635 mm in male and 370-580 mm in female ; tail measure 200-317 mm in male and 163-284 mm in female ; body weight in male 5.6-14.5 kg and in female 3.0-10.7 kg ; crown hairs directed backwards from the brows and without a median parting ; face bare, light pink to reddish ; cheek hairs short, forming a whorl ; the upper back olive to greyish brown in colour ; loins, rump and base of tail orange-red and more brightly coloured than the fore quarters ; skin around ischial callosities naked ; under surface of body sparsely haired and paler than above ; females smaller and lighter than males ; new-born infants dark brown and almost black (Fig. 2).

Hanuman Langur : Large in size ; body grey, with long limbs ; sex skin well developed and does not show cyclic changes ; tail longer than head and body ; head and body measures 58-64 cm in length in male and 55-57 cm in female ; tail measures 85-105 cm in male and 79-88 cm in female ; body weight in male 9.0-20.9 kg and in female 7.5-18.0 kg ; in adult hairs of head behind the brows radiating from a frontal whorl, crown hairs rise into a crest or tuft ; eye brows well developed ; face black ; colour of the hands and feet black and the black colour varies from season to season ; tail longer than head and body, they differ in their tail carriage and show geographical and subspecific variations ; coat colour greyish black in nortnern India, paler in south and almost whitish in dry zone of south-east India ; females smaller and lighter than males ; brown natal coat colour present in infant in first few months of life and slowly it changes to normal grey colour (Fig. 3).

A. Statewise Results

Jammu & Kashmir : A total of 343 rhesus monkeys in 7 groups were sighted in the survey districts but only a few langurs were counted.* The social structure and habitat wise distribution of rhesus macaque are given in Table 1. The sex ratio of adult male to female was 1 : 6 : 5 and 20% of the adult females had infants. The local people reported the presence of langurs in the state but as only a few langurs were recorded this figure has not been included in the Table 1 and in the present estimate. Due to logistic difficulty caused by weather conditions and irregular terrain it was not possible to conduct a thorough survey of the two districts. The 343 monkeys in 7 groups were all forest dwellers. Langurs were also observed in the forest habitat. The population of rhesus monkey in this state was estimated to be about 13,000.

*One of us (K. K.) had, while touring Kashmir Valley in the summer of 1955, sighted a number of groups of hanuman langur in the hills adjacent to Shalimar garden near Braen village, and in the forest at Batakoot near Pahalgam. It appears that Hanuman langurs are not uncommon in certain parts of the Kashmir valley.

Fig.1. APPROXIMATE RANGE OF DISTRIBUTION OF RHESUS MACAQUE AND HANUMAN LANGUR

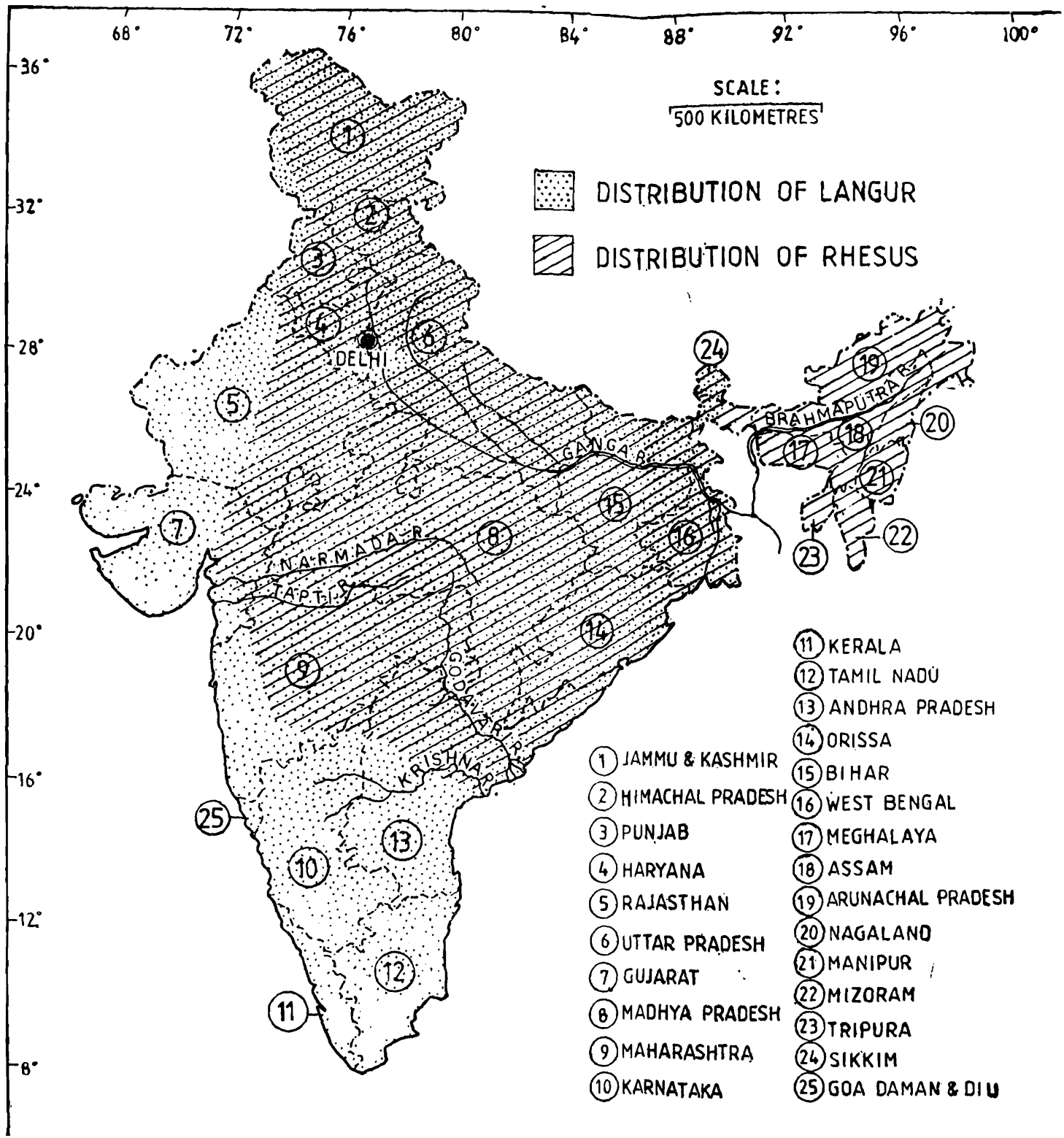

Fig. 2. Rhesus macaque (*Macaca mulatta*)

Fig. 3. Hanuman Langur (*Presbytis entellus*)

TABLE—1.

Species	Total no. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	7	33	213	55	42	—	343

Distribution	F	T	B	V	R	CT	H	FA	Rs	Total
M. mulatta	343 (7)	—	—	—	—	—	—	—	—	343 (7)

F=Forest ; T=Temple ; B=Bazar ; V=Village ; R=Roadside ; CT=City & Town ; H=Hill ; FA=Factory ; Rs=Railway Station

Figures in parenthesis represent number of groups.

Himachal Pradesh : The two districts that were surveyed under the project were heavily forested and presented considerable difficulty in locating and counting monkeys in the irregular terrain. Rhesus macaques actually sighted numbered 695 in 21 groups and 25 langur groups that were encountered contained a total of 533 individuals. The social structure and habitat wise distribution of rhesus and hanuman langur are given in Table 2. The adult male to female ratio of rhesus macaque was 1 : 4.69 and 42% of the adult females had infants. The sex ratio of adult male to female in hanuman langur was 1 : 5.23 and 40% of the adult females had infants. Population of rhesus and langur were estimated to be about 20,000 and 15,000 individuals respectively. In this state majority of the rhesus inhabited the forest. Only two groups were recorded from the temple and bazar habitats. All the 25 groups of langur were recorded from the forest habitat.

TABLE—2.

Species	Total no. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	21	67	314	173	131	10	695
Presbytis entellus	25	43	225	160	105	—	533

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	605 (19)	70 (1)	20 (1)	—	—	—	—	—	—	695 (21)
P. entellus	533 (25)	—	—	—	—	—	—	—	—	533 (25)

Haryana : In the two districts of Haryana a total of 22 groups of rhesus and 6 groups of langur were encountered. The social structure and habitat wise distribution of rhesus and langur are incorporated in Table 3. The sex ratio of adult male to female was 1 : 3.41 and 47% of the adult females had infants in case of rhesus ; and the sex ratio of adult male to female was 1 : 3.26 and 45% of the adult females had infants in case of langurs. The populations of rhesus and hanuman langur were estimated to be about 4,000 and 1,000 respectively. The rhesus monkey shared the habitats of forest, temple, bazar, village, roadside, city, town and hill but majority of the groups were recorded from the forests. The six langur groups inhabited the forests and the hilly terrain.

TABLE—3.

Species	Total no. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	22	39	133	81	62	8	323
Presbytis entellus	6	8	26	14	14	—	62

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	151	10	44	45	33	27	13	—	—	323
	(8)	(1)	(2)	(6)	(1)	(3)	(1)			(22)
P. entellus	27	—	—	—	—	—	35	—	—	62
	(2)						(4)			(6)

Punjab : Ten groups of rhesus were recorded in the 3 districts of Punjab. No langurs were sighted in any of the districts that were surveyed. The social structure and habitat wise distribution of rhesus are included in Table 4. The sex ratio of adult male to female was 1 : 3.10 and 66% of the adult females had infants. The population of rhesus macaque in Punjab was estimated to be about 5,000 individuals. Out of the 10 groups, 7 inhabited the forest and the rest 3 groups shared the bazar, village and roadside habitats.

TABLE—4.

Species	Total no. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	10	63	195	98	127	36	519

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	449	—	40	26	4	—	—	—	—	519
	(7)		(1)	(1)	(1)					(10)

Delhi : In Delhi a total of 22 rhesus groups with 403 individuals were recorded but no langurs were observed. The social structure and the distribution of the 22 groups are given in Table 5. The adult male to female sex ratio was 1 : 4.09 and 90% of the adult females had infants. The population of rhesus in Delhi was estimated to be about 1,000 at a very conservative basis.

Delhi, the capital of India, has a good residential population of rhesus macaques. Occupying an outlier of the Aravalli chain of hills the undulating city of Delhi is now gradually being levelled into units of human habitation of different sizes and densities. The whole city is a big urban complex which can not be conventionally classified. The rhesus are mostly confined to the outer perimeter of the city studded with small rural habitations and slums or medium sized middle class townships. Of the total 22 groups of rhesus that were sighted roughly six occured in rural habitation or villages, 11 were recorded from the medium sized townships or city. The roadside trees and bazars contained 3 and 2 groups respectively. In the ancient ruins of Tughlaqabad Fort there is a fairly large group of rhesus macaques. The number of individuals in village locations was 80. The city contained 181 individuals while the 2 bazar groups contained only 20 individuals. The roadside groups had 122 individuals which indicate that the roadside habitats were preferred by rhesus monkeys in Delhi. Newspaper reports indicate that the macaques make occasional forays into the official complexes, sometimes creating funny situations.

TABLE—5.

Species	Total no. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys				Total
Macaca mulatta	22	43	176	112	71	1				403
Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	—	—	20	80	122	181	—	—	—	403
			(2)	(6)	(3)	(11)				(22)

Uttar Pradesh : The state of Uttar Pradesh is very well known for the concentration of rhesus monkey in India. The 12 districts that were surveyed under the project recorded a total of 171 groups of rhesus macaque and 149 groups of langur. The social structure and habitat wise distribution of these two species of non-human primates are included in Table 6. The ratio of adult male to female was 1 : 3.24 and 49% of the adult females had infants in rhesus population. In langurs the sex ratio of adult male to female was 1 : 3.50 and also 49% of the adult female had infants. The population of rhesus and hanuman langur were estimated to be about 68,000 and 45,000 respectively.

Uttar Pradesh is probably the state with the largest population of rhesus macaque inhabiting practically all the habitats but the population is distributed mainly in forests, temples, bazars, villages, roadsides, cities and towns. Three very diverse habitats, i. e. forest, temple and bazar are the most preferred habitats of rhesus macaque in Uttar Pradesh. Large number of groups have been encountered in human habitations like villages, towns and cities but with lesser number of monkeys per group. Road side groups were frequent but the group size was smaller. Like rhesus macaque, the langurs were recorded from almost all the habitats. However, in addition to forests majority of the population occurred in roadsides and villages, much less in towns and cities. A significant feature of langur population appears to be that the groups size does not vary much in different ecological habitats.

TABLE—6

Species	Total No. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	171	682	2,209	1,167	1,079	11	5,148
Presbytis entellus	149	444	1,555	682	689	42	3,412

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	1236	1379	825	582	393	706	13	12	2	5148
	(25)	(24)	(25)	(40)	(25)	(29)	(1)	(1)	(1)	(171)
P. entellus	1865	161	57	790	359	84	60		36	3412
	(62)	(5)	(2)	(47)	(22)	(5)	(3)	—	(3)	(149)

Rajasthan: The six districts of Rajasthan were intensively searched for the presence of monkeys. In this dry part of India, more langurs were recorded than rhesus. The social structure and habitat wise distribution of rhesus and hanuman langur are given in Table 7. In rhesus the sex ratio of adult male to female was 1 : 6.23 and 30% of the adult females had infants. The sex ratio of adult male to female was 1 : 3.06 and 34% of the adult females had infants in langur populations. The populations of rhesus and langur in this arid zone were estimated to be about 6,000 and 26,000 respectively. However, in recent survey of 1991 good populations of langur and rhesus macaque were recorded in Ranthombhor and Sariska Tiger Reserves. In Rajasthan the 23 rhesus groups with 637 individuals were recorded from habitats like villages, temples, cities, roadside trees, railway stations and bazars. It is worth noting that the largest group size occurred in temple habitat. The langur population in Rajasthan was predominant and a total of 105 groups with 2,850 langurs were

counted in the sampling areas. In Rajasthan, where the animals are generally protected, a good density of langur population was recorded. Majority of the langur groups were recorded from the forest and village habitats.

TABLE—7

Species	Total No. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	23	31	193	88	57	268	637
Presbytis entellus	105	421	1,287	609	444	89	2,850

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	—	372 (8)	98 (6)	58 (3)	23 (2)	79 (3)	—	—	7 (1)	637 (23)
P. entellus	1356 (44)	209 (5)	—	838 (34)	129 (5)	291 (15)	15 (1)	—	12 (1)	2,850 (105)

Madhya Pradesh : The seven districts that were selected for census in this state revealed the presence of more langurs than rhesus macaques. A total of 1,295 rhesus in 26 groups was recorded. The social structure and habitat wise distribution of rhesus and langurs are given in Table 8. The sex ratio of adult male to adult female, and female to infant, in rhesus macaque were calculated to be 1 : 3.38 and 1 : 0.37 respectively. The 264 langur groups contained a total of 7,539 individuals, and the sex ratio of adult male to female was 1 : 7.61 and 24% of the adult females had infants. The population of rhesus and langur were estimated to be about 25,000 and 78,000 respectively.

The rhesus macaques were recorded from forest, village, temple, city and road side habitats. It is worth noting that in the forest habitat in Madhya Pradesh the group size of rhesus was bigger in comparison to other habitats. Of all the states the maximum number of langur groups were recorded from Madhya Pradesh. The habitat wise distribution of rhesus and langur showed that the forest habitat contained the maximum population of these two species in this state.

TABLE—8

Species	Total No. of group	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	26	189	629	246	231	—	1,295
Presbytis entellus	264	541	4,117	1,890	973	18	7,539

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	1238 (21)	18 (1)	—	8 (1)	29 (2)	2 (1)	—	—	—	1,295 (26)
P. entellus	7067 (242)	9 (1)	—	219 (9)	217 (11)	—	27 (1)	—	—	7,539 (264)

Gujarat : The two districts that were surveyed in the state of Gujarat situated on the western part of India washed by the Arabian Sea. Only langur groups were recorded from census areas. Social structure and habitat wise distribution are recorded in Table 9, The survey of two districts revealed a total of 896 langurs in 20 groups. The sex ratio of adult male to female was 1 : 4.67 and 52% of the females had infants. The population of langur was estimated to be around 16,000. The habitat wise distribution showed that the maximum concentration is in the forest habitat. Gujarat, where animals are also given protection, the group size of langurs in different habitats was fairly large.

TABLE—9

Species	Total No. of group	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Presbytis entellus	20	90	420	167	219	—	896

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
P. entellus	710 (13)	60 (2)	25 (1)	101 (4)	—	—	—	—	—	896 (20)

Bihar : The survey of four districts of Bihar revealed the presence of 27 rhesus and 56 langur groups. The social structure and habitat wise distribution of the two species are given in Table 10. The sex ratio of adult male to female in rhesus macaque was 1 : 2.29 and 48% of the adult females had infants. The sex ratio of adult male to female in hanuman langur was 1 : 4.18 and 38% of the adult females had infants. The population of rhesus and langur were estimated to be about 7,000 and 14,000 respectively. The rhesus occupied the forest, village, temple, city and road side habitats and the langur was recorded from forest, village, temple, city, roadside. mountain and bazar habitats.

TABLE—10

Species	Total No. of group	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	27	56	134	86	64	6	346
Presbytis entellus	57	94	393	170	149	—	806

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	127 (9)	73 (3)	—	37 (4)	14 (3)	95 (8)	—	—	—	346 (27)
P. entellus	294 (17)	46 (4)	51 (3)	329 (24)	45 (3)	17 (2)	24 (3)	—	—	806 (56)

Orissa : A total of 24 groups of rhesus containing 1,096 individuals was counted in two out of three districts that were surveyed in Orissa. The adult male to female ratio was 1 : 3.3 and 53% of the adult females had infants in rhesus macaque. No rhesus monkeys were recorded in Sundergarh district, though the area was well forested. The local people in this district reported the occurrence of these monkeys, which were said to migrate to other areas during the lean dry period. The area is extremely mined for iron ore causing too much disturbances and the local "Behore" community in the area is also said to trap monkeys by nets and keep them in captivity to be eaten at leisure. The "Behore" are locally known as 'Makrkhora', which means monkey eaters.

Hanuman langur seemed to be slightly more abundant in Orissa. A total of 78 groups containing 1,220 langurs were observed in the three districts. The sex ratio of adult male to female was 1 : 5.27 and 40% of the adult females had infants in langur population. Social structure and habitat wise distribution of two species are given in Table 11. On the basis of survey conducted in the three districts, the estimated population of rhesus macaque and langur appear to be 7,000 and 8,000 respectively. The rhesus monkeys occupided the habitats of forest, village, temple, city and roadside and the langur was recorded from the forest, village, temple and roadside.

TABLE—11.

Species	Total No. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	24	126	419	324	224	3	1,096
Presbytis entellus	78	110	580	297	233	—	1,220

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	902	71	—	16	15	92	—	—	—	1,096
	(18)	(2)		(1)	(1)	(2)				(24)
P. entellus	576	31	—	533	80	—	—	—	—	1,220
	(37)	(1)		(32)	(8)					(78)

West Bengal : In West Bengal the three districts that were surveyed under the project indicate that macaques were negligible in the plains whereas the langurs were dominant. A total of 11 groups of rhesus macaques and 12 groups of Assamese macaque were recorded mostly from the Darjeeling district. The social structure and habitat wise distribution of rhesus macaque and langur are given in Table 12. The 12 groups of Assamese macaques, containing a total of 156 individuals including 30 adult males, had 42 adult females, 29 juveniles and 14 infants. Forty one monkeys could not be sexed. The sex ratio of adult male to female was 1 : 1.40 and 33% of

the adult females had infants in case of Assamese macaque, whereas 42% of adult females had infants in case of rhesus. It appears that the two macaques are not sympatric in nature. Assamese macaque was sighted in the montane terrain above 400 to 500 m.

Langurs were quite abundant in this state. The sex ratio of adult male to female was 1 : 4.15 and 14% of the adult females had infants. On the basis of the information that have been collected from the survey of three districts it was estimated that the rhesus population was about 2,000 and langur was more than 6,000. However, in a recent survey (1991) of the three districts ; Hooghly, Howrah and North 24-Parganas, a good population of langurs was recorded. In Hooghly district a total of 33 groups with 367 langurs, in Howrah district a total of 29 groups with 432 langurs and in North 24 Parganas a total of 17 groups with 189 langurs were counted. The distribution of macaque in West Bengal* presents a very poor picture and it appears thai rhesus are found only in isolated pockets. The 23 groups of rhesus and Assamese macaques which were recorded solely from Darjeeling district contained a total of 254 monkeys of which 20 groups with 231, and 3 groups with 23 monkeys, were observed in the forest and roadside habitats respectively, The 12 groups of Assamese macaque with 156 individuals were recorded from the forest of Darjeeling district. However, the langurs are quite abundant in West Bengal.

TABLE—12.

Species	Total no. of group	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	11	29	28	22	11	8	98
Presbytis entellus	60	132	548	163	75	20	938

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	98	—	—	—	—	—	—	—	—	98
	(11)									(11)
P. entellus	33	20	—	813	72	—	—	—	—	938
	(3)	(1)		(52)	(4)					(60)

Tripura : This tiny state is situated in the eastern part of India and it does not have hanuman langurs. In this part the langurs have been replaced by capped langur (*Presbytis pileatus*) and Phayre's leaf monkey (*Presbytis phayrei*). The other non-human primates that are found in this state are rhesus, pig-tailed and stump-tailed macaques, slow loris and hoolock gibbon. The Phayre's leaf monkeys occur only in Tripura

*In the city of Calcutta there is a well known group of rhesus macaques in the Hastings area which appears to be the mascot of the Jawans. In the Indian Museum complex there used to be a good colony of rhesus which was gradually decimated and finally eliminated through human interference.

and south Cachar of Assam within the Indian limits. Probably it also occurs in Mizoram. In some places all these species occur in the same forest and their home ranges overlap. Many parts of Tripura are still well forested and out of the three districts only the south district fell under the sampling unit. The social structure and habitat wise distribution of rhesus are given in Table 13. The 33 groups of rhesus macaque that were sighted during survey contained 937 monkeys. The sex ratio of adult male to female in rhesus macaque was 1 : 3.38 and 40% of the adult females had infants. The estimated population of rhesus macaque in this state was more than 6,000. Though this state is much smaller in size in comparison to other states of India, it seems to have a very good concentration of rhesus macaque and diversity of non-human primate fauna. The majority of the rhesus population was recorded from the forested areas. The recent survey of all the districts of Tripura revealed that the rhesus macaque is present in good numbers in all the districts (Mukherjee and Chakraborty, 1990).

TABLE—13.

Species	Total no. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	33	128	433	203	173	—	937

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	674 (23)	—	—	225 (8)	38 (2)	—	—	—	—	937 (33)

Manipur : The non-human primates of this state seem to contain rhesus and Assamese macaques, hoolock gibbon and capped langur. The south district which fell under the sampling unit was surveyed. Due to prevalent practice of hunting monkeys for food by many ethnic groups and extensive 'Jhooming' (shifting cultivation) in the area, the monkeys are mostly concentrated in deeply forested and practically inaccessible valleys with the result that it is difficult to locate and count them. The estimated population of rhesus macaque in this state was roughly to the order of 2,000 individuals. Most of the non-human primates were recorded from the forested areas.

Maharashtra : In the sampling areas of Maharashtra no rhesus macque was observed but 40 groups of langur with 1,221 individuals were recorded. This reveals abundance of hanuman langur population in this state. The social structure and habitat wise distribution of hanuman langurs are given in Table 14. Five all male groups with 58 langurs were recorded during the survey. The sex ratio of adult male to female was 1 : 3.49 and 28% of the adult females had infants. It was estimated that the population of langur in this state was more than 25,000. A small resident group of rhesus was also sighted by one of us (K. K.) at Lonavala in 1976. Local inquiries revealed that it was the progeny of few individuals, discarded by some madari (nomadic people who use pet monkeys for roadside entertainment). Though in the sampling areas in

Maharashtra visited by the survey teams no rhesus was sighted, this macque is by no means absent in this state, One of us (K. K.) has sighted a number of rhesus groups at Nagpur in the Telankheri area, with one group inhabiting a temple. In western Maharashtra the rhesus is replaced by bonnet monkey.

TABLE—14.

Species	Total no. of gaoups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Presbytis entellus	40	147	513	223	146	192	1,221

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
P. entellus	902 (21)	23 (1)	—	266 (16)	30 (2)	—	—	—	—	1,221 (40)

Andhra Pradesh : In the limited districts of Andhra Pradesh which fell within the census area fairly good number of rhesus and langur groups were observed. The distribution of rhesus macaque in Andhra Pradesh was recorded as far south as the river Krishna which supercedes the earlier reports which state the Tapti in the north and Godavari in northeast are the limits of distribution of rhesus macaque in peninsular India.

The social structure and habitat wise distribution of rhesus macaque and hanuman langur are given in Table 15. In langur twenty individuals in 3 groups were unisexual all male groups. The sex ratio of adult male to females was 1 : 2.43 and 25% of the adult females had infants in case of rhesus monkeys ; and in case of langurs the sex ratio of adult male to female was 1 : 3.05 and 22% of the adult females had infants. The estimated population based on the data collected in the field was about 25,000 rhesus and more than 6,000 langurs. According to Kurup (1984) the estimated population of rhesus in Andhra Pradesh is 50,000, a figure twice as much as our estimate calculated on the basis of actual counts. Most of the rhesus and langur groups were recorded from the forested habitats.

TABLE—15.

Species	Total no. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	42	375	911	575	241	40	2,142
Presbytis entellus	30	61	186	70	40	40	397

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	1,108 (23)	—	—	108 (3)	835 (15)	91 (1)	—	—	—	2,142 (42)
P. entellus	278 (20)	7 (1)	—	24 (2)	59 (4)	29 (3)	—	—	—	397 (30)

B. Habitat wise : Overall analysis of habitat concentration of rhesus and hanuman langur indicates that they are concentrated in the forest habitat more than in other habitats. In case of rhesus monkeys about 50% have been sighted in forested areas. This represents a significant change from 20 years ago when Southwick, Beg and Siddiqui (1965) estimated that only 12% of the rhesus population lived in forest areas. The main difference have been the sharp decline of rhesus in agricultural areas, especially villages, roadside, and canal bank habitats (Southwick, Siddiqui and Oppenheimer, 1983).

The next most suitable habitat that was found to contain more rhesus was temple, having about 14.08% of the total population. The other habitats like roadside trees, cities, villages and bazars show the population distribution of 10.80%, 8.99%, 8.37% and 7.40% respectively. Social situation like factories, hilly terrain and railway stations have a very low percentage of rhesus population (0.36%).

Likewise 68.63% of langur population inhabited the forests. The next suitable habitat for langur was found to be the village with 19.69%, and the roadside, temple and city habitats contained 4.99%, 2.85% and 2.12% of the population respectively. The other habitats like hilly terrain, railway station and bazar had comparatively poor langur population (1.72%).

POPULATION ESTIMATE OF RHESUS AND HANUMAN LANGUR

	Rhesus	*Langur*
Jammu & Kashmir	13,000	*
Himachal Pradesh	20,000	15,000
Punjab	5,000	—
Haryana	4,000	1,000
Delhi	1,000	—
Uttar Pradesh	68,000	45,000
Rajasthan	6,000	26,000
Gujarat	—	16,000
Madhya Pradesh	25,000	78,000
Bihar	7,000	14,000
Orissa	7,000	8,000
West Bengal	2,000	6,000
Tripura	6,000	—
Manipur	2,000	—
Maharashtra	—	25,000
Andhra Pradesh	25,000	6,000
Total	1,91,000	2,40,000

* Due to insufficient data of Jammu and Kashmir the estimate has not been done, possibly there are sizeable populations of Hanuman langurs in this State. (cf. Footnote on p. 352)

Based on the survey conducted in the selected districts of 15 states and Delhi it can be estimated that there are about 200,000 rhesus macaques and 250,000 hanuman langurs in extra peninsular India and part of peninsula.

In a similar survey conducted by Kurup (1984) in southern states of India (Andhra Pradesh, Karnataka, Tamil Nadu and Kerala), the estimated population of Hanuman langurs for these states is 90,000 and of rhesus macaque 50,000 (in Andhra Pradesh only). Kurup's estimate compared with ours appear to be on the higher side. This can possibly be explained by very orthodox and conservative approach adopted by us, which has relied mostly on actual sightings and count. Our population estimates are rather on the low side. There is every likelihood that more intensive surveys in future may reveal higher populations than estimated by us in the present survey.

Southwick (1960) estimated 2,000,000 rhesus monkeys in whole of India. However, Southwick, Siddiqi and Oppenheimer (1983) in recent surveys indicate that the population of rhesus macaque has declined substantially in northern India. Uttar Pradesh still has the greatest rhesus abundance of all the places surveyed under the project. Among other states Jammu and Kashmir, Himachal Pradesh, Madhya Pradesh and Andhra Pradesh has the greatest abundance of rhesus population, whereas the other states like Rajasthan, Gujarat, Bihar, Orissa, Himachal Pradesh, Uttar Pradesh and Maharashtra have fairly good populations of langurs. During our survey we did not sight langurs in Jammu and Kashmir, Punjab and Delhi. Likewise rhesus was not seen in Gujarat. This could be shotcoming of our survey, and we think more intensive svrveys will reveal their presence in states where we found them absent.

Population Abundance of Rhesus Macaque and Hanuman Langur in Different Forest Types

Among the major forest types the rain forests which are mostly located in the north eastern part of India, have the largest diversity of non-human primate species in the Indian sub-continent. The dominant langur species of the Indo-gangetic plain and peninsular India, *Presbytis entellus*, is absent from Assam, and adjacent hill states. One does not know for certain the eastern most limits of distribution of hanuman langur in north eastern India, but perhaps the Sankosh river seperating West Bengal and Assam may be the dividing line. In the present census the extension of hanuman langur in its distribution to the eastern part of India was observed only upto West Bengal. Presuming that this species evolved some where in the northern India, its eastward extension might have encountered resistance in Assam and further east where at least three species of leaf monkeys, viz., capped langur, golden langur and Phayre's leaf monkeys were established. Of these three the most wide spread is the capped langur which bears the same zoogeographic relationship to the hanuman langur in North India as the bonnet macaque bears to rhesus in South India. The capped langur

has habits and habitats similar to those of hanuman langur and if they co-existed in north eastern India they could have competed for food and roosting trees. This may explain why the hanuman langur which is so well distributed elsewhere in India including the hills of the north has not been able to penetrate into the north eastern part of India.

On the contrary the rhesus macaque which has a wide distribution in whole of extra peninsular India and parts of the peninsula is very abundant in Assam and adjacent hill states. In fact this is one of the most wide spread species of macaques in South and South East Asia, extending from Afganistan in West through Pakistan and North India to Assam, Bangladesh, Myanmar, Thailand and South China, but in the Indian peninsula it has not spread into far south. The bonnet macaque, another species of non-human primates, endemic to south India is well established there.

There are, however, indications that the rhesus macaque which was said to occur north of Tapti and north east of Godavari, has penetrated south of Tapti to the Dang's forest in Gujarat and in south west it has infiltrated beyond Godavari to the Krishna delta where in some places it is allopatric with bonnet macaque. (Fooden *et al* 1981, Saha, 1984).

As far as the abundance of rhesus monkeys in different forests is concerned roughly 50% of the observed rhesus macaque populations inhabit the rain forests, moist evergreen and deciduous forests, whereas the remaining 50% occupy other habitats. In case of hanuman langur, the position is reversed. Most of the rain forests of north-eastern India occur in Assam region from where the langur is absent. Nearly eighty two percent of hanuman langur populations occur outside the rain forest tracts, whereas only 18% inhabitat the moist evergreen forests.

The tropical and sub-tropical moist and dry deciduous forests contain the majority of rhesus population, whereas the residual habitats contain a small percentage of rhesus population in the same area. By and large these forests have greater abundance of hanuman langurs. In the moist deciduous forests the langur population occupies 92% whereas the 8% inhabitat the other residual habitats.

In the peninsular India, the pattern of abundance of rhesus populations broadly conforms to that in the moist deciduous belt of north. The representation of rhesus monkey groups in this habitat is 44% in forests and 56% in residual habitats. In case of hanuman langurs 57% occur in the dry deciduous forested areas and 43% in the residual areas.

Unlike in north and penisular forests, the rhesus populations in the arid and semi-arid tract of Rajasthan and parts of western India mostly occur outside forests, whereas in the case of langur it is just the reverse. Thus in the arid and semi-arid tracts 24% of rhesus populations occur in the forests mostly of scrub jungles and

xerophytic vegetation and 76% occupy non-forested niches. Of the hanuman langur population 55% inhabit the arid and semi-arid forest while the remaining 45% occupy the non-forested habitats.

Current data on the population of non-human primates in the temperate forests is scanty and no generalisation is possible at this stage beyond stating that both the rhesus macaque and hanuman langur are not uncommon in these forests.

Discussion

Inspite of rich diversity of non-human primate species in India, detailed field studies of these animals have not been made till the middle of this century. In the first half of the present century only a few field studies of non-human primates in India were carried out though anecdotal notes and reports by naturalists abound. Notle (1955) probably published the first account that deals with the social structure, ecology, behaviour etc., of the bonnet macaque of South India. Serious field studies of non-human primates in India started with the pioneering work of Phyllis Jay, Southwick and Sugiyama in the mid fifties and sixties but these were restricted to a few species and also in restricted pockets. In recent years primatologist have started paying more attention to various species of non-human primates particularly those found in the south and north-eastern parts of India. The two common species i.e. the rhesus macaque and hanuman langur have been well studied in the field by various workers. The field studies on other species of macaques, leaf eating monkeys and hoolock gibbon are now in progress by a number of workers and it is hoped that more information about non-human primates of India will be available in the near future.

So far no attempts has been made to study and to estimate the population of non-human primates, particularly the rhesus macaque and hanuman langur, in the entire country. In the present census attempt is made to cover a vast area of the country to study their distribution, abundance, status, social structure, etc.

This study reveals, when compared with the whatever little information that is available, that there is a real decline in the population of rhesus macaque in most parts of the country. The earlier census when compared with the present study reveals that the rhesus monkeys are more abundant in the States of Uttar Pradesh, Jammu and Kashmir, Himachal Pradesh, Madhya Pradesh, Andhra Pradesh and Tripura, whereas the langurs are more in the states of Uttar Pradesh, Rajasthan Madhya Pradesh, Bihar, Orissa, Gujarat, Himachal Pradesh and Maharashtra.

Rhesus population in Uttar Pradesh was supposed to be about 5 to 10 millions about four decades back. Southwick, Beg and Siddiqui (1961) estimated 800,000 to 1,000,000 rhesus monkeys in Uttar Pradesh and about 2,000,000 in whole of India. Present estimate indicates that there are about 70,000 rhesus macaque in Uttar Pradesh and a total of about 200,000 in the census states. Previous to this survey no estimate of langur population has been made.

Southwick, Siddiqi, and Oppenhaimer (1983) in recent surveys indicated the sharp decline in rhesus population in northern India. They pointed out that roadside populations declined by 77%, canal bank populations decreased by 76%, village populations declined by 89% and in towns the decline in population was 24% over the past 20 years. In some places they have noted the decline in rhesus population to the tune of more than 90%. This supports the findings of the present census that there is a decline of rhesus macaque population in India. This also indicates that there is need for continuous monitoring of some of the populations to know the future demographic trend and to evolve suitable conservation and management programme of non-human primates in India.

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