

BULLETIN

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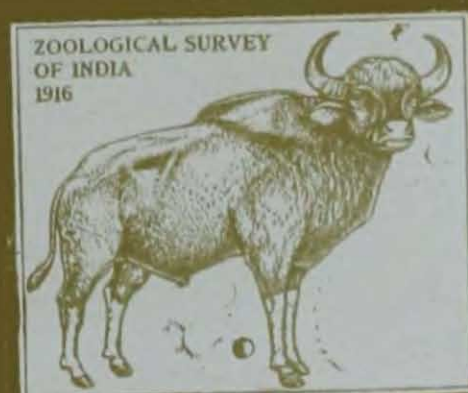
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BULLETIN OF THE ZOOLOGICAL SURVEY OF INDIA

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INDIAN SPECIES OF THE GENUS *ARIXYLEBORUS* HOPKINS
(SCOLYTIDAE : COLEOPTERA)

By

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ABSTRACT

The paper deals with taxonomic account of all the Indian species of the genus *Arixyleborus* Hopkins. The species are *Arixyleborus moestus* (Eggers), *A. malayensis* (Schedl), *A. mediosectus* (Eggers) and *A. rugosipes* Hopkins, all of which are recorded only from the eastern India, including the Islands of Andaman. The diagnostic characters of the genus have been redefined and all the species have been dealt with regard to their synonym, morphology, distribution, taxonomic remarks, etc. In addition, a key has been formulated for the easy identity of each species based on the characteristic features of the female.

Keywords. Genus *Arixyleborus* dealing with all four Indian species.

INTRODUCTION

The genus *Arixyleborus* Hopkins, belonging to the tribe Xyleborini in the subfamily Scolytinae is predominantly an Indo-Malayan genus only with a few species extending up to Japan and New Guinea. The members of the genus usually infest unhealthy trees and felled logs of mostly *Dipterocarpus* plants and are known as true ambrosia beetles for their close association with ambrosia fungi inside their tunnels in the wood.

HISTORICAL ACCOUNT

The genus *Arixyleborus* was first erected by Hopkins (1915) with its type-species, *A. rugosipes* Hopkins from the Philippines.

Since then, many species have been transferred to this genus from other genera, namely, *Xyleborus* Eichhoff, *Xyleboricus* Eggers and *Webbia* Hopkins. The genus *Xyleboricus* is now synonymised with *Arixyleborus*, while the other two still exist as valid genera.

The first record of the genus from India was made by Schedl (1958) when he transferred *Xyleborus moestus* Eggers to *Arixyleborus*, which was described by Egges (1930) from Shillong, Meghalaya. In the same paper, Schedl (1958) also considered his own species, *Xyleboricus malayensis* Schedl from Java as *Arixyleborus malayensis* (Schedl) which was later recorded by the same author (1969) from Sibsagar, Assam, India.

Beeson (1941) reported in his book *Xyleboricus medius* Eggers, a species infesting a number of host plants occurring in India and its neighbouring countries, without referring to any particular locality in India. This species has not been considered as a synonym of *Arixyleborus rugosipes* Hopkins by Schedl (1958). Similarly, another species *Xyleboricus mediosextus* Eggers was also reported by Beeson (1941) which was also transferred to this genus by Schedl (1958) as *Arixyleborus mediosextus* Eggers. In the present study, both these species have also been recorded from north-east India including the islands of Andaman. However, the taxonomic identity of all these four species referred to above is in a very confused state, since the species are poorly described mostly in different languages. No specific key is available to aid to their correct recognition and even the characteristics of the genus are not properly defined. This keeping in view, an attempt has been made in the present paper to deal with all these four species with regard to their synonyms, taxonomy, characteristics relationship, distribution, variation, etc. In addition, a key has been formulated for easy identification of respective species based on the characters of the females. Further, the characteristics and inter-relationship of the genus have also been dealt in details.

MATERIAL AND METHODS

The study is mainly based on the authentically identified species as well as our own identification of the unnamed collection present in the Entomological Collection of

Forest Research Institute, Dehra Dun, India.

Dry, set and pinned material were studied under a Stereoscopic Binocular Microscope. The most recent classification of the family Scolytidae proposed by Wood (1978 and 1980) has been followed in the present study.

INTER-GENERIC RELATIONSHIP

The genus is characterised in having inflated posterior surface of protibiae with distinct tubercles; antennal funicle with 5 segments; no suture on the posterior face of antennal club; striae either shallowly or deeply marked with reticulate sculpture either inside or outside the punctures; interstriae either ridged or weakly convex (except in elytral basal area) with uniseriate or multiseriate granules. Though some of these characters intergrade with some other genera, the combination of these characters keep the genus distinct from all other related genera. In spite of its name *Arixyleborus*, the genus is not very close to *Xyleborus* which is the largest and the most common genus among all the scolytid-beetles in India. However, it resembles closely to certain genera, particularly, *Cnestus* Sampson, *Xyleborinus* Reitter, *Xyleborus* Eichhoff and *Kalantanius* Nunberg in having no suture on the posterior face of antennal club, which is also absent in *Xylosandrus* Reitter and *Apoxyleborus* Wood. These two latter genera are easily separated from *Arixyleborus* in having widely separated pro-coxae. The characteristic inflated posterior surface of protibiae with distinct tubercles separates the genus from all other allied ones under the tribe Xyleborini.

SYSTEMATIC ACCOUNT

Subfamily : *SCOLYTINAE*Tribe : *XYLEBORINI*Genus : *Arixyleborus* Hopkins, 1915.

Arixyleborus Hopkins, A. D. 1915. *Rep. U. S. Dept. Agric.*, 99 : 10 and 59. *Type-species* : *Arixyleborus rugosipes* Hopkins from Philippines ; Browne, F. G. 1955. *Sarawak Mus. J.*, 6 : 350 ; Schedl, K. E. 1958. *Tijdschr. Ent.*, 101 : 143 ; Schedl, K. E. 1959. *Trans. Roy. ent. Soc. Lond.*, 111 : 491 ; Browne, F. G. 1961. *Malay. Forest Rec.*, no. 22, p. 178 ; Schedl, K. E. 1966. *Entom. Abh. Mus. Tierk. Dresden*, 35 : 43 ; Wood, S. L. 1978. *Annls. Soc. ent. Fr. (N. S.)*, 14(1) : 114 ; Nobuchi, A. 1978. *Bull. For. & For. Prod. Res. Inst.* no. 301, p. 2 and 7 ; Wood, S. L. 1980. *Gt. Basin. Nat.*, 40(1) : 96.

Xyleboricus Eggers, H. 1923. *Zool. Meded.*, 23 : 212-213, *Type-species* : *Xyleboricus canaliculatus* Eggers ; Browne, F. G. 1963. *Ent. Ber.*, 23 : 55 (Synonymy) ; Schedl, K. E. 1936. *Philipp. J. Sci.*, 60 : 59-67.

Generic characters : (i) *Female* : Body short and stout to long and cylindrical, yellowish brown to blackish brown in colour ; total length of body, 1.70-2.70 mm.

Head globose, weakly narrowing anteriorly ; frons flatly to moderately convex ; head dorsum reticulate with a few scattered punctures, fairly granulate above the epistomal margin ; median line distinctly or indistinctly marked. Eyes elongately oval, strongly emarginate on anterior margin. Antennae small, scape swollen ; funicle with 5 segments, 1st segment broad and club shaped, other gradually increasing in width ; club obliquely truncate, anterior face with segment 1 corneous with costate margin forming a complete ring, suture 2 incomplete and crescentic in shape (not visible in *A. medio-sectus*) ; posterior face without any suture.

Pronotum nearly as long as or distinctly longer than broad ; basal margin substraight or weakly sinuate, lateral margins of posterior two-thirds subparallel, whence converging anteriorly and terminating into angularly or broadly rounded apex ; anterior one-third to less than half portion declivous dorsally with weak asperities gradually increasing in size anteriorly (asperities on anterior margin somewhat prominent only in *A. malayensis* Schedl) ; posterior two-thirds or almost half portion with reticulate surface with sparse shallow punctures and with or without any setae.

Elytra slightly longer than and as wide as pronotum ; lateral margins subparallel up to apical one-third, whence narrowing posteriorly and terminating into an angular or broadly rounded apex ; postero-lateral margins of declivity with or without carina ; apical one-third declivous, declivity either abrupt or gradual, with flat or weakly convex face ; elytral disc either smooth and shining or coarse and opaque with granules and tubercles ; interstriae either weakly convex or ridged with uniseriate or multiseriate granules or tubercles ; discal striae either shallowly or deeply marked by punctures, punctures sculptured reticulately within ; declivital striae usually deeply marked with punctures also sculptured within (except in *A. moestus*) ; declivital interstriae distinctly marked with granules or tubercles.

Procoxae contiguous, femur moderately long and slender, pro-tibiae having teeth at the anterior margin, posterior surface inflated with distinct tubercles ; mid and hind-tibiae dilated at middle with 6-7 marginal teeth ; tarsi 5-jointed, 4th small and emarginate.

(ii) *Male*: The generalised characters of the males are not taken into account. Out of four species, the males of *A. malayensis* (Schedl) and *A. rugosipes* Hopkins are known of which those of the former species are available for study. The males of two other species, *A. moestus* (Eggers) and *A. medio-sectus* Eggers are unknown.

*Key to the Indian species of the genus
Arixyleborus Hopkins based on females.*

- 1(2) Interstriae with multiseriate blunt granules (except, a narrow basal strip of elytral disc); both striae and interstriae somewhat obsolete on declivital face with confused irregular granules throughout; frons with a very distinct median line ... *moestus* (Eggers)
- 2(1) Interstriae with somewhat uniseriate granules (except, either narrow or broad basal strip of elytral disc); both striae and interstriae well marked on declivital face; frons without any distinct median line.
- 3(6) Interstriae either sharply or bluntly ridged and with distinct granules both on disc and declivity; species short and stout.
- 4(5) Interstriae on disc flat and shiny up to little above the commencement of declivity, whence sharply ridged and granulate up to middle of declivital face except the sutural striae; postero-lateral margins of declivity with distinct carina; interstriae with a few minute hairs, but a tuft of hairs on apex of sutural striae on the declivity; pronotum subquadrate with angularly rounded apical margin marked with a few distinct pointed asperites ... *malayensis* (Schedl)

- 5(4) Interstriae on disc somewhat flat and shiny only on a narrow basal strip, whence bluntly ridged and tuberculate up to elytral apex; postero-lateral margins of declivity without any carina; interstriae with numerous short and long hairs; pronotum subrectangular with broadly rounded apical margin marked with indistinct asperities ... *rugosipes* Hopkins
- 6(3) Interstriae not distinctly ridged, rather weakly ridged and granulate only near commencement of declivity; species long and cylindrical ... *mediosectus* (Eggers)

Description of the species

1. *Arixyleborus moestus* (Eggers)

- Xyleborus moestus* Eggers, H. 1930. *Indian Forest Rec.*, 14(9): 189, Female, Type-locality: India: Meghalaya, Shillong; Beeson, C. F. C. 1930. *Indian Forest Rec.*, 14(10): 73, India: Assam and West Bengal; Beeson, C. F. C. 1941. *Ecology and Control of Forest Insects of India and Neighbouring Countries*, p. 301.
- Arixyleborus moestus* (Eggers) Browne, F. G. 1955. *Sarawak Mus. J.*, 6: 350; Schedl, K. E. 1958. *Tijdschr. Ent.*, 101: 145.

Material: 1 ♀, from Debrepani, 1832m, Darjeeling Dist., West Bengal, J. C. M. Gardner coll., 14.ix. 1929, ex. *Quercus lamellosa* (det. C. F. C. Beeson).

Morphological characters: *Female* (Figs. 1, a-c): Body stout and somewhat cylindrical; head, pronotum and elytra blackish brown, and antennae and legs paler in colour. Body length 2.59 mm.

Head globose, weakly narrowing anteriorly, frons with a distinct median line, surface finely reticulate, with large compara-

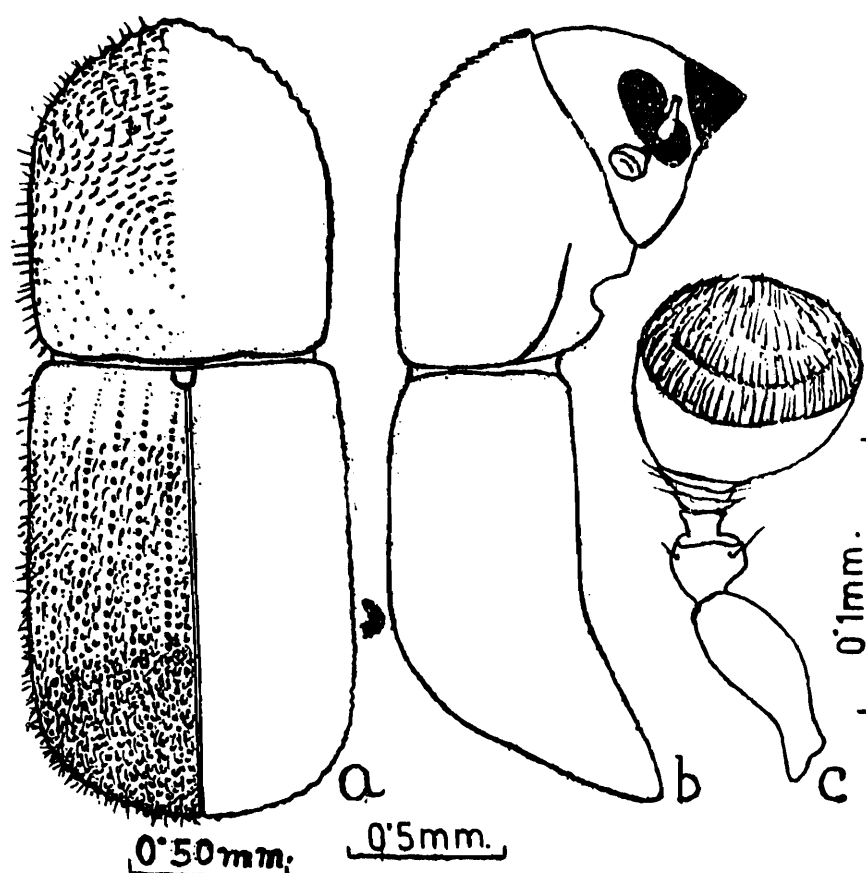


Fig. 1. a-c, *Arixyleborus moestus* (Eggers), Female : a, Dorsal view ; b, Lateral view ; c, Antenna.

tively close punctures ; epistomal margin fringed with sparse and fine hairs, and a few distinct granules somewhat in transverse rows above it. Eyes deeply emarginate. Antennal scape short and stout, funicle with 5-segments ; club obliquely truncate, anterior face with segment 1 corneous and with costate margin forming a complete ring, suture 2 conspicuous, but incomplete and crescentic in shape ; posterior face unmarked by sutures.

Pronotum subrectangular, 1.16 times as long as wide ; basal margin substraight, very weakly emarginate on either side of middle, sides subparallel up to basal three-fifths, whence weakly converging anteriorly with broadly rounded apex ; anterior half with weak asperities gradually increasing in

size anteriorly and with scattered fine short hairs ; posterior half reticulate and apilose with scattered indistinctly visible granules and punctures.

Scutellum subround and shiny.

Elytra 1.30 times as long as and slightly wider than pronotum and 1.44 times as long as wide itself ; basal margin substraight ; lateral margins subparallel up to two-thirds, thence weakly converging posteriorly with broadly rounded apex ; postero-lateral margins not carinate, but with granules ; nearly one-fifth of basal disc somewhat smooth and shiny, rest of elytra opaque ; disc with deeply impressed striae marked by distinct punctures with sculptured within ; interstriae rather weakly convex with irregular and blunt granules increasing in

size posteriorly and a few tubercles along with granules, somewhat distinct at commencement of declivity.

Declivity commencing abruptly at posterior one-third and declivital face flat, opaque and roughened with numerous blunt irregular granules; striae 1 and 2 distinctly marked beyond the middle and 3 and 4 up to middle and rest obsolete; interstriae with two or three rows of irregular recumbent hair-like setae.

Distribution—INDIA : Meghalaya : Shillong (Type-locality); West Bengal : Darjeeling District, Debrepani.

Taxonomic remarks : The species belongs to the *granifer* group of the genus *Arixyleborus* in having multituberculate interstriae. The species can easily be distinguished from all other Indian species of

the genus in having this character as well as with confused blunt granules in the declivity.

2. *Arixyleborus malayensis* (Schedl)

Xyleboricus malayensis Schedl, K.E. 1936. *Philipp. J. Sci.*, 60(1) : 64 (nom. nud.); Schedl, K.E. 1954. *Philipp. J. Sci.*, 83 : 150, Male, Type-locality : Indonesia : Java : Batoerraden.

Arixyleborus malayensis (Schedl), Schedl, K.E. 1958. *Tijdschr. Ent.*, 101 : 145, Female, Java; Schedl, K. E. 1969. *Oriental Ins.*, 3(1) : 52, Assam : Sibsaigar; Beaver, R.A. and Browne, F.G. 1978 *Oriental Ins.*, 12(4) : 582, Malaya, Indonesia, Vietnam, India and Sri Lanka.

Material : 10 Females and 2 Males Dahura, Bagdogra and Kurseong, Darjeeling Dist., West Bengal. N. C. Chatterjee coll., 25.iii.1934, ex. *Machilus* sp. (RRD : 580, B. C. R.-55, Cage-187).

Morphological characters : (i) *Female*

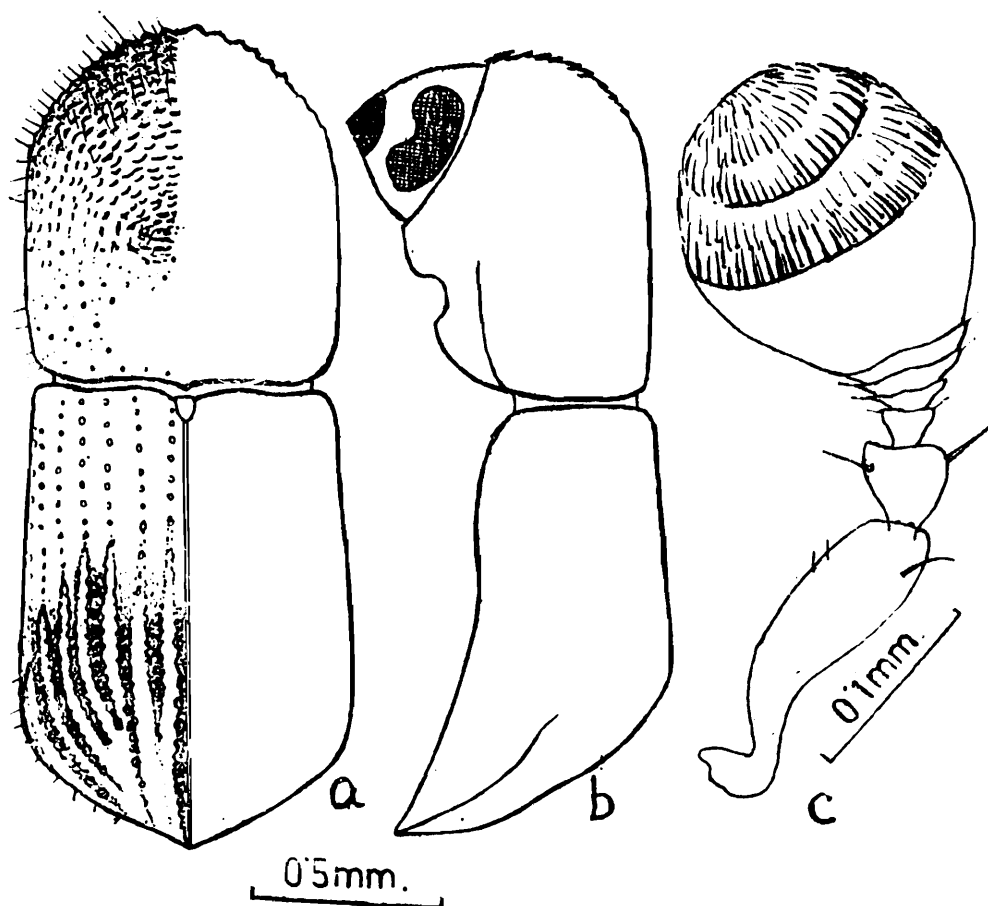


Fig. 2. a-c, *Arixyleborus malayensis* (Schedl), Female : a, Dorsal view ; b, Lateral view ; c, Antenna.

(Figs. 2, a-c) : Body stout and cylindrical ; head, pronotum and elytra blackish brown with legs and antennae yellowish brown in colour. Body length 2.10-2.15 mm.

Head globose, slightly narrowing anteriorly, frons weakly convex, surface reticulate with a few scattered punctures and hairs, and without any distinct median line ; a few scattered granules above the epistomal margin. Eyes elongate and deeply emarginate. Antennal scape short ; funicle with 5-segments ; club obliquely truncate, anterior face with segment 1 corneous with costate margin forming a complete ring, suture 2 conspicuous and crescentic in shape ; posterior face unmarked by suture.

Pronotum subrectangular, 1.18 times as long as wide ; basal margin weakly bisinuate on either side of median portion, sides subparallel up to anterior one-third, whence weakly narrowing anteriorly and terminating into angularly rounded apex, a few distinct asperities (6 or so) and hairs on apical margin ; less than anterior half with asperities gradually increasing in size anteriorly and with a few scattered hairs ; summit not at all raised ; posterior half finely reticulate with minute punctures.

Scutellum subrounded and distinctly shiny.

Elytra slightly longer than and as wide as pronotum and 1.38 times as long as its width ; basal margin weakly incurved on either side of middle ; lateral margins subparallel up to anterior two-thirds, whence narrowing posteriorly and terminating into an angular apex ; postero-lateral margins with distinct carina ; elytral basal third smooth and shiny, striae marked by minute and shallow punctures ; interstriae flat with indistinct punctures ; interstriae on apical two-thirds

somewhat ridged, gradually becoming narrow within declivity and marked by uniseriate granules ; striae in the area just before the commencement of declivity rather impressed and marked by large close punctures reticulately sculptured within ; striae 1, 2, 3, 6 and 7 extending up to apical margin, while striae 4 and 5 terminating almost at the middle of declivity ; interstriae 2, 4, 5 terminated in the middle of declivity and others almost reaching to the apical margin ; interstriae with setiferous uniseriate granules ; dense setae towards apical portion of sutural interstriae.

Declivity steep and commencing at apical third, declivital face weakly convex ; sutural interstriae raised a little below the middle of declivity.

(ii) Male—The male is very similar to the female. Only the differentiating characters are stated below.

Frons paler in colour ; a weak median depression above epistomal margin.

Pronotum 1.3 times as long as wide, slightly broader anteriorly ; anterior margin broadly rounded with a few weak but distinct asperities ; dorsal summit feeble and slightly anteriorly placed.

Elytra slightly shorter than pronotum ; interstriae on anterior half of disc as well as on declivity not so strongly ridged as in the female.

Distribution : INDIA : Assam ; Indonesia : Java and Sumatra, Malaya, Vietnam and Sri Lanka.

Taxonomic remarks—The species, *Arixyleborus malayensis* Schedl, can easily be distinguished from all other Indian species in having strongly ridged interstriae with

distinct uniseriate granules and distinct asperities on the anterior portion of pronotum. Striae are deep in between ridged interstriae and marked by distinct large punctures which are sculptured reticulately within.

3. *Arixyleborus mediosextus* (Eggers)

Xyleboricus mediosextus Eggers, H. 1923. *Zool. Meded.*, 7 : 215, ♀, Type-locality : Sinabang, Simalur Island (South Sumatra); Schedl, K. E. 1936. *Phillip J. Sci.*, 60 : 64; Beeson, C. F. C. 1941. *Ecology and Control of Forest Insects of India and Neighbouring Countries*, p. 361.

Arixyleborus mediosextus (Eggers), Schedl, K. E. 1958. *Tijdschr. Ent.*, 101 : 145; Schedl, K. E. 1959. *Trans. Roy. ent. Soc.*, 111 : 492; Browne, F. G. 1961. *Malay. Forest Rec.*, no. 22, p. 182; Schedl, K. E. 1969. *Kontyu*, 37(2) : 206; Beaver, R. A. and Browne, F. G. 1978. *Oriental Ins.*, 12(4) : 582.

Material—42 Females, Middle Andaman, B. M. Bhatia coll., 8. xii. 1928, ex. *Canarium*

euphyllum; 1 Female N. Andaman, C. F. C. Beeson coll., 2. iii. 1930, ex. *Artocarpus chaplasi*; 15 Females, Stewart sound, North Andaman, C. F. C. Beeson coll., 4. iii. 1930; 1 Female, North Andaman, C. F. C. Beeson coll., 9. iii. 1930, ex. "unknown wood"; 1 Female, North Andaman, B. M. Bhatia coll., 16. xii. 1929, ex. *Terminalia bialata*; 1 Female, North Andaman, C. F. C. Beeson coll., 9. iii. 1930, ex. *Dendrocalamus strictus*; 19 Females, North Andaman, B. M. Bhatia coll., 15-16. xii. 1928, ex. *Dipterocarpus turbinatus*; 12, Females, North Andaman, C. F. C. Beeson coll., 8. iii. 1930, ex. *Dipterocarpus turbinatus*; 3 Females. Digboi Reserve, Lakhimpur, Assam, C. F. C. Beeson coll., 2. iii. 1936, ex. *Dipterocarpus pilosus*.

Morphological characters—: (i) Female (Figs. 3, a-c):—Body long and cylindrical;

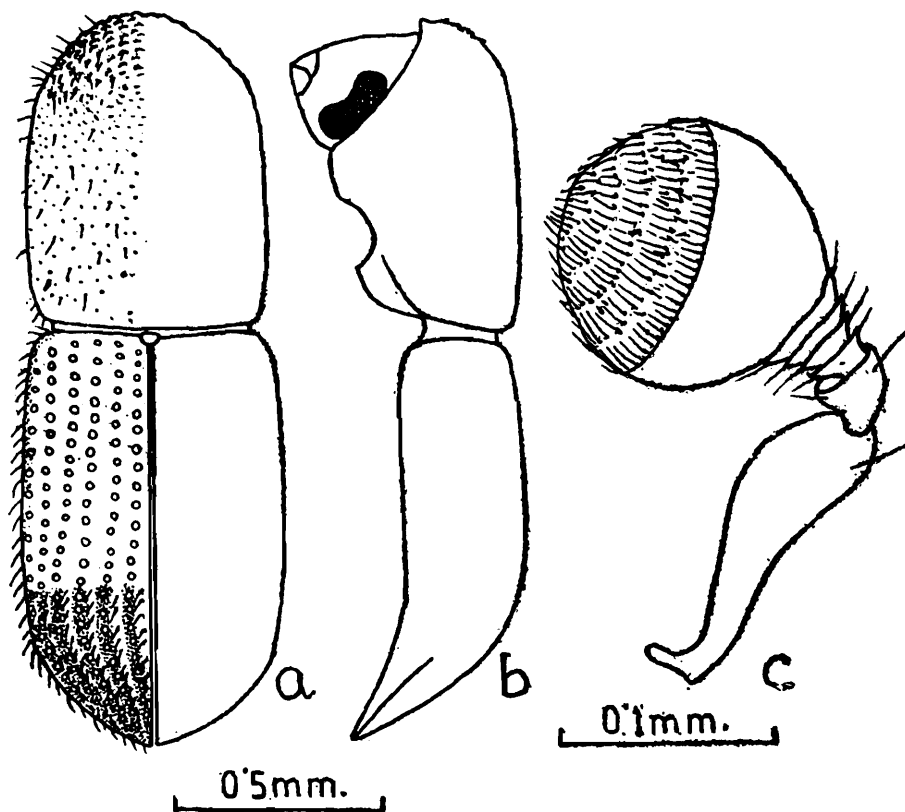


Fig. 3. a-c, *Arixyleborus mediosextus* (Eggers), Female : a, Dorsal view ; b, Lateral view ; c, Antenna.

pronotum blackish brown and elytra, legs and antennae light brown in colour. Body length 2 mm, 2.8 times as long as wide.

Head globose, weakly narrowing anteriorly, frons moderately convex, surface reticulate with sparse punctures and fine hairs; median line absent; fringe of long hairs along epistomal margin distinct and irregular indistinct granules below it. Eyes elongate, deeply emarginate. Antennal scape short and funicle with 5 segments; club obliquely truncate, anterior face with segment 1 corneous with costate margin forming a complete ring, suture 2 not visible; posterior face unmarked by sutures.

Pronotum elongate, 1.3 times as long as wide, basal margin substraight, sides substraight and subparallel up to posterior two-thirds, antero-lateral margins weakly narrowing and broadly rounded anteriorly; anterior one-third with fine asperities, with sparse erect long setae; posterior portion finely reticulate with sparse minute punctures.

Scutellum sub-round and small.

Elytra 1.1 times as long as and as broad as pronotum; basal margin substraight; lateral margins straight and subparallel up to basal three-fourths, then narrowing posteriorly and terminating into an angular apex; nearly half of elytra smooth, flat and dull; striae not at all impressed, but marked by moderately large and very shallow punctures; interstriae with sparse hair-like setae in row, becoming weakly ridged slightly before the commencement of declivity.

Declivity abrupt, commencing from posterior one-fourth of elytra, declivital face plano-convex, postero-lateral margins of declivity distinctly carinate; declivital striae

marked by large and shallow punctures, punctures weakly reticulately sculptured inside and with a single minute hair in each; interstriae weakly but sharply ridged slightly before the commencement of declivity up to centre of declivital face; interstriae with prominent tubercles and recumbent hairs in row, particularly at the commencement of declivity whence gradually distinctly marked towards lateral margin of declivital face than at the middle.

(ii) *Male* : Unknown.

Distribution : INDIA : Assam, Andaman; Khmer Republic (Cambodia), Sri Lanka; Malaysia; Indonesia : Sumatra and Vietnam.

Taxonomic remarks—The two-thirds of elytra smooth, weakly impressed striae line and interstriae not at all convex except only at the commencement of declivity where it is distinctly raised with prominent tubercles. None of the other Indian species possess this character along with its slender and narrow body form.

4. *Arixyleborus rugosipes* Hopkins

Arixyleborus rugosipes Hopkins, A.D. 1915. *Rep. U.S. Dept. Agric.*, 99 : 59, Female, *Type-locality* : Pagbilae, Philippines; Schedl, K. E. 1959. *Trans. Roy. ent. Soc. Lond.*, 111 : 492, Sri Lanka; Browne F.G. 1960. *Philipp. J. Sci.*, 89 : 207, Male; Schedl, K.E. 1965. *Ark. Zool.* 18(3) : 22, Sumatra; Schedl, K.E. 1966. *Entom. Abh. Mus. Tierk. Dresden*, 35 : 44.

Webbia medius Eggers, H. 1927. *Philipp. J. Sci.*, 33 : 104-105, Female, *Type-locality* : Mindanao and Mindoro, Philippine Islands.

Xyleboricus medius (Eggers), Schedl, K. E. 1936. *Philipp. J. Sci.*, 60 : 64; Beeson, C.F.C. 1941. *Ecology and Control of Forest Insects of India and Neighbouring Countries*, p. 307; Schedl, K.E. 1951-52. *Ent. Bl.*, 47-48 : 161-162 (Synonymy).

Webbia camphorae Eggers, H. 1936. *Ann. Mag. nat. Hist.*, 17(10) : 634, Femals, *Type-locality* : Johore : Khrang, Malaya Archipelago ; Browne, F.G. 1955. *Sarawak Mus. J.*, 6 : 351 (Synonymy).

Xyleboricus camphorae (Eggers), Beeson, C.F.C. 1941. *Ecology and Control of Forest Insects of India and Neighbouring Countries*, p. 307 ; Schedl, K.E. 1958. *Tijdschr. Ent.*, 101 : 145.

Material—31 Females, Middle Andaman, B. M. Bhatia coll., 8-29.xii.1928. ex *Canarium euphyllum* ; 11 Females, North Andaman, B.M. Bhatia coll., 15.xii,1928, ex. *Sterculia villosa* ; 1 Female, North Andaman, B.M. Bhatia coll., 16.xii.1928, ex. *Terminalia bialata* ; 6 Females, North Andaman, B.M. Bhatia coll., 16,xii.1928, ex. *Dipterocarpus turbinatus* ; 1 Female, North Andaman, C.F.C. Beeson coll., 8.iii.1930, ex. *Dipterocarpus turbinatus* ; 1 Female, Stewart Sound, North Andaman, C.F.C. Beeson coll., iii,1930 ; 1 Female, Middle Andaman, B.M. Bhatia coll., 8.xii.

1928, ex. *Terminalia manii* ; 2 Females, North Andaman C.F.C. Beeson coll., 9.iii.1930, ex. *unknown wood* ; 1 Female, North Andaman, B.M. Bhatia coll., 16. xii. 1928, ex. *Diospyros oocarpa* ; 1 Female, Middle Andaman, B.M. Bhatia coll., 15.i.1929, ex. *Artocarpus chaplasi*.

Morphological characters :—(i) *Female*, (Figs. 4, a-d) :—Body long and cylindrical ; head, pronotum and elytra deep reddish brown, legs and antennae yellowish brown. Body length 1.7 mm.

Body globose, weakly narrowing anteriorly, frons moderately convex, surface finely reticulate, with a few scattered punctures and fine hairs ; median line indistinct ; fringe of hairs below epistomal margin distinct and with irregular indistinct granules below it. Eyes elongate, deeply emarginate. Antennal scape short ; funicle with 5 segments ; club obliquely truncate, anterior face with segment

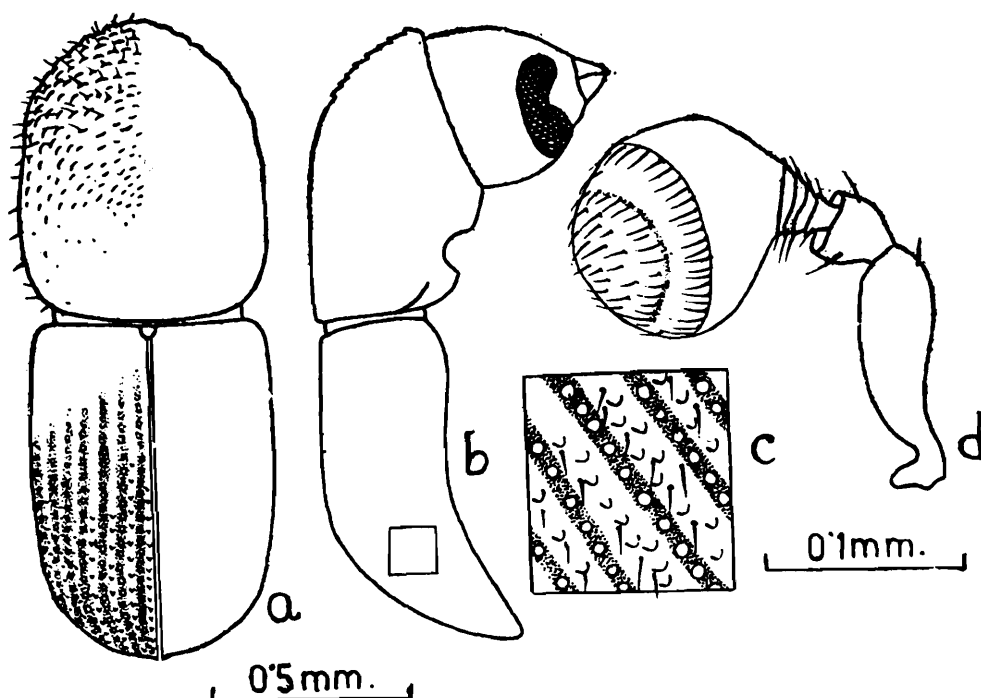


Fig. 4. a-d, *Arixyleborus rugosipes* Hopkins, Female : a, Dorsal view ; b, Lateral view ; c, Enlarged portion of elytral declivity ; d, Antenna.

1 corneous with costate margin forming a complete ring, suture 2 conspicuous and crescentic in shape ; posterior face unmarked by sutures.

Pronotum elongate, 1.3 times as long as wide, basal margin substraight, sides subparallel up to anterior one-third, antero-lateral margins weakly narrowing and broadly rounded anteriorly ; anterior half with fine asperities, gradually increasing in size anteriorly intermingled with scattered fine short hairs ; posterior half finely reticulate with sparse minute shallow punctures.

Scutellum subround and shiny.

Elytra slightly longer and as wide as pronotum, and 1.4 times as long as wide ; basal margin substraight ; lateral margins subparallel up to basal two-thirds, broadly rounded postero-laterally and terminating into a somewhat angular apex ; postero-lateral margins not carinate, rather marked by 2 rows of distinct granules ; a narrow transverse strip of elytral base somewhat smooth and shiny, rest of elytra opaque ; all striae posteriorly beyond the basal strip deeply impressed, reticulately sculptured, hardly marked by any distinct punctures ; interstriae ridged, attaining maximum height at commencement of declivity, with minute and blunt tubercles and short hairs almost in single row.

Declivity gradually sloping posteriorly, commencing from posterior one-third of elytra, declivital face moderately convex, declivital striae and interstriae distinctly marked as on the disc ; striae 1, 2, 3, 6 and 7 running almost to the posterior margin, striae 4 and 5 forming loop almost at the middle of declivity ; all interstriae running upto posterior margin except 5th ; decumbent setae at the base of tubercles in declivity.

(ii) *Male* : No male available in the present study.

Distribution : India, Philippines, Malaysia, Borneo, Vietnam, Indonesia, Sri Lanka and Australia (imported).

Taxonomic remarks : The species *Arixyleborus rugosipes* Hopkins is rather easily distinguished from all other species in this genus by somewhat flat, shiny interstriae on a narrow transverse strip of the elytral basal portion.

ACKNOWLEDGEMENTS

Grateful acknowledgement is made to the Director, Zoological Survey of India, for providing necessary facilities ; to Dr. P. K. Sen Sarma, Director, Biological Research, Forest Research Institute, Dehra, Dun, for lending some unidentified material as well as allowing us to consult reference collection of FRI ; and to Dr. S. L. Wood, Professor of Entomology, Brigham Young University, Provo, Utah, USA, for kindly confirming some of our identifications.

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NOTES ON THE SPECIES OF *PARALABIS* BURR (DERMAPTERA :
CARCINOPHORIDAE) FROM INDIAN SUBCONTINENT

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ABSTRACT

In the Indian subcontinent this genus is represented by four species. Besides, three more species viz., *P. nandii*, *P. carinatus* and *P. denticulatus*, are described as new to science. It is proposed to place *P. antennatus* Ramamurthi as synonym of *P. lefroyi* (Burr). A key for the discrimination of various species is provided.

INTRODUCTION

The genus *Paralabis* was erected by Burr (1915) with *P. owenii* Burr, as its type and three other species viz. *P. pervicina* (Burr), *P. dohrni* (Kirby) and *P. greeni* (Burr). Excepting, *P. pervicina* (Burr), all others are still included in the genus.

At present altogether four species viz., *P. lefroyi* (Burr), *P. dohrni* (Kirby), *P. greeni* (Burr) and *P. montshadskii* Bey-Bienko are included from the Indian subcontinent. Besides three more species are described as new to science in the present paper.

The distribution of various species appears to be interesting. Excepting *P. dohrni* (Kirby) which occurs in Sri Lanka and almost throughout India, all others have much restricted distribution. *P. greeni* (Burr) is endemic to Sri Lanka and *P. lefroyi* (Burr) alongwith *P. nandii* sp. n., are confined to peninsular India. The remaining two new

species viz., *P. carinatus* and *P. denticulatus* together with *P. montshadskii* are restricted to Eastern Himalayas in India excepting the last one which occurs in South China also.

Since *P. antennatus* Ramamurthi appears to be identical with *P. lefroyi* in most details it is placed as synonym of the latter.

Genus *Paralabis* Burr

Paralabis Burr, 1915, *J. R. micr. Soc.*, 1915 : 540.

Type-species : *Anisolabis owenii* Burr, 1911.

Diagnostic characters : Male parameres about as long as broad or slightly longer, broader at base or middle, narrowed towards apex with tip obtuse, outer margin convex and inner margin concave ; distal lobes variously armed.

Distribution : Ethiopian and Oriental Regions.

Remarks : Due to the unsatisfactory position of various genera of subfamily Carcinophorinae it is thought desirable to follow Burr's (1915) arrangement which certainly helps in recognizing them.

Key to the species (♂♂ only)

1(10). Penultimate sternite entire posteriorly	
2(5). Elytra perfect	
3(4). Elytra with hind margin feebly oblique ; sides of abdominal segments 6 to 9 rugosely punctate and acute angled posteriorly	... <i>P. lefroyi</i> (Burr)
4(3). Elytra with hind margin truncate ; sides of abdominal segments 6 to 9 smooth and obtuse angled posteriorly	... <i>P. dohrni</i> (Kirby)
5(2). Elytra abbreviated or apterous	
6(9). Elytra abbreviated ; sides of abdominal segments ecarinate	
7(8). Pronotum broader than long, widened posteriorly ; elytra abbreviated as narrow ovate flaps on mesonotum ; sides of abdominal segments 7 to 9 acute angled posteriorly and rugosely punctate	... <i>P. nandii</i> sp.n.
8(7). Pronotum longer than broad, almost of uniform width throughout ; elytra abbreviated, narrowed at base exposing large part of mesonotum and posteriorly slightly overlapping along the median line ; sides of abdominal segments 6 to 9 obtuse angled posteriorly and punctate	... <i>P. greeni</i> (Burr)
9(6). Apterous ; sides of abdominal segments 7th and 8th with a median oblique carina	... <i>P. carinatus</i> sp.n.

10(1). Penultimate sternite emarginate in middle posteriorly	
11(12). Body punctation distinct ; legs with femora in distal one fourth yellowish ; an oblique carina on the sides of ultimate tergite distinct and distal lobes unarmed	... <i>P. montshadskii</i> Bey-Bienko
12(11). Body feebly punctate ; legs uniformly coloured ; sides of ultimate tergite with a weakly developed oblique carina ; distal lobes apically armed with chitinous denticulated pad	... <i>P. denticulatus</i> sp.n.

***Paralabis lefroyi* (Burr)**
(Figs. 1—5)

Anisolabis brunneri ? Burr (néc Dohrn), 1906, *J. Asiat Soc. Beng* (N.S.), 2 (4) : 389 ♀ (néc ♂), Purneah, Dist., N. Bengal (now in Bihar).

Psalis lefroyi Burr, 1910, *Faune Brit. India, Dermaptera* : 77, pl. 3, fig. 20, ♀ (not ♂), Bombay, Mahim, "feeding on plaintain roots", Pusa Bengal ; type ♀ in British Museum (Natural History), London.

Euborellia lefroyi ; Srivastava, 1971, *Entomologist Rec. J. Var.*, 83 : 206. figs. A-C (♂ genitalia) ; Srivastava, 1976, *Rec. zool. Surv. India, Occ. Pap.*, 2 : 23.

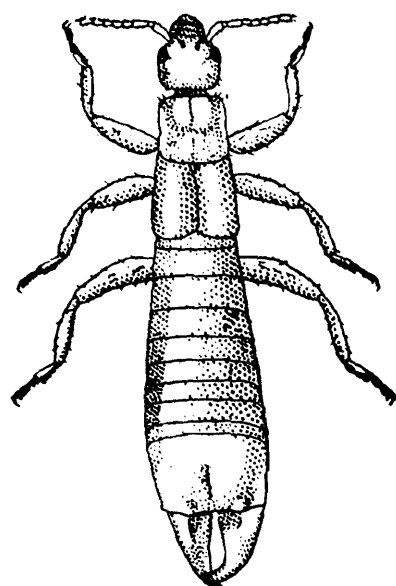
Paralabis antennatus Ramamurthi, 1973, *Zool. Anz.*, 5/6 : 441, figs. 11-13 (1 ♂, 3 ♀♀, 1 nymph, Tamil Nadu, Kallar-types with the author).—syn. nov.

♂ : General colour blackish brown, antennal segments 2nd, 13th and 14th and pronotum laterally yellow ; legs yellow but femora banded with black.

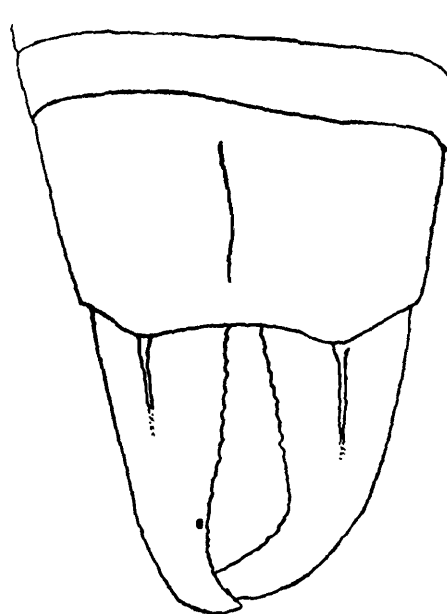
Head smooth, about as long as broad, triangular, sutures faint, frons convex. Antennae 17-segmented, 1st shorter than the distance between antennal bases ; 2nd short ; 3rd long and slender ; 4th and 5th almost

equal in length. Pronotum slightly longer than broad, anterior margin straight, sides very slightly concave in middle, hind margin briefly rounded, median sulcus faint, prozona feebly convex. Elytra perfect, smooth, meeting along the middle line, at base axillary angle slightly rounded off to show a small

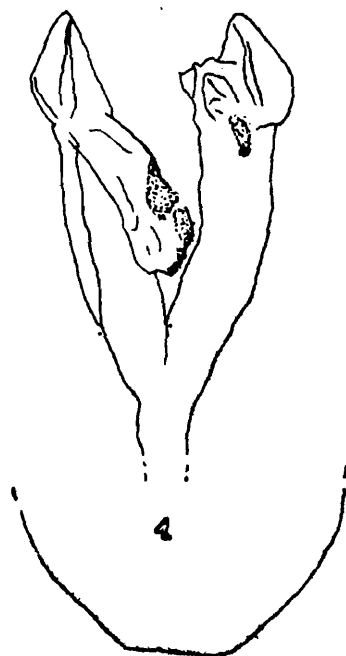
scutellum, hind margin truncate, slightly oblique. Legs normal. Wings wanting. Abdomen punctate, convex, gently enlarging posteriorly, sides of segments 6 to 9 acute angled posteriorly and rugosely punctate. Penultimate sternite triangular with hind margin briefly rounded or sub-truncate,



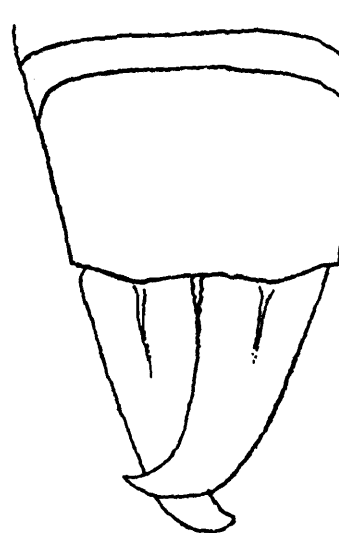
1



3



2



5

Figs. 1-5 : *Paralabis lefroyi* (Burr), ♂, 1. Dorsal view, 2. Posterior margin of penultimate sternite ; 3. Ultimate tergite and forceps 4. Genitalia ; ♀. 5. Ultimate tergite and forceps.

manubrium three times as long as the sternite with its apex dilated. Ultimate tergite transverse, gently narrowed posteriorly, laterally with a longitudinal fold, hind margin trisinate, laterally feebly oblique, median sulcus short. Forceps with branches subcontiguous at base, trigonal with ridge present in basal one third only, weakly asymmetrical, right branch more curved and crossing over the left near apex, tip pointed, gently hooked, inner margin finely crenulate. Genitalia with parameres broadest at about middle, inner margin straight, distal lobes with denticulated chitinous pads.

♀ : Agrees with ♂ in most characters except that ultimate tergite comparatively narrowed posteriorly; penultimate sternite obtusely rounded in middle posteriorly and forceps with branches contiguous and straight.

Measurements : (in mm)

	♂	♀ ♀
Length of body	12.2-13.0	9.0-10.0
Length of forceps	2.0-2.2	1.7-2.0

Material examined : INDIA : MADHYA PRADESH : Dist. Shadol, left bank of Narbada between Kund and Kapil Dhara, 2 ♂ ♂ (1 ♂ with genitalia mounted between two coverslips and pinned with the specimen), 22.v.1962 (*P. Singh*) ; ANDHRA PRADESH : Gytimamidi, E. Ghats, 2 ♂ ♂ (1 ♂ with genitalia mounted between two coverslips and pinned with the specimen), 3 ♀ ♀, 3 nymphs, 23.ii.1985 (*S. Saha*).

Distribution : India : Andhra Pradesh, Bihar, Madhya Pradesh and Maharashtra.

Remarks : This species resembles *P. dohrni* (Kirby) but differs by its slightly larger size, stouter build, sides of abdominal

segments 6 to 9 acute angled posteriorly and rugosely punctate. It can also be separated by the posterior margin of elytra in being slightly oblique but this character alone may not be very reliable.

Since *P. antennatus* Rammamurthi agrees well with *P. lefroyi* in almost all the details it is proposed to sink the former as synonym of the latter.

***Paralabis dohrni* (Kirby)**

(Figs. 6-10)

Nannopygia dohrni Kirby, 1891, *J. Linn. Soc. (Zool.)*, 23 : 508. (♀ ; Ceylon-Type in British Museum (Natural History), London ; Bormans, 1900, *Das Tierreich*, 11 : 11.

Labidura femoralis ; Dubrony (nec Dohrn), 1879, *Annali Mus. civ. Stor. nat. Giacomo Doria*, 14 : 353.

Carcinophora caeruleipennis Bormans, 1900, *Das Tierreich*, 11 : 40.

Carcinophora dohrni ; Burr, 1901, *J. Bombay nat. Hist. Soc.*, 14 : 328, pl. B, fig. 20 (♂, ♀, Description) ; Brindle, 1971, *Ent. Scand. Suppl.*, 1 : 219.

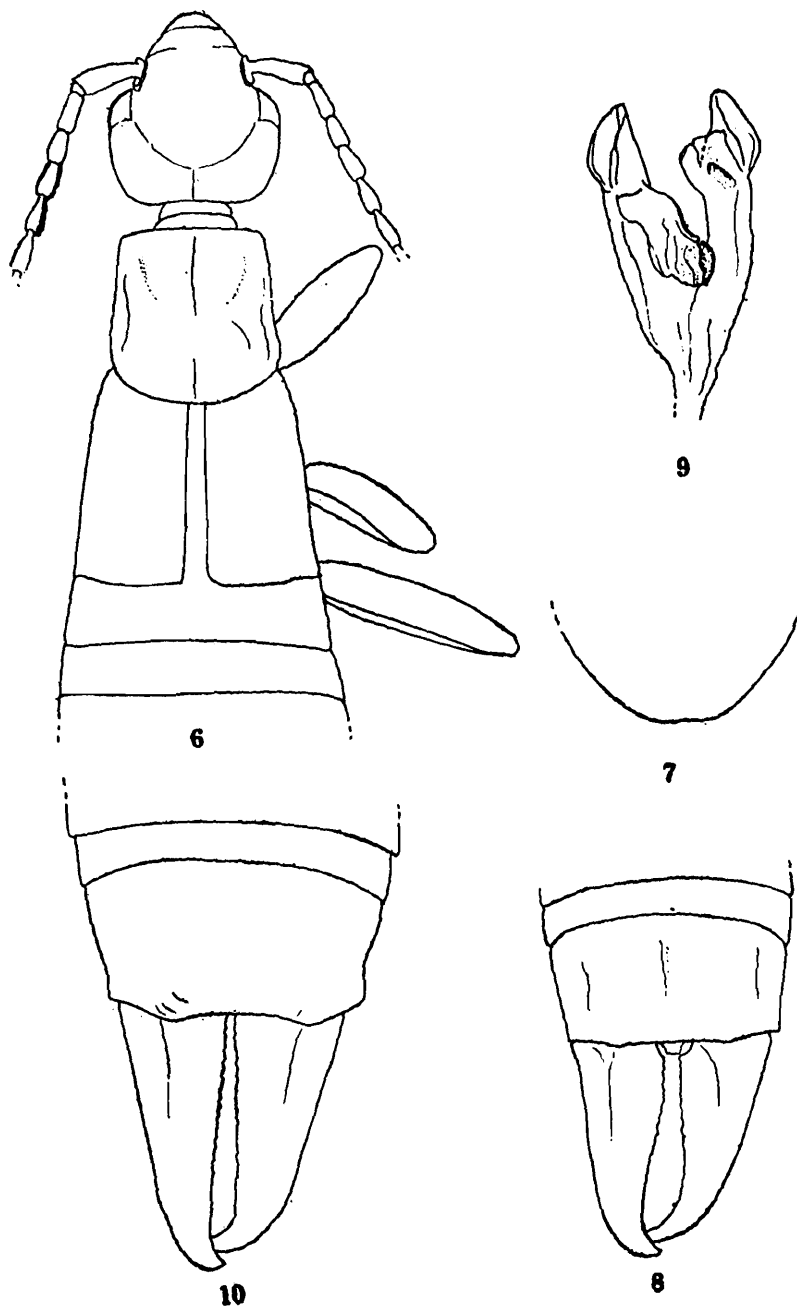
Psalis dohrni ; Burr, 1910, *Fauna Brit. India Dermaptera* : 76, pl. 3, fig. 19 ; Burr, 1911, *Genera Insect.*, 122 : 74 ; Burr, 1912, *Annln naturh. Mus. Wien*, 26 : 74 ; Burr, 1913, *Rec. Indian Mus.*, 8 (2) : 138 ; Burr, 1914, *Rec. Indian Mus.*, 10 : 287.

Paralabis dohrni ; Burr, 1915, *J. R. micr. Soc.*, 1915 : 540, pl. 12, fig. 1 (♂ genitalia) ; Borelli, 1931, *Rev. Suisse Zool.*, 38 : 295 ; Kapoor, 1958, *Agra Univ. J. Res. (Sci.)*, 16 (1) : 9 ; Srivastava, 1971, *Entomologist Rec. J. Var.*, 83 : 19 ; Srivastava, 1976, *Rec. zool. India, Occ. Pap.*, 2 : 23.

♂ : General colour blackish to reddish brown ; basal antennal segment and one or two pre-apical segments yellow ; pronotum pale on sides ; legs yellowish brown, femora banded with black.

Head about as long as broad, convex, sutures faint. Eyes black, smaller than the post-ocular length. Pronotum slightly longer than broad, gently widened posteriorly, sides straight, hind margin rounded, median sulcus faint. Elytra slightly longer than the pronotum, hind

margin truncate, a small scutellum visible. Wings generally wanting, sometimes present. Abdomen obscurely punctulate, gently widened posteriorly, sided of segments 6 to 9 obtuse angled posteriorly and smooth. Penultimate sternite rounded posteriorly. Ultimate tergite transverse, gently narrowed



Figs. 6-10 : *Paralabis dohrni* (Kirby), ♂, 6. Anterior portion of body, legs of one side only shown ; 7. Posterior margin of penultimate sternite ; 8. Ultimate tergite and forceps ; 9. Genitalia ; ♀, 10. Ultimate tergite and forceps.

posteriorly, hind margin trisinate, laterally oblique, postero-lateral angles a little projecting, laterally with an oblique fold. Forceps subcontiguous, trigonal in basal one third, tapering apically, apices gently incurved, inner margin finely crenulate. Genitalia with parameres semicircular, broadest near base, inner margin straight, distal lobes with denticulated chitinous pads apically.

♀ : Agrees with ♂ but differs by the sides of the abdominal segments convex ; penultimate sternite obtuse posteriorly and forceps simple and straight.

Measurements : (in mm)

	♂ ♂	♀ ♀
Length of body	10-12	9.5-12.5
Length of forceps	2-2.5	1.9-2.5

Material examined : SRI LANKA : Peradenya, 2 ♂ ♂ (1 ex. winged), 10.vi.'10, 1 ex. (only head remaining), 14.vi.'10, 2 nymphs, 17.vi.'10 ; Kandy, 2 ♀ ♀ (1 ex. winged) ; all det. by Burr. INDIA : MAHARASHTRA : Poona, University compound, 2 ♀ ♀, 23.vi.1962 (B. K. Halder) ; Satara, Koyna valley, 1 ♂ (genitalia mounted between two coverslips and attached with the specimen), 26-27.iv.1912 (F. H. Gravely), det. by M. Burr ; ASSAM : Sadiya, Abor, Exped., 1 ♂ (winged, ♂ genitalia mounted between two coverslips and pinned with the specimen), 27.xi.'11 (Kemp), det. by M. Burr.

***Paralabis greeni* (Burr)**

(Figs. 11-14)

Anisobasis greeni Burr, 1899, *Ann. Mag. nat. Hist.*, (7)4 : 257 (♂, ♀, Pundalu—Oya (nec Punduloya), Ceylon—types in British Museum (Natural History), London ; Burr, 1901, *J. Bombay nat. Hist. Soc.*, 14 : 319 ; Brindle, 1971, *Ent. Scand. Suppl.*, 1 : 219, figs. 16, 20.

Borellia greeni : Burr, 1907, *Bull. Mus. Hist. nat. Paris*, 13 : 87.

Euborellia greeni ; Burr, 1910, *Trs. R. ent. Soc. Lond.* 1910 ; 30 ; Burr, 1912, *Annln naturh. Mus. Wien*, 26 : 75 ; Burr, 1914, *Rec. Indian Mus.*, 10 : 285.

Paralabis greeni ; Burr, 1915, *J. R. micr. Soc.* : 540, pl. 12, fig. 2 (♂ genitalia).

♂ : General colour shining dark blackish brown ; antennae and legs dark brown ; whole body i.e., head, pronotum, elytra, exposed part of mesonotum, metanotum and abdominal tergites finely but distinctly punctate.

Head longer than broad, convex above, hind margin emarginate in middle ; antennae 14-segmented or more, 1st stout, expanded apically, longer than the combined length of 2nd to 4th ; 2nd small, about as long as broad ; 3rd long and slender, longer than the 4th and 5th ; 6th onwards segments gradually increasing in length and each segment gently expanded apically. Eyes shorter than the post-ocular length. Pronotum slightly longer than broad, all margins straight, sides gently reflexed, median sulcus faint. Elytra abbreviated, narrowed in basal half, exposing a large transverse mesonotum, afterwards greatly enlarged and slightly overlapping along the median line, hind margin straight. Legs normal. Abdomen spindle shaped, moderately convex above, sides of segments 6 to 9 obtuse angled posteriorly, pilose, shining and punctate. Penultimate sternite faintly punctate, triangular, hind margin in middle obtuse. Ultimate tergite transverse, gently sloping and narrowed backwards, hind margin straight in middle, laterally slightly oblique. Forceps stout, remote and broadened at base, tapering apically, almost straight in basal two thirds, afterwards gently

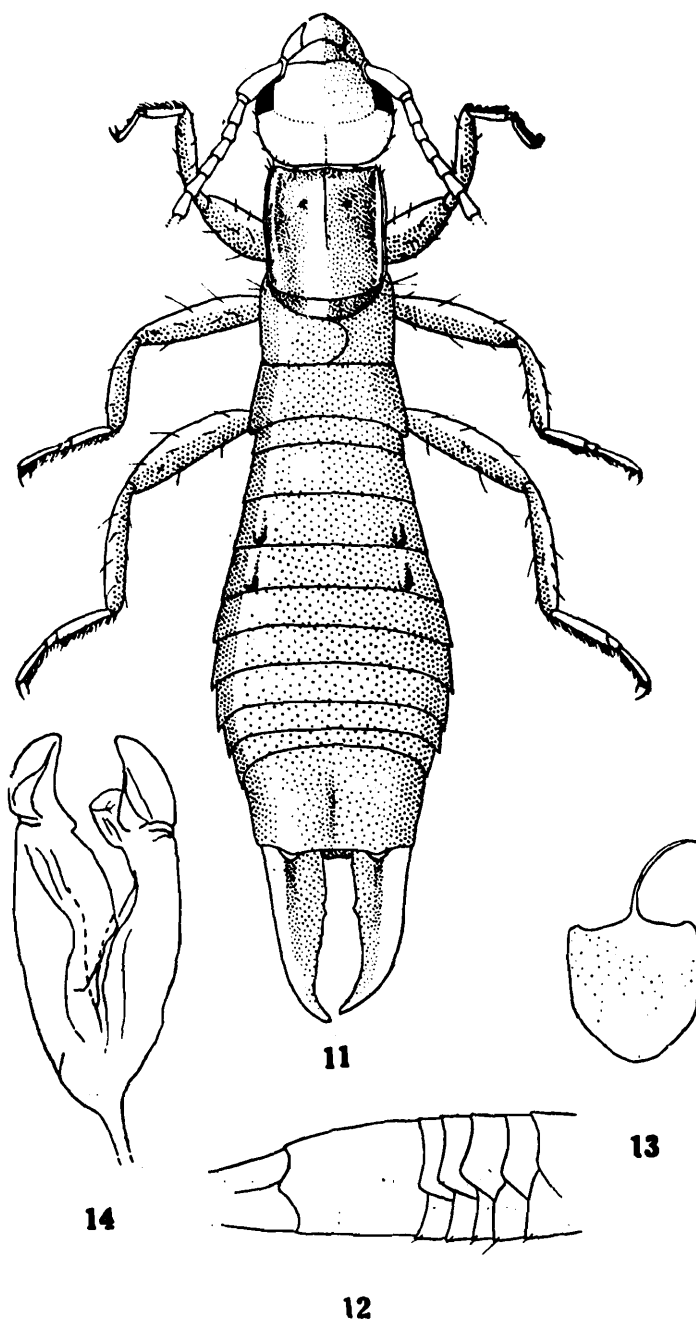
incurved with apices hooked and crossing, trigonal above in basal one thirds, afterwards depressed, inner margin faintly serrated, with a minute tooth at about middle. Genitalia with parameres gradually narrowing from base to apex, external margin regularly convex and inner margin concave; distal lobes unarmed.

♀ ; Agrees with ♂ in most characters

except that pronotum sometimes gently enlarged posteriorly and equal in length and width and sides of abdominal segments convex posteriorly.

Measurements : (in mm)

	♂	♀
Length of body	14.9	21.0
Length of forces	2.3	4.4



Figs. 11-14 : *Paralabis greeni* (Burr), ♂, 11. Dorsal view, 12. Sides of a few posterior abdominal segments ; 13. Penultimate sternite ; 14. Genitalia.

Material examined : SRI LANKA : CENTRAL PROVINCE : Ramboda, 7 mls NW Nuwara Ellya, 1 ♂, 4.iii.1962, Loc. 118 ; Tel-deniya, 1400 ft, 6 mls E of Kandy, 1 ♀, 10.iii.1962, det. by Brindle as *Anisolabis greeni* (Burr) ; Kanpola, 5 mls ENE Nuwara Ellya, 1 nymph, 4.iii.62, Loc. 115, under stones, ravine with stream, det. by Brindle as *Anisolabis kudagae* (Burr).

Distribution : Sri Lanka.

Remarks : The original description the species is based on 3 ♂ ♂, 3 ♀ ♀ labelled as Sri Lanka, Punduloya, V & X, '97, under stones in bunglow ; II.99, under stones, (coll. E. E. Green). Of these one specimen is designated as the 'Type' which was examined by Hebard (1923). From the available literature, it appears that some variations in colour and size of various body parts exist.

This species resembles, in external features with *Epilabis punctata* Srivastava, from various parts of South India but the ♂ parameres in the latter are quite distinctive.

It may be mentioned here that various records of this species from India are most likely referable to *Epilabis punctata* Srivastava.

***Paralabis nandii* sp.n.**

(Figs. 15-18)

♂ : General colour shining brownish black with varying shades on certain body parts ; basal and 2nd antennal segments and legs yellowish brown.

Head smooth, slightly longer than broad, globose, frons convex, sutures fine, hind margin almost straight. Eyes not prominent, about half as long as the post-ocular length. Antennae 17-segmented or more (since apical ones broken in the present material), 1st

segment distinctly shorter than the distance between antennal bases ; 2nd about as long as broad ; 3rd long and cylindrical ; 4th shorter than 3rd ; 5th and 3rd almost equal ; remaining gradually becoming slender and narrowed basally. Pronotum smooth, slightly broader than long, widened posteriorly, lateral margins straight, gently reflexed, hind angles and margin rounded, median sulcus faint, prozona and metazona not well differentiated. Mesonotum obscurely punctate and with elytra as narrow, lateral ovate flaps, median sulcus faint. Metanotum transverse, median sulcus faint, obscurely punctate, hind margin broadly concave.

Legs normal. Abdomen gradually enlarging posteriorly, convex above, punctation feeble, sides of segments obtuse angled posteriorly and feebly punctate and that of 7th to 9th acute angled posteriorly and rugosely striate. Penultimate sternite triangular, obscurely punctate, hind margin almost truncate. Ultimate tergite strongly transverse, smooth, feebly convex but gently depressed in middle posteriorly, sides straight with an oblique carina, above the base of forceps with a feebly raised area, hind margin trisinate, laterally oblique. Forceps stout, remote, dilated and trigonal at base with a dorsal ridge in basal one fourth only, afterwards depressed, tapering apically, incurved in apical two thirds, apices gently hooked and pointed, inner margin feebly dentate. Genitalia with parameres roughly semicircular, about twice as long as broad, narrowed apically with external margin regularly convex, inner margin feebly concave, distal lobes with a small denticulated pad.

♀ : Agrees with males in most characters except that sides abdominal segments smooth and convex ; penultimate sternite

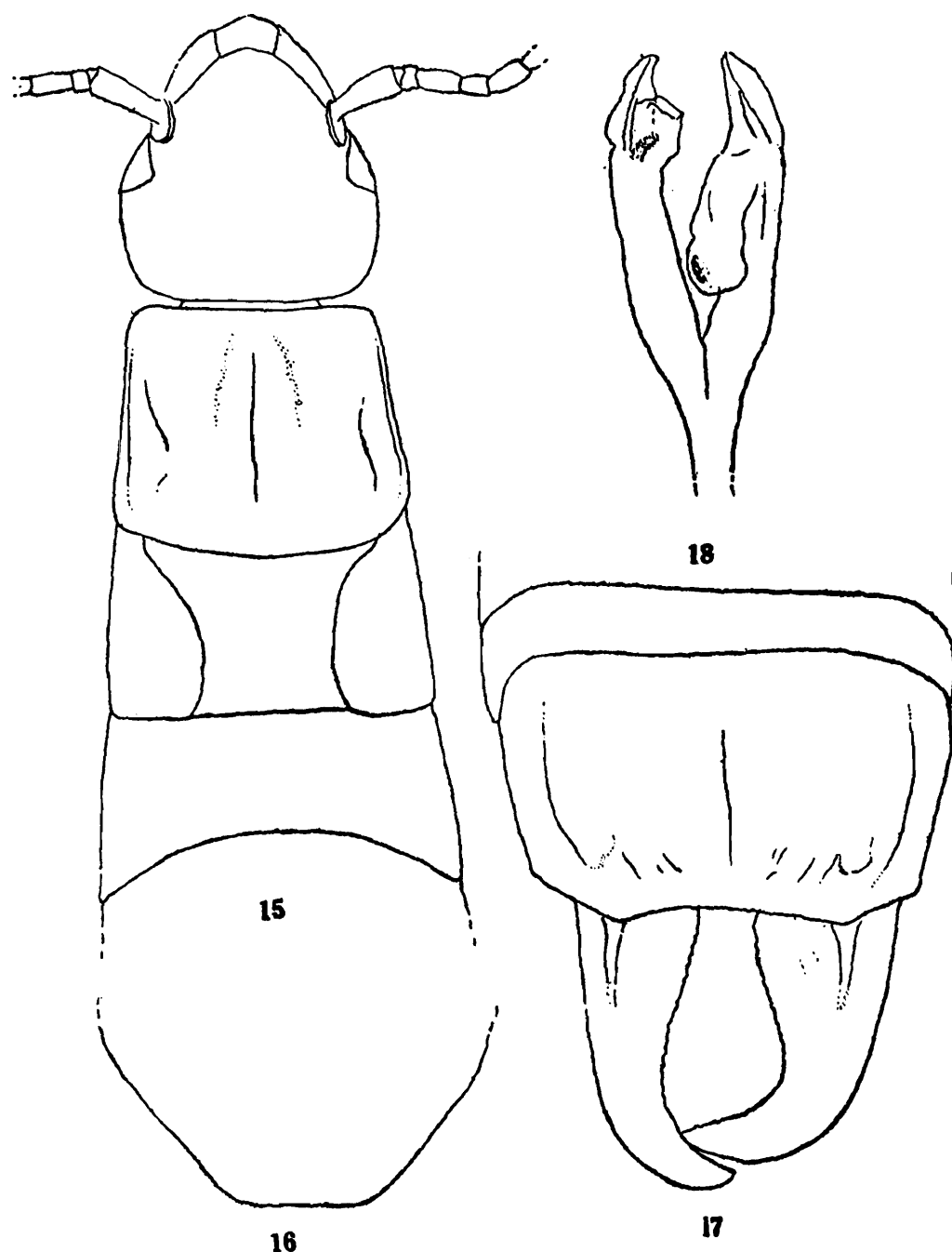
obtuse posteriorly ; ultimate tergite narrowed posteriorly and forceps simple, almost straight and contiguous.

Measurements : (in mm)

	Holotype	Paratypes	
	♂	2 ♂♂	2 ♀♀
Length of body	14.3	11.3-12.4	10.7-14.8
Length of forceps	2.0	1.7-2.0	1.9-2.0

Material examined : INDIA : KARNATAKA : Dist. Kolar, Nandi Hill, Holotype ♂, Paratypes 2 ♂♂ (genitalia mounted between two coverslips and pinned with the respective specimens), 2 ♀♀, 1 nymph, 2.iii.1978 (M. B. Rao), deposited in the Zoological Survey of India, Calcutta.

Distribution : India (Karnataka).



Figs. 15-18 : *Paralabis nandi* sp. n., Holotype ♂. 15. Anterior portion of body, legs of both sides not shown ; 16. Posterior margin of penultimate sternite ; 17. Ultimate tergite and forceps, 18. Genitalia.

Remarks : This species can be easily separated from the other Indian species of the genus by the presence of elytra as narrow ovate, lateral flaps on mesonotum. Besides male genitalia especially parameres are distinctive.

***Paralabis carinatus* sp.n.**

(Figs. 19-22)

Euborellia aborensis (pars); Burr, 1913, *Rec. Indian Mus.*, 8(2): 137 (1♂, Assam, Dibrugarh, excluding remaining material).

Paralabis aborensis (pars); Srivastava, 1968. *Entomologist Rec. J. Var.*, 80: 292 (Material same as above); Srivastava, 1971, *Entomologist Rec. J. Var.*, 83: 22 (figs. B, D & F only).

♂ : General colour dark blackish brown, legs and antennae reddish brown, sides of abdomen, ultimate tergite and forceps with traces of black. Whole body clad with long and short golden pubescence.

Head slightly longer than broad, weakly depressed, sutures distinct, hind margin slightly emarginate in middle. Eyes shorter than the post-ocular length. Antennae partly damaged (8 segments on the right and 11 on the left remaining), 1st stout, gently expanded apically and shorter than the distance between antennal bases; 2nd short; 3rd long and slender; 4th and 5th subequal, globular and both shorter than the 3rd; 6th onwards segments gradually increasing in length and each gently expanded apically. Pronotum anteriorly slightly narrower than the head, sides straight, parallel sided, gently reflexed, hind margin subtruncate, median sulcus faint, prozona weakly convex and not well differentiated from flat, weakly convex metazona. Elytra and wings wanting. Legs normal, with long pubescence. Abdomen

weakly depressed, punctate, tergites gradually enlarging posteriorly, sides of segments 6 to 9 acute angled posteriorly but median longitudinal carina present on segments 7th and 8th only. Penultimate sternite narrowed posteriorly, obtuse in middle. Ultimate tergite weakly transverse, disc feebly depressed, median sulcus distinct, sides with a distinct oblique carina, hind margin in middle almost straight, very slightly oblique on sides, the area close to hind margin with serrations. Forceps subcontiguous, tapering apically, left branch almost straight, only gently incurved near apex, right branch incurved from middle and crosses over the left a little before apex, apices gently hooked and pointed, inner margin serrated. Genitalia with parameres broadest at base, gradually narrowed apically with tip obtuse, external margin convex, inner margin concave, distal lobes with a pair of chitinous, denticulated rods.

♀ : Unknown.

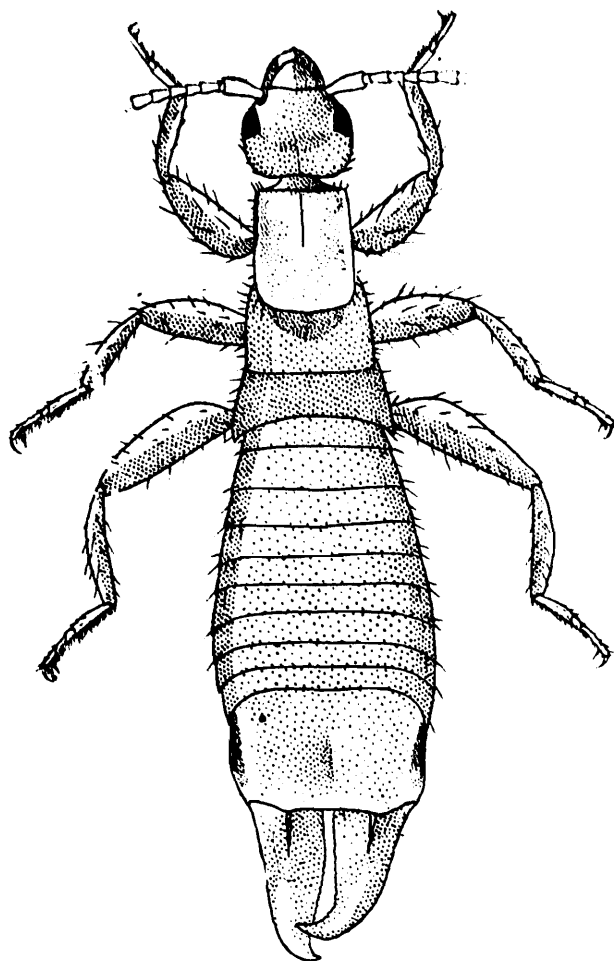
Measurements : (in mm)

	Holotype ♂
Length of body	12.0
Length of forceps	2.3

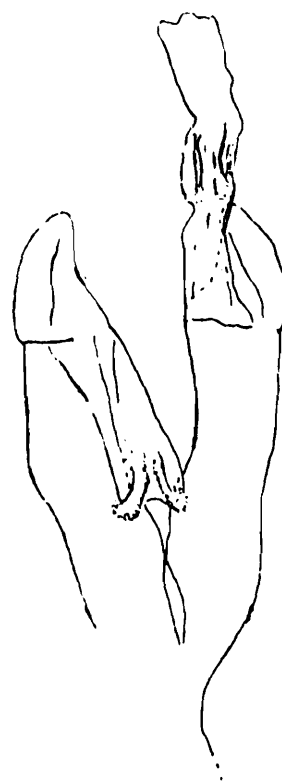
Material examined : INDIA : ASSAM : Dibrugarh, Holotype ♂ (Reg. No. 2432/19), 17-19.xi.1911, Abor Expedition (S.W. Kemp), deposited in the Zoological Survey of India, Calcutta.

Distribution : Known from the type locality only.

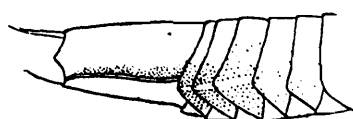
Remarks : It differs from the other known species from the Indian subcontinent in having the body pubescent and male genitalia with distal lobes armed apically with a pair of chitinous denticulated rods.



19



22



20



21

Figs. 19-22 : *Paralabis carinatus* sp.n., Holotype ♂, 19. Dorsal view, 20. Sides of a few posterior abdominal segments ; 21. Posterior margin of penultimate sternite ; 22. Genitalia.

***Paralabis montshadskii* Bey-Bienko**
(Figs. 23-28)

Anisolabis (Paralabis) montshadskii, Bey-Bienko, 1959, *Ent. Obzor.* 38 : 600, fig. 16 (♂, ♀ ; China : Yunnan—Types at Academy of Zoology, Leningrad, U.S.S.R.).

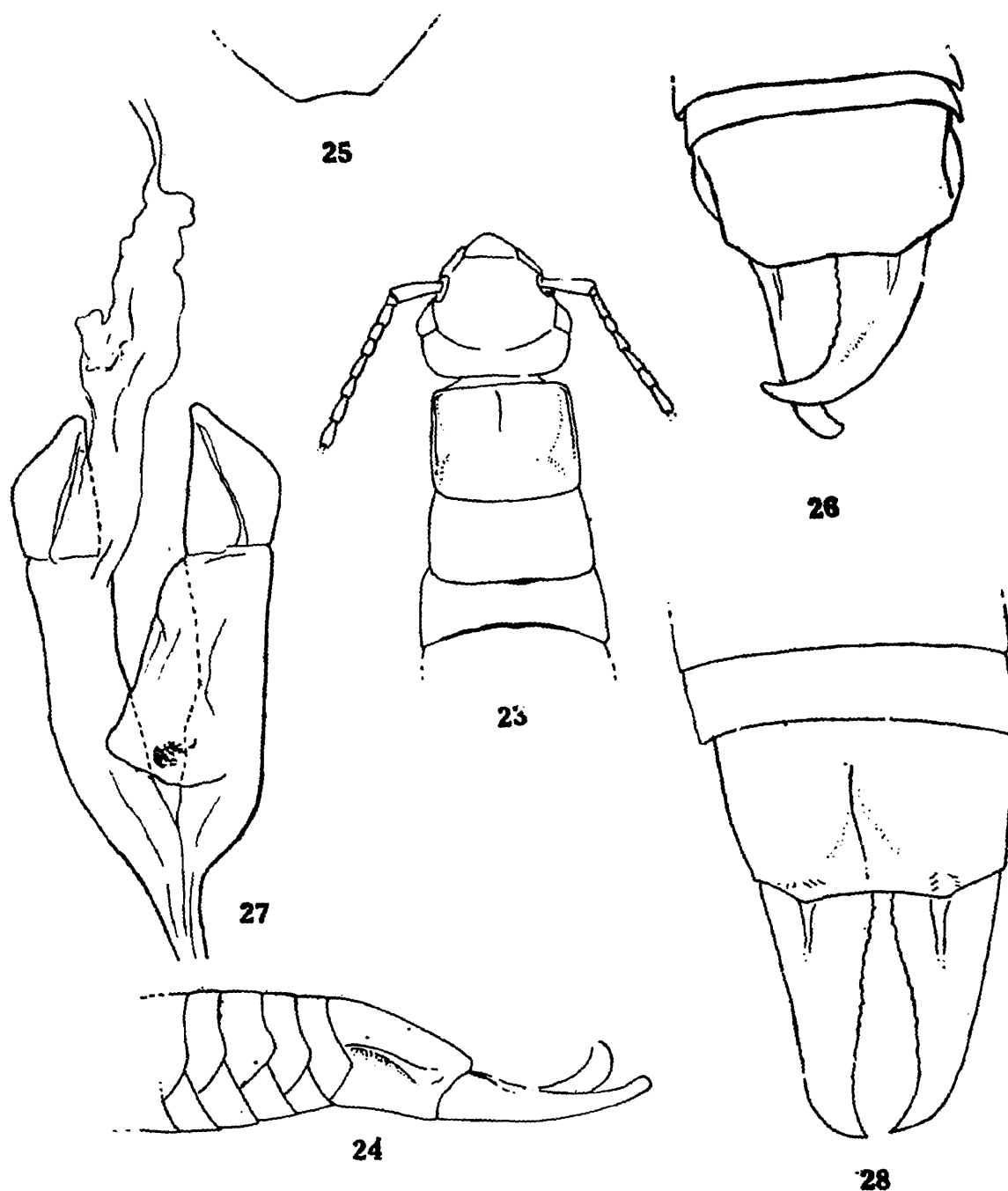
♂ : General colour dark blackish brown, mouth parts and distal half of basal antennal

segment, 2nd and a few preapical ones yellow ; legs with femora in distal one fourth and whole of tibia and tarsi yellowish ; sides of pronotum light brown.

Head slightly longer than broad, smooth, sutures faintly marked. Eyes shorter than the post-ocular length. Antennae 15-segmented or more ; 1st about as long as the dis-

tance between antennal bases, narrowed basally; 2nd small, transverse; 3rd long and cylindrical almost equal to 5th; 3rd and 4th stout; 4th slightly longer than the preceding; 4th onwards segments gradually increasing in length and becoming thinner, each narrowed basally and gently expanded apically. Pronotum about as long as broad,

gently expanded posteriorly, all margins straight, sides gently reflexed. Legs normal. Elytra and wings wanting. Abdomen weakly convex, gently expanded posteriorly, feebly punctulate, punctulations weaker in posterior half of each tergite, lateral tubercles on 3rd and 4th tergites weakly developed, sides of segments 7 to 9 more rugosely punctured,



Figs. 23-28 : *Paralabis montshadskii* Bey-Bienko, ♂, 23. Anterior portion of body, legs of both sides not shown; 24. Hind portion of body in lateral view, 25. Posterior margin of penultimate sternite, 26. Ultimate tergite and forceps; 27. Genitalia; ♀, 28. Ultimate tergite and forceps.

ecarinate and obtuse angled posteriorly. Penultimate sternite broadly sinuate posteriorly. Ultimate tergite transverse, narrowed posteriorly, almost smooth, median sulcus distinct, oblique carina present on sides. Forceps trigonal above in basal one fourth, afterwards depressed, tapering apically, curved in apical one third, right branch more curved and crossing over the left, internally crenulate. Genitalia with distal lobes lacking virga or chitinous teeth.

♀ : Agrees with male in most characters except that the abdomen more feebly punctulate and the sides of all the abdominal segments convex, not rugose ; penultimate sternite obtuse posteriorly and forceps simple and straight.

Measurements : (in mm)

	♂ ♂	♀
Length of body	13.0-14.5	13.7
Length of forceps	2.6- 3.0	2.6

Material examined : INDIA : ARUNACHAL PRADESH : Lohit Dist., Tihun, 2 ♂ ♂, 4160 ft., 12.xii.1969, Wakro, 1 ♀, 1700 ft., 1.xi.1969 Daphabum Exped. (J. M. Julka).

Distribution : India (Arunachal Pradesh) and China (Yunnan). Previous records of this species from India (Srivastava, 1971 and 72) are referable to the new species described in following pages.

Remarks : In one of the males forceps are subcontiguous and apices are almost touching.

***Paralabis denticulatus* sp. n.**

(Figs. 29-33)

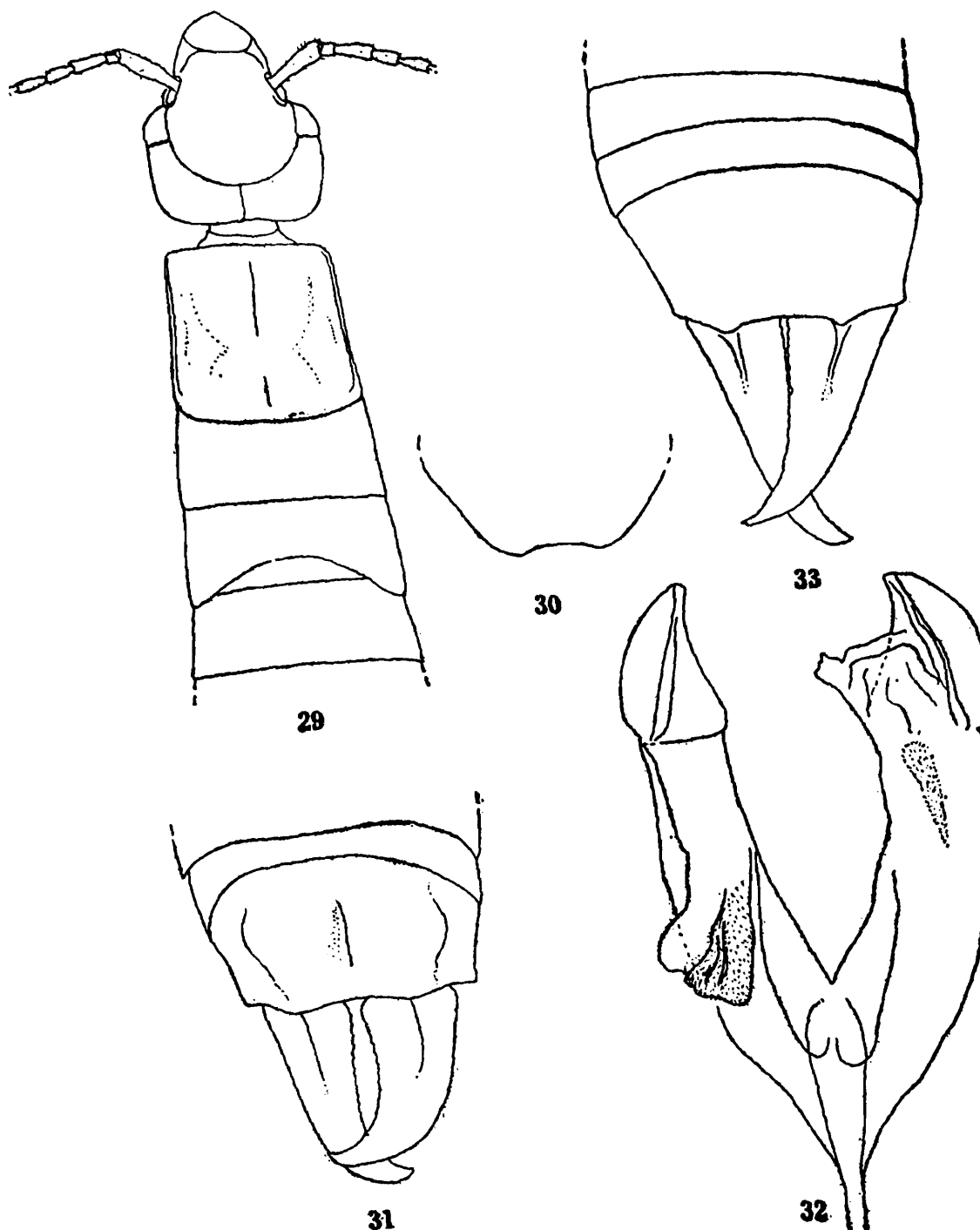
Paralabis montshadskii (nec Bey-Bienko) ; Srivastava, 1971, *Entomologist Rec. J. Var.*, 83 : 22 ; Srivastava, 1972, *Rec. zool. Surv. India*, 66 (1-4) : 134 (♂, ♀ ; NEFA (now Arunachal Pradesh).

♂ : General colour reddish brown with traces of black on certain body parts ; mouth parts yellowish ; 1st and 2nd antennal segments and legs testaceous brown.

Head slightly longer than broad, smooth, convex above, sutures fine but distinct, gently narrowed behind eyes, hind margin almost straight, faintly depressed in middle. Eyes about half as long as the post-ocular length. Antennae (partly broken) 17-segmented or more ; 1st stout, about as long as the distance between antennal bases, narrower at base and expanded apically, third onwards length of corresponding segments on right and left side variable in Holotype ♂ only, segments more elongated in right antennae, left antennae with 3rd segment long and cylindrical, 4th shorter than the preceding, narrowed basally ; 5th equal to 3rd, further segments gradually increasing in length and thinner ; antennae of right side with 3rd segment cylindrical, only slightly shorter than the 1st and almost equal to 6th ; 4th and 5th shorter than 3rd. Pronotum about as long as broad, smooth, sides straight, feebly reflexed in middle only, gently diverging posteriorly with hind margin sub-rotundate, median sulcus faintly marked, prozona weakly raised and poorly differentiated from flat metazona. Mesonotum and metanotum transverse, smooth, hind margin truncate in the former and broadly emarginate in the latter. Elytra and wings absent. Legs normal. Abdomen weakly convex, enlarging from base to 6th tergite and narrowing feebly from 7th to 9th tergites, finely punctulate, lateral tubercles on 3rd and 4th tergites almost obsolete, sides of segments 6 to 9 acute angled, rugosely punctate but punctuation weaker on 6th segment. Penultimate sternite

transverse, narrowed posteriorly, hind margin broadly sinuate, in posterior half above with a rounded, depressed area and a faintly raised longitudinal stripe in the middle. Ultimate tergite transverse, almost smooth except for a few punctations sparsely placed, narrowed posteriorly, laterally raised above in middle,

median sulcus distinct, laterally oblique carina weakly marked, hind margin trisinate, oblique laterally. Forceps subcontiguous, branches stout, tapering apically, almost straight in basal two third, afterwards gently incurved, right branch more strongly curved and crossing over the left, apices gently



Figs. 29-33 : *Paralabis denticulatus* sp.n. ; Holotype ♂, 29. Anterior portion of body ; 30. Posterior margin of penultimate sternite ; 31. Ultimate tergite and forceps ; 32. Genitalia ; Paratype ♀ ; 33. Ultimate tergite and forceps.

hooked with tip pointed, trigonal above in basal one third and afterwards depressed, internal margin faintly crenulate. Genitalia with parameres about twice as long as broad, gradually narrowing apically, distal lobes with chitinous denticulated pads apically.

♀ : Agrees with ♂ in most characters except that the sides of abdominal segments smooth, convex posteriorly ; penultimate sternite obtusely rounded posteriorly ; ultimate tergite comparatively strongly narrowed posteriorly and forces contiguous, simple and straight.

Measurements : (in mm)

	Holotype		Paratypes	
	♂	♂ ♂	♀ ♀	
Length of body	13.8	12.6	9.2-12.9	
Length of forceps	2.2	2.2	1.9-3.1	

Material examined : INDIA : ARUNACHAL PRADESH : Kameng Dist., Milankang, Holotype ♂ (genitalia mounted between two coverslips and pinned with the specimen), Paratypes 4 ♀ ♀, 2 nymphs, 18.vi.1961 ; milankang Digian, Paratype 1 ♀, 20.vi.1961, 6500 ft., Shergaon, Paratype 1 ♀, 28.iii.1961, 6600 ft., Chug, Paratypes 2 ♀ ♀, 17.iii.1961, (K. C. Jayaramkrishnan) ; Dirang, Paratype 1 ♂, 12.iii.1973, 1526 m ; Sappen, Paratypes 1 ♂ and 1 ♀, 13.iii.1973, 1800 m (S. K. Tandon and A. N. T. Joseph), all deposited in the Zoological Survey of India, Calcutta.

Distribution : Known from the type locality only.

Remarks : This species was confused with *Paralabis montshadskii* Bey-Bienko, by Srivastava (1971 and 1972) but differs in males by the uniformly coloured legs, com-

paratively feeble body punctulations, weakly developed oblique carina on the sides of ultimate tergite and genitalia provided with chitinous denticulated pads at the apical end of distal lobes.

In the present material general body colouration varies between reddish brown and dark blackish brown.

ACKNOWLEDGEMENTS

I am thankful to the Director, Zoological Survey of India, Calcutta for providing necessary facilities and to Dr. Roy Danielson, Zoological Institute, Department of Systematics, Lund, Sweden for the loan of valuable material referred under *Paralabis greeni* (Burr).

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ON A NEW SPECIES OF *KRYPTOPTERUS* (PISCES : SILUROIDEA, FAMILY :
SILURIDAE) FROM NAMDAPHA WILDLIFE SANCTUARY,
ARUNACHAL PRADESH, INDIA

A. K. DATTA, R. P. BARMAN & K. C. JAYARAM

Zoological Survey of India, Calcutta.

ABSTRACT

In the faunistic survey of the Namdapha area Tirap district, Arunachal Pradesh, India, a new fish of the family Siluridae, genus *Kryptopterus* Bleeker was found. *Kryptopterus indicus* sp. nov. is described here and its zoogeographical affinities are discussed.

INTRODUCTION

An interesting collection of fish comprising 235 examples were collected during the survey and one example of catfish of the genus *Kryptopterus* (Family : Siluridae) was found to be new, it is named as *Kryptopterus indicus*.

MATERIAL

(Fig. 1)

Holotype : 218 mm. in standard length.
Reg. No. Z. S. I. F. F. 1699. *Locality*—Horn

bill point, Namdapha river, Namdapha Wildlife Sanctuary, Arunachal Pradesh, India. *Coll.* Dr. S. Biswas & S. Saha. Date 18.4.81.

DIAGNOSIS

Dorsal fin rudimentary with one minute ray, adipose dorsal absent. Anal fin long with 88 rays, continuous with caudal fin. Eyes subcutaneous above the angle of mouth. Vent with a papilliform appendage.



Fig. 1. Lateral view of *Kryptopterus indicus* Datta, Barman and Jayaram.

DESCRIPTION

Dorsal fin rudimentary with one minute ray and adipose dorsal fin absent, body laterally compressed beyond vent. Abdomen rounded, head depressed dorsoventrally flattened. Depth of body 5.45 in standard length. Length of head 5.89 in standard length, its width 1.32 in its length. Anterior part of back convex, posterior part concave. Eye nearer to cleft of mouth, 9.25 in head, 3.25 in snout, 4.25 in interorbital width. Jaws subequal, maxilla over hanging, gape of mouth extending near to the anterior border of eye. Maxillary barbel tip filamentous, 1.48 in head length, reaching beyond posterior margin of pectoral fin. Mandibular barbel half the length of head. Caudal fin with 17 rays shorter than head. Anal 88 rays. Pelvic shorter than pectoral, with 8 rays.

AFFINITIES

The new species *Kryptopterus indicus* is closely allied to *K. limpok* Bleeker. Smith (1945) differentiated eight species of *Kryptopterus* found in Thailand. These are *K. apogon* (Bleeker), *K. bicirrhys* (C. & V.), *K. bleekeri* Günther, *K. cryptopterus* (Bleeker), *K. hexapterus* (Bleeker), *K. limpok* (Bleeker), *K. micronema* (Bleeker), *K. moorei* Smith. The differences between the new species and the allied species (*K. limpok*) are in respect to the maxillary barbel reaching posterior margin of pectoral fin versus maxillary barbel reaching posterior fourth of anal fin, mandibular barbel half the length of head versus mandibular barbel longer than head, anal fin rays eighty eight versus anal rays seventy. The common characters are dorsal fin having

one ray, ventral rays seven, anal fin confluent with the base of caudal.

Measurement in mm

Standard length	— 218
Depth of body	— 40
Length of head	— 37
Height of head	— 23
Width of head	— 28
Length of snout	— 13
Diameter of eye	— 4
Interorbital width	— 17
Lateral line	— Present
Dorsal fin	— rudimentary with one ray
Length of pectoral	— 24
Distance from anterior origin of pelvic to base of caudal	— 150
Anal fin rays	— 88 (3/85)
Distance from vent to anal	— Overlapping
Pectoral fin rays	— 12 (1/11)
Anal length	— 135
Vent	— papillated cirris-like
Length of Maxillary barbel	— 55
Length of Mandibular barbel	— 18
Brancheostegal ray	— 12
Ventral fin rays	— 8(1/7)
Length of ventral fin	— 13

ZOOGEOGRAPHY

The occurrence of *Kryptopterus indicus* in Namdapha area, with its closest allies in Thailand is of zoogeographical interest.

Namdapha river originates and drains North-west slope of Patkai Bum, thereafter flowing westward to join the Brahmaputra river. The head waters of Namdapha is close to Chindwin drainage having a common catchment area.

Hora (1939) postulated that the fish fauna of peninsular India has the so called Malayan element and there exists affinities at the generic level among the fauna found in Malaya and peninsular India. Hora thought that the Malayan elements dispersed westward along the Garo-Rajmahal hills and reached peninsular areas through the Western ghats. Jayaram (1974) showed that the ichthyofauna of peninsular India was dispersed by several intrusions of the so-called Malayan element that was derived from Indo-China. He suggested that the maior faunal dispersal centre was the Yunnan plateau and it was the epicentre of dispersal in all directions.

Considering the above views, it may be said that *Kryptopterus indicus* is one such offshoot of the Indo-chinese element in the Indian fauna.

ACKNOWLEDGEMENT

The authors are graterul to the Director, Zoological Survey of India for giving the opportunity to do this work.

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SHELL MODIFICATIONS IN INDIAN LAND OPERCULATES AND THEIR SIGNIFICANCE

By

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ABSTRACT

There are about 35 genera of land operculates in India. Among these, at least 12 genera show various modifications in their shell characters. Four genera, viz. *Alycaeus*, *Dioryx*, *Pearsonia* and *Rhaphaulus* possess perfectly built tubes. *Pterocyclus* and *Rhiostoma* have imperfectly built tubes. Others, viz. *Pupina*, *Tortulosa*, *Schistoloma*, *Megalomastoma*, *Cyclotus*, and *Diplommantina* show various minor modifications like grooves, notches, canals or even simple tooth-like projections. These structures have been described generawise and the possible significance of the same has been discussed.

INTRODUCTION

Terrestrial molluscs belong to two different subclasses, Prosobranchia (operculates) and Pulmonata (non-operculates).

Adaptation to terrestrial habitat involves mainly the maintenance of internal water which is influenced by the humidity. Though phylogenetically terrestrial molluscs belong to two different classes all have to face certain problems in aerial respiration and in tiding over the unfavourable conditions. As an answer to these problems of aerial life each mollusc has developed its own devices.

Slugs, the evolution of which has taken place as a result of natural selection in a condition of plentiful moisture and scarcity of calcium (Solem, 1974) face no such problem since they have no shell to withdraw

themselves. They just burrow inside the soil and aestivate and have no difficulty in carrying on respiration.

Terrestrial pulmonates have developed their own methods for withdrawing and shutting themselves inside the shell during aestivation. They secrete thin membranaceous epiphragms (either one or more than one). These epiphragms are permeable and usually with slit-like openings, through which passage of air is maintained.

Terrestrial prosobranchs, which are operculates, find it difficult to maintain exchange of air once they close their hard calcareous operculum. Possibly, to overcome this, it becomes necessary for them to resort to structural modifications. These modifications take different shapes to provide

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various notches, grooves, pores and tubes. There are 35 genera of land operculate snails in India, distributed in 6 families, viz, Hydrocenidae, Helicinidae, Cyclophoridae, Pomatiasidae, Pupinidae and Diplommatinidae. Out of these, at least 12 genera belonging to the families Cyclophoridae, Pupinidae, and Diplommatinidae, have modifications of some kind or other in their shells, either at the peristome or close to it or both.

Sporadic reports on this aspect, on American forms (Handerson and Bartsch, 1920), Indo-Australian forms (Bentham Jutting, 1948) and the forms from the Indian sub-continent (Godwin-Austen, 1910 : Gude, 1921 and Blanford, 1863), are available. Rees, (1964) in his study considered the tropical land operculates as a whole. Since, the modifications of shells of land operculates occurring in India and neighbouring countries have not been given much attention by previous workers, an attempt is made to make a report on them and discuss the possible significance of such modifications.

OBSERVATIONS

Detailed observations, on the modifications in the shells of different species of land operculates, present in National Zoological Collections, Zoological Survey of India, were made and are described generawise.

Rhaphaulus : Peristome is double, thick, strongly reflected, notched at columella with a well built tube on the sutural side. The tube is open at both ends and runs upwards [e.g. *R. chrysalis* (Pl. I, fig. 1), *R. blanfordi*], downwards [e.g. *R. assamica*] (Pl.

I, fig. 3) or runs horizontally as in *R. aborensis* (Pl. I, fig. 11). In *R. luyorensis* the sutural tube is flattened and finely perforated at intervals.

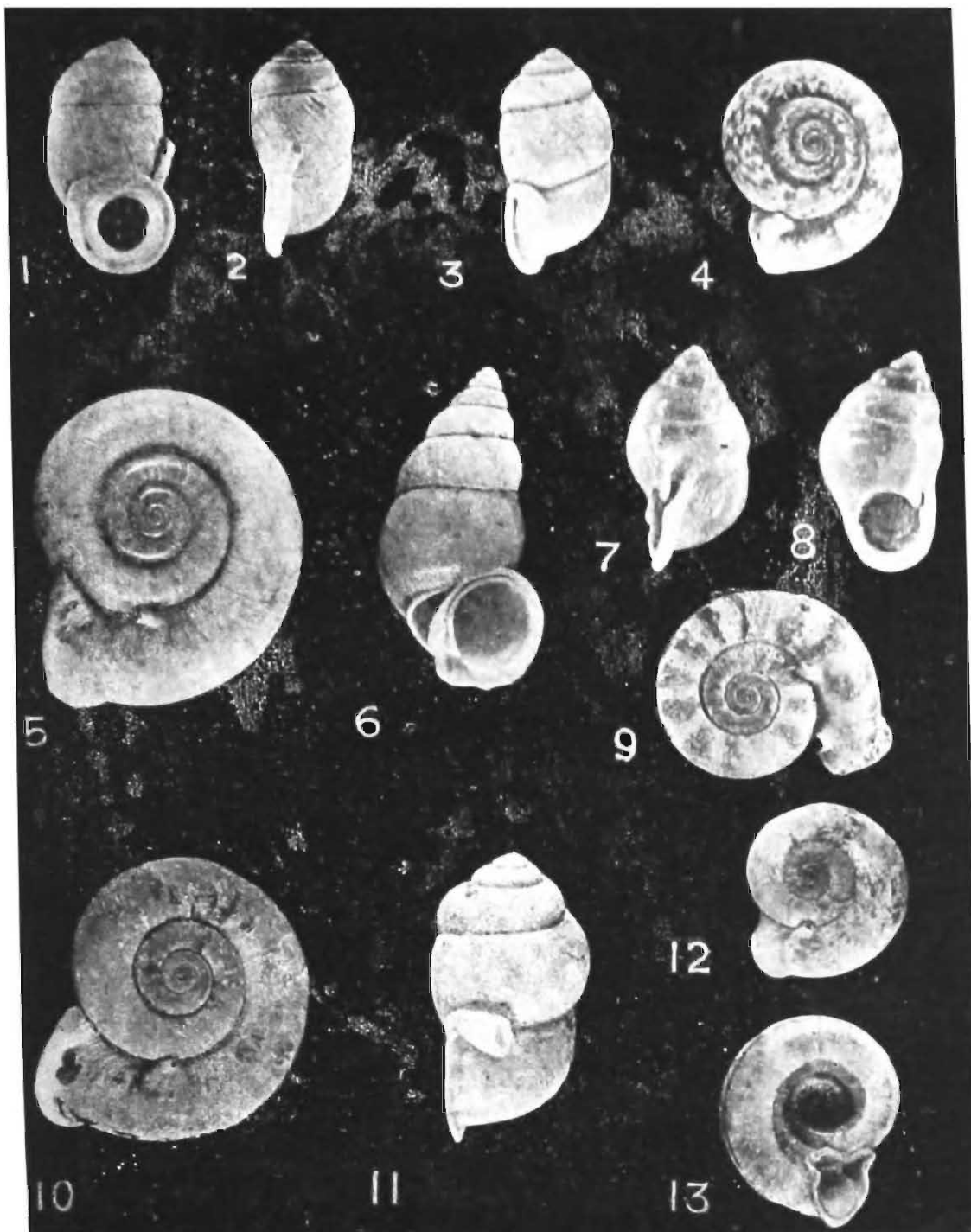
Pearsonia : Here the sutural tube originates from a little behind the aperture, opens at both ends. It is usually curved backwards [e.g. *P. nevillei*] (Pl. I, fig. 10) or forward [e.g. *P. beddomei*], (Pl. I, fig. 5) sometime arched [e.g. *P. hispida*], (text fig. 3) or erect (e.g. *P. assamensis*). Besides, a sinus resulted from an incision of the peristome with a wing at the point where the peristome meets the bodywhorl, is also present. In *P. fairbanki* (Pl. I, fig. 12, 13) in addition to the wing and thin sutural tube, a gutter shaped projection is present at the base near the columellar margin. In *P. bitubifera* (Pl. I, fig. 9) the wing near the aperture takes the shape of an imperfect tube.

Alycaeus : Body whorl is much distorted, swollen and again constricted in front of aperture, a closed sutural tube runs backward adhering to the shell, aperture trumpet-shaped,. The blind tip of the tube is comparatively thin and seems to be porous (Fig. 1).

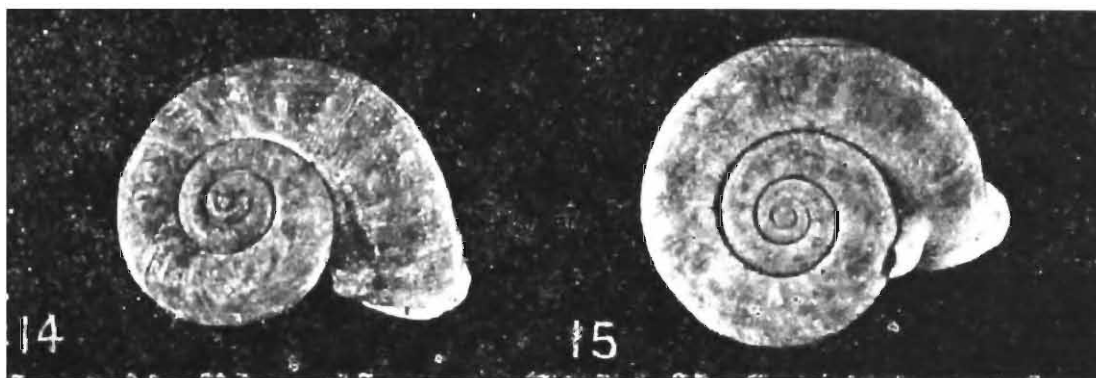
Dioryx : Modifications are same as in *Alycaeus*, only the sutural tube is comparatively longer in size (Fig. 2).

Rhiostoma : Body whorl detached and descending near the aperture, peristome free, notched above, a prominent but rather imperfectly built tube is present at the aperture (Pl. II, fig. 14).

Pterocyclus : Peristome is interrupted above to produce a sinus, outer peristome arched forming a wing-like projection over the sinus. In *P. bilabiatus* (Pl. I, fig. 4) the



Figs. 1-13. 1. *Rhaphaulus chrysalis* (Pfeiffer), 2. *Rhaphaulus chrysalis* (Pfeiffer), 3. *Rhaphaulus assamicus* Godwin-Austen, 4. *Pterocyclus bilabiatus* (Sowerby), 5. *Pearsonia beddomei* (Blanford), 6. *Tortulosa recurvatus* (Pfeiffer), 7. *Pupina imbricifera* Beuson, 8. *Pupina imbricifera* Benson, 9. *Pearsonia bitubifera* (Theobald), 10. *Pearsonia nevilli* (Godwin-Austen), 11. *Rhaphaulus aborensis* (Godwin-Austen), 12. *Pearsonia fairbanki* (Blanford), 13. *Pearsonia fairbanki* (Blanford)



Figs. 14-15. 14. *Rhiostoma simplicilabris* Pfeiffer, 15. *Pterocyclus magnus* Godwin-Austen

wing curls and takes a tubular shape. In *P. magnus* (Pl. II, fig. 15) the projection is far more developed and shapes like an imperfect tube opening inside the mouth.

Pupina : Two distinct canals, produced

by the incision of the peristome, one at the sutural side and the other at columellar side (Pl. I, figs. 7, 8).

Tortulosa : Peristome is reflected and interrupted, producing a circular groove at

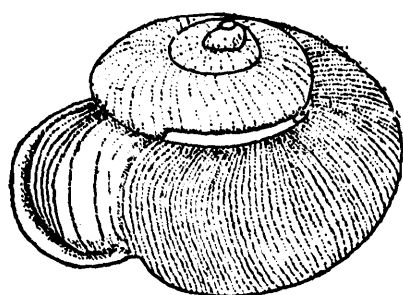


fig. 1

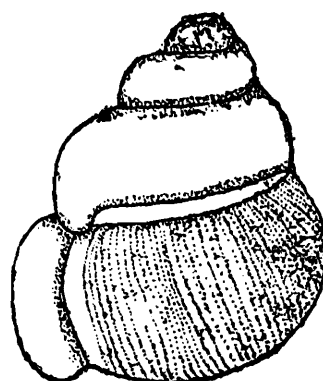


fig. 2

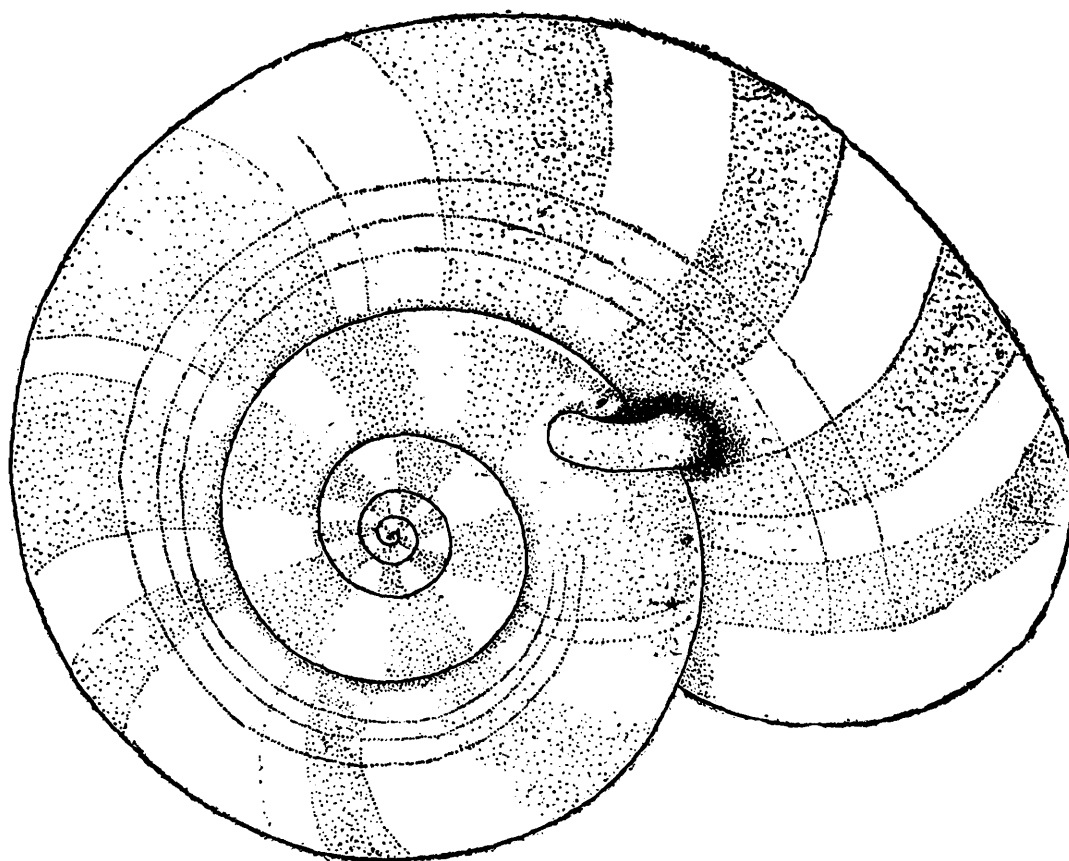


fig. 3

Figs. 1-3 : 1. *Alycaeus stylifer* Benson ; 2. *Dioryx urnula* (Benson),
3. *Pearsonia hispida* (Pearson).

the base on the left side. The opening of the groove is never blocked by the operculum (Pl. I, fig. 6).

Schistoloma : Inner peristome is slightly grooved at the upper margin.

Megalomastoma : Peristome is slightly notched at the top near the columella.

Cyclotus : A wing is present in some cases.

Diplommatina : A tooth like projection is present on the columellar side inside the aperture.

The opercula in most of these genera are typical with concave inside and convex outside. Edges of the whorls are mostly with raised keels.

DISCUSSION

From the study it is seen that the shells of land operculates have undergone modifications to give rise to various notches, grooves, pores and tubes. Since the location of these modified structures is almost similar in different genera it is clear that the purpose is common to all. Of all these modified structures, the sutural tube is most interesting. It is conspicuous in *Rhaphaulus*, *Alycaeus*, *Dioryx* and *Pearsonia*. The direction of the tube in *Rhaphaulus* and *Pearsonia* varies with the species, perhaps to suit specific mode of life. It appears that species with distinct sutural tube, open at both ends have undergone extreme modifications in serving the desired purpose. On the otherhand, inspite of possessing well developed tubes, members of the genus *Alycaeus* have succeeded in producing micropores instead of a single macropore, probably to check unwanted infiltrations. In this respect, *Alycaeus* may

be considered as the highly modified group and at the same time the most primitive. The formation of an imperfect tube (e.g. *Rhiostoma*, *Pterocyclus*) as a result of the extension of the outer peristome, may be considered as a step towards the abolition of the sutural tube. This can be well documented if we look at the gradual changes these modifications have undergone. The cannals produced by the incision of the peristome in *Pupina*, are confined to a groove on the left side of the reflected peristome in *Tortulosa*, again being further reduced to a mere notch in *Megalomastoma* or to just a tooth-like projection in *Diplommatina*.

Obviously, these changes had to be made keeping in view the inconvenience these awkward, yet essential, structures created so far as locomotion and other activities were concerned for these particular snails.

The possible significance of such modifications is an art to give rise to certain structures to facilitate the breathing of the snail species concerned. In most cases the operculum closes the shell aperture at the margin of the inner peristome and the air entering through the tubes comes in contact with the mantle and brings about exchange of gases. The space between the operculum and the opening of the sutural tube is covered by the mantle. But why a good number of species have to develop such devices while other related forms flourish in much the same sort of environment without these, is still a puzzling problem. It is quite possible that the snails without such modifications bear an operculum which is either porous or the air passes through the interspaces left between the operculum and the inner wall of the shell aperture.

ACKNOWLEDGEMENTS

Sincere thanks are due to the Director and Dr. O. B. Chhotani, Deputy-Director, Zoological Survey of India, for facilities to work and also to Shri D. K. Thakur, Asst. Zoologist, for figures.

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ON THE NUMBER OF SPECIMENS, REPOSITORY, AND THE HETEROGENEITY
OF THE TYPE-SERIES OF *VESPERTILIO MONTIVAGUS*
DOBSON, 1874 (MAMMALIA : CHIROPTERA).

By

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ABSTRACT

Confusion exists as to the total number of type-specimens of *Vespertilio montivagus* Dobson, 1874, and the current repository of these specimens. It has been shown that the original type-series of *Vespertilio montivagus* consisted of a total of six specimens (one male and five females) and that all the specimens were originally deposited in the Indian Museum, Calcutta. Subsequently, two specimens of the type-series were handed over to the British Museum, on two different occasions. At present, four of the syntypes of *Vespertilio montivagus* are in the National Zoological Collection of India, housed in the Zoological Survey of India, Calcutta, while the two other syntypes are at the British Museum (Natural History), London. Further, as one of the specimens of the type-series of *Vespertilio montivagus* Dobson, 1874, has been found not to be an example of *montivagus* at all, the type-series has been regarded as heterogeneous. External and cranial measurements, and other relevant particulars of the specimens of the type-series have been appended. The skull of the male specimen of the type-series maintained at the Zoological Survey of India, has been figured.

INTRODUCTION

Dobson (1874), while describing *Vespertilio montivagus*, was silent about the number of type-specimens. Later, however, he (Dobson 1876) mentioned a total of six type-specimens of *Vespertilio montivagus* present at the Indian Museum, Calcutta. But Anderson (1881) listed only five specimens as types of the same taxon present at the same museum, while Hill (1962) stated : '.....the co-typical specimens of

Vespertilio montivagus Dobson, both of which are now preserved in the collections of the British Museum (Natural History)'. Again, Khajuria *et al.* (1977) listed only three of these type-specimens in the collection of the Zoological Survey of India.

Thus, confusion exists as to the total number of type-specimens of *Vespertilio montivagus* Dobson and the current repository of these specimens. It was, therefore, felt necessary to make an attempt to clear this confusion.

NUMBER OF TYPE-SPECIMENS AND THEIR REPOSITORY

As has been stated earlier, Dobson (1874) did not specifically mention the number of type-specimens in the original description of *Vespertilio montivagus*. In this connection, he only stated: 'The above description is taken from adult male and female specimens preserved in alcohol, obtained by Dr. J. Anderson during the Yunan Expedition, and deposited in the Indian Museum, Calcutta. However, two years after the publication of this description, the same author (Dobson 1876) appended a catalogue of the specimens of bats present in the collection of the Indian Museum, Calcutta, to his monograph of the Asiatic Chiroptera, wherein he listed a total of six specimens (one male and five females, bearing his Catalogue Numbers 658 to 663) as the types of *Vespertilio montivagus*. It, therefore, appears quite safe to assume that there were a total of six specimens before Dobson when he was describing *Vespertilio montivagus*. Following the general practice of the day, Dobson (1874) did not specify any of the type-specimens as 'the type' (*i. e.*, holotype). Accordingly, all the six specimens of the type-series (Dobson 1876) are to be accepted as syntypes.

Under *Vespertilio montivagus*, Dobson (1878) listed one alcohol-preserved, unsexed, adult specimen from the type-locality (Hotha, Yunan), as present at the British Museum, with the indication that it was obtained in exchange from the Calcutta Museum (*i. e.*, Indian Museum, Calcutta). He, however, simultaneously stated: 'Type in the collection of the Indian Museum'. On the other hand, Anderson (1881) mentioned only

five specimens (one male and four females, bearing his Catalogue Numbers 178*a* to 178*e*) of this taxon, as types and present at the Indian Museum, Calcutta. It would, therefore, follow that the specimen listed by Dobson (*op. cit.*) is one of the type-series of *Vespertilio montivagus* which was obtained by the British Museum in exchange from the Indian Museum, Calcutta, between 1876 and 1878. In fact, Hill (1962) mentioned an alcohol-preserved female specimen bearing British Museum Registration Number 76.3.10.5 as one of the syntypes of *V. montivagus*. The registration number clearly indicates that the said specimen was received by the British Museum at a period not later than 1876. Obviously, this specimen makes up the discrepancy in the number of type-specimens of *V. montivagus*, as given by Dobson (1876) and Anderson (1881). The Zoological Survey of India which received the entire mammalian collection of the Indian Museum in 1916, should, therefore, have five of these six type-specimens. In the forties of this century, however, Dr. M. L. Roonwal, the then Officer-in-Charge of the mammalian collection of the Zoological Survey of India, could locate only four of these specimens, bearing Anderson's Catalogue Numbers 178*a* to 178*c* and 178*e*. Therefore, a second specimen bearing Anderson's Catalogue Number 178*d*, also appeared missing from the collection of the Zoological Survey of India, even at that time. Hill (1962) also mentioned a second type-specimen of *Vespertilio montivagus* to be present at the British Museum, bearing the Registration Number 9.4.4.5. This specimen, according to Hill (*op. cit.*), is a male, and was obtained by the British Museum as a donation from the Indian

Museum. The registration number indicates that this specimen was received by the British Museum at a period not later than 1909. This explains why Dr. Roonwal could find only four specimens of the type-series of *V. montivagus*.

Subsequently, Khajuria *et al.* (1977) found only three of the type-specimens mentioned above (bearing Anderson's Catalogue Numbers 178a to 178c), in the collection of the Zoological Survey of India.

However, a thorough search conducted by the present author, resulted in locating the missing fourth type-specimen in the general collection. This specimen bears Dobson's Catalogue Number 663 and Anderson's Catalogue Number 178e.

It is, therefore, clear that the type-series of *Vespertilio montivagus* Dobson, 1874, originally consisted of a total of six specimens and that all the specimens of the type-series were initially deposited in the Indian Museum, Calcutta. But one female specimen (bearing Dobson's Catalogue Number 660) of the type-series was given to the British Museum, in exchange, in 1876, while a second specimen was donated to the same museum in 1909 (Hill 1962). Thus, the National Zoological Collection of India, housed in the Zoological Survey of India (which received the entire mammalian collection of the Indian Museum) has, at present, only four of the original six syntypes of *Vespertilio montivagus* Dobson, while the British Museum (Natural History), London, has the other two. The relevant particulars and current repositories of these type-specimens have been given in Table 1.

HETEROGENEITY OF THE TYPE-SERIES

The skull of one of the syntypes (No. [F]

76.3.10.5) of *Vespertilio montivagus* present at the British Museum, has been extracted and cleaned. The skull of the other syntype housed in the same museum has not been extracted (Hill 1962). The skull of none of the four syntypes present in the Zoological Survey of India, was extracted till 1966 when G. Topal of the Hungarian Natural History Museum, during his visit to India, extracted and cleaned the skull of one of these specimens. The skull of two other syntypes were extracted and cleaned by the present author, while that of the fourth syntype present in the Zoological Survey of India, has not been extracted yet.

Careful examination of the skulls of the syntypes of *Vespertilio montivagus* present in the Zoological Survey of India, has revealed that in one skull (Anderson's Catalogue Number 178b) the second upper premolar, though small, is not minute, and all the three upper premolars are in the tooth-row. The relative sizes and positions of the upper premolars of this skull, which are quite different from those of the upper premolars of *Vespertilio montivagus*, as given in the original description, clearly establish that this specimen is not at all an example of *V. montivagus*. Unfortunately, due to lack of sufficient comparative material, the specific identity of this example cannot be determined with certainty. The skull of the second syntype present at the British Museum should also be specially examined to ascertain whether it is an example of *montivagus* or not. Incidentally, the sex of this specimen is also to be re-examined, as there exists some controversy on this point. Both Dobson (1876) and Anderson (1881) mentioned only one example of male specimen in the type-series of *Vespertilio montivagus*. The male specimen

was at the Indian Museum from where it was transferred to the Zoological Survey of India, the institution which still maintains it. But according to Hill (1962), the second syntype present at the British Meuseum, is also a male.

The skull of the male specimen (Dobson's Catalogue Number 658, Anderson's Catalogue Number 178*a*, Zoological Survey of India Registration Number 15579) of the type-series

of *Vespertilio montivagus* Dobson, 1874, present in the Zoological Survey of India, is figured to illustrate the skull of this species (Fig. 1).

The relevant particulars, current repositories, and external and cranial measurements of specimens of the type-series of *Vespertilio montivagus* Dobson, 1874, are given in Tables 1, 2 and 3.

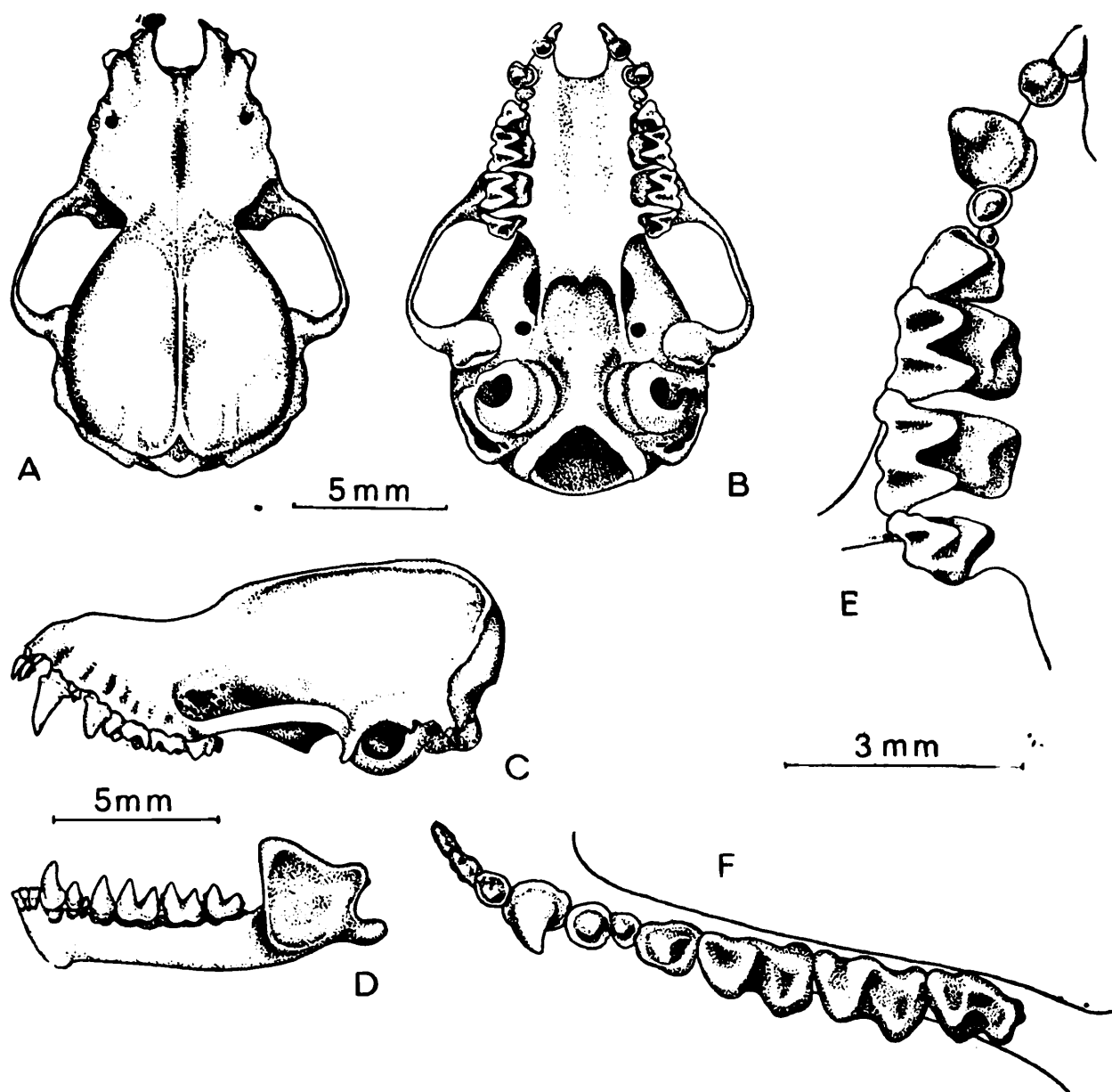


Fig. 1. Skull of *Vespertilio montivagus* Dobson, 1874 : A. dorsal view, B. ventral view, C. lateral view, D. lateral view of the lower jaw of the left side, E. upper tooth-row of the right side, F. lower tooth-row of the left side.

*List of abbreviations used in Tables 1, 2 and 3.*III¹ = length of the first phalanx of the third digitIII² = „ „ „ second „ „ „ „ „III^m = „ „ „ third metacarpalV¹ = „ „ „ first phalanx of the fifth digitV² = „ „ „ second „ „ „ „ „V^m = „ „ „ fifth metacarpal

And. Cat. No. = Anderson's Catalogue Number

BM = British Museum (Natural History)

Cal = Calcar

cb = condylobasal length

c¹-c¹ = canine width

ccl = condylocanine length

c-m³ = length of the maxillary tooth-row

cw = cranial width

Dob. Cat. No. = Dobson's Catalogue Number

E = length of ear

Fa = „ „ forearm

F & Cl = length of foot and claws

iw = least interorbital width

l = greatest length of the skull

m³-m³ = molar width

ml = mandibular length

mstw = mastoid width

NZCI = National Zoological Collection of India

Reg. No. = Registration Number

Tb = length of tibia

Tl = „ „ tail

Tr = „ „ tragus

ZSI = Zoological Survey of India

zw = zygomatic width

TABLE 1 : Relevant particulars and current repositories of specimens of the type-series of *Vespertilio montivagus* Dobson, 1874, collected from Hotha, Yunan, China, by Dr. J Anderson in 1868, during the First Expedition to Yunan.

Dob. Cat. No.	Sex	And. Cat. No.	ZSI Reg. No.	BM Reg. No.	Repository
658	♂	178a	15579	—	NZCI
659	♀	178b	15580	—	NZCI
660	♀	—	—	76.3.10.5	BM
661	♀	178c	15581	—	NZCI
662	?♀	178d	—	9.4.4.5	BM
663	♀	178e	20170	—	NZCI

TABLE 2: External measurements of specimens of the type-series of *Vespertilio montivagus* Dobson, 1874.

Reg. No.	Fa	Tl	F & Cl	E	Tb	Tr	III ^m	III ¹	III ²	V ^u	V ¹	V ²	Cal
ZSI													
15579	39.2	39.6	8.4	13.4	16.5	6.0	35.3	14.6	14.8	33.6	9.4	7.0	15.0
ZSI													
15580	37.3	35.7	9.4	13.4	16.1	6.9	34.3	12.5	14.9	32.4	8.9	8.4	13.7
BM													
76.3.10.5*	41.5	—	—	14.5	—	—	—	—	—	—	—	—	—
ZSI													
15581	40.0	38.5	8.2	11.9	16.9	6.0	35.8	14.9	13.8	33.5	9.3	7.1	15.3
BM													
9.4.4.5	—	—	—	—	—	—	—	—	—	—	—	—	—
ZSI													
20170	39.9	37.3	8.3	10.5	16.9	6.0	—	15.0	13.3	34.3	9.3	7.3	—

TABLE 3: Cranial measurements of specimens of the type-series of *Vespertilio montivagus* Dobson, 1874.

Reg. No.	l	ccl	cb	zw	iw	cw	mstw	c ¹ -c ¹	m ³ -m ³	c-m ³	ml	Remarks
ZSI												
15579	15.0	13.9	14.4	10.8	3.6	7.5	7.6	4.4	6.5	6.0	11.8	Skull extracted by author.
ZSI												
15580	15.0	13.9	13.9	9.8	3.4	7.4	7.5	3.8	6.0	5.8	10.6	Skull extracted by author. Not <i>montivagus</i> .
BM												
76.3.10.5	15.4	14.0	—	—	3.8	7.1	7.9	4.3	6.7	6.0	11.5	Measurements from Hill(1962).
ZSI												
15581	15.3	13.8	14.5	10.5	3.4	7.0	7.8	4.4	6.8	6.1	12.0	Skull extracted by G. Topal in 1966.
BM												
9.4.4.5	—	—	—	—	—	—	—	—	—	—	—	Skull not extracted.
ZSI												
20170	—	—	—	—	—	—	—	—	—	—	—	Skull not extracted. Lower jaw broken.

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* Measurements from Hill (1962).

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NOTES AND ILLUSTRATIONS ON SOME DERMAPTERA (INSECTA) PRESERVED
IN THE "RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN"

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ABSTRACT

Results of investigation on types of six species viz ; *Proreus ludekingi* (Dohrn) ; *P. ritsemae* (Bormans) ; *P. sobrius* (Bormans) ; *Adiathella fuscipennis* (Haan) ; *Cordax armatus* (Haan) ; and *Eparchus tenellus* (Haan) are given. Beside providing detailed redescrptions for some species and additional characters for others, following synonymies are also proposed : *Eutimomena* Bey-Bienko under *Cordax* Burr ; *Proreus shaffi* Bharadwaj and Kapoor under *Proreus ritsimae* (Bormans) ; *Adiathella philippinensis* Srivastava under *Adiathella fuscipennis* (Haan) and *Eutimomena paradoxa* Bey-Bienko under *Cordax armatus* (Haan).

INTRODUCTION

The present paper deals with types of six species of Dermaptera viz., *Proreus ludekingi* (Dohrn) ; *P. ritsemae* (Bormans) ; *P. sobrius* (Bormans) ; *Adiathella fuscipennis* (Haan) comb. nov., under the family Chelisochidae and *Cordax armatus* (Hann) and *Eparchus tenellus* (Haan) under the family Forficulidae. Of these, species described by de Haan (1842), and Dohrn (1865) are redescrbed since they are known by brief description. However, some additional information is provided for Bormans' (1884) species also.

As a result of this study following synonymies are proposed : *Proreus shaffi* Bharadwaj and Kapoor under *P. ritsemae* (Bormans) ; *Adiathella philippinensis* Srivastava under *A. fuscipennis* (Haan) ; and

Eutimomena paradoxa Bey-Bienko gen. and sp. under *Cordax armatus* (Haan) gen. and sp. The *Cordax* Burr (1910) is redefined in the light of above proposed synonymy.

***Proreus ludekingi* (Dohrn)**

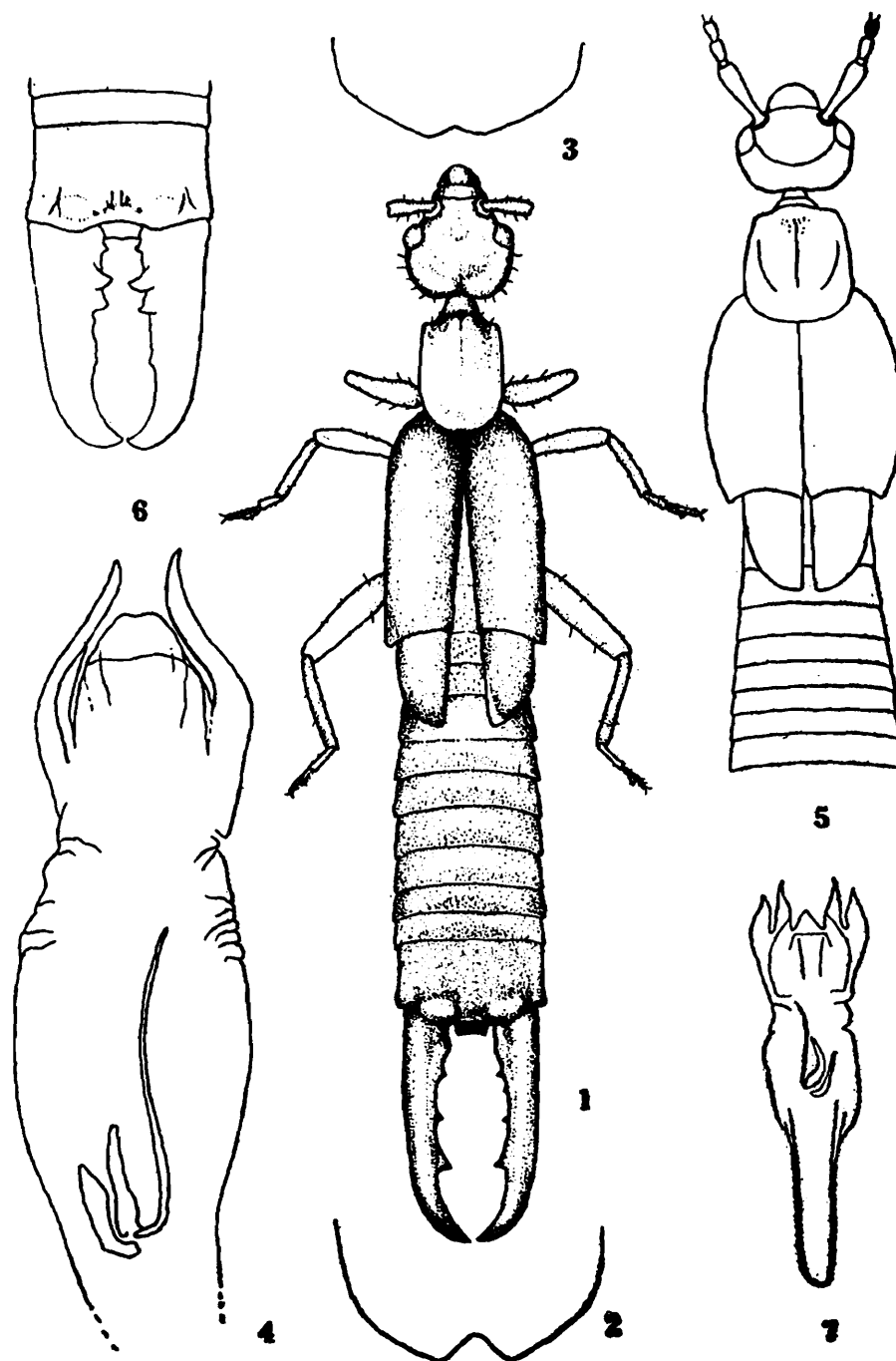
(Figs. 1-4)

Lobophora ludekingi Dohrn, 1865, *Stettin. ent. Ztg.*, 26 : 73 (♂ ; in Insula Sumatra).

Material examined : Type ♂ labelled as : (i) Ludeking Sumatra-printed ; (ii) *Lobophora ludekingi* Dohrn, type-written probably by Bormans ; (iii) Museum Leiden, *P. ludekingi* Dohrn var. B, Det. M. Boeseman and (iv) Mus. Leiden No. 5011/4 ; designated as the Lectotype (genitalia mounted between two celluloid slips and pinned with the specimen).

Type ♂ labelled as : Labels (i) and

(ii) same as above ; (iii) ♂ -printed ; (vi) Mus. Leiden No. 5011/43 ; designated
 (iv) 2ex. Lud., Sumatra, paar de Bormans as Paralectotype.
 gweest ; (v) Museum Leiden, *P. ludekingi* ♂ : General colour yellowish brown ;
 Dohrn, var. b., Det. M. Boeseman and legs yellow ; pronotum anteriorly, wings and



Figs. 1-7 : *Prorhexia ludekingi* (Dohrn), Lectotype ♂, 1. Dorsal view, 2. Posterior margin of penultimate sternite, 3. Posterior margin of penultimate sternite of Paralectotype ♂, 4. Genitalia ; *Prorhexia ritsemae* (Bormans), Type ♂, 5. Anterior portion of body, without legs, 6. Ultimate tergite and forceps and 7. Genitalia.

abdominal tergites somewhat darker ; elytra dark yellowish brown with median portion yellow.

Head about as long as broad, strongly depressed, occiput raised with two darker oblique stripes, sutures obsolete, hind margin deeply emarginate in middle. Eyes distinctly shorter than the post-ocular length. Antennae (broken, only 1st segment remaining) with 1st segment long, narrowed basally, shorter than the distance between antennal bases. Pronotum slightly longer than broad, anteriorly convex, sides straight, depressed, almost parallel, hind angles and the margin well rounded, median sulcus distinct ; prozona weakly raised and not well differentiated from flat metazona. Elytra and wings well developed, former with shoulder rounded. Legs with femora sulcate above in a little less than apical half, hind tarsi with 1st segment slightly shorter than the 3rd ; 2nd narrowed apically, extending below 3rd segment. Abdomen moderately convex, punctulations obscure, parallel sided. Penultimate sternite rounded posteriorly with a deep emargination in middle. Ultimate tergite weakly transverse, sides parallel, postero-lateral angles a little projecting, hind margin trisinate, laterally oblique, feebly tumid above the bases of forceps and provided with a compressed tubercle postero-internally, the area in middle posteriorly depressed with a pair of small compressed tubercles in middle and at close to posterior extremity of the depression. Pygidium vertical, trapezoidal, sides straight, gently contracted posteriorly, postero-lateral angles pointed and hind margin straight. Forceps with branches stout, depressed, almost straight, gently incurved in apical one third, tips pointed and hooked, internal margin

below sharp, provided with two smaller, tooth in basal two third, followed by another triangular tooth directed ventre-posteriorly. Genitalia as in fig. 4. Length : body, 14.4-14.6 mm ; forceps, 4.3 mm.

Remarks : There appears to be some variation in the posterior emargination of penultimate sternite. It is more pronounced in the case of Lectotype.

This species comes very close *P. unidentatus* Bey-Bienko, from South China but differs in having the posterior margin of penultimate sternite sinuate in middle and parameres narrower.

Proreus ritsemae (Bormans)

(Figs. 5-7)

Chelisoches ritsemae Bormans, 1884, *Notes Leyden Mus.*, 6 : 185 (1♂), Moeara Laboe (Exped. Scientif. Néerland).

Proreus shaffii Bharadwaj and Kapoor, 1967, *Bull. Ent.*, New Delhi, 8 (2) : 4 (♂ ; Port Blair, Andamans—Indian Agric. Res. Inst., New Delhi)—syn. nov.

Material examined : Sumatra, Moeara Laboe (Exped. Scientif. Néerland.), 1♂, II. 1877, Leiden Museum ; this is the type of Bormans ; Pasumah Estate Palemb, 1♀, viii. 1965, Coll. *E. Jacobson* (Det. by M. Boeseman).

Remarks : Bormans' (1884) original description is quite adequate. The male genitalia from the type is figured here besides other body parts.

The description of *Proreus shaffii* Bharadwaj and Kapoor, is almost identical except the forceps which represent the mesolabic form. For this reason it is treated here as synonym of this species,

Proreus sobrius (Bormans)

(Figs. 8-9)

Chelisoches ? sobrius Bormans, 1884, *Notes Leyden Mus.*, 6 : 188 (♂ ; Padang, Sumatra).

Material examined : Holotype ♂ labelled as : (i) Ludeking, Sumatra-Printed ; (ii) *Froficula sobria* Dohrn, testes Dohrn-handwritten probably by Dohrn ; (iii) *Chelisoches ? sobrius* ♂ Dohrn-handwritten by Bormans ; (iv) 1 ex. Ludek. Sumatra paar de Bormans geweest-handwritten ; (v) in dezen toestand van Dr. M. Burr teruggekregen. Chez.-handwritten ; (vi) ♂-typed ; (vii) TYPE-Printed on pink paper ; (viii) Mus. Leiden No. 5011/5.

Remarks : The Holotype male lacks antennae except left basal segment and legs. Basal antennal segment is longer than the distance between antennal bases and is narrowed at base. Eyes are about half as long as the post-ocular length. Sides of abdominal segments are rounded posteriorly but segments 8th and 9th rugosely striate also. Genitalia (Fig. 2) is figured here for the first time.

The original description of the species is quite adequate and no further elaboration is necessary.

The general facies and the shape of ♂ genitalia justify its inclusion in the genus *Proreus* Burr.

Amongst the Oriental species it has close resemblance with *P. cunctator* Burr and *P. fletcheri* Hebard, both known from India, but differs in being slightly larger in size, stouter in build and having distinctive ultimate tergite, pygidium and ♂ genitalia.

Adiathella fuscipennis (Haan) comb. nov.

(Figs. 12-14)

Forficula (Psalidophora) fuscipennis Haan, 1842, *Verh. nat. Ges. nederl. Overz. Bezitt.*, 1842 : 241 (♂, ♀ ; Batang Singalang (Sumatra), Krawng).

Adiathella philippinensis Srivastava, 1976, *Pacif. Insects*, 17 (1) : 126 (♂, ♀ ; Philippines—Bishop P. Mus., Honolulu, Hawaii and Zool. Surv. India, Calcutta)—syn. nov.

Material examined : Sumatra : Padang, Muller ♂ (Type *Psalidophora fuscipennis* de Haan) ; Batang, Singalang, ♀ (Det. label probably in Haan's handwriting). Both the specimens are labelled as 'Type' but Haan (1842) instead of Padang mentions of Krawang in addition of Batang, Singalang. Original description being very brief it is described here in detail :

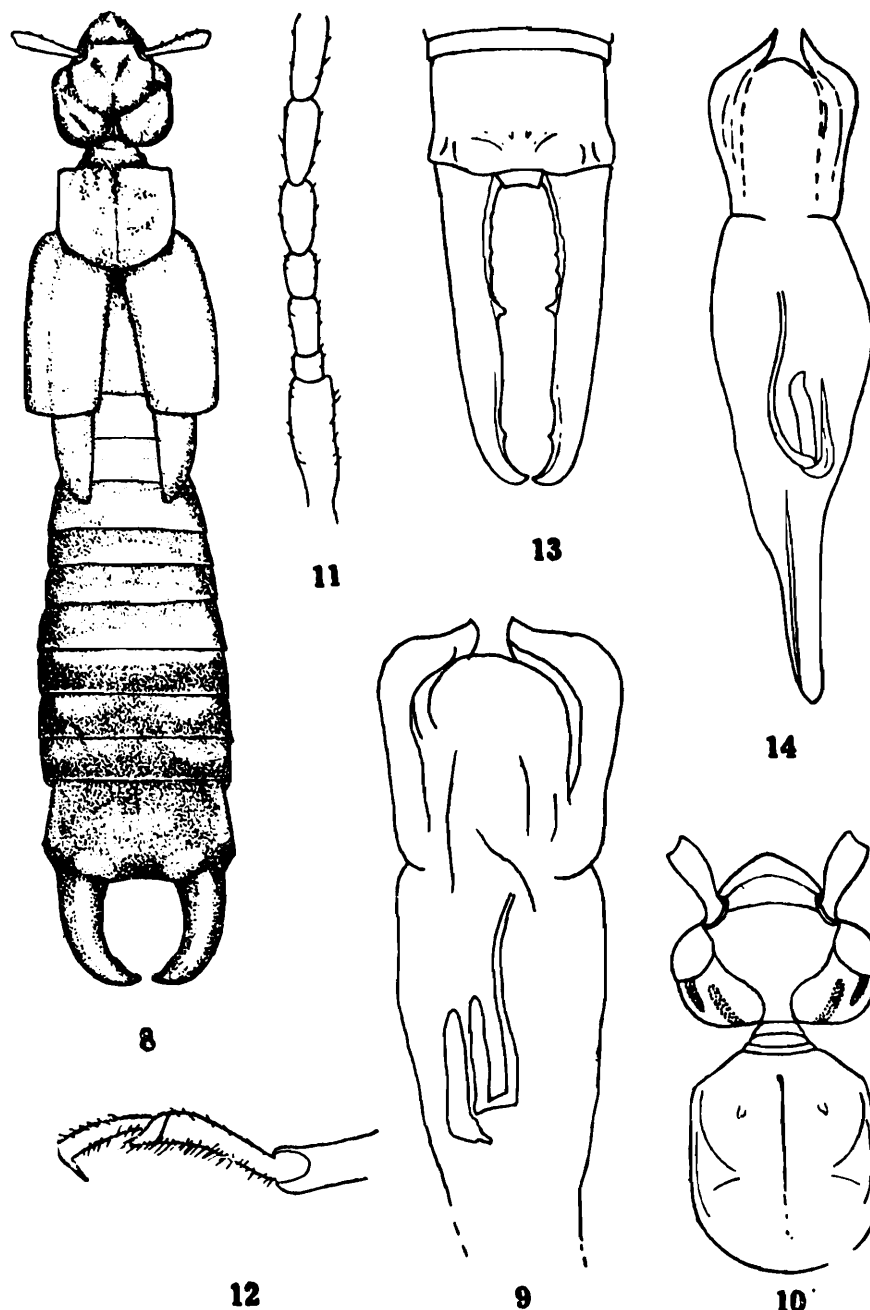
General colour blackish brown, head orange, occiput with a pair of oblique longitudinal blackish brown stripes, forceps yellowish brown.

Head smooth, about as long as broad, frons convex, occiput comparatively more convex, divisible into two halves by a depression in place of median suture ; transverse suture well marked. Eyes prominent, black, slightly longer than the genae (or post-ocular length). Antennae damaged ; only 11-segments remaining ; segments long and slender ; 1st stout, gently expanded apically ; slightly longer than the distance between antennal bases ; 2nd small ; 3rd longer than 4th and equal to 5th ; remaining gradually increasing in length and thinning ; 11th segment in apical half orange and remaining portion blackish brown.

Pronotum slightly longer than broad, smooth, anteriorly convex, sides almost straight, gently reflexed and parallel, hind angles and margin well rounded ; prozona tumid and well differentiated from flat metazona, median sulcus faint. Elytra and wings normal, former with humeral angles weak, costal margin straight, smooth. Legs long

and slender, tibiae sulcate above at extreme apex, hind tarsi with 1st segment slightly longer than the combined length of remaining two segments together ; tarsi clad with fine pubescence on underside. Abdomen parallel sided, convex, smooth, glabrous, sides of segments rounded. Penultimate sternite

transverse, broadly rounded posteriorly. Ultimate tergite transverse, smooth, postero-lateral angles a little projecting, hind margin trisinate, laterally oblique, the area above the roots of forceps tumid with a faint ridge, intervening space depressed with two small compressed tubercles on either side of middle



Figs. 8-14 : *Proreus sobrius* (Bormans), Type ♂ ; 8. Dorsal view, without antennae and legs, 9. Genitalia ; *Adiathella fuscipennis* (Haan), Type ♂ ; 10. Head and pronotum, 11. A few basal antennal segments, 12. Hind tarsus, 13. Ultimate tergite and forceps and 14. Genitalia.

line. Pygidium subvertical, sides and posterior margin emerginate. Forceps with branches remote, stout, depressed, straight, tapering apically with tip gently hooked; internal margin ventrally with several teeth ending with a strong conical tooth at middle, afterwards dorsally margin sharp but unarmed except for a small triangular tooth, ventrally placed, a little before apex. Genitalia as in fig. 14.

♀ : Agrees with male in most characters but differs in having the abdomen shortened and elytra and wings extending up to the middle of ultimate tergite; forceps internally armed near base with a strong pointed tooth, followed by several minute teeth up to middle, afterwards margin almost smooth.

Remarks : In having the tibiae sulcate at extreme apex, smooth and glabrous elytra and wings, this species should be placed under the genus *Adiathella* Brindle (1970). Moreover, the forceps in both sexes are also alike.

A. philippinensis Srivastava (1976) is treated as a synonym of this species.

Cordax Burr

Cordax Burr, 1910, *Fauna Brit. India, Dermoptera* : 184 (Type-species-*Forficula armata* Haan, 1842).

Eutimomena Bey-Bienko, 1970, *Zool., Zhur.*, 49 : 1819 (Type-species-*Eutimomena paradoxa* Bey-Bienko, 1970)—syn. nov.

Remarks : This genus agrees with *Timomenus* Burr, in most characters except that the first antennal segment is flat above with sides slightly raised or occasionally forming a sort of ridge and ventrally convex.

Burr (1910) assigned *Forficula armata* Haan, as the type but his description and

diagrams are based on the material from Celebes which perhaps belong to some other species. The remaining species now placed under this genus will require a new genus—a subject which will be discussed elsewhere.

Since the type species of this genus and the *Eutimomena* are synonymous latter will automatically fall as synonym of former. This has already been pointed out by Stivastava (1981).

Cordax armatus (Haan)

(Figs. 15-19)

Forficula armata Haan, 1842, *Verh. nat. Ges. Nederl. Overz. Bezitt.*, 1842, : 243, pl. 23, fig. 13 (1 ♀, 1 ex. Sumatra, Batang Singalang).

Eutimomena paradoxa Bey-Bienko, 1970, *Zool. Zhur.*, 49 : 1819, fig. 8, 9 (Holotype ♂, Chapa N. Vietnam—Leningrad Mus.)—syn. nov.

Material examined : Lectotype ♂ labelled as : (i) Batang Singalang—rounded label handwritten; (ii) *Forficula armata* de Haan—handwritten, probably by Haan; (iii) 2 exs paar de Bormans geweest—handwritten; (iv) ♂-typed; (v) Museum Leiden, *C. armata*, Det. M. Boeseman—1st line printed, rest handwritten; (vi) Museum Leiden No. 5011/6 (Genitalia mounted between two coverslips and pinned with the specimen).

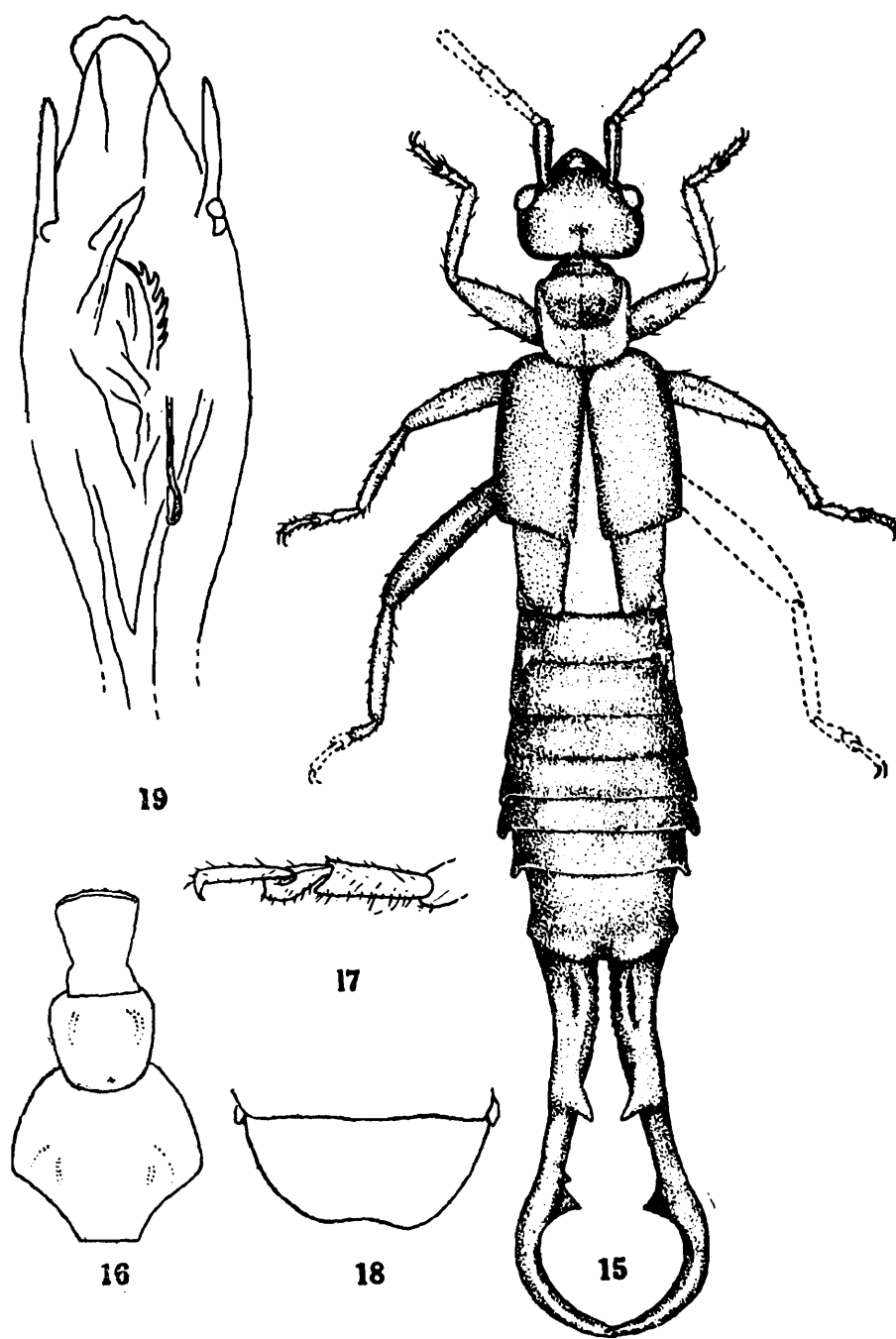
De Haan (1842) has not made any mention of number of specimens examined by him. However, Boeseman (1954) records two specimens as types (or syntypes) one of which a ♂, listed above, is designated as the lectotype. Since the original description is brief, the species is redescribed :

General colour brownish black, pronotum yellowish laterally and in posterior half; apical portion of tibia and tarsi light brown,

elytra somewhat yellowish brown ; wings darker with inner tip yellow, abdominal tergites light brown in middle.

Head smooth, about as long as broad, weakly convex with faint depression in middle, sutures obsolete, hind margin straight. Eyes shorter than the post-ocular

length and 1st antennal segment. Antennae partly broken (1st segment on the left and five basal ones on the right remaining), 1st segment stout, expanded apically, in cross section convex ventrally and deplanate above ; 2nd about as long as broad ; 3rd slightly



Figs. 15-19 : *Cordax armatus* (Haan), Lectotype ♂, 15. Dorsal view, 16. Sternal plates, 17. Hind tarsus, 18. Penultimate sternite and 19. Genitalia.

shorter than the 4th ; 5th longer than the preceding, all long and thin, cylindrical. Pronotum about as long as broad, anteriorly straight, sides feebly convex and raised, hind margin and angles rounded, median sulcus faint ; prozona raised and well differentiated from flat metazona. Leg long and slender, fore-femora swollen middle and hind one compressed, hind tarsi with 1st segment slightly longer than the third, 2nd enlarged, emarginate in middle posteriorly. Prosternum longer than broad, narrowed posteriorly. Mesosternum about as long as broad, gently narrowed posteriorly with hind margin rounded. Metasternum transverse, narrowed posteriorly between hind coxae with hind margin truncate. Elytra and wings well developed. Abdomen narrowed at base, gradually enlarging apically up to 9th tergite, lateral tubercles on 3rd and 4th tergites prominent but former comparatively weakly developed, obscurely punctulate, sides of segments 6th to 9th with a posteriorly directed tubercle but their size not uniform, on 6th segment weakest and on 7th strongest, 8th and 9th of intermediate size. Penultimate sternite transverse, obscurely punctate, hind margin rounded with slight emargination in middle. Ultimate tergite transverse, sloping and contracted backwards, sides contracted in middle, stripes of obscurely marked punctures and smooth areas alternating, faintly tumid above the bases of forceps and slightly depressed in middle, hind angles a little projecting and margin in middle almost straight and laterally oblique. Pygidium vertical, about as long as broad with a faint median groove in middle. Forceps stout, subcontiguous, depressed, almost straight and with a faint depression above in middle

and sides feebly raised in basal one third, afterwards compressed, gradually diverging for a short distance and strongly incurved in apical third, internally serrated in basal one third, armed with a strong vertical, posteriorly directed tooth at middle and another triangular tooth present at apical two thirds, horizontal and directed internally, in profile branches gently raised in middle. Genitalia as in figure 19. Length : body, 11.5 mm ; forceps, 6.2 mm.

Distribution : Burma and Vietnam.

***Eparchus tenellus* (Haan)**

(Figs. 20-21)

Forficula tenella Haan, 1842, *Verh. nat. Ges. Nederl. Overz. Bezitt.*, 1842 : 243 (♂, ♀ ; Java).

Material examined : Syntype ♂ labelled as : (i) Java, Kuhl & V Hass.—circular label handwritten ; (ii) *tenella* Hagb. —handwritten probably by Haan ; (iii) ♂ ; (iv) 3 exs paar Bormans geweest—handwritten ; (v) Museum Leiden, *tenellus* de Haan, Det. M. Boeseman—partly handwritten, partly printed and (vi) Mus. Leiden No. 5011/11 (forceps missing).

Syntype ♀, labelled as : (i) Java, Kuhl & H. —circular label, handwritten ; (ii) *Forficula tenella* Hagb. in Mus. hagd. Bat. —handwritten ; (iii) ♀ ; (iv) Museum Leiden, *E. tenellus* de Haan, Det. M. Boeseman—partly printed, partly handwritten and (v) Mus. Leiden No. 5011/10,

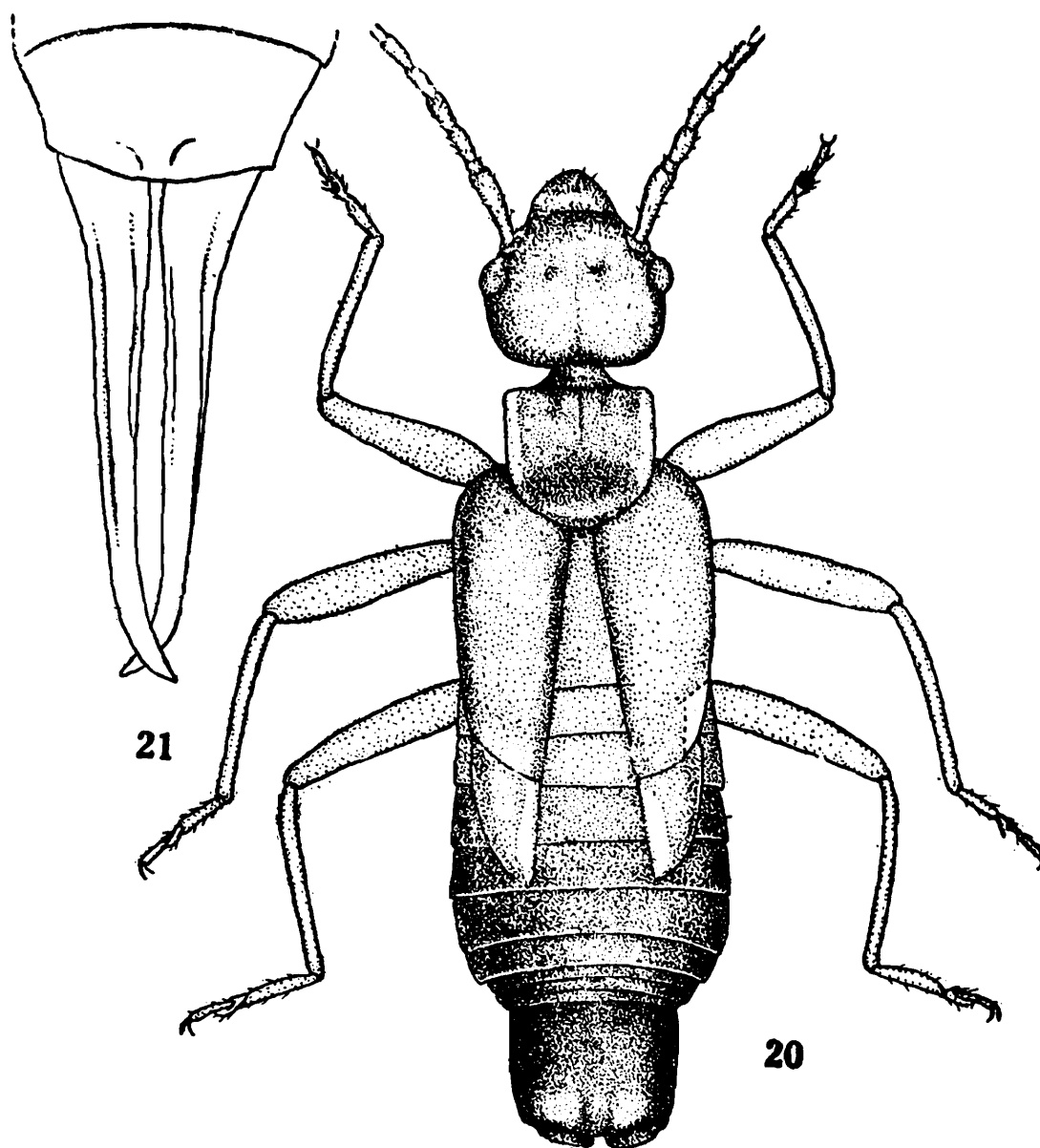
Syntype ♀, labelled as : (i) Java, Kuhl & V. Hass—circular label handwritten ; (ii) *tenella* Hagb.—handwritten probably by Haan ; (iii) ♀ ; (iv) Museum Leiden, *E. tenellus* de Haan, Det. M. Boeseman—partly printed and partly handwritten ; and (v) Mus.

Leiden No. 5011/9 (This specimens is partly eaten up by psocids).

The above three specimens according to Boeseman (1954) are the types of present species and are treated here as syntypes. Unfortunately the forceps in ♂ are missing. Since the original description by Haan (1842) is quite brief and the subsequent descriptions need checking, a detailed description from the syntypes is provided :

General colour blackish brown ; pronotum yellow laterally ; antennae with one or two pre-apical segments yellow, elytra somewhat reddish brown in ♂ but in ♀ with a yellow spot externally in basal half, wings reddish brown, internally with a yellow stripe ; legs light blackish brown, abdominal tergites darker.

♂ : Head slightly longer than broad, frons weakly raised, sutures obsolete, hind



Figs. 20-21 : *Eparchus tenellus* (Haan), Syntype ♂, 20. Dorsal view, without forceps ; Syntype ♀ ; 21. Ultimate tergite and forceps.

margin straight, scarcely emarginate in middle. Eyes shorter than the post-ocular length. Antennal segments long and slender, 3rd slightly shorter than the 4th, remaining gradually increasing in length and thinning. Pronotum about as long as broad, anterior margin straight and angles a little projecting, sides straight, gently reflexed, converging posteriorly, hind margin obtusely rounded, median sulcus faint, prozona raised and well differentiated than the depressed metazona. Legs long and slender, hind tarsi with 1st segment longer than the 3rd; 2nd lobed; claw without arolium. Elytra and wings normal, smooth. Abdomen smooth, convex, enlarged in middle. Penultimate sternite broadly rounded posteriorly. Ultimate tergite weakly transverse, contracted and sloping backwards, depressed in middle posteriorly and areas above the base of forceps with broad, low tumid elevation, hind margin in middle straight, laterally oblique. Forceps missing. Length: body, 8.7 mm (without forceps).

♀: Agrees with males in most characters except that the ultimate tergite more narrowed posteriorly and forceps simple and straight. Length: body, 7.3-7.9 mm; forceps, 2.4-2.6 mm.

Remarks: The male specimen before me unfortunately lacks forceps. However, according to Haan (1842) forceps in male are armed in middle with a tooth above.

Günther (1934) recognises as many as eight subspecies for this species.

ACKNOWLEDGEMENTS

I am thankful to the Director, Zoological Survey of India, Calcutta for necessary facili-

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A NEW MESOSTENINE GENUS *PSEUDOTRICAPUS* FROM INDIA
(HYMENOPTERA : ICHNEUMONIDAE)

By

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ABSTRACT

Pseudotricapus longipetiolatus gen. et. sp. nov., is described from Darjeeling District of West Bengal and Sikkim.

The new genus *Pseudotricapus* belongs to subtribe Goryphina of the tribe Mesostenini [family Ichneumonidae, subfamily Cryptinae (Gelinae)]. In the key to genera of Goryphina (Townes, 1970 : 239), it runs to the genus *Tricapus* Townes. It shows affinities with this by having genal carina strongly curved and joining hypostomal carina at the base of mandible, in other genera of the subtribe the genal carina joins the hypostomal carina a distance above the base of mandible (Townes, 1970 : 250), clypeus with a median tooth and first tergite with basal lateral tooth. It also shows affinities with *Colaulus* Townes, but differs in having a distinct median apical tooth on clypeus, genal carina ending at the base of mandible, or in other words both the carinae meeting at the basal corner of mandible, both mandibular teeth almost equal in size and sternaulus reaching about 0.6 the distance to middle coxa.

This new genus is described from material collected in the North-Eastern Himalayan Region (Sikkim ; Gangtok and West Bengal :

[H]

Darjeeling district) and can be recognized from the most allied genera, viz., *Tricapus* Townes and *Colaulus* Townes 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 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 intercepted at its
lower 0.4 ; branchiella faintly
present..... *Pseudo-*
tricapus, gen. nov.

Genus *Pseudotricapus*, nov.
(Fig. 1, a-d)

Description ; Body slender, the head
rather wider than long. Frons with a

median vertical carina (Fig. 1,b). Face short,
wider than long, with a median and two
lateral swellings. Clypeus somewhat rect-
angular at base with a transverse swelling, its
apical margin weakly arched and with a
pointed median tooth (Fig. 1,b). Genal
carina sinuate and joining hypostomal carina
at thg base of mandible. Mandible strong
with almost equal teeth : malar space and
area near the base of mandible strongly
depressed. Epomia moderate in size.

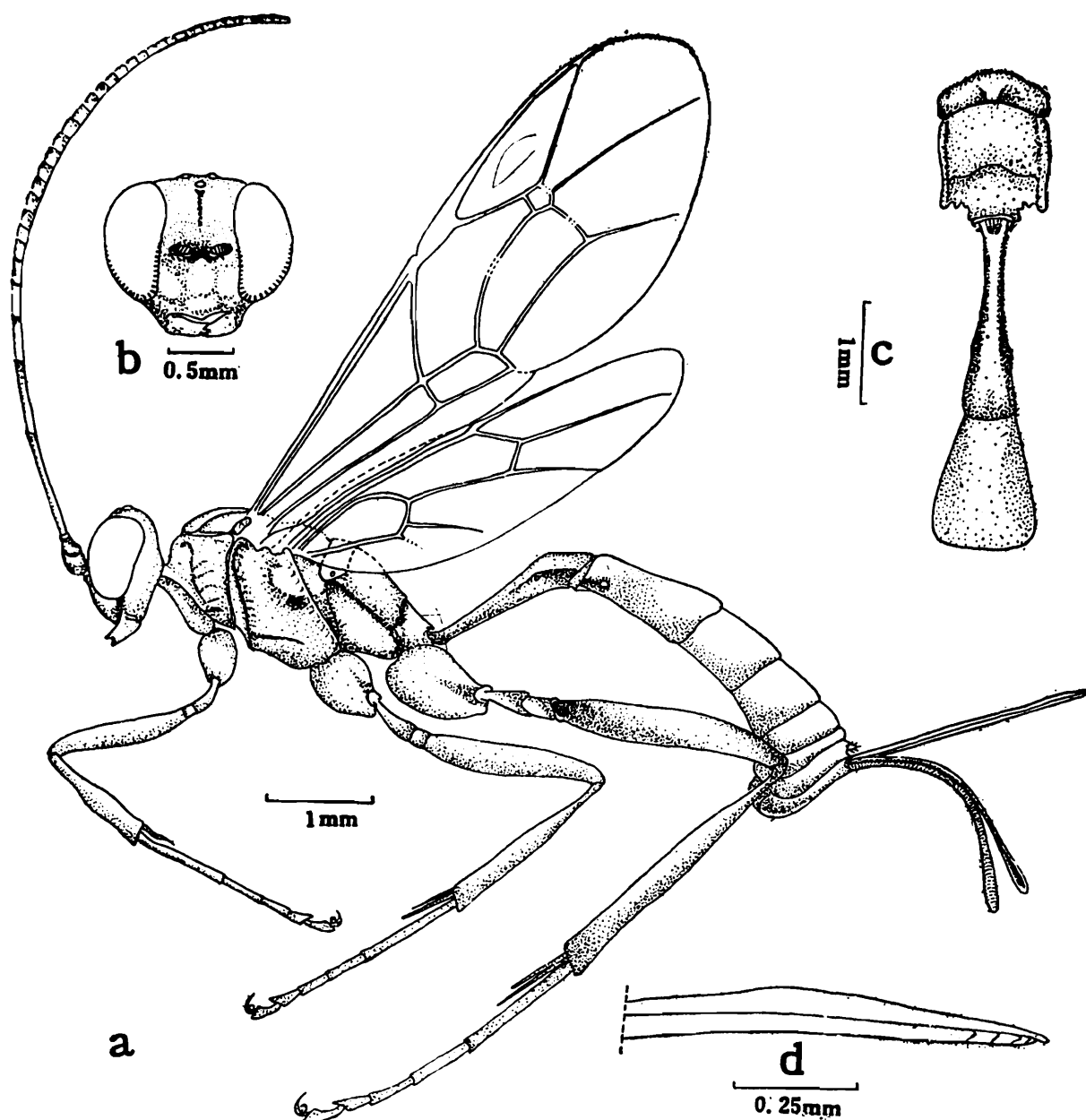


Fig. 1. *Pseudotricapus longipetiolatus*, gen. et. sp. nov. : a, side view of whole insect ; b, head in front view ; c, propodeum and first tergite in dorsalview ; d, ovipositor tip.

Notauli long and deep and meeting each other behind scutellum. Sternaulus deep with cross-ridges in the groove, extending ± 0.6 the length of mesopleurum. Propodeum (Fig. 1, a,c) long in profile, both the transverse carinae weakly arched and complete, apical carina forming lowcrest-like apophysis; spiracle about $2.5 \times$ as long as wide. Areolet pentagonal, about $0.6 \times$ as high as the portion of second recurrent vein above bulla. intercubiti weakly convergent, second recurrent evenly arched. Nervulus interstitial, postnervulus intercepted above the middle. Nervellus intercepted at its lower 0.4 , brachiella faintly present (Fig. 1, a). First tergite long and slender, about $3.6 \times$ as long as wide at apex, at base with distinct lateral tooth, petiolar area long and tubular, postpetiole longer than wide, spiracles closer to each other than to apex, dorsomedian carinae absent, dorso-lateral and ventro-lateral carinae present between spiracle and

apex; spiracle minute, round (Fig. 1, a, c); ovipositor long, about as long as hind tibia, its tip long and pointed, lower valve with 3-4 weak teeth (Fig. 1, d).

Type-species and single known species : *Pseudotricapus longipetiolatus*, gen. et. sp. nov.

***Pseudotricapus longipetiolatus*, sp. nov.**

(Fig. 2. a-c)

Female : Face subpolished, ruguloso-punctate, punctures shallow, face on lateral swellings minutely and sparsely punctate. Clypeus sparsely and shallowly punctate at the basal swelling, rest smooth and shiny. Malar space granulate, about equal to the basal width of mandible. Frons largely smooth and shiny except with a few scattered small punctures in the middle. Vertex and temple smooth and shiny, except temple below sparsely punctate. Pronotal collar smooth, striate in the scrobe, obliquely striato-wrinkled above, with sparse punctures

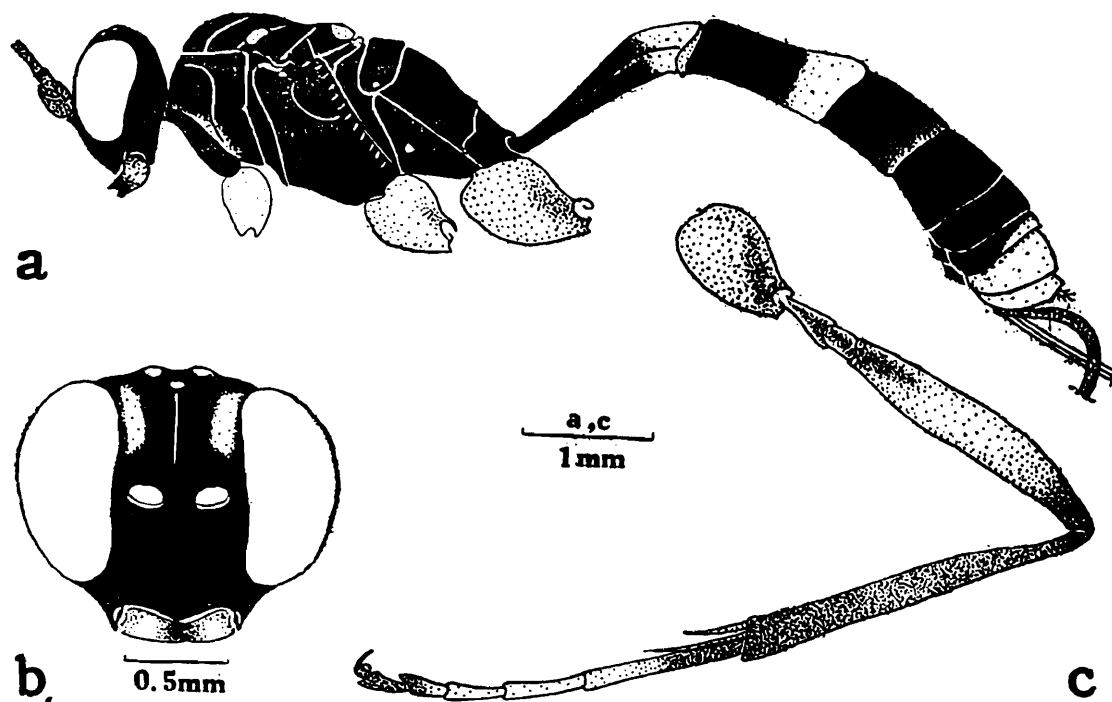


Fig. 2. *Pseudotricapus longipetiolatus*, sp. nov. showing colour pattern : a, body side view ; b, head front view ; c, hind leg.

in between the striae. Mesoscutum smooth and shiny. Scutellum, metascutellum smooth and shiny, lateral carinae more or less confined to the base. Mesopleurum smooth and polished, prepactal carina extending up to the base of subtegular ridge, short ridges present in the groove along the prepectal carina, short striae also present along the anterior margin of speculum to the base of subtegular ridge. Metapleurum subpolished weakly punctate, juxtacoxal carina absent. Propodeum between apical carina and base smooth and shiny, except for a few scattered shallow punctures, apical of apical carina rugose. First tergite with sparse punctures in the apical half, rest smooth; second and third tergites with dense fine puncture, following tergites mat and subpolished; other structures and wing venation as under generic description.

Black. Antennal flagellum from apex of 5th to 11th segments above, white; scape and pedicel reddish-brown in front. Clypeus at base, mandible except the teeth, orbital stripes (Fig. 2, b) on frons, pronotal collar narrowly, tegula, subtegular ridge, apical 0.45 of scutellum, metascutellum, apices of abdominal tergites first to third, sixth in the middle, seventh and eighth wholly, yellow (Fig. 2, a). Fore and middle legs with their coxae and trochanters yellowish, their femora, tibiae and tarsi, dark yellow, except middle tarsus clouded with dark brown. Hind leg (Fig. 2, c) with coxa, trochanter and femur yellowish-brown with an oval yellow mark above on coxa, its trochanter and femur at apex dark brown, its tibia blackish with light yellow at base, tarsus white except basal 0.5 of its first segment and whole of fifth segment and apex of sixth, blackish; wings clear hyaline.

Male: Similar to female in all respects; except body more polished and slender; upper margin of pronotum shiny with sparse minute punctures; 11th to 15th flagellar segments white; clypeus without any mark; orbital mark on frons small, oval; almost all the tergites narrowly and seventh tergite broadly, yellow.

Length: ♀, Body 5.2-9 mm; fore wing 4-6 mm; ovipositor sheath 1.75-2.25. ♂, Body 5.75-8 mm; fore wing 4.5-5.75.

Holotype: ♀, INDIA: SIKKIM: Gangtok, 1650 m, 11.v.1966, colls. D. T. Tikar and J. K. Jonathan, colln, Nos. T 242 & J 148. *Paratypes* 6 ♀♀, 42 ♂♂. INDIA: SIKKIM: Gangtok, 1650 m, 3 ♀♀, 21 ♂♂, 11 & 12. v.-18. v. 1966, colls, V. K. Gupta, J. K. Jonathan, M. K. Mamath, D. T. Tikkar, D. Ram, T. Chand, colln, Nos. 178, J 148-154, K 108 & 111, T 256-260. WEST BENGAL: Rangiroon, 2000 m, near Darjeeling, 3 ♀♀, 20 ♂♂, 25.v.-29.v. 1960, colls. V. K. Gupta, J. K. Jonathan, M. K. Mamath, T. Chand, colln. Nos. 186, J 157 & 159, K. 116-120.

Distribution: India: Sikkim and West Bengal.

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TAXONOMIC REMARKS ON THE INDOMALAYAN *MICROTERMES*
WASMANN (ISOPTERA : TERMITIDAE : MACROTERMITINAE)

By

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ABSTRACT

Position in respect of the type of genus *Microtermes* and the Indomalayan species of the genus is discussed.

INTRODUCTION

The genus *Microtermes* (Isoptera : Termitidae : Macrotermitinae) was described by Wasmann (1902) who created it for the smaller forms of the genus *Termes* s. str. relegated to the section with *Termes incertus* Hagen for type. He included the species *Termes incertus* from Africa and "Ostindien", *Termes pallidus* Haviland from "Ostindien" and his new species *Microtermes globicola* from Sri Lanka, basing the genus on the characters of imago and soldier and also gave the differentiating characters of the soldiers by which these three species could be separated. We discuss here certain aspects of controversy in literature in respect of oriental *Microtermes*.

TAXONOMIC REMARKS

Type of Microtermes :

There is some confusion about the type of *Microtermes*. Chatterjee and Thakur (1964) mentioned *M. globicola* Wasmann as the type stating that "The generic name *Microtermes* was first introduced in literature by Wasmann

in 1902, who included under it only one species *Microtermes globicola* from Ceylon, without designating it as generitype. Later workers like Fuller (1922), Sjöstedt (1926), Snyder (1949) and Ahmad (1955) also did not designate any generitype. However by virtue of its being a monotypic species, it is designated as a generitype." This statement is not correct since Wasmann (1902, p. 115) clearly states : "Ich gründe diese Gattung auf einige sehr kleine, der Gattung *Termes* s. str. nahe stehende Arten, deren Typus *Termes incertus* Hag. ist." Evidently the original reference of Wasmann, (1902) was not available to Chatterjee and Thakur (1964). Bose (1984) has clarified the position and designated *Termes incertus* Hagen as the type of the genus.

The Oriental Microtermes :

Microtermes incertus (Hagen) occurs only in Mozambique and South Africa and not in "Ostindien" as mentioned by Wasmann (1902). Snyder (1949) records *globicola* Wasmann, *incertoides* Holmgren, *insperatus* Kemner, *jacobsoni* Holmgren, *macronotus* Holmgren, *mycophagus* (Desneux), *obesi* Holmgren,

pallidus Haviland, *sindensis* (Desneux), *tenuis* Oshima and *unicolor* Snyder from the Indomalayan region. Later, the species *dimorphus* Tsai & Chen from southern China and *imphalensis* Roonwal & Chhotani, *pakistanicus* Ahmad and *umsae* Roonwal & Chhotani, from the Indian region, were described, bringing the total to 15 species from the Indomalayan region. The species *umsae* and *pallidus* were treated as synonymous with *pakistanicus* by Krishna (1965). Thus, till the species *pakistanicus* was transferred to the genus *Ancistrotermes* by Akhtar and Hussain (1980),

13 species of *Microtermes* were known to occur from the Indomalayan region. Since the soldier of the species *dimorphus*, *insperatus* and *jacobsoni* have a subsquarish to rounded and sparsely hairy head and strongly incurved mandibles, which are the characters of genus *Ancistrotermes*, Chhotani (in press) stated that they probably belong to *Ancistrotermes*, thus keeping the remaining species, of which the soldier has an oval head and weakly incurved mandibles, in the genus *Microtermes*. The soldier of all the species in the genus *Microtermes* have an oval and densely hairy head,

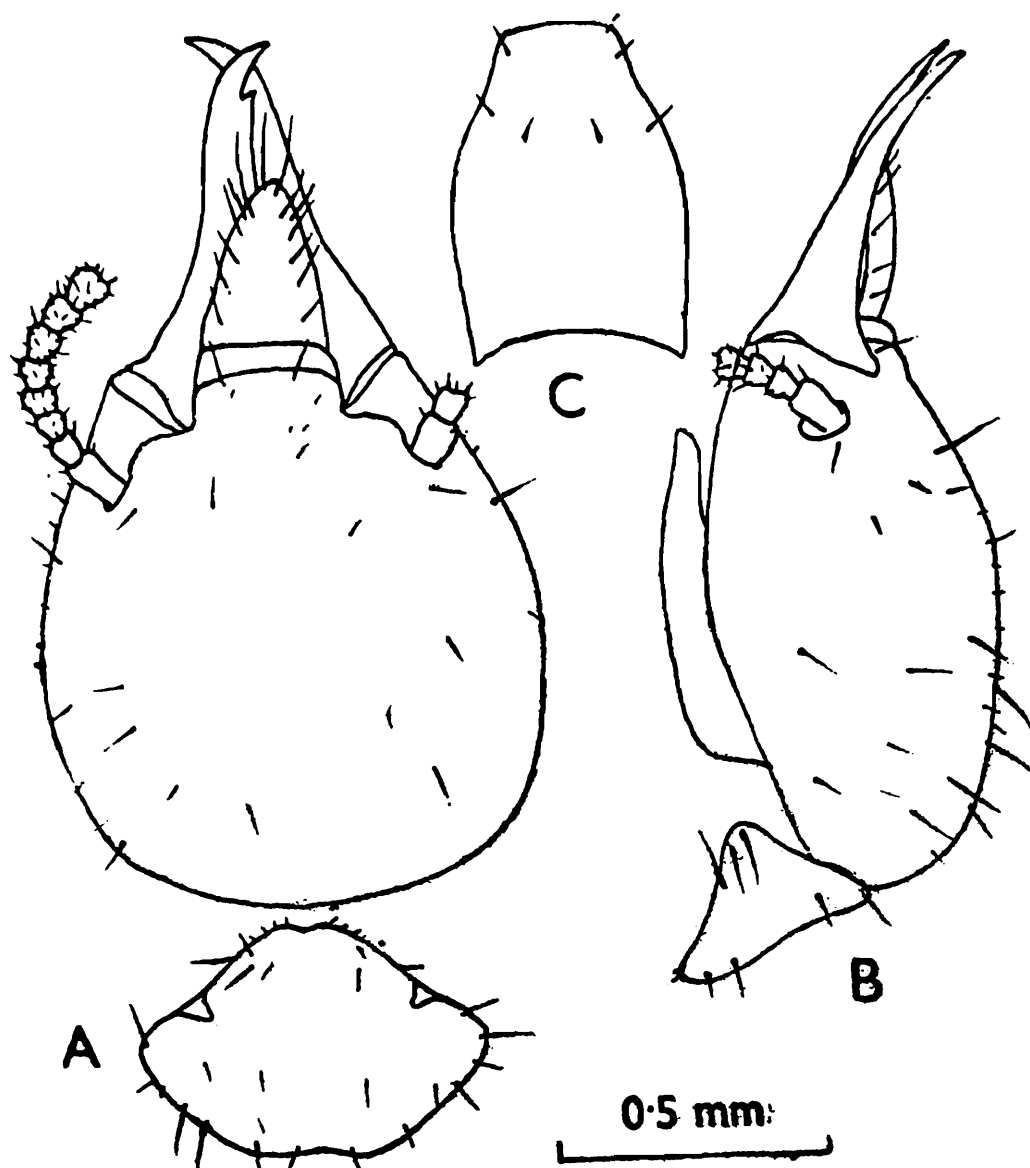


Fig. 1. *Odontotermes mycophagus* (Wasmann). Type Soldier. A, Head in dorsal view ; B, Head in side view ; C, Postmentum in ventral view.

delicate and weakly curved mandibles and either toothless or faintly toothed left mandible, except in *M. globicola* the soldier of which has a prominent tooth on left mandible, weakly hairy head and stronger mandibles.

Remarks on Microtermes globicola Wasmann :

Holmgren (1913) had some doubts about

the assignment of *globicola* to *Microtermes* but left the question open till the types of *globicola* could be examined. The present authors have examined the type soldier and are of the view that it belongs to the genus *Odontotermes*.

Bose (1975) described the species *Odontotermes roonwali* from soldier and worker from southern India and Thakur

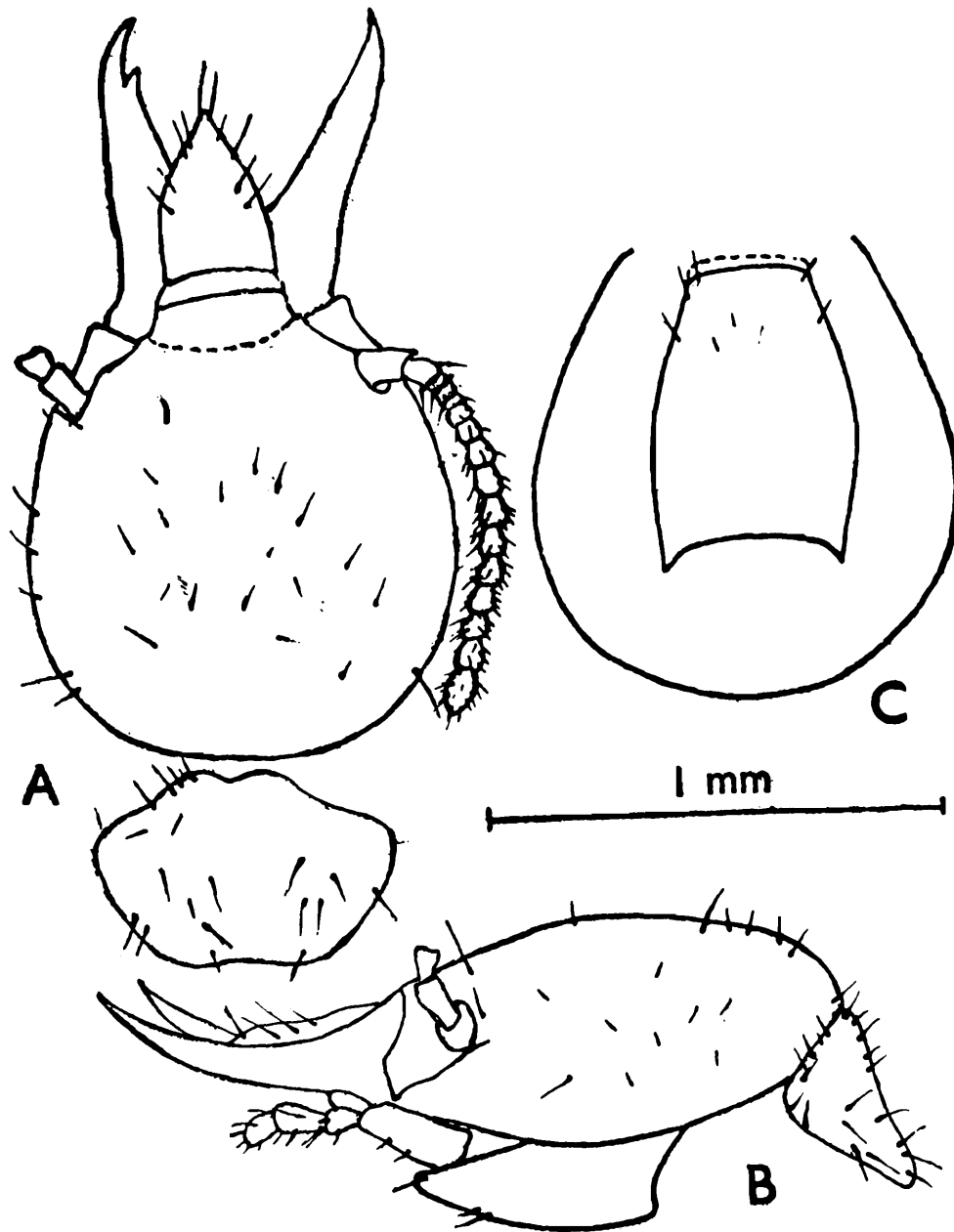


Fig. 2. *Odontotermes roonwali* Bose, Paratype Soldier. A, Head and pronotum, in dorsal view ; B, Ditto, side view ; C, Head, ventral view, showing postmentum (ex. Bose, 1975).

(1981) has treated it as a valid species. On comparison of type soldiers of *roonwali* and *globicola* it is found that they cannot be differentiated from each other, as such *O. roonwali* Bose is treated as a synonym of *O. globicola* (Wasmann). For comparison, the figures and measurements of the type soldier of *globicola* and those given by Bose (1975) for *roonwali* are included here. However, a point which creates some doubts about this assignment is that Wasmann (1902) gave a photograph of the fungus comb of *globicola* which is small and much like that of other *Microtermes*, but we feel that this fungus comb probably did not belong to *globicola*.

Some soldier measurements (in mm) of types of globicola and roonwali for comparison :

	<i>globicola</i>	<i>roonwali</i>	
Type		(ex Bose, 1975)	
(=Holotype)		Holotype	Paratype
Length of head to base of mandibles	1.00	0.95	0.90-1.03
Max. width of head	0.90	0.89	0.83-0.95
Length of mandibles :			
a) Left	0.65	0.60	0.60-0.69
b) Right	0.65	0.60	0.60-0.65
Left mandibular tooth from tip	0.14	0.13	0.13-0.15
Width of pronotum	0.60	0.64	0.63-0.76

Chatterjee and Thakur (1964) state that holotype of *globicola* was not selected by the author. But a pin holding a soldier and four workers on card bears a label marked "Type" in the Wasmann Collection at Naturhistorisches Museum, Maastricht (Nether-

lands). Boven (1969) has also mentioned 'Type soldier, labelled E. Wasmann'. The so called 'cotypes' examined by Chatterjee and Thakur and which are present in the Forest Research Institute, Dehra Dun, should, therefore, be treated as paratypes.

ACKNOWLEDGEMENTS

Grateful thanks are acknowledged to Dr. B. K. Tikader, former Director, Zoological Survey of India, for facilities and to Dr. M. L. Roonwal, former Director and the well known termitologist in India, for very kindly giving suggestions. We are also very thankful to the authorities of Naturhistorisches Museum, Maastricht (Netherlands) for the loan of type of *Microtermes globicola* Wasmann.

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OCCURRENCE OF FOSSIL *MIOTRAGOCERUS* CF. *PUNJABICUS* (PILGRIM)
MAMMALIA : ARTIODACTYLA : BOVIDAE FROM THE PLEISTOCENE
DEPOSITS OF SUSUNIA, BANKURA, WEST BENGAL, INDIA.

By

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Zoological Survey of India, Calcutta.

ABSTRACT

The fossil fragment of the left mandible with one premolar and three molar teeth collected from Aduri, Susunia, Bankura, West Bengal is described in the paper as *Miotragocerus* cf. *punjabicus* (Pilgrim). This is a new record of *Miotragocerus* from the Pleistocene deposits Susunia, India.

INTRODUCTION

Amongst the fossil remains from Susunia hill, Bankura, West Bengal deposited in the Zoological Survey of India by the Archaeological Department, Govt. of West Bengal, we came across a partially broken mandible with molars and premolar. On examining the material it appeared to be mandible of *Miotragocerus* cf. *punjabicus* (Pilgrim). As far as we could ascertain from literatures (Pilgrim, 1910, 1937 and 1939) and (Thomas, 1979), the species cf *Miotragocerus* are reported in India from Dhok Pathan and Nagri formation of Siwalik hills. Our discovery of mandibular remains of *Miotragocerus* from pleistocene, therefore, constitutes the new record from Indian pleistocene deposits of Susunia.

The material under report was collected by the State Archaeological Department, Govt. of West Bengal during the field session 1969 from a dry bank of Gandheswari river bed at Aduri, Susunia, Bankura, West Bengal, when Geological Survey of India in collaboration with the State Archaeology Department undertook a programme of exploration and excavation of Palaeozoological sites in West Bengal.

Systematic Account

Phylum	:	CHORDATA
Class	:	MAMMALIA
Order	:	ARTIODACTYLA
Family	:	BOVIDAE
Subfamily	:	BOVINAE
Genus	:	MIOTRAGOCERUS
<i>Miotragocerus</i> cf. <i>punjabicus</i> (Pilgrim)		

MATERIAL

(Plate IV)

Fragment of left ramus of mandible with 1st., 2nd., 3rd. molars and 4th. premolar teeth: Z.S.I. Reg. No. VP 16, Aduri, Susunia, Bankura, West Bengal, 29th. Sept. 1969.

DESCRIPTION

The mandibular ramus includes part of angular and dentary. Three molars and premolars are implanted in the alveoli of the mandible. Teeth are hypsodont. In 4th premolar the inner valley is open and large posteriorly directed flange is present on the metaconid. 1st and 2nd molar teeth are composed of two half cylinders forming the crescentic ridges on the grinding surface and the 3rd molar has an additional half cylinder. The medial interstyler ribs are present in the molars, very large goat-folds, (transverse folds) are also found on the mesial ends of the molars. The crescentic ridges are formed by vertical descending folds. The basal pillars is strongly present in the 1st molar, feeble in the 2nd molar and completely absent in the 3rd molar. Crescentic islands are much compressed, unlike teeth of *Bos* and *Bubalus*, there is complete absence of cement. The mandible was compared with the mandible of recent *Boselephas tragocamelus* Pallas and fossil *Miotragocerus punjabicus*, it is found to be more akin to *Miotragocerus punjabicus* (Pilgrim) present in the Geological gallery of the Indian Museum, Calcutta.

The mandible is partially fossilised and the organic material has been replaced partially by inorganic substances with the impregnation of quartzite material and silica.

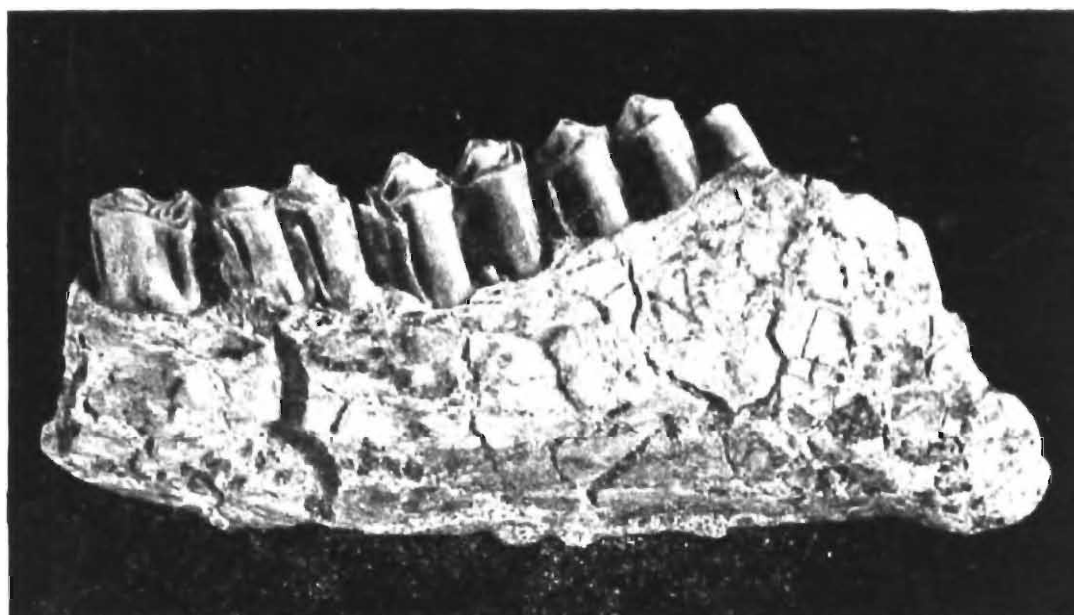
DISCUSSION

The measurements in the table show that 3rd molar tally lineary with the authenticated identified teeth of *Miotragocerus punjabicus* (G. S. I. No. B 563), the 2nd and 1st molars are also identical with the same. The 4th premolar is also indential in measurement with the G. S. I. specimen of *Miotragocerus punjabicus* (G. S. I. No. B 564). The width of the mandibular ramus under 3rd molar is 1 mm. larger than the G. S. I. specimen (G. S. I. No. B 564), which is insignificant.

The Susunia material agrees with *Motrragocerus punjabicus* in measurements and morphological characters. The 4th premolar of *Miotragocerus punjabicus* (G.S.I. B 563, 564) has an open inner valley and a large posteriorly directed flange in the metaconid. The medial interstyler ribs, the large "Goat folds" or transverse folds on the molar are present in the *Miotragocerus punjabicus* of the G.S.I. specimens are also present in the Susunia specimen. Considering all the above characters and the measurements, it confirms that the mandible having 1st, 2nd, 3rd molars and 4th premolar from Sununia is the fossil ramus of *Miotragocerus cf. punjabicus* (Pilgrim).

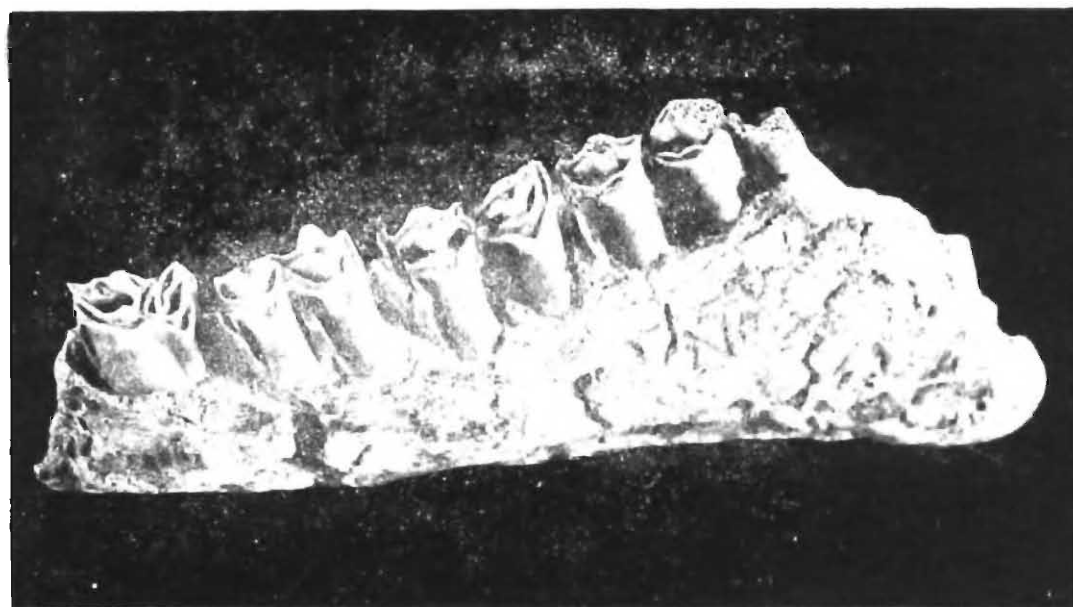
The known fossil remains of *Miotragocerus* in India has been recorded by Pilgrim, *Tragocerus punjabicus* (Pilgrim, 1910), *Tragocerus browni* (Pilgrim, 1937) and their locality and geological distribution is from Dhok Pathan and Nagri formation (Thomas, 1979) Siwalik hills.

The present material was collected from the dry bank of a stream Gandheswari at Aduri. The area as a whole belongs to pleistocene deposits from where a number



A

5CM



B

Figs. A-B. A. Lateral view of the left mandible of *Miotragocerus* cf. *punjabicus* (pilgrim) from Susunia hill, Bankura, West Bengal showing the 3rd, 2nd, 1st, molars and 4th premolar teeth.

B. Vertical view of the left mandible of *Miotragocerus* cf. *punjabicus* (pilgrim) from Susunia hill, Bankura, West Bengal showing the cusps of the 3rd, 2nd, 1st molar and 4th premolar teeth.

TABLE

Measurements of mandibles of Indian species of *Miotragocerus*, *Tragoprotax*, *Boselaphns tragocamelus* and fossil specimen from Susunia hill, Bankura, West Bengal along with the molars & premolar (in mm.)

M=Molar P=Premolar	Specimen from Susunia.	<i>B. tragocamelus</i> Pallas	<i>T. cf. islami</i> G.S.I No. 577 B. 820	<i>Miotragocerus</i> <i>punjabicus</i> G.S.I. No. B 563	<i>Miotragocerus</i> <i>punjabicus</i> G.S.I.No. B 564	<i>Miotragocerus</i> <i>cf. browmi</i> ANM-29884.	<i>Tragoprotax</i> sp G .S.I. No. B558
M_3 Length	30.5	33.5	21.5 25.0	30.0	26.0	25.5	25.0
M_3 Width	10.7	13.3	12.0 12.0	13.5	13.5	12.0	11.0
M_2 Length	21.8	24.0	18.5 20.0	21.0	20.5	19.0	18.5
M_2 Width	12.2	13.5	12.5 14.0	13.0	14.0	12.0	11.5
M_1 Length	18.5	18.5	17.0 17.0	19.0	17.5	16.0	16.5
M_1 Width	12.6	12.6	11.5 11.0	12.5	12.0	11.0	11.0
P_4 Length	16.0	16.8	15.0 16.0	—	17.5	16.5	14.0
P_4 Width	10.0	10.0	9.5 9.5	—	10.0	9.0	8.0
Width of ramus under M_3	21.7	48.5	17.5 19.5	18.0	20.5	—	17.0

N. B. The measurements of *Miotragocerus punjabicus* (= *Tragocerus punjabicus*) Pilgrim.

of fossil vertebrates are known, *Bos namadicus* Falc. (Banerjee and Saha, 1976), *Giraffa* cf. *camelopardalis* Brisson (Banerjee and Ghosh, 1977) and *Panthera pardus* Linn. (Saha, Banerjee and Talukdar, 1984). In this context Sastry (1966) and Sastry et al. (1976) have ascertained that the beds yielded these fossils seems to have been deposited during the pleistocene period.

Till date *Miotragocerus punjabicus* have been reported from Siwalik hills only. The specimen described above is akin to *Miotragocerus punjabicus* from Siwalik hills and it is reported here as a new record of fossil species from Susunia, as well as from the Eastern sector of India.

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DESCRIPTION OF HITHERTO UNKNOWN MALES OF THREE SPECIES OF
SCOLYTID BEETLES (SCOLYTIDAE : COLEOPTERA) FROM INDIA

By

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ABSTRACT

Hitherto unknown males of three species of scolytid beetles namely, *Xyleborus concinnus* Beeson from Nagrakata, *Microperus mus* (Eggers) from Samsing, North Bengal and Sikkim and *Xyleboricus subspinosus* (Eggers) from Lepchajagat, all from North Bengal and Sikkim, have been described here for the first time. The first species, so far only known from Java and Burma is also recorded for the first time from India occurring in North Bengal. Further, the species *Xyleborus mus* Eggers and *Xyleborus subspinosus* Eggers have been transferred to the genera *Microperus* Wood and *Xyleboricus* Reitter respectively, according to the new concept of generic classification of the group.

(Key words : taxonomy, morphology of undescribed males from North-east Himalaya, India.)

Running Title : Males of Indian scolytid beetles

INTRODUCTION

The members of the family Scolytidae, popularly known as the pin-hole borers, are of considerable economic importance, since they cause damage to dead and dying trees in the forest stand, felled logs in the extraction centres, timbers in storage and wood in human use. The majority of the Indian known species, particularly belonging

to the advanced genera under the tribe Xyleborini, refer to females only, since the males are in general rarely represented in the collection. Such males, when available unassociated with females, are very difficult to recognise due to their great morphological variations as compared to those of the females.

However, while studying the scolytid beetles of the eastern India, some unknown males of three species have been discovered from North Bengal, which have been described in details and illustrated for the first time in the present paper. Further, each species is provided with the synonymy distribution, taxonomic remarks, etc.

DESCRIPTION

1. *Microperus mus* (Eggers)

Xyleborus mus Eggers, H. 1930. *Indian Forest Rec.*, 14 (9): 203-204, Female, Type-locality: Chittagong hill tracts, Bangladesh.

(a) Material

(i) 1 male from Samsing (540 m.), Darjeeling District, West Bengal, C. F. C.

Beeson coll., 2. x, 1933, ex. "dead *Michelia champaca*"; (ii) 2 males from Fatak near Mamring, North Sikkim, 925 m. alt., R. K. Varshney COLL., 12.iv.1981, ex. "under soft wood of unknown broken branch".

(b) Morphological characters.

Male (Fig. 1, 1-4): Body somewhat cylindrical, strongly narrowing posteriorly,

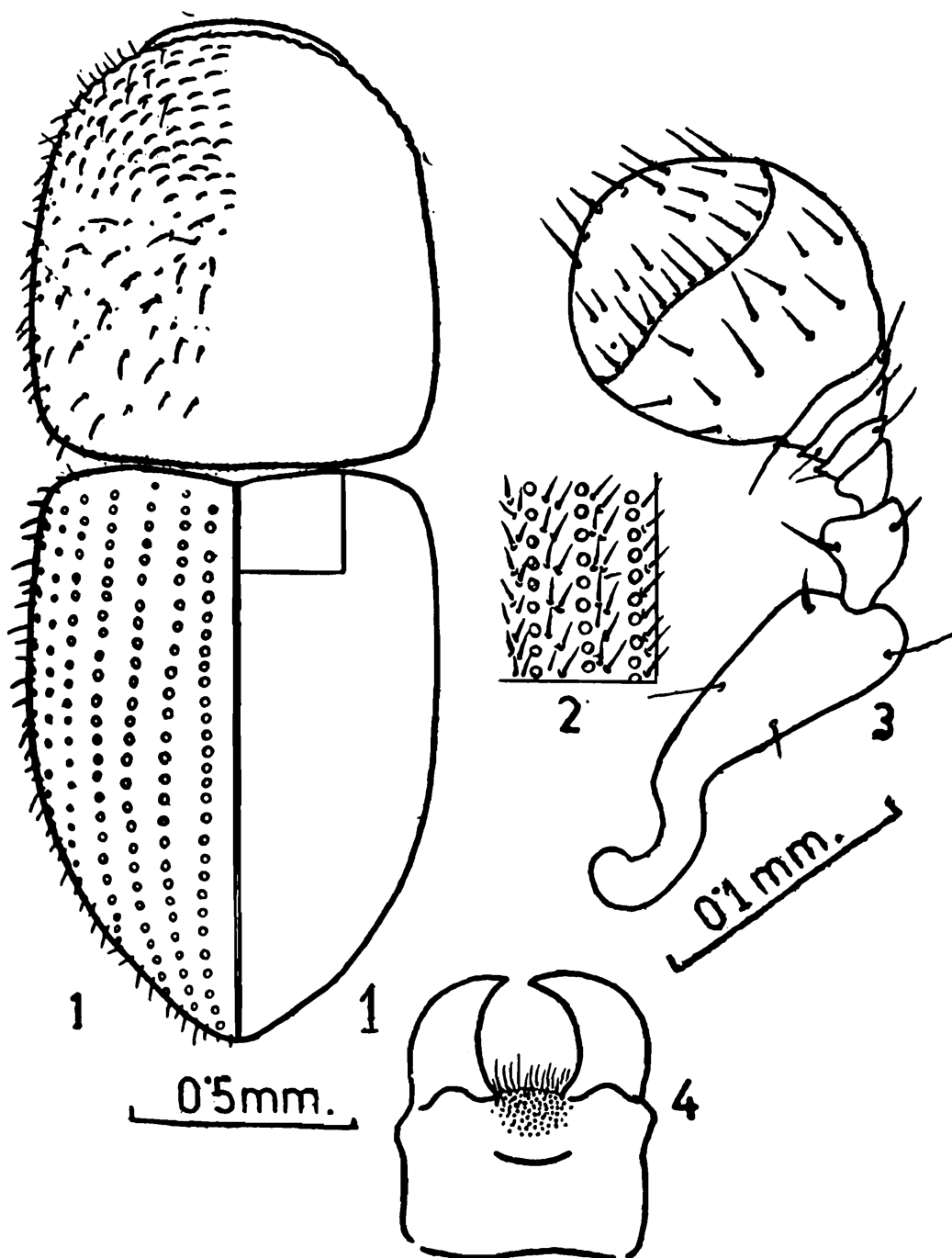


Fig. 1. 1-4. *Microperus mus* (Eggers) 1. Dorsal view ; 2. enlarged portion of elytra ; 3. Antennae ; 4. anterior part of head with mandible.

yellowish brown to dark brown in colour, head and pronotum much darker, legs and antennae comparatively paler. Body length, 2.30 mm., 2.6 times as long as wide.

Head not concealed from above by pronotum ; frons convex, anterior part of frons and epistomal area arcuately depressed, either side of which on lateral margins with two rounded swellings amongst numerous long erect hairs, surface weakly roughened. Mandibles fairly large, sickle-shaped, inner margin without any dentition. Eyes small and reduced like a transverse strip. Antennae small, funicle with 5 segments, club comparatively large and obliquely truncate, anterior margin of basal corneous portion well marked, but not costate.

Pronotum slightly longer than broad, lateral sides substraight, very weakly diverging anteriorly and with broadly rounded apex, basal margin substraight ; in profile, dorsal surface very weakly convex without any distinct summit, very weak asperities at anterior one-third and rest of the surface opaque and granulate, with scattered punctures throughout ; a faint longitudinal narrow median depression on the posterior half ; fairly densely pubescent throughout, increasing towards basal margin at the middle.

Scutellum not visible.

Elytra 1.4 times as long as pronotum and 1.5 times as long as its width ; each elytral basal margin weakly outcurved, without any scutellar emargination in between ; elytral base narrower than pronotal base, lateral margins very weakly divergent posteriorly up to middle, thence narrowing posteriorly with somewhat pointed apex ; striae indistinct, marked with very minute shallow punctures ;

interstriae plano-convex, much wider than striae and marked with a row of fine pubescence, increasing in length towards apex.

Declivity gradual and declivital face weakly convex, with striae and interstriae as on disc. Procoxae contiguous ; metafemur with ventral margin acutely carinate ; protibia with 8 and mid- and hind-tibia with 9 socketed teeth.

(c) *Remarks* : The species has been originally described by Eggers (1930) as *Xyleborus mus* from Chittagong Hills, Bangladesh, based on only females. With the discovery of males, the species has been re-examined in the present study, for its generic assignment and is put under the genus *Microperus* Wood in having the following characters : Scutellum not visible, posterior face of antennal club with one suture, apical margin of corneous area well marked, but not costate, body rather slender. In all essential characters, all the males are very much identical, except the smaller size of the specimens from North Bengal than those from Sikkim.

2. *Xyleborinus subspinosus* (Eggers)

Xyleborus subspinosus Eggers, H. 1930. *Indian Forest Rec.*, 14 (9) : 27, Female, Type-locality : Shillong, Meghalaya, India.

(a) *Material* :

- (i) 2 males from Lepchsjagat, Darjeeling District, West Bengal, *J. C. M. Gardner coll.*, 20. x. 1929 (R. R. D. 22, B. C. R. 474, Cage-206), ex. *Juglans regia*.
- (ii) 1 male from Lepchajagat, Darjeeling District, West Bengal, *J. C. M. Gardner coll.*, 20. xi. 1929 (R. R. D. 22, B. C. R. 466, Cage-451), ex. "*Symplocos theaefolia*".

(b) *Morphological characters :*

Male (Fig. 2, 1-2): Body long and cylindrical, yellowish brown in colour. Body length. 2.20 mm.

Head concealed from above, frons much narrower than pronotum, frons plano-convex, surface finely reticulate with large distinct irregular punctures and a few scattered hairs throughout. Eyes of moderate size, weakly emarginate. Antennae well developed, funicle with 5 segments, club obliquely truncate,

anterior margin of the corneous portion distinctly recurved.

Pronotum 1.1 times as long as broad, surface very shiny, basal margin substraight with obtuse postero-lateral angles; lateral sides substraight, very weakly divergent anteriorly with broadly rounded apex; in profile, very weakly convex, anterior one-third with granule-like weak asperities and rest of the posterior surface with small sparse punctures, with short and long erect hairs mostly on anterior third and on sides.

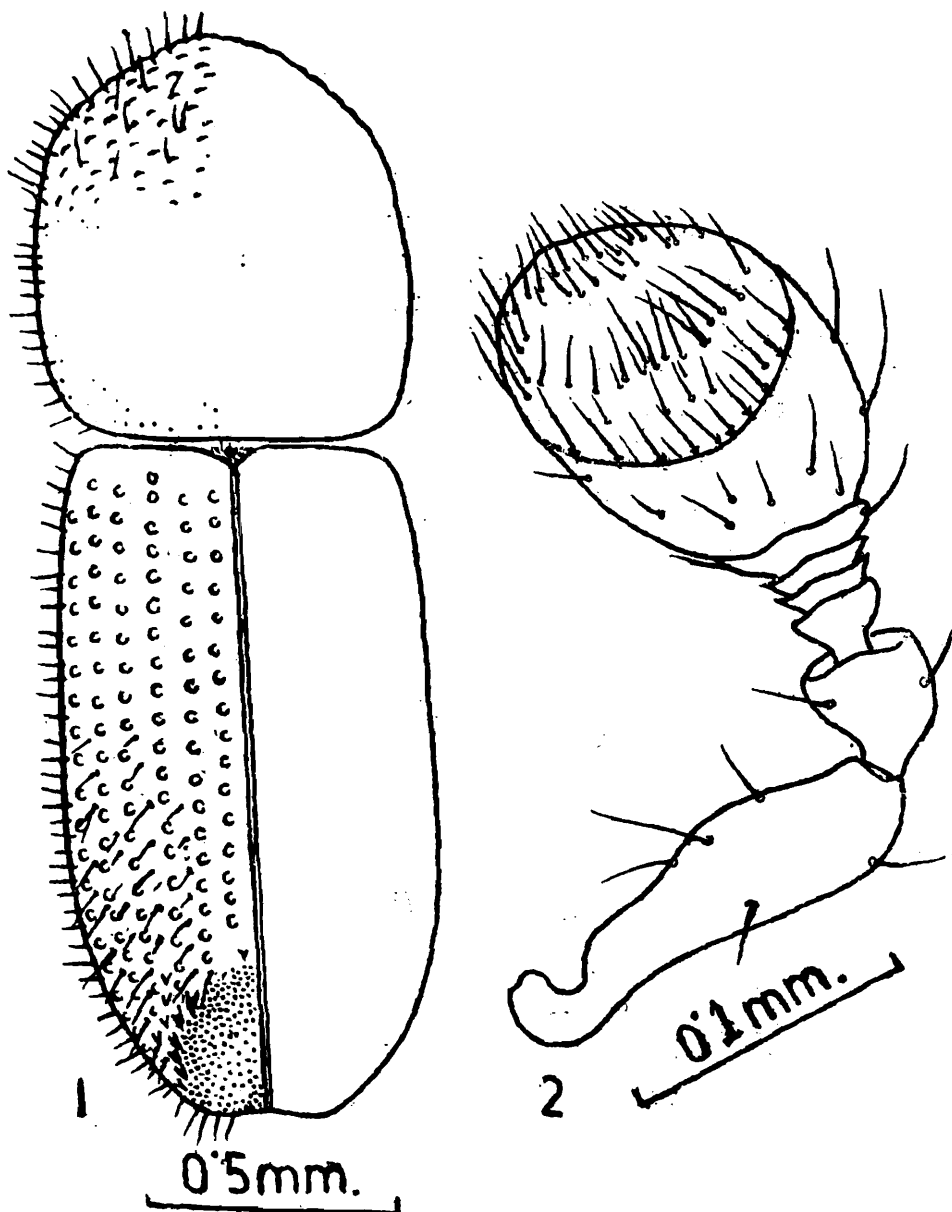


Fig. 2. 1-2. *Xyleborinus subspinosus* (Eggers). 1. Dorsal view; 2. Antennae.

Scutellum tubercle-like, raised beyond the level of elytra, scutellar space with close hairs.

Elytra 1.6 times as long as pronotum and 1.8 times as long as its width ; basal margin with scutellar emargination, otherwise substraight ; sides subparallel up to posterior three-fourths, whence converging posteriorly with narrowly rounded apex, sometimes appearing somewhat weakly emarginate in dorsal view ; striae with uniseriate row of indistinct and shallow punctures, interstriae slightly wider than striae, smooth, rather flat, with uniseriate row of long hairs.

Declivity steep, commencing slightly beyond the posterior one-fourth of elytra, striae and interstriae 1 and 2 comparatively much depressed with small hairs, both striae and interstriae 3 onwards weakly convex with long erect hairs, interstria 3 forming an excavital margin bearing 4 to 5 distinct tubercles almost in row, interstria 4 with three smaller tubercles, each sutural interstria with one smaller granule at commencement of declivity. Procoxae contiguous, protibiae with 7 and mid and hind-tibiae with 9 socketed teeth.

(c) *Remarks* : The species has originally been described on females only, as *Xyleborus subspinosus* by Eggers (1930) from Shillong, Meghalaya. Since then, it was unknown until the description of the males from North Bengal was made in the present paper. Following a detailed study, the species has been transferred here to the genus *Xyleborinus* Reitter on the basis of the characters, such as, tubercle-like scutellum surrounded by closely set of setae in the wide scutellar space, anterior margin of pronotum unarmed,

antennal club with posterior face unmarked by any suture, etc.

3. *Xyleborus concinnus* Beeson

Xyleborus concinnus Beeson, C. F. C. 1930. *Indian Forest Rec.*, 14 (10) : 214, Female, *Type-locality* : Burma and Java, Indonesia.

(a) *Material* :

I male from Nagrakata, Jalpaiguri District, West Bengal, S. C. Das coll., ex., "dead stump of a tea plant".

(b) *Morphological characters* :

Male : (Fig. 3,1.) : Body small and stout, pale yellow in colour, head and pronotum comparatively darker. Body length 1.60 mm.

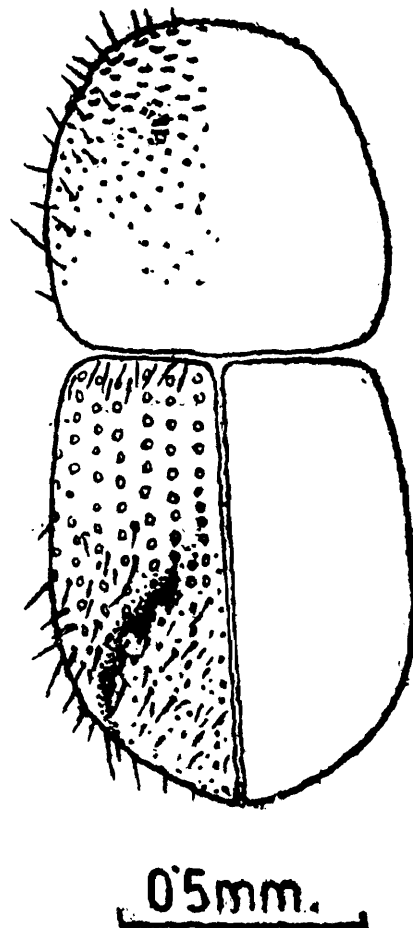


Fig. 3. *Xyleborus concinnus* Beeson, Dorsal view.

Head almost concealed from above ; frons plano-convex, surface finely reticulate with a few scattered minute granules and

long erect hairs; epistomal margin with distinct fringe of hairs. Eyes of moderate size with weak emargination. Antennae well developed, funicle with 5 segments, club obliquely truncate, anterior margin of basal corneus poriton distinctly marked.

Pronotum subquadrate, slightly wider than long; basal margin substraight, sides weakly out-curved, postero-lateral angles broadly and antero-lateral angles comparatively narrowly rounded, with anterior margin substraight; in profile, dorsal margin very weakly convex, weak asperities on anterior one-third and a few extending laterally, posterior two-thirds with sparse fine granules on reticulate surface; postero-median area with comparatively dense pubescence, above which with a short longitudinal median depression.

Elytra 1.33 times as long as pronotum and 1.25 times as long as its width; each basal margin weakly outcurved at the level of 3rd and 4th interstriae and fringed with stout hairs; sides nearly straight and subparallel up to anterior two-thirds, thence gradually converging posteriorly up to feebly produced apex; disc with weakly impressed striae marked with indistinct punctures; interstriae weakly convex with uniseriate row of fine hairs.

Declivity gradual, commencing just before the middle; interstria 1 weakly ridged and widened towards apex with a few minute granules in row, interstriae 2 obsolete at commencement of declivity, 3, 4 and 5 acutely raised at summit of declivity and with a few uniseriate and minute granules more distinct on interstriae 3 and 4, whence becoming flat and obsolete but marked by indistinct

granules; declivital face with indistinct striae or interstriae, roughened with minute granules intermingled with fine hairs; postero-lateral margin without any distinct carina as in females, but broadly elevated. Procoxae slightly separated from each other.

(c) *Remarks*: The species has originally been described by Beeson, (1930) from Burma and Java based on females only. Since then the species has been unknown until now, when it has been collected from Nagrakata Tea Estate, North Bengal, infesting tea bushes in association with another tea infesting species *Xyleborus fornicatus* Eichhoff. However, the species *X. concinnus* Beeson seems to be a potentially important pest of tea plantations in the eastern India.

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HISTOLOGICAL OBSERVATIONS ON THE ALIMENTARY TRACT OF THE LIZARD, *HEMIDACTYLUS FLAVIVIRIDIS*

By

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*Zoological Survey of India, Calcutta**

ABSTRACT

The present investigation reveals the structure of tissues of the alimentary tract of *Hemidactylus flaviviridis*, and its differences from that of other lizards recorded and interpreted. The alimentary tract consists of five major functional zones viz. oesophagus, stomach, duodenum intestine and rectum. The oesophagus is devoid of oesophageal glands but consists of mucous cells, goblet cells and columnar epithelial cells. Mucous cells are mucoid, goblet cells are secretory and columnar epithelial cells are absorptive in function. Stomach contains gastric glands of peptic, oxyntic and mucoid type. Duodenum lined with absorptive cells is devoid of duodenal glands. Goblet cells in intestine is an adaptation for water absorption. Lymphoid tissue in intestine and rectum is meant for defence and nutrition.

INTRODUCTION

Important contribution on histology of alimentary tract of lizards have been made by Reese (1913), Stayley (1925), Eltouby and Bisahai (1958), Bisahai (1960 & 61), and Amar and Ismail (1975 & 79). However, nothing is known about the histology of alimentary tract of house lizard, *Hemidactylus flaviviridis* and thus the present investigation has been under-taken.

MATERIAL AND METHODS

For histological studies, oesophagus, stomach, duodenum, intestine and rectum were removed from the freshly dissected

specimens of *Hemidactylus flaviviridis* (collected from Vidisha, M. P.) and were washed in saline water. These tissues were fixed in alcoholic Bouin's picroformal solution for 20 hours. The material was dehydrated, cleared and embedded in wax and sections of five micron thickness were cut. The sections were stained with Delafield's Haematoxylin and counter stained with Eosin. Toluidine blue and Mayer's mucicarmine were used for mucus staining.

OBSERVATIONS

Oesophagus : Its wide lumen lined by ciliated mucosa, bears numerous short

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folds which are richly branched. It consists of mucosa, submucosa, muscularis and serosa layers. Mucosa is a mucous membrane made up of double layered columnar epithelium and lamina propria with numerous goblet cells indispersed with lymphocytes and blood capillaries. The goblet cells are cylindrical with homogenous cytoplasm and irregular basal nuclei, while the columnar epithelial cells possess granular cytoplasm and oval nuclei. The submucosa is well developed and consists of connective tissue formed of collagenous fibres and fibroblasts. It is richly supplied with blood vessels, lymphocytes and nerve fibres. The muscularis consists of a smooth muscle coat containing an outer poorly developed longitudinal and an inner thicker circular layer. Longitudinal muscle layer is made up of loose areolar muscle fibres. The oesophagus is enveloped by a thin single layer of adventitia consisting of fibro-elastic tissue.

Stomach : It is divisible into an anterior cardiac and posterior pyloric region. Like oesophagus, both the parts of stomach are consisting of mucosa, submucosa, muscularis and serosa layers. Mucosa of cardiac stomach consist of epithelium, lamina propria and muscularis mucosae layers. The mucous membrane is thrown into a number of longitudinal folds. Tubular gastric glands of mucosa open into the lumen of stomach by gastric pits. Gastric glands consists of peptic cells and oxyntic cells. Peptic cells are dome shaped with projecting apical ends and possess granular cytoplasm with centrally placed spheroidal nuclei while the oxyntic cells are oval and irregular with light cytoplasm.

Histologically, pyloric stomach resembles

cardiac stomach except that the columnar epithelial cells are elongated, compactly arranged and gastric glands are replaced by pyloric glands lined with columnar mucus secreting cells. A distinct muscularis mucosae occurs throughout the cardiac and pyloric regions of the stomach. The submucosa of cardiac and pyloric parts is highly vascular and contain nerve fibres, near the plexuses of blood vessels. An outer poorly developed layer of longitudinal muscle fibres and an inner thick layer of circularly disposed muscle fibres is also observed. The inner layer is about three times thicker than the outer layer.

Duodenum : It consists of mucosa, submucosa, muscularis and serosa. The mucosa is thrown into number of high narrow folds where the connective tissue of the submucosa extends as a thin layer of lamina propria. The lining epithelium is formed of tall columnar absorptive cells with granular cytoplasm and oval nuclei. These cells possess a scarcely distinct striated border and contain goblet cells in between. The goblet cells increase in number towards the intestinal region. Lamina propria contain lymph spaces, blood vessels and lymphocytes ; the latter are crowded at the base of the columnar epithelial cells.

Intestine : It is a thick walled tubular structure made up of mucosa, submucosa, muscularis and serosa layers. Mucosa, consists of columnar epithelium, lamina propria and muscularis mucosae. Lamina propria is well developed due to thick banding of connective tissue and it is composed of stratum granulosum, stratum compectum and blood vessels. The stratum compectum is a strengthening substance



Figs. 1-8 : 1. T. S. of oesophagus showing mucosa, submucosa, muscularis and serosa along with mucous cells, columnar epithelial cells and lymph spaces. 2. T. S. of stomach showing the structure of its villus and glandular tissues. 3. Showing the peptic cells, oxyntic cells, interglandular spaces, and cardiac glands. 4. Showing the presence of pyloric glands, peptic cells, oxyntic cells, columnar epithelial cells and lymphocytes. 5. T. S. of duodenum showing goblet cells, columnar epithelial cells along with lamina propria and muscularis mucosae. 6. T. S. of intestine showing mucosa, submucosa, muscularies and serosa along with abundant columnar epithelial cells, mucous cells, blood vessels and nerve fibres. 7. Showing mucous cells, columnar epithelial cells, goblet cells, nerve cells and lymphatic capillaries. 8. Showing the presence of columnar epithelial cells, goblet cells, mucous cells and scattered wandering cells in rectum.

composed of collagen fibres. Mucosa is characterized by the presence of columnar epithelial cells, goblet cells and absorptive mucous cells. Columnar epithelial cells having central nuclei are raised into a number of finger shaped villi. Mucous cells are spindle shaped with swollen base and narrow neck found at the top of mucosal folds open into the lumen. Narrow strands of smooth muscle fibres extends from the muscularis mucosae into villi which impart them flexibility. Submucosa consists of dense collagenous fibres enclosing blood capillaries, blood vessels, lymph spaces and abundant lymphoid tissue. Muscularis is differentiated into an outer thin longitudinal and an inner thick circular muscle layer. Serosa forms a thin outer most covering made up of flattened cells.

Rectum : Like intestine, its mucosal folds are short and broad. Epithelium has typical columnar absorptive cells, few goblet cells and scattered wandering cells. Lamina propria supports the columnar epithelium and connects it with the muscularis mucosae. Lamina propria carries blood and lymphatic capillaries and consists of unstriated muscles fibres which increase the absorptive surface of villi. Submucosa, muscularis and serosa are similar to that of intestine.

DISCUSSION

Structure of mucosa of the oesophagus of *Hemidactylus flaviviridis* resemble with the findings of Eltouby (1936), Bisahai (1961) and Eltouby and Bisahai (1958) in lizards viz. *Scincus officinalis*, *Varanus griseus* and *Uromastix aegyptia*. The present observation in *Hemidactylus flaviviridis* also agrees with the findings of Bisahai (1961) in *Varanus griseus*

and Amar and Ismail (1975) in *Mubaya quinquetaeniata* who have reported the absence of oesophageal glands, while Eltouby and Bisahai (1958) in *Uromastix aegyptia* and Bisahai (1960) in *Chamaeleon vulgaris* and *Chamaeleon chamaeleon* reported the presence of oesophageal glands.

Like the findings in *Hemidactylus flaviviridis*, Eltouby (1936), Eltouby and Bisahai (1958), Amar and Ismail (1975) observed circular and longitudinal muscle layers in muscularis region of oesophagus of the lizards viz. *Scincus scincus*, *Uromastix aegyptia* and *Mubaya quinquetaeniata* but Bisahai (1960 & 61) reported the absence of longitudinal muscle layer in oesophagus of *Chamaeleon vulgaris* and *Varanus griseus*.

Presence of peptic cells and oxyntic cells in the gastric glands of cardiac stomach and pyloric glands in the pyloric stomach of *Hemidactylus flaviviridis* confirms the findings of Stayley (1925), Eltouby and Bisahai (1958) and Amar and Ismail (1975) in *Alligator mississippiensis*, *Uromastix aegyptia*, *Mubaya quinquetaeniata* and *Agama stellio*. Bisahai (1961) observed the fundic glands in the stomach of *Varanus griseus* which are gradually replaced by mucus secreting glands in the posterior region of stomach.

Eltouby (1936) observed the absence of longitudinal muscle fibre in muscularis layer of stomach of *Scincus officinalis*. Eltouby and Bisahai (1958) reported duodenal glands in *Uromastix aegyptia*, but Amar and Ismail (1975) found absence of duodenal glands in *Chamaeleon vulgaris*, *Varanus griseus* and *Mubaya quinquetaniata* like *Hemidactylus flaviviridis*. Presence of goblet cells in the intestine of *Hemidactylus flaviviridis* confirms the findings of Bisahai (1961) which absorb

water in arid and semi-arid condition. Lymphoid tissue in rectum indicates a defence reaction and helps in nutrition. Presence of wandering cells and goblet cells in epithelial

mucosa of rectum of *Hemidactylus flaviviridis* is also in conformity with the findings of Amar and Ismail (1975 & 79) in *Mubaya quinquetaeniata* and *Agama stellio* lizards.

ABBREVIATIONS USED

M=Mucosa, V=Villi, S=Serosa, SM=Submucosa, MS=Muscularis, LP=Lamina propria. MM=Muscularis Mucosae, GC=Goblet cells, PC=Peptic cells, Oc=Oxyntic cells, CG=Cardiac gland, PG=Pyloric gland, MC=Mucous cells, PT=Peritoneum, CEC=Columnar epithelial cells, CML=Circular muscle layer, LML=Longitudinal muscle layer, IGS=Inter glandular space, IGT=Inter glandular tissue, NF=Nerve Fibre, LT=Lymphoid Tissue, BV=Blood vessel, BC=Blood capillaries.

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STORED PRODUCT BEETLES (COLEOPTERA) OF SIKKIM

By

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ABSTRACT

So far, no account was available on beetles associated with stored products from Sikkim. In the present study author has dealt with nine species belonging to the families Anobiidae, Bruchidae, Cleridae, Curculienidae, Dermestidae, Silvanidae and Tenebrionidae. A key to the species and illustrations are also given.

INTRODUCTION

During April-May 1983, Coleoptera Section of Zoological Survey of India conducted a survey of Sikkim led by Mr. B. N. Das. During the survey author has examined a number of food products and collected 86 beetles which cause damage to various stored products. The twelve different stored products examined are Cumin

seed, Green gram, Dry fish, Maize grain, Pulses ('Matar', 'Maskalai', 'Musur', 'Arhor' and 'Chola'), Suji, Groundnut and Flour. There is no published information of beetles attacking stored products from Sikkim and in the present communication author has studied nine species belonging to seven families from that region. A short account of each species and a key to the species is given.

TABLE 1 : Stored Product Beetles from Sikkim

Name of Species	Family	Product Infested	Association
1. <i>Stegobium paniceum</i> (L.)	Anobiidae	Cumin Seeds (<i>Cuminum</i> sp)	—
2. <i>Callosobruchus maculatus</i> (F.)	Bruchidae	Green gram (<i>Phaseolus aureus</i>)	<i>Sitophilus oryzae</i> (L.)
3. <i>Necrobia rufipes</i> (Degeer)	Cleridae	Dry fish	<i>Necrobia ruficollis</i> (F.) <i>Dermestes maculatus</i> (Degeer)
4. <i>Necrobia ruficollis</i> (F.)	Cleridae	Dry fish	<i>Necrobia rufipes</i> (Degeer) <i>Dermestes maculatus</i> (Degeer)

Name of species	Family	Product Infested	Association
5. <i>Sitophilus oryzae</i> (L.)	Curculionidae	Maize grain (<i>Zea mays</i>) 'Matar' Pulses (<i>Pisum sativum</i>) 'Maskali' Pulses (<i>Phaseolus mungo</i>) 'Musur' Pulses (<i>Lens esculentus</i>) 'Athor' Pulses (<i>Cajanus cajans</i>) 'Chola' Pulses (<i>Cicer arietinum</i>) Green gram (<i>Phaseolus aureus</i>) Suji	<i>Tribolium castaneum</i> (Herbst) <i>Oryzaephilus surinamensis</i> (L.) <i>Callosobruchus maculatus</i> (F.)
6. <i>Dermestes maculatus</i> Degeer	Dermestidae	Dry fish	<i>Necrobia rufipes</i> (Degeer) <i>Necrobia ruficollis</i> (F.)
7. <i>Oryzaephilus mercator</i> (Fauvel)	Silvanidae	Groundnut (<i>Arachis hypogea</i>)	<i>Tribolium castaneum</i> (Herbst)
8. <i>Oryzaephilus surinamensis</i> (L.)	Silvanidae	Flour Maize grain (<i>Zea mays</i>)	<i>Sitophilus oryzae</i> (L.) <i>Tribolium castaneum</i> (Herbst)
9. <i>Tribolium castaneum</i> (Herbst)	Tenebrionidae	'Matar' Pulses (<i>Pisum sativum</i>) 'Chola' Pulses (<i>Cicer arietinum</i>) Groundnut (<i>Arachis hypogea</i>), Suji, Flour	<i>Oryzaephilus mercator</i> (Fauvel) <i>Oryzaephilus surinamensis</i> (L.) <i>Sitophilus oryzae</i> (L.)

Family ANOBIIDAE

Representatives of this family are commonly known as 'Death Watch beetles'. Species are usually small, 2-6 mm in length, shape subcylindrical or oval, colour brown or piceous, head deflexed and often covered by pronotum, antenna serrate or pectinate, legs contractile, tarsi 5-5-5 and its segment 1 usually long. Most of the Anobiids are wood borers and the family includes several serious pests of timber. The family includes two species that are associated with stored

products, *Lasioderma serricorne* (F.) and *Stegobium paniceum* (L.)

Stegobium paniceum (L.)

(Pl. III, Fig. A)

Common Name : Drugstore Beetle

This species is known to be a general feeder, attacking a great variety of stored foods, seeds and other materials. In the present study only two examples were collected from Cumin seeds at Ranipool Market, Ranipool. These were found in

association with one *Tribolium castaneum* (Herbst) and these beetles perforate the cumin seeds by feeding upon them. In India, this species is recorded from West Bengal, Kerala and Maharashtra.

Family BRUCHIDAE

Bruchidae, commonly known as 'Pea and bean beetles' may be recognised by their characteristic shape, head small with a short snout-like prolongation, dull-coloured oval chunky body covered with fine hairs, which is often ornamented with spots, antenna clavate, eyes often with a deep emargination which extends backwards from the base of antennae, legs stout with hind femora markedly developed tarsi pseudo-tetramerous, species usually less than 6 mm long. Most of the Bruchidae live on the seeds of Leguminosae and several species are known as pests of cultivated pulse.

Callosobruchus maculatus (Fabricius)

(Pl. III, Fig. B)

Common Name : Pulse Beetle

This species was found to infest green gram at Ranipool in Sikkim in association with *Sitophilus oryzae* (L.). Infection was low and the kernel of the pulses were hollowed out leading to the exterior through a circular hole and several of these harboured dead specimens. In India this species has been found destroying Chola or Chana (*Cicer arietinum*), pea or motor (*Pisum sativum*), Arhor (*Cajanus cajan*) and Mung (*Phaseolus aureus*).

Family CLERIDAE

The Cleridae or Chequered beetles are usually brightly coloured and covered with erect setae, species elongated, varies from 3-24 mm, antenna 11-segmented usually with a distinct club, eyes usually emarginate tarsal formula 5-5-5, abdomen with 5 or 6 visible sternites which are completely covered with elytra. The members of this family are mainly predaceous.

Necrobia rufipes (Degeer)

(Pl. III, Fig. C)

Common Name : Copra Beetle or Red legged ham Beetle

This species was found to infest dry fishes at Gangtok in Sikkim. Infection was low and it was found in association with *Dermestes maculatus* Degeer and *Necrobia ruficollis* (F.). After *Dermestes maculatus* Degeer it forms the next predominant pest of dry fish. It was observed to feed on the surfaces of the fish's body and on disturbed they run rapidly and take to flight. Probably the diet of *N. rufipes* is supplemented by predation on larvae of *D. maculatus*. *N. rufipes* is a cosmopolitan pest causing considerable damage to certain oil seeds and other stored commodities especially those important in protein foods. In India, this species has been recorded from Calcutta, Kurseong and Darjeeling : West Bengal, Shillong : Meghalaya, Srinagar : Kashmir and Coconada : Tamil Nadu.

Necrobia ruficollis (F.)

(Pl. III, Fig. D)

Common Name : Red shouldered ham beetle

This is a cosmopolitan species which infests products of animal origin only. This species was found to infest dry fish along with *Dermestes maculatus* Degeer and *Necrobia rufipes* (Degeer). Of these three species, *Necrobia ruficollis* (F.) is the least destructive pest. As compared to *Necrobia rufipes* (Degeer) it is less agile although it also feeds directly on the fish.

Family CURCULIONIDAE

This is one of the largest groups of Coleoptera which may be recognised by the distinct usually long and slender snout, the generally geniculate antennae inserted on the snout and the generally compact antennal club. Many species are pests of growing crops of many kinds throughout the world, but only a few are pests of crops after harvesting. Some of them are however of outstanding importance, namely the Rice and Grain weevils.

Sitophilus oryzae (L.)

(Pl. III, Fig. E)

Common Name : Rice Weevil

This is a cosmopolitan species and it was found in such products as Maize grain, Suji and the various pulses. Damage by these beetles are that the grains are hollowed and the kernels are reduced to mere powder. Besides, infestation by this species paves the way for infestation by the other species of beetles as *Tribolium castaneum* (Herbst) and *Oryzaephilus surinamensis* (L.). In most cases of infestation this species was observed to remain at the surface of the product.

Family DERMESTIDAE

Representative of this family, commonly known as 'Skin beetles' are mostly scavengers feeding on animal and plant material of high protein content. They may be recognised by being small (1-12mm), usually oval and compact in shape covered with hairs or scales, head small and deflexed, antenna clubbed and lie on antennal cavities in repose and hind coxae excavated.

Dermestes maculatus Degeer

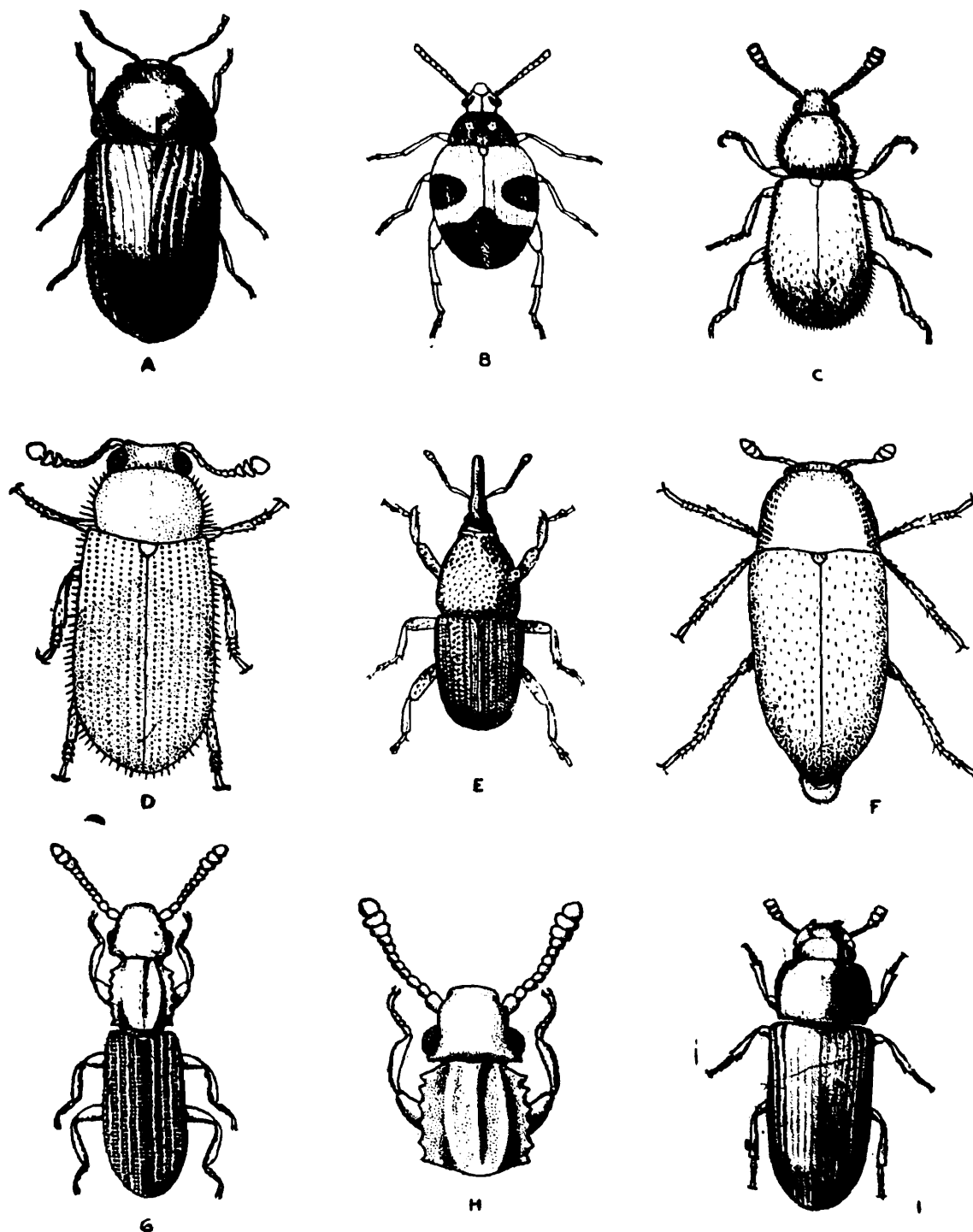
(Pl. III, Fig. F)

Common Name : Hide beetle or Leather beetle

It is a cosmopolitan species which causes extensive damage to dry fish. Of the three species *Desmestes maculatus* Degeer, *Necrobia rufipes* (Degeer) and *Necrobia ruficollis* (F.) that infest dry fish at Sikkim, *D. maculatus* is the most predominant pest accounting for about 70% of the damage. The beetle feed directly on the flesh of the fish which reduces its nutritive value and may quickly render it totally unfit for human consumption.

Family SILVANIDAE

The members of this family are small, flat beetles formerly included under the family Cucujidae. Crowson (1955) treated them under a separate family Silvanidae. They may be recognised by the following characters : 5-5-5 tarsi in both sexes, 11 segmented antenna with or without club, front coxal cavity usually closed, mesocoxal cavity open and elytral puncturation arranged in 8-11 regular rows. Most members of this family are of little or no economic importance except the



Figs. A-I. A. *Stegobium paniceum* (L.), B. *Callosobruchus maculatus* (F.) C. *Necrobia rufipes* (Degeer), D. *Necrobia ruficollis* (F.), E. *Sitophilus oryzae* (L.), F. *Dermestes maculatus* Degeer, G. *Oryzaephilus surinamensis* (L.), H. *Oryzaephilus mercator* (Fauvel), I. *Tribolium castaneum* (Herbst).

three species *Oryzaephilus surinamensis* (L.), *O. mercator* (Fauvel) and *Ahasverus advena* (Waltl) which are serious pests.

***Oryzaephilus mercator* (Fauvel)**

(Pl. III, Fig. H)

Common Name : Merchant Grain Beetle

Infection was very low and only a solitary example was found along with an example of *Tribolium castaneum* (Herbst) in groundnuts. This species unlike *Oryzaephilus surinamensis* (L.) are fond of oil seeds and their products. In India they are severe pests of cashewnuts and it has been recorded also from wheat, cornflakes, unboiled rice and groundnuts.

***Oryzaephilus surinamensis* (L.)**

(Pl. III, Fig. G)

Common Name : Saw Toothed Grain Beetle

This species was found to infest flour and maize grain at Ranipool and Gangtok in Sikkim. Infection was low and it was found in association with *Tribolium castaneum* (Herbst) and *Sitophilus oryzae* (L.). This pest is cosmopolitan in distribution and is found all over India in almost any stored food of vegetable origin, e.g. flour, maida, biscuit, raisins etc. It is a directly destructive pest and causes considerable loss by directly feeding on grains.

Family TENEBRIONIDAE

Large family which can be distinguished by the following characters : body hard, antennal insertion hidden under frons, elytra usually completely covering the abdomen, abdomen with five visible sternites and first

three segments connate, front coxal cavities closed behind, heteromerous tarsi, tarsal segments and claws simple. Comparatively few of its species are pests of stored products.

***Tribolium castaneum* (Herbst)**

(Pl. III, Fig. I)

Common Name : Rust red flour Beetle

It is one of the economically most important species that is cosmopolitan in distribution. Though commonly known as Flour beetle it is versatile and infests a wide range of commodities. Infection in all cases were found to be low and *T. castaneum* (Herbst) feed directly on the products of infestation and causes extensive damage.

Key to the Stored Product Beetles of Sikkim

1. Pronotum with six lateral teeth ...	2
Pronotum without any lateral teeth ...	3
2. Length of temple of head about as long as 3-4 eye facets and length of eye usually less than twice the length of temple	
<i>Oryzaephilus surinamensis</i> (L.)	
Length of temple of head about as long as 2-2.5 eye facets and length of eye about 3.5-4 times the length of temple	
<i>Oryzaephilus mercator</i> (Fauvel)	
3. Head produced in front having a feeble or prominent beak ...	4
Head without any beak ...	5
4. Prothorax with densely set round or irregular punctures, antenna geniculate	
<i>Sitophilus oryzae</i> (L.)	
Prothorax finely punctate, antenna serrate	
<i>Callosobruchus maculatus</i> (F.)	
5. Head deflexed, prothorax hood shaped	
<i>Stegobium paniceum</i> (L.)	
Head not deflexed, prothorax never hood shaped ...	6
6. Tarsi 5-5-4 segmented	
<i>Tribolium castaneum</i> (Herbst)	
Tarsi 5 segmented ...	7

7. Pronotum with lateral band of white hairs. Posterior margin of elytra toothed with an acute spine

Dermestes maculatus Degeer

Pronotum without lateral band of white hairs, Posterior margin of elytra smooth ...

8

8. Entire dorsal surface of the body shiny blue

Necrobia rufipes (Degeer)

Prothorax and basal fourth of elytra raddish brown and rest of dorsal surface shiny blue *Necrobia ruficollis* (F.)

DISCUSSION

In India, loss due to insect infestation of grains is about 15%. Infestation of stored product beetles of Sikkim were low to moderate in most cases which could be due to the low temperature and humidity at that time. However, most of these beetles cause serious damage to the products of infestation by directly feeding upon them and depredating their nutritional value. It was noted that *Tribolium castaneum* (Herbst) and *Sitophilus oryzae* (L.) are the most predominant pests infesting a wide range of commodities. *Oryzaephilus* spp are of secondary importance so far as destruction of the product is concerned and was found to infest only grains and groundnut. The association of *Dermestes maculatus* Degeer, *Necrobia rufipes* (Degeer) and *Necrobia ruficollis* (F.) were present in the only animal product surveyed, dry fish. *Necrobia rufipes* (Degeer) though recorded to infest many other commodities by predation were not found in any other product. *Callosobruchus maculatus* (F.) or pulse beetle was found to infest only whole grain pulses such as green gram (*Phaseolus aureus*) but were absent in the other varieties of pulses such as 'Matar' (*Pisum sativum*), 'Musur' (*Lens esculentus*)

and 'Arhor' (*Cajanus cajan*s). *Stegobium paniceum* (L.) which is more of a temperate species than tropical is naturally found in Sikkim which have a temperate climate.

The present study represents the result of survey of a small region from Sikkim, while extensive survey of the state could reveal many more species and further information of stored product beetles.

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ON SOME ASILIDAE (DIPTERA) FROM INDIA

By

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ABSTRACT

This paper provides information on the distribution of 32 species of Asilidae representing 19 genera collected in India by various survey parties. Of these, 13 species are described as new, viz., *Maira indiana*, *Microstylum marudamalensis*, *Xenomyza dentata*, *X. himalayaensis*, *Michotamia pruthii*, *Ommatius dubius*, *O. gopalpurensis*, *Astochia muralidharani*, *A. pseudoguptai*, *Heligmoneura himalayana*, *H. ladakhensis*, *Machimus pseudonicobarensis*, and *Neoitamus dhenkundensis*.

INTRODUCTION

Over years asilid specimens collected by the various faunistic survey parties were deposited in the National Zoological Collection, Calcutta. The present paper deals with these specimens plus one provided on loan by Mr. K. G. V. Smith of the British Museum (Natural History), London, where new species have been described. The types have been deposited in the collection of the Zoological Survey of India in Calcutta, with one exception (*Ommatius dubius* n. sp.) which is deposited in the British Museum (Natural History), London. The arrangement of genera followed in this paper is based on that given in 'A Review of the Asilidae (Diptera) from the Oriental Region' by Joseph and Parui (1984).

Leptogaster Meigou

1. *Leptogaster cheriani* Bromley

Leptogaster cheriani Bromley, 1938, *Indian J. agric. Sci.* 8 : 863 ; Joseph and Parui, 1984, *Oriental Ins.* 17 : 280.

Material examined : 4♂, 2♀ Tamil Nadu : Coimbatore District : Agricultural University Compound, 1. i. 1976. coll. Joseph and Parui.

Remarks : This species has been previously recorded only from Tamil Nadu.

Laxenecera Macquart

2. *Laxenecera albibarbis* Macquart

Laxenecera albibarbis Macquart, 1838, *Dipt. exot.* 1(2) : 195 ; Joseph and Parui, 1948, *Oriental Ins.* 17 : 297.

* Zoological Survey of India, Marine Biological Station, Madras.

Material examined: 1 ♂, 30. ix. 1955, coll. Nayar; 1 ♀, 29. viii. 1960, coll. Sharda; 1 ♀, 23. x. 1960, coll. Ghatak; 1 ♀, 5. viii. 1961, coll. Sarojk; 1 ♂, 16. vi. 1962, coll. Girish; 1 ♂, 30. viii. 1962, coll. A. Seth; 1 ♂, 20. x. 1962, coll. Sharda; 1 ♂, 4. ix. 1968, coll. Sharda; all collected on the Delhi University Campus.

Remarks: It has been previously recorded from West Bengal, Bihar, Uttar Pradesh and Maharashtra.

Maira Schiner

3. *Maira indiana* n. sp.

(Fig. 1)

A medium sized black species with dorsum of thorax and abdomen shining metallic blue, legs black with shining metallic blue femora, wings dark brown. Male: length 18 mm, wing 14 mm.

♂. **Head** broader than thorax, black with greyish-yellow and grey tomentum; mystax pale yellow with a few black bristles above; fronto-orbital plate with black and pale yellow hairs, ocellar hairs black, postcranium sparsely tomentose with golden yellow hairs below and with both black and golden yellow hairs above, some of the black well developed and forming bristles. Antennae black with black bristles on segments 1 and 2, segment 1 about one-and-a-half times length of 2, segment 3 about one-and-a-half times the combined length of segments 1 and 2. Palpi and proboscis black with golden yellow hairs, the former also with a few black hairs.

Thorax black, shining metallic blue dorsally; pronotum black, golden yellow haired; mediolongitudinal stripe of mesonotum indistinct, tomentum more or less confined to the sides, hairs black except for a few

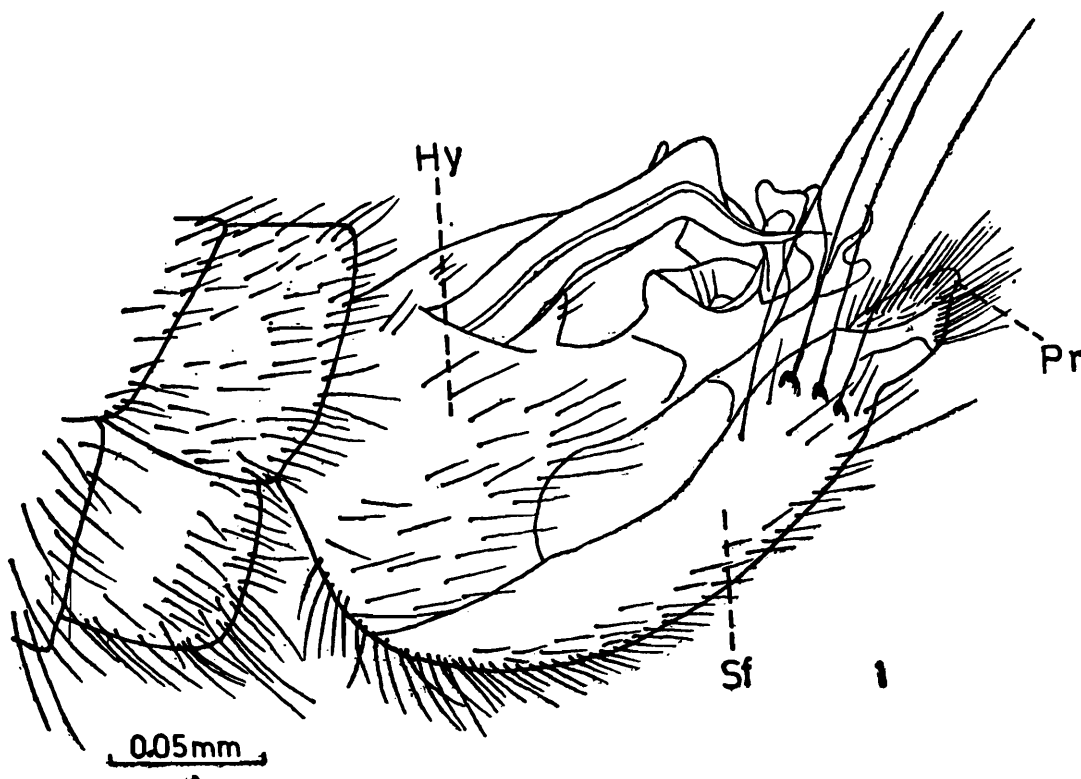


Fig. 1. *Maira indiana* n. sp., lateral view of male genitalia.

anterolateral pale yellow ones, bristles black ; scutellum with disc black haired, hind border with elongate black and pale yellow hairs ; mtaupleuron with golden yellow and black bristles. Halteres yellowish-brown.

Legs black, femora shining metallic blue ; fore and mid femora and tibia bearing dense, elongate hairs, hairs predominantly golden yellow with some black hairs intermixed, distal half of fore tibia anteriorly and basal two or three tarsal segments, both anteriorly and ventrally, bearing a mat of golden yellow pubescence, on middle tarsi golden yellow mat confined to ventral surface, on hind leg the golden yellow mat present posteriorly and ventrally at the apex of tibia and tarsal segments, hairs mixed black and golden yellow.

Wings dark brown, slightly lighter basally, hyaline area present in anal cell and axillary cell.

Abdomen shining metallic blue dorsally, tergites 1-4 with golden yellow hairs laterally and posteriorly, lateral hairs long, remaining hairs black. Male genitalia (Fig. 1) black and yellowish-brown, hairs black and pale yellow.

This beautiful fly can be separated from all other *Maira* in Southeast Asia on the basis of the structure of the male genitalia.

Holotype ♂, Reg. No. 7261/H6, India : NEFA (Arunachal Pradesh) : Maghi Basti (Lekhabali), 8.x.1966, coll. S. K. Tandon and party.

Cyrtopogon Loew

4. Cyrtopogon laphrides Walker

Cyrtopogon laphrides Walker, 1851, *Insecta Saundersiana* 1 : 99 ; Joseph and Parui, 1948, *Oriental Ins.* 17 : 308.

Material examined : 1 ♂, 1 ♀, Simla, 3.x.1966, coll. Raman ; 1 ♂, North West Himalaya ; Dalhousie, 3.x.1968, coll. Sarla ; 1 ♂, Narkanda, 15.v.1971, coll. Gupta ; all in Himachal Pradesh.

Remarks : So far this species has been recorded only from Himachal Pradesh and Uttar Pradesh.

Microstylum Macquart

5. Microstylum marudamalaiensis n. sp.

(Fig. 2)

A medium sized black species with black legs and brownish wings. Male ; length 19 mm, wing 12 mm.

♂. **Head** as broad as thorax, black, grey tomentose ; mystax black ; fronto-orbital plate with black hairs, ocellar bristles black, postcranium white haired below and black haired above, postocular bristles black. Antennal segments 1 and 2 black, with black bristles, segments 1 shorter than 2, segment 3 subequal in length to 1 and 2 combined, apical truncate microsegment with a small projection. Palpi and proboscis black, the former black haired while the latter pale yellow haired.

Thorax black, grey tomentose, pronotum pale yellow haired with usually three black bristles on either side ; mesonotum devoid of mediolongitudinal stripe, anterolaterally and posterolaterally it is dark brown with some pale yellow hairs, vestiture black, scutellar disc black haired, hind border with a pair of black bristles, metanotal collosity with a tuft of pale yellow hairs, pleura sparsely grey tomentose. Halteres pale yellow.

Leg black, except for basal half of hind tibia being comparatively lighter coloured ; hairs and bristles intermixed black and white ; mid tibia devoid of spur.

Wings brownish, but posterior half comparatively lighter coloured.

Abdomen black, tomentum indistinct, tergites 1 and 2 laterally with some long pale yellow hairs, remaining hairs intermixed black and pale yellow. Male genitalia (Fig. 2) black with pale yellow and black hairs, hypandrium distally bearing tuft of elongate hairs.

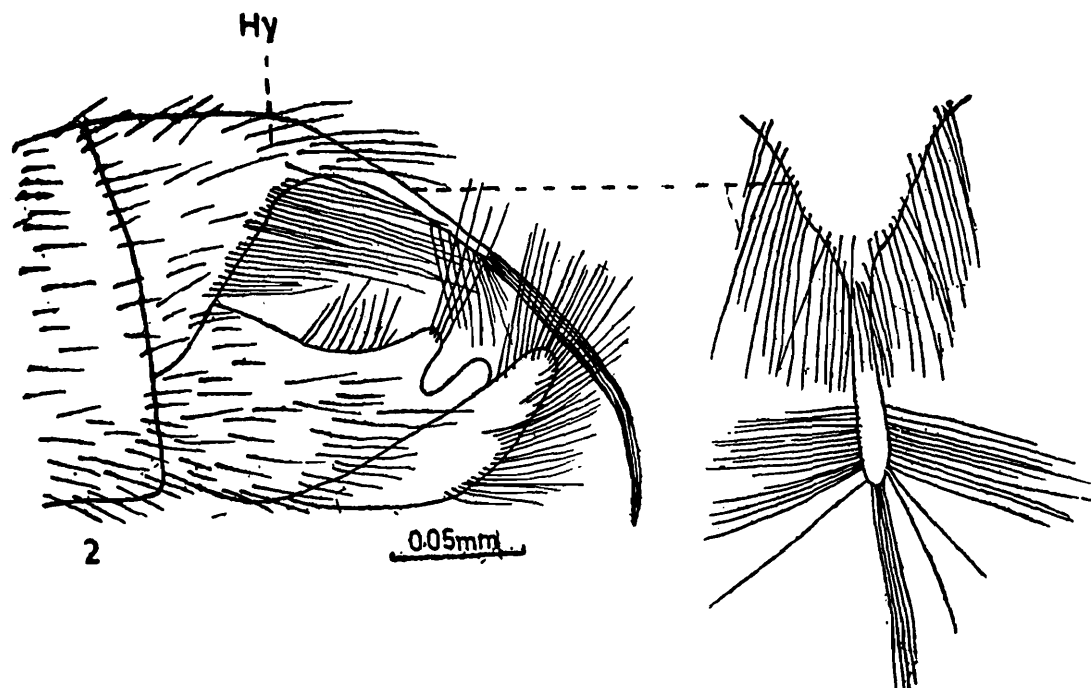


Fig. 2. *Microstylum marudamalaiensis* n. sp , lateral view of male genitalia.

The genus *Microstylum* is represented by fourteen species in India. Of these, the present species is most closely related to *M. bhattacharyai* Joseph and Parui based on the structure of the genitalia, but differs from that species in colour of mystax and legs and in the shape of hypandrium.

Holotype ♂, Reg. No. 7245/H6, South India : Coimbatore District : Marudamalai Hills, 549 m, x.1972, coll. P. S. Nathan.

Saropogon Loew

6. *Saropogon hulli* Joseph and Parui

Saropogon hulli Joseph and Parui, 1981, *Oriental Ins.* 15(1) : 27-28 ; Joseph and Parui, 1984, *Ibid.* 17 : 314.

Material examined : 1 ♂, 1 ♀, Kerala : Ernakulam District : Idamalaya, 18.xii.1978, coll. Joseph and Parui.

Remarks : The only other species in the genus described from India is *S. scalaris* Bigot (1878). The present authors described this second species from Kerala and Karnataka.

Xenomyza Wiedemann

7. *Xenomyza artigasi* Joseph and Parui

Xenomyza artigasi Joseph and Parui, 1984, *Ent. Scand.* 15 : 447.

Material examined : 1 ♂, 1 ♀, Kerala ; Ernakulam District : Idamalaya, 18.xii.1979, coll. Joseph and Parui.

Remarks : This is the second record from Kerala, the type locality.

8. *Xenomyza dentata* n. sp.

(Fig. 3)

A medium sized black species with yellowish-brown and black or dark brown legs and apically and anteriorly infuscated wings. Male : length 9 mm, wing 9 mm ; female : length 9 mm, wing 9 mm.

♂. *Head* broader than thorax, black infuscated with grey tomentum, mystax black ; fronto-orbital bristles and ocellar bristles black, postcranium black haired above, pale yellow haired and with a row of black hairs below. Antennae black, bristles

disc sparsely pale yellow haired, hind border with a row of long black bristles ; pleura greyish-yellow and grey tomentose. Halteres yellowish-brown, knobs dark brown.

Legs yellowish-brown and black ; coxa and trochanter black, femur black anteriorly on fore and middle legs and anteriorly as well as dorsally on hind legs, remainder of femur yellowish-brown, tibia yellowish-brown with black apex, the black colouration more extensive on hind tibia, tarsal segments yellowish-brown with black apex, hind legs larger in comparison with the others, trochanter swollen ventrally towards apex

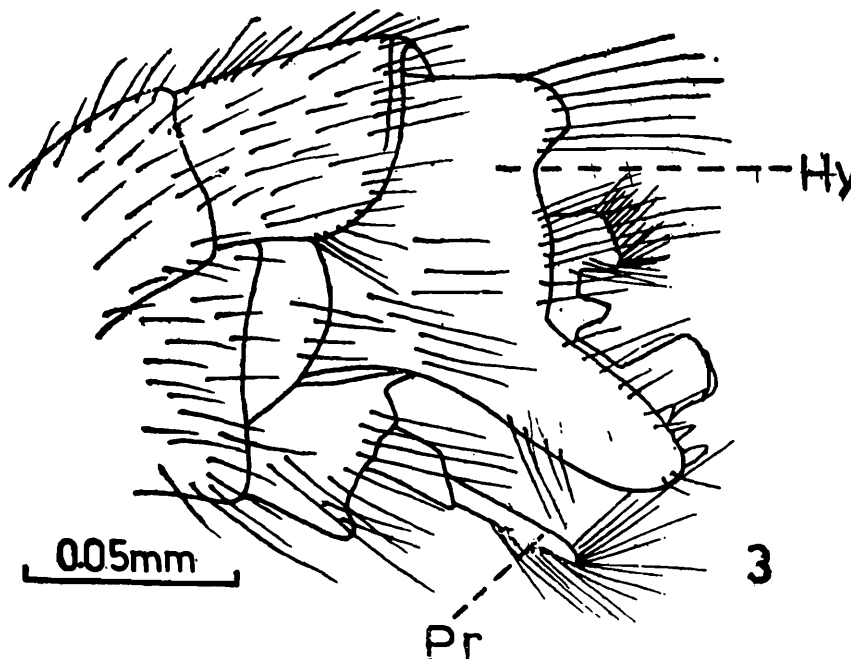


Fig. 3. *Xenomyza dentata* n. sp., lateral view of male genitalia.

of segments 1 and 2 black with an elongate one on the former, segment 2 globular and much longer than 1. Palpi and proboscis black, the former black and pale yellow haired, the latter nearly bare.

Thorax black with grey and greyish-yellow tomentum ; pronotum white haired, hairs dense laterally ; mesonotum medially black, hairs and bristles black, scutellar

which bears dense black bristles, femur on distal half bearing anteroventral and postero-ventral row of bristles, hairs of legs black and pale yellow, bristles black.

Wings apically and at anterior border infuscated, otherwise hyaline.

Abdomen black, grey tomentose, tergites 1-3 laterally with long pale yellow hairs,

remaining hairs pale yellow and black. Male genitalia (Fig. 3) yellowish-brown, lower arm of hypandrium bearing three small projections.

♀ Similar to male; legs yellowish-brown to dark brown, genitalia black.

Members of the genus *Xenomyza* can only be differentiated on the basis of male genitalic structure, since other characters do not exhibit much variation. The species under consideration can be distinguished readily from all the other known regional species by the presence of tooth-like projections on the lower arm of hypandrium.

♂. *Head* broader than thorax, black infuscated with grey tomentum; mystax composed of a transverse row of three or four pale yellow and black bristles, fronto-orbital plate bare, ocellar bristles absent, postcranium grey tomentose with sparse white hairs below. Antennae black, bristles of segment 1 black, one of which is elongate, segment 2 lacking bristles, segment 1 shorter than 2, the latter globular. Palpi and proboscis black with pale yellow hairs.

Thorax black infuscated with grey tomentum; pronotum pale yellow haired, hairs dense laterally; mesonotum medially

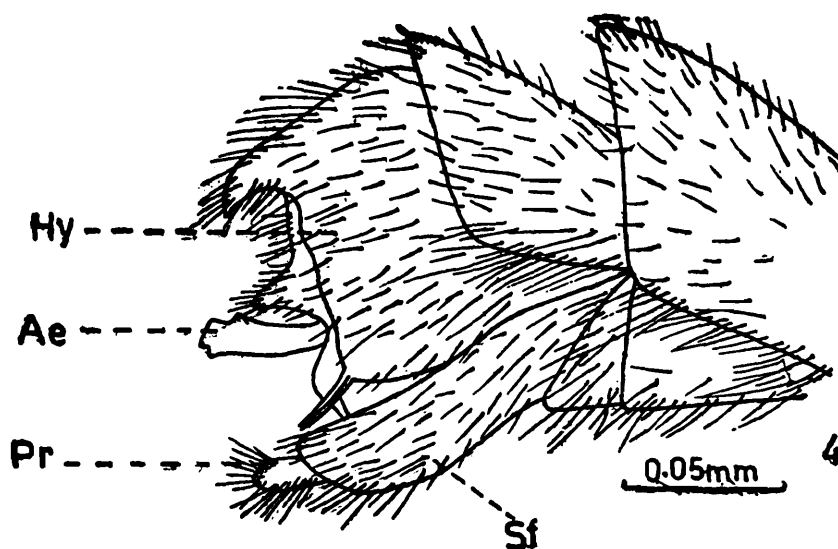


Fig. 4. *Xenomyza himalayaensis* n. sp., lateral view of male genitalia.

Holotype ♂, Reg. No. 7249/H6, India: Palni Hills, Kodaikanal, 2042-2134 m, viii. 1922, coll. S. Kemp. *Paratype* ♀, Reg. No. 7250/H6, lacking data.

9. *Xenomyza himalayaensis* n. sp.
(Fig. 4)

A medium sized species with black thorax, yellowish-brown abdomen and legs, and brown wings. Male: length 10-11 mm, wing 9-10 mm.

black, dark brown anterolaterally and posterolaterally, medial hairs black, white on sides; scutellum sparsely pale yellow haired, hind border with a row of elongate pale yellow setae; pleura sparsely grey tomentose. Halteres pale yellow or yellowish-brown.

Legs uniformly yellowish-brown; hind leg larger in comparison with other legs, trochanter swollen ventrally at apex which bears dense pale yellow hairs, some of which

closely adhere and appear like a pair of bristles, femur swollen and at distal half with an anteroventral and posteroventral row of spiny bristles, in paratype posteroventral bristles few in number ; vestiture of legs pale yellow and black, bristles black.

Wings brown but gradually becoming light brown posteriorly.

Abdomen yellowish-brown, tergites 1-3 with lateral long pale yellow hairs, remaining hairs pale yellow. Male genitalia (Fig. 4) dark brown, hypandrium at the lower angle bearing a pair of spinous bristles.

Of the various known regional species of *Xenomyza*, it is most closely related to *X. artigasi* Joseph and Parui based on the male genitalia but otherwise it is quite distinct differing both in the colouration of legs and structural details of the male genitalia.

Holotype ♂, Reg. No. 7247/H6, Himalayas : Manali, 1829 m, 24.vi.1955, coll. V. K. Gupta (Prof. M. S. Mani, School of Entomology, Expedition Himalayas). *Paratype* ♂, Reg. No. 7248/H6, Dehra Dun, on grass, 31.vii.1913, presented by Forest Research Institute per G. Ricardo, 30.xi.1922, for Zool. coll.

Cophinopoda Hull

10. *Cophinopoda chinensis* (Fabricius)

Asilus chinensis Fabricius, 1794, *Ent. Syst.* 4 : 383.

Cophinopoda chinensis : Oldroyd, 1975, *A Catalog of the Diptera of the Oriental Region* 2 : 129 ; Joseph and Parui, 1984, *Oriental Ins.* 17 : 326.

Material examined : 1 ♂, 1 ♀, Sikkim : Rangpo : Miming, 18.ix.1978, coll. A. N. T. Joseph. 1 ♂, 2 ♀, Assam : Garo Hills : Darugimi Forest Rest House, 16.v.1979, coll.

S. B. Ray. 2 ♂, Kerala : Trichur District : Valapad, 12.xii.1980, coll. A. N. T. Joseph. 1 ♂, Uttar Pradesh : Uttar Kashi District : Dharoti Village, Herseil, 9. ix. 1979, coll. S. K. Gupta.

Remarks : It is a cosmopolitan species. In India it has been recorded thus far from Bihar, Orissa and Tamil Nadu. These are the first records for Sikkim, Assam, Uttar Pradesh and Kerala.

Michotamia Macquart

11. *Michotamia fuscifemorata* Joseph and Parui

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

Material examined : 1 ♀, Kerala : Idukki : Kumili, 13.xii.1979 ; 1 ♂, Trichur District : Chalakudi, 23.xii.1979 ; all collected by Joseph and Parui.

Remarks : This species was described by us from specimens collected in Kerala and Karnataka.

12. *Michotamia pruthii* n. sp.

(Fig. 5)

A small black species with black and pale yellow legs and infuscated wings. Male : length 9 mm, wing 6 mm.

♂. *Head* broader than thorax, black with grey and greyish-yellow tomentum ; mystax pale yellow with a few black bristles above, fronto-orbital plate with a few black bristles, ocellar bristles black, postcranium pale yellow haired, postocular bristles black. Antennae with segments 1 and 2 yellowish-brown, 3 dark brown, bristles of segments 1 and 2 black, segment 2 slightly shorter than

1, segment 3 about twice the combined length of segments 1 and 2, style slightly longer than half of segment 3. Palpi dark brown with pale yellow hairs, proboscis black with white hairs.

Thorax black, grey tomentose ; pronotum with pale yellow hairs with a transverse row of black bristles, mesonotum damaged, black, hairs black with some pale yellow ones on anterolateral angles, bristles black ; scutellum with disc bearing sparse pale yellow hairs, hind border lacking bristles, pleura grey tomentose. Halteres pale yellow.

yellow hairs. Male genitalia (Fig. 5) black with concolourous and pale yellow hairs.

The genus *Michotamia* is represented thus far by five species in India, viz., *M. indiana* Joseph and Parui, *M. analis* Macquart, *M. aurata* (Fabricius), *M. fuscifemorata* Joseph and Parui and *M. macquarti* Joseph and Parui. Of these, the present species is closest to *M. fuscifemorata* Joseph and Parui in the shape of the superior forceps, but differing in having predominantly black legs, wholly black abdomen and deeply infuscated wings.

Holotype ♂, Reg. No. 7246/H6, Kumaun

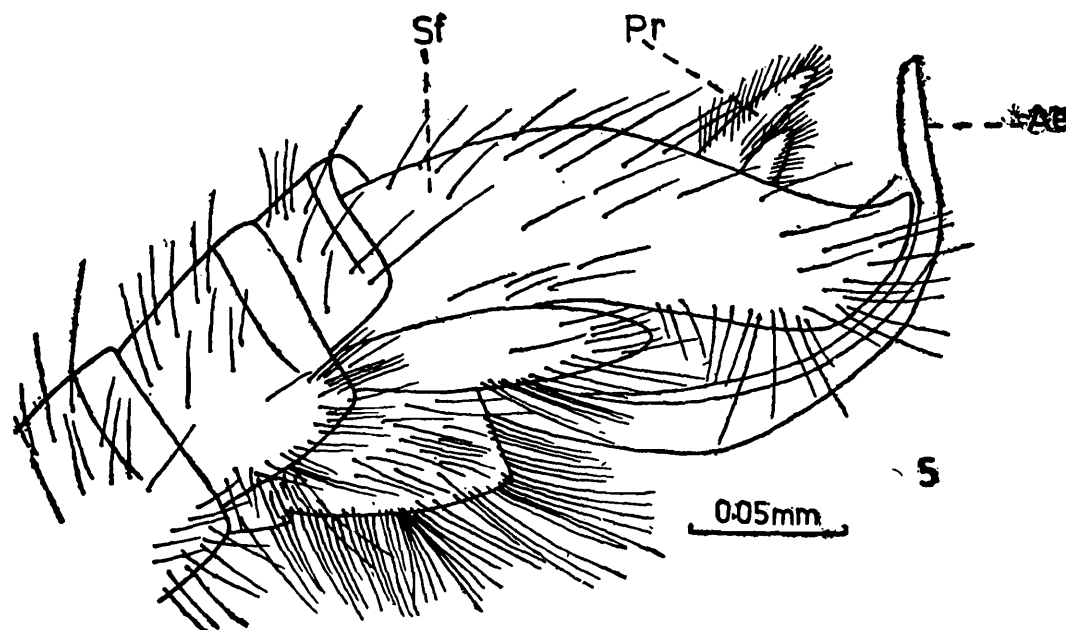


Fig. 5. *Michotamia pruthii* n. sp., lateral view of male genitalia.

Legs black and pale yellow ; coxa, trochanter, femur and tarsus black, fore and mid tibia pale yellow with black apex, hind tibia with the basal one-third pale yellow and the remaining two-thirds black, hairs pale yellow and black, bristles black.

Wings infuscated.

Abdomen black, tergite 1 laterally with a few pale yellow hairs and three or four black bristles, tergites 2 and 3 with some long pale

Hills ; Bhim Tal : grassy part of the dry bed of the lake, station 36, 1356 m, 17.v.1930, coll. H. S. Pruthi.

Ommatius Wiedemann

13. **Ommatius dubius** n. sp.

(Fig. 6)

A medium sized black species with black, dark brown, yellowish-brown and pale yellow legs, infuscated wings and a trifid aedeagus. Male : length 12 mm, wing 9 mm.

♂. *Head* black with sparse grey and greyish-yellow tomentum ; mystax pale yellow with a few black bristles above ; fronto-orbital bristles and ocellar bristles black, postcranium above sparsely and below densely grey tomentose, postocular bristles black, postgena white haired. Antennal segments 1 and 2 yellowish-brown, segment 3 and style dark brown, segment 2 slightly shorter than 1, segment 3 attenuate, much longer than combined length of segments 1 and 2. Palpi and proboscis black, the former with black bristles, latter white haired.

Legs variable in colour ; coxa black, trochanter yellowish-brown to dark brown, femur yellowish-brown, tibia pale yellow but in hind leg posteriorly yellowish-brown, tarsus dark brown, hind tibia and basal two tarsal segments posteriorly with mat of golden yellow pubescence, vestiture mostly black with some pale yellow hairs, bristles black.

Wings infuscated.

Abdomen black, posterior border of tergites 2-4 dark brown and 5-7 with pale

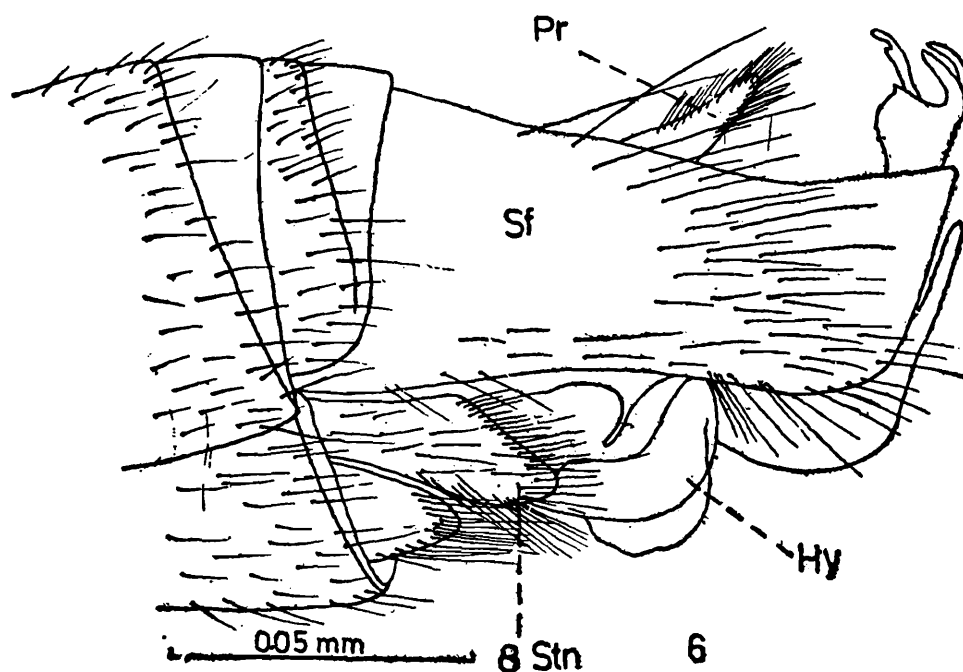


Fig. 6. *Ommatius dubius* n. sp., lateral view of male genitalia.

Thorax black with grey tomentum ; pronotum sparsely white haired with a transverse row of four black bristles ; mesonotum black but anterolaterally and posterolaterally dark brown, sparsely grey tomentose, mediolongitudinal stripe lacking ; scutellum damaged ; pleura sparsely grey tomentose, metapleuron with a transverse row of black bristles, hypopleuron bare. Halteres pale yellowish-brown.

yellow bands, posterolateral angles of tergite 1 with pale yellow and black bristles, hairs pale yellow and black. Male genitalia (Fig. 6) dark brown and yellowish-brown with black and pale yellow hairs, aedeagus trifid.

This species has a distinctive genitalia with trifid aedeagus (Fig. 6), which readily separates it from all the known regional members of the genus *Ommatius*. The long,

attenuate third antennal segment and the shape of the superior forceps are similar to those seen in *Michotamia* Macquart.

Holotype ♂, India, coll. T. R. Bell, British Museum, 1934-394, no other details.

14. *Ommatius gopalpurensis* n. sp.
(Fig. 7)

A small black species with black and yellowish-brown legs, distally infuscated wings and clavate abdomen. Male: length 9-10 mm, wing 6-8 mm.

♂. *Head* black infuscated with greyish-yellow and grey tomentum; mystax black above, pale yellow below; fronto-orbital bristles and ocellar bristles black, postcranium above sparsely grey tomentose, below densely grey tomentose, hairs white, sparse above and dense below, postocular bristles black. Antennae including bristles black, segment 2 slightly shorter than 1, segments 3 and 1 subequal in length. Palpi and proboscis

black, the former black haired with a few pale yellow hairs, proboscis wholly white haired.

Thorax black with grey tomentum; pronotum sparsely white haired with a transverse row of four bristles, inner pair black and outer pair pale yellow; mesonotum lacking mediolongitudinal stripe, tomentum sparse and restricted to sides; scutellar disc sparsely white haired with a pair of black bristles on border; pleura grey tomentose, metapleuron and hypopleuron with a transverse row of black and pale yellow bristles. Halteres yellowish-brown.

Legs black and yellowish-brown; coxa, trochanter and femur black, tibia yellowish-brown, black apically, basitarsus yellowish-brown with black apex, rest of tarsal segments black or yellowish-brown and black, fore and mid femur ventrally with long white hairs, hind femur with anteroventral and posteroventral row of black spines, hairs intermixed black and white, bristles black.

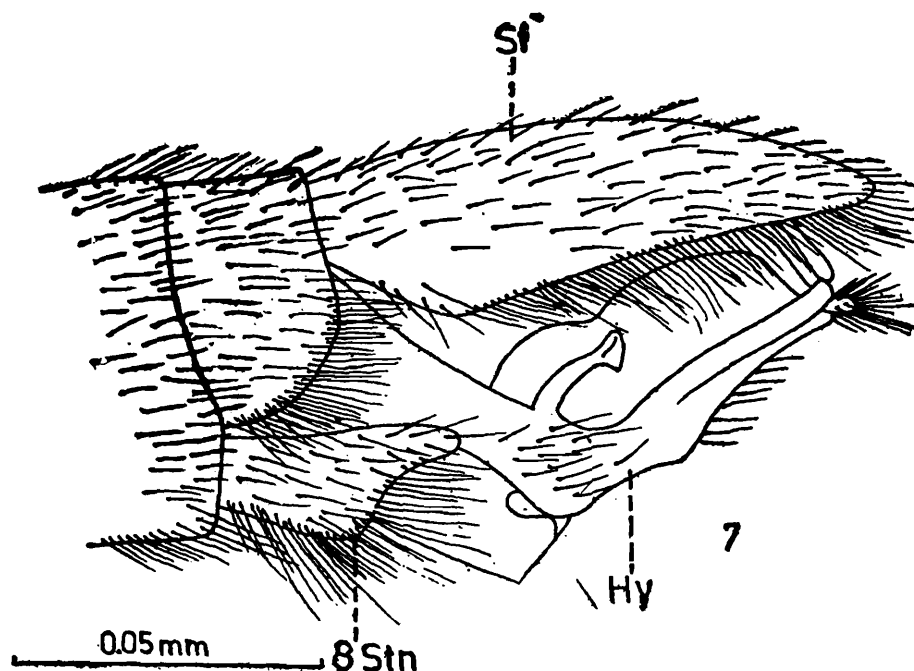


Fig.:7. *Ommatius gopalpurensis* n. sp., lateral view of male genitalia.

Wings infuscated but basally and medially hyaline, the infuscation deeper anteriorly.

Abdomen clavate, black with its sides yellowish-brown in holotype and grey in paratype, tergites 1 and 2 with some long white or pale yellow hairs on sides, hairs intermixed black and white. Male genitalia (Fig. 7) black with black and pale yellow hairs.

The male genitalia of *Ommatius gopalpurensis* n. sp. and *O. peregrinus* (Wulp) are similar in shape but they differ widely in structural details.

Holotype ♂, Reg. No. 7259/H6, India : W. Bengal : 24 Parganas : Gopalpur, 24.vi.1983, coll. P. Parui. *Paratype* ♂, Reg. No. 7260/H6, rest of data as in holotype.

15. *Ommatius indicus* Joseph and Parui

Ommatius indicus Joseph and Parui, 1983, *Ent. Scand.* 14(1) : 86 ; Joseph and Parui, 1984, *Oriental Ins.*, 17 : 332.

Material examined : 2 ♀, Kerala : Idukki : Periyar, 900 m, 12.xii.1979, 2 ♂, 2 ♀, Ernakulam District : Malayattur, 16.xii.1979 ; 2 ♀, 2 ♀, Ernakulam District : Pandupara, 16.xii.1979 ; 8 ♂, 11 ♀, Ernakulam District : Idamalaya, 18.xii.1979 ; 3 ♂, 3 ♀, Trichur District : Anamalai Hills : Poringalkuth, 21.xii.1979 ; 2 ♂, 6 ♀, Trichur District : Chalakudy : Kannakuzhi, 22.xii.1979 ; all collected by Joseph and Parui.

Remarks : It has thus far been recorded only from Kerala and Karnataka.

16. *Ommatius tuberculatus* Joseph and Parui

Ommatius tuberculatus Joseph and Parui, 1983, *Ent. Scand.* 14 (1) 87 ; Joseph and Parui, 1984, *Oriental Ins.* 17 : 336.

Material examined : 1 ♂, Kerala : Idukki : Periyar, 900 m, 12.xii.1979, coll. Joseph and Parui.

Remarks : This species has thus far been recorded only from Kerala and Tamil Nadu.

Astochia Becker

17. *Astochia muralidharani* n. sp.

(Fig. 8)

A medium sized black species with black and pale yellow legs and brownish wings. Male : length 19mm, wing 12mm.

♂. *Head* broader than thorax, black, dense greyish-yellow tomentose ; mystax white with black bristles above and laterally, fronto-orbital bristles and ocellar bristles black, postcranium white haired below, black haired above, postocular bristles black. Antennae black but base and apex of segment 2 and base of segment 3 yellowish-brown, bristles on segments 1 and 2 black, segment 2 slightly shorter than 1, segment 3 subequal to segments 1 and 2, style longer than segment 3. Palpi and proboscis black, the former pale yellow haired, the latter white haired.

Thorax black covered with grey tomentum, pronotum white haired with a transverse row of four black bristles ; mesonotum greasy, the presence of medio-longitudinal stripe cannot be ascertained, hairs black with some pale yellow ones laterally, bristles black ; scutellar disc black haired, hind border with a pair of black bristles, metapleuron and hypopleuron with a transverse row of long pale yellow bristles. Halteres pale yellow to yellowish-brown.

Legs black and pale yellow; coxa, trochanter, femur and tarsus black, fore and mid tibia anteriorly and ventrally black, the rest pale yellow, basal one-fourth of hind tibia yellowish-brown, the remainder black, fore tibia ventrally at apex with a brush of long black hairs, hind tibia at apex posteriorly and basitarsus posteriorly with adpressed golden yellow pubescence, hairs intermixed white and black, bristles black.

Wings brown, but medially light brown.

Of the known regional species in the genus, it is closer to *Astochia guptai* Joseph and Parui from which it can be readily distinguished by the presence of elongate apical hairs on the fore tibia, narrow and darker abdomen and by the shape of the superior forceps.

Holotype ♂, Reg. No. 7251/H6, India: Tripura: S. Tripura District: 1 km. east of Forest Rest House, 28.ix.1977, coll. N. Muralidharan.

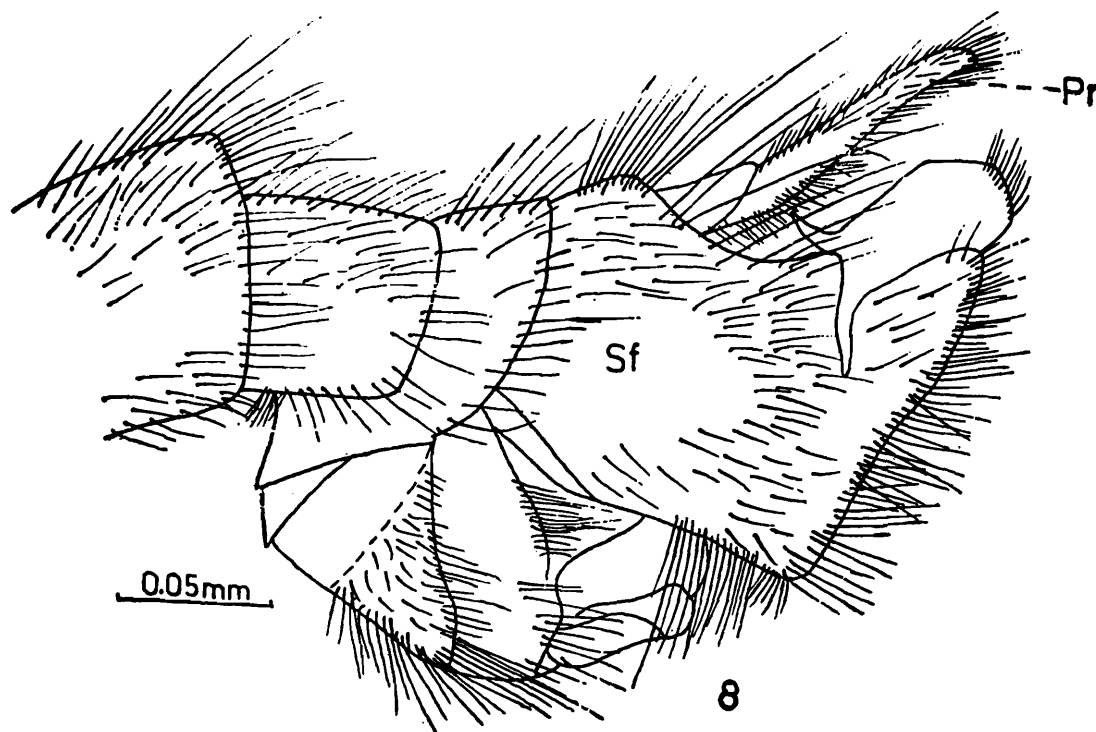


Fig. 8. *Astochia muralidharani* n. sp., lateral view of male genitalia.

Abdomen black with posterolateral angles of tergites infuscated with grey, the grey infuscation gradually decreasing in area from the anterior to posterior tergites, tergite 1 laterally with a brush of white hairs, a few of which form bristles, hairs black with some white ones laterally. Male genitalia (Fig. 8) black with black and white hairs.

18. *Astochia pseudoguptai* n. sp.

(Fig. 9)

A medium sized black and grey species with dark brown and pale yellow legs and infuscated wings. Male: length 17 mm, wing 11 mm.

♂. *Head* broader than thorax, black, tomentum grey, sparse and restricted to

occiput ; mystax pale yellow, fronto-orbital plate with mostly black and a few yellowish-brown bristles, ocellar bristles black, postcranium with sparse black and white hairs above, white haired below, postocular bristles black and four on either side. Antennae black, yellowish-brown on base and apex of segment 2 and base and lower side of segment 3, bristles on segments 1 and 2 black, segment 2 slightly shorter than 1, segment 3 subequal to the combined length of segments 1 and 2, style slightly longer than segment 3. Palpi and proboscis black with pale yellow hairs.

black spots followed by another small black spot, hairs black ; scutellum densely grey tomentose, hairs on disc mostly white with some black ones, border with two black bristles ; pleura densely grey tomentose, metapleuron and hypopleuron each with elongate pale yellow hairs. Halteres with pale yellowish-brown knob and lighter coloured stalks.

Legs dark brown and pale yellow ; coxa, trochanter, femur and tarsus dark brown, tibia pale yellow with black apex, the black colouration more extensive on hind tibia

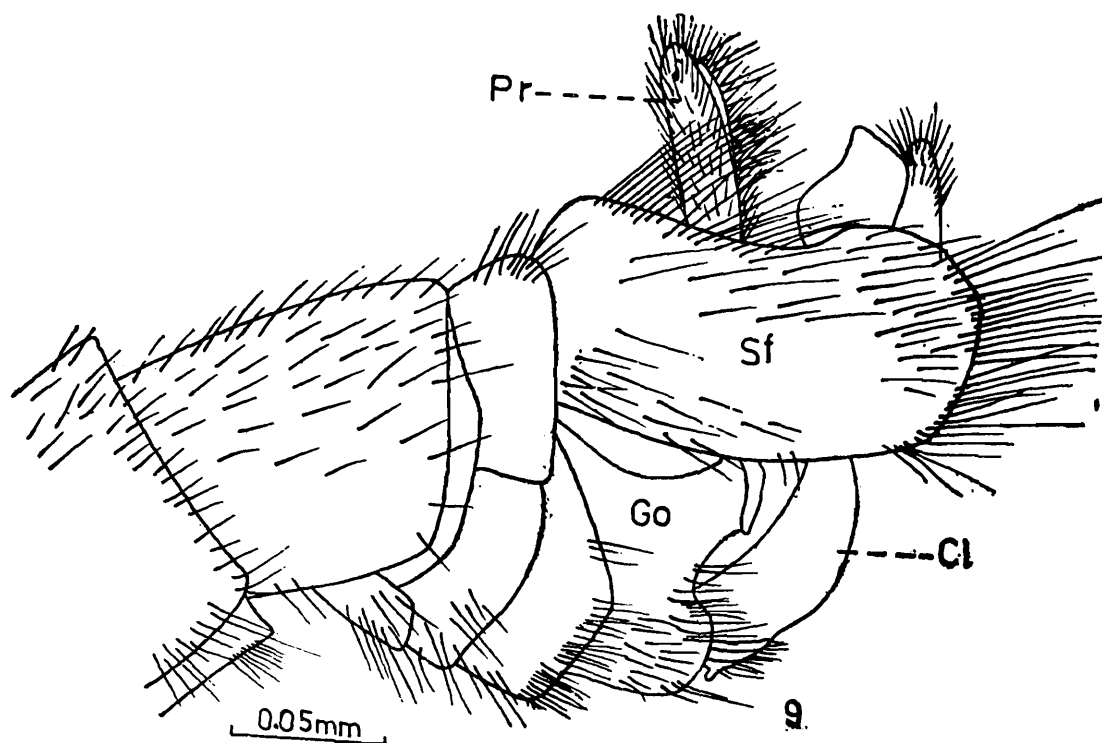


Fig. 9. *Astochia pseudoguptai* n. sp., lateral view of male genitalia.

Thorax black with grey tomentum ; pronotum pale yellow haired with a transverse row of four pale yellow bristles ; mesonotum with a mediolongitudinal slate grey stripe divided by a grey stripe, the stripe extending from the anterior border to well beyond the transverse suture, each side with two large

and hind basitarsus, distal part of hind tibia posteriorly with adpressed golden yellow pubescence, hairs intermixed white and black, bristles black.

Wings infuscated, but medially almost hyaline.

Abdomen black with a transverse grey band at posterior border of tergites, the grey border decreasing in area from anterior to posterior tergites, tergite 1 laterally with elongate white hairs amidst which present four black bristles, tergite 2 laterally with elongate white hairs, remaining hairs white. Male genitalia (Fig. 9) dark brown to black with intermixed black and white hairs.

It is closely allied to *Astochia guptai* Joseph and Parui from which it can be distinguished by the not so dense hairs on the sides of abdominal tergites 2 and 3 and the shape of superior forceps.

Holotype ♂, Reg. No. 7252/H6, Sikkim : Rangli, 810 m, 2.v. 1962. coll. S. Ali.

sparsely grey tomentose ; mystax with white or pale yellow bristles surrounded by black ones ; fronto-orbital bristles and ocellar bristles black, postcranium black haired above and white haired below, postocular bristles black. Antennal segment 3 missing, segments 1 and 2 black with black bristles, segment 2 slightly longer than half of preceding. Palpi and proboscis black, the former with pale yellow hairs, the latter white haired.

Thorax black, grey tomentose ; pronotum white haired with one black bristle on each side ; mesonotum with faint mediolongitudinal black stripe divided by a narrow black stripe, lateral spots indistinct, vestiture black

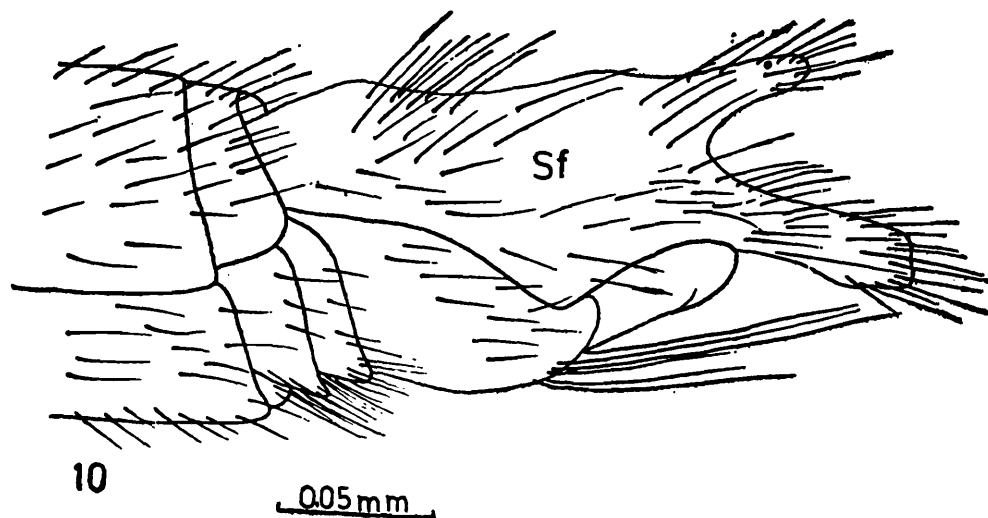


Fig. 10. *Heligmoneura himalayana* n. sp., lateral view of male genitalia.

Heligmoneura Bigot

19. *Heligmoneura himalayana* n. sp.

(Fig. 10)

A black species with black legs, black and pale yellow mystax and brownish wings. Male : length 17-19 mm, wing 11-13 mm.

♂. **Head** as broad as thorax, black,

with a few pale yellow hairs on anterolateral angles, bristles black ; scutellum black, sparsely grey tomentose, hairs of disc black, border with four black bristles. Halteres yellowish-brown.

Legs black, but tarsal segments dark brown ; fore femur densely haired, mid and hind femora with anteroventral row of white

bristles, in holotype an anterodorsal row of white bristles is present on the hind femur, hairs intermixed white and black.

Wings light brown.

Abdomen black with a transverse grey band on posterior border of tergite 1 and 2, and on both posterior and anterior borders of tergites 2 to 5, grey band indistinct in paratype, sides of tergite 1 with pale yellow hairs amidst which occur a row of black bristles, tergites 2 and 3 with long black hairs laterally, and a few black bristles posterolaterally, hairs black, with a few pale yellow ones intermixed. Male genitalia (Fig. 10) black with black and pale yellow hairs.

Paratype ♂, Reg. No. 7243/H6, India : U. P. : Mussoorie, 15.viii. 1971, coll, name indistinct.

20. *Heligmoneura ladakhensis* n. sp.

(Fig. 11)

A black species with yellowish-brown legs, white and black mystax and brownish wings. Male : length 12 mm, wing 8 mm.

♂. *Head* as broad as thorax, black, densely grey tomentose ; mystax with white bristles surrounded by black ones ; fronto-orbital bristles pale yellow, ocellar bristles black, postcranium pale yellow haired. Antennal segments 1 and 2 yellowish-brown with pale yellow bristles, segment 3 black, segment 2 shorter than 1, segment 3 slightly

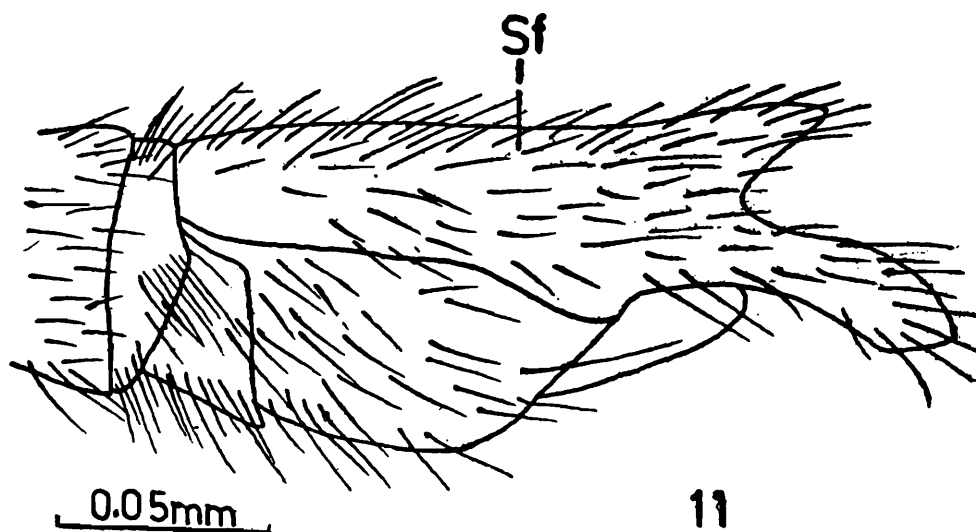


Fig. 11. *Heligmoneura ladakhensis* n. sp. ; lateral view of male genitalia.

In the key to Indian species of *Heligmoneura* (Joseph and Parui 1980), it would come under the couplet 13 and is somewhat similar to *H. gnava* (Wulp) from which it differs due to the slender abdomen, wholly black legs and quite distinct male genitalia.

Holotype ♂, Reg. No. 7242/H6, Himalaya : Mussoorie, 15.viii. 1968, coll. Renuka.

longer than 1+2 combined, style much shorter than segment 3. Palpi and proboscis black with white hairs.

Thorax black, grey tomentose ; pronotum white haired, mesonotum with a mediolongitudinal black stripe divided by a longitudinal grey stripe, the stripe extending from anterior border to midway between the transverse

suture and posterior border, hairs black with a few pale yellow ones on anterolateral angles, bristles black; scutellum with disc pale yellow haired and with five black and white bristles on posterior margin. Halteres pale yellow.

Legs yellowish-brown; mid and hind femora with anteroventral row of white bristles, hind femur also with a row of posteroventral long white bristles, hairs predominantly white with some black ones intermixed, bristles both white and black.

Wings light brown.

Abdomen black with posterior border of tergites grey tomentose, tergite 1 with a tuft of white hairs laterally, postero-lateral angles of tergites 2-4 with three pale yellow bristles, hairs pale yellow and black. Male genitalia (Fig. 11) black with pale yellow hairs.

Of the various known regional species of *Heligmoneura*, the species under consideration is nearest to *H. himalayana* n. sp. from which it differs by its smaller size, yellowish-brown legs and the specific difference in the shape of superior forceps.

Holotype ♂, Reg. No. 7244/H6, Kashmir; Ladakh: Drass, 3900 m, 12.vi.1973, coll. Girish (No. G. 35).

21. *Heligmoneura poonmudiensis*

Joseph and Parui

Heligmoneura poonmudiensis Joseph and Parui, 1980, *Ent. Scand.* 11(3): 287; 1984, *Oriental Ins.* 17: 351.

Material examined: 1 ♂, Kerala: Ernakulam District: Idamalaya, 18.xii.1979, coll. Joseph and Parui.

Remarks: This is only the second record of this species from the type locality. It has not been recorded elsewhere.

Machimus Loew

22. *Machimus angularis* (Ricardo)

Tolmerus angularis Ricardo, 1921, *Ann. Mag. nat. Hist.* (9) 10: 64-

Machimus angularis: Oldroyd 1975, *A Catalog of Diptera of the Oriental Region*, 2: 144; Joseph and Pauri, 1984, *Oriental Ins.* 17: 354.

Material examined: 1 ♂, Himachal Pradesh: Simla, 3.x.1966, coll. Ram; 2 ♂, Uttar Pradesh: Mussoorie, 17.vi.1967, coll. Gupta; 1 ♂, Uttar Pradesh: Mussoorie, 2100 m, 20.x.1972, coll. Khanna; 3 ♂, 21.x.1972; 6 ♂, 4 ♀, 22.x.1972; 1 ♂, 2 ♀, 23.x.1972 and 2 ♂, 2 ♀, 25.x.1972, other details as in preceding; 1 ♂, Uttar Pradesh: Kumaon Hills: Dhakuri, 2621 m, 29.xi.1973, coll. Gupta.

Remarks: So far the species has only been recorded from Uttar Pradesh. This is the first record for Himachal Pradesh.

23. *Machimus inutilis* Bromley

Machimus inutilis Bromley, 1935, *Rec. Indian Mus.* 27: 222; Joseph and Parui, 1984, *Oriental Ins.* 17: 355.

Material examined: 1 ♂, Himachal Pradesh: Manali, 1828 m, 13.v.1970, coll. M. Gupta; 1 ♂, Himachal Pradesh: Dhenkund, 2743 m, 5.v.1971.

Remarks: Thus far this species has been collected only in Himachal Pradesh.

24. *Machimus pseudonicobarensis* n. sp.

(Fig. 12)

A rather large black species with black legs, infuscated wings and eighth sternite not produced. Male : length 20 mm, wing 14 mm.

♂ : *Head* narrower than thorax, black, grey tomentose ; *mystax* black with some pale yellow bristles below, fronto-orbital bristles and ocellar bristles black, postcranium pale yellow and black haired above, with some black hairs just below it, and the remaining almost bare, postocular bristles black, postgena densely white haired. Antennae

white, sparse : mesonotum with a broad, black mediolongitudinal stripe divided by a medium stripe, the stripe extending from anterior margin to well beyond the transverse suture, sides with three black spots in a longitudinal row, hairs and bristles black ; scutellum black haired with a few pale yellow ones laterally, posterior border with five black bristles ; metapleuron and hypopleuron each with a transverse row of black bristles, black on the former and black and pale yellow on the latter. Halteres whitish.

Legs black ; fore femur with five long

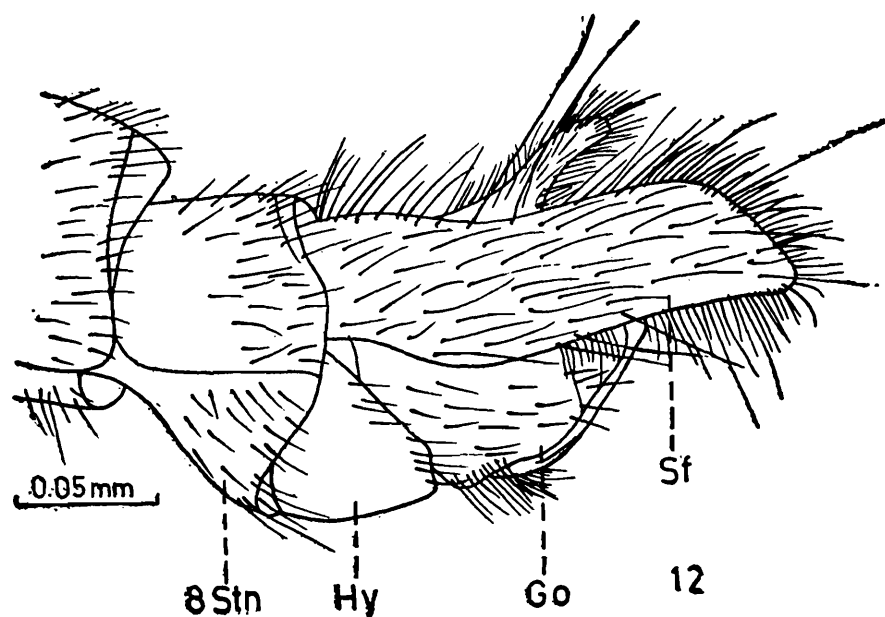


Fig. 12. *Machimus pseudonicobarensis* n. sp., lateral view of male genitalia.

black, segments 1 and 2 bearing black bristles, segment 2 about two-thirds the length of 1, style subequal to segment 3. Palpi and proboscis black, the former black haired, the latter white haired.

Thorax black with grey and greyish-yellow tomentum ; pronotum with a median transverse row of black bristles, some black hairs present on posterolateral angles, vestiture

black hairs ventrally on the basal half, mid femur with an anteroventral row of bristles from base to middle, hind femur with anterodorsal, anteroventral and posteroventral rows of bristles extending well beyond the middle, on hind leg distal part of tibia and whole of basitarsus posteriorly with adpressed golden yellow pubescence, hairs black and pale yellow.

Wings infuscated but medially and basally almost hyaline.

Abdomen black and grey, tergite 1 grey, 2-4 laterally and posteriorly grey with a median black spot, 5-8 laterally grey and medially black, tergite 1 laterally with a tuft of pale yellow intermixed with black bristles, tergites 2-4 laterally with some pale yellow and black bristles in a row, hairs black. Male genitalia (Fig. 12) black with concolourous hairs, eighth sternite neither produced nor bearing dense bristles.

It is closely allied to *Machimns nicobarensis* (Schiner) from Nicobar from which it differs in its larger size and lack of dense hairs on eighth sternite.

Holotype ♂, Reg. No. 7262/H6, India : Himachal Pradesh : Dhenkund, (trap), 2743 m, 5, viii. 1971, coll. name not given.

Neoitamus Osten-Sacken

25. *Neoitamus dhenkunde* is n. sp.

(Fig. 13)

A medium sized black species with black and pale yellow legs and apically infuscated wings. Male : length 13 mm, wing 9 mm ; female : length 16-21 mm, wing 11-13 mm.

♂. *Head* as broad as thorax, black, grey tomentose ; mystax white surrounded by black bristles ; fronto-orbital bristles and ocellar bristles black, postcranium bare above, with black and pale yellow bristles below. Antennae black with base and apex of segment 2 and base of segment 3 yellowish-brown, bristles on segments 1 and 2 black, segment 2 at least one and-a-half times that of 1, segment 3 subequal to segments 1 and 2. Palpi and proboscis black, the former

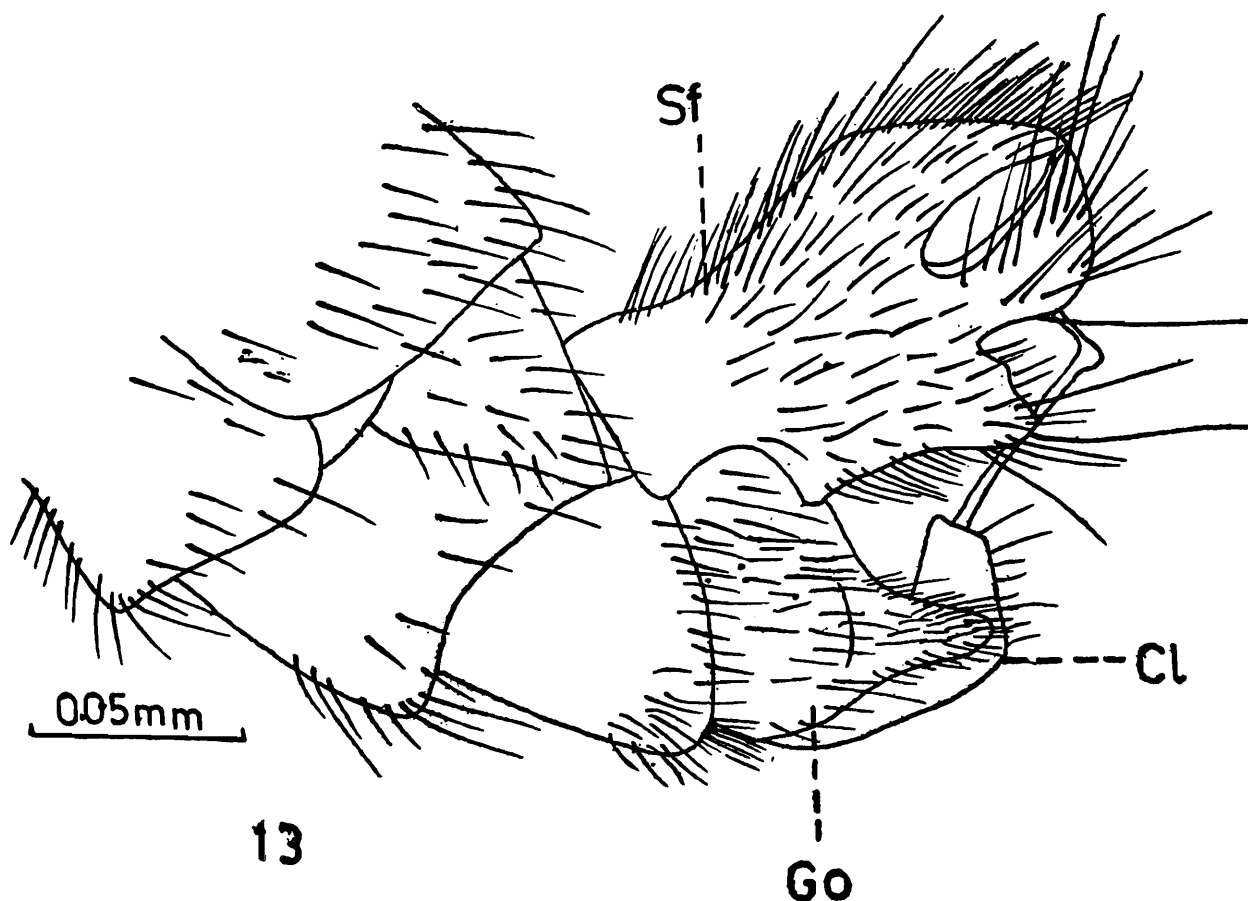


Fig. 13. *Neoitamus dhenkundensis* n. sp., lateral view of male genitalia.

with black and some pale yellow hairs, the latter pale yellow haired.

Thorax black, grey tomentose; pronotum pale yellow haired, medially with a transverse row of pale yellow bristles; mesonotum with a faintly marked medilongitudinal black stripe divided by a grey line, the stripe extending from anterior margin to midway between the transverse suture and the posterior border, hairs black with some pale yellow ones on posterolateral angles, bristles black; scutellar disc black and pale yellow haired, border bearing a pair of black bristles; pleura grey tomentose, metapleuron with a brush of elongate white hairs. Halteres whitish.

Legs black and pale yellow; coxa, trochanter and femur black, tibia pale yellow with black apex, tarsus pale yellow but apex of segments of hind leg dark brown; fore and mid femora with black bristles ventrally from base to middle, hind femur with a posteroventral row of white bristles, hairs and bristles both black and white.

Wings apically infuscated extending posteriorly into the fifth posterior cell.

Ahdomen black, grey infuscated, tergite 1 laterally with a few elongate hairs, hairs both black and pale yellow. Male genitalia (Fig. 13) black and yellowish-brown with mostly black and a few pale yellow hairs.

♀. Similar to male but with the following differences: some specimens comparatively darker in which case mystax with a pair of pale yellow bristles or wholly black; antennae in one paratype completely black; black colouration of tibia more extensive in some paratypes.

It is closely allied to *Neoitamus barsilensis* Joseph and Parui from which it differs in the shape of superior forceps and gonopod.

Holotype ♂, Reg. No. 7253/H6, India: Himachal Pradesh: Dhenkund (trap), 2743 m, v-vi.1971, coll. name not given. **Paratypes** 5 ♀, Reg. No. 7254/H6 to 7258/H6, details as in holotype.

Neomochtherus Osten Sacken

26. **Neomochtherus gnavus** (Van der Wulp)

Mochtherus gnavus van der Wulp, 1872, *Tijdschr. Ent.* 15 : 243.

Neomochtherus gnavus: Oldroyd, 1975, *A Catalog of Diptera of the Oriental Region* 2 : 148; Joseph and Parui, 1984, *Oriental Ins.* 17 : 358.

Material examined: 13 ♂, 5 ♀, Sikkim: Rangpo: Duga, 400 m, 16.x.1978. coll. Joseph and Parui.

Remarks: This is a widely distributed species in the Oriental Region. In India it has been reported from Assam, Arunachal Pradesh and Uttar Pradesh. This is the first record for Sikkim.

Orophotus Backer

27. **Orophotus montanus** (Ricardo)

Asilus montanus Ricardo, 1922, *Anu. Mag. nat. Hist.* (9) 10 : 47.

Orophotus montanus: Oldroyd, 1975, *A Catalog of Diptera of the Oriental Region* 2 : 148; Joseph and Parui, 1984, *Oriental Ins.* 17 : 36.

Material examined: 1 ♂, Uttar Pradesh: Almora District: Kausani, 1.vi.1930, coll. H. S. Pruthi.

Remarks: The species was described from Assam. The Z.S.I. collection contains specimens from West Bengal. It is recorded here for the first time from Uttar Pradesh.

Philodicus Loew**28. Philodicus femoralis Ricardo**

Philodicus femoralis Ricardo, 1921, *Ann. Mag. nat. Hist.* (9) 8 : 190 ; Joseph and Parui, 1984 *Oriental Ins.* 17 : 361.

Material examined : 1 ♂, Goa : Mercus, 24.iii.1966 ; 1 ♂, Margoa, 11.iv.1966 ; 1 ♀, Velury : Valpoi, 13.iv.1966 ; and 1 ♂, Margoa : Fatonda, 21.iv.1966 ; all collected by Pradhan and Party. 6 ♂, 2 ♀, Kerala : Trichur District : Chalakudy, 12.xii.1980, coll. A.N.T. Joseph.

Remarks : The species has been collected in Meghalaya, Arunachal Pradesh, West Bengal, Bihar and Uttar Pradesh. These are the first records for Goa and Kerala.

29. Philodicus javanus (Wiedemann)

Asilus javanus Wiedemann, 1819, *Zool. Mag.* (Wied.) 1 (3) : 32.

Philodicus javanus : Oldroyd, 1975, *A Catalog of Diptera of the Oriental Region* 2 : 149 ; Joseph and Parui, 1984, *Oriental Ins.* 17 : 362.

Material examined : 1 ♂, Himachal Pradesh : Kufri, 2500 m, 12.ix.1969 ; and 1 ♂, Solan : Saprion, 1450 m, 31.ix.1969 ; all collected by G. S. Arora. 2 ♂, 1 ♀, Uttar Pradesh : Garhwal District : Sirar Village, 1372 m, 6.ix.1979 ; and 1 ♀, Hersil, 2438 m ; all collected by S. K. Gupta.

Remarks : This species was previously recorded from Sikkim, Assam, Arunachal Pradesh, West Bengal, Bihar, Uttar Pradesh, Tamil Nadu and Karnataka. It is recorded here for first time from Himachal Pradesh.

Promachus Loew**30. Promachus duvaucelii (Maquart)**

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

Promachus duvaucelii : Oldroyd, 1975, *A Catalog of Diptera of the Oriental Region* 2 : 152 ; Joseph and Parui, 1984, *Oriental Ins.* 17 : 366.

Material examined : 1 ♀, 25.viii.1960, coll. N. Viswani ; 1 ♀, 21.vii.1961, coll. Saxena ; 1 ♀, 2.ix.1962, coll. P. Seth ; 1 ♀, 9.ix.1962, coll. K. B. ; 1 ♂, ix.1962, coll. Gupta ; and 1 ♀, 2.ii.1963, coll. S. Mohla ; all collected on Delhi University Campus. 2 ♀, Uttar Pradesh : Chaukettia, 2000 m, 17.viii.1973, coll. Neelam. 2 ♀, Delhi : Ridge. 30.viii.1975, coll. Mohan.

Remarks : Records are available for West Bengal, Uttar Pradesh, Madhya Pradesh, Punjab, Gujarat, Delhi, Karnataka, and Tamil Nadu.

31. Promachus genitalis Joseph and Parui

Promachus genitalis Joseph and Parui, *Bull. Zool. Surv. India.* (In press).

Material examined : 2 ♂, Madhya Pradesh : Jabalpur, 487 m, ix.1957, collector's name not given.

Remarks : This is the second record, and it is from the type locality.

Trichomachimus Engel**32. Trichomachimus pubescens (Ricardo)**

Asilus pubescens Ricardo, 1922, *Ann. Mag. nat. Hist.* (9) 10 : 67.

Trichomachimus pubescens : Oldroyd, 1975, *A Catalog of Diptera of the Oriental Region* 2 : 156 ; Joseph and Parui, 1984, *Oriental Ins.* 17 : 372.

Material examined : 1 ♂, Sikkim : Gangtok, 500 m, 20.x.1978, coll. A. N. T.

Joseph and party. 1 ♂, Arunachal Pradesh : Subansiri District : Baskem Village, 27.x. 1981, coll. S. K. Gupta and M. Prasad.

Remarks : The only previous records thus far for India were from Sikkim. This is the first record from Arunachal Pradesh.

ACKNOWLEDGEMENTS

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Abbreviations used in text-figures

Ae, aedeagus ; Cl, clasper ; Go, gonopod (gonocoxite) ; Hy, hypandrium ; Pr, proctiger ; Sf, superior forceps (epandrium) ; 8 Stn, eighth sternite.

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NOTES ON A COLLECTION OF DERMAPTERA PRESENT IN
ZOOLOGISK MUSEUM, COPENHAGEN

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ABSTRACT

The present paper deals with 26 species (excluding 3 determined up to generic level) belonging to 20 genera, from Thailand, of which two species, namely, *Paralabis henriki* and *Chaetolabia pygidiata* are new to Science. In addition, *Paratages sakaii* gen. and sp. n., are also described. Brief notes on certain species are given.

INTRODUCTION

The present paper is based on a small collection of Dermaptera from Thailand with exception of 1 example each from Australia and Cooks Isl. (New Zealand). Altogether 26 species (excluding 3 identified up to generic level, since represented by females only) belonging to 20 genera are treated, including *Paralabis henriki* and *Chaetolabia pygidiata* as new to science. Besides, a new genus and species viz., *Paratages sakaii* are described from Thailand.

According to Ramamurthi (1973) and available literature a total of 21 species are reported from Thailand. As result of present study another 18 species are added to the fauna of the area.

PYGIDICRANIDAE

PYGIDICRANINAE

Cranopygia modesta (Bormans)

Pygidicrana modesta Bormans, 1884, *Annali Mus. civ. Stor. nat. Giacomo Doria*, (2) 14 : 375 (♂, ♀ ; Burma).

Material examined : Thailand : Chiang Mai Province Doi Suthep N. P. Konthathan, 6-700 m, 1♂ (genitalia mounted between two coverslips and pinned with the specimen), 30.ix.1981.

Remarks : Originally described from Burma it has since been recorded from Java and Philippines Isls. as well.

ECHINOSOMATINAE

Echinosoma sp.

Material examined : Thailand : Doi

Suthep-Pui natn. Park, Doi Pui Road,
1000 m, 1 ♀, 23-26.x.1979.

Remarks: It is not possible to determine this isolated female up to species level.

PROLABISCINAE

Prolabisca infernalis (Burr)

Chaetospania infernalis Burr, 1913, *Ent. Mitt.*, 12 : 67, figs. (Taihorin, 1 ♂, 7 ♀♀ and nymphs, excluding 1 ♂ (nec ♀), Kosempo).

Prolabisca infernalis: Srivastava, 1984, *Bull. zool. Surv. India*, 5(2 & 3) : 105 (♂ genitalia of Lectotype).

Material examined: Thailand: Doi Suthep-Pui natn. Park, Konthathan waterfall area, 600 m, 1 ♀, 20-27.x.1979.

Remarks: This characteristic species could be easily determined even on the isolated females.

It appears to be widely distributed throughout the Oriental Region.

CARCINOPHORIDAE

PLATYLABIINAE

Platylabia major Dohrn

Platylabia major Dohrn, 1867, *Stettin. ent. Ztg.*, 28 : 347 (♀, Celebes-Holotype in PAN Zoologiczny Instytut, Warszawa, Poland); Srivastava, 1983, *Bull. zool. Surv. India*, 4(1) : 104, figs. 1-5.

Material examined: Thailand: Doi Suthep-Pui natn. Park, Doi Pui Road 1000 m, 7 nymphs, 23-26.x.1979, Chiang Mai Province, Doi Saket, 950 m, 3 nymphs, 3.x.1981, N. F. Mahidol Waterfall, 1250 m 1 ♀, 27.x.1981.

Remarks: Appears to be widely distributed in the Oriental Region.

CARCINOPHORINAE

Gelotolabis cavaleriei (Borelli)

(Fig. 1)

Anisolabis cavaleriei Borelli, *Bull. Mus. Hist. nat. Paris*, 27 : 158 (♂, ♀; Kouy Ichéou).

Anisolabis (Gelotolabis) cavaleriei: Bey-Bienko, 1959, *Ent. Obzor*, 38 : 600.

Material examined: Thailand: Chiang Mai Province, Doi Inthanon NP, main road, 1900 m, 1 ♂ (genitalia mounted between two coverslips and pinned with the specimen), 2 ♀♀ and 1 nymph, 6.x.1981; 1 ♂ (genitalia mounted between two coverslips and pinned with the specimen), 1 ♀ and 5 nymphs, 15.x.1981.

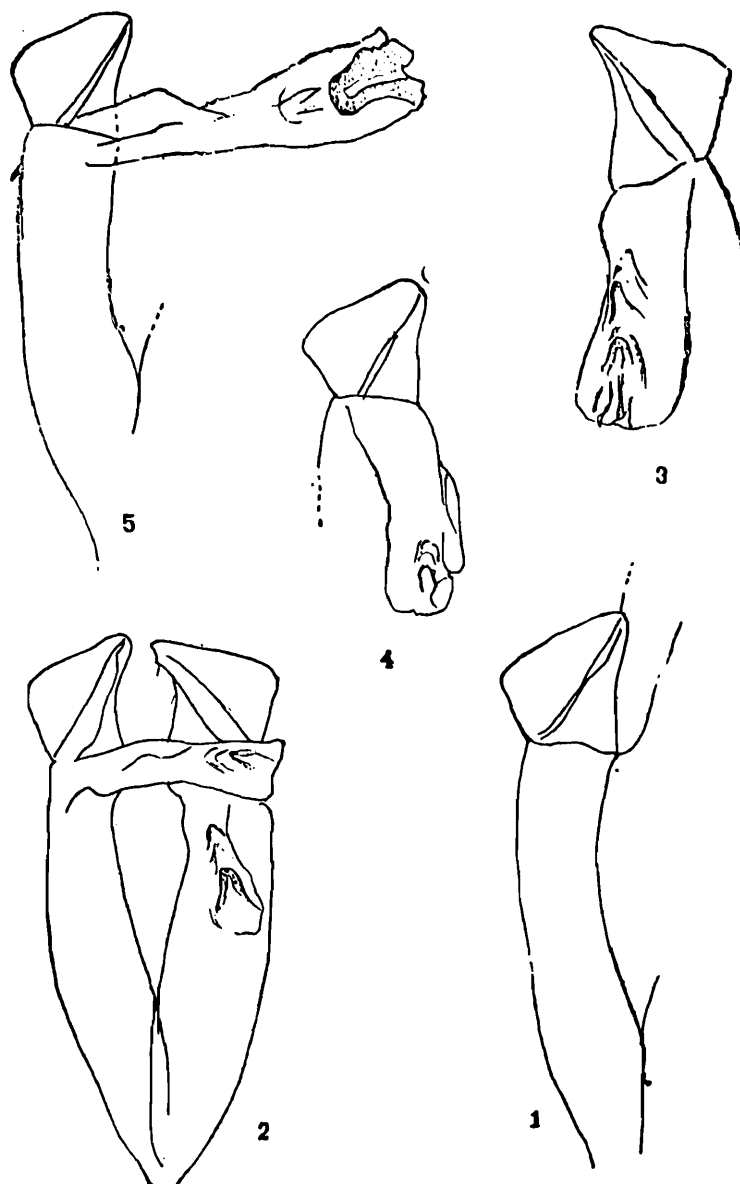
Remarks: There appears to be some variation in the colour of legs. In males it is uniform dark brownish yellow whereas in the females femora in basal half may be sometimes dark brownish black.

Gelotolabis affinis (Ramamurthi)

(Figs. 2-3)

Mongolabis affinis Ramamurthi, 1973, *Steenstrupia*, 3 : 12 (♂, ♀; Thailand NE, Doi-Suthep and Phu Kradung).

Material examined: Thailand: Doi Suthep-Pui natn. Park, Konthathan, waterfall area, 500 m, 1 ♂ (genitalia mounted between two coverslips and pinned with the specimen), 1 nymph, 20-27.x.1979; Doi Pui road, 1000 m, 1 ♀, 6 nymphs, 23-26.x.1979; Doi Pha Hom Pok, NW of Fang, 1550-1600 m, 1 ♂ (genitalia mounted between two coverslips and pinned with the specimen), 4 ♀♀, 3 nymphs, 21.x.1981; 7 km NW of Fang, Horticultural Experimental Station, 2 ♀♀, 1 nymph, 30.x.-2.xi.1981; Chiang Mai Province, Doi



Figs. 1-5 : *Gelotolabis cavaleriei* (Borelli), ♂, 1. A portion of genitalia ; *Gelotolabis affinis* (Ramamurthi), ♂, 2 and 3. A portion of genitalia ; *Gelotolabis omei* Bey-Bienko, ♂, 4 and 5. A portion of genitalia.

Suthep, 14-1500 m, 1 ♂ (genitalia mounted between two coverslips and pinned with the specimen), 2.x.1981.

Remarks : In view of confused taxonomy of various genera of Carcinophorinae it is considered desirable here to follow Burr's (1915) arrangement with some minor modifications.

The genus *Gelotolabis* Zacher, includes those species which possess parameres about

as long as broad or slightly longer, external apical angle slightly produced and tip narrowed, often produced like a snout.

It may be pointed out here that genera based on the shape of parameres may be considered as valid. The other minor characters, viz, presence or absence of virga or teeth are of some value only at species level in combination with other morphological characters. Accordingly, it

is proposed to transfer this species here from *Mongolabis* Zacher to *Gelotolabis* Burr.

As indicated by Bey-Bienko (1959, p. 541), the genus *Mongolabis* Zacher should include those species which have the abdomen expanded posteriorly as in the genus *Gonolabis* Burr. However, it needs further investigation.

***Gelotolabla omei* Bey-Bienko**
(Figs. 4-5)

Anisolabis (Gelotolabis) omei Bey-Bienko, 1959, *Ent. Obzor*, 38 : 542, figs. 19, 21 (♂, China, Szechwan, Omei Shan).

Material examined: Thailand : Chieng Mai Inthenon N.P., Main Road, 1900 m, 2 ♂♂ (genitalia mounted between two coverslips and pinned with the specimen), 1 ♀ and 7 nymphs, 7.x.1981.

Remarks: The males agree with the original description of the species except that the sides of abdominal segments are regulose and striate but without any carina. Ultimate tergite sublaterally above in posterior half provided with a trace of tubercle and distal lobes of genitalia with denticulated pads.

Legs are generally uniform brownish yellow but in a few nymphal forms, the femora are banded with dark brown in basal half only.

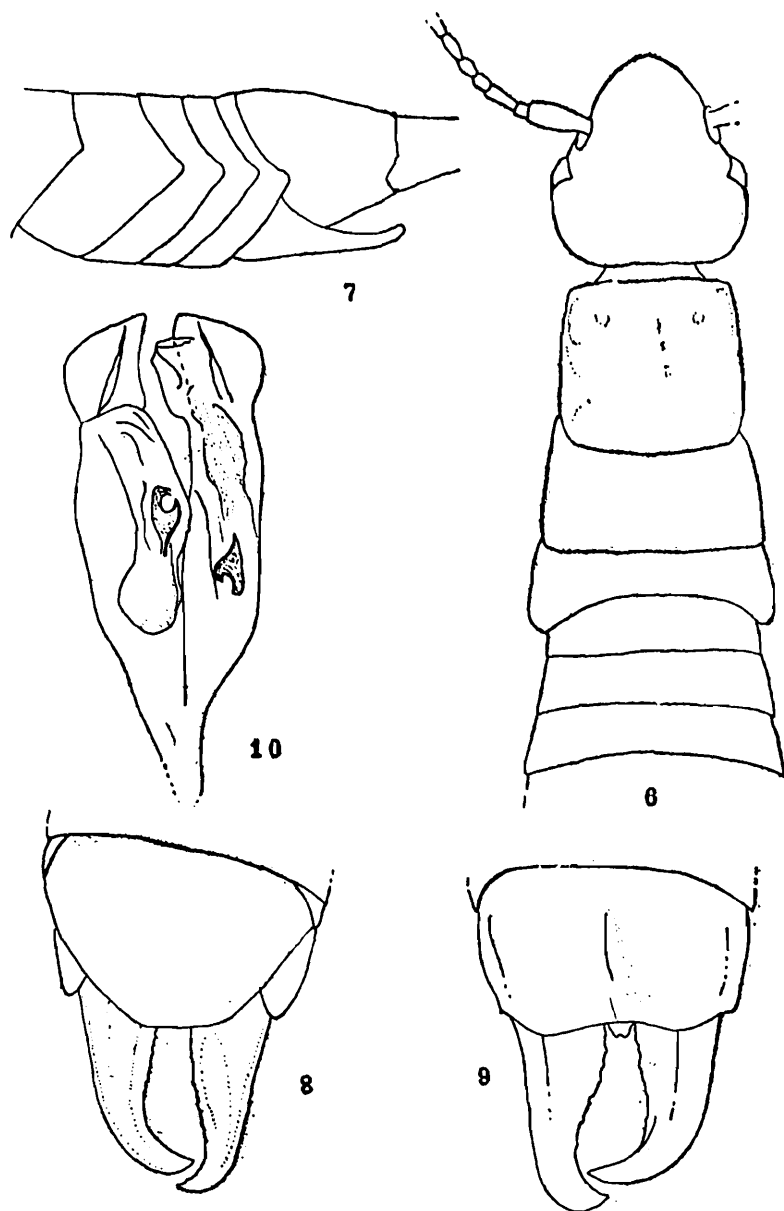
Hitherto it was known by its types from China, Szechwan Province and the present record is new for Thailand.

***Paralabis henriki* sp. n.**
(Figs. 6-10)

♂ : General colour brownish black, hind margin of abdominal tergites and forceps reddish in part. Antennae light

brownish black with basal two and basal half of the third segment yellowish brown. Legs yellowish brown, femora with longitudinal patches of black.

Head slightly longer than broad, frons convex, sutures fine, hind margin almost straight. Eyes not prominent, distinctly shorter than the post-ocular length. Antennae 19-segmented, 1st stout, narrowed at base, almost equal to the distance between antennal bases ; 2nd small, about as long as broad ; 3rd long and slender ; 4th stouter than the preceding and succeeding segments ; 5th slightly shorter than the 3rd ; 6th onwards segments gradually increasing in length and a few preapical ones thin. Pronotum about as long as broad, quadrate, all margins straight, smooth median sulcus obsolete ; prozona weakly raised and well demarcated from weakly depressed metazona. Mesonotum about twice as broad as long, hind margin truncate. Metanotum broadly emarginate posteriorly. Sternal plates typical for the genus. Legs normal, hind tarsi with 1st segment distinctly longer than the 3rd. Abdomen gradually enlarging posteriorly, almost smooth or obscurely punctulate, moderately depressed, sides of segments 6th to 9th acute angled, rugose, with a faint, oblique rugosity on the segments 7th to 9th only. Penultimate sternite smooth, triangular, narrowed posteriorly with hind margin truncate, a few long hairs present. Ultimate tergite transverse, faintly punctulate, disc moderately convex, sublaterally above with a faint convexity, posteriorly in middle scarcely depressed and sloping, median sulcus faintly marked, hind margin trisinate, laterally above the base of forceps oblique. Forceps remote at base, tapering apically, almost straight in basal



Figs. 6-10: *Paralabis henriki* sp. n., Holotype, ♂, 6. Anterior portion of body, 7. Sides of abdominal segments, 8. Penultimate sternite and forceps, 9. Ultimate tergite and forceps, 10. Genitalia.

half, afterwards gently curved with tip hooked and pointed, trigonal above in basal one third, afterwards depressed, internal margin faintly serrated. Genitalia with parameres semicircular, external margin regularly convex, inner margin lightly concave, tip narrowed and obtuse, membrane narrow,

distal lobes with characteristic chitinous, dentate pads.

♀ : Agrees with male in most characters except that the colour slightly darker, pronotum gently windened posteriorly, penultimate sternite obtusely triangular, ultimate tergite narrowed posteriorly, forceps

simple and straight, internal serrations slightly more prominent.

Measurements (in mm) :

	Holotype	
	♂	♀
Length of body	14.8	14.0
Length of forceps	2.6	2.9

Material examined : Thailand : Chieng Mai Province, Doi Inthanon N. P., main Road, 1600 m, Holotype ♂ (genitalia mounted between two coverslips and pinned with the specimen), 15.x.1981 ; 1 ♀, same data, 2200 m, 7.x.1981 ; deposited in the Zoologisk Museum, Copenhagen.

Remarks : The female specimen, referred here may be treated with some reserve since it is not yet possible to say with certainty about isolated females. It has been collected from the type locality but at a slightly higher elevation and on a different date. Perhaps it is correctly assigned since it agrees well the Holotype ♂.

Amongst the Oriental species of the genus, it comes close to *P. montshadskii* Bey-Bienko from China but differs in having the pronotum about as long as broad (vs slightly longer than broad in *P. montshadskii*) ; sides of abdominal segments 6th to 9th rugose, acute angled posteriorly, with a faint, oblique rugosity on 7th and 8th only (vs punctulate, obtuse angled and without rugosity) ; penultimate sternite truncate posteriorly (vs feebly emarginate) ; genitalia with paramere semicircular and distal lobes provided with characteristic chitinous dentate pad (vs paramers somewhat oval with external margin briefly arcuate, distal lobes without any chitinous dentate pad).

The species is named after Dr. Henrik

Enghoff, Zoologisk Museum, Copenhagen, Denmark.

BRACHYLABINAE

***Metisolabis caudelli* (Burr)**

Brachylabis caudelli, Burr, 1908, *Ann. Mag. nat. Hist.*, (8) 2 : 251 (♂, ♀ ; Burma).

Material examined : Thailand : Chieng Mai Province, Doi Suthep Summit, 600 m, 1 ♂ (genitalia mounted between two coverslips and pinned with the specimen), 30.ix.1981, Light catch ; Doi Inthanon N. P., Mae Ya, 600-700 m, 1 ♀, 12.x.1981.

Remarks : Both the specimens are agreeing with the description of the species but the female is slightly more distinctly punctulate and is brownish black whereas male is black with obscure punctulations.

LABIDURIDAE

LABIDURINAE

***Labidura riparia* (Pallas)**

Labidura riparia Pallas, 1773, *Reise Reichs*, 2 : 727 (Shores of Irtysh River, Western Siberia).

Material examined : Thailand, Chieng Mai Province, Fang Agricult. Exp. Station, 550-600 m, 1 ♂, 20.x.1981.

Remarks : World wide in distribution.

NALINAE

***Nala lividipes* (Dufour)**

Forficula pallipes Dufour, 1820, *Ann. Gener. Sci. Phy. Bruxelles*, 4 : 316 (♂, ♀ ; Lower Catalonia, Spain).

Forficula lividipes Dufour, 1829, *Ann. Sci. nat.*, 13 : 340 (new name proposed).

Material examined : Thailand : Chieng Mai Province Fang Horticult. Exp. Station,

550-600 m, 1 ♂, 1 ♀, 21.x.1981, 2 ♂ ♂, 22.x.1981.

Remarks : A widely distributed species throughout the world, especially in tropical parts.

Nala sp.

Material examined : Australia : Queensland, Atherton, 1 ♀, 30.x.1972, A. M. Hemmingsen leg.

Remarks : In the absence of male it is not possible to place this specimen up to the species level.

LABIIDAE

SPONGIPHORINAE

Spongovostox semiflavus (Bormans)

Spongophora semi-flava Bormans, 1894, *Annali Mus. civ. Stor. nat. Giacomo Doria*, (2) 14 : 385 (♂, ♀ ; Burma).

Material examined : Thailand : 7 km NW of Fang, Horticultural Experimental Station, 3 ♀ ♀, 30.x.-2.xi.1979 ; Chiang Mai Province, Doi Inthanon N. P., Mae Ya, 6-700 m, 3 ♀ ♀, 12.x.1981 ; Fang Horticult. Exp. Station, 550-600 m, 1 ♂, 22.x.1981.

Remarks : Widely distributed in the Oriental Region.

LABIINAE

Labia curvicauda (Motschulsky)

Labia curvicauda Motschulsky, 1863, *Bull. Soc. Imp. Nat. Moscou*, 36 : 2 (♂, ♀ ; Nura Illia Mountains, Ceylon).

Material examined : Thailand : Doi Suthep-Pui natn. Park, Konthathan waterfall area, 600 m, 2 ♂ ♂, 9 ♀ ♀ and 2 nymphs, 20-27.x.1979 ; 7 km NW of Fang Horticultural Experimental Station, 2 ♂ ♂, 1 ♀,

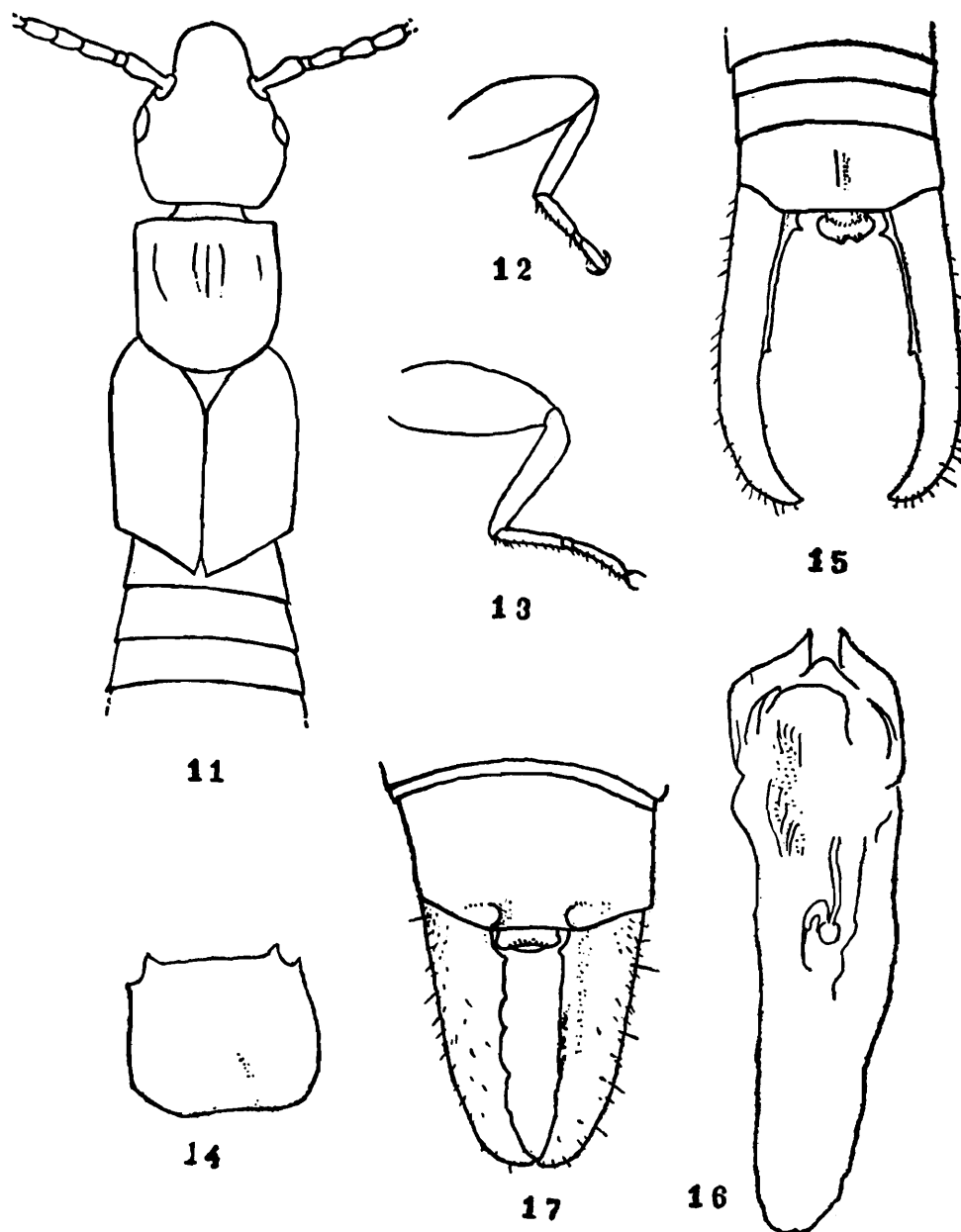
30.x.-2.xi.1979 ; Chiang Mai Province, Doi Inthanon N. P., Siripum, 13-1400 m, 1 ♂, 5 ♀ ♀, 8.x.1981 ; Mae Klang, 3-400 m, 1 ♀, 9.x.1981 ; Mae ya, 6-700 m, 1 ♂, 2 ♀ ♂, 12.x.1981, Puai Sai, Luang, 10-110 m, 3 ♂ ♂, 14.x.1981, Fang Horticult. Exp. Station, 550-600 m, 1 ♂, 1 ♀ and 19.x.1981.

Remarks : Widely distributed throughout the globe.

Chaetolabia pygidiata sp. n.

(Figs. 11-17)

♂ : General colour shining blackish brown, shaded with black on various body parts. Abdominal tergites especially hind ones and forceps reddish. Legs and mouth parts yellowish but former with femora in basal half blackish. Antennae partly broken (on the left side only 10 and on the right right 8 segments remaining), segments mostly stout, 1st gently expanded apically, about as long as the distance between antennal bases ; 2nd short, about as long as broad ; 3rd long and slender, about twice as long as broad ; 4th stouter, but shorter than preceding ; 5th longer than 3rd, narrowed basally, afterwards segments very slightly thinning and gradually increasing in length distally. Eyes not prominent, shorter than the post-ocular length. Head slightly longer than broad, smooth, frons convex, sutures obsolete, hind margin feebly emarginate in middle. Pronotum only a trifle longer than broad, sides almost straight and depressed, hind margin convex, prozona weakly raised and feebly differentiated from depressed metazona, median sulcus fairly distinct. Elytra slightly longer than the pronotum, covered with fine pubescence, punctulate, humeral angle weak



Figs. 11-17: *Chaetolabia pygidiata* sp. n., Holotype ♂, 11. Anterior portion of body, 12. Fore leg, 13. Hind leg, 14. Penultimate sternite, 15. Hind portion of body, 16. Genitalia; *Chaetospania mandex* Borelli, ♀, 17. Ultimate tergite and forceps.

and anal angle rounded off to show a small, triangular scutellum, meeting along the median line, hind margin oblique. Wings scarcely projecting beyond the elytra. Legs typical for the genus, femora swollen, 1st hind tarsal segment almost equal to 3rd and 2nd short, about as long as broad. Abdomen weakly convex, fine and short

pubescence present on sides of certain tergites, smooth, narrowed at base, lateral tubercles on 3rd and 4th tergites obsolete, sides of segments broadly convex. Penultimate sternite transverse, obscurely punctulate, hind margin briefly rounded with slight emargination in middle. Ultimate tergite smooth, rectangular, transverse,

moderately depressed, in the middle of disc with a faint impression, hind margin feebly thickened, trisinate, oblique above the base of forceps. Pygidium subvertical at base, apically horizontal and somewhat round, in the middle posteriorly with pair of minute tubercle separated by a small but deep emargination. Forcep straight, slightly curving in posterior half, depressed, tapering apically with tip pointed and gently hooked, internal margin ventrally with a triangular tooth at base, directed inwards, followed by another but smaller tooth at a little beyond middle and directed posteriorly, dorsal border sharp in basal two thirds, afterwards merging with the ventral one. Genitalia with parameres broader in basal two thirds, afterwards narrowed with tip acute, preputial sac provided with rows of fine chitinous teeth, virga short, tubular, at base with a vesicle.

♀ : Unknown.

Measurements : (in mm)

	Holotype
	♂
Length of body	4.1
Length of forceps	1.2

Material examined : Thailand : Chieng Mai Province, Fang Horticult. Exp. Station, 550-600 m, Holotype ♂ (genitalia mounted between two coverslips and pinned with the specimen), 23.x.1981, deposited in the Zoologisk Museum, Copenhagen, Denmark.

Remarks : On the basis of its general appearance the described species may be referred under the genus *Chaetolabia* Brindle, which at present is known by three species from Micronesian Islands and five others from Africa. Some of the Oriental species,

now included under *Chaetospania* Karsch, will have to be transferred under *Chaetolabia* when further studies on the latter are taken up.

The described species differs from all the known species of the *Chaetolabia* in the combination of various characters. It, however, comes very close to *Chaetospania dexter* Steinmann, from Thailand but differs by the shape of pygidium in being rounded posteriorly with a short but distinct emargination, bounded on either side by two small tubercles (vs narrowed posteriorly with margin shallowly concave in *C. dexter*) and genitalia with parameres broader in being twice as long as broad and narrowed at apex to a sharp point (vs parameres narrower, about three times longer than broad, gradually narrowed apically).

Chaetospania mandex Borelli

Chaetospania mandex Borelli, 1932, *Konowia*, **11** : 90, 1 text fig. (♂ ; Tanasserim Tadang) ; Srivastava, 1981, *Annali Mus. civ. Stor. nat. Giacomo Doria*, **83** : 296, figs. 15-20.

Material examined : Thailand : Doi Suthep-Pui natn. Park, Konthathan waterfall area, 600 m, 1 ♀, 20-27.x.1979, Chieng Mai Province, Doi Suthep N. P. Konthathan, 600-700 m, 1 ♂ (genitalia mounted between two coverslips and pinned with the specimen), 30.ix.1981.

Remarks : Hitherto known from Burma and the present record is new to Thailand.

Apovostox pygidiatus (Dubrony)

Labia ? pygidiata Dubrony, *Annali Mus. civ. Stor. nat. Giacomo Doria*, **14** : 364.

Material examined : Thailand : Chieng Mai. Province, Doi Inthanon N. P., Siripum,

13-1400 m, 1 ♂, 1 ♀, 8.x.1981, Doi Suthep-Pui natn. Park, Doi Pui road, 1000 m, 1 ♂, 23-26.x.1981.

Remarks: Although widely distributed in the Oriental Region there appears to be no previous record of the species from Thailand.

Apovostox stella (Bormans)

Spongophora stella Bormans, 1899, *Annali Mus. civ. Stor. nat. Giacomo Doria*, 20 : 454 (♂, ♀ : Iles Mentawai, Sipora).

Material examined: Thailand : Doi Suthep-Pui natn. Park, Konthathan waterfall area, 600 m, 1 ♂, 3 ♀ ♀, 5 nymphs, 20-27.x.1979.

Remarks: It is reported from Thailand, Malaya, Borneo and Philippine Isl.

Srivastava (1985) has resurrected *Apovostox* Hebard.

IRDEXINAE Srivastava (1985)

Irdex nitidipennis (Bormans)

Irdex nitidipennis Bormans, 1894, *Annali Mus. civ. Stor. nat. Giacomo Doria*, 14 : 382 (♂ ; Burma).

Material examined: Thailand : Doi Suthep Pui natn. Park, Doi Pui Road, 1000 m, 1 ♀, 23-26.x.1979, 7 km NW of Fang, Horticultural Experimental Station, 2 ♂ ♂, 3 ♀ ♀, 30.x.-2.xi.1979, Chiang Mai Province, Doi Inthanon N. P., Siripum, 13-1400 m, 1 ♂, 2 ♀ ♀, 8.x.1981, Fang Agricult. Exp. Station, 550-600 m, 1 ♀, 20.x.1981.

Remarks: Srivastava (1915) has discussed in detail the identity of this species.

HOMOTAGINAE Srivastava (1985)

Genus **Paratages** nov.

Body almost bare, without pubescence.

Size small (6.4 to 6.9 mm including forceps). Antennae 15-segmented, 1st stout, shorter than the distance between antennal bases, segment 4th onwards conical or subconical, except apical one thin and slender. Eyes half as long as the post-ocular length. Legs long and slender, fore femora slightly swollen, middle and hind ones slender ; tibiae thin and cylindrical ; 1st tarsal segment of fore and middle legs equal to the combined length of 2nd and 3rd ; hind tarsi with 1st segment slightly longer than the combined length of 2nd and 3rd segments ; 2nd almost of uniform width or scarcely narrowed basally and slightly longer than half the length of 3rd one. Elytra and wings well developed, often covering the basal abdominal tergite. Pygidium short but distinct. Forceps simple and straight, internally unarmed.

Sternal plates with prosternum longer than broad, narrowed posteriorly, feebly constricted between fore coxae ; mesosternum quadrate, about as long as broad with all margins straight, and metasternum transverse, apically between hind coxae narrowed with hind margin truncate.

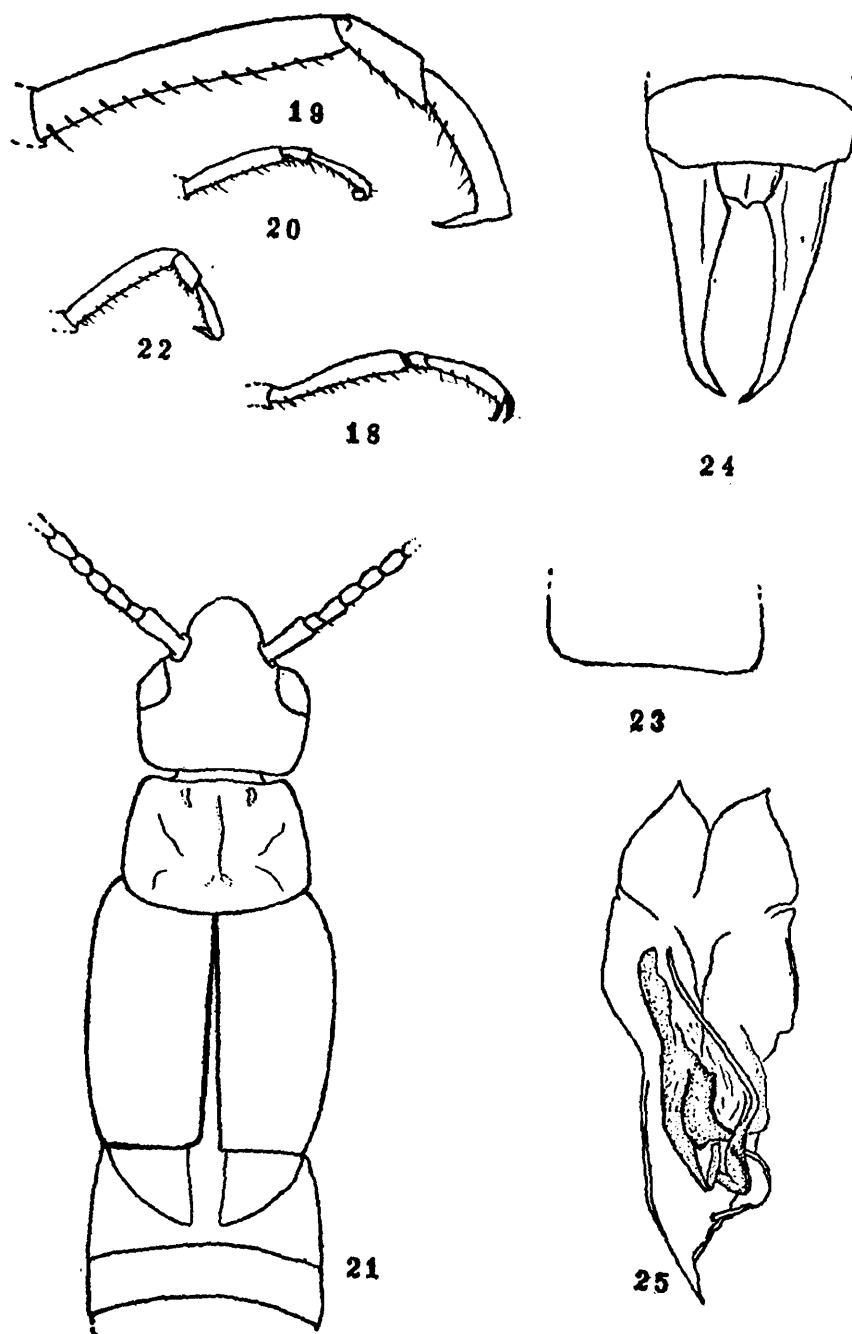
Type-species: *Paratages sakaii* sp. n.

Remarks: This genus is erected for the reception of a undescribed species, *P. sakaii* sp. n. from Thailand.

The described genus is included under the subfamily *Homotaginae* Srivastava (1985) in having the body bare and hind 2nd tarsal segment longer than broad and a little over half the length of 3rd segment. It can be easily separated from the only known genus of the subfamily viz., *Homotages* Burr, by the small size, shape of antennal segments in being stout and conical and forceps simple and unarmed.

It may be mentioned here that members of the subfamily Spongiphorinae belonging to the genera *Spongovostox* and *Marava* possess hind 2nd tarsal segment slightly longer than broad, strongly narrowed posteriorly and is about half as long as the

third. Besides, 1st hind tarsal segment is slightly shorter than the combined length of 2nd and 3rd. According to the information available through literature same condition is found amongst the members of the genus *Spongiphora* Serville.



Figs 18-25 : *Labia minor* (L.), ♂, 18. Hind tarsi ; *Homotages feae* (Bormans), ♂, 19. Hind tarsi ; *Spongovostox semiflavus* (Bormans), ♂, 20. Hind tarsi ; *Paratages sakaii* gen. and sp. n., Holotype ♂, 21. Anterior portion of body, 22. Hind tarsi, 23. Posterior margin of penultimate sternite, 24. Ultimate tergite and forceps, 25. Genitalia.

Recently, Srivastava (1985) has presented a new key for the subfamilies of Labiidae on the basis of shape and relative length of hind tarsal segments together with other characters. In this key Spongiphorinae has been placed under the couplet having 2nd tarsal segment broader than long, near to Labiinae. But in the light of foregoing remarks it needs to be transferred under the category with 2nd tarsal segment longer than broad.

Now the subfamily Homotaginae can be separated from Spongiphorinae by the shape and the relative length of hind tarsal segment. In the former hind 2nd tarsal segment in profile is almost of uniform width or only scarcely narrowed basally and is slightly longer than half the length of 3rd segment, besides 1st segment being slightly longer than the combined length of last two segments.

Paratages sakaii sp. n.

(Figs. 21-25)

♂ : General colour black with antennae, sides of pronotum, sometimes hind margin of abdominal tergites and legs yellowish brown. Body smooth.

Head about as long as broad, moderately convex, sutures obsolete, area behind eyes straight, parallel, hind margin emarginate in middle. Eyes about half as long as the post-ocular length. Antennae 15-segmented, 1st stout, expanded apically, slightly shorter than the distance between antennal bases; 2nd short; 3rd long and slender, only slightly shorter than the 1st; 4th conical but sometimes globular; 5th subconical, about as long as broad, both shorter than the 3rd; 6th equal to 3rd but stouter, remaining gradually increasing in length but cylindrico-

conical. Pronotum rectangular, scarcely broader than long, smooth, all margins briefly convex, prozona weakly raised and poorly differentiated from flat metazona, median sulcus faintly marked. Legs long and slender, fore-coxa swollen, hind tarsi with 1st segment slightly longer than the combined length of 2nd and 3rd; 2nd longer than broad, only slightly shorter than the 3rd; claw without an arolium.

Elytra and wings well developed, smooth, former with humeral angles prominent, hind margin truncate, about twice as long as the pronotum and the latter about one third as long as the elytra, occasionally extending up to 3rd or 4th abdominal tergites. Abdomen strongly convex, smooth, narrowed posteriorly, in normal condition segments very much telescoped, lateral tubercles on 3rd tergite weakly and on 4th strongly developed, sides of segments rounded. Penultimate sternite in normal condition mostly covered by 8th sternite, transverse, hind margin with a faint emargination in middle, manubrium shorter than the sternite in length, apex broad, rounded. Ultimate tergite transverse, smooth, gently sloping and depressed in middle posteriorly, hind margin between the branches of forceps almost straight, laterally above the branches of forceps oblique and concave. Pygidium scarcely visible from above, generally covered laterally by the bases of forceps, subvertical, slightly longer than broad, gently contracted apically, hind margin provided with minute points, one each laterally and in the middle, at base convex above but depressed near apex. Forceps subcontiguous at base, cylindrical, almost straight, tapering apically, tip arcuate and sharply pointed, internally unarmed, at base with a short emargination.

♀ : Unknown.

Measurements : (in mm)

	♂ ♂
Length of body	5.5-5.8
Length of forceps	0.95-1.0

Material examined : Thailand : Chieng Mai Province, Doi Pha Hom Pok, NW of Fang, 1550-1750 m, Holotype ♂ (genitalia mounted between two coverslips and attached with the specimen), Paratypes 3 ♂ ♂ (1 ♂ with genitalia and another 1 ♂ with hind leg mounted between two coverslips and attached with respective specimens), 22.x.1981 ; deposited in the Zoologisk Museum, Copenhagen, except Paratype 1 ♂ with the author.

Distribution : Known from the type locality only.

Remarks : This species has external resemblance with the members of the genera *Spongovostox* Burr and *Marava* Burr, but differs from both by the shape tarsal segments, especially hind pair of legs.

The species is named after Prof. Dr. S. Sakai, Daito Bunka University, Tokyo, Japan, who has made notable contributions in Dermaptera.

CHELISOCHIDAE

CHELISOCHINAE

Hamaxas feae (Bormans)

Chelisothes feae Bormans, 1894, *Annali Mus. civ. Stor. nat. Giacomo Doria*, (2) 14 : 393 (♂, ♀ : Burma).

Hamaxas feae : Srivastava, 1981, *Annali Mus. civ. Stor. nat. Giacomo Doria*, 83 : 297, figs. 24-29 (Lectotype ♂ and Paralactotypes 2 ♂ ♂ designated).

Material examined : Thailand : Doi Suthep-Pui natn. Park, Konthathan waterfall area, 600 m, 3 ♂ ♂ (in one ex. right arm of

forceps totally missing and in the other one only apical portion seems to be broken off due to injury), 2 ♀ ♀, 20-27.x. 1979 ; Chieng Mai Province Doi Suthep N. P., Konthathan, 6-700 m, 1 ♀, 30.ix.1981.

Remarks : The male forceps exhibit usual macrolabic and mesolabic forms.

Cheliosches sp.

Material examined : Cooks Isl., Rarotonga 1 ♀ xi. 1977, N.L.H. Krauss leg.

Remarks : Although it agrees with female of *Chelisothes morio* it is not possible to determine it, with certainty, up to specific level in the absence of a male.

FORFICULIDAE

ALLODAHLINAE

Allodahlia scabriuscula (Serville)

Forficula scabriuscula Serville, 1839, *Histoire Naturelle des Insectes Orthopteres* : 38 (♀).

Material examined : Thailand : Doi Suthep Pui natn. Park, Doi Pui Road, 1000 m, 2 ♂ ♂, 4 ♀ ♀, 23-26.x. 1979 ; Chieng Mai Province, Fang Horticult. Exp. Station, 550-600 m, 1 ♂, 21.x. 1981 ; 3 ♀ ♀, 22. x. 1981.

Remarks : It generally occurs in the mountains of Oriental Region between 150 m and 1700 m.

Allodahlia coriacea (Bormans)

Anechura coriacea Bormans, 1894, *Annali Mus. civ. Stor. nat. Giacomo Doria*, 2(14) : 304 (♂, Burma).

Material examined : Thailand : Chieng Mai Province, Fang Horticult. Expt. Station, 550-600 m, 2 ♂ ♂, 4 ♀ ♀, 21.x.1981, 2 ♂ ♂ 30.x.-2. xi.1979 ; Doi Suthep-Pui natn. Park,

Konthathan waterfall area, 600 m, 1 nymph, 20-27.x.1979 ; Doi Inthanon N.P., Hui Sai Luang, 10-1100 m, 1 ♂, 1 ♀, 14.x.1981.

Remarks : It has been reported occurring in the mountains of Oriental Region between 1680 and 3100 m.

OPISTHOCOSMIINAE

Eparchus simplex (Bormans)

Opisthocosmia simplex Bormans, 1894, *Annali Mus. civ. Stor. nat. Giacomo Doria*, (2) 14 : 396 (♂, ♀ ; Burma).

Eparchus simplex Srivastava, 1981, *Annali Mus. civ. Stor. nat. Giacomo Doria*, 83 : 302, fig. 42-50 (Lectotype and Paralectotypes designated).

Material examined : Thailand : 7 km NW of Fang, Horticultural Experimental Station, 1 ♂ (♂ genitalia mounted between two coverslips and pinned with the specimen), 30.x.-2.xi. 1979.

Remarks : Srivastava (1981) has clarified the status of the species on the basis of syntypes.

In the present specimen sides of abdominal segments are ecarinate and convex, forceps simple, horizontal without any tooth internally near apex.

Eparchus insignis (Haan)

Eparchus insignis Haan, 1842, *Verh. Nat. Gesch. Nederl. Overzee Bezitt, Orth.*, 1 : 243, pl. 23, fig. 14 (♂, ♀ ; Java).

Material examined : Thailand : Chiang Mai Province, Doi-Inthanon N.P., Siripum, 1 ♂, 4.x.1981 ; Doi Suthep-Pui natn. Park, Konthathan waterfall area, 600 m, 3 ♀ ♀, 20-27.x.1979.

Remarks : A common species throughout the Oriental Region.

Timomenus lugens (Bormans)

Opisthocosmia lugens Bormans, 1894, *Annali Mus. civ. Stor. nat. Giacomo Doria*, (2) 14 : 398 (♂, ♀ ; Burma).

Material examined : Thailand : 7 km NW of Fang, Horticultural Experimental Station, 1 ♂, 2 ♀ ♀, 2 nymphs, 30.x.-2.xi. 1979 ; Chiang Mai Province, Fang Horticultural Exp. Station, 550-600 m, 1 ♀, 22.x.1981 ; Doi Saket, 950 m, 1 ♀, 30.x.1981.

Remarks : The specimen are brownish black. The basal antennal segment in males stout, rather swollen and cylindrical whereas in females comparatively less stout and slender.

Hypergus humeralis (Kirby)

Opisthocosmia humeralis Kirby, 1981, *J. Linn. Soc. (Zool.)*, 23 : 532 (♀ ; Ceylon).

Material examined : Thailand : Chiang Mai Prov., Fang Horticult. Exp. Station, 550-600 m, 2 ♂ ♂, 19.x.1981, 1 ♂, 1 ♀, 21.x. 1981.

Remarks : Although widely distributed in the Oriental Region it does not appear to have been recorded from Thailand.

Hypergus grata (Hebard)

Sadyia grata Hebard, 1923, *Mem. Dep. Agric. India Ent. Ser.*, 17(11) : 223 (♂, ♀ ; Sadiya, Assam).

Material examined : Thailand : Chiang Mai Province Fang Horticult. Exp. Station, 550-600 m. 1 ♂, 21.x.1981.

ACKNOWLEDGEMENTS

I am thankful to the Director, Zoological Survey of India, Calcutta for necessary facilities. My thanks are also due to Dr. .

Henrik Enghoff, Zoologisk Museum Copenhagen, Denmark for placing this interesting collection at my disposal.

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RECORD OF *HOPLOPLEURA MALABARICA* WERNECK (ANOPLURK :
HOPLOPLEURIDAE) FROM INDIA.

By

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ABSTRACT

Hoplopleura malabarica Werneck ex. *Bandicota* spp., known earlier from Sri Lanka and Thailand is recorded from *Baudicota bengalensis* for the first time from India. The adults are redescribed and illustrated.

INTRODUCTION

Hoplopleura malabarica was described by Werneck (1954) from *Bandicota bengalensis* of Sri Lanka. Subsequently, Johnson (1959) and Kim (1966) redescribed the species and recorded it from two more host species, *B. indica* and *B. malabarica* from Thailand. During present study, several specimens from *Bandicota bengalensis* were collected from various localities of West Bengal, India. The terminologies used herein follow Mishra (1981). The voucher materials are in the National Zoological Collection at Zoological Survey of India, Calcutta.

***Hoplopleura malabarica* Werneck 1954.**

Hoplopleura malabarica Werneck, 1954, *Rev. Brazil Biol.*, 14 : 113-116.

Female : (Figs. 1-5). The mean body length 0.85 mm. ; range 0.84 to 0.88 mm. (4 specimens).

Head (Fig.2) : Approximately 1.3 times as long as wide ; Post antennal angle rounded. All typical head setae present. OS 3 to 4 pairs. ADHS close to PDHS. MHS in straight line. Antennal sensoria contiguous.

Thorax : Sternal plate (Fig.3) 0.12 mm. long, 0.08 mm. wide ; pearshapped with anterior process small ; posterior process rounded at apex. MDTS long, one pair. ADTS two pairs, minute. Legs : same as in other member of genus.

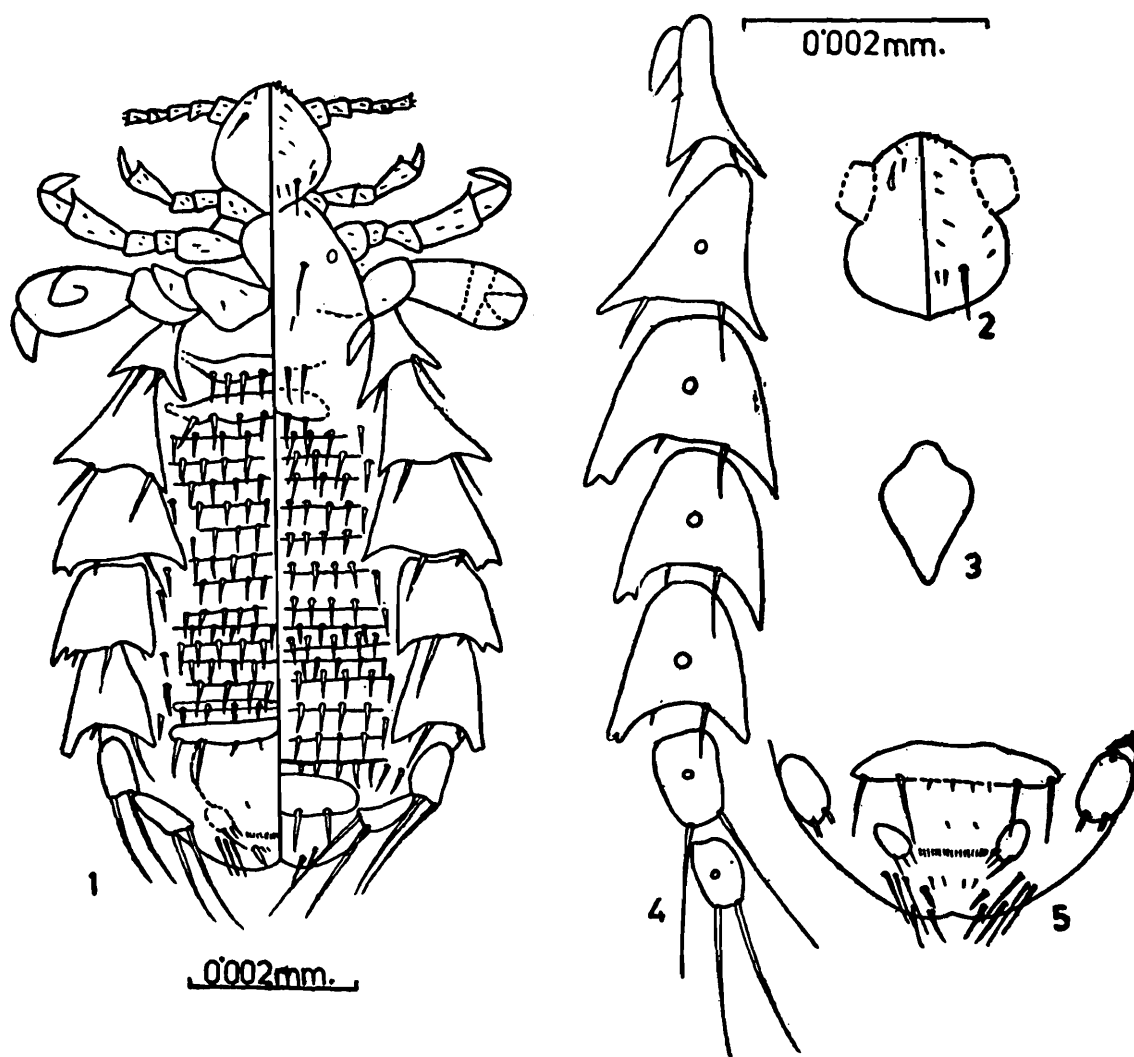
Abdomen. Dorsal : Segment II with a single tergite ; two rows of setae, anterior row with 2 minute setae posterior row with 2 pairs of thin and elongate setae, posterior row associated with tergite. Segment III with 3 tergites ; first distinct, others being narrow, having 4 to 6 setae each. Segment IV to VII each with 3 indistinct very narrow tergites, having 6 to 10 sword-shaped setae. Segment VIII and terminal segment each with

single tergite, having 4 setae. Setae off the plates between tergites and paratergites number 4 to 6 on each side (DAAS).

Ventral : Segment II with a single sternite, lateral extensions produced antero-laterally, articulating with corresponding paratergite, having 8 setae. Segment III with 4 sternites : first broad with lateral extensions, with 2 groups of 2 enlarged setae laterally and 3 narrow setae mesially ; remaining sternites very narrow, indistinct, having 7 or 8 setae. Segment IV to VI each with 3 very narrow indistinct sternites, having 6 to 9 setae each. Segment VII with 2 narrow

sternites, anterior having 6 to 8 setae ; posterior with 2 pairs of long and 2 pairs of small setae. Remaining sternites modified to form genitalia. Setae off the plates between sternites and paratergites number 7 to 9 on each side (VAAS).

Lateral : Paratergites (Fig. 4) well developed. Paratergite II with long tapering posterior angles, ventral much longer than dorsal ; dorsal seta much longer than ventral side. Paratergite III with dorsal and ventral posterior angle long and acute ; both setae long. Paratergite IV to VI each with dorsal posterior lobes notched ventral posterior



Figs. 1-5 : 1. *Hoplopleura malabarica* Werneck ; 2. Head ; 3. Thoracic sternal plate ; 4. Paratergites ; 5. Genitalia.

outer angle well developed and pointed ; ventral seta long, longer than lobes, dorsal seta minute. Parategites VII and VIII devoid of lobes ; each with 2 long setae.

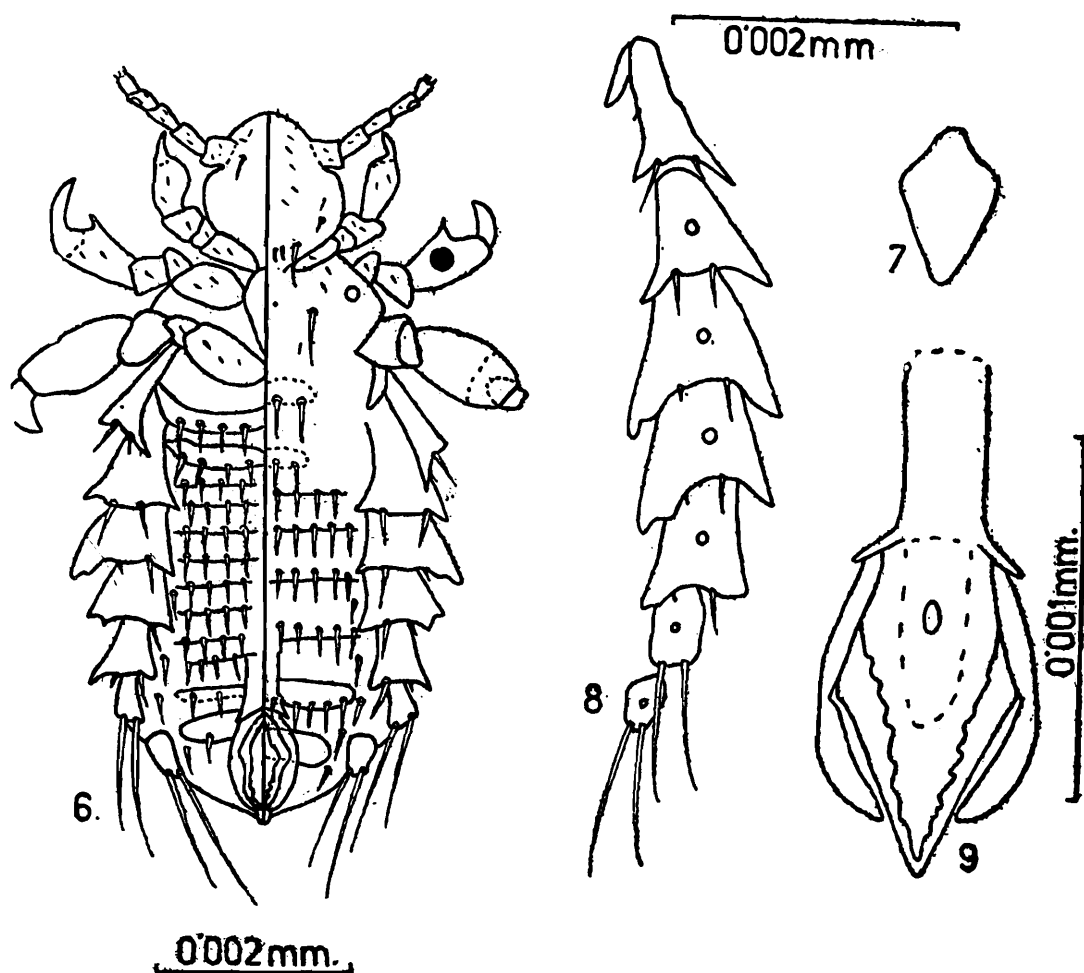
Genitalia (Fig. 5) : Genetal plate of segment VIII fused with posterior sternite of segment VII to form complete genital plate ; outline of the plate indistinct posteriorly, with 2 pairs of long and 4 pairs of minute setae. Gonopod paired, with 3 setae each. Genetal seta slightly enlarged. Opening of the vulva situated between the gonopods.

Male : (Figs. 6, 7, 8, 9). The mean body length 0.62 mm. ; range 0.61 to 0.64 mm. (4 specimens).

Head, Thorax and Legs as in female. Thoracic sternal plate (Fig. 7) 0.11 mm. long ; 0.07 mm. wide.

Abdomen. Dorsal : Segment II as in female. Segment III with 2 tergites, anterior tergite distinct, having 4 setae, posterior narrow indistinct, having 8 setae. Segment IV to VI, each with single narrow indistinct tergite, having 8-10 setae. Segment VII with narrow tergite, having 10 setae. Segment VIII with single tergite without setae. Setae off the plates between tergites and paratergites number 4 to 5 on each side (DAAS).

Ventral : Segment II as in female. Segment III with 3 sternites ; anteriormost as in



Figs. 6-9 : 6. *Hoplopleura malabarica* Werneck, male ; 7. Thoracic sternal plate ; 8. Paratergites ; 9. Genitalia.

female, remaining two, indistinct and narrow, with 7 or 8 setae each. Segment IV to VII each with 2 very narrow sternites, having 6 to 9 setae each. Segment VII and VIII, each with single sternite, former with 4, latter with 2 setae. Terminal segment with several minute setae. Setae off the plates between sternites and paratergites number 3 to 4 on each side (VAAS).

Lateral : Paratergites (Fig. 8) almost same as female except ventral posterior outer angle of paratergite VI not lobed.

Genitalia : (Fig. 9) parameres anteriorly notched, not strongly curved inward ; pseudopenis serrated.

Nymph : unknown.

Material Examined : 2 females, 1 male, Chandra, Midnapur dist., West Bengal, India, 10.9.1984. and 2 females, 3 males Susunia hill, Bankura Dist., West Bengal, India, 6.1.85.

Host : *Bandicota bengalensis* (Gray)

Remarks : The present specimens correspond with those described by Johnson (1959) and Kim (1966) from Sri Lanka and Thailand, but with following differences. PDHS long ; tergites and sternites of anterior and posterior segments both males and females distinct ; others being indistinct and very narrow. Paratergites IV to VI with dorsal posterior lobes notched in both sexes. Ventral posterior outer angle of

paratergite VI well developed only in females. Females with DAAS 4 to 6 pairs, VAAS 7 to 9 pairs. Males with DAAS 4 to 5 pairs, VAAS 3 to 4 pairs.

ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India, for laboratory facilities, to Dr. A. K. Ghose, Deputy Director, Zoological Survey of India, for supervision of the work and to Dr. P. K. Chaudhuri, Reader in Zoology, Burdwan University for going through manuscript. Sincere thanks are due to Dr. V. C. Agarwal, Dr. K. Rai, P. K. Das for helping in various ways.

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A NEW COMBINATION PROPOSED FOR INDIAN GROUSE-LOCUSTS
(ORTHOPTERA : TETRIGIDAE)

By

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ABSTRACT

Coptotettix parvulus Hancock is transferred to the genus *Paratettix* Bolivar. Comparative characters of both the genera viz. *Coptotettix* Bolivar and *Paratettix* Bolivar are discussed briefly.

INTRODUCTION

Coptotettix parvulus was described by Hancock (1912) from India and was retained subsequently by him (1913 and 1915) and Fletcher (1921) under the same genus. Since the name of this species was preoccupied for *Coptotettix parvulus* Hancock, 1908, the former species has been renamed as *Coptotettix hancockus* (Shishodia and Varshney, in press). During the present study, it is found further that the Type of *Coptotettix parvulus* Hancock, 1912 (Type No. H 691) bears a label on which "*Paratettix parvulus* (Hancock), Det Tinkham 1937", is mentioned, but from the available literature it appears not to have been published earlier. However, on the basis of comparative characters for the genera *Coptotettix* and *Paratettix*, this species

(*Coptotettix hancockus*) should be referred to latter, in having its vertex not narrowed in front; the depression on either side of median carinula not narrowed and median carina of pronotum neither low nor undulated.

The original description of the species being brief, it is redescribed here in detail and illustrated for the first time. Besides, a list of Indian species and a table giving comparative characters for the separation of both the genera viz., *Coptotettix* Bolivar and *Paratettix* Bolivar, are provided.

SYSTEMATIC ACCOUNT

List of Indian species included under the genera *Coptotettix* Bolivar and *Paratettix* Bolivar.

Genus *Coptotettix* Bolivar

1. *Coptotettix fossulatus* Bolivar, 1887
2. *C. testaceus* Bolivar, 1887
3. *C. indicus* Hancock, 1912
4. *C. annandalei* Hancock, 1915
5. *C. conspersus* Hancock, 1915
6. *C. retractus* Hancock, 1915

Genus *Paratettix* Bolivar

1. *Paratettix cingalensis* (Walker, 1871)
2. *P. indicus* Bolivar, 1887
3. *P. hirsutus* Brunner, 1893
4. *P. curtipennis* (Hancock, 1912)
5. *P. alatus* Hancock, 1915
6. *P. latipennis* Hancock, 1915
7. *P. rotundatus* Hancock, 1915

Paratettix hancockus* (Shishodia & Varshney) *Comb. nov.

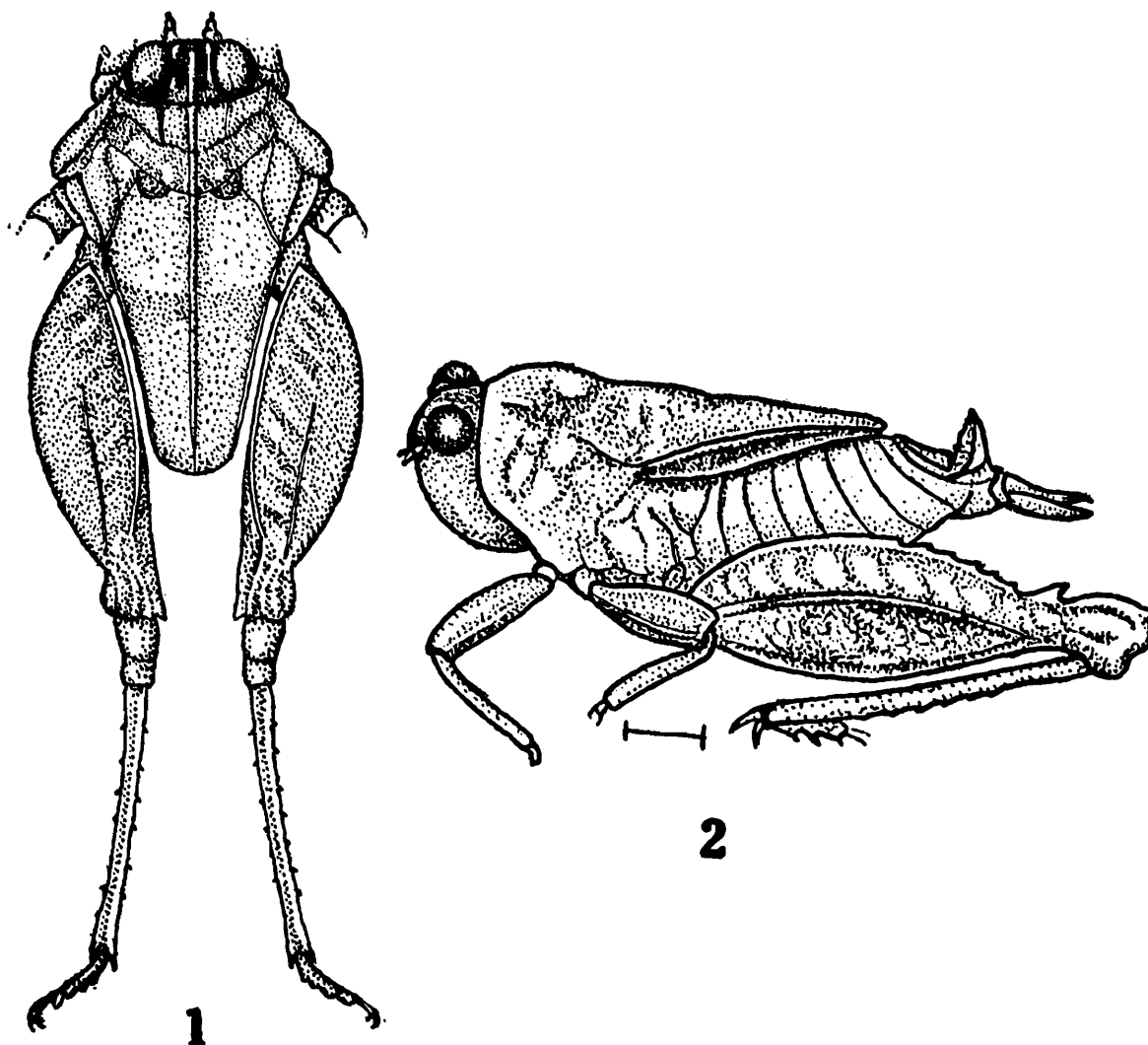
(Figs. 1 & 2).

Coptotettix parvulus Hancock, 1912. *Mem. Dep. Agric. India ent. Ser.*, 4 (No. 2) : 145-146.*Coptotettix hancockus* Shishodia and Varshney, *J. Bombay nat. Hist. Soc.*, in Press (Preoccupied by *C. parvulus* Hancock, 1908).*Material examined* : 1♂, Type, Chapra, Bengal, (now in Bihar), Mackenzie.

Description : Size very small. Colour brownish, light and variegated with fuscous on the pronotum, a large dark brown spot present on either side behind the shoulders ; posterior tibiae annulated with yellow and dark brown colour ; lower external carina of posterior femora marked with black spots.

Head not exserted above the pronotum ; vertex as broad as an eye, fossulated on either side of the median carinula, ampliate behind the fossulae, produced in front as far as eyes ; front margin transverse, low, reflexed laterally ; lateral carinulae extend upto the level of eyes ; median carinula distinct, raised upto the level of lateral carinulae, and extend upto the two-third length of eyes behind ; frontal costa bifurcated behind the paired ocelli, and narrowly sulcated between them but widely sulcated in front, arcuate between the antennae ; paired ocelli placed a little below the middle of eyes ; antennae filiform, and located on the inferior margin of eyes ; eyes globular in form while examining from the top view.

Pronotum scarcely obtuse-angulate anteriorly, abbreviated posteriorly and extend beyond the middle of posterior femora but never upto the apices of abdomen, the apex widely rounded ; dorsum granulate, transversely tectiform between the shoulders ; median carina compressed, little arcuate forward in front of the shoulders, straight on the disc, low towards the apex ; abbreviated carinae on the shoulders absent ; prozonal carinae distinct, a little convergent posteriorly ; humeral angles obtuse carinate ; posterior angles of lateral lobes of pronotum deflexed downward, medium in size, and rounded at apex ; paranota with two projections ; elytra very small ; wings not visible ; anterior femora compressed, elongate, bicarinate, margins entire and with white pubic hairs ; middle femora also elongate, compressed, bicarinate, lower margin embeded with white pubic hairs, upper margin with very small serrations ; posterior femora stout, crassate, the superior margin minutely



Scale 1mm.

Figs. 1 & 2. Dorsal view of *Paratettix hancockus* Shishodia & Varshney. Lateral view of *Paratettix hancockus* Shishodia & Varshney.

serrulated and bear an angulated-lobe before the apex ; the first article of posterior tarsi longer than the third ; the first and second

pulvilli small, acute spinose ; the third pulvilli longer than the previous two, and less acute.

Measurements in mm.

Body length upto the apex of abdomen	Pronotum length	Posterior femora length/width	Shoulder width	Eyes width	Inter ocular distance
5.9	4.3	4.53/1.7	1.7	.54	.54

The measurements of the Type specimen taken at present, vary with the original.

Comparative characters of genera *Coptotettix* Bolivar and *Paratettix* Bolivar.

Coptotettix Bolivar

1. Body more or less rugulose or granulose.
2. Head not exserted above the pronotum.
3. Vertex smooth, equal or narrow than the width of an eye and more narrow in front.
4. Vertex with depression on either side of median carinula, narrow and linear.
5. Median carina of pronotum low, undulated, rarely without undulations.

Paratettix Bolivar

1. Body granulose, slightly rugulose.
2. Head a little or not at all exserted above the pronotum.
3. Vertex narrower, or wider, or equal in width to an eye but not narrowed in front.
4. Vertex with depression on either side of median carinula, generally not narrowed.
5. Median carina of pronotum a little raised and without undulations.

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Natural Science of Philadelphia, U.S.A., for mailing the Type specimen. Thanks are also due to Dr. G.K. Srivastava for going through the manuscript.

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NEMATODES FROM WEST BENGAL (INDIA)
XVIII. STUDIES ON THE SPECIES OF THE SUBFAMILY
TYLENCHORHYNCHINAE
(TYLENCHORHYNCHIDAE : TYLENCHIDA)

By

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ABSTRACT

Tylenchorhynchus mashhoodi Siddiqi & Basir, 1959 is being recorded from several localities of Burdwan, Birbhum, Murshidabad and West Dinajpur districts of West Bengal. *Tylenchorhynchus goldeni* Rashid & Singh, 1982 is being considered a synonym of *T. mashhoodi*. The study of the type specimens of *Tylenchorhynchus swarupi* Singh & Khera, 1978 reveals that it is a synonym of *T. goffarti* Sturhan, 1966. The paper also reports the morphometric variations in *T. goffarti*. *Quinisulcius capitatus* (Allen, 1955) Siddiqi, 1971 and *Merlinius affinis* (Allen, 1955) Siddiqi, 1970 are being reported for the first time from West Bengal.

INTRODUCTION

Singh & Khera (1978) and Chaturvedi & Khera (1979) have reported *T. mashhoodi* Siddiqi & Basir, 1959 from the rhizosphere of different hosts at Howrah, 24-Parganas, Hooghly, Nadia, Burdwan, Bankura and Murshidabad districts of West Bengal. Singh & Khera (1978) have also described a new species *Tylenchorhynchus swarupi* (=now *T. goffarti* Sturhan, 1966) from 24-Parganas and Hooghly districts. *Tylenchorhynchus nudus* Allen, 1955 has been reported by Baqri & Ahmad (1981) from district Jalpaiguri (West Bengal). Baqri & Ahmad (l.c.) have also studied the morphometric variations in *T. nudus*.

The recent extensive and intensive surveys

of plant and soil nematodes conducted by the authors in several districts of West Bengal have revealed that *Tylenchorhynchus mashhoodi* is a widely distributed species.

The present study mainly deals with the morphometric variations in *T. goffarti* and concludes that *T. swarupi* Singh & Khera, 1978 is a synonym of the former. Our observations are based on the study of the type specimens of *T. swarupi*, available in the National Collection of Zoological Survey of India.

MATERIAL

All the specimens have been mounted in anhydrous glycerin, registered and deposited in the National Collection of Zoological

Survey of India. The type specimens ($n=24 \text{ } \text{♀} \text{ } \text{♀}$ & $18 \text{ } \text{♂} \text{ } \text{♂}$) of *Tylenchorhynchus swarupi* Singh & Khera, 1978, available in the National Collection of Zoological Survey of India, have also been included in the present study.

Tylenchorhynchus mashhoodi Siddiqi &

Basir, 1959

(Fig. 1, A—C)

- Syn. 1959. *Tylenchorhynchus mashhoodi* Siddiqi & Basir, *Proc. 46th Indian Sci. Congr. Part IV (Abs.)*, : 35.
1961. *Tylenchorhynchus mashhoodi* Siddiqi, *Z. Parasitenkunde*, 21 : 56-58.
1970. *Tylenchorhynchus mashhoodi* Baqri & Jairajpuri, *Rev. Brasil. Biol.*, 30 : 61-64.
1978. *Tylenchorhynchus mashhoodi* Singh & Khera, *Bull. zool. Surv. India*, 1 : 27-28.
1979. *Tylenchorhynchus mashhoodi* Chaturvedi & Khera, *Zool. Surv. India, Tech. Mongr. No. 2* : 8-9 pp.
1982. *Tylenchorhynchus goldeni* Rashid & Singh, *Indian J. Nematol.*, 12 : 193-195, new synonymy.

Dimensions :

Females (10) : L (mm)=0.53-0.64 (0.60) $SD=0.04$; $a=25-29$ (28) $SD=1.20$; $b=4.8-5.5$ (5.1) $SD=0.37$; $c=12-18$ (15) $SD=1.89$; $c'=2.5-3.5$ (3.2) $SD=1.96$; $V=52-57$ (55.7) $SD=1.83$; $G_1=20-29$ (23) $SD=2.94$; $G_2=19-26$ (21.6) $SD=1.90$; Stylet (μm)=15-19 (15.9) $SD=1.20$; Metenchium (μm)=8-10 (8.5) $SD=0.66$; $m=50-56$ (53.5) $SD=1.20$.

Males (10) : L (mm)=0.49-0.60 (0.55) $SD=0.04$; $a=27-31$ (28) $SD=1.85$; $b=4.6-5.1$ (4.9) $SD=0.15$; $c=14-16$ (14.8) $SD=0.92$; $c'=2.5-3.0$ (2.7) $SD=0.23$; $T=39-52$ (45.8) $SD=4.36$; Stylet (μm)=15-17 (15.8) $SD=0.92$; Metenchium (μm)=8-9 (8.3) $SD=0.42$; $m=50-53$ (52) $SD=1.41$; Spicules

(μm)=19-22 (19.4) $SD=3.40$; Gubernaculum (μm)=10-12 (10.5) $SD=0.67$.

Habitat and locality : Soil around roots of paddy (*Oryza sativa* L.) at Saldar, District Burdwan.

Other localities : Several localities in the districts of Burdwan, Birbhum, Murshidabad and West Dinajpur.

Discussion : Rashid & Singh (1982) described a new species *Tylenchorhynchus goldeni* from soil around roots of sugarcane hybrid, at Lucknow (U.P.) and differentiated it from *T. annulatus* (Cassidy, 1930) Golden, 1971 and *T. mashhoodi*. From *T. mashhoodi* they have differentiated *T. goldeni* in having a longer body, longer stylet, lower value of b and larger number of tail annules. While comparing with the dimensions and description provided by Allen (1955) and Baqri and Jairajpuri (1970) of *T. mashhoodi*, it is hereby noted that differential characters used by Rashid & Singh (1982) are either overlapping or insignificant. These are as follows : $L=0.57-0.82$ mm against $L=0.54-0.76$ mm in *T. mashhoodi* ; stylet=16-19 μm against 16-19 μm in *T. mashhoodi* ; tail annules=19-36 against 14-29 in *T. mashhoodi*.

This comparison reveals that the only character in which the description of *T. goldeni* differs from *T. mashhoodi* is the higher number of tail annules. However, we feel that 19-36 tail annules against 14-29 should not be treated as diagnostic character because this has been found highly variable character in *Tylenchorhynchus* species (Baqri and Ahmad, 1981 in *T. nudus* ; and the present study in *T. goffarti*). It is, therefore, proposed that *T. goldeni* is a synonym of *T. mashhoodi*.

***Tylenchorhynchus goffarti* Sturhan, 1966**

(Fig. 1, D-F)

Syn. 1970. *Tylenchorhynchus goffarti* Baqri and Jairajpuri, *Rev. Brasil. Biol.*, 30 : 64-65.1978. *Tylenchorhynchus swarupi* Singh and Khera, *Bull. zool. Surv. India*, 1 : 25-28, new synonymy.**Dimensions :***Narendrapur population* : Table I***Birbhum population* :**

Females (9) : L (mm)=0.57-0.63 (0.61) SD=0.03 ; a=31-34(32.5) SD=1.01 ; b=4.8-5.3(5.1) SD=0.17 ; c=14-15(14.2) SD=0.44 ; c'=3.0-3.6(3.4) SD=0.18 ; V=52-60 (54) SD=1.83 ; G₁=23-28(25) SD=1.67 ; G₂=20-28(23) SD=2.65 ; Stylet (μm)=16-17(16.4) SD=0.53 ; Metenchium (μm)=8-9(8.6) SD=0.49 ; m=50-56(52) SD=2.50.

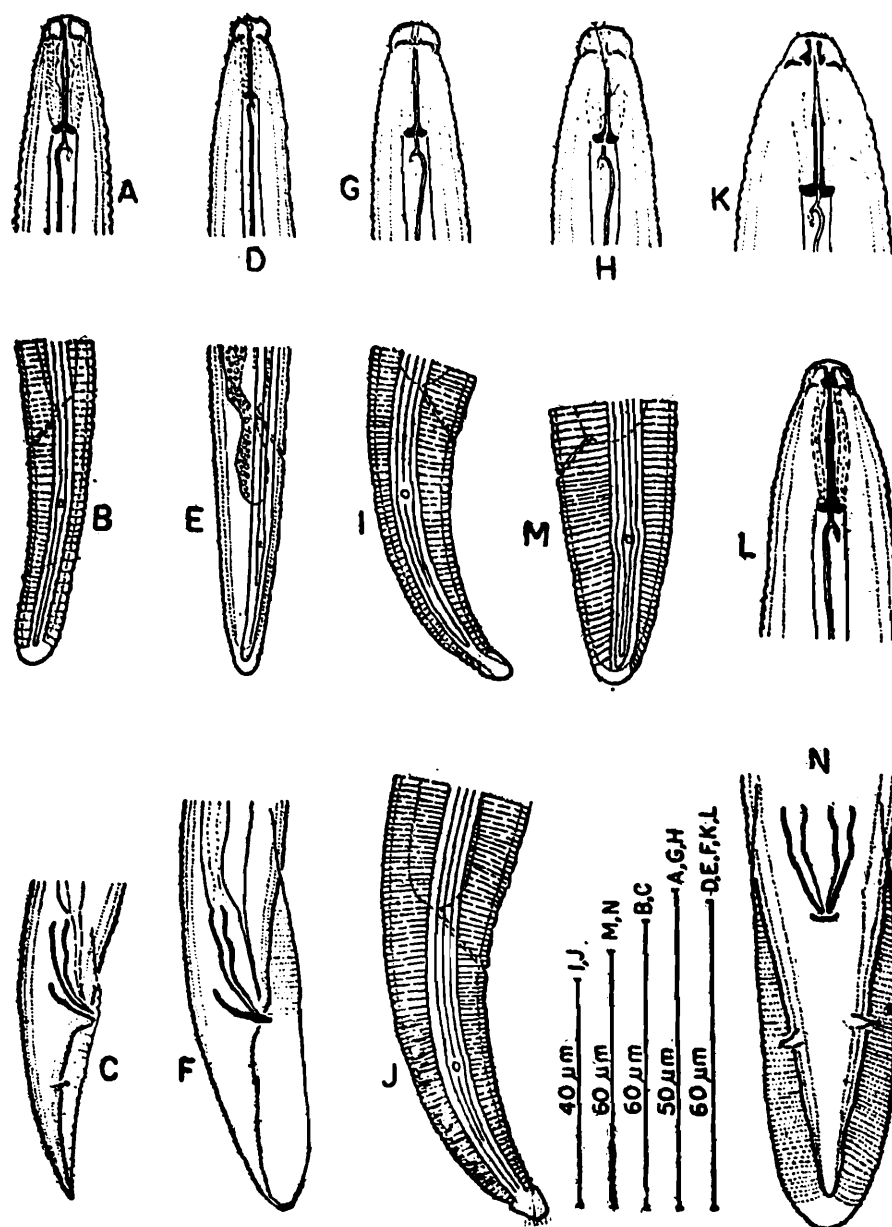


Fig. 1. *Tylenchorhynchus mashhoodi* (A-C) : A. Anterior end ; B. Female tail ; C. Male tail. *T. goffarti* (D-F) : D. Anterior end ; E. Female tail ; F. Male tail. *Quinisulcius capitatus* (G-J) : G. & H. Anterior end ; I & J : Female tails. *Merlinius affinis* (K-N) : K & L. Anterior end ; M. Female tail ; N. Male tail.

TABLE—I. Morphometric and Allometric Variations in Adults of *Tylenchorhynchus goffarti*.

Characters	Female (n=24, paratypes of <i>T. swarupi</i>)			Male (n=18, paratypes of <i>T. swarupi</i>)		
	Range	Mean $\pm$ S. D.	C. V. (%)	Range	Mean $\pm$ S. D.	C. V. (%)
Length (μm)	478-637	558 $\pm$ 36.27	6.5	458-637	534 $\pm$ 44.80	8.5
a	26-32	30 $\pm$ 1.84	6.1	28-35	33 $\pm$ 2.68	8.1
b	4.7-5.7	5.1 $\pm$ 0.28	5.5	4.5-5.8	5.0 $\pm$ 0.36	7.2
c	13-17	15 $\pm$ 1.28	8.5	13-22	16.5 $\pm$ 2.09	13.0
c'	2.6-3.2	2.9 $\pm$ 0.16	5.5	2.3-3.0	2.7 $\pm$ 0.24	8.9
V/T	52-58	53 $\pm$ 1.64	3.1	55-66	61 $\pm$ 3.56	5.8
G ₁	24-30	27 $\pm$ 2.37	8.8	—	—	—
G ₂	20-30	25 $\pm$ 2.51	10.0	—	—	—
m	50-57	53 $\pm$ 2.11	4.0	49-54	53 $\pm$ 2.53	4.8
Head height (μm)	3-4	3.3 $\pm$ 0.20	6.1	3-4	3.2 $\pm$ 0.20	6.4
Head width (μm)	6-8	6.8 $\pm$ 0.46	6.8	6-8	6.4 $\pm$ 0.62	9.7
Stylet (μm)	13-14	13.4 $\pm$ 0.39	2.9	13-14	13.2 $\pm$ 0.55	3.0
Stylet knobs (μm)	3-3.5	3.04 $\pm$ 0.14	4.6	3-3.5	3.03 $\pm$ 0.14	4.6
Metenchium (μm)	7-8	7.1 $\pm$ 0.42	5.9	7-8	7.2 $\pm$ 0.38	5.3
Oesophagus* (μm)	100-121	109 $\pm$ 5.27	4.8	100-115	107 $\pm$ 4.12	3.9
Median bulb* (μm)	49-58	54 $\pm$ 2.80	5.2	49-54	53 $\pm$ 2.53	4.8
Median oesophageal bulb length (μm)	10-13	12.4 $\pm$ 0.49	4.0	10-13	11.8 $\pm$ 0.81	6.9
Median oesophageal bulb width (μm)	8-10	9.4 $\pm$ 0.65	6.9	7-10	8.6 $\pm$ 0.78	9.1
Nerve ring* (μm)	66-76	71 $\pm$ 3.13	4.4	66-74	69 $\pm$ 2.52	3.7
Excretory pore (μm)	80-95	88 $\pm$ 3.94	4.5	79-94	87 $\pm$ 3.24	3.4
Vulva* (μm)	264-343	304 $\pm$ 18.50	6.1	—	—	—
Anterior gonad (μm)	126-195	154 $\pm$ 17.50	11.0	—	—	—
Posterior gonad (μm)	108-182	141 $\pm$ 19.56	14.0	—	—	—
Vagina (μm)	9-13	10.3 $\pm$ 1.17	14.0	—	—	—
Vulva body width (μm)	16-22	19 $\pm$ 1.72	9.1	14-19	17 $\pm$ 1.70	10.0
Anal body diameter (μm)	12-15	12.6 $\pm$ 1.01	8.0	11-13	11.9 $\pm$ 0.73	6.1
Rectum (μm)	9-11	9.8 $\pm$ 0.64	6.5	—	—	—
Tail (μm)	35-44	38 $\pm$ 3.16	8.3	25-39	32 $\pm$ 3.38	11.0
Tail annules	24-43	35 $\pm$ 8.50	24.0	—	—	—
Spicules (μm)	—	—	—	18-24	21.3 $\pm$ 1.28	6.0
Gubernaculum (μm)	—	—	—	7-10	8.8 $\pm$ 1.06	12.0

* Distances from anterior end

S. D.=Standard deviation

C. V.=Coefficient of variability

Male : L (mm)=0.62 ; a=31 ; b=5.1 ; c=15 ; c'=3.0 ; T=41 ; Stylet (μm)=16.0 ; Metenchium (μm)=8.0 ; m=53.

Description : Female : Cuticle transversely striated 1-2 μm apart. Longitudinal striations absent. Lateral fields marked by 4 incisures, 1/5th-1/4th the body-width near middle. Lip region set off from the body, bearing 5-6 indistinct striae, 6-8 μm wide and 3-4 μm high. Head framework slightly sclerotized. Stylet 1.6-2.3 head-width long, its anterior part (metenchium) 50-57% of stylet length.

Stylet knobs slopping downward, 3-5 μm wide. Orifice of dorsal oesophageal gland about 2 μm from base of stylet. Median oesophageal bulb ovate, 46-54% of oesophageal length. Hemizonid prominent, 2-3 annules long, situated 0-5 annules from excretory pore. Vulva a transverse slit. Vagina about 1/2 the corresponding body-width. Gonads typical to the genus. Spermatheca functional, ovate or spherical in shape. Tail with a smooth rounded terminus, marked with 32-43 annules ventrally. Post intestinal

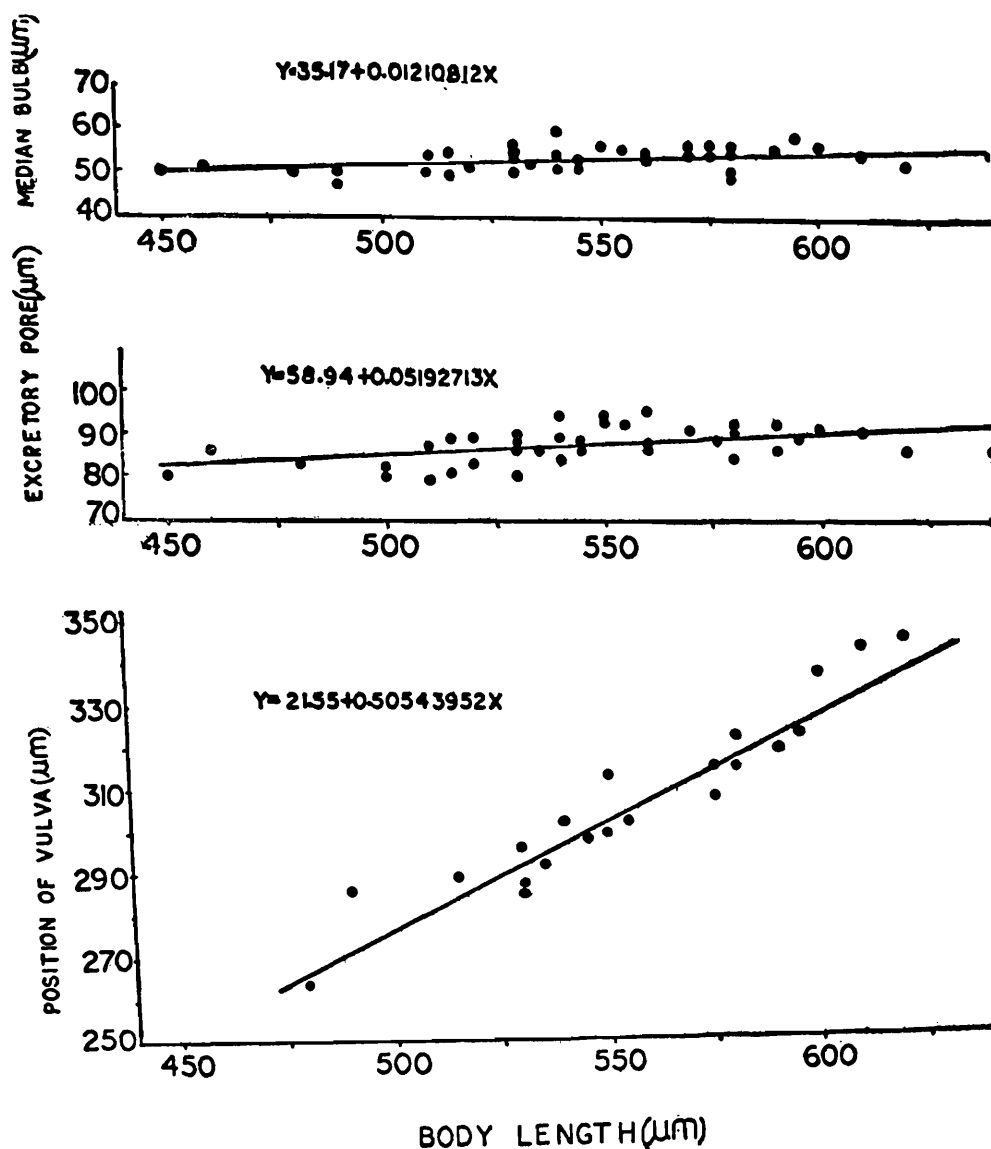


Fig. 2. *Tylenchorhynchus goffarti* : Body length in relation to position to median bulb, position of excretory pore and position of vulva.

sac about 1.1-1.3 anal body-width long. Phasmids in the anterior half, 36-40% of tail from anus.

Male : Male resembles females in general morphology. Spicules 18-24 (21.3) μm long medially. Gubernaculum trough shaped, 7-10 (8.8) μm long. Tail elongate conoid with acute terminus, 2.6-3.2 times the anal body diameter. Phasmids in the anterior half, 33-40% of the tail.

Morphometric and Allometric variations : The various morphometric and allometric characters analysed statistically for their variability in adults (Narendrapur population) are presented in Table I. This has been noted that the position of median oesophageal bulb, excretory pore and vulva are significantly correlated with body length (Fig. 2). The coefficient of correlations are respectively $R=0.707$, 0.728 and 0.929 . The length of stylet ($R=0.432$), oesophagus ($R=0.659$), Gonads ($R=0.802$) and Tail ($R=0.234$ in females and 0.460 in males) are not significantly correlated with the body length.

Among the various morphometric and allometric characters evaluated for their variability, the length of stylet and value of 'V' have been found least variable, their C.V. being 2.9-3.0% and 3.1% respectively. The highly variable characters ($\text{C.V.} > 10\%$) are length of genital branches ($\text{C.V.}=11-14\%$), vagina ($\text{C.V.}=14\%$), value of c ($\text{C.V.}=13\%$), and tail length ($\text{C.V.}=11\%$ in males only), length of gubernaculum ($\text{C.V.}=12\%$), and tail annules ($\text{C.V.}=24\%$). Remaining characters have been found either moderately variable ($\text{C.V.}=4-6\%$) or markedly variable ($\text{C.V.}=7-10\%$).

Remarks : The present description, based on 42 paratypes of *T. swarupi*, agrees with the

description provided by Singh & Khera (1978) except the differences noted by us in the tail terminus and the fusion of the inner two incisures in tail region. Surprisingly they (l.c.) have reported and illustrated striated tail terminus whereas our study confirms that the tail terminus is smooth (Fig. 1,E). This is further being confirmed that inner two incisures fuse well below the phasmids in the tail region (after Singh & Khera, "the inner two incisures fuse at the phasmids).

Singh & Khera (1978) described *T. swarupi* from Narendrapur, district 24-Parganas (West Bengal) and separated it from *T. vulgaris* Upadhyay *et.al.* 1974, *T. brevilineatus* Williams, 1960 and *T. brassicae* Siddiqi, 1966. The present study reveals that their observations on tail terminus as striated instead of smooth, has led the misidentification of *T. goffarti* as a new species. In fact, the specimens belong to *T. goffarti*. Hence, *T. swarupi* is hereby proposed a synonym of *T. goffarti*. Singh & Khera (1978) were having 42 paratypes of *T. swarupi* but they measured only 10 females and 10 males.

Quinisulcius capitatus (Allen, 1955)

Siddiqi, 1971

(Fig. 1, G—J)

- 1961. *Tylenchorhynchus capitatus* Siddiqi, *Z. parasitenkunde* 21 : 62-63.
- 1975. *Quinisulcius capitatus* Coomans & Saltakoglu, *Meded. Fac. Landbwel. Gent.*, 40 : 497-500.

Dimensions :

Female (7) : L (mm) = 0.67-0.76 (0.72)
SD = 0.04 ; a = 20-33 (30.6) SD = 1.72 ;
b = 4.9-5.5 (5.2) SD = 0.21 ; c = 14-16 (15)

SD=0.90 ; $c' = 2.6-2.9$ (2.7) SD=0.10 ; $V = 52-59$ (55) SD=2.30 ; $G_1 = 25-29$ (27) SD=1.27 ; $G_2 = 22-25$ (24) SD=0.89 ; Stylet (μm) = 17-18 (17.2) SD=0.39 ; Metenchium (μm) = 8.5-9.6 (9.1) SD=0.19 ; $m = 50-53$ (52) SD=1.46.

Description :

Female : Cuticle transversely striated, 1-2 μm apart. Longitudinal lines absent, lateral fields marked by five incisures, 1/5th-1/4th of the body-width near middle. Lip region set off from the body, bearing 5-6 annules, 4-5 μm high and about 8 μm wide. Head framework slightly sclerotized. Stylet 2.1-2.3 times the head-width, its anterior part (metenchium) 50-53% of the stylet length. Stylet knobs indented anteriorly, about 3.0-3.5 μm wide. Hemizonid about 2 annules long, situated at 1-5 annules above the excretory pore. Tail cylindrical ending in an acute smooth terminus, marked with 37-44 annules ventrally. Phasmids in the anterior half (23-37%) of the tail.

Male : Not found.

Habitat and locality : From soil around roots of *Citrus* sp. at Dalapchand basti, Kalimpong, Darjeeling, West Bengal.

Merlinius affinis (Allen, 1955) Siddiqi, 1970 (Fig. 1, K-N)

Dimensions :

Female (4) ; L (mm) = 0.78-0.91 (0.84) SD = 0.06 ; $a = 20-21$ (20.9) SD = 0.82 ; $b = 5.2-6.0$ (5.5) SD = 0.36 ; $c = 13-16$ (15) SD = 1.41 ; $c' = 1.41-2.41$ (1.87) SD = 0.42 ; $V = 53-56$ (54) SD = 1.50 ; $G_1 = 20-21$ (20.5) SD = 0.58 ; $G_2 = 14-20$ (18.0) SD = 2.83 ; Stylet (μm) = 26-28 (27.1) SD = 0.85 ; Metenchium (μm) = 14-14.5 (14.4) SD = 0.25 ; $m = 52-54$ (53) SD = 0.96.

Male (2) : L (mm) = 0.78-0.87 (0.82) SD = 0.07 ; $a = 22-24$ (23) SD = 1.41 ; $b = 5.4-5.6$ (5.5) SD = 0.14 ; $c = 12-17$ (14.5) SD = 3.54 ; $c' = 1.93-2.5$ (2.3) SD = 0.43 ; $T = 29-40$ (35.4) SD = 7.78 ; Stylet (μm) = 26-28 (27.0) SD = 1.42 ; Metenchium (μm) = 13-15 (14) SD = 1.41.

Description :

Female : Cuticle transversely striated, 2 μm apart. Longitudinal lines absent, lateral fields $\frac{1}{5}$ th- $\frac{1}{4}$ th of the body near the middle. Lip region slightly set off from the body, flat at apex, bearing 6 annules, 3-4 μm high and 6.5-8.0 μm wide. Head framework heavily sclerotized. Stylet 2.6-2.8 times the head width, its anterior part (metenchium) about 50-54% of stylet length. Stylet knobs slightly indented anteriorly. Hemizonid 1-2 annules long, situated 0-1 annule above the excretory pore. Gonads typical to genus. Tail broadly rounded, marked with 28-34 annules ventrally. Phasmids in the anterior half (30-35%) of the tail.

Male : Similar to females in general morphology except the male genital system and tail shape. Spicules 24 μm medially. Gubernaculum stout, 6 μm long. Tail elongate conoid with acute terminus, 1.9-2.5 times the anal body diameter. Phasmids in the anterior half (37-45%) of the tail.

Habitat and locality : From soil around roots of Tea (*Thea sinensis* L.) at Lebong, Darjeeling, West Bengal.

ACKNOWLEDGEMENT

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Research Project on Nematode Pests of Crops and Their Control is also acknowledged.

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THE SPECIES OF THE GENUS *XIPHINEMA* COBB, 1913
(XIPHINEMATIDAE : DORYLAIMIDA) FROM MALAYSIA

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ABSTRACT

The soil samples collected from Malaysia yielded the following four known species of *Xiphinema* ; *X. insigne* Loos, 1949 ; *X. brevicolle* Lordello & Da Costa, 1961 ; *X. basilgoodeyi* Coomans, 1965 ; and *X. monohysterum* Brown, 1968. Besides, a new species *Xiphinema ilyasi* is being described which is characterized by $L=2.03-2.13$ mm, odontostyle= $109-110$ μ m, odontophore= $59-62$ μ m, guiding ring= $90-92$ μ m and tail= $23-26$ μ m.

INTRODUCTION

Dr. M. Ilyas, Lecturer, School of Physics, University of Science of Malaysia, Penang, collected and brought 10 soil samples from five different localities in Malaysia. These samples yielded five different species of *Xiphinema* Cobb, 1913 which are reported hereunder. One of these species is new and has been named after the collector.

MATERIAL

All the specimens are registered and deposited in the National Zoological Collection, Zoological Survey of India, Calcutta. Holotype and paratype females of *X. ilyasi* n. sp. are mounted on slide W. N. 492.

Xiphinema insigne Loos, 1949

(Fig. 1, A-C)

1949. *Xiphinema insigne* : Loos, J. Zool. Soc. India, 1 : 25.

Measurements :

Female (1) : $L=2.29$ mm ; $a=52$; $b=5.9$;
 $c=26$; $c'=3.8$; $v=\frac{8}{31}$; odontostyle= 61 μ m ; guiding ring= 96 μ m.

Description : Female : Body upon fixation ventrally curved in posterior half of its length. Lip region slightly marked off from body. Amphids 5 μ m from anterior extremity. Odontostyle about 11 lip region-widths long. Odontophore 56% of odontostyle length. Basal expanded part of oesophagus occupying 23% of oesophageal length or 2.5 times the corresponding body-width. Female reproductive system amphidelphic. Vagina 19 μ m long or slightly less than half the corresponding body-width. Tail 88 μ m long, elongate-conoid, with three caudal pores on each side.

Habitat and locality : Soil around roots of Jack tree, *Artocarpus heterophyllus* Lamk. from Balik Pulau Area, Penag, Malaysia.

Xiphinema brevicolle Lordello &
Da Costa, 1961

(Fig. 1, D-G)

1961. *Xiphinema brevicolle*: Lordello & Da Costa,
Rev. brasil. Biol. 21 : 363.

Measurements :

Female (4) : L=1.60 – 1.84 mm ; a=41 – 45
b=5.1 – 6.2 ; c=79 – 11 ; c'=0.8-

8-10 8-9
0.9 ; V= 51 – 53 ; odontostyle=
103-111 μ m ; odontophore=52 –
59 μ m ; guiding ring=76 – 78 μ m.

Description : Female : Body 'C' shaped
upon fixation, Lip region marked by a slight
depression from body. Amphids about 5 μ m
from anterior extremity, stirrup-shaped ; their
apertures occupying about 43% of correspon-

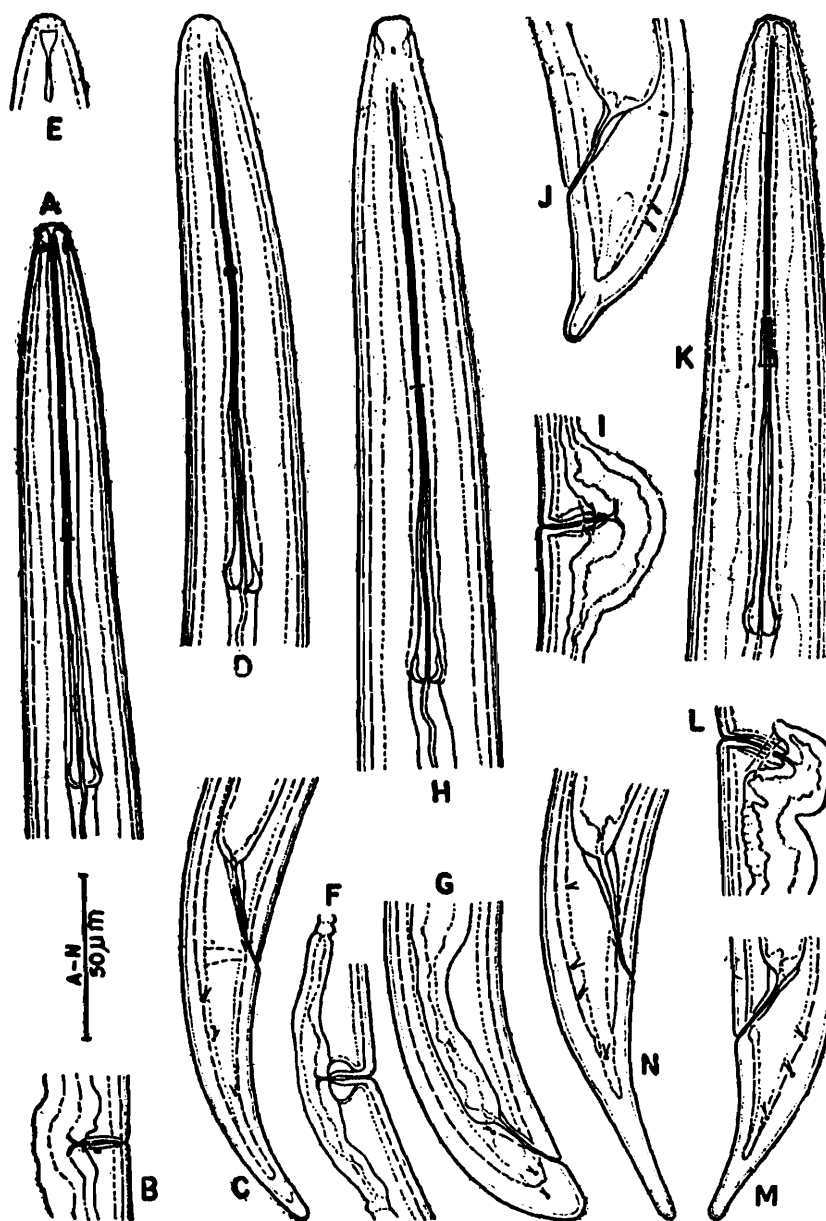


Fig. 1. A—C *Xiphinema insigne* Loos : A—Anterior end ; B—Vulva region ; C—Female tail ; D—G *Xiphinema brevicolle* Lordello & Da Costa : D—Anterior end ; E—Anterior end, superficial view ; F—Vulva region ; G—Female tail ; H—J *Xiphinema basilgoodeyi* Coomans : H—Anterior end ; I—Vulva region ; J—Female tail ; K—N *Xiphinema monohysterum* Brown : K—Anterior end ; L—Vulva region ; M & N—Female tail.

ding body-width. Odontostyle about 9 lip region-widths long. Odontophore 48–57% of the odontostyle length. Basal expanded part of oesophagus occupying 20–24% of oesophageal region or about 1.8–2.2 times the corresponding body-width. Female reproductive system amphidelphic. Vagina 15–18 μm long or less than half the corresponding body-width. Tail 15–23 μm long, rounded, its dorsal surface convex and ventral almost straight, with two caudal pores on each side.

Habitat & locality : Soil around roots of Durian tree *Durio zibethinus* Murr. from Balik Pulau Area, Penang, Malaysia.

***Xiphinema basilgoodeyi* Commans, 1965**

(Fig. 1, H-J)

1965. *Xiphinema basilgoodeyi* : Coomans, *Nematologica*, 10 : 582.

Measurements :

Female (1) : $L = 2.95 \text{ mm}$; $a = 56$; $b = 7.3$;
 $c = 63$; $c' = 1.3$; $V = \frac{5.4}{49}$; odontostyle = 121 μm ; odontophore = 62 μm ; guiding ring = 114 μm .

Description : Female : Body upon fixation ventrally curved in posterior third of its length. Lip region continuous with body. Amphids 5.5 μm from anterior extremity. Odontostyle about 10 lip region-widths long. Odontophore 51% of odontostyle length. Basal expanded part of oesophagus 24% of oesophageal length or about two times the corresponding body-width. Female reproductive system amphidelphic. Vagina 25 μm long or about half of corresponding body-width. Tail 47 μm long, short-conoid, with a small

peg-like structure and two caudal pores on each side.

Habitat & Locality : Soil around roots of Mangosteen tree, *Garcina mangostana* Linn. from Sungei Batu, Penang, Malaysia.

***Xiphinema monohysterum* Brown, 1968**

(Fig. 1, K-N)

1968. *Xiphinema monohysterum* : Brown, *Nematologica*, 13 : 635.

Measurements :

Females (3) : $L = 2.19 - 2.41 \text{ mm}$; $a = 43 - 47$;
 $b = 5.6 - 6.5$; $c = 27 - 40$; $c' = 2.3 - 3.2$
 $V = \frac{8 - 9}{24 - 27}$; odontostyle = 112 – 113 μm ; odontophore = 60 – 65 μm
guiding ring = 96 – 125 μm .

Description : Female : Body upon fixation ventrally curved in posterior half of its length. Lip region marked with a slight depression from body. Amphids 4.0–5.5 μm from anterior extremity, stirrup-shaped, apertures occupying 47–60% of corresponding body-width. Odontostyle about 10–11 lip region-widths long. Odontophore 54–55% of the odontostyle length. Basal expanded part of oesophagus occupying 22–24% of oesophageal region or about 1.8–1.9 times the corresponding body-width. Female reproductive system mono-opisthodelphic. Vagina 22–29 μm or about half of the corresponding body-width. Tail 61–82 μm long, elongate-conoid, with 2–3 caudal pores on each side. In one female the tail tip is broken and its length has been measured 33 μm ($c = 66$, $c' = 1.4$).

Habitat & Locality : Soil around roots of Jack tree, *Artocarpus hettrophyllus* Lamk. from Balik Pulau Area, Penang, Malaysia.

***Xiphinema ilyasi* n. sp.**

Syn. *X. ensiculiferum* apud Williams, 1959
(Fig. 2, A-F)

1959. *Xiphinema ensiculiferum*: Williams, *Occ. Pap. Mauritius*. 3. *Sug. Ind. Res. Inst.*, No. 3.

Measurements :

Holotype female : $L=2.03$ mm ; $a=41$;
 $b=5.5$; $c=88$; $c'=0.8$; $V=32^{12}$;
odontostyle= $110\text{ }\mu\text{m}$; odontophore
= $62\text{ }\mu\text{m}$; guiding ring= $92\text{ }\mu\text{m}$.

Paratype ; 1 ♀ : $L=2.13$ mm ! $a=43$; $b=5.6$; $c=82$; $c'=0.9$; $V=31^{10}$;
odontostyle= $109\text{ }\mu\text{m}$; odontophore= $59\text{ }\mu\text{m}$; guiding ring= $90\text{ }\mu\text{m}$.

Description : Female : Body upon fixation ventrally curved in the posterior half of its length, tapering slightly towards both ends. Cuticle $2.5-7.5\text{ }\mu\text{m}$ (thickest on tail). Lateral chords about $1/5$ th of body-width near middle. Lip region rounded, almost continuous with body, its width about $1/5$ th of

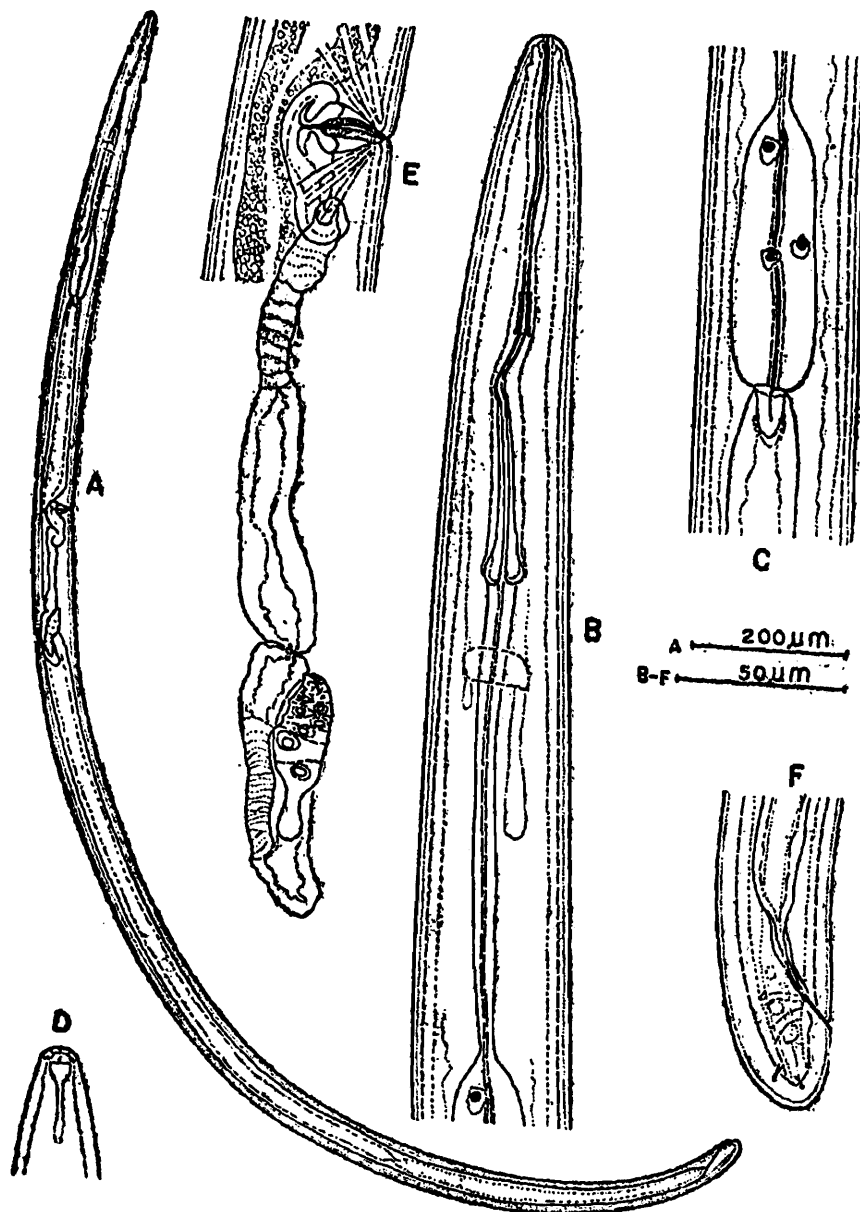


Fig. 2. A-F *Xiphinema ilyasi* n. sp. : A—Entire female ; B—Anterior region showing slender part of oesophagus ; C—Basal expanded part of oesophagus ; D—Anterior end, superficial view ; E—Female reproductive system ; F—Female tail,

body-width at base of oesophagus. Amphids stirrup-shaped, their apertures $4.5 - 5.0 \mu\text{m}$ from anterior extremity and $6.0 - 6.5 \mu\text{m}$ wide or $52 - 54\%$ of the corresponding body-width. Odontostyle about 10–11 lip region widths long. Odontophore with well developed basal knobs, $50 - 56\%$ of the odontostyle length. Nerve ring $193 - 194 \mu\text{m}$ or $50 - 51\%$ of oesophageal region from anterior extremity. Basal expanded part of oesophagus occupying $21 - 22\%$ of neck length or 1.7–1.8 times the corresponding body-width. Positions of Oesophageal gland nuclei and orifices as follows : $Do = 80.0 - 80.4$; $DN = 81.2 - 81.4$; $DO - DN = 1.0 - 1.2$; $S_1N_1 = 88.3 - 88.8$; $S_1N_2 = 89.2 - 89.3$; $S_2O = 95.9 - 96.4$. Cardia tongue-shaped, enveloped by intestinal tissue. Prerectum $326 - 421 \mu\text{m}$ or 11–14 anal body-widths long. Rectum $36 - 37 \mu\text{m}$ or about 1.2–1.3 anal body-width long. Vulva a transverse slit. Vagina $27 - 28 \mu\text{m}$ or about half of corresponding body-width long. Female reproductive system mono-opisthodelphic, anterior sexual branch absent. Posterior sexual branch consists of a reflexed ovary, distal narrow and proximal expanded part of oviduct, and a long uterus. Tail short rounded, $23 - 26 \mu\text{m}$ or 0.8–0.9 anal body-width long, with two caudal pores on each side.

Male : Not found.

Type habitat & locality : Soil around roots of Jack tree, *Artocarpus heterophyllus* Lamk. from Balik Pusu Area, Penang, Malaysia.

Differential diagnosis : *Xiphinema ilyasi* n. sp. comes close to *X. loosi* Southey & Luc, 1973 and *X. ensiculiferum* (Cobb, 1893) Thorne, 1937. From the former it differs in the absence of anterior genital sac and the mammillate tail terminus or rudimentary

mucro (anterior genital sac about $3/4$ th of vulva body width and tail with slightly mammillate terminus or rudimentary mucro in *X. loosi*). From *X. ensiculiferum* the new species differs in having shorter odontostyle and odontophore, anteriorly situated guiding ring and longer tail (odontostyle = $149 - 158 \mu\text{m}$; odontophore = $74 - 81 \mu\text{m}$; guiding ring = $143 \mu\text{m}$; and $c' = 0.57 - 0.67$ in *X. ensiculiferum*). It can further be differentiated from *X. loosi* and *X. ensiculiferum* in having lip region marked by a slight depression.

Discussion : Two females identified by Williams (1959) from Mauritius as *X. ensiculiferum* were tentatively considered by Southey & Luc (1973) as conspecific with *X. loosi* despite some significant differences because they were unable to study Williams's specimens. The type specimens of present new species, *X. ilyasi*, fit well with the description provided by Williams (1959) in having almost continuous lip region or slightly marked by a depression, rounded tail and no anterior genital sac. The type specimen of *X. ilyasi* and Williams's specimens jointly differ from *X. loosi* in the following characters : Lip region continuous from body or slightly marked by a depression against offset by a slight constriction, anterior genital sac absent whereas it is about one vulva body-width in *X. loosi*, and rounded tail against mammillate tail or with a vestigial mucro associated with a terminal canal. On the basis of these differences, we feel justified to propose a new name, *X. ilyasi*, for the specimens from Malaysia and Mauritius.

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MALACOLOGICAL NOTES ON SAGAR ISLAND

By

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INTRODUCTION

Earlier reports on molluscs of Gangetic delta, lower Bengal, are from Stoliczka (1869), Nevill (1880), Annandale (1907), Preston (1915), Annandale & Prashad (1919), Roonwal (1954a, 1954b, 1967), Rajagopalaiengar (1961, 1966), Rajagopal (1964, 1970) and Subba Rao *et al* (1983). The studies covered the vast areas of Sunderbans in general. No particular attention was paid to the molluscs of Sagar, an important island in the Sunderbans. Keeping this in view, a project was undertaken and regular surveys were conducted in different seasons, to study the malacofauna of Sagar island, with special reference to their bioecology. Results of these studies covering a period of two years (1979-81), are summarised here.

PHYSIOGRAPHY OF SAGAR ISLAND

Sagar island (Lat. 21°39'N., Long. 63°03'E.) is situated about 105 kms. south of Calcutta, in the mouth of river Hooghly. The island is approximately 300 Sq. kms. bounded by the branches of the river Hooghly on all sides, except on the south, where is there Bay of Bengal. The branch flowing west is known as Hooghly and the other flowing north and east

is Muriganga or Burtola. On the southern side is a sandy beach interspersed with mudflats. Three creeks crisscross the island. The major one is Chemaguri creek, running from east end to west, and is stagnant at present. A few mangrove patches are present in the south. The island is surrounded by mud bunds all around to prevent inflow of saline waters. Erosion is rather common, particularly in monsoon and bamboo poles are erected as supports to prevent this. Two jetties, one at Kachuberia, the northern tip and the other at Chemaguri, the southern tip of the island, 11 kms. north-east of Ganga Sagar, are present.

Based on the ecology, a total of five stations were established in the island. These are I. Kachuberia, II. Costala, III. Sagar Thana, IV. Chemaguri and V. Ganga Sagar. In addition, nearby islands i.e. Ghoramara, Lohachora, Kakdamari were also surveyed. The details of the stations are given below.

KACHUBERIA (Station. I)

Kachuberia is situated on the northern part of the island. The piles of the jetty, damaged by the shipworms were replaced by iron pillars recently. A 50 metre brick wall along the bank is on the east.

The terrain on either side of the jetty is hard, interspersed with brick pieces, stones etc. and devoid of vegetation. In the eastern side the bank is steep to very steep and in the west it is shallow with grass vegetation beyond 200 metres of the jetty. No fauna was recorded on either side of the jetty except mud skippers and hermit crabs at high water mark as the area is constantly disturbed by human activity. The wooden jetty piles were found covered with sea anemones (*Metridium* sp.), barnacles, oysters and gastropods, *Littorina scabra scabra* (Pl. V, fig. 5). *Nerita articulata* (Pl. V, figs. 1 & 2) and *Cymia lacera* (Pl. VI, fig. 6). The first mentioned species was dominant and occupies the highest position on the piles. Occasionally empty shells of *Littorina melanostoma* (Pl. V, fig. 6), *Natica tigrina* (Pl. VI, figs. 2 & 3) and *Nerita articulata* inhabited by hermit crabs were also seen. Though the piles were damaged by the shipworms, no live animals were found during the visits. The empty tunnels were occupied by crabs, isopods, polychaetes etc. A list of molluscs occurring in this station are given in Table I.

COSTALA (Station II)

The place is situated about 3 kms. north west of Kachuberia. Here the river bifurcates and the bank is protected by mud bund. During low tide about 0.5 km. of the bed is exposed. There is a small patch of mangrove vegetation of plants locally called as, 'Ban' (*Avicenia* sp.) and Harcoza (*Acanthus illicifolius*). Rest of the bed is covered with grass extending upto mid water mark and gradually decreases towards low water mark.

The terrain is hard to semi-hard between high to mid water mark and semi-hard to loose between mid to low water mark,

traversed by a few small creeklets. At high water mark large number of ditches are present. The malacofauna is dominated by assiminiid, *Assiminea brevicula* (Pl. V, fig. 11) and the tower shells, *Telescopium telescopium* (Pl. V, fig. 15) which are found crawling on mud banks. The former extends from mid to low water mark with a gradual increase in their numbers. The latter is mostly found along the creeklets and ditches near the bund. In addition, the ditches are inhabited by stenothyrids, *Stenothyra deltae* (Pl. V, fig. 8), slugs, *Onchidium tenerum* (Pl. VII, fig. 1). The latter burrows below the surface and comes out only at night. However, the number of faecal pellets of these animals is greater in rainy season.

The mangrove plants offer shelter to *Littorina melanostoma*, which cling to their branches. In addition, *Assiminea francesiae* (Pl. V, figs. 9 & 10) and *Pila globosa* (Pl. V, fig. 7) are noticed crawling on the substratum in September. The occurrence of latter, a common freshwater species is interesting. It indicates either a fall in the salinity or the tolerance of the species to salinity. Bivalves were collected from exposed bed during low tide.

SAGAR THANA (Station III)

It is about 6kms. south east of Kachuberia. A creek known as Bomankhali opens into the main river at this point. The river bank is similar to that at Costala with no mangrove vegetation. The banks of the creek are steep and slippery, semi hard in the upper and slushy in lower region. Grass vegetation extends from mid to high water mark and upto the bund.

The malacofauna is similar to that of Costala except for the absence of littorinids.

Assiminids are dominant and concentrated on the banks of the creek rather than in the main river. Assiminids are represented by two species, *Assimineia brevicula* and *A. beddomeana*, but the latter is not abundant. In the slushy ditches at high water mark and creeklets stenothyrids, *Stenothyra deltae*, atyids, *Haminea crocata* (Pl. VI, figs. 13 & 14), and tower shells *Telescopium telescopium* are found. Occurrence of slugs was also indicated by their faecal pellets. Table I presents the list of molluscs.

CHEMAGURI (Station IV)

Chemaguri, situated slightly interior, is about 11 kms. north east of Ganga Sagar. A creek flowing through this place opens into the main river at a distance of about 2 kms. from Chemaguri village. The banks of the creek are steep with thick mangrove vegetation all along upto the mouth, with patches of grass locally called 'Dhani' gach' (*Oxyza* sp.) from mid to lower water mark. The terrain is hard to semi-hard with loose slushy patches at low water mark. The malacofauna is similar to that of other stations, but *Cerithidea obtusa* (Pl. V, figs. 12 & 13) and *Littorina melanostoma* clinging to the branches of mangrove trees were recorded. During low tide they become active and seen crawling on the exposed slushy mud.

The jetty piles are thickly coated with sea anemones (*Metridium* sp.) in addition to the usual barnacles and oysters, *Crassostrea cuttackensis*, *Littorina scabra scabra* and *Cymia lacera*. Some of these piles are damaged by the shipworms, but no live ones could be collected.

A mud flat is exposed near the mouth of

the creek during spring tides. The substratum consists of very loose mud with slushy pockets, criss-crossed by small creeklets. The slushy pockets are kneedeep to waist-deep. Only tall grass is present in the middle of the flat. The malacofauna in this mud flat in order of dominance consists of *Cerithidea cingulata* (Pl. V, fig. 14), *Telescopium telescopium*, *Nassarius foveolatus* (Pl. VIII, fig. 8) and *Macoma birmanica* (Pl. VIII, figs. 6 & 7). The former two species were concentrated in the centre of the flat and latter two near the bank, the last mentioned occurring at a depth between 15 to 30 cms. in the slushy pockets. Presence of these animals inside the burrows were indicated by their protruding siphons spread out on the slushy mud surface.

GANGA SAGAR (Station V)

It is on the southern tip of the island facing sea. The beach is confined to in between the two river mouths. A creek which opens into the sea about 0.5 kms. east of the Irrigation bungalow, runs north-west after separating in two tributaries. One of the branches, the course of which is obstructed by the irrigation bungalow, runs behind the Kapil Muni temple ending in a marshy mangrove forest, which spreads over most part of the region, particularly on the west. For convenience of survey three sub-stations were established viz. Ganga Sagar beach, the creek and its branches, and mangrove forest.

Ganga Sagar beach :

The beach is mostly sandy admixed with fine mud and interspersed with mud flats. Vertically three zones have been recognised on the beach i.e. supra littoral, littoral and eulittoral zones. At supra littoral zone the beach is mainly sandy with sand dunes

extending upto the Kapil Muni temple. Beyond the temple there are hard mud flats. The vegetation on sand dunes is that of *Ipomea* creepers (*Ipomea bilabiata*) and on west the mangrove forest consists mainly of 'Henthal' (*Phoenix peludosa*) trees. The region between high to mid-water mark is sandy towards east and interspersed by more mud flats in the west. The terrain is semi hard on sandy patches due to admixture of silt. The mud flats are very hard, corrugated, slippery, criss-crossed with small canals and with mangrove stumps and their roots. Several dead and empty shells washed ashore were noted (Table. I). However, the mud flats near mid water mark support a small population of *Glaucanome sculpta* (Pl. VIII, figs. 12 & 13). Further down towards low water mark, the beach is hard to semi hard with patches of mud flats in between. During spring tides a vast area of the beach is exposed, often extending for about a kilometre from the supra littoral zone. Apparently the beach appears barren. A careful observation, soon after the receding tide, however reveals a large number of tiny nudibranchs (*Limapontia* sp.) tunnelling through the sub-surface level of the sandy beach leaving clear tracks behind. The number of these animals are comparatively higher when the sun is not too hot. In addition to these, *Nassarius stolatus* (Pl. VI, fig. 10), *Natica gualteriana* (Pl. VI, fig. 4) are common. Occasionally species like *Acrilla acuminata* (Pl. VI, fig. 1), *Donax incarnatus* (Pl. VIII, figs. 10 & 11) are also found. The mud flats support a rich population of *Glaucanome sculpta* and thinly populated pholads, *Barnea candida* (Pl. VIII, figs. 16 & 17) and *Solen kempfi* (Pl. VIII, fig. 18). The mangrove stumps on the mud flats are inhabited by *Littorina scabra scabra*, *Larina*

burmana (Pl. VII, fig. 4) and also oysters, *Cra-ssoostrea cuttackensis*. Some of these stumps are damaged by shipworms, *Banka rochii*.

Creek at Ganga Sagar :

Unlike that of other creeks at Chemaguri and Sagar thana the present creek has a wider mouth opening into the sea. The mouth is shallow and sandy. Up-stream the banks are more steep and muddy with mangrove plants.

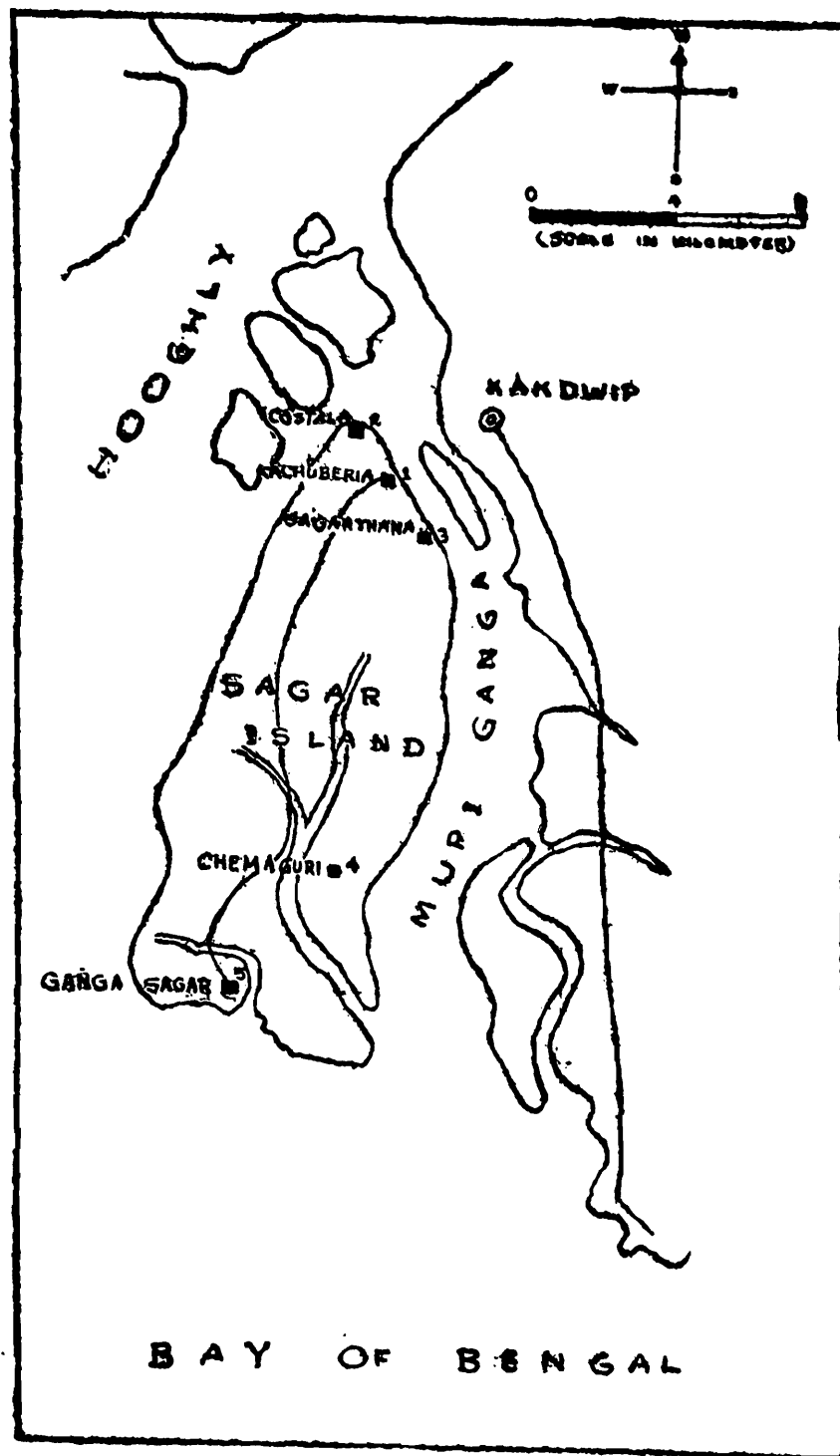
The malacofauna near the mouth include *Cerithidea cingulata*, *Nassarius stolatus* and *Meretrix meretrix* (Pl. VII, figs. 10 & 11). The last mentioned species is a burrowing form. The banks of the creek are inhabited by *Assimineia brevicula*, *Telescopium telescopium*, *Stenothyra deltae* and *Haminea crocata* in order of dominance. A small population of *Littorina melanostoma* is found clinging to the plants on the bank.

Mangrove forest :

The mangrove forest extends from the irrigation bungalow to west almost upto the mouth of Hooghly. The major constituents of the forest is henthal, which grows upto a height of 2.5 to 3 metres, with thorny branches. Other plants include Ban, Ganwa (*Excoecaria agallocha*) and Harcoza. The terrain is muddy with puddles and ditches. During spring tides water enters this region, but at other times it is semi dry. Molluscs inhabiting this region include *Telescopium telescopium*, *Cerithidea obtusa*, *Auricula translucens* (Pl. VII, fig. 2) and *Pythia plicata* (Pl. VII, fig. 3).

DISCUSSION

A total of 55 species belonging to 43 genera included in 34 families were collected



Map showing the Physiography of Sagar Island

TABLE—I. List of species occurring in Sagar Island

Name of the species	Stations					Remarks
	I	II	III	IV	V	
Class : GASTROPODA						
Family : NERITIDAE						
<i>Nerita articulata</i> (Gould)	+	—	—	+	+	empty shells
<i>Pseudonerita sulculosa</i> (Martens)	+	—	—	—	—	
<i>Neritina (Dostia) violacea</i> (Gmelin)	+	+	+	—	—	
Family : PILIDAE						
<i>Pila globosa</i> (Swinson)	—	+	+	—	—	
Family : LITTORINIDAE						
<i>Littorina (Littorinopsis) scabra scabra</i> (Linnaeus)	+	—	—	+	+	
<i>L. (Littorinopsis) melanostoma</i> Gray	—	+	—	+	+	
Family : STENOTHYRIDAE						
<i>Stenothyra deltae</i> (Benson)	—	+	+	—	+	
Family : ASSIMINEIDAE						
<i>Assiminea brevicula</i> Pfeiffer	+	+	+	+	+	
<i>A. beddomeana</i> Nevill	—	—	+	+	—	
<i>A. francesiae</i> (Wood)	—	+	—	—	—	
Family : POTAMIDIDAE						
<i>Cerithidea (Cerithidiopsis) cingulata</i> (Gmelin)	—	—	—	+	+	
<i>C. obtusa</i> Lamarck	—	—	—	+	+	
<i>Telescopium (Telescopium) telescopium</i> (Linnaeus)	—	+	+	+	+	
Family : EPITONIDAE						
<i>Acrilla acuminata</i> (Sowerby)	—	—	—	—	+	
Family : NATICIDAE						
<i>Natica tigrina</i> (Roding)	—	—	—	—	+	
<i>N. gualteriana</i> Recluz	—	—	—	—	+	
Family : CYMATIDAE						
<i>Gyrineum natator</i> (Roding)	—	—	—	—	+	empty shell
Family : MURICIDAE						
<i>Cymia lacera</i> (Boin)	+	—	—	+	—	
Family : VOLEMIDAE						
<i>Pugilina cochlidium</i> (Linnaeus)	—	—	—	—	+	
Family : NASSARIIDAE						
<i>Nassarius stolatus</i> (Gmelin)	—	—	—	—	+	
<i>N. foveolatus</i> Dunker	—	—	—	+	+	
<i>N. nodifera</i> (Powis)	—	—	—	—	+	
Family : OLIVIDAE						
<i>Amalda ampla</i> (Gmelin)	—	—	—	—	+	
Family : TEREBRIDAE						
<i>Terebra duplicata</i> Linnaeus	—	—	—	—	+	
Family : ATYIDAE						
<i>Haminea crocata</i> Pease	—	—	+	—	+	
Family : LIMAPONTIIDAE						
<i>Limapontia</i> sp.	—	—	—	—	+	
Family : ONCHIDIIDAE						
<i>Onchidium tenerum</i> Stoliczka	—	+	—	—	—	
<i>O. tigrinum</i> Stoliczka	—	—	+	—	—	

Name of the species	Stations					Remarks
	I	II	III	IV	V	
Family : ELLOBIIDAE						
<i>Auricula translucens</i> Annandale & Prashad	+	+	+	+	+	empty shells
<i>Pythia plicata</i> (Gray)	+	+	+	+	+	empty shells
Family : THIARIDAE						
<i>Larina burmana</i> Blanford	—	—	—	—	+	
Class : SCAPHOPODA						
Family : DENTALIIDAE						
<i>Dentalium octangulatum</i> Donovan	—	—	—	—	+	empty shells
Class : BIVALVIA						
Family : ARCIDAE						
<i>Anadara granosa</i> (Linnaeus)	—	—	—	—	+	empty valves
Family : MYTILIDAE						
<i>Modiolus undulatus</i> (Hanley) (Pl. VII, figs. 8 & 9)	—	—	—	—	+	
Family : OSTREIDAE						
<i>Crassostrea cuttackensis</i> (Newton and Smith)	—	—	—	—	+	valves
Family : VENERIDAE						
<i>Meretrix meretrix</i> (Linnaeus)	—	—	—	—	+	
<i>Dosinia eudeli</i> Fischer Piette & Delmas	—	—	—	—	+	empty valves
<i>D. trigona</i> Reeve (Pl. VII, figs. 13 & 14)	—	—	—	—	+	empty valves
<i>Paphia malabarica</i> (Schroeter) (Pl. VII, fig. 12)	—	—	—	—	+	do
Family : MACTRIDAE						
<i>Mactra luzonica</i> Deshayes (Pl. VII, figs. 15 & 16)	—	—	—	—	+	do
<i>M. mera</i> Deshayes (Pl. VIII, fig. 1)	—	—	—	—	+	do
<i>M. turgida</i> (Gmelin) (Pl. VIII, fig. 3)	—	—	—	—	+	do
<i>M. violacea</i> Gmelin (Pl. VIII, fig. 2)	—	—	—	—	+	do
Family : PSAMMOBIIDAE						
<i>Sanguinolaria</i> (<i>Soletellina</i>)						
<i>acuminata</i> (Philippi) (Pl. VIII, figs. 4 & 5)	—	—	—	—	+	do
Family : TELLINIDAE						
<i>Macoma birmanica</i> (Philippi)	—	—	—	+	+	
<i>Strigilla splendida</i> Anton	—	—	—	—	+	
<i>Tellina iridiscens</i> (Benson)	—	—	—	—	+	
Family : SEMELIDAE						
<i>Theora opalina</i> (Hinds) (Pl. VIII, figs. 8 & 9)	—	—	—	—	+	
Family : GLAUCONOMIDAE						
<i>Glaucanome sculpta</i> (Sowerby)	—	—	—	—	+	
Family : DONACIDAE						
<i>Donax incarnatus</i> Gmelin	—	—	—	—	+	
Family : SOLENIDAE						
<i>Solen kemp</i> Preston	—	—	—	—	+	
Family : CULTELLIDAE						
<i>Siliqua albida</i> Dunker	—	—	—	—	+	
<i>Tanysiphon rivalis</i> Benson	—	+	—	—	—	
Family : PHOLADIDAE						
<i>Barnea candida</i> (Linnaeus)	—	—	—	—	+	
Family : TEREDINIDAE						
<i>Bankia rochi</i> Moll	—	—	—	—	+	

from the island (Table. I). Out of these, gastropods are represented by 30 species, bivalves by 24 species and scaphopoda by a single species. Ganga Sagar (Station V) supports a large number of species (46 spp.) followed by Chemaguri (Station IV) 13 spp., Costala (Station II) 12 spp., Sagar Thana (Station III) 11 spp. and Kachuberia (Station I) 8 spp. Ganga Sagar is in the immediate vicinity of the sea thus having maximum marine influence. Chemaguri is nearer to Ganga Sagar and has more species than other stations which are not primarily marine in nature.

Of all the species, *Assiminea brevicula*, *Auricularia translucens* and *Pythia plicata* are common to all stations. *Telescopium telescopium* and *Stenothyra deltae* are common to all except for station I (Kachuberia) where the ecology is disturbed more due to human interference and also due to wide salinity fluctuations. The species like *Littorina scabra scabra* and *Cymia lacera* are common at both Kachuberia and Chemaguri, the latter species is only found attached to jetty piles whereas the former species, along with *Larina burmana* is found on jetty piles as well as mangrove stumps at Ganga Sagar beach. Total absence of *Neritina violacea* (Pl. V, fig. 4), even their shells from last two stations i.e. IV & V, perhaps indicates their inability to tolerate high salinity. Occurrence of *Pila globosa*, a freshwater form and *Assiminea francesiae*, which is near freshwater in habit, at Costala and Sagar Thana, during September obviously points to the either fall in salinity or the tolerance of the species to salinity after the monsoon. The species *Pseudonerita sulculosa* (Pl. V, fig. 3), *Acrilla acuminata*, *Pugilinus cochlidium* (Pl. VI, fig. 7),

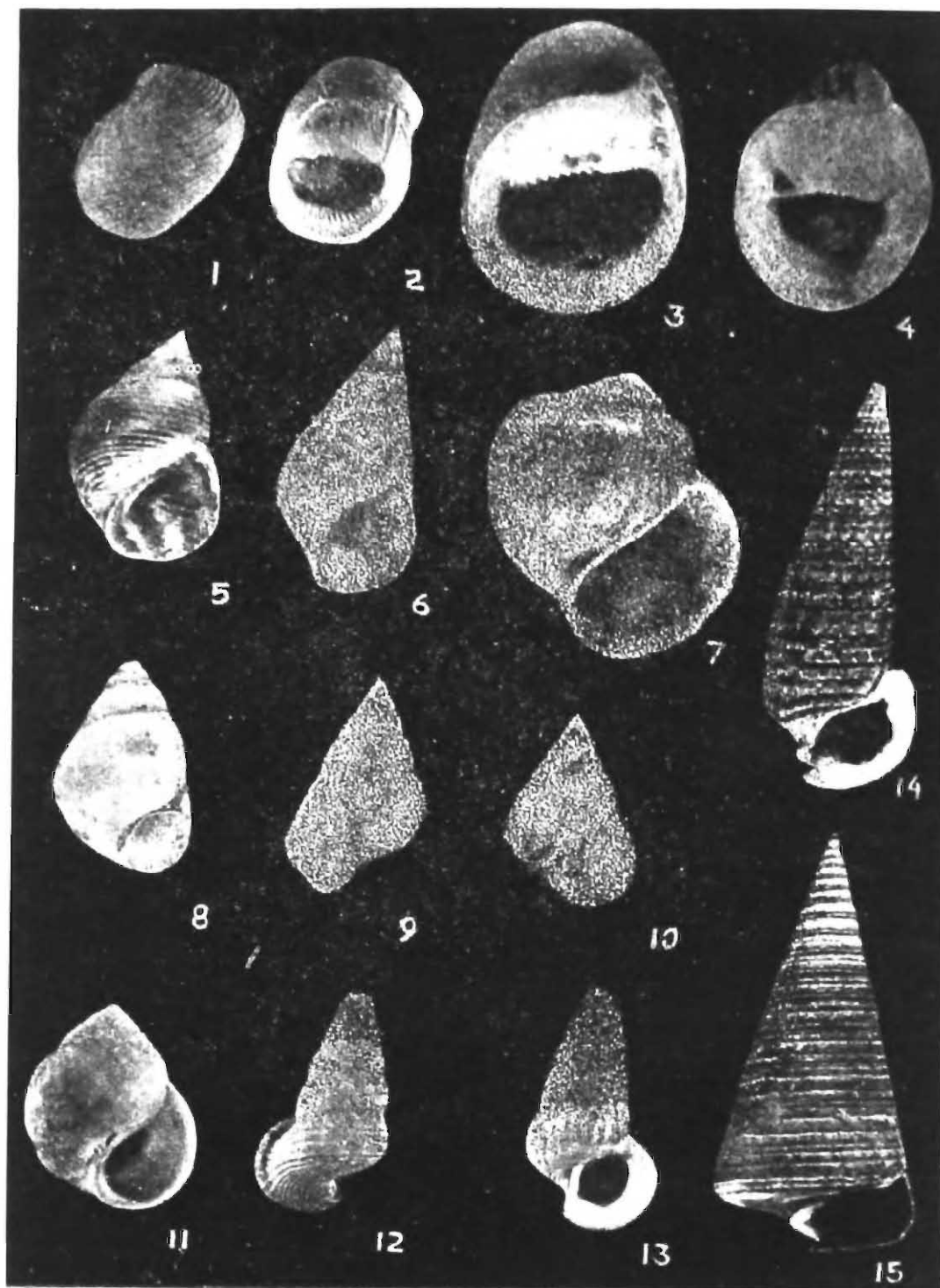
Nassarius nodifera (Pl. VI, fig. 9), *Amalda ampla* (Pl. VI, fig. 11), *Terebra duplicata* (Pl. VI, fig. 12) and *Haminea crocata* among gastropods and *Strigilla splendida*, *Siliqua albida* (Pl. VIII, fig. 14 & 15) and *Tanysiphon rivalis* among bivalves are found rarely. Most of the bivalves listed are found as empty shells except for the species *Glaucanome sculpta*, *Barnea candida*, *Solen kempii* and *Bankia rochii*.

The species occurring throughout the year in order of dominance are *Assiminea brevicula*, *Telescopium telescopium*, *Littorina scabra scabra*, *L. melanostoma*, *Natica tigrina*, *Cerithidea cingulata*, *C. obtusa*, *Nassarius stolatus*, *Glaucanome sculpta* and *Barnea candida*. Population counts were taken for the most common species i.e. *Assiminea brevicula* of gastropods and *Glaucanome sculpta*, a bivalve. The assimineids are found on the mud banks extending from high water mark to low water mark, the maximum number (833 to 100/sq.m.) being in November-December period. During this period young ones are abundant along the low water mark gradually becoming scarce towards high water mark, which is occupied by adults. Size range varies between 0.5 to 6 mm. Pairing was noticed from August to October. Glaucanomids found at depths of 7-15 cms. in the mud flats at Sagar island beach, are dominant between mid water mark to low watermark. The young shells are at a depth between 10-15 cms, whereas the adults are in superficial layer, a part of the body remaining exposed. The size range varies from 0.3 to 33 cms. Maximum number (450-503/sq.m.) which includes mostly young ones are found in the month of November.

Table II shows dominance of the fauna in a particular ecological niche. A perusal

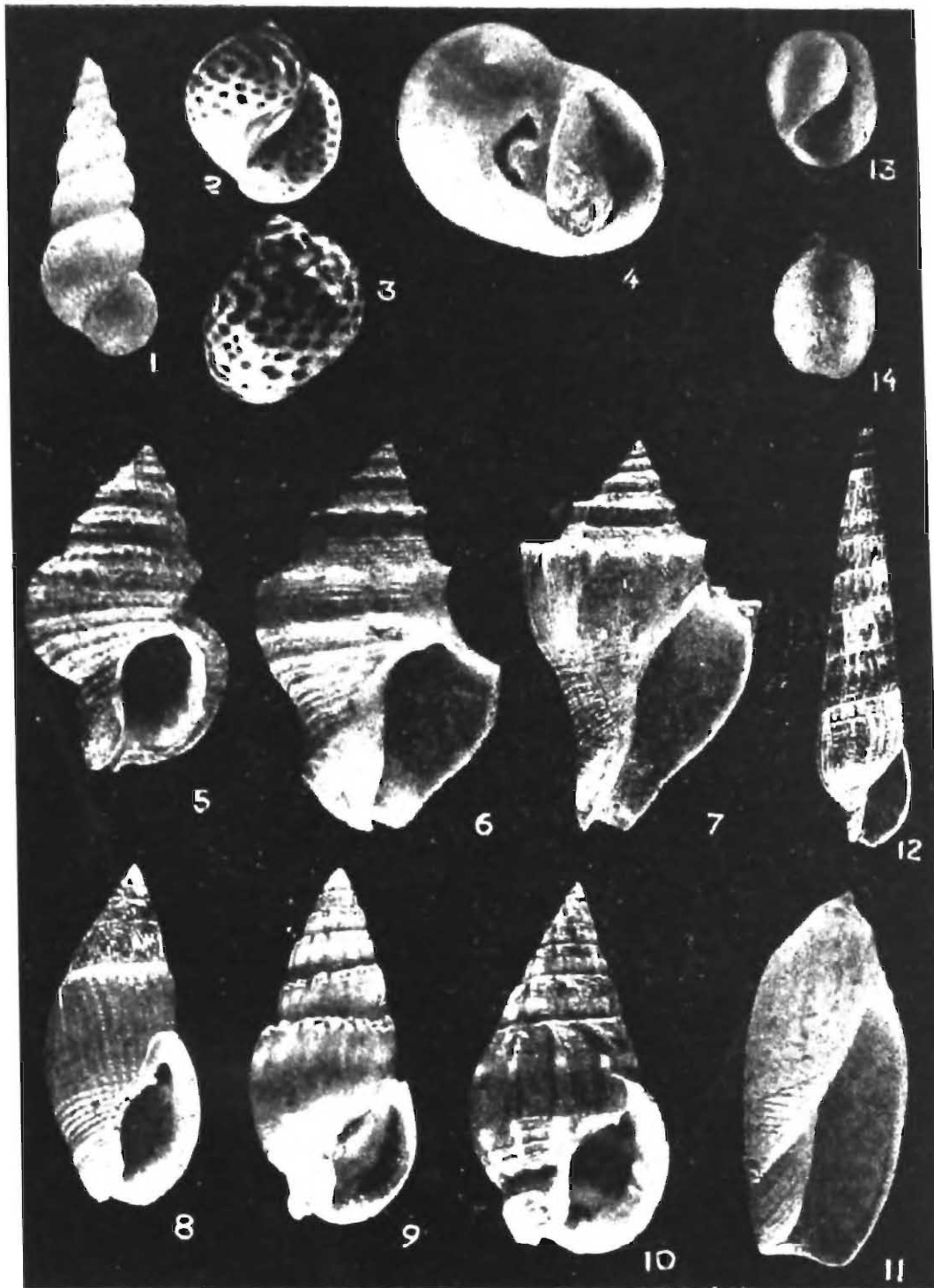
TABLE—II Table showing the different ecological niches with dominant malacofauna
(In order of dominance)

Mud banks and mud flats exposed in riverine system	Mangrove forest	Ganga sagar beach	Mud flats on sea beach	Jetty piles & Mangrove stumps on sea beach
<i>Assiminea brevicula</i> Pfeiffer	<i>Cerithidea obtusa</i> Lamarck	<i>Limapontia</i> sp.	<i>Glauconome sculpta</i> (Sowerby)	<i>Littorina scabra scabra</i> Linnaeus
<i>Telescopium telescopium</i> (Linnaeus)	<i>Littorina melanostoma</i> Gray	<i>Nassarius stolatus</i> (Gmelin)	<i>Barnea candida</i> (Linnaeus)	<i>Cymia lacera</i> (Born)
<i>Cerithidea cingulata</i> (Gmelin)	<i>Nerita articulata</i> (Gould)	<i>Natica tigrina</i> (Roding)	<i>Solen kemp</i> Preston	<i>Bankia rochi</i> Moll
<i>Stenothyra deltae</i> (Benson)	<i>Auricula translucens</i> Annandale & Prashad	<i>Natica gualteriana</i> Recluz	<i>Cochlidium pugilinus</i> (Linnaeus)	<i>Larina burmana</i> Blanford
<i>Onchidium tenerum</i> Stoliczka	<i>Pythia plicata</i> Gray	<i>Cerithidea cingulata</i> (Gmelin)		
<i>Onchidium tigrinum</i> Stoliczka		<i>Donax incarnatus</i> Gmelin		
<i>Macoma birmanica</i> (Philippi)		<i>Nassarius nodifera</i> (Powis)		
<i>Nassarius foveolatus</i> Dunker		<i>Amulda ampla</i> Gmelin		
<i>Haminea crocata</i> Pease		<i>Terebra duplicata</i> Linnaeus		
<i>Assiminea beddomeana</i> Nevill		<i>Acrilla acuminata</i> (Sowerby)		
<i>A. francesiae</i> (Wood)		<i>Meretrix meretrix</i> (Linnaeus)		
<i>Pila globosa</i> (Swainson)				



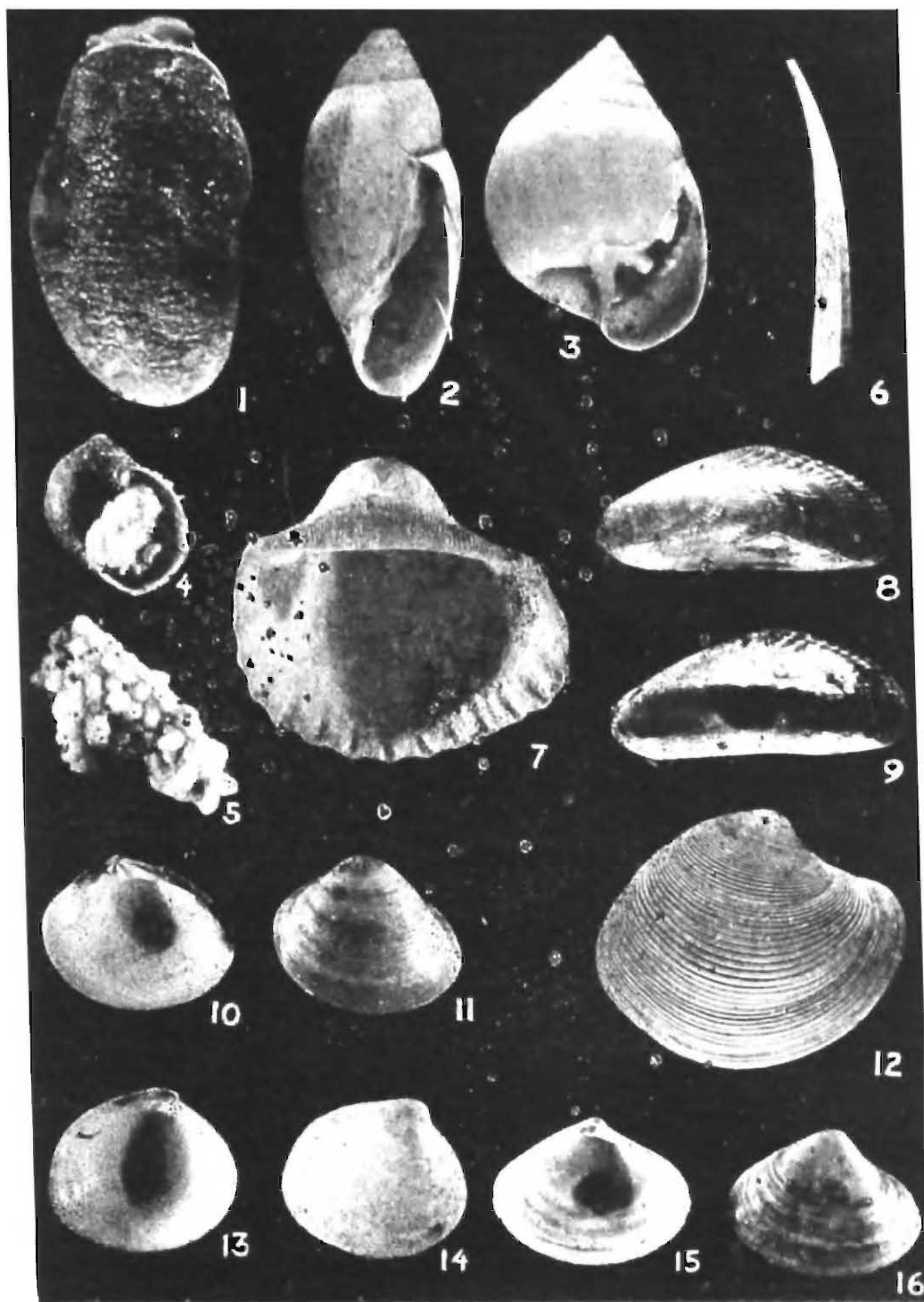
Measurements in MM

- Figs. 1-15. 1. & 2. *Nerita articulata* (Gould) 31.75×29.34 (Dorsal) & 32.10×29.15 (Ventral) 3. *Pseudonerita sulculosa* (Martens) 6.40×6.10 4. *Neritina* (*Dostia*) *violacea* (Gmelin) 19×10.85 5. *Littorina* (*Littorinopsis*) *scabra scabra* (Linnaeus) 9.40×6.43 6. *Littorina* (*Littorinopsis*) *melanostoma* Gray 21.40×11.95 7. *Pila globosa* (Swainson) 49×42.10 8. *Stenothyra deltae* (Benson) 5.30×3.55 9. & 10. *Assiminea francesiae* (Wood) 9.30×5.45 (Dorsal); 8×5.35 (Ventral) 11. *Assiminea brevicula* Pfeiffer 6×4.6 12. & 13. *Cerithidea obtusa* Lamarck 42.20×22.65 (Dorsal); 42.68×23.55 (Ventral) 14. *Cerithidea* (*Cerithidiopsis*) *cingulata* (Gmelin) 25×9.20 15. *Telescopium telescopium* (Linnaeus) 73.45×33.85



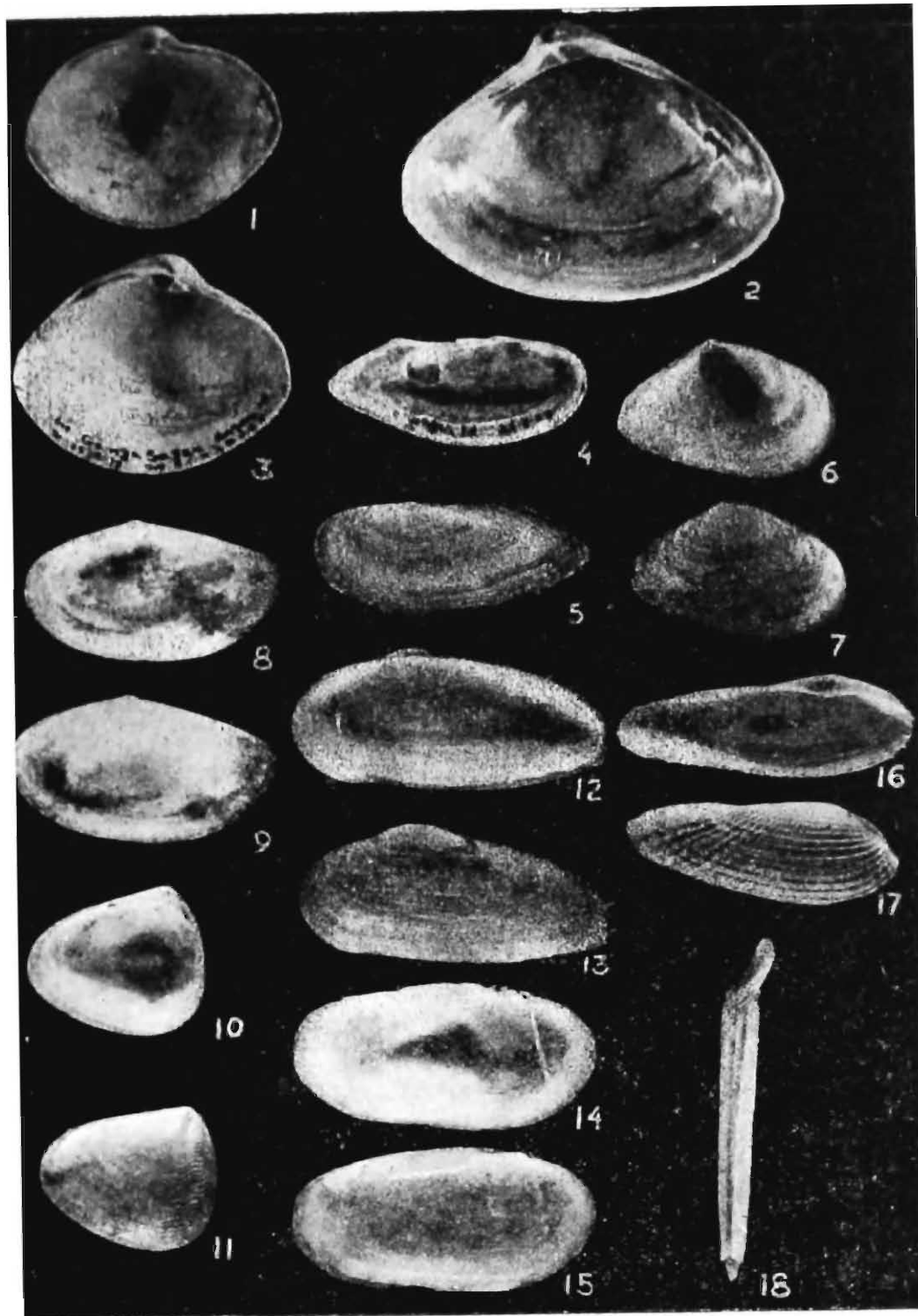
Measurements in MM

- Figs. 1-14. 1. *Acrilla acuminata* (Sowerby) 4.96×1.90 2. *Natica tigrina* (Roeding) (Dorsal) 12.45×10.8 3. *Natica tigrina* (Ventral) 13.45×10.95 4. *Natica gualteriana* Recluz 9.25×8.10 5. *Gyrineum natator* (Roeding) 40.9×25 6. *Cymia lacera* (Born) 26.66×17.05 7. *Pugilinus cochlidium* (Linnaeus) 86.40×48.40 8. *Nassarius foveolatus* (Dunker) 18.85×8.50 9. *Nassarius nodifera* (Powis) 10.80×5 10. *Nassarius stolatus* (Gmelin) 23.15×12.40 11. *Amalda ampla* (Gmelin) 21.55×9.85 12. *Terebra duplicata* Linnaeus 22.45×5.90 13. *Haminea crocata* Pease (Dorsal) 8×5.95 14. *Haminea crocata* Pease (Ventral) 8.35×6.25



Measurements in MM

- Figs. 1-16. 1. *Onchidium tenerum* Stoliczka 37.75×18.80 2. *Auricularia translucens* Annandale & Prashad 24.15×10.30 3. *Pythia plicata* (Gray) 19.45×13.10 4. *Larina burmana* Blanford 9.60×7.80 5. *Larina burmana* Blanford (egg mass) 6. *Dentalium octangulatum* Donovan 18.65×2.62 7. *Anadara granosa* (Linnaeus) 64.84×63.18 8. *Modiolus undulatus* (Hanley) (Outer view) 16.46×6.84 9. *Modiolus undulatus* (Hanley) (Inner view) 16.46×6.84 10. *Meretrix meretrix* (Linnaeus) (Outer view) 50.26×41.82 11. *Meretrix meretrix* (Linnaeus) (Inner view) 50.26×41.82 12. *Paphia malabarica* Schroter 51.20×41.85 13. *Pelecypora trigona* (Reeve) (Outer view) 12.85×12.02 14. *Pelecypora trigona* (Reeve) (Inner view) 12.85×12.02 15. *Mactra luzonica* Deshayes (Outer view) 20.95×15.38 16. *Mactra luzonica* Deshayes (Inner view) 20.95×15.38.



Measurements in MM

- Figs. 1-18. 1. *Mactra mera* Deshayes 40×32.62 2. *Mactra violacea* Gmelin 55.90×43.78 3. *Mactra turgida* (Gmelin) 46.60×56.50 4. *Sanguinolaria* (Soletellina) *acuminata* (Philippi) (Outer view) 31.64×72.75 5. *Sanguinolaria* (Soletellina) *acuminata* (Philippi) (Inner view) 29.26×67.20 6. *Macoma birmanica* (Philippi) (Outer view) 50.35×30.70 7. *Macoma birmanica* (Philippi) (Inner view) 50.35×30.70 8. *Theora opalina* (Hinds) (Outer view) 11.65×9.94 9. *Theora opalina* (Hinds) (Inner view) 11.29×8.84 10. *Donax incarnatus* Gmelin (Outer view) 10.05×11.10 11. *Donax incarnatus* Gmelin (Inner view) 10.05×11.10 12. *Glauconome sculpta* (Sowerby) (Outer view) 25.70×11.54 13. *Glauconome sculpta* (Sowerby) (Inner view) 25.70×11.54 14. *Siliqua albida* Dunker (Outer view) 19.48×9.30 15. *Siliqua albida* Dunker (Inner view) 19.48×9.30 16. *Barnea candida* (Linnaeus) (Outer view) 69.94×26.02 17. *Barnea candida* (Linnaeus) (Inner view) 74.48×26.32 18. *Solen kempii* Preston (Lateral view) 13.05×2.65 .

of the table reveals that the sea beach including mud flats and mud banks in the riverine system has almost equal number of species (14 and 12 respectively). The commonest and most dominant species in the riverine system is *Assiminea brevicula*. The other two species of the genus *A. beddomiana* and *A. francesiae* are rare to very rare. *Telescopium* occupies the next position and lastly *Nassarius foveolatus*. The commonest species on the sea beach is the small gray coloured nudibranch (to be identified). Next in order of dominance are *Nassarius stolatus* and *Natica tigrina*, which occur throughout the year. Though, *Cerithidea cingulata* are common on beach, they occur more near the mouth of the creek and on the exposed mud flat near Chemaguri and in other back water in the beach. *Natica gualteriana* and *Donax incarnatus* are found occasionally. The mud flat on the sea beach is inhabited by four species. *Glaucanome sculpta* being the dominant among them and rarest is the *Pugilinus cochlidium*.

The molluscs of the mangrove zone include *Cerithidea obtusa* and *Littorina melanostoma*. The other species, *Nerita articulata*, *Auricula translucens* and *Pythia plicata* occur near the base of the plants or in the crevices. The first mentioned species is also found at a height of 2 to 2.5 metres above the ground level on the 'Ban' trees elsewhere. The other two species are represented by empty shells along the mud bund, where they might have been carried along with the mud from the mangrove swamp. However, a few live specimens are found in the crevices of the plants in the month of September.

The last zone i.e. mangrove stumps on the beach at Ganga Sagar and jetty piles at Kachuberia and Chemaguri harbour have

entirely different type of fauna. The commonest and dominant among them are *Littorina scabra scabra*. The species is gregarious and found in groups occupying the highest position on the piles and in the crevices of the dead stumps. Interestingly a rare species, *Larina burmana* Blanford is also found on these stumps along with sea anemones (*Metridium* sp.). One of us (N.V.S.) has studied the ecology and breeding habits of this species. These animals and their egg mass (Pl. VII, fig. 5) are found in September-March period. Most of the tunnels of damaged jetty piles and dead trees are empty while a few are with worms within all round the year.

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REDESCRIPTION OF *PARAYASA ELEGANTULA* DISTANT WITH NOTES
ON ITS BIOLOGY AND IMMATURE STAGES
(HOMOPTERA : MEMBRACIDAE)

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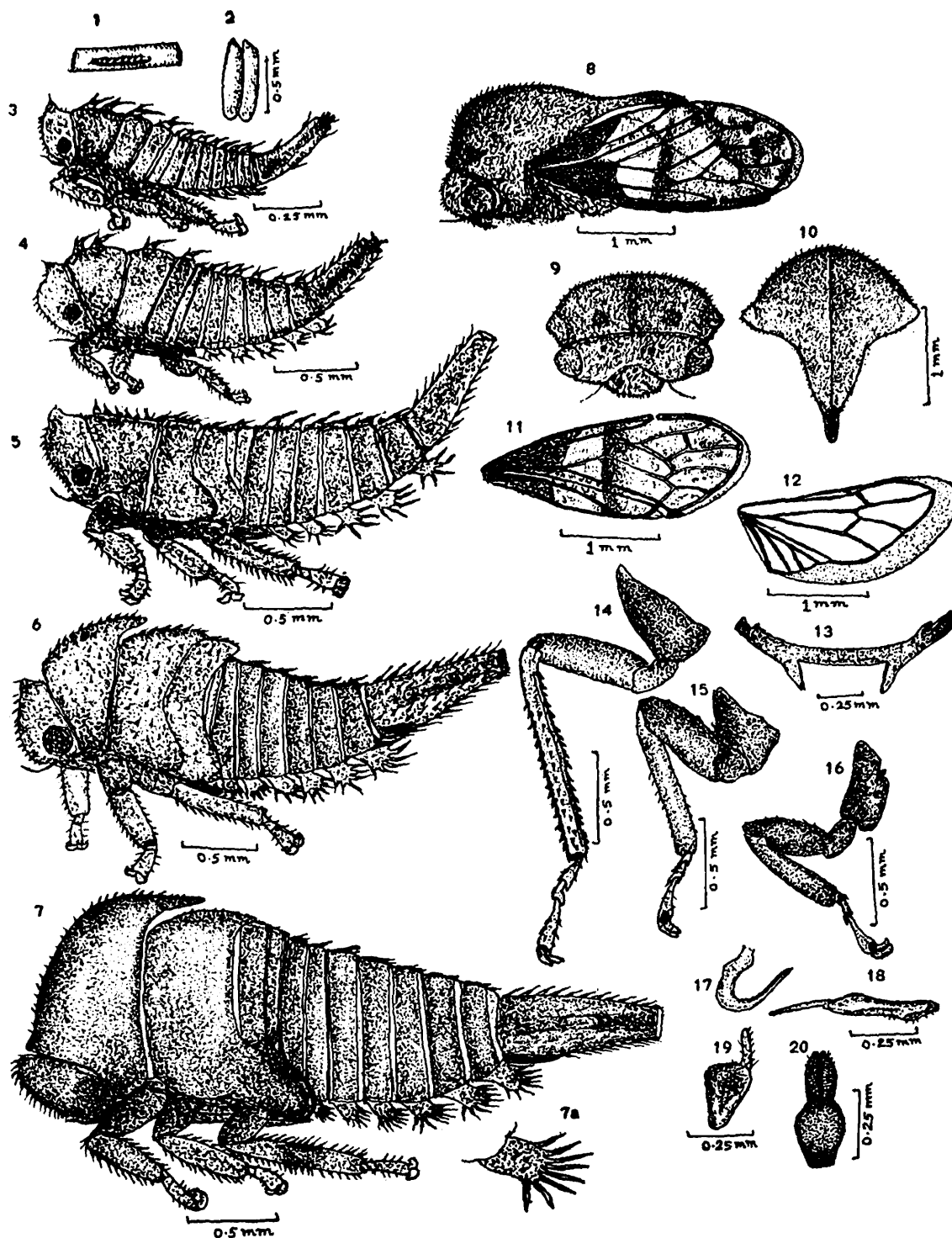
ABSTRACT

Redescription of *Parayasa elegantula* Distant (Homoptera : Membracidae) and its immature stages is made. Biological notes on the species are presented.

The genus *Parayasa* was erected by Distant (1916) to accommodate the species closely related to the genus *Yasa* Distant. Members of the former genus are diagnosed by the pronotal posterior process short, more or less concavely sinuous, never reaching the posterior angle of the inner margin of the tegmina, and the hind tibiae slightly curved. Fifteen species of the genus *Parayasa* are known to date, the distribution of which is confined to southern India. The immature stages of none of these species are known except for the short account of the fifth instar nymph of *P. fasciata* Ananthas. (Ananthasubramanian, 1980). The present paper deals with the detailed description of *P. elegantula* Distant, commonly occurring in Nilgiri, Mudumalai and Kodaikanal (Tamil

Nadu), together with descriptions of its immature stages and a brief account of biology.

Female (fig. 8) : General colour pale brownish yellow. Head (fig. 9) vertical, 3.0X as wide across extremities of eyes as length, finely pilose with pale white bristles, upper margin of vertex shallowly sinuate, lower margins somewhat subhorizontally continued to frontoclypeus ; eyes subglobose, pale yellowish ; ocelli closer to eyes than to each other and situated above centro-ocular line ; frontoclypeus broader than long, extending to about one half of its length below lower margins of vertex, sparsely longly pilose, frontoclypeal lobes indistinct. Pronotum (fig. 9) ochraceous, thickly pilose with short, adpressed greyish white bristles, metopidium

*Parayasa elegantula* Distant

Figs. 1-20. 1. Egg-slit with eggs. 2. Two eggs. 3. First instar nymph. 4. Second instar nymph. 5. Third instar nymph. 6. Fourth instar nymph. 7. Fifth instar nymph; 7a. Lateral lamella. 8. Adult female. 9. Head and pronotum frontal view. 10. Pronotum dorsal view. 11. Tegmina. 12. Hind wing. 13. Scutellum. 14. Hind leg. 15. Middle leg. 16. Foreleg. 17. Aedeagus. 18. Paramere. 19. Lateral valve. 20. Subgenital plate.

about 2.7X as wide as high, vertical, sloping backward to disc; supraocular callosities entire, bare; humeral angles prominent, thickly pilose, apices subacute; posterior distinctly concavely sinuate, its apex black, nearly reaching the posterior angle of the inner margin of tegmina; scutellum (fig. 13) obsolete in the middle; tegmina (fig. 11) 2.6X as long as wide, basal one-third coriaceous, punctate, dark brown, followed by a broad whitish fascia, a narrow yellowish transverse fascia at about the middle, apical half pale white with small brownish yellow patches, veins light brownish yellow, apical limbus moderately broad, hyaline, with a distinct spot opposite to the 5th apical cell, 1st apical cell about 5.0X as long as wide, veins to apical area moderately inwardly curved, 1st discoidal cell petiolate, petiole nearly as long as the cell; hind wings (fig. 12) with 3 apical cells; legs dark brownish in the coxal region, tibia yellowish brown, tarsi pale white, femora of pro- and mesothoracic legs with a longitudinal row of setae (figs. 16 & 15), hind tibia with 3 longitudinal rows of cucullate setae (fig. 14); abdomen pale brownish yellow beneath, black above, finely pilose.

Measurements: Length from frontal margin to tips of tegmina 3.5 mm., to tip of posterior process 2.4 mm., width across apices of humeral angles 1.9 mm., at eyes 1.7 mm.

Male: Similar to female in size and general colour. Genitalia with aedeagus U-shaped (fig. 17), shaft with minute teeth on anterior surface; parameres (fig. 18) expanded apically; lateral valves (fig. 19) 0.026 mm. long, its process about 0.5X as long as the valve (0.01 mm.), long, slender, weakly chitinised; subgenital plate (fig. 20)

divided to half of its length from its apex, its basal half conspicuously wide.

Measurements: Length from frontal margin to tips of tegmina 3.4 mm., to tip of posterior process 2.2 mm.; width across apices of humeral angles 1.8 mm., at eyes 1.7 mm.

Immature stages: There are five nymphal instars which display morphological characters specific to each stage.

First instar nymph (fig. 3): General colour pale green, mottled with light brown on dorsal surface, paler on ventral surface. Body subcylindrical, thorax appearing triangular in cross section; head directed obliquely backward, about 2.5X as wide as long, rostral apex reaching base of abdominal segment IV, cranial tubercles reduced to a pair of tuberculated spines; vertex about 2.0X as wide as long, fringed with short setae; eyes pale white, encircled by setae; antennae filiform. Thorax nearly as long as abdomen excluding anal tube; pronotum about as long as the combined length of mesonotum and metanotum, with a pair of dorsal tubercles, each with 2 spines (one inclined forward and the other backward), one slightly shorter tubercle just behind the anterior one, also with a pair of apical spines; mesonotum longer than metanotum, each bearing a pair of dorsal tubercles with 1 apical spine and smaller spines basally. Abdomen with 8 visible segments, segment XIII forming the anal tube; segment II much narrower than III, segments III-VII more or less similar, each with a pair of dorsal tubercles with long, acute, backwardly directed spine and a smaller spine in front; transversely arranged slender setae on lateral aspects of these segments visible only at high magnification; lateral lamellae moderately developed, each

with 2 backwardly inclined tuberculate spines; anal tube about 0.33X as long as total body length, with 2 dorsal tuberculate spines, 1 near base and 1 subterminal; ventral surface of anal tube with 1 basal and 1 subterminal tuberculate spines corresponding to dorsal spines. Length of the nymph 1.1 mm.

Second instar nymph (fig. 4): General colour as in instar I. Body 2.0X as long as instar I. Head obliquely directed downward and then caudad; rostral apex reaching base of abdominal segment III; tuberculate spines on head similar to those of instar I. Thorax with pronotum slightly raised, mesonotum about 2.0X as long as metathorax; prothoracic tergite with 2 pairs of dorsal tubercles each with 2 apical spines on meso- and metathoracic tergites similar to those of instar I but longer. Abdomen slightly longer than thorax excluding anal tube; pilosity scattered over entire abdomen including anal tube; dorsal tubercles of segment II obsolete, those of segments III-VIII as in instar I; abdominal lateral lamellae longer than in instar I, each bearing 2 penicillate spines; anal tube about 4.0X as long as wide and about 0.4X as long as body length, fringed with a circlet of sensory setae apically and lined with 5 or 6 tubercles each with a spine dorsoapically and a similar row of spines ventro-apically. Length of the nymph 2.2 mm.

Third instar nymph (Text-fig. 5): General colour pale green with yellowish hue; first three segments of legs reddish brown with black dots on tubercular bases; vertex of head thickly pilose, cranial tubercles well developed, rostral apex reaching the base of abdominal segment II. Thorax with pronotum directed forward over head and fringed with a double row of dorsal tubercles tipped with

spines directed obliquely forward; meso- and metathoracic tergites fringed with a double row of dorsal tuberculate spines directed backward; wing pads visible as broad, triangular lobes bordered with chalazae. Abdomen with 9 visible segments, the first very narrow and less chitinised; dorsal tubercles on segments II-VIII longer than those of instar II; lateral lamellae conspicuous, each with 5 penicillate spines; anal tube about 0.4X as long as body, the arrangement of tuberculate spines on anal tube similar to that of instar II. Length of the nymph 2.8 mm.

Fourth instar nymph (fig. 6): General colour light green; legs except tibiae and tarsi reddish brown. Body about 3.0X as long as instar I. Head obliquely directed backward and concealed from dorsal aspect due to the forward growth of pronotum. Thorax with metopidium obliquely continued to disc; pronotal posterior process extending over basal half of mesonotum; wing pads more conspicuous than those of instar III, densely setose, margins fringed with short chalazae; dorsal tubercles less prominent than in instar III, inclined backwards. Abdominal dorsal tubercles directed caudad and more or less inconspicuous, adpressed to the tergites; abdominal lateral lamellae very prominent, each with 5-6 tuberculate, penicillate spines arranged in a digital fashion; anal tube 0.33X as long as body, with longitudinal rows of tuberculate spines inclined backward; genitalic rudiments visible at basal one-fifth of anal tube. Length of the nymph 3.25 mm.

Fifth instar nymph (fig. 7): General colour as in instar IV. Body laterally compressed. Head 3.0X as wide as long, densely pilose obscuring the ocelli, rostral apex

reaching abdominal segment II ; vertex plate at base, frontoclypeus densely pilose, never extending below lower margins of vertex. Thorax with metopidium convex, gradually sloping backward to disc, fringed with numerous tuberculate setae. Thorax with pronotal posterior process extending over basal half of mesonotum, apex subacute ; mesonotum about 4.0X as long as metanotum ; wing pads conspicuous, their apices reaching the basal part of abdominal segment III ; legs with foretibiae rather broad. Abdomen triangular in cross section, abdominal dorsal tubercles less prominent than those of instar IV, inclined backward, closely adpressed to the tergites ; lateral lamellae (fig. 7a) more or less rectangular, fringed with 8 tuberculate setae arranged in a digitate manner. Anal tube 0.25X as long as body, with tuberculate setae arranged as in instar IV ; genitalic rudiments about 0% as long as anal tube. Length of the nymph 3.4 mm.

Biological notes : According to the observations made at Mudumalai, near the Wildlife sanctuary during the months of December to February of 1984-86, eggs are deposited by *P. elegantula* females on tender twigs of *Vitex negundo* in groups of 4-6. The oviposition injury results in the swelling up of the bark which becomes cracked longitudinally as a very fine, whitish, narrow streak (fig. 1). The eggs (fig. 2) are whitish translucent, obtusely rounded at one end and tapering to an acute angle at the opposite end, with sides almost parallel from rounded end to about three-fifths of length, then gradually tapering to acute tip, with one side slightly flat. The egg measures, on an average, 0.8 mm. long and 0.27 mm. wide. Hatching occurs in 7-10 days. The young nymphs

resemble closely the green colour of the twigs. In the early stages they remain at the bases of petioles in the axils of the host plant and remain gregariously in groups of 4-6 ; they migrate later to the internodal region of the twigs and remain there till the last moulting. The colour of the nymphs blends with the colour of the twigs on which they feed and make them most in conspicuous. If disturbed, they adhere tenaciously and firmly to the twigs. The adults are decidedly solitary, getting scattered considerably on all twigs. Both nymphs and adults of this membracid species are attended by a small species of ant identified as *Paratrechina longicornis* which very often betrays the presence of the otherwise undetectable nymphs. The duration of immature stages is found to be 30—38 days. The eggs of this membracid are observed to be parasitized by two species of Trichogrammatidae, *Brachygrammatella indica* Viggiani and Hayat and *Mirufens afrangiata* Viggiani and Hayat.

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INSECTS ASSOCIATED WITH SOME WEEDS IN SOUTH INDIA

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ABSTRACT

An inventory of insect pests of twelve species of weeds, common in cultivated field in and around Madras is presented. Main characteristics of the pests as well as host plants, life cycles and population trends etc. of the pests and insect-weed relationships are briefly outlined.

The problem of weeds in cultivated field is well known. According to a reliable estimate weeds account for 11.3% of the loss of potential production in Asia. The loss is in yield and quality; weeds also increase the cost of cultivation. Some weeds act as alternate host plant for insect pests and plant pathogens. Many weeds either do not yield to chemicals or against which use of chemicals is too expensive or impracticable specially when the cultivated crop is also in the field. However, the use of phytophagous insects have been strikingly successful in controlling some of the world's worst weeds, such as prickly pear, *Opuntia* spp. in Australia by the moth *Cactoblastis cactorum* (Berg.) (Dodd, 1959), Kalmath weed, *Hypericum perforatum* L. in U.S.A. by the beetle *Chrysolina quadrigemina* Suffrian (Holloway, 1964; Huffaker and Kennett, 1959). A good

deal of information is available on the biological control of weeds in developed countries e.g. Batra, 1979; Bendixen, 1981; Bess and Huffaker, 1951; King, 1966; Kumar Jayaraj and Muthukrishnan, 1979; Mc Fadyen, 1979; Miller, 1936; Palel *et al* 1964; Robbins *et al* 1942; Simmonds, 1982; Tillyard, 1930; Verma *et al* 1978 and Vogt, 1960. Basic information such as the natural enemies of weeds, their taxonomy, feeding habits and biology is essential in selecting the best insect agent for biological control of the weed. With this in view an attempt has been made to list natural insect pests of weeds in cultivated fields in South India. Various groups of insect pests of weeds with their main characteristics, seasonal life cycles and the insect-weed relationship are briefly outlined. Considerable attention has been paid in India to pest of crops, but very little

is known about the natural enemies of weeds.

Some of the common weeds in South India includes *Cleome viscosa* Linn., *Gynandropsis pentaphylla* Dc., *Euphorbia hirta* Linn., *Leucas aspera* Spreng., *Amaranthus spinosus* Linn., *Digera arvensis* Forsk., *Cyperus rotundus* Linn., *Echinochloa crusgallai* Beauv., *Eclipta alba* Hassk., *Croton sparsiflorus* Morong., *Cassia occidentalis* Linn., *Ludwigia parviflora* Roxb. *Trianthema portulacastrum* Linn., *Centella asiatica* Urban, *Oldenlandia umbellata*, *Grangea maderaspatana* Poir., *Lactuca runcinata* Dc., *Sonchus oleraceus* Linn., *Heliotropium indicum* Linn., *Solanum xanthocarpum* Schard & Wendl., *Datura fastuosa* Linn., etc. (Tadulingam and Venkatanarayana, G., 1955, Barnes, D.E. and Chandapillai, M.M., 1972).

Surveys were conducted at regular intervals in cultivated fields in and around Madras for an inventory of insects infesting some of the common weeds. All weeds have been numbered with Roman and insect pests with Arabic numbers.

I *Cleome Viscosa* Linn.

Family : CAPPARIDACEAE

(Hindi : Hulhul ; Tamil : Manja Kadugu ; Malayalam : Nai Kadugu ; Telugu : Kukka vaminta).

Herbaceous annual, erect, 30-90 cm. high ; stems grooved, densely clothed with glandular and simple sticky hairs. Fruit is a lean capsule 5-7.5 cm. long. The plant is easily distinguished by its viscid hairs, 3-5 foliolate leaves, glandular sessile ovary and the yellow flowers. It has a saltish bitter taste and a strong odour.

1. *Phyllotreta chotanica* Duvr.

Tiny beetle, 2 mm long, shiny dark brown

to black ; antennae extend a little beyond the middle of elytra ; first segment long, thickened and club-shaped ; second shorter than first ; third slightly longer than second ; last five segments slightly thickened ; prothorax broader than long ; scutellum small, triangular.

The flea beetles are by far the most important pest of *Cleome viscosa*. The adult beetles cause severe injury to the plant by eating off the leaves and flower buds, resulting in small rounded or irregular holes in the leaves and buds. Heavy feeding on the foliage retards growth of the plants. As many as 40-45 adult beetles were found feeding on a plant in May-August.

The Beetles jump readily when approached. The hind coxae are distinctly enlarged and thickened. They attack young plants as soon as they come up and the damage continues for some time.

Distribution : This species is previously recorded from Darjeeling.

2. *Acrosternum graminea* Fabr.

(Hemiptera : Pentatomidae)

Yellowish-green stink bugs, 7-9 mm long ; thickly punctate ; apex of scutellum with two small whitish spots ; antennae greenish.

Adults and nymphs cause injury to the plant by sucking on stems, leaves, flower buds and pods. They congregate on the plant in large numbers and suck the sap, stunting the plants and destroying developing seeds. 20-24 adult bugs may be found on a plant during peak activity (September-November). The most important damage is caused by puncturing the pods and seeds. The pods become crooked and when seriously infested,

only bear a few underdeveloped, shrivelled seeds.

Eggs are spherical, pale white are usually deposited upright in two or three rows at the rate of 17-24 a day on the pods or on tender leaves. Nymphs hatch from the eggs in 6-8 days and begin to feed on the plant sap. Newly hatched nymphs are gregarious and those from one egg-cluster feed close together. They feed and grow for three to four weeks, passing through five instars before they are capable of mating and laying eggs. The population of these bugs normally builds up during rainy season, reaching the peak in September-November. An entire generation may develop in a month and there are four or five generations in a year. In summer the bugs are very scarce.

The range of host plant of this bug is very wide. *Leucas aspera* Spreng, *Ocimum sanctum* Linn. (Labiatae), *Acalypha indica* L. ; *Croton sparsiflorus* Morong ; *Ricinus communis*, (Euphorbiaceae) *Gynandropsis pentaphylla* Dc. (Capparidaceae) *Oryza sativa*, *Pennisetum typhoides*, *Sorghum vulgare*, *Zea mays* (Gramineae). *Dolichos lab. lab*, *Sesbania grandiflora* are other known hosts.

Distribution : Occurs in many parts of India and Sri Lanka.

3. *Bagrada cruciferarum* Kirk. (Hemiptera : Pentatomidae)

These black ochraceous bugs may occasionally attack the plants. They do not appear in large numbers. They suck sap from the leaves, tender shoots and pods. This pest is of minor importance to the plant. The period of activity of this bug is from October to November. Other host plants are Cabbage and other cruciferous plants.

Distribution : India and Sri Lanka.

4. *Exelastis atomosa* Wlsm. (Lepidoptera)

This frail, very small, day active moth is a serious pest of the plant. The caterpillars bore into the green pods, devour the seeds, and hollow them out. Attacked pods ripen prematurely and turn yellow. Flower buds may also be attacked.

Eggs are laid singly on young pods and buds. The caterpillars are slender and pale green. The full grown caterpillar is about 8-10 mm long studded with short clubbed hairs and long spines. Pupation takes place in partially rolled leaves and the pupal period is about 5-7 days. The caterpillars are very destructive during July to November. Ten to twelve caterpillars were found on a plant in peak period. Other host plants : Red Grams (*Cajanus indicus*), *Dolichos lab. lab*.

Distribution : Throughout South India.

II *Gynandropsis PentaPhylla* DC. (Family : CAPPARIDACEAE)

Hindi : Churota, Hulhul ; Tamil : Kattu Kadugu, Telugu : Vavinta, Malayalam : Karvela.

This is a familiar weed of waste land and cultivated dry lands. It is a tall freely branching annual herb. Leaves long-petioled alternate and palmately compound with five obovate leaflets. Leaf stalks and stems are covered with small, stiff hairs. Flowers are purple or white. Flowering time is June-July and October-November. Fruit is a capsule, 5-7.5 cm. long. Seeds are small, dark brown, kidneyshaped, covered with ridges of minute tubercles.

1. *Acrosternum graminea* Fabr.
(Hemiptera : Pentatomidae)

These green bugs are active during September-December. 9-12 bugs were found on a plant during this peak period. The adults and nymphs cause slight injury to the plant by sucking on stems, leaves, flower buds and pods.

2. *Crociodolomia binotalis* Zell.
(Webworm) (Lepidoptera)

This is a major pest of the plant. Its presence is indicated by loosely woven, dirty white webs enclosing the foliage on the ends of the branches. These webs contain black pellets of excrement from the worms. The fully grown caterpillars are between 13-15 mm long their colour varies from dirty white to greenish and the body is coarsely haired. There are five brown longitudinal lines on the dorsal side of the body.

The infestation starts when the plants are about to bloom. The adult moths lay the eggs on the leaves. The caterpillars feed on the terminal leaves, webbing them together. Later in the season they attack the flowers and penetrate in to the pods and feed on the developing seeds. Peak period of infestation is July-August and November-December. 12-15 caterpillars were found feeding on a plant in the peak period. It is a common pest of cultivated mustard.

III *Lencas Aspera* Spreng
(Family : LABIATAE)

Hindi : Guma ; Tamil : Thumbai ; Telugu : Thumbai ; Malayalam : Thumba.

This weed thrives best in well-drained loamy soils on bunds, in rice fields, in waste

lands and along road sides. The weed springs up in large numbers in cultivated fields after the rains. They are not found in very moist places.

It is a herbaceous annual which grows up to a height of 45 cm. The stem is square in cross section, grooved on all sides and covered with coarse hairs ; leaves are simple, opposite, exstipulate and shortly stalked. The blade is linear, lanceolate, long, with or without toothed margin. Flowers are white, sessile crowded in dense axillary or terminal clusters. Bracts usually occur in three or four rows. Calyx is tubular. Fruit consists of four brown, smooth, oblong nutlets. Flowering and fruiting time is September to October.

1. *Agonoscelis* spp.
(Hemiptera : Pentatomidae)

Agonoscelis nubila Fabr., and *A. tamilandensis* Mathew attack the weed in considerable numbers.

Adult *A. nubila* Fabr. bugs are about 9-11 mm in length. The upper side of the body is reddish brown or ochraceous speckled with black markings. The head is stripped black and yellowish-brown. The body is covered with deep coarse black punctures ; connexivum is orange-yellow with black spots at the apices of the incisures. The veins of the membraneous part of the wings are stained black or dark brown. *A. tamilnadensis* Mathew is very similar to *A. nubila* from which it can be distinguished by having the rostrum extending upto the last visible abdominal segment.

The adults as well as nymphs suck sap from the developing seeds and calyx. They curtail the production of seeds by destroying

seeds and thus prevent rapid spread of the weed. Though the insect continues to feed and breed during the entire year, highest infestation is noticed in September-November. As many as 12-16 adult bugs were found feeding on a plant during peak period of activity. In summer these bugs are very scarce.

Eggs are deposited upright in three to four rows on tender leaves. Upto 30 eggs are laid at a time. The chorion, is sculptured with numerous outgrowths which give a reticulated appearance. The eggs hatch in about 4-7 days into tiny brown nymphs. They begin to feed immediately after hatching and the young nymphs from one egg cluster usually feed close together. The nymphs get into the calyx and feed and hence they are not usually seen outside. They pass through five instars and require about 21-28 days to complete their development. Other host plants are aniseed, cholam and flower heads of coriander.

Distribution : They are recorded from Kashmir, Sind, Khasi Hills, Calcutta, Bombay, Poona, Nilgiri Hills, Mysore, Tamilnadu, Kerala and also from Burma, Sri Lanka, China, Japan and Malaya.

2. *Sciocoris lateralis* Fieb. (Hemiptera : Pentatomidae)

These small bugs, 4-4.5 mm long are ochraceous ; body darkly and coarsely punctate ; a broad longitudinal three-cornered whitish spot on the lateral margins of pronotum ; scutellum with the apex ochraceous ; membrane pale brown, connexivum alternately ochraceous and piceous ; antennae brown, third segment much shorter than second segment, fifth segment is the longest.

The bugs are found among the cluster of flowers and they feed on sap from the developing seeds. Peak period of activity is from September to December. Considerable damage is observed to the developing seeds.

Pale yellow eggs are laid singly on the ground or on stems of grass which grow under or near the weed. Chorion is sculptured with incrustations and outgrowths. Eggs hatch in 4-6 days into tiny orange-coloured nymphs. There are five instars and the nymphs become full grown in about three weeks. Because of their obscure colouration and hiding habits these insects are not generally noticed.

Distribution : Coonoor, Madras, Courtallam and Wynad and also Sri Lanka.

3. *Dolycoris indicus* Stal. (Hemiptera : Pentatomidae)

This brownish-ochraceous densely punctate bug is about 9-9.5 mm long, apical margins of juga, lateral margins of pronotum apex of scutellum, ventral side of the body, legs, basal segment and bases of antennal segments 2-5, luteous, connexivum spotted with black at the incisures. This pest is only occasionally recorded from leucas plant and can be considered as casual feeder. The extraction of sap from the plants by this insect is of minor importance. The adults were recorded from the plant in June-July.

Other host plant of this bug is cholam.

Distribution : This bug is widely distributed in India.

4. *Acrosternum graminea* (Fabr.) (Hemiptera : Pentatomidae)

This green bug occasionally attacks the

plant in small numbers. Nymphs and adults suck from the tender buds and developing seeds. Injury is not very severe to the plant. *Cleome viscosa* L. a weed usually found in cultivated fields and waste lands along with *Leucas aspera* is the main host plant. They usually infest the plants during September-November.

5. ***Nezara viridula* L.**
(Hemiptera : Pentatomidae)

These large, flattened, shield-shaped, bright green, stinking bugs about 12-16 mm long, occasionally found on the lower surface of the foliage of grown-up plants, in small numbers. They suck from the tender shoots, buds and developing seeds. This is a minor pest of *Leucas*. It is only a casual feeder. The host plants of this bug include castor, potato, tenai, cumbu, cholam, rice and caravelle seed.

Distribution : Throughout India, Holarctic and Ethiopian, Neotropical, Oriental and Australian Region.

6. ***Plantia fimbriata* Fabr.**
(Hemiptera : Pentatomidae)

The adults are 9-11 mm long ; head, pronotum and scutellum bright olivaceous-green ; corium purplish-red. They are found sucking on the developing seeds and tender shoots. They usually infest *Leucas* plant in summer months (May-July). It is only a minor pest. Other host plant is *Solanum torvum* Sw.

Distribution : They are widely distributed and are recorded from Sikkim, Naga Hills, Bombay, Calcutta, Nilgiri Hills, Kerala, Javadi Hills, Sri Lanka, Burma, Malaya, China, Japan and Madagascar.

7. ***Bythoscopus chlorophara* Melich**
(Homoptera : Jassidae)

The slender, greenish-yellow, active, leaf hoppers are 4-4.5 mm long. The wings are held roof like above the abdomen. They run side ways when disturbed. They are found on the stem, underside of the leaves and among the flowers. They suck sap from the stem just below the terminal clusters and from the calyx. The feeding of the insects causes the flowers and the terminal portion of the shoot to wither. Peak period of activity is from December to February ; 22-24 adults were recorded at a time from a plant during this period.

8. ***Cassida* sp. nr. *saginata* Spaeth**
(Coleoptera : Chrysomelidae)

Small beetles, 4 mm long, turtle-shaped, flat below, with margins of the body extended so as to hide the head and legs, chocolate-brown in colour ; the disk mottled with black. The adult beetles and larvae either eat the entire leaf or the foliage of the plant is cut full of holes. Usually they feed from the underside of the leaf. When the beetles attack the plant in large numbers the injury may be very severe. They are very destructive to *Leucas* during October to December. 12-15 adults were found feeding on a plant during this period.

The females of the tortoise beetle excavate small holes on the underside of leaves by eating the epidermis and mesophyll and lay their eggs one in each hole, covering each dull yellow egg with a very fine muslin like material which prevents the egg from falling down and also protects it. The egg is ellipsoid and is laid horizontally. The chorion is smooth. The tint of the egg is dull yellow.

In about 7-9 days the eggs develop into tiny yellowish-green larvae which are about 1.4 mm in length and the margins of their bodies are beset with 32 thorny spines. Two thick tail like projections which can be turned up over the back at an angle of 90 degrees from the leaf, bear the shed skins. 21-24 days are required to complete the life cycle. Fully grown larvae are about 4.5 mm in length. When growth is completed the larvae fasten themselves to leaves. Pupation period is about 6-9 days.

IV. **Plectranthus wightii** Benth.
(Family : LABIATAE)

A tall herb with white flowers speckled with red points and large panicles of prominently small-bracted cymes. The leaves are cordate at base. This plant is recorded from Western Ghats, Nilgiris, Anamalis and Shevaroy Hills.

1. **Carbula scutellata** Dist.
(Hemiptera : Pentatomidae)

This slender bug is upto 8 mm in length and ochraceous in colour ; thickly and blackly punctate ; head narrow, elongate lobes of equal length ; thorax much broader than long ; posterior lateral angles acutely produced into black spines ; scutellum triangular, as long as broad at base ; two large spots at the basal angles and the apex ochraceous ; corium with purplish tinge, deeply punctate.

Numerous bugs have been observed feeding on the plant. The extraction, of sap from the plants by this insect is usually of minor importance.

Distribution : Kashi Hills, Bombay, Burma, Silent Valley and Shinagad, Pune.

2. **Carbula socia** Walk.
(Hemiptera : Pentatomidae)

Ochraceous, deeply and thickly punctate ; *head* : twice as long as broad between eyes ; lobes of equal length ; *thorax* : twice as broad as long ; anterior margin deeply emarginate ; anterior angles acute ; posterior angles produced into moderately long obtuse black spines ; *scutellum* : triangular, a large spot at each basal angle and apex ochraceous ; corium with purplish tinge ; *length* : 8 mm.

Numerous bugs were found feeding on the plant along with *C. scutellata*.

V. **Amaranthus spinosus** Linn.
(Family : AMARANTHACEAE)

Hindi : Chalai ; Kanta nutiya ; Tamil : Mullu Keerai ; Telugu : Mulla Thotakoora ; Malayalam : Mullan Cheera.

Stout spinous annual shrub upto about 39 to 60 cms. tall ; slender spines arise from leaf axils ; The stem is rounded, green or reddish-green ; leaves alternate, oval to oblong in outline, tip blunt with a hair-like point ; inflorescence in dense spikes arising from leaf-axile ; flowers small, green ; common in fields gardens and waste lands.

1. **Amaranthus Weevil**
Hypolixus truncatulus F.
(Coleoptera : Curculionidae)

The amaranthus weevil is the most serious insect pest of amaranthus plant in South India. The grubs of the weevil bore into the top shoots and stem and produce gall-like swellings. The grubs eat the soft part of the stem by tunneling and the plant is killed by the time adult emerges out from the plant. The grubs pupate inside the stem 12-15 grubs

were found in a full grown plant. Incidence of the insect is the maximum in October-December.

2. *Zinckenia* (= *Hymenia*) *fascialis* Cramer
(Lepidoptera : Pyralidae)

Small, dark brown; forewing with a medial black edged white band, its outer margin irregular and toothed on vein 2; hind wing with the band wider, slightly narrowing to the inner margin. The caterpillars feed on the leaves. The moths lay eggs on the tender leaves during October-November, pupate inside rolled leaves.

Distribution : Neotropical, Ethiopian; Palearctic, Asia, (from Syria to Japan) Oriental region and Australian region.

VI. *Digera arvensia* Forsk
(Family : AMARANTHACEAE)

Hindi : Latmahuria ; Tamil : Thoya Keerai ;
Telugu : Chenchali Koora.

Common weed found in most loamy soil of the cultivated field. A slender herb with prostrate branches; the stem is round, striate; glabrous. Leaves are simple and alternate; flowers are pink and green.

1. *Cassida exilis* Boh.
(Coleoptera : Chrysomelidae)

Small beetle 3.75 mm long, yellow-brown to light yellow in colour without markings; head smooth with a few scattered punctures; prothorax elliptical, the lateral angles acute, the front margin forming an arch and drawn forward in the middle; the disc convex, smooth and impunctate; on each elytron nine to ten rows of punctures.

The adults feed mainly on the leaves; they chew rounded holes into the leaf blades (fig. 7) and weaken the plant. The beetles were found feeding on the plant in large numbers in September-October.

VII. *Echinochloa crusgalli* Beauv.
(Family : GRAMINEAE)

Hindi : Samak ; Tamil : Swau ; Telugu :
Othagaddi.

A slender, annual growing to a height of 30-60 cm.; stem tufted, bend upward; blades laceolate; inflorescence consists of terminal racemes; spikelet broadly oval, pointed; spikelets crowded in small groups on the spikes; very common in rice fields, open damp places, waste grounds and sandy or clay soils.

1. *Menida histrio* Fab.
(Hemiptera : Pentatomidae)
(Fig. 8)

Reddish-ochraceous, 6-8 mm in length; head with the margins and four longitudinal lines blackly punctate; pronotum with an anterior submarginal black line and two transverse annulate black markings on anterior area; scutellum with a reddish ochraceous spot on each basal angle; an anterior discal spot and one on each lateral margin a little before the apex black; corium with the disk greyish olivaceous, the apical area reddish ochraceous; connexivum ochraceous spotted with black; membrane colourless; a central abdominal series of spots black; antennae ochraceous; abdominal spine reaching intermediate coxae. They damage the developing spikelets by sucking the juice and thus prevent seed formation.

Main host plants are rice and millets. When the rice is ripe the bugs feed on the weeds. The highest infestation is in June-August.

Distribution : West Bengal, Karnataka, Sri Lanka, Burma, China and Formosa.

VIII. *Eclipta Alba* Hassk

(Family : COMPOSITAE)

Hindi : Babri, Bhangra ; Tamil : Karasalanganni ; Malayalam : Kyonni, Telugu : Guntakalavaraku.

Common weed in rice fields, bunds of irrigation canals and tank beds ; annual ; stem is round with strigose hairs, leaves 2.5-9 cm. long, both sides covered with hairs.

1. *Spodoptera mauritia* Boid.

(Lepidoptera)

Grey and Black moth with a blotch of white on the forewing, tufts of hair on the fore legs of the male.

This species is widely distributed and is a major pest of rice. The caterpillars which are green eat the leaves of the weed in large numbers during and after rain. The infestation is very severe in October-November.

IX. *Euphorbia Hirta* Linn.

(Family : EUPHORBIACEAE)

Hindi : Dudhi, Tamil : Ammam Paccharisi ; Telugu : Nanabalu.

Herb, hairy, 30 cm tall, branched from near the base ; stem often tinged reddish, leaves opposite ; main stem and leaf stalk, hairy ; single leaf oblong, base rounded and unequal, margins toothed, leaf stalk very short, inflorescence arise from the axils of leaves ; common in rice fields and waste land.

1. *Achoea janata* L. (Fig. 9)

(Lepidoptera : Noctuidae)

Pale Reddish-brown moth with hind wings black with a medial white band and three large white spots on outer margin.

Eggs round, blue green in colour : eggs are laid on the under surface of the leaves singly ; 1-6 eggs are laid at a time ; incubation period 2-5 days, first instar larva slender, yellowish green, full grown larva 60-65 mm in length with a black head ; apex of loop black with a red spot and tubercles red ; larvae gregarious, feed voraciously on leaves : they defoliate the plants leaving only the veins of leaves ; larval period ranges from 11-15 days ; pupates in the soil, pupal stage lasts 10-14 days.

Major pest of castor. Apart from castor it feeds on rose, pomegranate, *Tridax procumbens*, *Ficus bengalensis* and *Cardiospermum halicacabum* L.

X. *Croton Sparsiflorus* Morong

(Family : EUPHORBIACEAE)

Erect, branched annual, growing to a height of 1-3 feet ; stem green, woody at base, ends in an inflorescence ; leaves are simple, alternate, exstipulate and crowded towards the tops ; fruit is a capsule ; seeds oblong, polished.

1. *Acrosternum graminea* Fabr.

(Hemiptera : Pentatomidae)

This bug attacks the plant by sucking on stems, leaves and flowers. Both adults and nymphs are injurious to the plant.

XI. *Acalypha Indica* Linn.

(Family : EUPHORBIACEAE)

Hindi : Kuppi, Kuppaimeni, Malayalam : Kuppaimeni, Telugu : Muripindaku. Erect, herbaceous

annual, growing to a height of 30-60 cm ; the stem is round or angular, leaves simple, alternate ; flowers minute, green, unisexual, arranged in axillary spike ; male flowers many, minute, clustered towards the top of the spike.

The weed is very common in cultivated fields and waste lands especially after the rains.

1. **Acrosternum graminea** Fabr.
(Hemiptera : Pentatomidae)

Both adults and nymphs feed on the leaves and stem.

XII. **Borreria laevicaulis** Ridl.
(Family : RUBIACEAE)

Herb with wiry, square, purplish stems, upto about 50 cm tall, branched at the base ; leaves opposite ; single leaf about 3-5 cm long, oblong, widest near the base, tip pointed, flowers in small heads in the leaf axils.

1. **Spermatodes veariolosa** Walk.
(Hemiptera : Pentatomidae)

Very small, ochraceous, thickly punctate ; head anterior area of pronotum, basal margin of scutellum and body beneath brassy-green, a sub-triangular discal spot to scutellum castaneous ; two central spots on anterior area of pronotum, three spots at basal margin of scutellum, legs, antennae, bases of femora green.

Adults and larval stages feed on the flowers and thus damage the flowers. The bugs are found throughout the year, other host plants are not known :

Distribution : Madras, Wynad, Silent Valley, Shencottah, Sri Lanka.

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Fig. 1. Damage to leaves of *Cleome viscosa* by flea beetles, *Phyllotreta chotanica* Duvr.

Fig. 2. Pods of *Cleome viscosa* injured by Caterpillars of *Exelastis atomosa*.



Fig. 3. Cluster bug
Agonoscelis nubila
Fabr.

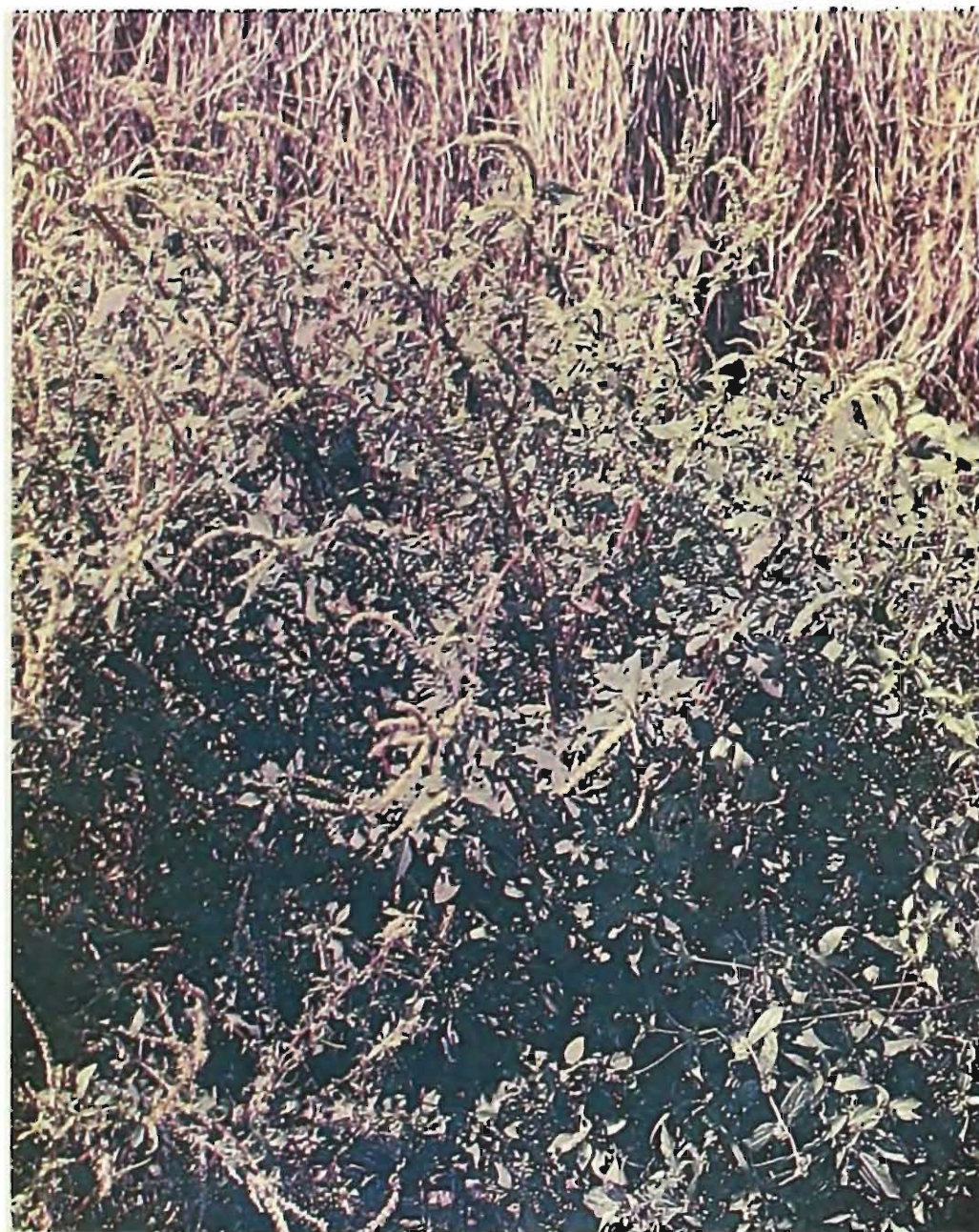


Fig. 4. *Amaranthus spinosus*
plants in cultivated field.



Fig. 5. *Hypolixus truncatulus* F. on *Amaranthus spinosus*.

Fig. 6. *Amaranthus* weevil, (*Hypolixus truncatulus*) larva boring in the stem of *Amaranthus spinosus*.





Fig. 7. Damage to leaves of *Digera arvensia* by *Cassida exilia*.

Fig. 8. *Menida histrio* on *Echinochloa crusgalli*.



ON SOME SPECIES OF THE FAMILY NOTOMMATIDAE (EUROTATORIA :
MONOGONONTA) FROM NORTH-EASTERN INDIA.

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ABSTRACT

This communication deals with nine species, belonging to three genera, of the family Notommatidae Remane 1933 (*partim*) from North-Eastern India. Amongst these, the genus *Monommata* Bartsch 1870 is being reported for the first time from this country. In addition, four species represent new records from India while eight species are new to this region. All the reported taxa are described and illustrated. Remarks are made on the ecology and distribution of the documented species.

INTRODUCTION

Notommatidae is one of the largest families of the monogonont rotifers. It is divided into two subfamilies and includes twenty genera (Koste 1978). Our knowledge about Indian representatives of this family is fragmentary. Various previous related contributions are those of Anderson (1889), Edmondson & Hutchinson (1934), Wulfert (1966), Dhanapathi (1975) and Sharma (1979)

The present contribution is a part of the investigations on the rotifer fauna of North-Eastern India and it deals with nine species, spread over three genera, of the family Notommatidae. Genus *Monommata* is not

recorded so far from India and this sub-continent as well. Further, four species comprise new reports from this country while eight are new to North-Eastern region. Various presently examined species are described and illustrated. Remarks are made on the ecology and distribution of the different species.

MATERIAL AND METHODS

This study is based on the samples collected from the different freshwater bodies in North-Eastern India (Sharma & Sharma 1987). Specimens mounted in Polyvinyl-lectophenol are examined for taxonomic details. All the drawings are made using a

camera lucida and the measurements are given in micrometers (μm).

SYSTEMATIC ACCOUNT

- Class : ROTIFERA
 Subclass : EUROTATORIA
 BARTOS 1959
 Super-order : MONOGONONTA
 WESENBERG-LUND 1889
 Order : PLOIMIDA DELAGE
 1897
 Family : NOTOMMATIDAE
 REMANE 1933 (*partim*)
 Genus : **Cephalodella** Bory
 De St. Vincent 1826

Body cylindrical, slightly curved, cuticle somewhat stiffened; with a dorsal and a ventral plate. Foot short; toes slightly curved, usually sharply pointed. Corona with a simple circumapical band of cilia and with a ventral buccal field. Mastax large, with virgate trophi.

Type species : *Cephalodella catellina* (O. F. Müller 1786)

Cephalodella spp. are mostly benthic, living in the macrophytes or above the sediments; only rarely found in the plankton samples. It is an exceptionally large genus and includes over 200 species. Presently, it is represented by only seven species.

Cephalodella catellina (O. F. Müller 1786)

(Figs. 1-3)

Material examined : Meghalaya.

Diagnosis : Body short, about and gibbous; projecting posteriorly over the foot. Lorica flexible, plates indistinct; lateral clefts parallel-sided. Foot small, ventrally

located. Toes short, stout, curved, parallel-sided for about $\frac{1}{2}$ of their length and then gradually tapering to acute points. Rami with symmetrical alulae. Manubrium terminal with a loop. Fulcrum without basal apophysis.

Measurements : Total length 90-102; toes 18-20; trophi 32.

Distribution : INDIA-Kashmir, Ladak and West Bengal; elsewhere-Cosmopolitan.

Cephalodella forficata (Ehrenberg 1832)

(Figs. 4-5)

Material Examined : Meghalaya.

Diagnosis : Body thin and cylindrical. Foot small; toes short, spindle-shaped, curved and tapering to acute points. Rami with symmetrical alulae. Free end of fulcrum broadened. Free ends of manubria curved.

The present specimens are smaller than those reported by Koste (1978).

Measurements : Total length 115-120; toes 30-32; trophi 26.

Distribution : INDIA—represents a new record; elsewhere-Cosmopolitan.

Cephalodella forficula (Ehrenberg 1832)

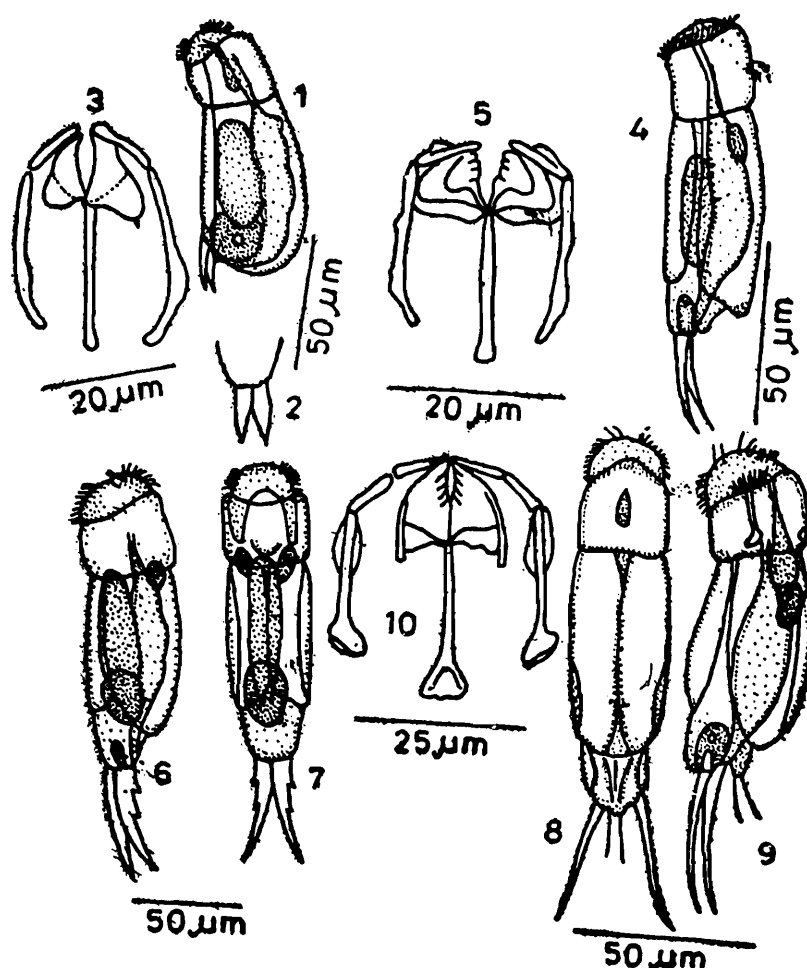
(Figs. 6-7)

Material examined : Meghalaya.

Diagnosis : Body fairly long, slender and spindle-shaped. Head relatively large and oblique anteriorly. Trunk cylindrical and narrow posteriorly. Toes short, stout, curved and acutely pointed; with a characteristic knob-like basal spine and another small spine. Sub-unci fan shaped. Frontal part of unci with rings.

It appears to be a variable species (Koste 1978). The present specimens are longer than those reported from West Bengal (Sharma 1979) but agree with the measurements given by Harring & Myers (1924).

Diagnosis : Body transparent, slender and cylindrical. Toes distinctly long and curved, widely separated at their bases and gradually tapering to acutely pointed spines. Rami symmetrical, with small alulae. Fulcrum



Figs. 1-10 : *Cephalaodella catellina* (Müller) : Figs. 1. lateral view ; 2. posterior end ; 3. trophi ;
Cephalaodella forficata (Ehrenberg) : Figs. 4. lateral view ; 5. trophi ;
Cephalaodella forficula (Ehrenberg) : Figs. 6. lateral view ; 7. dorsal view ;
Cephalaodella intuta (Myers) : Figs. 8. dorsal view ; 9. lateral view ; 10. trophi.

Measurements : Total length 175-180 ; toes 30-35.

Distribution : INDIA—West Bengal and Andhra Pradesh ; elsewhere-Cosmopolitan.

***Cephalaodella intuta* Myers 1934**
 (Figs. 8-10)

Material examined : Meghalaya.

with basal apophysis. Retrocerebral sac rounded.

Measurements : Total length 140-145 ; toes 38-40 ; trophi 35.

Distribution : INDIA—represents a new record ; elsewhere-Cosmopolitan.

Cephalodella gibba (Ehrenberg 1832)

(Figs. 11-12)

Material examined: Meghalaya, Assam, Nagaland.

Diagnosis: Body elongated, lorica firm and with distinct plates; lateral clefts narrow anteriorly and widening posteriorly. Foot small; toes long, curved, gradually tapering and with conical tips. Rami asymmetrical, manubria with curved free ends.

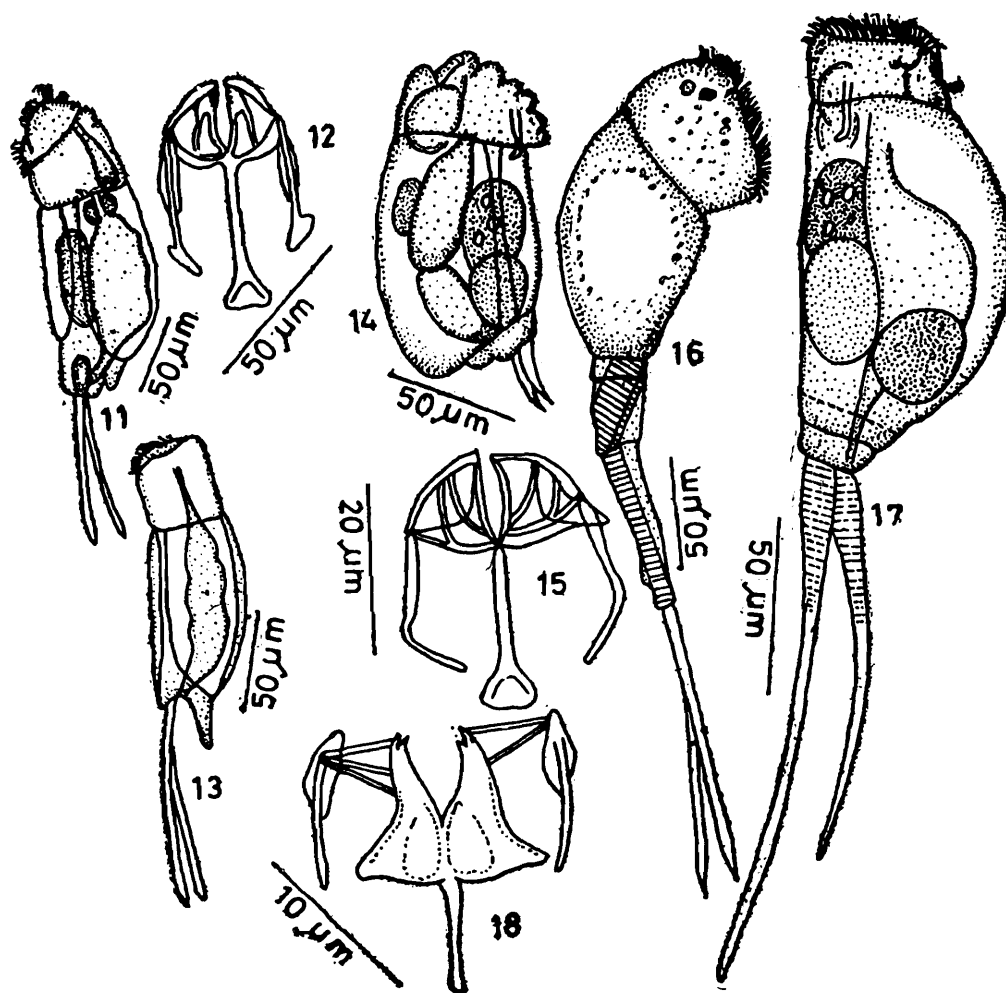
Measurements: Total length 280-300; toes 85-90; trophi 64.

Distribution: INDIA—Kashmir, Ladak, Gujarat and West Bengal; elsewhere-Cosmopolitan.

Cephalodella mucronata Myers 1924

(Fig. 13)

Material examined: Meghalaya.



Figs. 11-18: *Cephalodella gibba* (Ehrenberg): Figs. 11. lateral view; 12. trophi;
Cephalodella mucronata Myers: Fig. 13. lateral view;
Cephalodella ventripes Dixon-Nuttall: Figs. 14. lateral view; 15. trophi;
Scaridium longicaudum (Müller): Fig. 16. lateral view;
Monommata longiseta (Müller): Figs. 17. lateral view; 18. trophi.

Diagnosis : Body elongated, cylindrical ; lorica rigid and extending over foot into a projection of variable length. Toes almost as long as body, curved and tapering to acute points. Rami symmetrical.

Measurements : Total length 240-248 ; toes 115-120.

Distribution : INDIA—West Bengal ; elsewhere—Pantropical and subtropical.

Cephalodella ventripes Dixon-Nuttall 1901

(Figs. 14-15)

Material examined : Meghalaya

Diagnosis : Body gibbous, short, transparent and projecting dorsally over the foot. Foot ventrally located. Toes ventrally curved and ending into acute points. Rami symmetrical. Manubria with distal half semi-circular. Fulcrum with broad apophysis.

Measurements : Total length 138 ; toes 28 ; trophi 30,

Distribution : INDIA—represents a new record ; elsewhere—USA, USSR and West Germany.

Genus : *Scaridium* Ehrenberg 1830

Body cylindrical or spindle-shaped ; lorica thin. Foot very long, 3-segmented, terminal foot-segment longest ; segments with striated muscles. Toes long. Corona simple, with ventral ciliated zone. Trophi virgate.

Type species : *Scaridium longicaudum* (O.F. Müller 1786)

It lives amongst macrophytes in the littoral zone. This genus includes only two known species. Of these, *S. longicaudum* is present in the examined material.

Scaridium longicaudum (O. F. Müller 1786)
(Fig. 16)

Material examined : Meghalaya, Assam, Mizoram and Nagaland.

Diagnosis : Lorica thin, more or less cylindrical. Foot 3-segmented ; toes long and with blunt distal ends. Trophi modified virgate, unci broad.

It differs from *S. bostjani* Daems & Dumont 1974 in its total length and the shape of the unci.

Measurements Total length 370-380 ; foot 115-120 ; toes 128-130.

Distribution : INDIA—Gujarat, Punjab and West Bengal ; elsewhere—Cosmopolitan.

Genus : *Monommata* Bartsch 1870

Body cylindrical or spindle-shaped ; trunk with thin and flexible cuticle. Foot short and plumpy, 2-or 3-segmented ; with long and unequal toes, with striated muscles. Corona with ventral buccal field. Mastax not very conspicuous, trophi virgate and variable in shape.

Little is known about the conditions of life and reproduction of this genus (Ruttner-Kolisko 1974). It occurs mostly in boggy waters and is occasionally a migrant in the plankton. Presently this genus is represented by only one species.

Monommata longiseta (O. F. Müller 1786)
(Figs. 17-18)

Material examined : Meghalaya.

Diagnosis : Body transparent. Foot indistinctly 2-segmented ; toes unequal and of variable length. Inner end of each ramus

with a spine. Left uncus with two and right uncus with three rod-shaped teeth. Fulcrum without basal apophysis. Retrocerebral sac and subcerebral gland small.

Measurements : Total length 270-280 ; right toe 150-115 ; trophi 15.

Distribution : INDIA—represents a new report ; elsewhere—Cosmopolitan.

REMARKS

Previous Indian literature reflects lack of attention on the notommatid rotifers in particular and littoral, benthic and periphytic forms in general. So far only eighteen species, belonging to five genera, of the family Notommatidae are reported from this country. *Cephalodella wiszniowskii* n. n. proposed by Edmondson & Hutchinson (1934) is a synonym (refer Kutikova 1970) of *Cephalodella catellina* (Müller).

The present observations from North-Eastern India add four species to the earlier list. *Cephalodella catellina*, *C. forficata*, *C. forficula*, *C. intuta*, *C. ventripes* and *Monommata longiseta* are collected only from the state of Meghalaya. *Cephalodella gibba*, *C. mucronata* and *Scaridium longicaudum* show a relatively wider distribution in this region and India as well. Genus *Monommata* comprises a rare and interesting element in the rotifer fauna of this country. *M. longiseta*, though restricted in its occurrence, is common in the samples from paddy-fields in the Jaintia Hills (Meghalaya State). *Cephalodella forficata*, *C. intuta*, *C. catellina* and *C. ventripes* are very rare in the examined

material. *Cephalodella mucronata* and *Scaridium longicaudum* represent warm-stenothermous forms and are presently collected at temperatures between 15-20°C. *Monommata longiseta* is found at temperatures between 0-17.3°C (Koste 1978) ; recorded in the present collections between 12-14.8°C. Further, various species from Meghalaya State are found in acidic to slightly alkaline waters (pH 5.2-7.2).

ACKNOWLEDGEMENTS

Thanks are due to the Head, Department of Zoology, North-Eastern Hill University, Shillong for providing the necessary laboratory facilities.

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A NEW SPECIES OF *EUBASILISSA* MARTYNOV
(TRICHOPTERA : PHRYGANEIDAE) FROM INDIA

By

S. K. GHOSH & M. CHAUDHURY

ABSTRACT

A new species, *Eubasilissa wigginsi*, is described in the paper.

INTRODUCTION

In course of study of the material collected during Garhwal Survey, 1958 the authors have come across an interesting species of *Eubasilissa* Martynov belonging to the family Phryganeidae which has been described new to science. In this context, it may be mentioned that Mosely (1935) referred to three other species of the aforesaid genus, namely, *E. mclachlani* White, *E. regina* Mclachlan and *E. tibetana* Martynov from India. The new species differs from the aforesaid species by the wing markings.

Eubasilissa wigginsi, sp. nov.

Body : dark brown ; head : brownish and clothed with tawny hairs ; antenna ; brown, annulated with dark fuscous ; maxillary palpi : dark brown ; forewing (Figs. 1-2) :

with yellow ground colour but heavily mottled with dark brown markings ; eight distinct dark brown spots along costal margin, seven of which extending across forming seven interrupted bands ; brown markings coalescing towards apex of wing forming a dark brown patch in this region ; without any dark spot at extremities of apical sectors ; hindwing (Figs. 1, 3) : coloured dark brown with a broad transverse yellow band towards the apex leaving a dark patch at extreme apex ; band extending from lower to upper margin and continuing as a narrow yellow stripe along costal margin towards base leaving only a dark brown patch at extreme base ; female genitalia (Fig. 4) : subgenital plate with a pair of lateral and mesial processes ; mesial pair slightly longer than the lateral ones, chitinised strongly at base, membranous and slightly bilobed at apex.

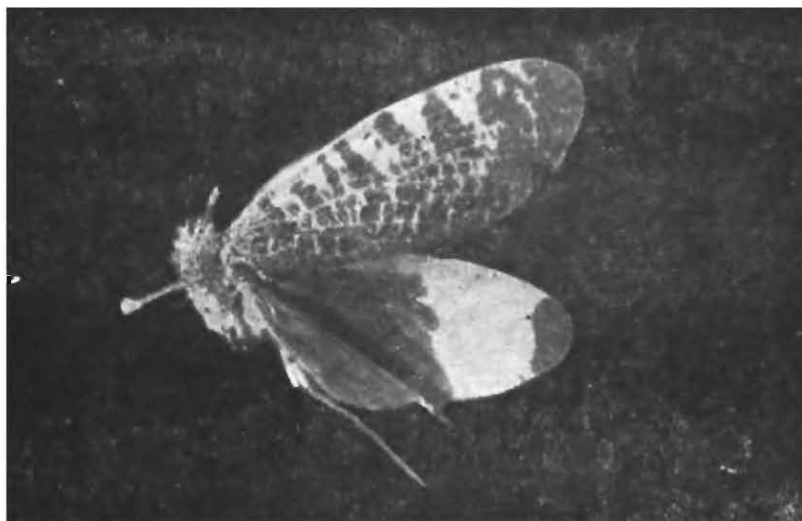


Fig. *Eubasilissa wigginsi* sp. nov. 1. Fore & hind wing showing colour pattern

Material examined : 1 ♀ (Holotype, ZSI, Reg. no. 118/H₈) India, Uttar Pradesh, Ghangria, Garhwal-Dt., alt. 10,000 ft., 12.vi.1958, coll. B. S. Lamba & party.

Measurement : 1 ♀ : length of forewing, 33 mm.

Distribution : India.

Remarks : This species resembles *E. regina* McLachlan but differs from it by the absence of dark spots along the apical margin at the extremities of the apical sectors and the yellow band in forewing and dark spots on the extreme lower margin of yellow band in hindwing. But the formation of bands across the costal margin in forewing and continuation of the yellow band as a narrow

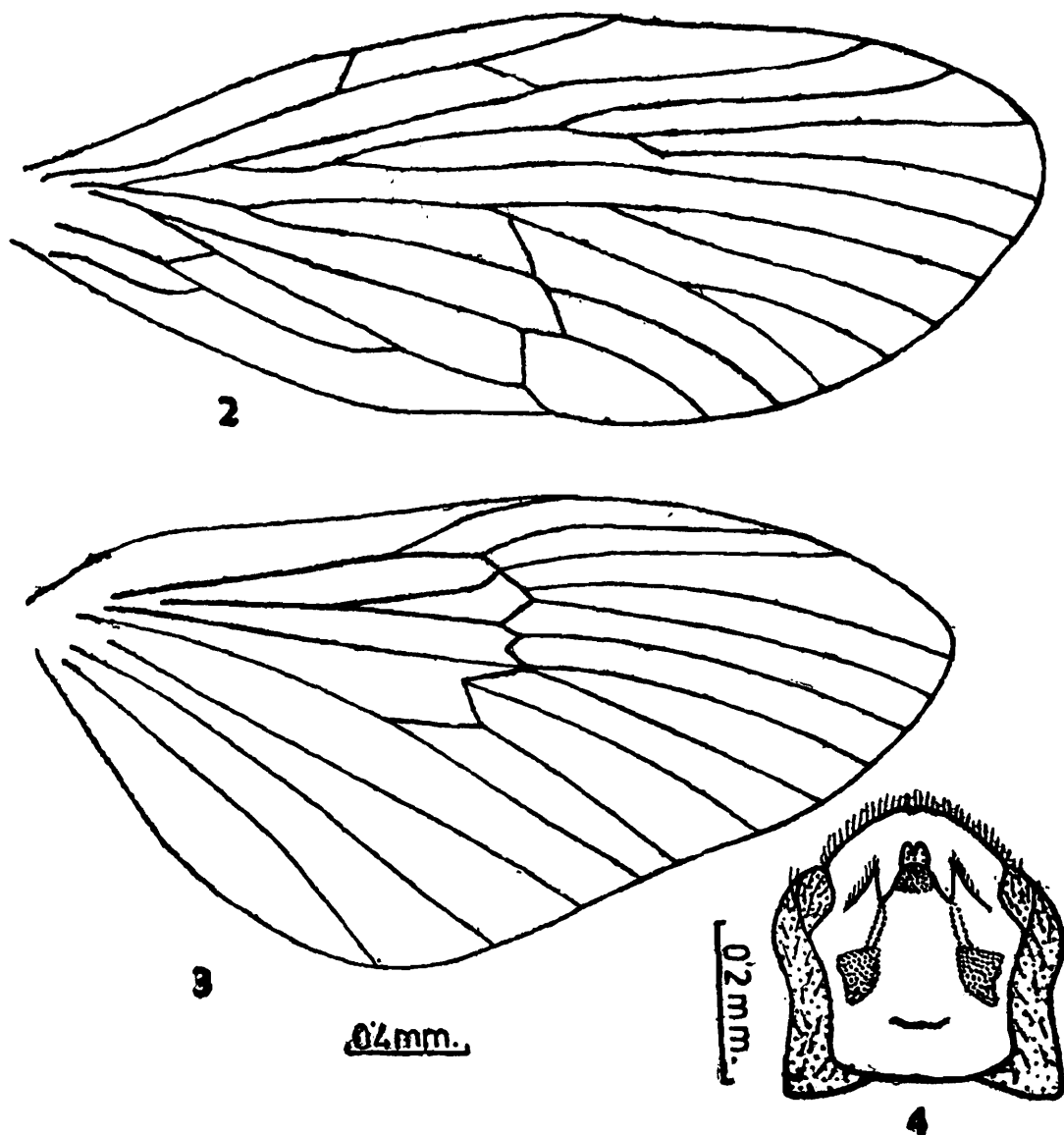
stripe along costal margin towards the base of hindwing are sufficient to separate this species not only from *E. regina* McLachlan but also from all other species of *Eubasilissa* Martynov from India.

ACKNOWLEDGEMENT

The authors are grateful to Dr. B. K. Tikader, former Director, Zoological Survey of India for laboratory facilities and to Dr. G. B. Wiggins, Professor, Dept. of Zoology, University of Toronto, Canada, for critically reviewing the paper.

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Figs. 2-4. 2. Forewing showing venation 3. Hindwing showing venation 4. Apex of abdomen, ventral view, showing subgenital plate.

DYNAMICS OF COLLEMBOLA AND ACARINA IN A GRASSLAND AREA OF CALCUTTA

By

S. K. MITRA AND *R. N. MUKHERJEE

Zoological Survey of India, Calcutta

ABSTRACT

Soil microarthropods, specially Collembola, play key role in the mineralisation process in the soil ecosystem. Collembolans being extremely sensitive to changes in the soil conditions are used as indicators of soil conditions and environmental changes. In India, observations on ecological aspects of Collembola have been sporadically published (Choudhury *et al*, 1971a, b, 1972, 1975 ; Mitra *et al*, 1977, 1981, 1983a, b, 1986 ; Singh *et al*, 1971) owing to the difficulties involved in the taxonomy of Collembola.

METHODS

The grassy plot of land is situated at Calcutta in the vicinity of Eden Gardens. The plot, throughout the years of sampling, sustained grassy vegetation belonging to *Cynodon dactylon* Pers. Twelve soil samples were drawn monthly from this plot by using stainless steel samplers having an inner cross sectional area of 8.55 cm² and length of 3 cm. During last three years, altogether 432 samples were drawn for this investigation. For measuring temperature, a soil thermometer and for relative humidity, a dial hair hygrometer were used. Soil samples were extracted in the laboratory by using a modified Tullgren apparatus by using 40W electric bulb generating about 39°C temperature within the apparatus.

RESULTS

The grassy site has a rich collembolan community, represented by about 21 species, viz., *Megalothorax minimus* Willem, *Cyphoderus albinus* Nicolet, *Lepidocyrtus* (*Lepidocyrtus*) *medius*, *Lepidocyrtus* (*Ascocyrtus*) sp., *Folsomides parvulus* Stach, *Isotomina thermophila* (Axelson), *Arrhopalites* sp., *Pseudosinella* sp., *Sphaeridia* sp., *Stenognathellus* sp., *Entomobrya* sp., *Isotomurus ciliatus* Stach, *Isotomiella minor* (Schaeffer), *Sminthurus* sp., *Sinella* (*Sinella*) sp., *Katianna* sp., *Brachystomella* cf. *curvula* Gisin, *Pseudachorutes* sp., *Tullbergia* (*Stenaphorura*) sp., *Salina bengalensis* Mitra.

During first year, Collembola quantitatively dominated over Acarina (Fig. 1). Highest peak of population of Collembola

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was observed during June, representing monsoon peak, followed by winter peak during October and summer one during March.

Winter peak of *Collembola* coincides with the highest peak population of *Acarina*, occurring from January to April followed by three medium peaks during June, August

population was observed during November (winter peak) preceded by two medium peaks during March (summer) and May (premonsoon). Absence of a monsoon peak is characteristic for this year presumably for low soil temperature during monsoon months specially in July this year (Fig. 2.).

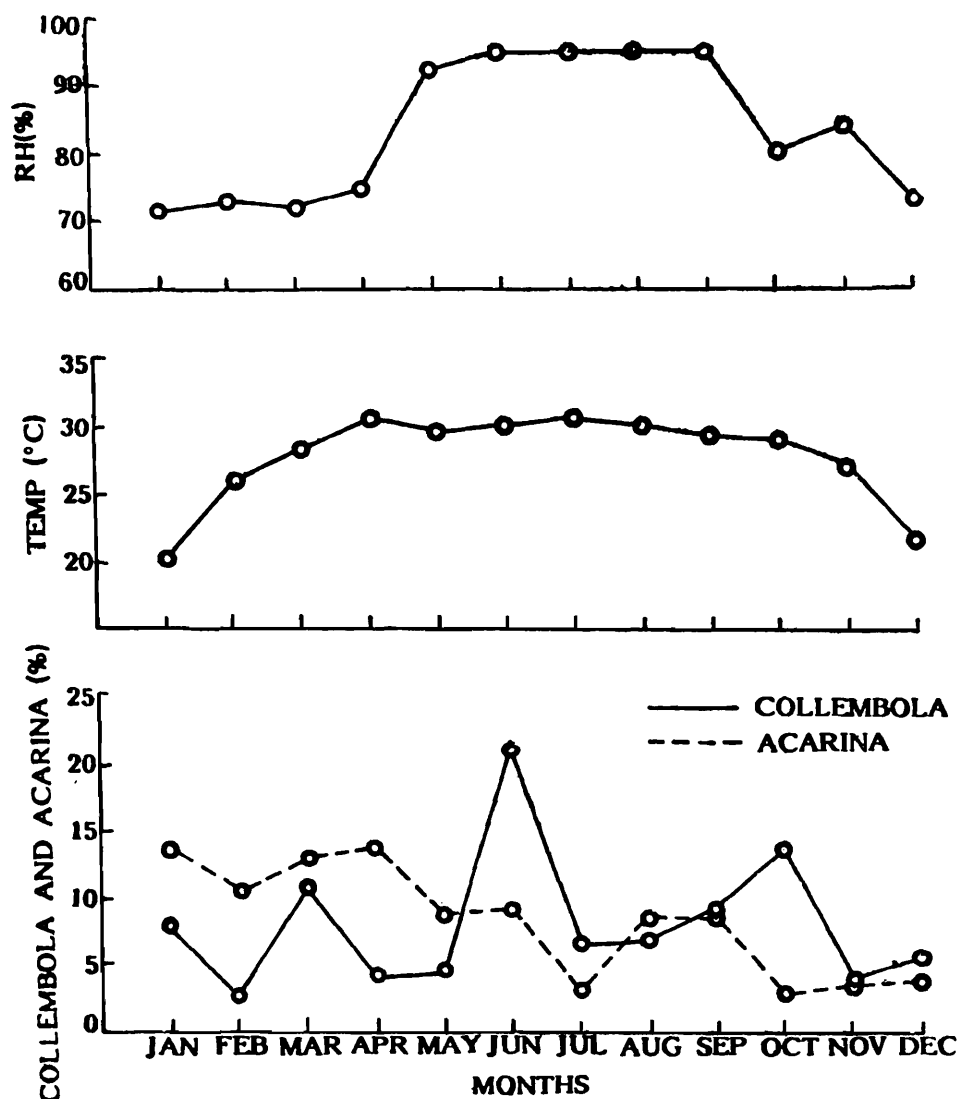


Fig. 1. Monthly changes in the population of *Collembola* and *Acarina* with reference to relative humidity and temperature during first year.

and September, while higher temperature coupled with very high relative humidity encourages the growth of *Collembola*, for *Acarina*, however, low R/H and temperature appeared as favourable factors.

During second year, highest peak of

The peak of collembolan population during third year was very pronounced during July coinciding with the highest R/H level and very high temperature of the soil, representing the monsoon peak. Premonsoon peak occurred during May preceded by

summer peak during March. Winter peaks were observed during October, December and January of which peak in December was quite pronounced coinciding with moderately low R/H and temperature. For Acarina, the highest peak in population was observed

peak of Collembola occurred during March followed by the monsoon peak in June and winter peak during December with an intermediate moderate prewinter peak in October. Acarina exhibited a pronounced summer peak during March followed by almost

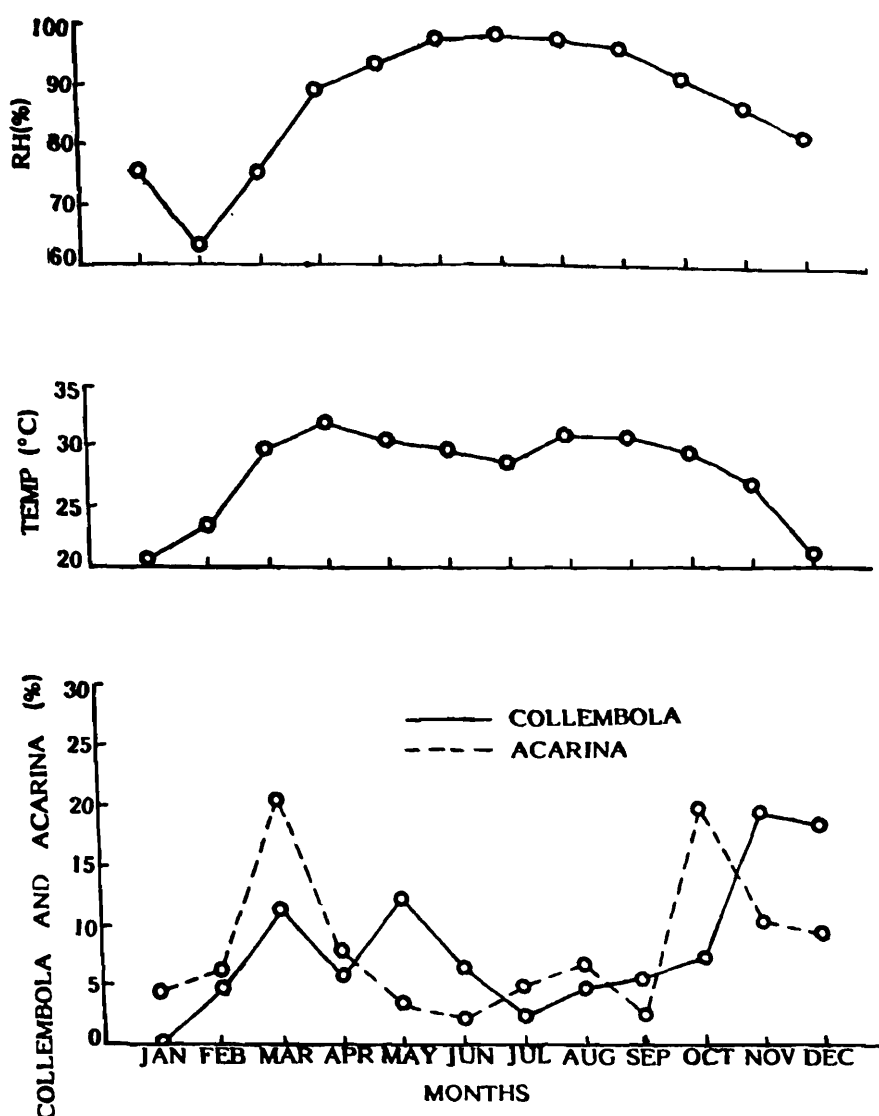


Fig. 2. Monthly changes in the population of Collembola and Acarina with reference to relative humidity and temperature during second year.

during January followed by intermittent medium peaks during March, April, July, September and November (Fig. 3).

The overall mean population of Collembola for three years reveal that the summer

uniform mean population during other months with smaller peaks (Fig. 4).

The mean of Collembola and Acarina population and abiotic factors is presented in Table-1 and their total number in Fig. 5.

TABLE 1. Mean of Collembola, Acarina and abiotic factors with standard deviation.

Year	Collembola	Acarina	Temp (°C)	RH (%)
1st	15.66±9.94	25.25±12.34	27.88±3.55	83.68±10.29
2nd	10.16±7.44	18.25±13.45	27.95±3.99	87.10±11.07
3rd	6.08±3.52	11.75± 8.83	28.64±4.89	82.79±10.09

TABLE 2. Correlation coefficient between Collembola and Acarina population, relative humidity and soil temperature.

X : Collembola	I yr	II yr	III yr	Mean of 3 years
Y ₁ : Acarina	*0.099	*0.336	-0.172	-0.197
Y ₂ : Temperature	0.120	-0.021	*0.145	*0.068
Y ₃ : RH (%)	*0.240	-0.07	*0.023	*0.058

*Significant at 5% level

TABLE 3. Correlation coefficient between Acarina population vs Collembola, temperature and relative humidity.

X : Acarina	I yr	II yr	III yr	Mean of 3 years
Y ₁ : Collembola	0.099	0.336	-0.172	-0.197
Y ₂ : Temperature	-0.069	-0.042	-0.575	-0.346
Y ₃ : RH (%)	-0.399	-0.281	-0.322	-0.655

Monthly relationship between Collembola and Acarina population is presented in Fig. 6.

Correlation coefficients between Collembola and Acarina population, relative humidity and soil temperature were worked out (Table-2).

From the table it appears that in the first year, the correlation is positive between Collembolan population vs Acarina, temperature and relative humidity. In the second year this correlation is negative for temperature and relative humidity. During the third year, while the correlation is negative between collembolan population and

physical factors while it is negative for Acarina.

In Table—3, correlation coefficients between Acarina population vs Collembola, temperature and relative humidity are presented. It appears from the table that while correlation coefficient is positive between Acarina and Collembola during first and second years, it is negative during third year and also with the mean correlation of three years population. Correlations between Acarine population, temperature and relative humidity are negative for all the three years including three years mean population.

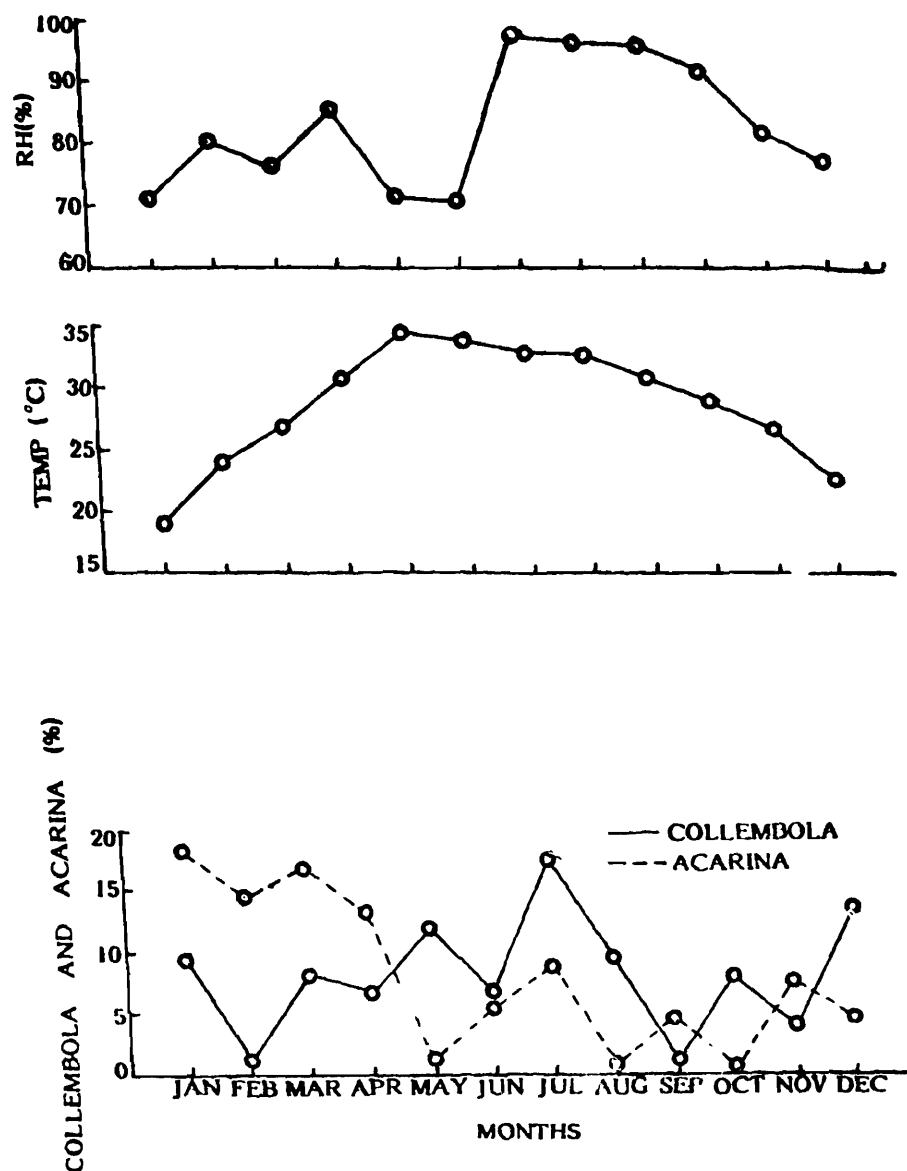


Fig. 3. Monthly changes in the population of Collembola and Acarina with reference to relative humidity and temperature during third year.

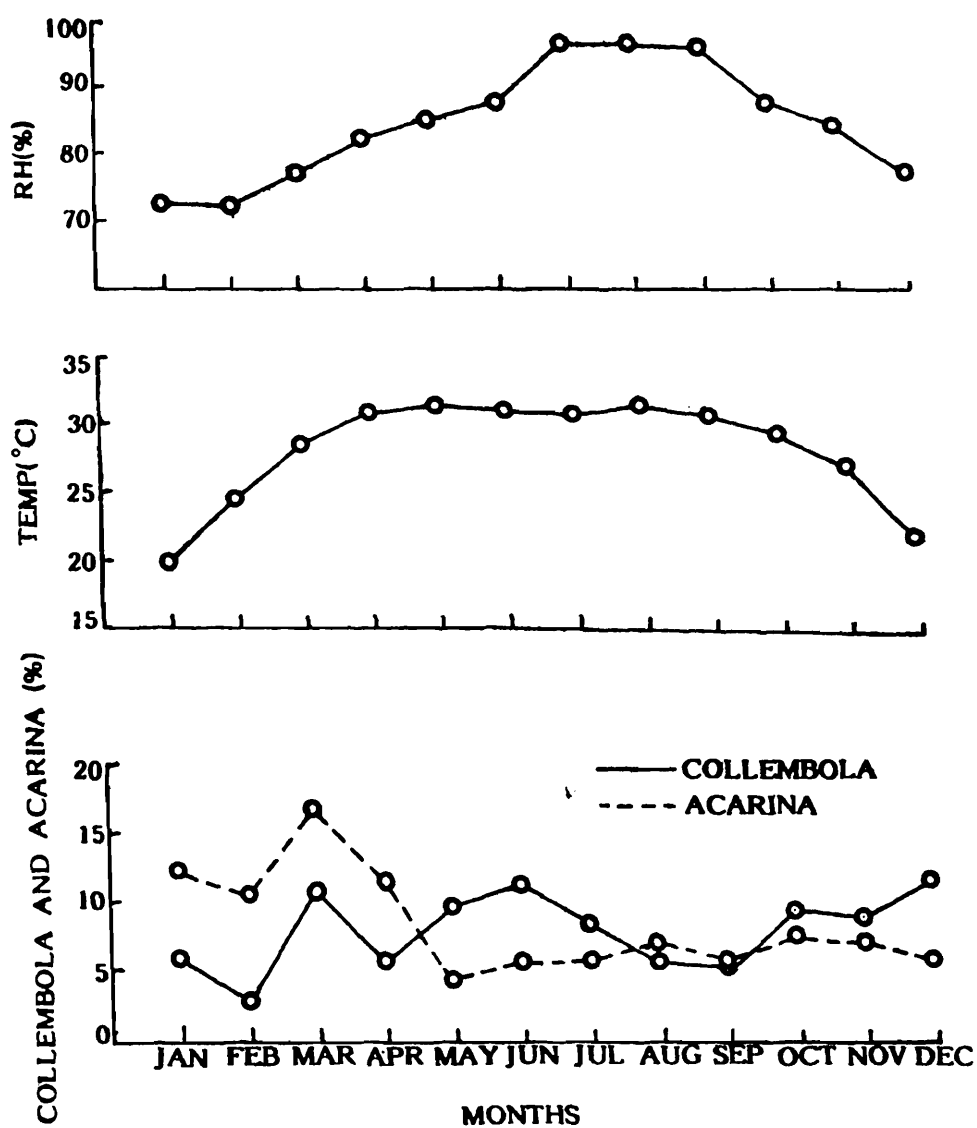


Fig. 4. Monthly changes in the population of Collembola and Acarina with reference to relative humidity and temperature during three-year period.

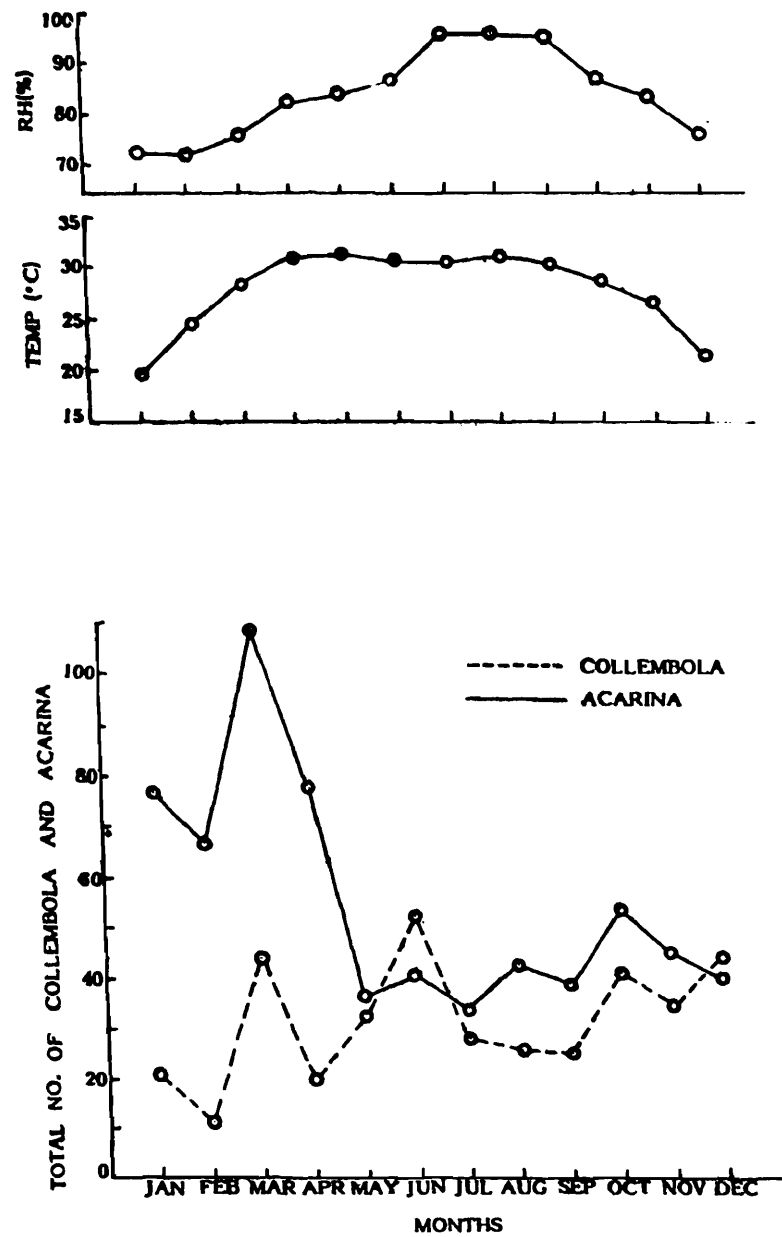


Fig. 5. Monthly changes in the population of Collembola and Acarina during three-year period with reference to relative humidity and temperature.

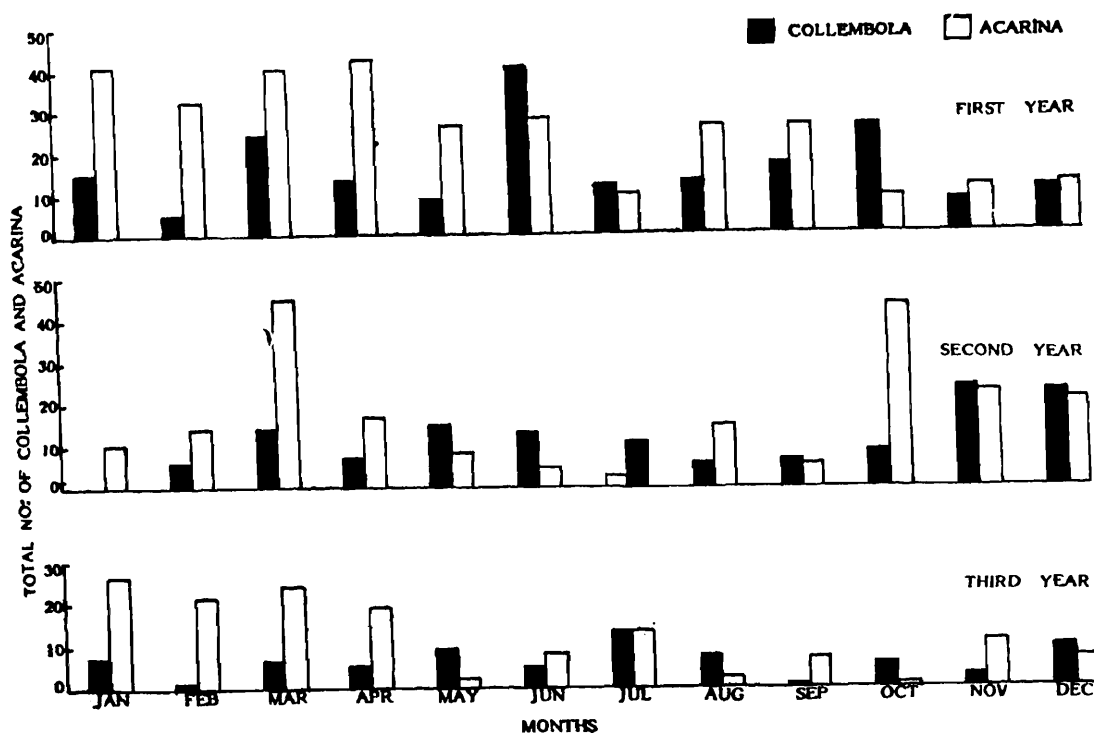


Fig. 6. Relationship between Collembolan and Acarine populations during first, second and third years.

DISCUSSION

At the grassy site the correlation between Collembola and Acarina, though significant for first two years, it is negatively correlated during third year presumably due to over-saturated condition of soil during this year. Collembolans being extremely sensitive to changes in temperature and relative humidity exhibit positive correlations in most of the cases. In the present study, the grassy site exhibited premonsoon and winter peaks, as characteristic of the gangetic alluvium, except during second year, when the monsoon peak was inconspicuous owing to low soil temperature, specially during July of this year.

SUMMARY

In the present investigation, population dynamics of Collembola and Acarina in a

grassland ecosystem at Calcutta is given with reference to the biotic relationship between Collembola and Acarina and two abiotic factors, viz., temperature and relative humidity on the basis of three years data.

ACKNOWLEDGEMENT

Grateful thanks are due to the Director, Zoological Survey of India for facilities.

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TWO NEW SPECIES OF THE GENUS *LYTOCESTOIDES* BAYLIS, 1928
(CESTOIDEA : CESTODA : CARYOPHYLLIDEA : LYTOCESTIDAE)
FROM A FRESHWATER FISH IN MAHARASHTRA, INDIA

G. B. SHINDE, A. D. MOHEKAR AND B. V. JADHAV
Department of Zoology, Marathwada University, Aurangabad.

AND

M. HAFEEZULLAH
Zoological Survey of India, Calcutta.

ABSTRACT

The present communication deals with two new caryophyllid species *Lytocestoides naldurgensis* and *L. mackiewiczi* from a freshwater fish *Cirrhinus mrigala* (Hamilton) examined at Naldurg, Osmanabad, Maharashtra. Both species are characterised by having (i) follicular rather than granular vitellaria in two sets—one laterally in the cortical region from the base of the scolex to the preovarian level, and the other group of follicles in the postovarian region, the two sets being connected by one or two rows of follicles lateral to ovary, and (ii) far less number of testes (80-85 in one and 50-55 in the other) as compared to very numerous testes (200-400) in the already known species. In these two characters the two new species differ from all the known species of the genus. They are further different from the type species *Lytocestoides tanganyikae* Baylis, 1928 in that the testes are uniformly distributed in the medullar parenchyma, whereas in the type species they are concentrated in the peripheral medullary region leaving the central part devoid of testes. The two new species are distinct from *L. aurangabadensis* Shinde, 1970 (including its two varieties, namely, *L. aurangabadensis* var. *minuta* Shinde, 1970 and *L. aurangabadensis* var. *minor* Shinde, 1970) and *L. paithanensis* Shinde and Deshmukh, 1975 in the possession of follicular vitellaria extending from the base of head to the posterior end of the body as against granular vitellaria from the anterior end to posterior end of the body, and in the absence of a group of testes in the postovarian region.

The new species *L. mackiewiczi* is distinguished from *L. naldurgensis* in having less number of testes (50-55 vs. 80-85) and in that the cortical vitellaria are in two rows (layers) as compared to one.

The shape of the head (or scolex) may vary according to state of contraction at the time of fixing.

INTRODUCTION

The genus *Lytocestoides* was erected by Baylis (1928) with its type species *L. tanganyikae* Baylis, 1928 from a freshwater fish *Alestitis* sp. at Kirando in Tanganyika, Africa.

Shinde (1970) described *L. aurangabadensis* and *L. aurangabadensis* var. *minor* from the fish *Barbus collus*, and *L. aurangabadensis* var. *minuta* from *Labeo calbasu* at Aurangabad, India. Later on, Shinde and Deshmukh

(1975) added one more species *L. paithanensis* to this genus from the fish *Pseudeutropius taakree* at Paithan, India. The present paper deals with two new species of this genus.

MATERIAL AND METHOD

The material for this paper was collected from a freshwater fish *Cirrhina mrigala* (Hamilton) from a lake at Naldurg, District Osmanabad, Maharashtra. The specimens were stained with Mayr's carmalum, dehydrated in grades of alcohol, cleared in xylol and mounted in Canada balsam. The drawings were made with the aid of a camera lucia. All the measurements are in millimeters. On study, the two lots of specimens were found to belong to two different species of the genus *Lytocestoides* Baylis, 1928. The holotype and paratype specimens are deposited with the Department of Zoology, Marathwada University, Aurangabad, Maharashtra.

SYSTEMATIC ACCOUNT

Lytocestoides naldurgensis n. sp.

(Figs. 1A, 1B)

Description (based on 5 of 10 specimens): Body single-segmented, broader anteriorly, gradually tapering posteriorly, 4.77-5.44 in length, 1.05-1.55 in maximum width. Head triangular, broader at base, narrow anteriorly, 0.66 in length, 1.50 in width.

Testes 80-85 in number, preovarian, anterior to cirrus pouch, oval in shape, situated in central medulla in a single field, extending laterally up to subcortical region and tending to protrude into region of head, each testis about 0.10 in length and 0.19 in width. External seminal vesicle indiscernible.

Cirrus pouch small, oval, transversely placed just posterior to middle of body, enclosing coiled cirrus.

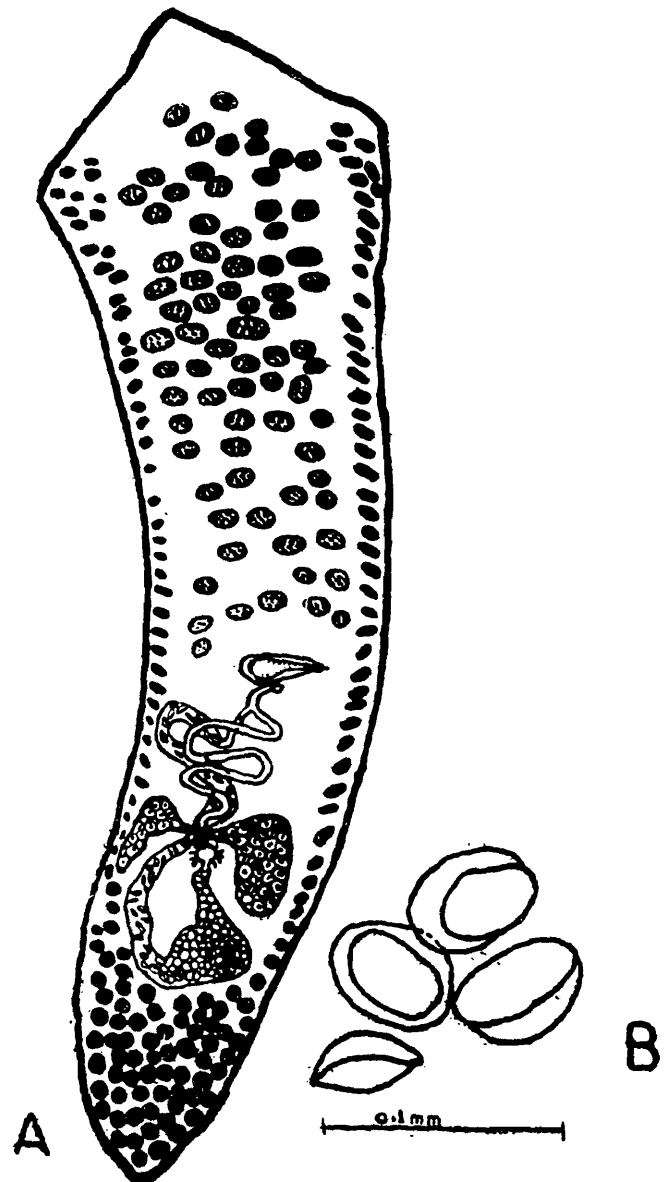


Fig. 1.

Fig. 1A. *Lytocestoides naldurgensis* n. sp.
Entire Worm.

Fig. 1B. *Lytocestoides naldurgensis* n. sp. Eggs.

Ovary follicular, bilobed with a narrow isthmus in between the two lobes, situated in medullary region at one-fourth from posterior margin, 0.33-0.49 in length, 0.66-0.77 in width. Uterus tubular, aglandular,

coiled, initially descending in postovarian region and then ascending anteriorly in preovarian region, 3.35 in length, 0.33 in width, filled with eggs. Vagina tubular, thin, coiled, joining uterine tube behind cirrus pouch. Uterovaginal opening slightly posterior to cirrus pouch. No genital atrium. Eggs numerous, operculated, 0.056×0.033 . Vitelline follicles almost in a single row in cortical field.

Host : *Cirrhina mrigala*
(Hamilton),
(Family : Cyprinidae).
Location : Intestine.
No. of specimens : 10
Locality : Naldurg, Maharashtra.
Holotype : M. U. Helm. Coll.
No. Z/C/140
Paratype : No. Z/C/P/101.

Discussion : *Lytocestoides naldurgensis* basically differs from the type species *Lytocestoides tanganyikae* in having follicular vitellaria (slightly less in size than testis) rather than granular ; in possessing much less number of testes (80-85 vs 200) which are distributed uniformly in medullar parenchyma (whereas in the type species they form a layer surrounding the central portion of parenchyma).

L. naldurgensis can easily be separated from *L. aurangabadensis* Shinde, 1970, *L. aurangabadensis* var. *minor* Shinde, 1970, *L. aurangabadensis* var. *minuta* Shinde, 1970 and *L. paithanensis* Shinde and Deshmukh, 1975 in having (i) follicular rather than granular vitellaria, (ii) granular vitellaria in the latter four forms distributed in the cortex from anterior end to posterior end of body, (iii) fewer number of testes (80-85 vs 300-400),

and (iv) in the absence of a group of testes in the postovarian region.

The shape of head or scolex may vary according to the state of contraction at the time of fixing.

***Lytocestoides mackiewiczi* n. sp.**

(Figs. 2A, 2B)

Description (based on 15 worms) : Body

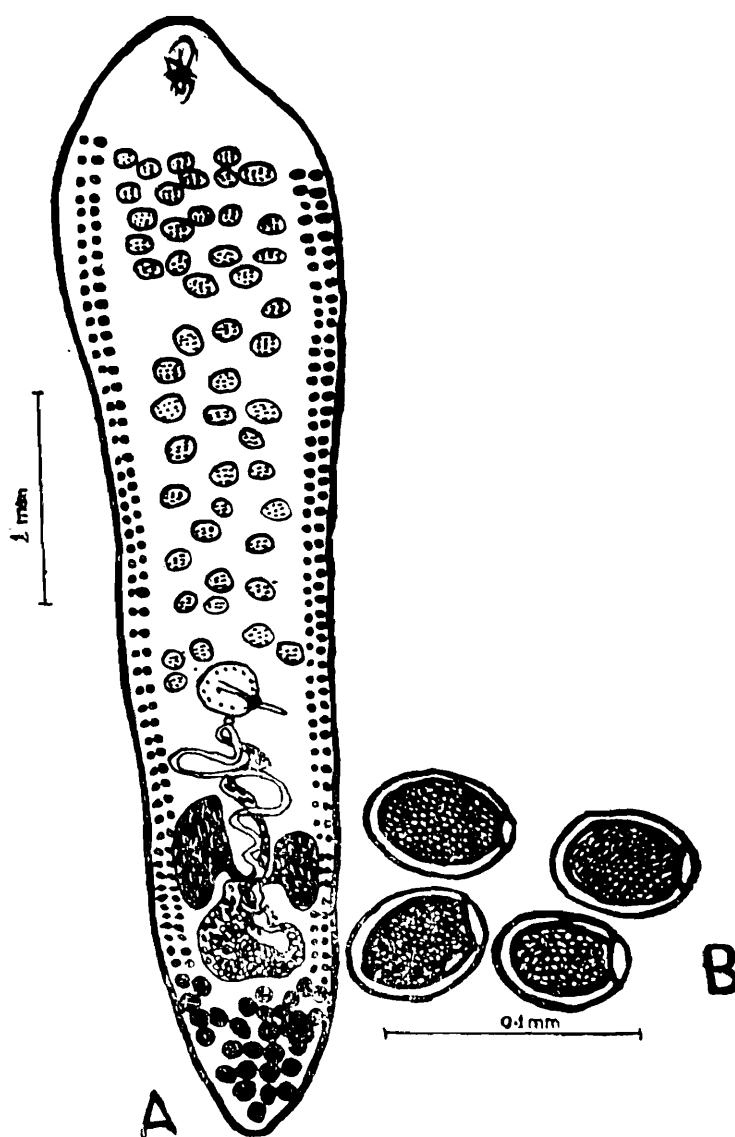


Fig. 2

Fig. 2A. *Lytocestoides mackiewiczi* n. sp. Entire Worm.

Fig. 2B. *Lytocestoides mackiewiczi* n. sp. Eggs.

single-segmented, broad anteriorly. tapering posteriorly, 5.0-6.0 in length, 1.0-1.3 in maximum width. Head broad at base, narrow and rounded at anterior end, with smooth or wrinkled surface.

Testes 50-55, anterior to cirrus pouch, in central medulla, extending anteriorly up to base of head, each 0.16 in average diameter. External seminal vesicle indiscernible. Cirrus pouch round, median, postequatorial, 0.30 in diameter. Cirrus protruded. Male genital pore lateral to cirrus pouch, submedian.

Ovary follicular, bilobed, lobes unequal in size, situated at one-fourth from posterior end of body, medullary but touching cortical region, connected by isthmus, 0.39-0.53 in length, 0.54-0.53 in width. Vagina tubular, thin, winding, preovarian, 1.8-2.0 in length. Uterus tubular, aglandular, wider than vagina, winding, initially descending in postovarian region and then ascending, 2.10-2.25 in length, 0.15 in width. Uterovaginal pore immediately posterior to cirrus pouch. No genital atrium. Eggs 0.067×0.044 . Vitellaria follicular, follicles 0.04-0.06 in diameter, in two rows in cortical region, extending from base of head to ovarian level and connected posteriorly to a group of postovarian follicles.

Host : *Cirrhinia mrigala* (Hamilton),
(Family : Ceprinidae).

Location : Intestine.

No. of
specimens : 15

Locality : Naldurg, Maharashtra.

Holotype : M. U. Helm. Coll. No.

Z/C/141.

Paratype : No. Z/C/P/102.

Discussion : The present new species can

be easily distinguished from the type species *Lytocestoides tanganyikae* Balis, 1928 by the presence of (i) follicular rather than granular vitellaria, (ii) less number of testes (50-55 vs 200), and (iii) by the nature of distribution of the testes in the medullary region (in the new species the testes are evenly distributed in the medulla whereas in the type species they are peripheral surrounding the central median medullary parenchyma).

It differs from *L. naldurgensis* (present paper) in having less number of testes (50-55 vs 80-85) and in that the lateral vitelline follicles are in two rows rather than one,

It is distinct from *L. aurangabadensis* Shinde, 1970, *L. aurangabadensis* var. *minor* Shinde, 1970, *L. aurangabadensis* var. *minuta* Shinde, 1970 and *L. paithanensis* Shinde and Deshmukh, 1975 in the presence of (i) follicular rather than granular vitellaria, (ii) granular vitellaria in the latter four forms dispersed in the cortex from anterior end to posterior end of body, (iii) far less number of testes (50-55 vs 300-400), and (iv) in the presence of a group testes in the posterior region.

The species has been named after Dr. S. Mackiewicz, Professor, Department of Biological Sciences, State University of New York at Albany, New York in token of his valuable contribution to the knowledge of world caryophyllid cestodes.

ACKNOWLEDGEMENTS

The authors are thankful to Prof. R. Nagbhushanam for providing facilities ; B. V. Jadhav is grateful to the C. S. I. R., New Delhi for awarding him post-Doctoral Fellowship.

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ON SOME INSECT BORERS OF MANGROVES OF ANDAMAN AND NICOBAR ISLANDS

By

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Zoological Survey of India, Port Blair

ABSTRACT

Biological observations on four species of insect borers from the mangrove forest ecosystem of Andaman and Nicobar islands are presented. These borers comprise of two species of cerambycid beetles, viz., *Plocaederus obesus* Gahan, *Megopis (Aegosoma) sulcipennis* (White), one species of curculionid beetle, *Camptorrhinus humeralis* Chev. and one undetermined species of moth of the family Pyralidae. All these species constitute first record as borers of mangrove trees.

INTRODUCTION

Mangroves are very important component in the forest ecosystem of Andaman and Nicobar islands and occupy about 20 per cent and 2 per cent of the total land area of the Andamans and the Nicobars respectively (Sahany, 1957). The borers invading the mangrove plants can be categorised under two broad subheads, the marine borers and terrestrial borers.

While the marine borers of mangroves of these islands have been studied in some detail (Das and Dev Roy 1980, 1981, 1984, Dev Roy and Das, 1985 ; Tiwari *et. al.*, 1980) the insect borers of this ecosystem are almost neglected. Only seven species of insect borers have been recorded so far from the mangroves of these islands (Beeson, 1941 ; Tiwari *et. al.*, 1980 ; Das and Dev Roy, 1982 ; Das, Dev Roy and Mitra *in press*). Recently, the present authors have collected and studied

four species of insect borers from mangrove ecosystem, of which two are cerambycid beetles, the third one is curculionid beetle and the fourth one is an unknown moth of the family Pyralidae (Lepidoptera). Both the species of cerambycids, namely, *Plocaederus obesus* Gahan and *Megopis (Aegosoma) sulcipennis* (White) attacked the sapwood ; while the curculionid beetle, *Camptorrhinus humeralis* Chev. and the undetermined moth were found to bore in the fruits. These are being dealt with in the present communication. All the insect borers recorded in the present paper are being reported for the first time as the borers of mangrove trees.

MATERIAL AND METHOD

Infested mangrove logs and fruits procured from different mangrove areas of South Andaman islands were brought to the laboratory of the Zoological Survey of India

1. Present address : Zoological Survey of India, Calcutta.

at Port Blair for insectary studies. Some of the larvae and pupae were preserved in Pampel's fluid for further studies. The pattern of gallery formation of the larval forms was also noted. Infested logs were kept inside galvanized iron chambers (70 cm × 37 cm × 37 cm) with one glass bottle on the top. But infested fruits were kept in glass jars (30 cm × 28 cm × 26 cm) with tops covered with mulmul. These were examined every day regularly between 9 hrs. and 10 hrs. IST.

Similar materials from the other islands were initially kept in the field laboratory and subsequently brought to Port Blair following the same method. Salinity of the creek water was measured by Harvey's method (1966) employing correction factors.

OBSERVATIONS

A. Wood borers

1. *Plocaederus obesus* Gahan (Coleoptera : Cerambycidae) (Plate X)

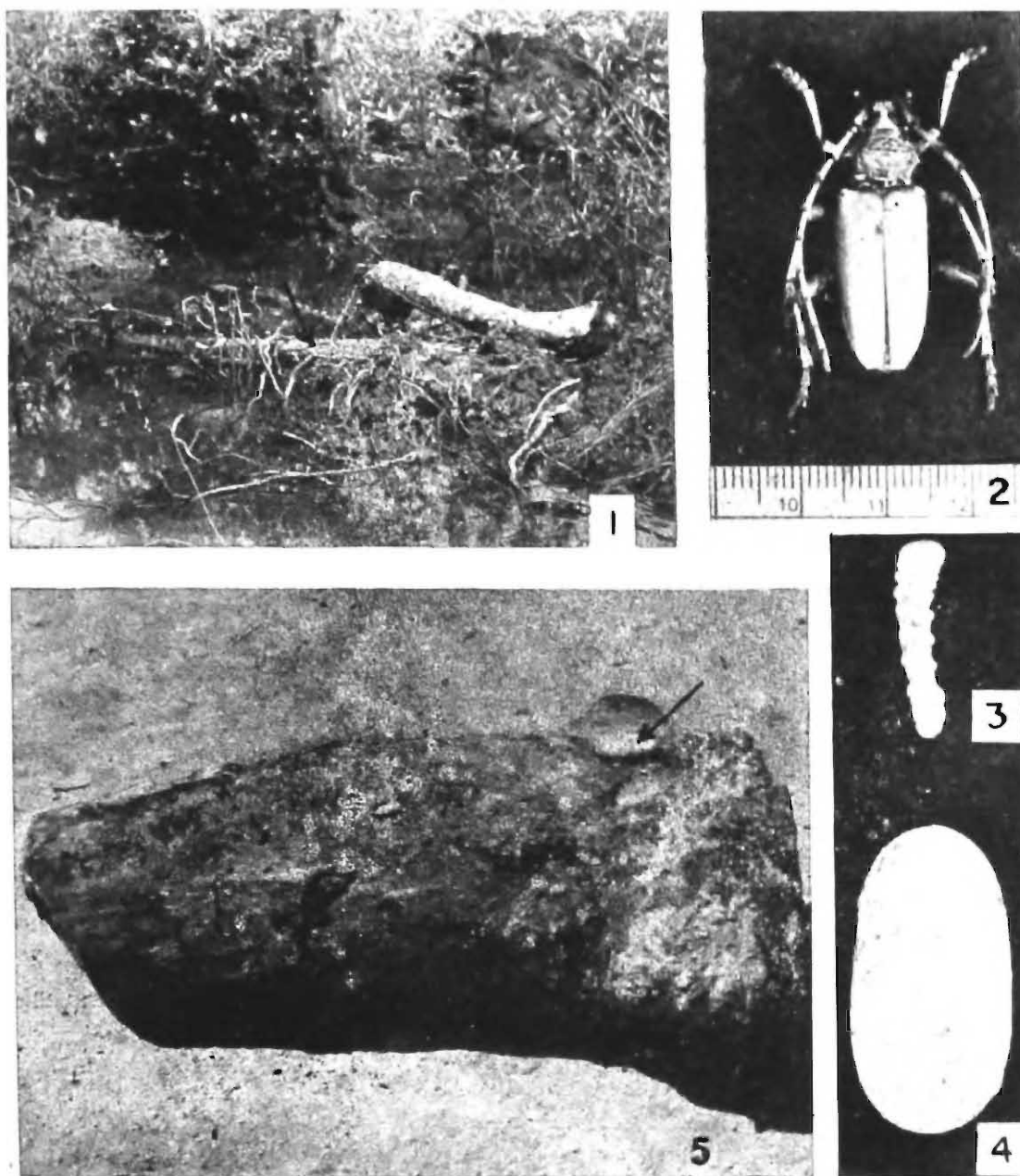
This cerambycine species is reported to be very common in the timber extraction and logging centres, timber depots and forest areas throughout the Andaman islands (Khan and Maiti, 1983). Although this borer has been collected from 13 species of host plants of these islands (Beeson and Bhatia, 1939 ; Khan and Maiti, 1983) still it has never been reported from any mangrove trees of Andaman islands as well as mainland India.

During the present study this borer has been collected from three felled logs of a mangrove tree, *Heritiera littoralis* in Bamboo-flat (South Andaman) within the mangrove areas in such part of the intertidal zone where seawater can reach only during the

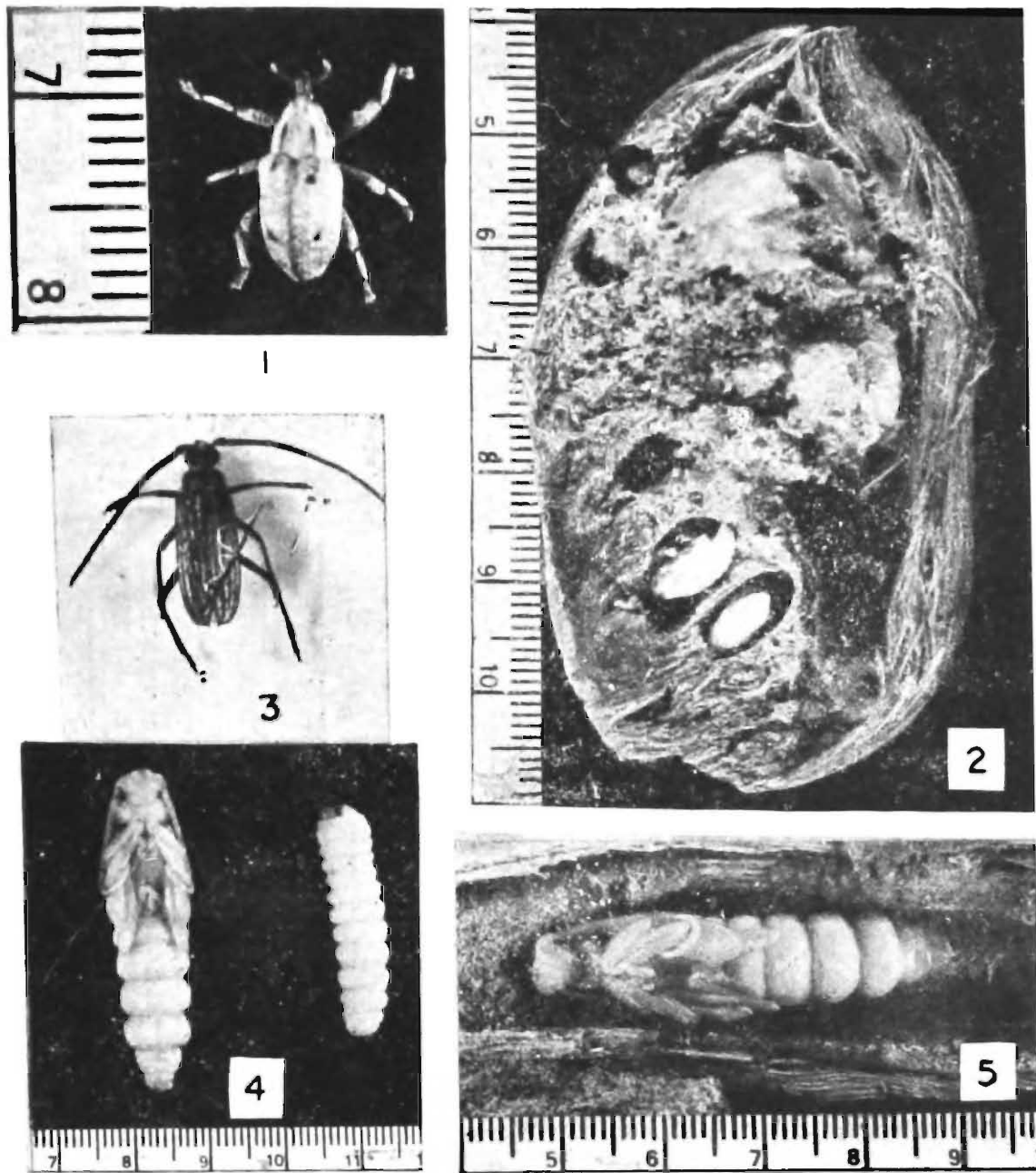
high tide and submerge the logs completely (Plate X, Fig. 1). These logs were found to be heavily infested with larvae which excavated wide and very irregular galleries in the sapwood. These galleries were packed tightly with coarse fibrous frass. Exact larval period of this species could not be ascertained. Pupation took place in solid cocoon and pupal chamber was formed inside a shallow pit under the bark. Cocoons are white, hard, thick, calcareous and oval or 'Tortoise-egg' shaped having 3.5 to 4 cm in length and 1.8 to 2 cm in width. In the laboratory pupal period varies from 240 to 270 days. The mature beetles emerged by breaking the cocoons.

Beeson (1941) described this species as a heartwood borer. Khan and Maiti (1983) corroborated the same with the exception of several instances where they observed this species to form pupal chamber in the sapwood. In the present case, the borer completed its life-cycle in the sapwood of the upper portion of the logs which were found to remain completely submerged under seawater during the hightide, the salinity of which ranged from 32.47‰ to 34.53‰ during the present study.

That the pupa within the cocoon is quite tolerant of seawater for a considerable period is ascertained by the fact that adult beetles emerged safely from the cocoon even after keeping the same up to 6 hrs. per day for successive three days in the seawater of 34.53‰ salinity and then placing the same in the pupal pit again in the laboratory. But it is not quite clear how larvae withstand saline water in the present circumstances. Rather, it has been seen that larvae cannot survive if they are exposed to seawater of the



Figs. 1-5. 1. Intertidal zone showing felled mangrove infested with *Plocaederus obesus* Gahan 2-4. *P. obesus* 2. Adult ; 3. Larva ; 4. Pupa 5. Cocoon of *P. obesus* inside the shallow pit of a mangrove log



Figs. 1-5. 1. *Camptorrhinus humeralis* Chev. just after emergence from the mangrove fruit of *Heritiera littoralis*, 2. L. S. of the fruit of *H. littoralis* infested with the larvae of *C. humeralis*, 3-5. *Megopis (Aegosoma) sulcipennis* (White); 3. Adult; 4. Larva (at the right) and Pupa; 5. Pupa inside the pupal chamber

above ranged salinity directly for more than an hour. It is yet to be studied whether seawater is soaked by the thick layer of frass granules in such a state that water which could reach the larvae does not affect their further development. Mention may be made here that larval infestation of the logs were first noticed during May 1982. From one lot of those larvae reared in the laboratory adult beetles emerged in the month of April 1983.

2. *Megopis (Aegosoma) sulcipennis* (white)
(Coleoptera : Cerambycidae)
(Plate XI, Figs. 3-5)

These beetles were found to attack dried up stumps of another mangrove tree, *Sonneratia alba* towards supralittoral zone of the mangrove forest near Uttara jetty, Kadamtala, Middle Andaman. The larvae tunnelled the sapwood, formed irregular but extensive galleries and occasionally penetrated upto the heartwood. As usual, the larval galleries were packed tightly with the coarse fibrous frass. After forming a larval chamber inside the tunnel the mature larvae underwent pupation. The pupal chamber was more or less parallel to the wood fibres.

In this case also, larval period could not be ascertained. Size of mature larva ranged from 2.8 to 3.3 cm and that of pupa from 3.5 to 4 cm in length. Pupation took place between 8 and 10 days in the laboratory. The adult beetles emerged by penetrating the distal end of the pupal chamber forming a more or less circular exit hole of 0.60 to 1.0 cm in diameter.

The larvae infested logs were kept in the laboratory on 28.3.83 and adult beetles emerged during 25.4.83 to 5.5.83. A total of

19 adults were collected, out of which 11 were males and 8 females.

This species is so far known from Andaman islands and Burma. From the available literature it appears that no work has been published so far on the biology or boring habit of this beetle.

B. Fruit borers

2. *Camptorrhinus humeralis* Chev.
(Coleoptera : Curculionidae)
(Plate XI, Figs. 1-2)

Fruits of *Heritiera littoralis* fallen on the ground in the mangrove forest of Bamboo flat, South Andaman were found heavily infested with the larvae of this beetle during March 1983.

These larvae fed on the kernal portion and formed pupal chamber in the mesocarp of the fruits (Plate XI, Fig. 2). Size of pupal chamber varied from 0.65 to 0.75 cm in length and 0.4 to 0.5 cm in width. In the laboratory pupal period ranged from 12 to 18 days. Adults emerged through the exit holes, the diameter of which varied from 0.35 to 0.4 cm. One to five exit holes per fruit were observed.

C. humeralis is so far recorded from the Andamans only. Its biology is yet to be studied. From India, only two species of *Camptorrhinus*, namely *C. affinis* and *C. albizziae* are known as borers, that too, as wood-borers (Beeson, 1941). The former is reported from the host plants, *Albizia lucida* and *Shorea robusta* while the latter from *Mangifera indica*.

4. Unknown moth (Lepidoptera : Pyralidae)

From some infested fruits of *Heritiera*

littoralis collected on the floor of the mangrove forest of Bambooflat (South Andaman) and kept in the insect rearing chambers in the laboratory adult moths belonging to the family Pyralidae were found to emerge. The identity of this moth is yet to be determined. The larvae were found to be covered with loosely packed frass material. The mature larvae formed pupal chamber within those frass material and underwent pupation. The pupa was enclosed in a white, transparent silken cocoon, the dimension of which ranged from 0.7 to 1.1 cm. Pupal period varied from 3 to 5 days under laboratory condition.

ACKNOWLEDGEMENT

Thanks are due to the Director, Zoological Survey of India, Calcutta for laboratory facilities, to Dr. P. K. Maity, Zoological Survey of India, Calcutta and to Dr. H. R. Pajni, Department of Zoology, Punjab University, Chandigarh for identifying the cerambycid and curculionid beetles respectively.

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ON A SMALL COLLECTION OF ASILIDAE (DIPTERA)
FROM ORISSA, INDIA

By

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Zoological Survey of India, Calcutta

ABSTRACT

This paper deals with 13 species of robberflies from Orissa, of which 3 species, viz., *Ommatius pseudokempi*, *Promachus obscurus* and *P. lehri*, are new. Out of the remaining 10 species, 9 are recorded for the first time from Orissa.

INTRODUCTION

During August 1983, one of us (P. Parui) undertook a survey of robberflies from Orissa State, the result of which is included in this paper. We have also included in it a few species which are present in the National Zoological Collection, Calcutta, and one example which belongs to a new species (*Promachus lehri*) is from Bihar. The species are arranged according to 'A Catalog of the Diptera of the Oriental Region' by Oldroyd (1975).

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

Cophinopoda Hull

Cophinopoda Hull, 1958, *Proc. ent. Soc. Wash.* 60 : 251.

1. **Cophinopoda chinensis** (Fabricius)

Asilus chinensis Fabricius, 1794, *Ent. Syst.* 4 : 383.

Cophinopoda chinensis : Oldroyd, 1975, *A Catalog of Diptera of the Oriental Region*, 2 : 129.

Material examined : 1 ♂, 14.vi.1973, 2 ♂, 15.vi.1973 and 1 ♂, 17.vi.1973, all from Raimona, Coll. S. K. Gupta.

Remarks : This is a cosmopolitan species. It is the first record from Orissa.

Michotamia Macquart

Michotamia Macquart, 1838, *Dipt. exot.* 1(2) : 72.

2. **Michotamia aurata** (Fabricius)

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

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

Material examined : 1 ♀, Mayurbhanj District : Baripada : Balidiya, 9.viii.1983 ; 3 ♂, 4 ♀, Sundargarh, 16.viii.1983 ; 1 ♂, 1 ♀, Sundargarh District : Sagbahal, 18.viii.1983 ; 8 ♂, 3 ♀, Sambalpur District : Rangli, 21.viii.1983 ; 1 ♂, Sambalpur District : Jhuripara, 23.viii.1983 ; 2 ♂, 2 ♀, Sambalpur District : Rangli B.D.O. Office compound, 24.viii.1983 ; 1 ♀, Dhenkanal District :

1. Marine Biological Station, Madras

Kapilas Deer Park, 28.viii.1983, all collected by P. Parui.

Remarks: This species is common in South India.

Ommatius Weidemann

Ommatius Weidemann, 1821, *Dipt. exot.* : 213.

3. *Ommatius pseudokempi* sp. nov.

(Fig. 1)

A small black species with yellowish-brown legs, femora marked with a small black spot anteriorly and wings wholly hyaline or apically pale brownish. Male : length 9 mm., wing 6 mm ; female : length 10-11 mm, wing 7 mm.

♂ : *Head* black with sparse grey tomentum ; *mystax* black and pale yellow coloured, fronto-orbital bristles pale yellow and that of ocellarium black, postcranium sparsely

grey tomentose, hairs pale yellow, postocular bristles pale yellow and black. Antenna black, bristles of basal two segments black, 1 and 2 nearly equal in length, 3 much longer than the others. Palpi and proboscis black, the former with black hairs while the latter pale yellow haired.

Thorax black with grey and greyish-yellow tomentum ; pronotum pale yellow haired with one black bristle on either side ; mesonotum without mediolongitudinal stripe, tomentum though sparse covering most of tergum, bristles black and pale yellow ; pleuron black with sparse grey tomentum, scutellum scarcely grey tomentose, sparse pale yellow hairs on disc and a pair of black bristles on the border ; metapleuron with pale yellow bristles. Halteres pale yellow with brownish marking.

Legs predominantly yellowish-brown, remaining segments yellowish-brown with apex of tarsal segments dark brown, apex

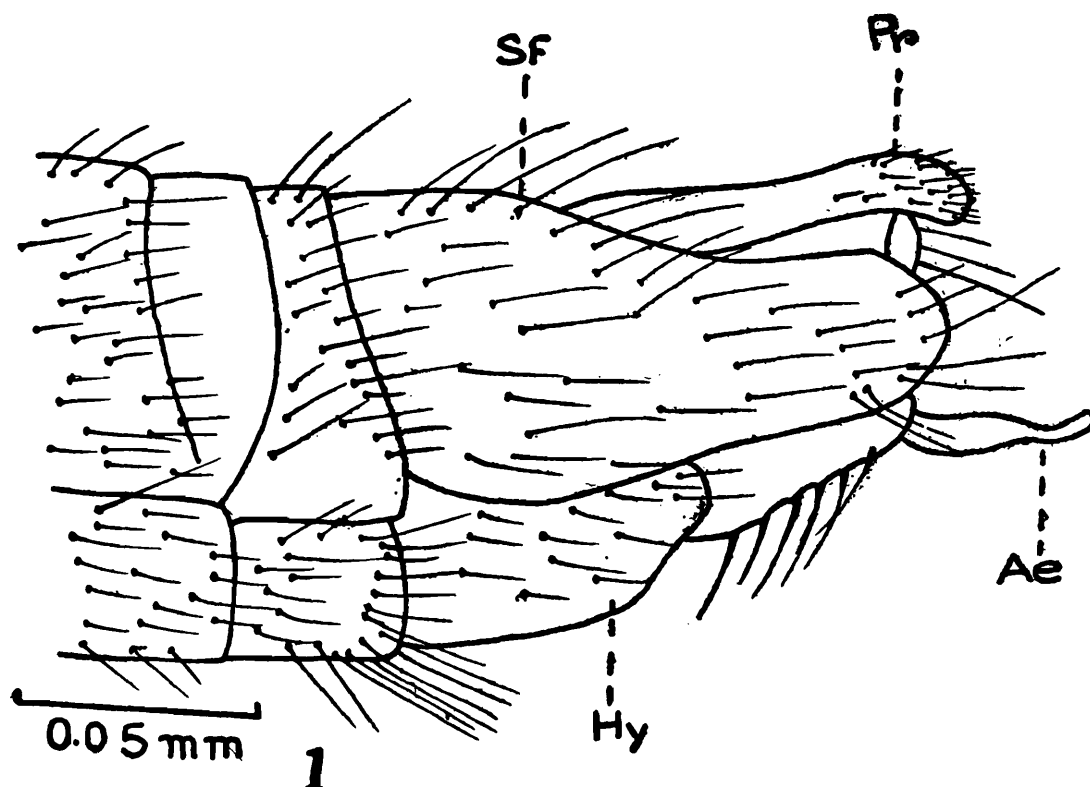


Fig. 1. Lateral view of male genitalia of *Ommatius pseudokempi* sp. nov.

of femur anteriorly with a black spot ; vestiture and bristles black and pale yellow.

Wings hyaline but apically pale brownish.

Abdomen black, sides of tergite 1 with pale yellow hairs and bristles, 2 and 3 with lesser number of pale yellow hairs, vestiture pale yellow and black. Male genitalia (Fig. 1) yellowish-brown with pale yellow and some black hairs.

♀ : Similar but with the following differences : head greyish-yellow and pale yellow tomentose or completely pale yellow tomentose ; postocular bristles pale yellow and black or wholly pale yellow ; scutellar bristles black and pale yellow ; wings wholly hyaline. Female genitalia black, tergite 9 hidden by tergite 8 and only slightly projected out laterally, cerci broad, gradually narrowed at apex and projected upwards with abundant black hairs.

The superior forceps of male genitalia in the species under consideration possesses an upper projection like that of *Ommatius kempii* Joseph and Parui but otherwise a quite distinct species with mixed coloured mystax and details of male genitalia.

Holotype ♂, Reg. No. 7239/H6, Sambalpur District : Jhuripara, 23.viii.1983, Coll. P. Parui, *Paratypes* 2 ♀ Reg. No. 7240/H6 and 7241/H6, rest of details as in holotype.

4. *Ommatius jabalpurensis* Joseph and Parui

Ommatius jabalpurensis Joseph and Parui, 1983, *Ent. Scand.* 14 : 90.

Material examined : 1 ♂, Sundargarh District : Panderipani, 17.viii.1983, Coll. P. Parui.

Remarks : So far this species is recorded

only from Madhya Pradesh, this is the first record from Orissa.

Clephyroneura Becker

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

5. *Clephyroneura wilcoxi* Joseph and Parui

Clephyroneura wilcoxi Joseph and Parui, 1979, *Ent. Scand.* 10(1) : 35.

Material examined : 3 ♂, Sambalpur District : Rangli B.D.O. Office compound, 24.viii.1983, Coll. P. Parui.

Remarks : The species is so far recorded from South India, it is the first record from Orissa.

Philodicus Loew

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

6. *Philodicus femoralis* Ricardo

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

Material examined : 2 ♂, Sambalpur District : Rangli B.D.O. Office compound, 24.viii.1983, Coll. P. Parui.

Remarks : This species has been reported from West Bengal, Meghalaya, Uttar Pradesh, Bihar and Goa. It is recorded here for the first time from Orissa.

7. *Philodicus javanus* (Wiedemann)

Asilus javanus Wiedemann, 1819, *Zool. Mag.* (Wied.) 1(3) : 4.

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

Material examined : 2 ♂, Keonjhar District : Ghat Gaon, 28.iii.1973, Coll. S.K. Mitra.

Remarks : Though it is the most common species in India, it is recorded for the first time from Orissa,

Promachus Loew

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

8. ***Promachus lehri* sp. nov.**

(Fig. 2)

A medium, black species with black legs, brownish wings with a smoky stripe in the marginal and first submarginal cells and well developed eighth sternite. Male : length 19-21 mm, wing 12-14 mm.

♂. *Head* as wide or wider than thorax, black, covered with greyish-yellow tomentum ;

Thorax black with greyish-yellow and grey tomentum ; pronotum pale yellow and black haired with a transverse row of black bristles ; mesonotum with a black medio-longitudinal stripe divided by a broad grey stripe, the stripe extending the entire length, sides with two black spots, vestiture black with some pale yellow hairs anterolaterally and posterolaterally, bristles predominantly black with a few pale yellow ones ; scutellum grey tomentose, disc pale yellow haired with a row of pale yellow bristles ; pleura greyish-yellow and grey tomentose with pale yellow, golden yellow and black hairs. Halteres with dark brown heads and yellowish-brown stalks.

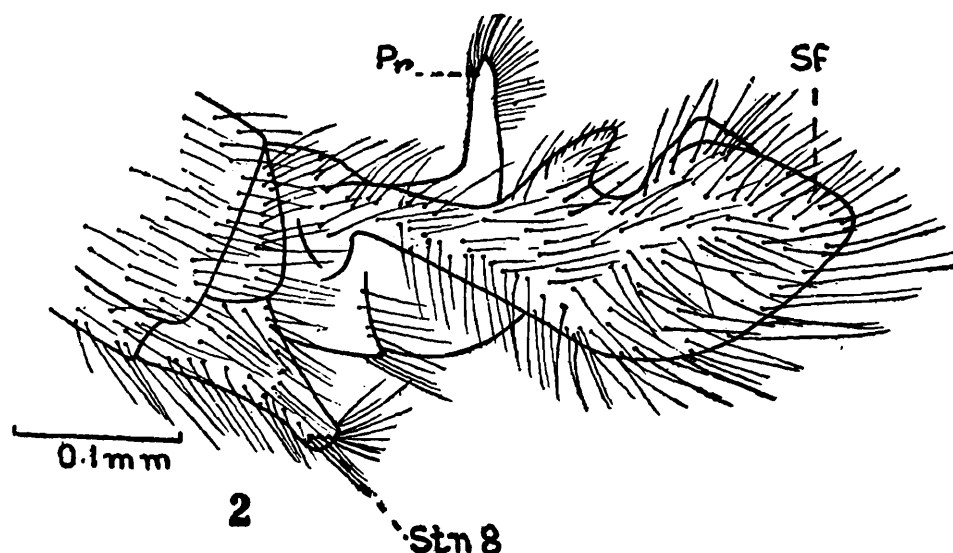


Fig. 2. Lateral view of male genitalia of *Promachus lehri* sp. nov.

mystax golden yellow, fronto-orbital hairs and ocellar bristles black ; postcranium pale yellow haired, postocular bristles black. Antennae dark brown, segment 1 with black and pale yellow bristles, 2 with black bristles, segment 2 slightly longer than half of 1, segments 3 and 1 nearly equal in length, style longer than segment 3. Palpi and proboscis black, the former golden yellow haired while the latter pale yellow haired.

Legs black, in fore and mid legs pale yellow and black hairs ventrally on the basal half, in hind legs the hairs wholly black, vestiture pale yellow and black, bristles black.

Wings brownish with a smoky stripe in the marginal and first submarginal cells.

Abdomen black with dense golden yellow hairs, density of hairs decreasing from the anterior to the posterior segments so such so

segment 7 devoid of yellow hairs, sides of tergite 2 onwards with black hairs which increase in posterior tergites and becoming wholly black in segment 7. Male genitalia (Fig. 2) black with black hairs, eighth sternite well developed, the dorsal tuft of white hairs absent.

Of the various known species, *Promachus lehri* sp. nov. is similar to *P. duvaucelii* (Macquart) differing from which in the robust size and stout male genitalia with a superior forceps inflated apically. It is named in honour of Dr. P.A. Lehr, Academy of Sciences, Vladivostak, USSR, who is a well known worker on Palaearctic Asilidae.

Holotype ♂, Reg. No. 7236/H6, Baripada District : Balidiya, 9.viii.1983, Coll. P. Parui. **Paratypes**. 1 ♂, Reg. No. 7237/H6, rest of details as in holotype ; 1 ♂, Res. No. 7238/H6, Bihar : Nalanda : Rajgir, 20.ix.1983, Coll. P. Parui.

9. *Promachus obscurus* sp. nov.

(Fig. 3)

A medium, black species with black legs, smoky brown wings and well developed

eighth sternite. Male : length 18 mm, wing 13 mm.

♂ **Head** as broad as thorax, black, sparsely grey tomentose ; mystax black, fronto-orbital bristles and ocellar bristles black ; postcranium black haired above and pale yellow haired below, postocular bristles black. Antennae black, segments 1 and 2 bearing black bristles, segment 2 slightly longer than half of 1, segments 3 and 1 nearly equal in length, style much longer than segment 3. Palpi and proboscis black, the former with black bristles while the latter pale yellow haired.

Thorax black with greyish-yellow tomentum ; pronotum black haired with a transverse row of black bristles ; mesonotum with a mediolongitudinal black stripe whose extent cannot be ascertained being greasy, laterally with two black spots, vestiture and bristles black ; scutellum on the disc with black hairs and four black bristles posteriorly, hind border with a row of black bristles ; pleura grey tomentose with black hairs. Halteres brown with the stalks lighter coloured.

Legs uniformly black, vestiture predomi-

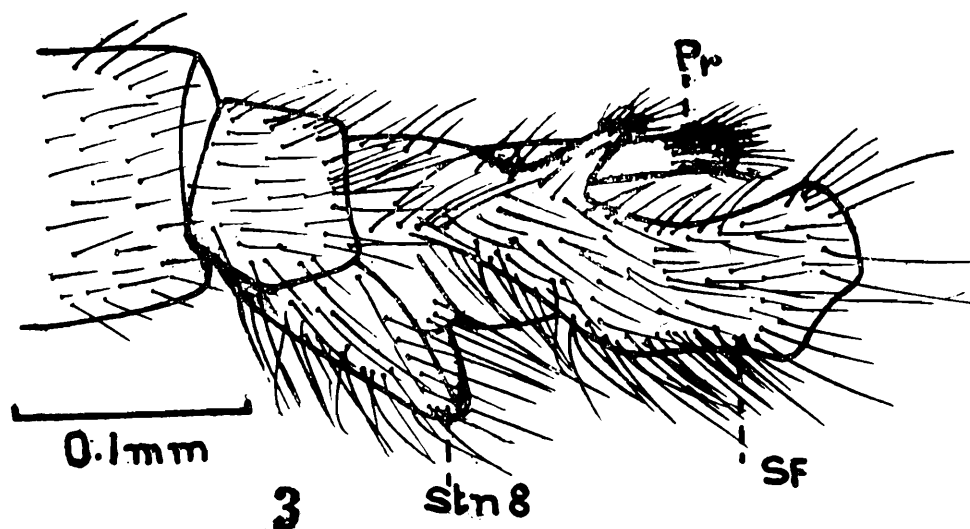


Fig. 3. Lateral view of male genitalia of *Promachus obscurus* sp. nov.

nantly black with some pale yellow hairs, bristles black.

Wings uniformly smoky-brown.

Abdomen black, sides of tergites 1 with a bunch of black hairs and bristles, segment 2 and to some extent 3 with a bunch of black hairs, vestiture black. Male genitalia (Fig. 3) black, eighth sternite well developed, hairs black but for the pale yellow ones on proctiger, the dorsal tuft of white hairs absent.

It is quite close to *Promachus genitalis* Joseph and Parui in male genitalia but differs in the entirely black mystax, occipital hairs and bristles, scutellar hairs and bristles and hairs of basal abdominal tergites. Besides wing is uniformly smoky-brown.

Holotype ♂, Reg. No. 7235/H6, Orissa : Sundargarh District : Panderipani, 17. viii. 1983, Coll. P. Parui.

10. *Promachus duvaucelii* (Macquart)

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

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

Material examined : 1 ♂, Sundargarh District : Panderipani, 17. viii. 1983, Coll. P. Parui, 1 ♂, Sambalpur District : Rangli B. D. O. Office compound, 24. viii. 1983, Coll. P. Parui.

Remarks : It is the first record of the species from Orissa, though it is widely distributed.

11. *Promachus genitalis* Joseph and Parui

Promachus genitalis Joseph and Parui, *Bull. zool. Surv. India* (in press).

Material examined : 2 ♂, Sambalpur

District : Rangli B. D. O. Office compound, 24. viii. 1983, Coll. P. Parui.

Remarks : This species is described from Madhya Pradesh ; this is the second record of it.

12. *Promachus yerburiensis* Ricardo

Promachus yerburiensis Ricardo, 1920, *Ann. Mag. nat. Hist.* (9) 5 : 220.

Material examined : 1 ♂, Keonjhar District : Ghat Gaon village, 28. iii. 1973, Coll. S. K. Gupta and Party ; 2 ♂, 1. iv. 1973, other details as in preceding.

Remarks : This species is so far recorded from Kerala, Tamil Nadu and Karnataka. It is the first report from Orissa.

Trichomachimus Engel

Trichomachimus Engel, 1933, *Ark. Zool.* (A) 25(22) : 10.

13. *Trichomachimus orientalis* (Ricardo)

Asilus orientalis Ricardo, 1922, *Ann. Mag. nat. Hist.* (9) 10 : 46.

Trichomachimus orientalis : Oldroyd, 1975, *A Catalog of Diptera of the Oriental Region*, 2 : 156.

Material examined : 1 ♀, Dhenkanal District : Kapilas Deer Park, 28. viii. 1983, Coll. P. Parui.

Remarks : It is so far reported only from Assam. National Zoological Collection, Calcutta, contain specimens from Uttar Pradesh, Kashmir, and Delhi. This is the first record from Orissa.

ACKNOWLEDGEMENTS

We are indebted to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta, for encouragements and facilities of work.

Abbreviation used in text-fig.

Ae, aedeagus ; Hy, hypandrium ; Pr, proctiger ; Sf, superior forceps (epandrium) ; Stn, eighth sternite.

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A NOTE ON THE BRITTLE STAR *OPHIOMUSIUM SIMPLEX* LYMAN
(ECHINODERMATA : OPHIUROIDEA) NEW TO THE BAY OF BENGAL

By

D. R. K. SASTRY

Zoological Survey of India, Calcutta,

ABSTRACT

The Ophiuroid species, *Ophiomusium simplex* Lyman of the family Ophiuridae, has hitherto been reported off Southern Japan, Philippine Islands and East Indian Archipelago from 54 to 300m. The new material reported here from the Andaman Islands (India) and Mergui Archipelago (Burma) extends the distribution of the species westward into the Bay of Bengal. The species has also been compared with *O. australis* H. L. Clark which has till recently been considered as a variety of *O. simplex* Lyman.

During the studies on unnamed Echinodermata in the Zoological Survey of India, Calcutta, the present author identified as *Ophiomusium simplex* Lyman (Ophiuridae, Ophiolpidinae) a few specimens collected off the Andaman Islands and Mergui Archipelago. The species has so far been reported only from S. Japan, Philippines and the Indonesian Islands. The present communication reports for the first time the occurrence of *O. simplex* in the Bay of Bengal. The following is a brief account of the specimens of *O. simplex* studied by the author.

Ophiomusium simplex Lyman
(Plate IX, figs. 1-4 ; Figs. 1, 2)

1878. *Ophiomusium simplex* Lyman, Bull. Mus. comp. Zool. Harv., V(7) : 115, pl. I, figs. 10, 11.

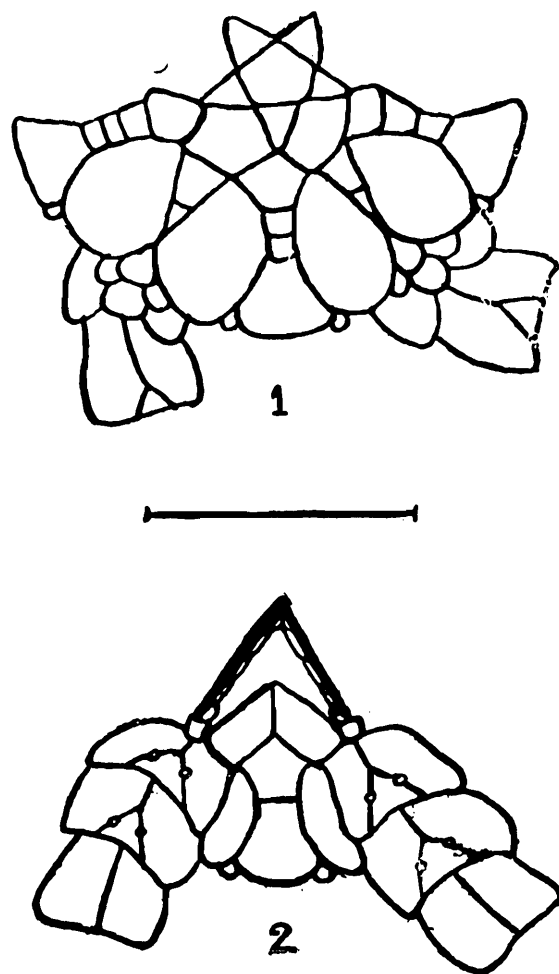
1882. *Ophiomusium simplex* : Lyman, Voy. Chall. Zool., 5 : 93, pl. I, figs. 7-9.
1904. *Ophiomusium sanctum* Koehler, Siboga Exped. Monog., 45a : 59, pl. XI, figs. 7-9.
1911. *Ophiomusium simplex* : Clark, Bull. U. S. natn. Mus., 75 : 109.
1922. *Ophiomusium simplex* : Koehler, Bull. U. S. natn. Mus., 100 (V) : 417, pl. 88, figs. 10, 11.
1930. *Ophiomusium simplex* : Koehler, Vidensk. Meddr dansk naturh. Foren., 89 : 241.
1963. *Ophiomusium simplex* : Murakami, Publs Seto mar. biol. Lab., XI(2) : 179.
1980. *Ophiomusium simplex* : Guille, Result. Camp. MUSORSTOM, 91 : 45.

Material : Sta. 238, Off Andamans ;
13°16'N 93°08'E ; 75-60 fms (137-110 m) ;
Bottom-stones ; R. I. M. S. "Investigator" ;
13.iv.1898 ; Two specimens.

Sta. 534, Off Mergui Archipelago ;
12°59'N 96°48'30'E ; 60 fms (110 m) ;

Bottom-coarse sand ; *R.I.M.S. "Investigator"* ;
17.iv.1913 ; One specimen.

Sta. 535, Off Mergui Archipelago ;
13°04'30"N 96°44'E ; 65 fms (119 m) ;



Figs. 1-2 : *Ophiomusium simplex* Lyman Sta. 535.
1. Dorsal view, 2. Ventral view. Scale 2 mm.

Bottom-sand mud ; *R.I.M.S. "Investigator"* ;
17.iv.1913 ; One specimen.

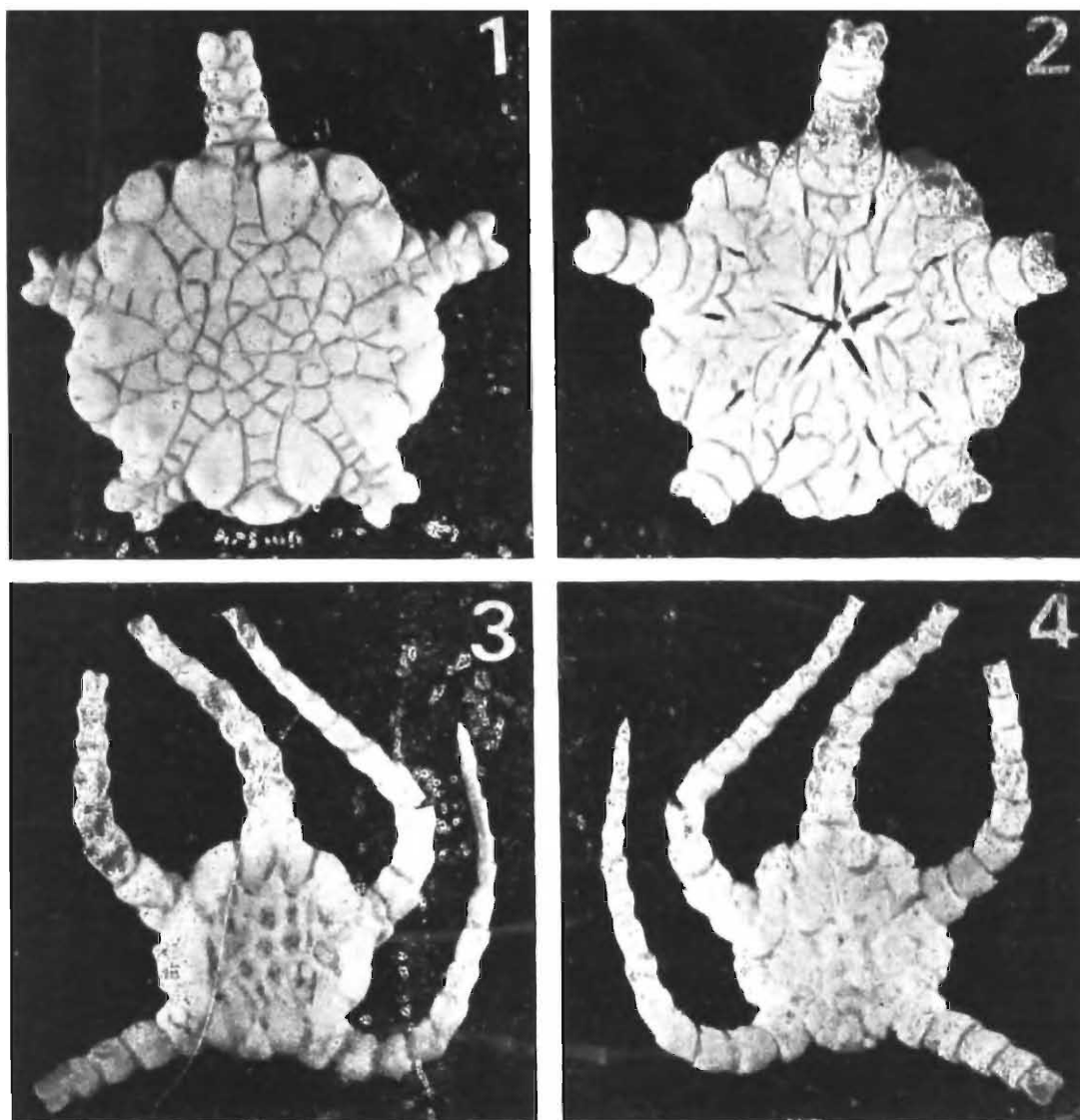
Description : The specimens range from 4 to 15 mm in disc diameter (d.d.) and have polygonal dorsal and ventral disc plates ; radial shields 1.43-1.60 times longer than their breadth and 0.23-0.25 of d.d. ; jaws with 4-6 lateral and one terminal oral papillae ; three ventral arm plates ; two pairs of small tentacle pores each with a

small rounded tentacle scale and genital slits 0.3-0.8 mm long, about as long as the second ventral arm plates or slightly longer. Proximally there are two short blunt spines set low on the lateral arm plates and one somewhat longer spine on distal segments.

Remarks : The smallest specimen measuring 4.0 mm d.d. from sta. 535 has arms about twice as long as d.d. with about 15 free segments and agrees with the description and figures of the holotype (Lyman, 1878) in having fewer dorsal disc plates, radial shields in a pair narrowly touching and only a central and two marginal plates in each ventral interbrachium. The radial shields and the dorsal and ventral marginal plates are, however, slightly swollen, though not distinctly, and a few smaller triangular plates separate the primary disc plates (Pl. IX, figs. 3, 4 ; Figs. 1, 2).

The two specimens from sta. 238 (d.d. 10.8 and 15 mm) and the one from sta. 534 (d.d. 12.7 mm) have 0-6 free segments of the different arms intact and agree with the figures given by Koehler (1904, 1922) in having swollen and well separated radial shields, swollen marginal plates and more number of disc plates on the dorsal side (Pl. IX, fig. 1) and on the ventral side a central plate, two swollen marginal plates, and 8-12 plates of which the two distal to the oral shield are larger, separating the oral shield, genital plates and the central plate from one another, in each interbrachium (Pl. IX, fig. 2). In the specimen from sta. 534 there are 1-3 very small ventral arm plates beyond the segment and three spines on one side of the fifth free segment of an arm.

Lyman (1878) mentioned the colour of of the holotype as white (probably decolour-



Figs. 1-4. *Ophiomusium simplex* Lyman 1. Specimen from Sta. 238, d. d. 15 mm, dorsal view, 2. Same, ventral view ; 3. Specimen from Sta. 535, d. d. 4mm, dorsal view ; 4. Same. ventral view.

raised) as is also of the present specimens. However, the colour of the specimen from sta. 534 was noted on the label as 'bright orange-scarlet'. Koehler (1904, 1922, 1930), Clark (1911) Murakami (1963) and Guille (1980) did not mention the colour of their specimens.

Koehler (1904) described *O. sanctum* based on two specimens of 10 and 19 mm d.d. differing from the small holotype of 6 mm d.d. of *O. simplex* Lyman, in having more dorsal and ventral disc plates; much swollen radial shields and marginal disc plates; two large plates distal to the oral shields and three arm spines. Later, Clark (1911) finding all intermediate forms between the two nominal species among specimens ranging from 4 to 14 mm d.d. relegated *O. sanctum* Koehler to the synonymy of *O. simplex* Lyman, which act was subsequently endorsed by Koehler himself (1922, 1930). The present specimens from the Bay of Bengal are also in conformity with the observations of Clark (1911).

Recently, Baker (1979) raised *O. simplex* var. *australe* Clark (1928, p. 449, fig. 135) to species level with *O. aporum* Clark (1928, p. 447, fig. 134 only the holotype) as its synonym. *O. australe* differs from *O. simplex* in having longer arms (3-4 d.d. as against 2-2.5 d.d. in *O. simplex*); rounded disc plates (cf. polygonal in *O. simplex*); fewer plates in the ventral interbrachium; two overlapping tumid plates at the interradian margin of disc in addition to one dorsal and two ventral plates-prominently visible from above and below, and the radial shields and marginal plates less prominently swollen even at 14 mm d.d. Further, *O. australe* has so far been known off the southern and western

coast of Australia south of 25°S latitude while *O. simplex* is known between 10°S and 33°N latitudes in the Indo-West Pacific.

Distribution : The single holotype of *Ophiomusium simplex* [B. M. (N. H.) 82.12.23.443] was collected off Amboina in 183 m depth (100 fms) by H. M. S. "Challenger" (Lyman, 1878). The species has also been reported from S. Japan (Clark, 1911, Murakami, 1963); Philippines (Guille, 1980); Sulu Sea (Koehler, 1922); Molo straight, Sw Flores; Timor (Koehler, 1904) and Kei Is (Koehler, 1930) mainly from sandy bottom in depths ranging from 54 to 300 m. According to Guille (1980) the south Australian record by H. L. Clark (1946) is doubtful. The species is here reported for the first time off the coasts of India (Andamans) and Burma (Mergui Archipelago) in the Bay of Bengal.

ACKNOWLEDGEMENTS

The author is grateful to the Director, Zoological Survey of India, Calcutta, for facilities and Dr. A. N. Baker, Assistant Director, National Museum of New Zealand, Wellington, for reviewing the manuscript.

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NEW MAMMAL RECORDS FROM WEST BENGAL

By

V. C. AGRAWAL AND T. P. BHATTACHARYA

Zoological Survey of India, Calcutta

During the faunistic survey of Bankura and Purulia districts of West Bengal, 20 species of mammals were collected. Out of these, four species, namely, *Funambulus palmarum* (Linnaeus), *Rattus blanfordi* (Thomas), *Mus dunni* (Wroughton) and *Mus saxicola* Elliot were found to be unrecorded from this State (*vide* Blanford, 1891 ; Wroughton, 1919 ; Ellerman and Morrison-Scott, 1951 ; Ellerman, 1961 ; and Marshall, 1977). Hence, they are reported hereunder.

All measurements are in millimetre and are taken after Ellerman (1961). The mean values are given in parentheses. The external measurements have been taken of freshly killed specimens in the field and the skull measurements in the laboratory.

The authors are thankful to the Director, Zoological Survey of India, for providing necessary facilities, and to Dr. B. Biswas, Emeritus Scientist, for going through the manuscript.

SYSTEMATIC ACCOUNT

Order RODENTIA

Family SCIURIDAE

Funambulus palmarum (Linnaeus)

Material : 1 ♀ : Matha, Purulia dist., 15 Jan 1985 ; 1 ♀ : Ajodhya Hills, Purulia dist., 17 Jan 1985. Coll. V. C. Agrawal.

Measurements : External : 2 ♀ : Head and body 146, 151 ; tail 126, 131 ; hindfoot 37, 38 ; ear 15, 17.

Cranial : 1 ♀ : Occipitonasal 38.4 ; condylobasal 35.5 ; nasal 11.5 ; palate 19.6 ; upper toothrow 6.9 ; bulla 7.2 ; zygomatic width 21.3 ; interorbital width 10.7 ; diastema 9.5.

Distribution : The known range of distribution of this species is peninsular India extending north to Madhya Pradesh and Bihar, and Sri Lanka. The present collection, therefore, constitutes its first record from West Bengal.

Remarks : Dorsal pelage of one specimen is light maroon which appears to be a case of partial albinism.

Family MURIDAE

Rattus blanfordi (Thomas)

Material : 5 ♂ : Matha, Purulia dist., 15-16 Jan 1985 ; 1 ♂, 4 ♀ : Ajodhya Hills, Purulia dist., 17-19 Jan 1985. Coll. V. C. Agrawal.

Measurements : External : 6 ♂, 4 ♀ : Head and body 151-182 (163.9) ; tail 185-202 (195.8) ; hindfoot 32-36.5 (33.7) ; ear 25-27 (25.9). Cranial : 6 ♂, 4 ♀ : Occipitonasal 40.6-43.9 (41.8) ; condylobasal 36.7-39.6

(37.7); nasal 15-17.2 (15.9); palate 19.8-21.6 (20.6); upper toothrow 6-7 (6.5); bulla 7.9-8.4 (8.1); anterior palatal foramina 7.8-9.5 (8.5); zygomatic width 18.4-19.9 (19.3); interorbital width 6.1-6.5 (6.2); diastema 10.3-11.4 (10.7); mandible 20-22.1 (20.7).

Distribution: The known range of this species in India is the southern India extending north to Madhya Pradesh and Bihar. Hence, the present collection is its first record from West Bengal.

Mus dunni (Wroughton)

Material: 1 ♀ : Susunia, Bankura dist., 7 Jan. 1985. Coll. V. C. Agrawal.

Measurements: External : 1 ♀ : Head and body 75 ; tail 55 ; hindfoot 14.5 ; ear 12.

Cranial: 1 ♀ : Occipitonasal 19.5 ; condylobasal 19.2 ; nasal 7.0 ; palate 10.4 ; upper toothrow 3.2 ; bulla 3.1 ; anterior palatal foramina 4.5 ; zygomatic width 9.9 ; interorbital width 3.2 ; diastema 5.3 ; mandible 11.2.

Distribution: This species has so far been reported from Haryana, Uttar Pradesh, Madhya Pradesh, Maharashtra and Tamil Nadu. The present collection from West Bengal extends its range much eastwards.

Mus saxicola Elliot

Material: 4 ♂, 1 ♀ : Susunia Hills, Bankura dist., 6-8 Jan 1985 ; 2 ♂, 2 ♀ : Raniband, Bankura dist., 11-13 Jan 1985 ; 1 ♂, 1 ♀ : Kuilapal, Purulia dist., 22 Jan 1985. Coll. V. C. Agrawal.

Measurements: External : 7 ♂, 5 ♀ : Head and body 80-99 (87.3) ; tail 63-74 (69.7) ; hindfoot 17-19 (18.1) ; ear 15.5-17 (16.2). Cranial : 7 ♂, 5 ♀ : Occipitonasal

23-27 (24.7) ; condylobasal 22.2-26.3 (23.8) ; nasal 9.2-11.8 (10.2) ; palate 12.5-14.4 (13.3) ; upper toothrow 4.1-4.7 (4.4) ; bulla 3.6-4.3 (3.9) ; anterior palatal foramina 5.2-6.7 (5.7) ; zygomatic width 11.1-13.1 (11.9) ; interorbital width 3.7-4.2 (3.9) ; diastema 6.4-8.1 (6.9) ; mandible 12.6-14.9 (13.5).

Distribution: *Mus saxicola* has so far been reported from Himachal Pradesh, Uttar Pradesh, Gujarat, Maharashtra, Karnataka, Tamil Nadu and Bihar in India and also from Nepal and Pakistan. Hence, the present record of this species from West Bengal not only constitutes its first report from that State but also shows that it occurs almost throughout India.

Remarks: The colour of specimens varies from slaty to dark brown and the fur is soft.

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ON SOME ASILIDAE (DIPTERA) PRESENT IN THE
B. P. BISHOP MUSEUM, HONOLULU I

A. N. T. JOSEPH

Marine Biological Station, Zoological Survey of India, Madras

AND

P. PARUI

Zoological Survey of India, New Alipur, Block-M, Calcutta

ABSTRACT

The paper deals with twenty-six species of fifteen genera of Asilidae from India and Nepal. Out of these, seven are new species, i. e., *Maira bicolor* sp. nov., *Microstylum coimbatorensis* sp. nov., *Xenomyza pseudoartigasi* sp. nov., *Ommatius bengalensis* sp. nov., *Neoitamus sedlaceki* sp. nov., *Neomochtherus himalayensis* sp. nov., and *Promachus genitalis* sp. nov. and in one species i. e., *Xenomyza dravidica* Joseph and Parui, the females are reported for the first time.

INTRODUCTION

Through the courtesy of Dr. Neal I. Evenhuis, Associate Entomologist, B. P. Bishop Museum, Honolulu, Hawaii 96819, we have received a small, but interesting, collection of robberflies from India and Nepal, and the result of the study is dealt within this paper.

Types are deposited in the B. P. Bishop Museum, Honolulu and the Zoological Survey of India, Calcutta.

Laphria Meigen

Laphria Meigen, 1803, *Magazin insektenkde*, 2 : 270.

1. *Laphria indica* Joseph and Parui

Laphria indica Joseph and Parui, 1981, *Ent. Scand.*, 12 (2) : 216.

Material examined : 2 ♂♂, India, Tamil Nadu, Anamalai Hills, Cinchona, 1050 m., i. 1967, Coll. P. S. Nathan.

Remarks : This is the second record of the species from type locality.

Maira Schiner

Maira Schiner, 1866, *Verh. Zool. bot. Ges. Wien*, 16 : 673.

2. *Maira bicolor* sp. nov.

(Fig. 1)

A small, black and yellowish-brown species with bicoloured abdomen and legs and infuscated wings. Male : length 10 mm, wing 9 mm.

Male : *Head* broader than thorax, black,

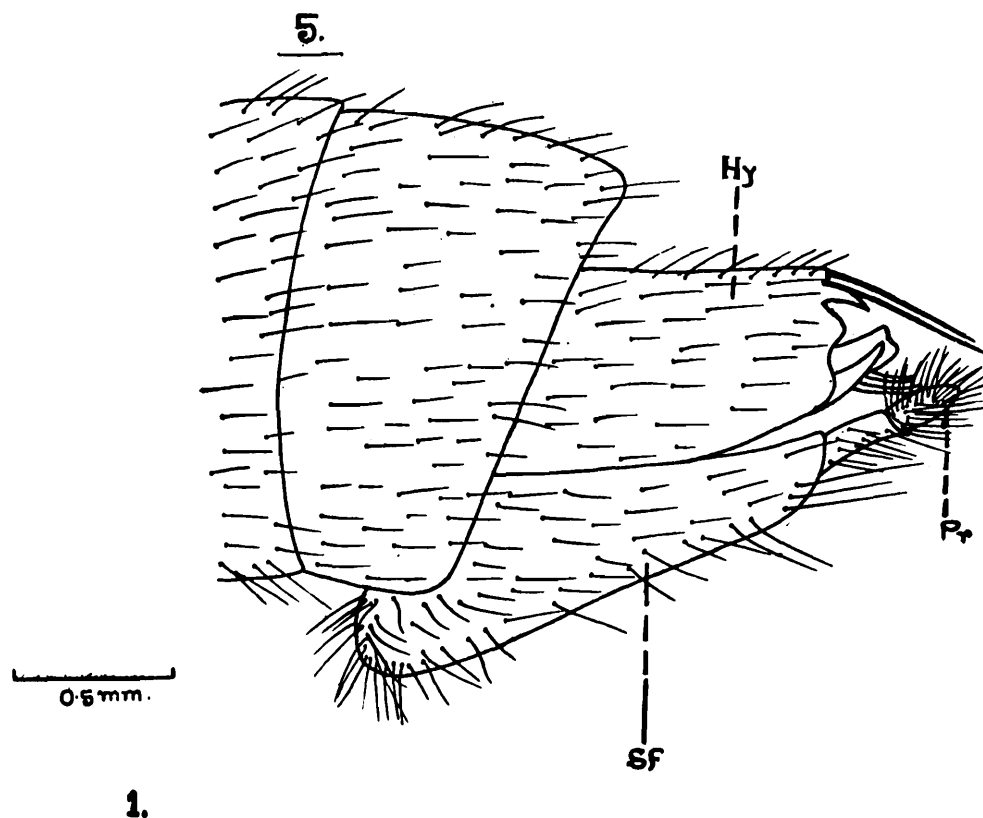


Fig. 1. *Maira bicolor* sp. nov., lateral view of male genitalia.

tomentum grey and greyish-yellow, mystax with long black and short golden yellow bristles ; fronto-orbital hairs golden yellow below and black above, ocellar hairs black ; postcranium above devoid of tomentum, below tomentose, above and sides with black hairs, postgena with pale yellow hairs. Antennae black, basal two segments with black hairs, segment 1 about thrice the length of 2, segment 3 about twice the combined length of segments 1 and 2. Palpi and proboscis black with pale yellow hairs.

Thorax shining black ; pronotum black haired ; mesonotum without mediolongitudinal stripe, vestiture very small, pale yellow ; sentellum with the disc bearing very small pale yellow hairs, hind border with a pair of black bristles ; metapleuron with a bunch of black bristles, pleura grey tomentose. Halteres yellowish-brown.

Legs black and yellowish-brown ; coxa and trochanter black, with its tip yellowish-brown, tibia and tarsus yellowish-brown but hind tibia distally dark brown, hind femur with a pair of short, spiny bristles anteroventrally on the distal side, vestiture pale yellow with some black hairs also, tibia on apex ventrally as well as tarsal segments ventrally with thick golden yellow hairs.

Wings infuscated, but lighter basally ; discal cell in one wing with a supernumerary cross-vein.

Abdomen yellowish-brown and shining black, segment 1 shining black, segment 2 yellowish-brown with a black mark on tergum, segments 3 and 4 yellowish-brown, 5 yellowish-brown and black, vestiture golden yellow, a few hairs laterally on segment 1 form bristles. Male genitalia (Fig. 1) shining black with black hairs.

It differs from all the other known Indian species of *Maira* by the yellowish-brown and black abdomen. In male genitalia it resembles to *M. hispidella* Wulp from Java from which it can be separated by the structural details of hypandrium.

Holotype ♂, India, Sukna, 55 km. S. of Darjeeling, v, 1966, Coll. J and M. Sedlaeck, B.M. Reg. No. 13104.

Microstylum Macquart

Microstylum Macquart, 1838, *Dipt. exot.*, 1 (2) : 26.

3. *Microstylum coimbatorensis* sp. nov. (Fig. 2)

A rather small, black species with heavily infuscated grey abdomen, almost wholly black legs and anteriorly brownish wings. Male : length 18 mm., wing 11 mm.

Male : *Head* broader than thorax, black, infuscated with grey tomentum ; mystax with a transverse row of apical black bristles ; fronto-orbital bristles and ocellar bristles black ; postcranium on sides densely grey tomentose and medially bare, postocular

bristles black, postgena with dense white to pale yellow hairs. Antennae lost from segment 3 onwards, segments 1 and 2 nearly equal in length, their hairs black with one or more ventrolaterally elongate. Palpi and proboscis black, the former bearing black hairs.

Thorax black infuscated with grey tomentum ; pronotum medially pale yellow haired and laterally black haired ; mesonotum sparsely grey tomentose medially and densely grey tomentose laterally, mediolongitudinal stripe absent, hairs and bristles black with a few white hairs on humeri ; scutellum sparsely grey tomentose, hind border bearing a pair of black bristles, metanotal slopes with a bunch of white hairs ; pleura densely grey tomentose. Halteres pale yellow to hyaline.

Legs black but tibia and tarsus comparatively lighter coloured ; vestiture predominantly white with some black hairs also, bristles mostly black with some pale yellow ones.

Wings brownish anteriorly and hyaline posteriorly.

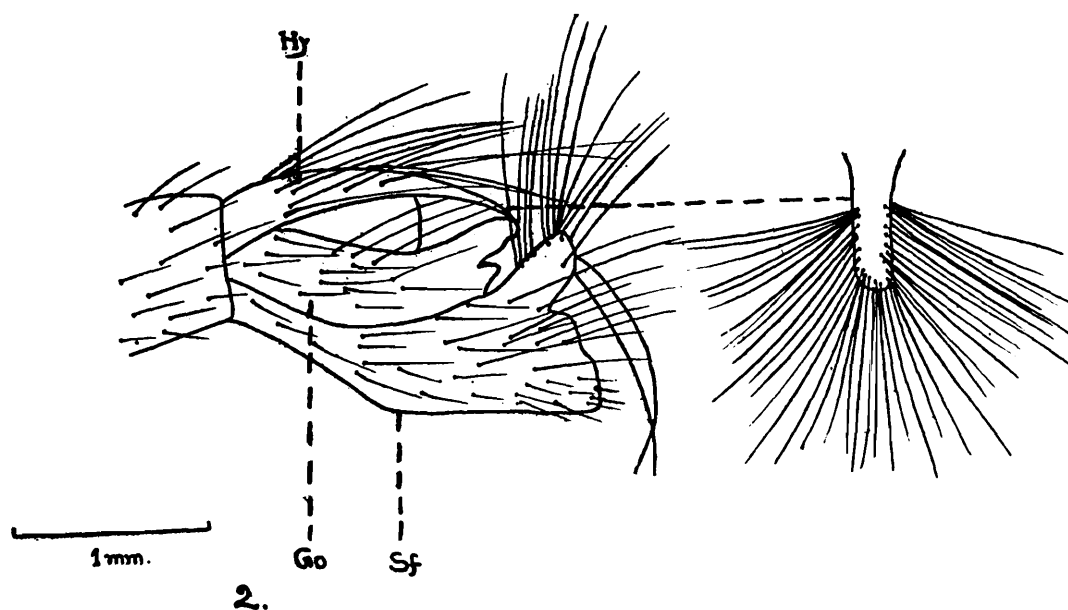


Fig. 2. *Microstylum coimbatorensis* sp. nov., lateral view of male genitalia.

Abdomen black with the tergites of segments 3-5 wholly and 6 distally densely grey tomentose, segments 1-3 with bunches of white hairs, vestiture white and black. Male genitalia (Fig. 2) black with black and a few white hairs on the apex of superior forceps, apex of hypandrium bearing a bunch of white hairs.

Of the various known regional species, *Microstylum coimbatorensis* sp. nov. is similar to *M. varshneyi* Joseph and Parui differing from which in the greyish infuscated abdomen, almost uniformly black legs, in the shape of hypandrium as well as its hairs being white, and in the shape of superior forceps.

Holotype ♂, South India, Madras State (Tamil Nadu), Coimbatore, 420 m., iv. 1960, Coll. P. S. Nathan, B. M. Reg. No. 13105.

4. *Microstylum ananthakrishnani* Joseph and Parui

Microstylum ananthakrishnani Joseph and Parui, 1984, *Ent. Scand.*, 15 : 449.

Material examined : 1 ♀, India, Kerala, Calicut District, Chembra Peak Area, 1067 m., v. 1970, Coll. P. S. Nathan.

Remarks : This species was described from Kerala and it is the second report.

5. *Microstylum varshneyi* Joseph and Parui

Microstylum varshneyi Joseph and Parui, 1984, *Ent. Scand.*, 15 : 452.

Material examined : 1 ♂, India, Tamil Nadu, Coimbatore, 420 m., iv. 1960, Coll. P. S. Nathan ; 1 ♂, ix. 1964, other data as in preceding.

Remarks : It is the second record of the species and from the type locality.

Stenopogon Loew

Stenopogon Loew, 1847, *Linn. Ent.* 2 : 453.

6. *Stenopogon hulli* Joseph and Parui

Stenopogon hulli Joseph and Parui, 1981, *Oriental Ins.*, 15 (1) : 27-28.

Material examined : 1 ♂, India, Kerala, Trivandrum District, Poonmudi Range, 900 m., iv-v. 1971, Coll. P. S. Nathan.

Remarks : So far the species is recorded from type locality only.

7. *Stenopogon manii* Joseph and Parui

Stenopogon manii Joseph and Parui, 1981, *Oriental Ins.*, 15 (1) : 106-107.

Material examined : 1 ♂, 5 ♀♀, Tamil Nadu, Anamalai Hills, Cinchona, 1050 m., iv. 1956, Coll. P. S. Nathan.

Remarks : This is the second record of the species from the type locality.

Trigonomima Enderlein

Trigonomima Enderlein, 1914, *Wein. ent. ztg.*, 33 : 164.

8. *Trigonomima anamaliensis* Joseph and Parui

Trigonomima anamaliensis Joseph and Parui, 1980, *Bull. zool. Surv. India*, 2 (2 & 3) : 197.

Material examined : 5 ♀♀, India, Tamil Nadu, Nilgiri Hills, Devala, 960 m., v. 1964, Coll. P. S. Nathan.

Remarks : This is the second record of the species.

Xenomyza Wiedemann

Xenomyza Wiedemann, 1817, *Zool. Mag. (Wied.)* 1 : 60.

9. *Xenomyza pseudoartigasi* sp. nov. (Fig. 3)

A black species with black thorax and abdomen, infuscated wings and black tinged hind femora. Male : length 9-10 m., wing 10 mm. ; female : length 10 mm., wing 11 mm.

Male : *Head* broader than thorax, black, grey tomentose, mystax a transverse row of black bristles ; fronto-orbital plate bare, ocellar bristles black ; postcranium greyish tomentose, postgena pale yellow hairs.

black marking, hind femur apically black and with a median black mark more or less forming a ring, tibiae yellowish-brown with black apex, tarsal segments basally yellowish-brown and apically black, the latter increasing

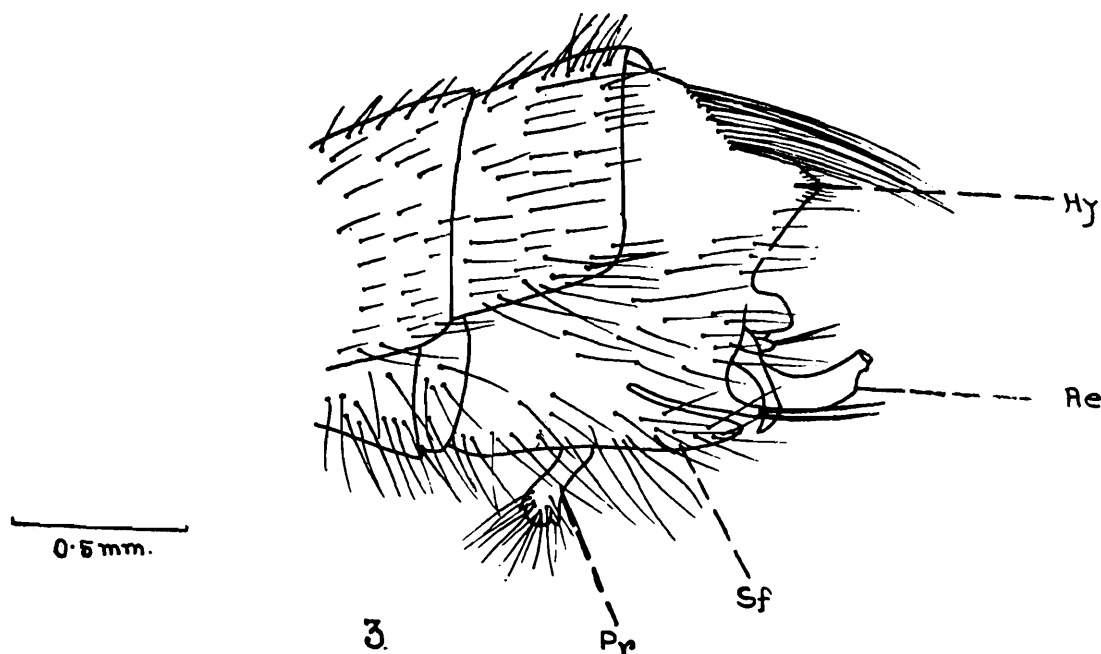


Fig. 3. *Xenomyza pseudoartigasi* sp. nov., lateral view of male genitalia.

Antennae black with the distal half of arista pale yellow, segment 1 small, shorter than half of 2 and ventrally bearing a long, black bristle, segment 2 globular. Palpi and proboscis black, their hairs pale yellow but for a few apical black ones on palpi.

Thorax black, infuscated with grey and greyish-yellow tomentum ; pronotum bearing white hairs laterally ; mesonotum black, sides grey tomentose, hairs mostly white with some pale yellow ones also, more or less confined to the sides ; scutellum greyish tomentose, nearly bare ; pleura greyish-yellow tomentose. Halteres brown with the stalks comparatively lighter.

Legs yellowish-brown and black to dark brown, coxa and trochanter black, mid and hind femora yellowish-brown with apical

in distal segments so much so the last segments almost wholly black ; hind leg enlarged, trochanter swollen anteroventrally which bears dense short black bristles, femur thickened with its distal half bearing an anteroventral and posteroventral row of black spiny bristles, vestiture black with some pale yellow hairs also.

Wings fuscous but gradually become lighter coloured posteriorly.

Abdomen black, sides of segments 1 and 2 with white hairs, vestiture white. Male genitalia (Fig. 3) black with some yellowish-brown marking, hypandrium with some long hairs, its lower angle bearing a pair of long bristles, near the middle with an obtuse projection, and below with a projection bearing two black bristles ; superior forceps narrow.

Female : Similar but the median black ring on hind femur faint.

It is allied to *Xenomyza artigasi* Joseph and Parui from which it differs in the comparatively narrow and black abdomen, narrow superior forceps and in the presence of an additional projection on the posterior margin of hypandrium.

Holotype ♂, India, Madras State (Tamil Nadu), Anamalai Hills, Cinchona, 1050 m., ix.1967, Coll. P. S. Nathan, B. M. Reg. No. 13100.

Paratypes : 1 ♂, data same as in holotype, ZSI Reg. No. 7233/H6 ; 1 ♀, xii. 1969, B. M. Reg. No. 13101, rest of details as in holotype.

10. *Xenomyza dravidica* Joseph and Parui

Xenomyza dravidica Joseph and Parui, 1984, *Ent. Scand.*, 15 : 444.

Material examined : 1 ♀, India, Tamil Nadu, Anamalai Hills, Cinchona, 1050 m., i. 1967 ; 1 ♀, Kerala, Trivandrum District, Poonmudi Range, 900 m., iv-v. 1971 ; 1 ♂, Tamil Nadu, Coimbatore, 420 m., iii-iv.1971, all collected by P. S. Nathan.

Remarks : It was described only on males ; this is the first report of females of this species.

11. *Xenomyza rufoabdominalis* Joseph and Parui

Xenomyza rufoabdominalis Joseph and Parui, 1984, *Ent. Scand.* 15 : 445.

Material examined : 2 ♂ ♂, India, Tamil Nadu, Coimbatore, 420 m., ii-iv. 1971, Coll. P. S. Nathan.

Remarks : This is the second record of the species and for the first time from Tamil Nadu.

Michotamia Macquart

Michotamia Macquart, 1838, *Dipt. Exot.*, 1 (2) : 72.

12. *Michotamia aurata* (Fabricius)

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

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

Material examined : 1 ♂, South India, Pondicherry, Karikal, x. 1968, Coll. P. S. Nathan.

Remarks : Although this species is very common and widely distributed in India, it is the first record from Pondicherry.

Ommatius Wiedemann

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

13. *Ommatius bengalensis* sp. nov.

(Fig. 4)

A small black species with black and yellowish-brown legs, brownish tinged wings and clavate abdomen. Male : length 9 mm., wing 7 mm.

Male : *Head* black, grey tomentose ; mystax wholly white ; fronto-orbital hairs pale yellow, ocellar bristles black ; postcranium sparsely grey tomentose, bare above, postocular bristles black, postgena white haired. Antennae broken off from segment 3 onwards, segment 1 black, 2 lighter coloured, segment 2 with brown bristles, shorter than 1. Palpi and proboscis dark brown, hairs dark brown on the former and white on the latter.

Thorax black with grey and greyish-yellow tomentum ; pronotal hairs sparse, grey ; mesotergum with the mediolongitudinal stripe faintly marked and extending from the anterior end to well beyond the transverse suture, devoid of the narrow dividing line,

laterally and posterior border greyish-yellow tomentose, bristles black; pleuron grey tomentose; scutellum grey tomentose, hind border with a pair of yellowish-brown bristles;

similar to *O. pseudodraavidicus* Joseph and Parui differing from which in the wholly white mystax and differences in the shape of superior forceps and hypandrium.

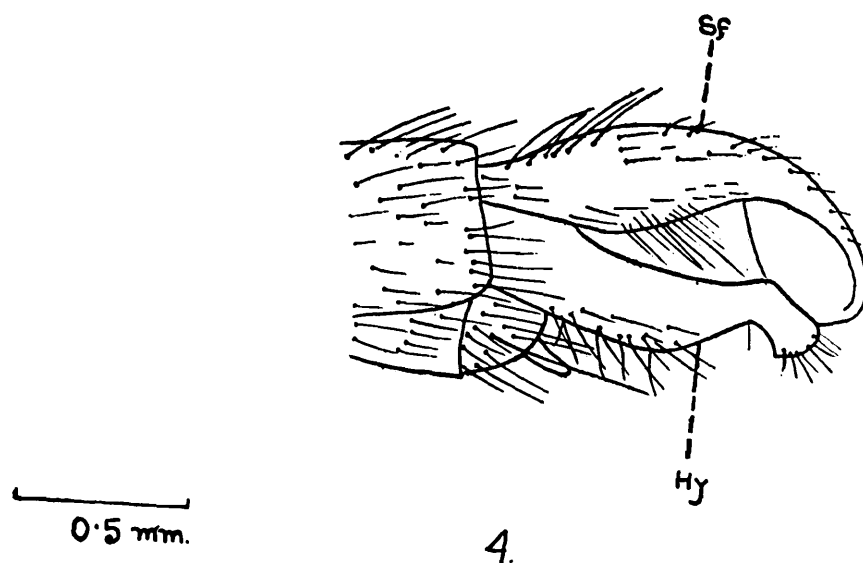


Fig. 4. *Ommatius bengalensis* sp. nov., lateral view of male genitalia.

metapleuron with pale yellow bristles. Halteres yellowish-brown, stalks lighter.

Legs black and yellowish-brown; coxa, trochanter and femur black, tibia yellowish-brown, hind tibia apically darkened, tarsal segment 1 yellowish-brown, in hind legs apically darkened, remaining segments dark brown; vestiture pale yellow, also with some black hairs, bristles black and pale yellow, hind femur with anteroventral and posteroventral rows of pale yellow bristles.

Wings brownish tinged with the base hyaline.

Abdomen black with the hind border of tergites 2-5 narrowly yellowish grey, tergite 1 on sides with a bunch of pale yellow hairs, vestiture pale yellow and black. Male genitalia (Fig. 4) yellowishbrown and dark brown with pale yellow hairs.

Ommatius bengalensis sp. nov. is generally

Holotype ♂, India, Sukna, 55 km. S. of Darjeeling, v. 1966, Coll. J. and M. Sedlacek, B.M. Reg. No. 13099.

14. *Ommatius tuberculatus* Joseph and Parui
Ommatius tuberculatus Joseph and Parui, 1983, *Ent. Scand.*, 14 : 87.

Material examined : 1 ♂, 2 ♀ ♀, India, Tamil Nadu, Anamalai Hills, Cinchona, 1050 m., i. 1967, Coll. P. S. Nathan; 1 ♂, iv. 1968, other details as in preceding.

Remarks : Recorded for the second time.

Astochia Becker

Astochia Becker, 1913, *Ann. Mus. Zool. Acad. St. Petersburg*, 17 : 538.

15. *Astochia tiwarii* Joseph and Parui
Astochia tiwarii Joseph and Parui, 1981, *Oriental Ins.*, 15 (1) : 18.

Material examined : 2 ♂ ♂, 1 ♀, India,

Tamil Nadu, Coimbatore, 420 m., iv. 1960, Coll. P. S. Nathan.

Remarks ; The species was described from Coimbatore and it is the second record.

Clephydroneura Becker

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

16. *Clephydroneura mudigorensis* Joseph and Parui

Clephydroneura mudigorensis Joseph and Parui, 1984, *Rec. Zool. Surv. India*, Occ. paper No. 66 : 14.

Materials examined : 1 ♂, South India, Pondicherry, Karikal, ii-iv. 1971, Coll. P.S. Nathan.

Remarks : The species was described from Karnataka. The present report is the first from Pondicherry.

17. *Clephydroneura robusta* Joseph and Parui

Clephydroneura robusta Joseph and Parui, 1984, *Rec. Zool. Surv. India*, Occ. paper No. 66 : 7.

Material examined : 1 ♂, South India, Pondicherry, Karikal, ii-iv. 1971, Coll. P.S. Nathan.

Remarks : It is the second report of the species and for the first time from Pondicherry.

Heligmoneura Bigot

Heligmoneura Bigot, in Thomson 1858, *Arch. ent.*, 2 : 356.

18. *Heligmoneura cheriani* Joseph and Parui

Heligmoneura cheriani Joseph and Parui, 1980, *Ent. Scand.*, 11 (3) : 286.

Material examined : 1 ♂, India, Tamil Nadu, Anamalai Hills, Cinchona, 1050 m., i. 1967, Coll. P.S. Nathan.

Remarks : This is the second record of

the species, which is also from the type locality.

Machimus Loew

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

19. *Machimus angularis* (Ricardo)

Tolmerus angularis Ricardo, 1922, *Ann. Mag. Nat. Hist.*, (9) 10 : 64.

Machimus angularis : Oldroyd, 1975, *A. Catalog of Diptera of the Oriental Region*, 2 : 144.

Material examined : 1 ♂, Nepal, Langtang Val., 60 km. North of Kathmandu, 2700-3400 m., 13-25.x.1965, Coll. L. M. Quate.

Remarks : This species was described from Uttar Pradesh. ZSI has also collection from Arunachal Pradesh and Himachal Pradesh.

20. *Machimus ricardoi* (Bromley)

Asilus ricardoi Bromley, 1935, *Rec. Indian Mus.*, 37 : 219.

Machimus ricardoi : Oldroyd, 1975, *A Catalog of Diptera of the Oriental Region*, 2 : 145.

Material examined : 1 ♂, Nepal, Bokai-hunde, 20 Km. N. of Trisuli (Nawakto), 2100 m., 13-17. xi.1965, Coll. L.W. Quate.

Remarks : From India, this species has so far been reported from Uttar Pradesh, Himachal Pradesh and Sikkim.

21. *Machimus subgenitalis* Bromley

Machimus subgenitalis Bromley, 1935, *Roc. Indian Mus.*, 37 : 221.

Material examined : 1 ♂, India, West Bengal, Darjeeling, Goom, 2100-2400 m., 24.iv.1966, Coll. J. and M. Sedlacek.

Remarks : The species was described from Himachal Pradesh. This is the second record and for the first time from West Bengal.

Neoitamus Osten-Sacken

Neoitamus Osten-Sacken, 1878, *Smithson. Misc. Colls.*, 16 : 82, 235.

22. *Neoitamus sedlaceki* sp. nov.

(Fig. 5)

A medium, black species with black and pale yellow and yellowish-brown legs and

Thorax black with greyish-yellow and grey tomentum ; pronotum pale yellow haired, mesonotum shining black with the mediolongitudinal stripe extending the entire length, the stripe anteriorly divided by a faint grey mediolongitudinal line, laterally greyish-yellow tomentose, vestiture and bristles black ; scutellum with the disc bear-

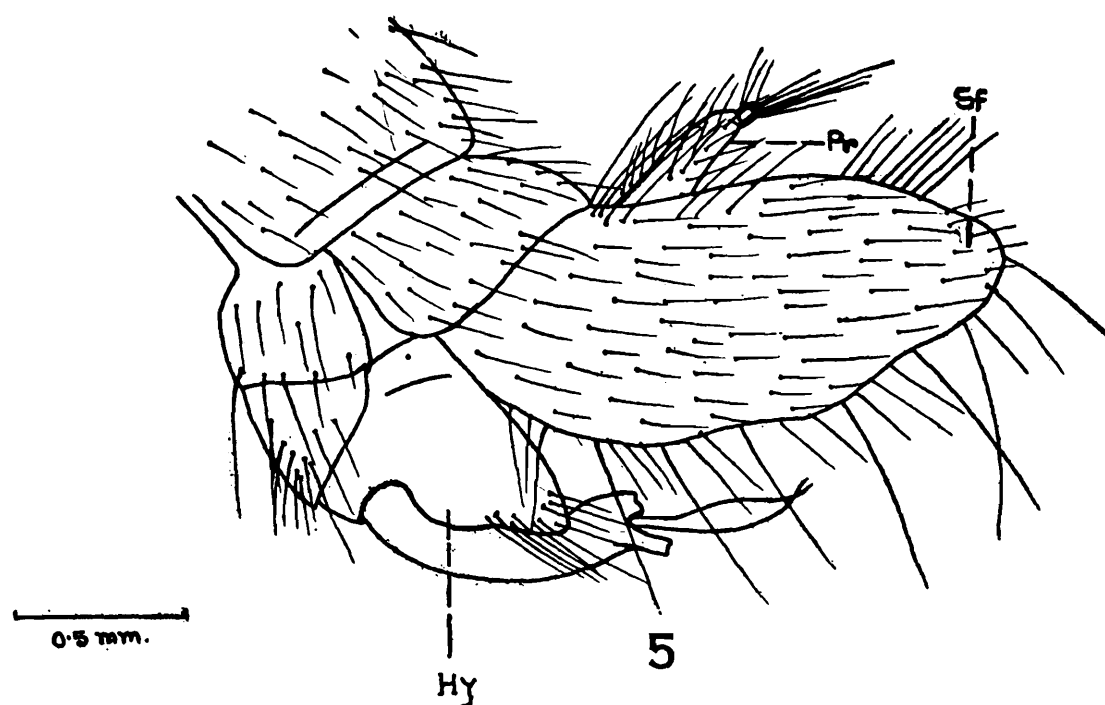


Fig. 5. *Neoitamus sedlaceki* sp. nov., lateral view of male genitalia.

infuscated wings. Male : length 15-16 mm., wing 11-13 mm.

Male : *Head* broader than thorax, black with greyish to grey tomentum ; mystax pale yellow bristles surrounded by black ones, fronto-orbital bristles and ocellar bristles black, postcranium bare above, postocular bristles black, postgena with pale yellow hairs. Antennae black, bristles on segments 1 and 2 black, segment 2 about two-thirds of 1, segment 3 slightly longer than the combined length of 1 and 2. Palpi and proboscis black, the former with black and the latter with apical yellow hairs.

ing sparse black hairs and hind border with a pair of black bristles ; pleura greyish-yellow and grey tomentose. Halteres yellowish-brown.

Legs black and pale yellow to yellowish-brown ; coxa, trochanter and femur black, tibia pale yellow to yellowish-brown with apical blackening, tarsal segment 1 yellowish-brown with blackened apex, remaining segments black, vestiture pale yellow and black, bristles black.

Wings apically infuscated which continues along the posterior border into fifth posterior cell.

Abdomen black, hind border of tergites 1-4 with transverse grey stripe, sides of tergite 1 with a bunch of pale yellow bristles, tergites 2-4 on sides with a pair or more of pale yellow bristles, vestiture predominantly black with a few pale yellow hairs laterally. Male genitalia (Fig 5) black with black hairs, in one example proctiger with pale yellow hairs.

This species is quite similar in colouration to *Neotamus barsilensis* Joseph and Parui and *N. cyanurus* Loew from both of them it can be separated by its distinct male genitalia.

Holotype ♂, Nepal, Kathmandu, 1300-1400 m., 7-12. v.1966, Coll. J. and M. Sedlacek, B.M. Reg. No. 13103.

Paratypes 2 ♂♂, details as in holotype.

Neomochtherus Osten-Sacken

Neomochtherus Osten-Sacken, 1878, *Smithson. Misc. Collns.*, 16 : 82, 235.

23. *Neomochtherus himalayensis* sp. nov.

(Fig. 6)

A small black species with black legs, pale yellow and black mystax and distally infuscated wings. Males : length 12 mm, wing 9 mm.

Male : **Head** broader than thorax, black, grey and greyish-yellow tomentose ; mystax pale yellow below and black above, fronto-orbital bristles and ocellar bristles black, postcranium medially and below grey to greyish-yellow tomentose, laterally black, postocular bristles black, postgena with pale yellow hairs. Antennae black, segment 2 more than half of 1, segment 3 slightly longer than the combined length of segments 1 and 2, style longer than half of segment 3. Palpi and proboscis black with pale yellow hairs.

Thorax black, grey tomentose ; pronotum heavily infuscated with grey tomentum,

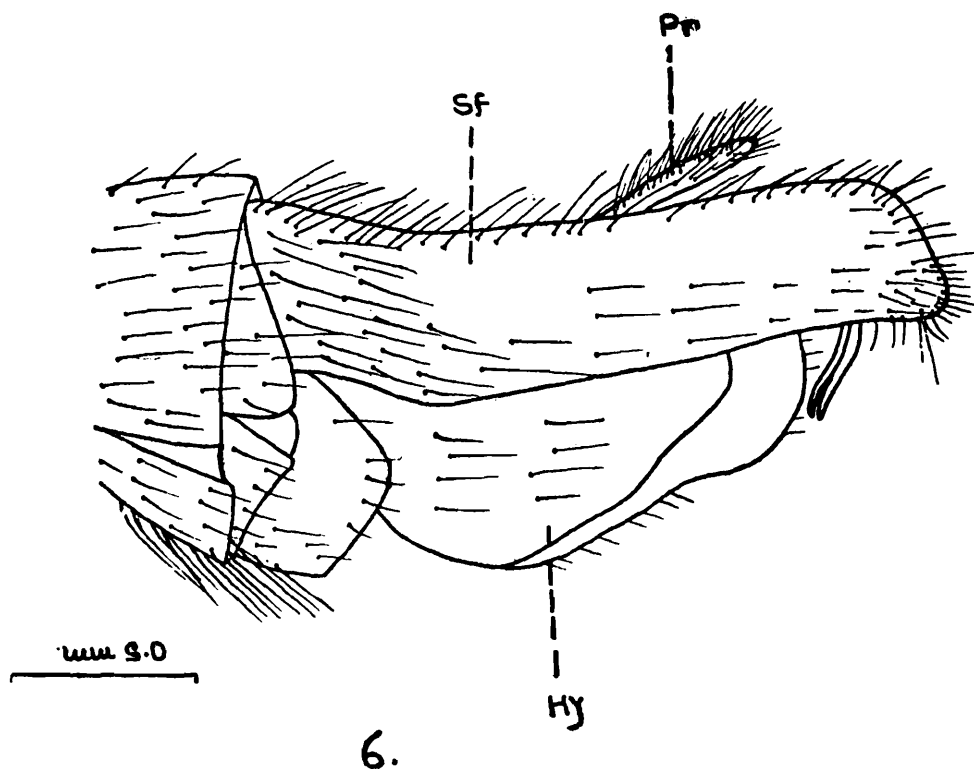


Fig. 6. *Neomochtherus himalayensis* sp. nov., lateral view of male genitalia.

hairs pale yellow, sparse and restricted to sides ; mesonotum with the mediolongitudinal black stripe extending the entire length but the stripe dividing it indistinct, laterally yellowish-grey tomentose ; bristles black anteriorly and golden yellow posteriorly ; scutellum with sparse pale yellow hairs on disc and a pair of golden yellow bristles on border. Halteres yellowish-brown, stalks lighter coloured.

Legs black with the tarsal segments dark brown, fore femur densely haired ventrally, vestiture pale yellow with some black ones also, bristles golden yellow to pale yellow and black.

Wings infuscated anteriorly which extends along the border into axillary cell.

Abdomen black, infuscated with grey or greyish-yellow tomentum which is dense on posterior segments, vestiture pale yellow and black, some hairs laterally on segments 1 and 2 elongate. Male genitalia (Fig. 6) black with black and a few pale yellow hairs, superior forceps entire at apex.

The genus *Neomochtherus* is represented by four species in India, viz., *N. congedus* (Walker), *N. gnavus* (Van der Wulp), *N. indianus* (Ricardo) and *N. trisignatus* (Ricardo), the species described here being quite different and having uniformly black legs and distinct genitalia, the superior forceps being entire at apex.

Holotype ♂, India, N. E. Darjeeling, Tiger Hill, 2250 m., 30.viii.1959, Coll. J. L. Gressitt, B. M. Reg. No. 13106.

Philodicus Loew

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

24. Philodicus javanus (Wiedemann)

Asilus javanus Wiedemann, 1819, *Zool. Mag.*, 1 (13) ; 4.
Philodicus javanus : Oldroyd, 1975, *A Catalog of Diptera of the Oriental Region*, 2 : 149.

Material examined : 1 ♂, South India, Pondicherry, Karikal, viii. 1970, Coll. P. S. Nathan.

Remarks : Though it is a very common species in India, it is the first record from Pondicherry.

Promachus Loew

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

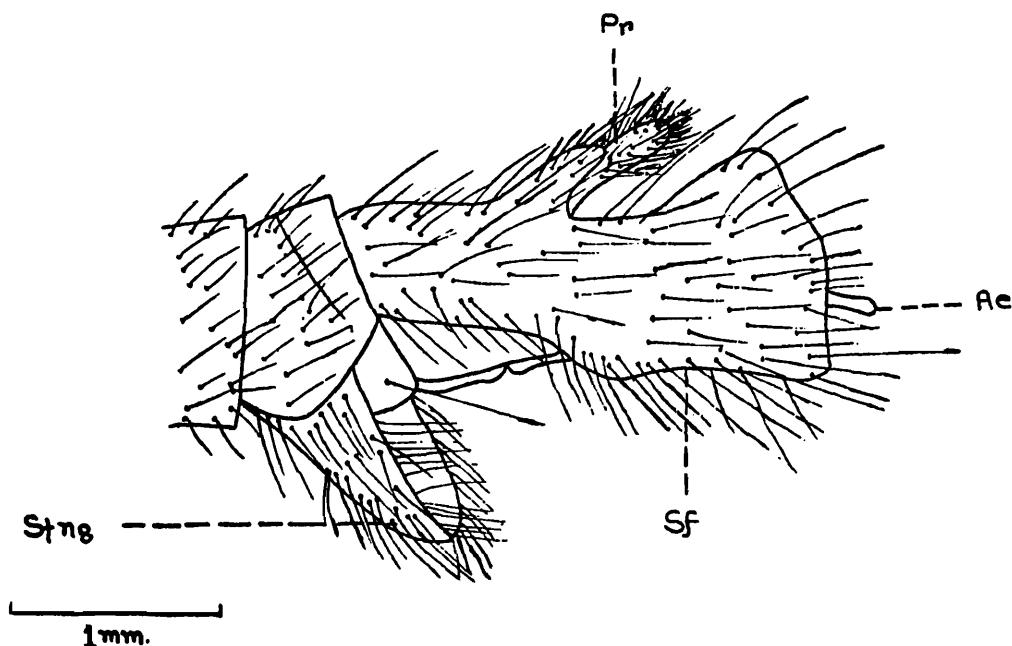
25. Promachus genitalis sp. nov.

(Fig. 7)

A medium black species with black legs infuscated wings, reddish haired abdomen and well developed eighth sternite. Male : length 20mm., wing 13mm. ; female length 18mm., wing 11mm.

Male : *Head* broader than thorax, black, densely grey and greyish-yellow tomentose ; mystax pale yellow with some black bristles above and laterally, fronto-orbital hairs pale yellow and black ; postcranium pale yellow haired, postocular bristles black. Antennae black, segments 1 and 2 bearing black hairs and bristles, segment 2 longer than half of 1, segment 3 subequal to 1, style elongate. Palpi and proboscis black, the former black and pale yellow haired while the latter wholly pale yellow haired.

Thorax black, grey and greyish-yellow tomentose ; pronotum pale yellow haired with a transverse row of black bristles in between ; mesonotum with the mediolongitudinal black stripe divided by a narrow greyish-yellow stripe, the stripe extending from the anterior end to well beyond the



7.

Fig. 7. *Promachus genitalis* sp. nov., lateral view of male genitalia.

transverse suture, on either side with two distinct black spots, vestiture black but some hairs on humeri and posteriorly pale yellow, bristles black; scutellum on the disc yellow haired with four black bristles in between, hind border bearing a pair of black bristles; pleura grey and greyish-yellow tomentose. Halteres with dark brown head and yellowish-brown stalk.

Legs uniformly black, vestiture black with some pale yellow hairs, bristles black.

Wings infuscated, but at base medially hyaline; marginal and first submarginal cells with an obscure streak.

Abdomen black, grey tomentose on sides and hind border of tergites from 2-7, tergites 1-4 and to some extent 5 reddish haired which decrease in density and length from the anterior to the posterior tergites, vestiture black. Male genitalia (Fig. 7) black, eighth sternite well developed, hairs black, devoid of tuft of white hairs.

Female: Similar but with the following

differences: scape with some white hairs laterally in addition to the black ones; mesonotum without mediolongitudinal stripe and lateral spots; scutellum with 6 black and yellow bristles on disc and hind border with 4 pale yellow bristles. Female genitalia shining black with black bristles, cercus broad with yellow hairs.

This species is generally similar to *Promachus duvaucelii* (Macquart) in the presence of tufts of reddish hairs on basal abdominal tergites as well as the obscure streak in the marginal and first submarginal cells of wings, but quite close to *P. jabalpurensis* Joseph and Parui from which it differs in the well produced eighth sternite as well as the tufts of reddish abdominal hairs.

Holotype ♂, Central India (Madhya Pradesh), Jabalpur, 480 m., x. 1957, Coll. P. S. Nathan, B. M. Reg. No. 13102.

Paratype ♀, details as in holotype. ZSI Reg. No. 7234/H6.

26. *Promochus jabalpurensis* Joseph & Parui

Promachus jabalpurensis Joseph and Parui, 1981, *Oriental Ins.*, 15 (1) : 25-26.

Material examined : 1 ♂, India, Madhya Pradesh, Jabalpur, 480 m., x. 1957, Coll. P. S. Nathan.

Remarks : This is the second record and it is also from type locality.

ACKNOWLEDGEMENTS

We are indebted to Dr. Neal L. Evenhuis, Associated Entomologist of B. P. Bishop Museum, Honolulu, Hawaii, for loaning the material for study. Our grateful thanks are also due to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta, and to his colleague Dr. S. K. Bhattacharya, Deputy Director, for their kind encouragements.

Abbreviations : Ae, aedeagus ; Cl, Clasper ; Go, gonopod (gonocoxite) ; Hy, hypandrium ; Pr, proctiger ; Sf, superior forceps (epandrium), Stn₈, eighth sternite.

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CULTURING GYMNAMEBAE FROM SALINE ENVIRONMENTS OF HOOGLY ESTUARY, INDIA.

By

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ABSTRACT

Small free-living gymnamebae of the genus *Acanthamoeba*, isolated from typical intertidal benthic habitat of the coastal belts of Sundarbans, India, may be cultured on saline distilled water agar (SDWA) media with habitat associated food microbiota. Other media include sea-water agar (SWA), cerophyl sea-water agar (CSWA) and soil-extract distilled water agar (SEDWA). Highest high tide isolate from mangrove litter-soil exhibited optimal growth in media with high organic components e. g., CSWA. While isolates from mid-littoral and lowest low tide belts favoured SWA and SDWA media more.

INTRODUCTION

Small naked amoebae are ubiquitous in their distribution and have been seen to be most well adapted to the interstitial milieu due to their plasticity. They are frequent in marine benthic situations (Sawyer, 1980) and make up most of the protozoa in terrestrial litters and soils (Bamforth, 1980 ; Coleman *et al.*, 1978). These amoebae form an essential component of the soil microbial ecosystem. It is worth mentioning that direct microscopic observations for quantitative as well as qualitative study from any definite amount of soil is not feasible with amoebae. Thus to initiate a comprehensive

investigation, be it their abundance in a natural habitat, both in the active or trophic form, or inactive or cystic form ; tolerance to particular physico-chemical parameters including temperature, salinity, pH, etc. ; or food preference study, requires one suitable method of culturing them under standardized laboratory conditions. Most of the reported cultural methodologies are either the original propositions of Singh (1945, 55) or a simplified version thereof (cf : Page, 1976). These include their growth monoxenically on non-nutrient agar media with suitable bacterial food ; either *Escherichia coli* or *Aerobacter aerogenes*. Additionally, Page (cf : Page, 1976) has extensively

used a number of media requiring sea water for culturing isolates from marine or semi-marine environments.

In the present investigation, *Acanthamoeba culbertsoni* (Singh & Das, 1970) strains (designated as strains HH, ML and LL in sequence for highest high tide, mid-littoral & lowest low tide areas respectively) isolated

texture as well as the chemical components of soils from the three different areas are different. The highest high tide belt area is a fair example of typical mangrove litter-soil ecosystem. The mid-littoral belt is characterized by hard loamy-clay and roots of recently deforested 'Mangal'. While the lowest-low tide belt is a sand-silt subsystem. The overall growth on optimal artificial media have been compared with that on three other media involving either the sea water, the soil extracts or specific sea weed extract as essential components.

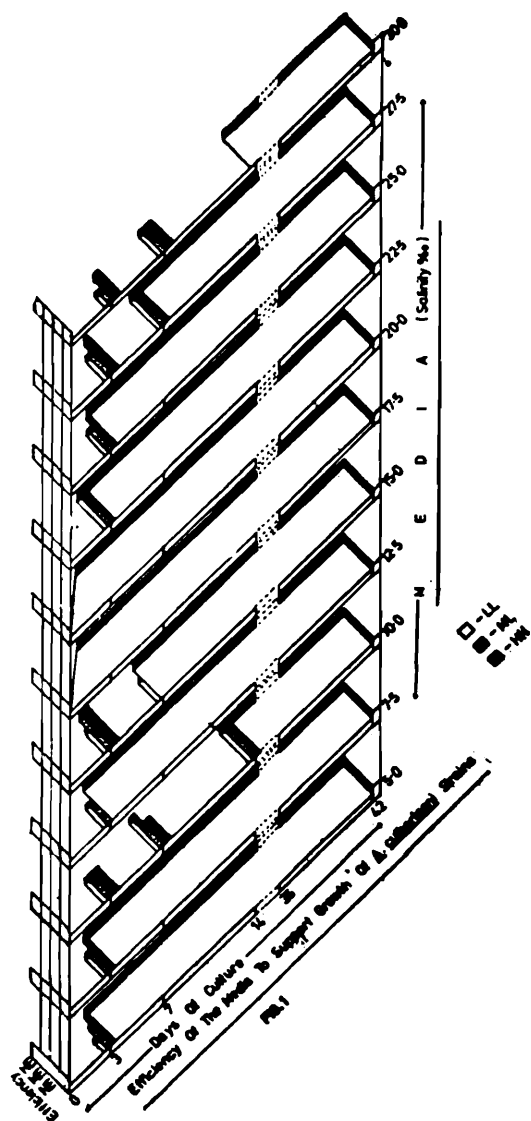
MATERIALS AND METHODS

Sampling : Samples from 2-6 cm depth of different littoral belt areas were collected aseptically. All the samples were transported to the laboratory and processed within 24 hr.

Isolation and identification of the strain :

Samples of all the three regions were inoculated on central microorganismic patch in sea water agar petri-dishes. Establishment of *A. culbertsoni* clones corroborated the observations of Singh and Hanumaiah (1979).

Food source : Associated microorganisms from respective samples were grown on saline adjusted bacterial nutrient agar slopes. It was made as follows : to 1 lit of glass distilled water (pH 6.5) were added 20g NaCl, 20g Bacto agar (Difco Laboratories, U.S.A.), 2.60g Na_2HPO_4 , 2g glucose, and 20g Bacto tryptone (Difco Laboratories, U.S.A.). It was then boiled in water bath, dispensed suitably and autoclaved. A very small quantity of the sample was inoculated aseptically on to the agar slopes and kept overnight at 37°C incubator. Repeated subcultures were made to avoid unwanted



during monsoonal periods (July to October) from the south of Sagar Island (21°3' to 21°50'N and 88°04' to 88°08'E) facing Bay have been cultured in a wide range of saline distilled water agar media. The physical

particles etc. A mixed culture of food micro-biota thus grown were used as food for the maintenance of respective clonal isolates.

The Supporting Media :

- (a) Media of different salinity gradients :
Saline Distilled Water Agar (SDWA)
media :

Each of the 3 sets of experiments require 11 media of different salinity strengths ranging from 5-30‰ (W/V) at 2.5‰ intervals. To each of the 11 containers, 1 lit of glass distilled water was taken and pH was adjusted to 8.3 which was found to be the approximate mean value of monsoonal

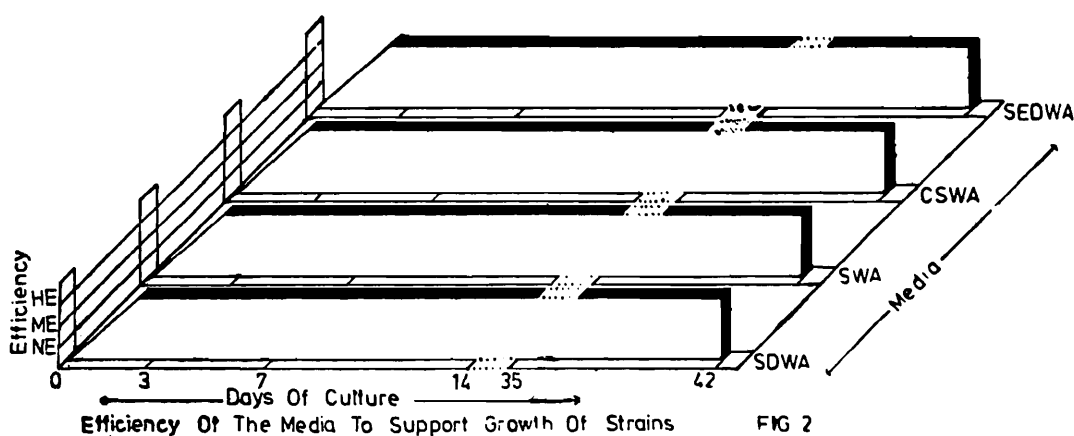
- (c) Cerophyl Sea Water Agar (CSWA)
medium :

Prepared after Page (1970) with minor modifications. 1g of cerophyl (Cerophyl Lab. Inc., U.S.A.) was boiled in 1 lit of filtered water as SWA medium, filtered thrice through glass wool. 15g of agar was then added, boiled and autoclaved. pH was adjusted as before.

- (d) Soil Extract Distilled Water Agar (SEDWA) medium :

Prepared after Singh (1975) with slight modification.

400g of seasonal sand/mud samples were boiled in 1 lit of glass distilled water for



littoral water. NaCl of the quantities 5.0g, 7.5g, 10.0g, 12.5g, 15.0g, 17.5g, 20.0g, 22.5g, 25.0g, 27.5g, and 30.0g were then added separately to each container along with 15.0g Bacto agar. They were boiled, autoclaved and dispensed in sterile 7.5 cm dia petri dishes in 5 replicates for each medium. Media plates were dried for 7 days at room temperature before use.

- (b) Sea Water Agar (SWA) medium :

To a lit of filtered monsoonal bay water 15g of agar was added, boiled and autoclaved. pH was adjusted as before.

30 min, extracts were decanted, filtered and finally made to 1 lit. 15g agar was added to each medium, boiled and autoclaved, pH was adjusted as before.

- Modified Page's Amoeba Saline (PAS) (Page, 1966) :

The chemical ingredients were same except NaCl which was adjusted as per the salinity of the respective fluid base of SDWA medium. To 1 lit of glass distilled water were added the following ingredients in g :

MgSO₄ · 7H₂O, 0.004 ; CaCl₂ · 2H₂O, 0.004 ; Na₂HPO₄, 0.142 ; KH₂PO₄, 0.136.

For other media all the chemicals other than NaCl were added to respective fluid bases. The pH value 8.3 was maintained throughout the experiment.

Experimental methodology :

Microorganisms from young cultures were suspended in as many tubes as sets of experiments containing respective modified sterile

Efficiency of the media of use to support the growth of strains under study was assessed as follows : One medium was considered non-efficient if the mean number of growing organisms of 6 fields of 2 replicate plates lies less than 25 per microscopic field (100x) after desired periods of 3, 7, 14, 28, 35 and 42 days. One moderately efficient

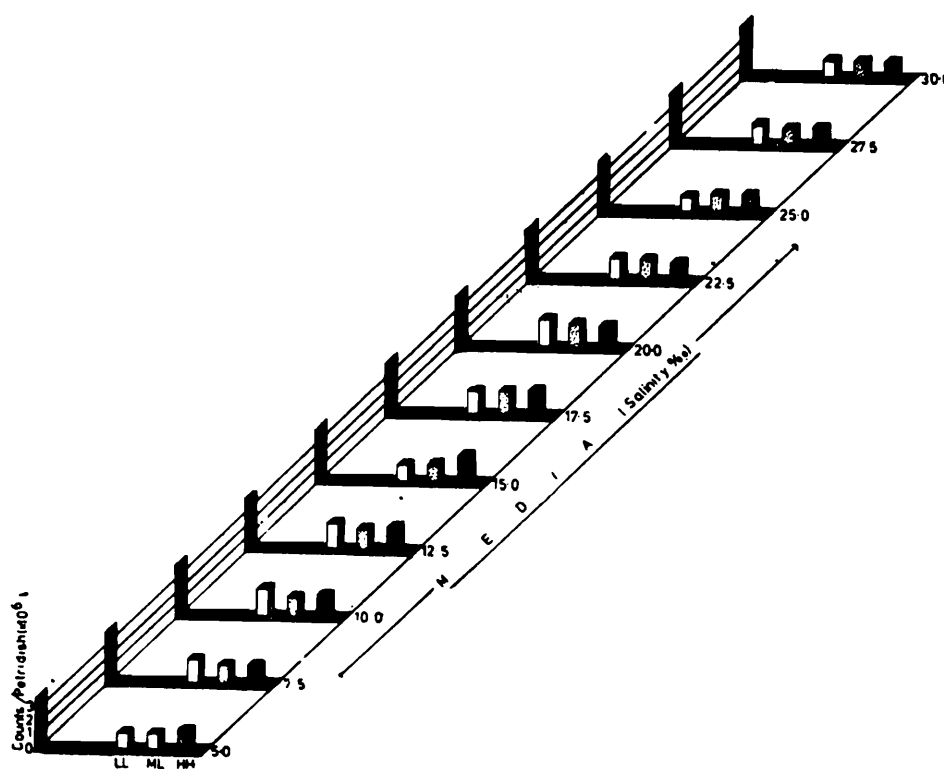


Fig. 3. Strains of *A. culbertsoni* showing overall growth.

PAS. After centrifugation and triple wash the pellets were resuspended to make a final wet weight suspension of 0.05g/ml and stored at 4°C.

To 5 replicate plates for each experiment, suspensions were added so that each received about 0.01g wet weight of microorganisms. Excess fluid was allowed to absorb. Cysts form clonal culture, one in number, were inoculated on media plates. After absorption of the transporting modified PAS the plates were inverted and kept at $25 \pm 1^\circ\text{C}$ BOD incubator.

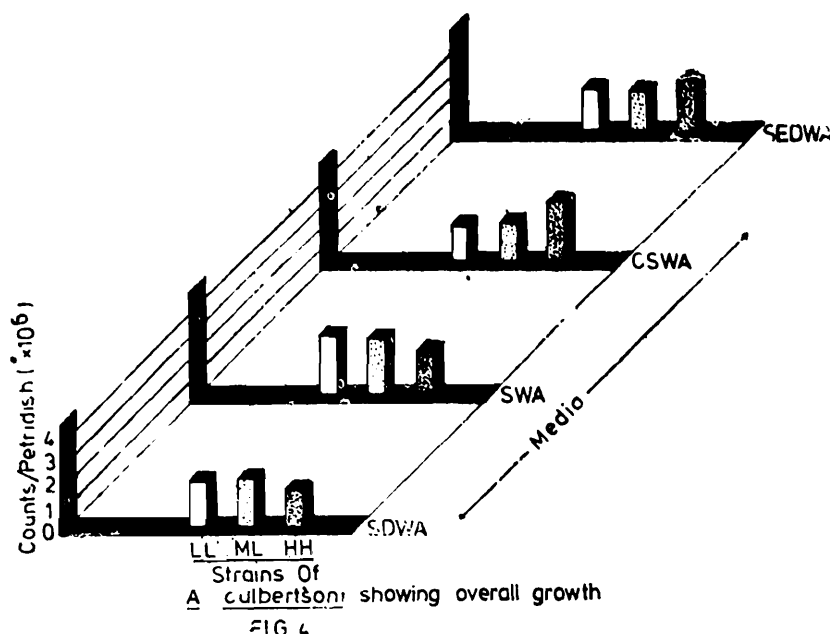
medium would show a range between 25 and 100 under such condition. While highly efficient medium exhibits more than 100 organisms per field. The overall growth was assessed on the basis of total population growth on 100 day old cultures and expressed in counts/petri-dish (mean of three replicate plates) using haemocytometer.

RESULTS

Growth curves of all the three strains in different media have been documented. Figure 1 shows the comparison of different

SDWA media to prove their efficiency to support growth. After 3 days media of 7.5, 10.0, 12.5, 15.0, 25.0 and 27.5‰, salinities show moderately efficient growth for LL strains while those of 17.5-22.5‰, exhibit

behaved in the same fashion is perhaps unexplained on this ground but may be due to some other factors of the media petri dishes. On the 7th day most of the media exhibit highly efficient growth except 15.0‰



highly efficient growth. Media of 5.0 and 30.0‰ only could support growth in non-efficient way. ML strains on the other hand, grew in highly efficient manner on media ranging from 12.5-20.0‰, salinities. Other media ranging from 5.0-10.0‰ and 22.5-27.5‰ during the same period could support only moderately efficient growth. The only medium found non-efficient for this strain was 30.0‰ salinity one. Most of the media supported highly efficient growth of HH strains on 3rd day of culture. In only two, namely 10.0‰ and 30.0‰ media, they grew moderately. The reason for this in 30.0‰ medium may be explained on the ground of its high salinity for isolate from highest high tide area where the same in most of the time is considerably low.

But why then medium of 10.0‰ strength

and 30.0‰ for LL isolate ; 10.0‰ and 27.5-30.0‰ media for ML one and 10.0‰ and 30.0‰ again for HH strains. Then onwards all the media were seen to support highly efficient growth for all the strains.

In figure 2 comparisons were made for four selected media. These were SDWA (20.0‰), SWA, CSWA and SEDWA. All the media were shown to be equally efficient to initiate highly efficient growth within the shortest periods of 3 days and maintain their efficiency throughout the periods of study.

Figure 3 represents a bar diagram to show the overall population growth of all the strains maintained for 100 days in each SDWA medium. This bar diagram depicts that the average mean values of the counts per petri-dish normally range between 1.2-2.0 $\times 10^6$. The greater values have been

seen to concentrate around media of moderate salinities.

In figure 4 population comparisons were made for four selected media. The average mean values of the counts per petri-dish range between $1.7-2.8 \times 10^6$. One interesting feature is this, greater values for HH strains were obtained from CSWA and SEDWA media while the same for LL and ML strains were recorded from SDWA and SWA media. Probable explanations have been attempted later on. CSWA medium was found to support maximum growth, being exhibited by HH strains.

DISCUSSION

The fact that encysted gymnamoebae can withstand the most adverse conditions for long periods combined with their microscopic size and the many avenues of transport which are open to them, ensure that there can be no topographic barrier against their distribution. Thus, the present study material, *A. culbertsoni* which is common inhabitant of most of the Indian soil types, is also a predominant member of saline water environment. Their way of life is ecologically very successful because crawling forms can move in-shallow water film with a large benthic surface in relation to volume of water and thus favours interface locomotion.

Thus to use this organism as a tool in planned works, establishment of optimal cultural conditions is a prerequisite. Media requiring distilled water as fluid base and sodium chloride in addition to Bacto-agar and habitat associated microbiota have been proposed as alternate to other more complicated media. Habitat associated microbiota, initially used as food organisms, may be

replaced by *E. coli*. To start with, one can make a number of media of different salinities from as low as 5.0‰ to as high as 30.0‰. Within two weeks it is always possible to find one moderate tolerable zone for any isolate from specific environments. Thus, while screening for the suitable media for organisms from a specific habitat, it is possible to study their salinity tolerance limits. Optimal cultural conditions are also required to enumerate their numbers in soil. Of the four media used in comparative study, CSWA and SEDWA media are the two organically enriched ones. *A. culbertsoni* strains from highest-high tide belt have been observed to favour these two media, perhaps in consequence to their existence in habitat with high organic content, characteristics of litter-soil. Strains from lowest-low tide and mid-littoral environments normally prefer SWA and SDWA media more. The primarily sand-soil of the former and the paucity of leaf-litter in the later make the habitat less enriched with organic components as expected. Thus, it will be quite safe to use the saline-distilled-water-agar media for isolates from wide saline environments.

ACKNOWLEDGEMENT

We are grateful to the Director, Zoological Survey of India, for his keen interest throughout the work. We further wish to record our appreciation to the Staff Members of Sushama Devi Choudhurani Marine Biological Research Institute, Sagar Island, West Bengal, for their assistance during field studies. Finally one of us (M.G.) is grateful to Department of Environment, New Delhi for the grant of Senior Research Fellowship.

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PLANKTON ECOLOGY OF GANDHISAGAR TANK IN NAGPUR, INDIA¹.

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ABSTRACT

Plankton ecology of a perennial tank from Nagpur has been studied. The tank is leased to fishermen for rearing fishes. Water samples and plankton was collected once a week for a period of two years. The physico-chemical factors recorded include temperature, turbidity, pH, free carbon dioxide, carbonate and bicarbonate alkalinity, chloride, total hardness, dissolved oxygen, phosphate and free ammonia.

Plankton samples were collected separately for qualitative and quantitative analysis. During the course of study 24 species of rotifers, 9 of cladocera and 3 copepod were recorded. Nauplius larvae were recorded both years. The annual % composition of various group is given. The phytoplankton contained major groups namely Myxophyceae, Englenophyceae and Bacillariophyceae. The Myxophyceae was the dominant group. The tank is stocked with large number of fish which feed on cladocera and copepoda, hence the rotifers dominated the Zooplankton.

INTRODUCTION

In India limnological work was initiated by Prashad (1916) who studied the seasonal conditions of pond life in Punjab. Pruthi (1933) made some observations in the physico-chemical factors and biota of tank in the Calcutta Indian Museum compound. Sewell (1934) examining Pruthy's collection, gave a record of the fauna during the different months. Further studies on the ecology of a few water bodies from Madras city has been made by Ganapati (1940, 41,

43). Ganapati and Chacko (1951) while working on fish ponds at Madras observed that age and nature of bottom sediments effects the Plankton yield. Das and Srivastava (1956) reported that the quantity of phytoplankton appeared to be inversely proportional to that of Zooplankton. Alikuhni et. al. (1955) worked on the Plankton of nursery pond of Cuttack during the carp fry rearing period. Similar ecological studies of a few water bodies have been appeared from time to time (George 1961,

1. Part of the thesis approved for the Ph. D. Degree of the University of Nagpur, 1977.

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1966; Krishnamoorthy and Visweswara 1963, 65; Jayangouder 1964, 80; Lakshminarayana 1965; Michael 1968, 80; Vyas and Kumar 1968; Munawar 1974; Kaul 1977; Kaul et. al. 1978; Zutshi & Khan 1977; Zutshi and Vass 1978; Zutshi et. al. 1980; Job and Kannan 1980, Harshey et al. 1982, Singh 1982; Patil et al. 83; Patil and Sen 1983; Balkhi et al, 1984; Kanungo et al. 1985). Recently Trisal (1985) studied trophic status of Kashmir lak. The present investigation concerning the plankton ecology of the perennial tank from Nagpur was carried out for a period of two years (August 1972 to July 1974).

In the present work the following aspects of plankton ecology have been studied. Physico-chemical conditions of water, temperature, turbidity, pH, dissolved oxygen, free carbondioxide, carbonate and bicarbonate alkalinity, chloride, ammonia, phosphate and total hardness.

The quantitative and qualitative estimation of the Zooplankton and phytoplankton have been carried out. The seasonal fluctuations in the abundance of the various groups of dominant individual species are given. Some physiocochemical factors have been correlated with plankton population.

TOPOGRAPHY OF GANDHISAGAR TANK

This is a rectangular tank situated in the heart of the city (fig. 1). The area of the tank is 47.3 acres, and on three sides of the tank there are cement roads and on the fourth side the tank is separated from another small tank with an area of 15.22 acres. The depth of the tank is almost uniform and varies from 6 metres to 10 metres. Three sides of the tank have stone embcnkment with stone steps running upto the water level. The tank is partly polluted by domestic sewage and due to seepage from the adjoining small tank receiving textile mill

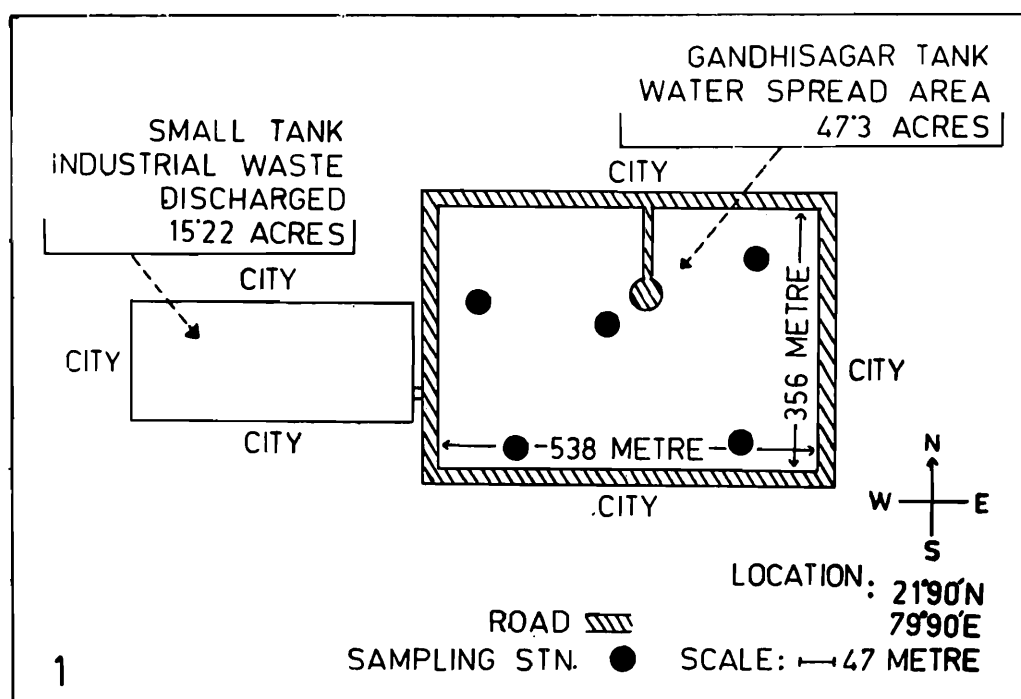


Fig. 1. Map of Gandhisagar tank showing location of sampling stations.

effluent. There is plenty of faecal pollution and on the sides along the road between the two tanks cattle are washed. Domestic garbage is also thrown into the tank. A small island is also present on one side of the tank which is approachable by a road. This tank is under the control of Nagpur Municipal Corporation and is leased to fisherman's Society for pisciculture. The location and number of sampling stations are given in the Map (fig. 1). In all five sampling stations have been selected for the present study.

Vegetation : There are very few hydrophytes and they are restricted to the marginal zone of the tank. As the tank is used for pisciculture, the aquatic hydrophytes have been removed from the tank.

MATERIAL AND METHODS

Water samples and plankton from the tank were collected once a week between 9.30 a.m. and 11.30 a.m. Water samples were collected by dipping a wide mouth bottle just below the surface of the water at a slightly inclined angle to avoid bubbling of air and were immediately brought to the laboratory for chemical analysis, which was generally completed within two to three hours.

Water analysis : For the estimation of dissolved oxygen water samples were taken in three hundred ml narrow mouth bottle having a glass stopper and the oxygen was fixed in the field according to modified Winkler method. The physical factors recorded include, temperature, turbidity and pH. The temperature of the water was noted in the field by an ordinary centigrade thermometer and pH was recorded by pH metre.

Turbidity was determined by a turbidometer. The reading for rainfall were taken from the data of Metrological Department. Chemical factors such as dissolved oxygen, free carbon dioxide, bicarbonate and carbonate alkalinity, chloride, free ammonia, phosphate and total hardness due to calcium and magnesium, estimated as per methods given in the "Standard methods for the examination of water and waste water" (American Public Health Association, 13th Edition 1971). Free Carbon dioxide was determined by titrating with N/44 NaOH using phenolphthalein indicator. Carbonate and bicarbonate alkalinity was determined by titration with N/50 sulphuric acid using phenolphthalein and Methyl orange indicators respectively. Chloride was estimated by Mohr's method and hardness by EDTA titration method. Free Ammonia was estimated by direct Nesslerisation and phosphate was determined by Stannous chloride method. The physico-chemical data represented in the tables is the average of weekly collections per month.

Plankton analysis : Weekly collection of plankton samples were made with the help of conical plankton net of Nylon-satin cloth of 200 mesh per square centimeter to which a rim less test tube was attached at the bottom. Plankton samples were collected for qualitative analysis by towing the net through surface layer of water. For quantitative analysis live organisms were examined. Plankton samples were obtained by filtering 20 litres of water through the net for quantitative estimation. The plankton concentrates were preserved in 5% formalin. The quantitative estimation of Zooplankton was done with the help of a Sedgwick Rafter cell under binocular microscope with magni-

fication of 100 x and the number of the various zooplankers was counted. Phytoplankton was enumerated by "drop method" under high magnification of 440 x (Pearsall et al, 1946). On an average three counts were made for each sample and the mean concentration were calculated for the zoo and phytoplanktonic forms. From this data the total count/litre was calculated and the various plankters were considered as units of organisms/Litre of water.

OBSERVATIONS

A. PHYSICAL AND CHEMICAL FACTORS

The data giving two years variation in Physico-chemical factors of water are given in Tables I to II.

Rainfall-

The data on total rainfall in cm. obtained from the Meteorological Department is given below :

It will be seen that during the first year of study (Aug. 1972 to July 1973) the total rainfall recorded was 38.00 cm. and during the second year (Aug. 1973 to July 1974)

38.87 cm. Though the total rainfall recorded during the two year period of investigation was nearly the same, their monthly record differs. Rainfall was recorded throughout the year except in the month of March, 1973. In the second year there was a long dry spell from Nov. 1973 to Feb. 1974 and April 1974.

Temperature : The temperature fluctuations (fig. 1) during the two year course of investigation (August 1972 to July 1974) were not very much and was 9.2°C,

The maximum temperature was recorded in the month of June 1973 and 1973 and a gradual rise in temperature was noticed from January to June and again a small rise in August 1973 and a gradual decrease in temperature from August to December or January. In June 1973 and June 1974 the maximum temperature were recorded and it was 28.2°C and 23.6°C respectively. The minimum temperature recorded was in January 1974 and it was 19°C.

Turbidity : The turbidity of water (fig. 3) in this tank was not very high and the turbidity range was 28.7 to 146 mg/litre. The

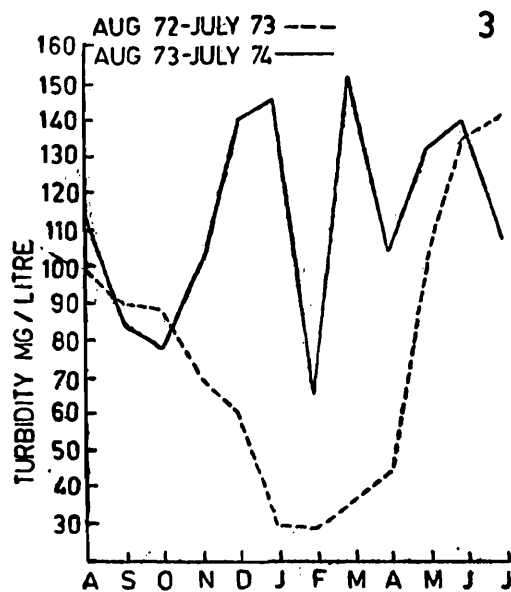
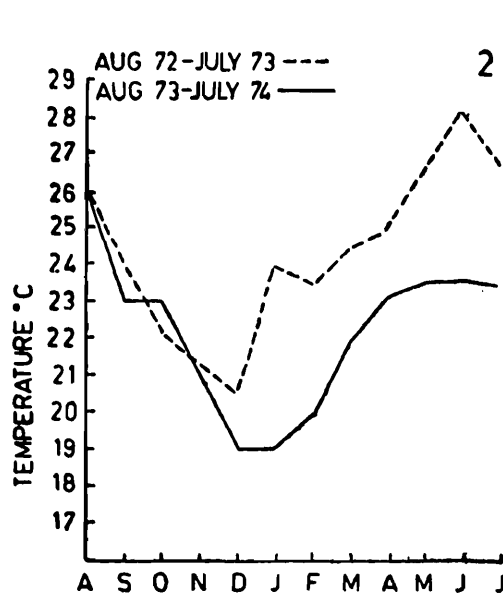
Month and year	Total rainfall CM.	Month and year	Total rainfall CM.
Aug. 1972	6.20	Aug. 1973	6.15
Sep. 1972	1.40	Sept. 1973	6.02
October 1972	4.64	Oct.	7.63
Nov. 1972	0.95	Nov. 1973	0.0
Dec. 1972	1.50	Dec. 1973	0.0
Jan. 1973	5.50	Jan. 1974	0.0
Feb. 1973	0.50	Feb. 1974	0.0
Mar. 1973	0.0	March 1974	0.50
April 1973	1.0	April 1974	0.0
May 1973	0.25	May 1974	2.30
June 1973	2.65	June 1974	8.45
July 1973	14.71	July 1974	7.15

TABLE—I Physico-chemical characteristic of water, August 1972 to July 1973.

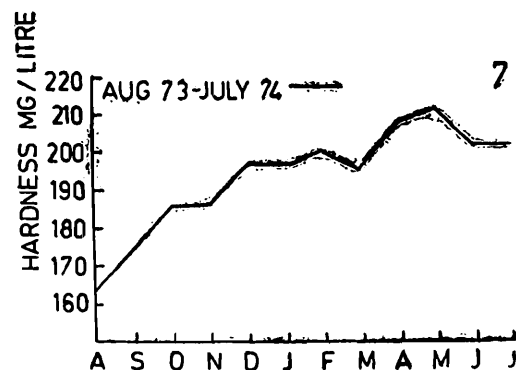
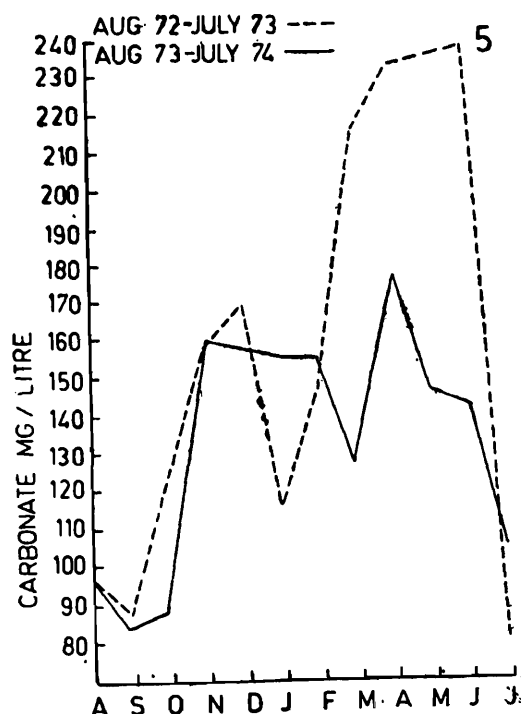
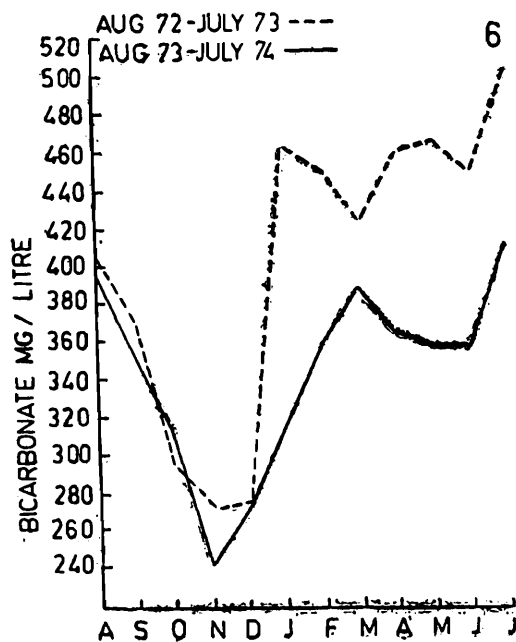
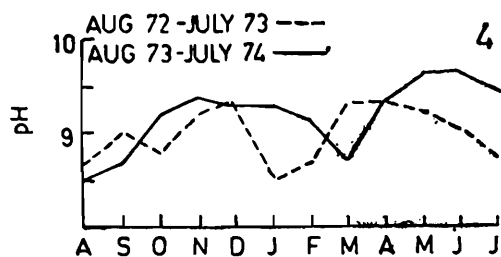
Month and Year	Temperature (°C)	Turbidity mg/Litre	pH	Free Carbon dioxide mg/Litre	Carbonate as CaCo ₃ mg/Litre	Bicarbonate as CaCo ₃ mg/Litre	Chloride as Cl. mg/Litre	Dissolved Oxygen mg/Litre
August 1972	26.2	99.0	8.7	Nil	96	405	129.5	9.2
Sept. 1972	24.2	90.00	9.0	Nil	88	372	125.4	9.94
Oct. 1972	22.2	88.0	8.8	Nil	124	296	120.9	8.8
Nov. 1972	21.4	70.0	9.2	Nil	158	273	124.3	9.78
Dec. 1972	20.5	61.0	9.35	Nil	170	277	158.0	10.2
Jan. 1973	24.0	30.5	8.5	Nil	116	464	201.0	7.8
Feb. 1973	23.5	28.7	8.7	Nil	150	451	202.0	7.2
March 1973	24.5	37.0	9.3	Nil	216	453	215.0	6.9
April 1973	25.0	45.0	9.3	Nil	232	461	219.0	7.4
May 1973	26.7	102.0	9.2	Nil	234	466	219.0	9.0
June 1973	28.2	135.9	9.0	Nil	236	449	200.0	8.2
July 1973	26.8	141.0	8.7	Nil	82	506	122.0	8.6

TABLE—II Physico-chemical characteristics of Water, August 1973 to July 1974.

Month and Year	Temperature (°C)	Turbidity mg/Litre	pH	Free Carbon dioxide mg/Litre	Carbonate as CaCo ₃ mg/Litre	Bicarbonate as CaCo ₃ mg/Litre	Total hardness as CaCo ₃ mg/Litre	Chloride as Cl mg/Litre	Dissolved Oxygen mg/Litre	Phosphate mg/Litre	Free Ammonia mg/Litre
August 1973	26.0	114.0	8.5	Nil	95	397	164	126.0	9.6	4.5	1.0
Sept. 1973	23.0	80.0	8.7	Nil	84	355	180	113.0	8.8	4.5	0.2
Oct. 1973	23.0	78.0	9.2	Nil	88	315	186	112.0	8.9	4.9	0.2
Nov. 1973	21.0	102.0	9.4	Nil	160	242	186	124.5	10.0	4.0	0.2
Dec. 1973	19.0	139.0	9.3	Nil	158	272	196	125.5	12.3	9.0	0.2
Jan. 1974	19.0	146.0	9.3	Nil	156	314	196	129.5	10.8	9.05	0.4
Feb. 1974	20.0	65.0	9.1	Nil	156	355	200	170.0	10.2	11.0	0.75
Mar. 1974	22.0	102.0	8.7	Nil	128	388	195	155.0	9.6	11.0	0.04
April 1974	23.2	104.0	9.31	Nil	178	365	207	138.5	11.8	6.82	1.05
May 1974	23.6	132.0	9.6	Nil	148	358	211	123.0	6.6	4.23	0.2
June 1974	23.6	140.0	9.62	Nil	144	357	202	123.5	6.7	3.80	0.7
July 1974	23.5	108.0	9.4	Nil	106	413	202	142.0	7.55	2.1	0.8



Figs. 2 & 3. Seasonal fluctuations in temperature and turbidity.



Figs. 4, 5, 6 and 7. Seasonal fluctuations in pH, Carbonate, bicarbonate and hardness.

turbidity values were generally low from January to April and high values were recorded from May to August. The high values of turbidity were due to the drying up of the tank in summer and later due to the onset of monsoon.

pH.

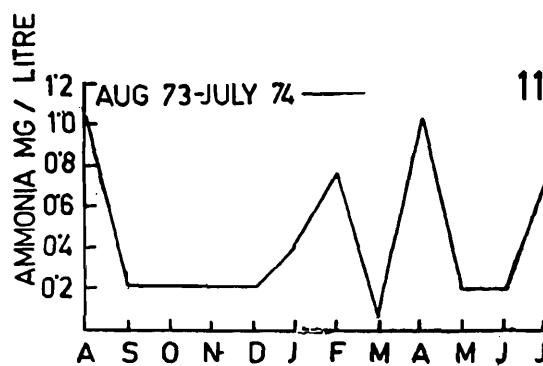
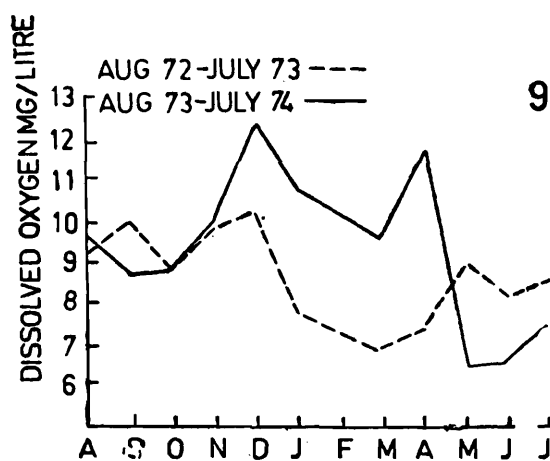
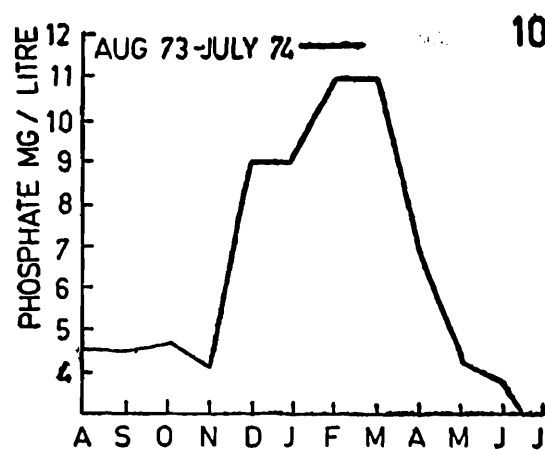
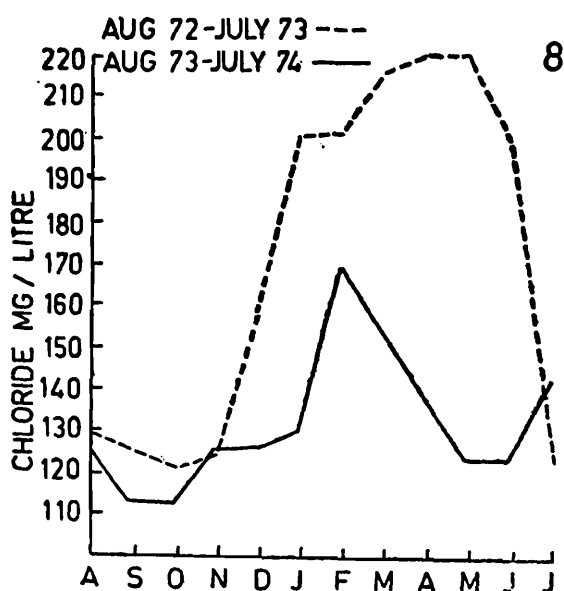
The water in the tank was always alkaline and the pH range was between 8.5 to 9.6. The minimum value was noticed in January and August 1973 and the maximum in June 1974 (fig. 4)

Free carbon dioxide :

Free carbon dioxide was not observed during the period of investigation.

Carbonate alkalinity : The reading of the carbonate alkalinity (fig. 4) showed wide fluctuations and the maximum amount of carbonate alkalinity of 232 to 236 mg/litre was recorded in the month of April, May and June 1973 and the minimum of 82 to 96 mg/litre in July, August and September.

Bicarbonate alkalinity : The range of bicarbonate alkalinity was between 242 to 506



Figs. 8, 9, 10 and 11. Seasonal fluctuations in chloride, dissolved oxygen, phosphate and ammonia.

mg/litre. It was found that the bicarbonate alkalinity was at its minimum in November 1973 and maximum in May or July 1973 (Fig. 5).

Total Hardness : It was noticed that the total hardness of water was generally high and the range was between 164 to 211 mg/litre. A gradual rise in total hardness was observed in this tank. from August 1973 to June 1974 (fig. 7)

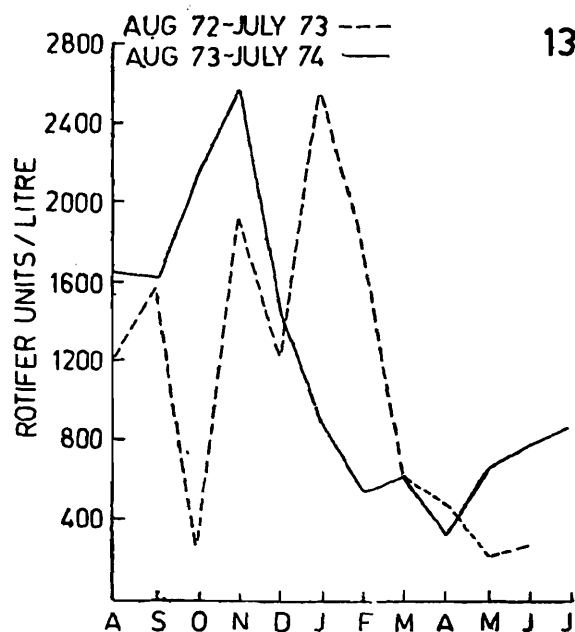
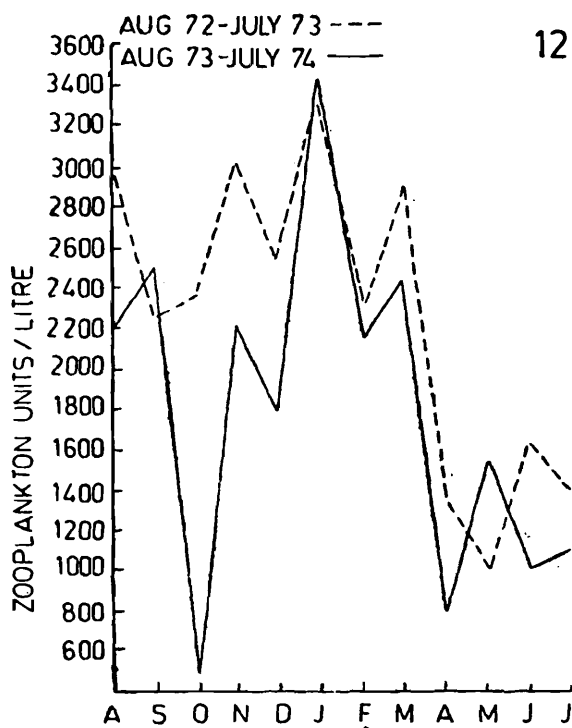
Chloride : High chloride content (fig. 8) was noticed in this tank and it was always more than 112 mg/litre and the maximum was 219/litre. A gradual increase in the chloride values from November or December 1972 onwards was observed and the maximum being in May 1973.

Dissolved oxygen : Dissolved oxygen

(fig. 9) was generally above 6 mg/litre and the D.O. values ranged between 6.6 to 12.3 mg/litre in this tank. The maximum D.O. values was observed in December or January. From December or January onwards dissolved oxygen decreased progressively till March and again there was a gradual increase with few fluctuation till the highest value was reached in December or January.

Phosphate : Inorganic phosphate content (fig. 10) was generally high and the maximum value of 11 mg/litre was observed in February and March 1974 and the minimum of 2.1 mg/litre in July 1974.

Free ammonia : It was observed that the maximum ammonia content was recorded in April 1974 and the range was between 0.04 to 1.05 mg/litre (fig. 11).



Figs. 12 & 13. Seasonal variations in the total zooplankton and Rotifer population.

B. ZOOPLANKTON

The zooplankton of the tank was composed of rotifers, cladocerans, copepods and crustacean larvae. The different planktonic forms recorded (Table III) and their quantitative variations are given in tables (IV, V). During the course of study for a period of two years 24 species of rotifers, 9 Cladocerans and 3 copepods were recorded.

Nauplius larvae were present in the tank practically throughout the period of investigation.

The maximum zooplankton population (Fig. 12) was recorded in the tank. It showed a pulse in January 1973 and 1974 and the maximum number of units/litre were 3441. The percentage distribution of the major group of zooplankters is shown below.

TABLE-III : List of Zooplankton species present in the tank.

Name of the Genera and species.

<i>Rotaria rotaria</i> (Pallas)	<i>Branchionus urccolaris</i> O. F. Muller
<i>Philodina</i> sp.	<i>Epiphanes macrourus</i> (Barrois & Daday)
<i>Floscularia</i> sp.	<i>Lecane</i> sp.
<i>Sinantharina</i> sp.	<i>Monostyla</i> sp.
<i>Conochilus unicornis</i> Rousselet	CLADOCERA
<i>Collotheca</i> sp.	<i>Diaphanosoma sarsi</i> Richard
<i>Synchaeta pectinata</i> Ehrenberg	<i>Daphnia dubia</i> Hirrick
<i>Polyarthra vulgaris</i> Carlln	<i>Daphnia carinata</i> King
<i>Filinia longiseta</i> (Errenberg)	<i>Simocephalus vetulus</i> Schdler
<i>Filinia terminalis</i> (Plate)	<i>Scapholeberis Kingi</i> Sars
<i>Keratella cochlearis</i> (Gosse)	<i>Moina brachiata</i> Jurine
<i>Keratella tropica</i> (Apstein)	<i>Moina dubia</i> de Guerne et Richard
<i>Asplanchna intermedia</i> (Hudson)	<i>Macrothrix spinosa</i> King
<i>Trichocerca</i> sp.	<i>Chydorus sphacricus</i> (O. F. Muller)
<i>Trichocerca cylindrica</i> Imhof	COPEPODA
<i>Branchionus angularis</i> (Gosse)	<i>Cyclops</i> sp.
<i>Branchionus caudatus</i> Barrois and Daday	<i>Mesocyclops hyalinus</i> (Rehberg)
<i>Branchionus forficula</i> Wierzejski	<i>Diaptomus</i> sp.
<i>Branchionus quadridentata</i> Hermann	Nauplius larvae

Table showing percentage distribution of Zooplankters during 1972-73 and 1973-74.

Period of investigation	1972-73	1973-74
Annual average units/litre of total Zooplankton	2273	1718
Percentage composition of		
(a) Rotifera	51.60%	60.3%
(b) Cladocera	2.10%	1.90%
(c) Copepoda	5.90%	6.60%
(d) Nauplius larvae	40.40%	31.20%

It is clear from the data that Rotifera is the dominant group. The Nauplius larvae are also found in good numbers and the Cladocera and Copepoda are better represented.

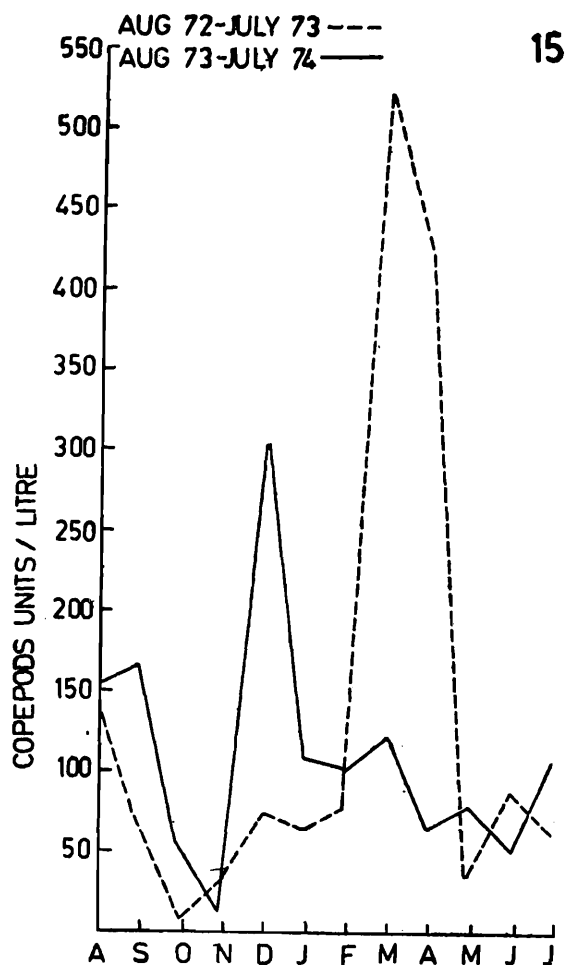
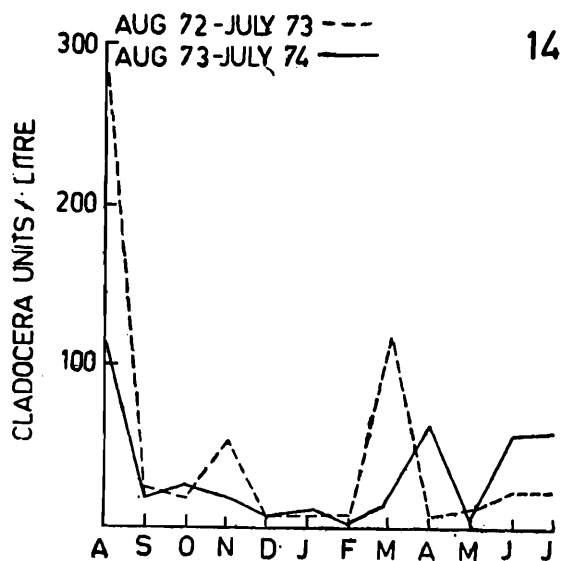
ROTIFERA

In this tank rotifers showed one pulse in the month of November 1972-(2571 units/litre) and *B. angularis*, *B. Calyciflorus* *Filinia longiseta* were the dominant forms in this tank. Seasonal variations of the rotifers which dominated in the plankton sample is given (Tables IV, V). In all 6 species of

Branchionus were recorded, out of which three were observed in sufficient numbers.

CLADOCERA

Cladoceran (Tables IV and V) were not found in abundance in the tank. In all 9 species of Cladocera were recorded from the plankton samples. Two maxima were noticed during the first year one in August, 1972 with 284 units/litre and the other in March 1973 with 119 units/litre. During the second year the maxima was in August 1973 with 120 units/litre. The dominant species was *Moina dubia* (Fig. 14).



Figs. 14 & 15. Seasonal variations in the Cladocera and Copepods population.

TABLE—IV. Zooplankton population of the tank, August, 1972 to July, 1973 (Units/Litre)

Name of the Genera and species	Aug. 72	Sept. 72	Oct. 72	Nov. 72	Dec. 72	Jan. 73	Feb. 73	March 73	April 73	May 73	June 73	July 73
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
ROTIFERA												
<i>Rotaria rotaria</i> (Pabeas)	22	8	134	—	55	—	6	—	—	—	—	—
<i>Philodina</i> sp.	5	—	—	—	2	—	—	—	—	—	—	—
<i>Floscularia</i> sp.	10	—	—	2	—	—	—	6	—	—	—	—
<i>Sinatherina</i> sp.	—	—	—	—	—	—	—	2	4	—	2	—
<i>Conochilus unicornis</i> Rousselet	2	5	—	—	—	—	—	—	—	—	—	—
<i>Collotheca</i> sp.	18	—	—	—	—	2	2	—	—	—	—	—
<i>Synchaeta pectineta</i> Ehrenberg	10	—	—	—	—	—	2	—	—	—	—	—
<i>Polyarthra vulgaris</i> Carlin	245	—	—	—	107	—	2	2	—	—	—	—
<i>Filinia longiseta</i> (Ehrenberg)	25	411	97	749	1037	254	56	140	87	461	51	523
<i>Filinia terminalis</i> (Plate)	—	—	3	—	—	—	—	—	—	—	—	5
<i>Keratella cochlearis</i> (Gosse)	335	2	—	—	—	—	12	11	16	—	—	—
<i>Keratella tropica</i> (Apstein)	107	6	52	—	—	32	5	—	4	—	—	—
<i>Asplanchna intermedia</i> Husson	33	—	—	—	55	—	—	—	—	6	—	13
<i>Trichocerea</i> sp.	2	—	—	—	—	—	—	—	—	—	—	—
<i>Trichocerea cylindrica</i> Imhof	48	—	—	—	—	16	18	—	—	—	—	—
<i>Brachionus angularis</i> (Gosse)	300	975	1159	654	36	528	354	401	49	137	650	60
<i>Brachionus calyciflorus</i> Wierzeiski	100	148	664	1120	5	—	35	45	132	30	63	260
<i>Brachionus caudatus</i> Barrois & Daday	10	2	15	9	—	—	—	—	—	4	8	—
<i>Brachionus forticula</i> Wierzeiski	376	12	3	—	6	18	17	2	33	28	8	—
<i>Brachionus quadridentata</i> Hermann	—	—	—	—	—	—	2	6	—	—	—	—
<i>Brachionus urceolaris</i> O. F. Muller	—	2	5	—	—	—	9	—	11	—	—	—
<i>Epiphanes macrourus</i> Barrois & Daday	4	22	—	—	—	—	12	—	—	—	—	—
<i>Lecane</i> sp.	—	—	—	27	—	32	2	—	—	—	—	—
<i>Monostyla</i> sp.	—	—	—	10	—	—	6	2	—	—	—	—
TOTAL :	1652	1593	2132	2571	1483	880	540	617	336	666	784	861

Contd....Table—IV

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
CLADOCERA												
<i>Diaphanosoma sarsi</i> Richard	—	—	—	4	—	—	—	46	—	3	3	—
<i>Daphnia dubia</i> Herrick	—	—	1	2	—	2	—	6	—	—	—	—
<i>Daphnia carinata</i> King	—	2	2	1	—	—	—	—	—	—	—	—
<i>Simocephalus vetulus</i> Schodler	—	—	—	—	7	2	—	—	—	—	—	—
<i>Scapholeseris kingi</i> Sars	—	—	—	—	—	1	4	—	—	—	—	—
<i>Moina brachiata</i> (Jurine)	80	2	—	—	—	—	—	7	—	—	—	—
<i>Moina dubia</i> de Guerne et Richard	203	20	11	48	1	—	4	60	8	8	15	20
<i>Macrothrix spinosa</i>	1	—	—	—	—	—	—	—	—	—	2	2
<i>Chydorus sphaericus</i> (O. F. Muller)	—	—	4	—	—	—	—	—	—	—	—	—
TOTAL :	284	24	18	55	8	5	8	119	8	11	20	22
COPEPODA												
<i>Cyclops</i> sp.	108	50	8	30	74	66	47	304	334	34	88	62
<i>Mesocyclops hyalinus</i> (Rehberg)	38	20	—	—	—	—	30	200	90	—	—	—
<i>Diaptomus</i> sp.	—	—	—	—	—	—	—	15	2	—	—	—
TOTAL :	146	70	8	30	74	66	77	519	426	34	88	62
Nauplius larvae	919	592	235	384	978	2379	1684	1668	478	277	731	441
TOTAL Zooplankton	3001	2279	2398	3040	2514	3330	2309	2923	2248	988	1623	1386

TABLE—V Zooplankton population of the tank, August, 1973 to July 1974 (Units/Litre)

Rotifera	Aug. 73	Sept. 73	Oct. 73	Nov. 73	Dec. 73	Jan. 74	Feb., 74	Mar. 74	April 74	May 74	June 74	July 74
1	2	3	4	5	6	7	8	9	10	11	12	13
<i>Rotaria rotaria</i> (Pallas)	3	—	—	5	27	—	—	—	—	—	—	4
<i>Rhilodine</i> sp.	—	—	—	—	4	—	2	—	—	—	—	—
<i>Floscularia</i> sp.	—	—	2	—	—	—	—	—	4	—	—	4
<i>Sinantharina</i> sp.	—	—	—	—	—	—	—	—	—	—	—	—
<i>Conochilus unicornis</i> Russelet	—	5	6	—	—	—	—	—	2	—	—	—
<i>Collotheca</i> sp.	—	—	—	—	—	—	10	—	—	—	—	—
<i>Synchaeta pectineta</i> Ehrenberg	—	2	—	—	—	—	—	—	—	—	—	—
<i>Polyarthra vulgaris</i> Carlin	—	10	8	2	—	—	—	—	—	—	—	—
<i>Filinia longiseta</i> Ehrenberg	485	423	16	23	32	28	17	2	11	19	57	135
<i>Filinia terminalis</i> (Plate)	—	5	—	—	—	2	9	—	—	—	—	—
<i>Keratella cochlearis</i> (Gosse)	25	20	27	700	657	775	1126	241	—	—	—	—
<i>Keratella tropica</i> (Apstein)	—	12	71	1098	386	716	485	221	5	24	28	8
<i>Asplanchna intermedia</i> Hudson	8	—	—	—	27	6	—	—	2	—	—	—
<i>Trichocera cylindrica</i> Imhof	—	—	—	—	17	8	—	—	—	17	10	—
<i>Brachionus angularis</i> (Gosse)	251	261	53	11	9	985	168	133	19	75	125	210
<i>Brachionus calyciflorus</i> Wierzecki	424	757	54	44	—	—	—	—	311	61	50	106
<i>Brachionus forticula</i> Weirzeiski	2	—	—	—	2	—	—	—	—	—	—	—
<i>Brachionus quadridentata</i> Hermann	—	—	—	2	—	—	—	—	—	—	—	—
<i>Brachionus urceoiaris</i> O. F. Muller	—	—	5	—	7	8	—	—	8	—	—	—
<i>Epiphanes macrourus</i> Barrois & Daday	—	50	2	—	—	—	—	—	38	—	—	—
<i>Lecane</i> sp.	—	—	—	5	2	0	—	—	—	—	—	—
<i>Monostyla</i> sp.	—	—	—	—	—	—	—	—	8	—	—	—
TOTAL :	1198	1545	244	1890	1170	2538	1817	591	498	169	270	4
CLADOCERA												

TABLE V—Contd.

1	2	3	4	5	6	7	8	9	10	11	12	13
<i>Diaphanosoma sarsi</i> Richard	—	—	—	—	—	—	—	—	—	6	8	—
<i>Daphnia dubia</i> Herrick	—	—	5	13	—	3	—	10	—	—	—	—
<i>Daphnia carinata</i> King	—	5	5	—	—	2	—	3	—	—	—	—
<i>Simocephalus vetulus</i> Schdler	—	—	—	—	6	2	—	—	—	—	—	—
<i>Scapholeberis kingi</i> Sars	—	—	—	—	—	2	1	—	—	—	—	—
<i>Moina brachiata</i> Jurine	9	—	—	—	—	—	—	—	—	—	—	—
<i>Moina dubia</i> de Guerne et Richard	110	11	4	3	—	—	—	—	62	—	46	57
<i>Macrothrix</i> sp.	1	—	—	—	—	—	—	—	—	—	—	—
<i>Chydorus sphaericus</i> O. F. Muller	—	—	6	2	—	—	—	—	—	—	—	—
TOTAL :	120	16	20	18	6	9	1	13	62	6	54	59
COPEPODA												
<i>Cyclops</i> sp.	100	108	55	26	211	70	92	123	68	81	56	111
<i>Diaptomus</i> sp.	—	—	—	—	—	—	12	3	—	—	—	—
<i>Mesocyclops hyalinus</i> Rehberg	5	60	—	—	100	40	—	—	—	—	—	—
TOTAL :	155	168	55	26	311	110	104	126	68	81	56	111
Nauplius larvae	709	707	138	309	284	784	214	1531	167	470	649	460
Total Zooplankton	2185	2436	457	2243	137	3541	2136	2267	775	753	1020	1106

COPEPODA

Copepods (Tables IV and V figs 15) though present in the tank were not found in large numbers throughout the period of investigation. The pulses were dominated by cyclopoids and calanoids. The copepodid stages of cyclopoids and calanoids were counted with the adults copepods, efforts were made to identify and place them into particular species of copepods. The maximum number of copepods was 519 units/litre in March, 1973 during the first year. the maximum was in December, 1973 (311 units/litre) dominated by *cyclops* sp. and *Mesocyclops hyalinus*. Only three species of copepods *Cyclops* sp., *Mesocyclops hyalinus*, *Diaptomus* sp. have been found.

In the present study male specimens were recorded on few occasions. The following data shows the specimen were recorded.

Specimens involved	Dates
<i>Brachionus angularis</i>	10.10.1972. 14.09.1973. 30.01.1974.
<i>Barchionus calyciflorus</i>	27.09.1973.
<i>Keratella cochlearis</i>	28.02.1974.
<i>Keratella tropica</i>	28.11.1973.

NAUPLIUS LARVAE

These crustacean larvae (Fig. 16) 9 were found in large numbers especially from

January to March 1973 and in March 1974. The maximum number of nauplii recorded was 2379 units/litre in January, 1973. This period i.e. from January to march could be taken as an intensive breeding period of the copepods. This view is further supported by the increase in the number of adults in the samples in March and April, 1973 and clearly indicates new recruitment.

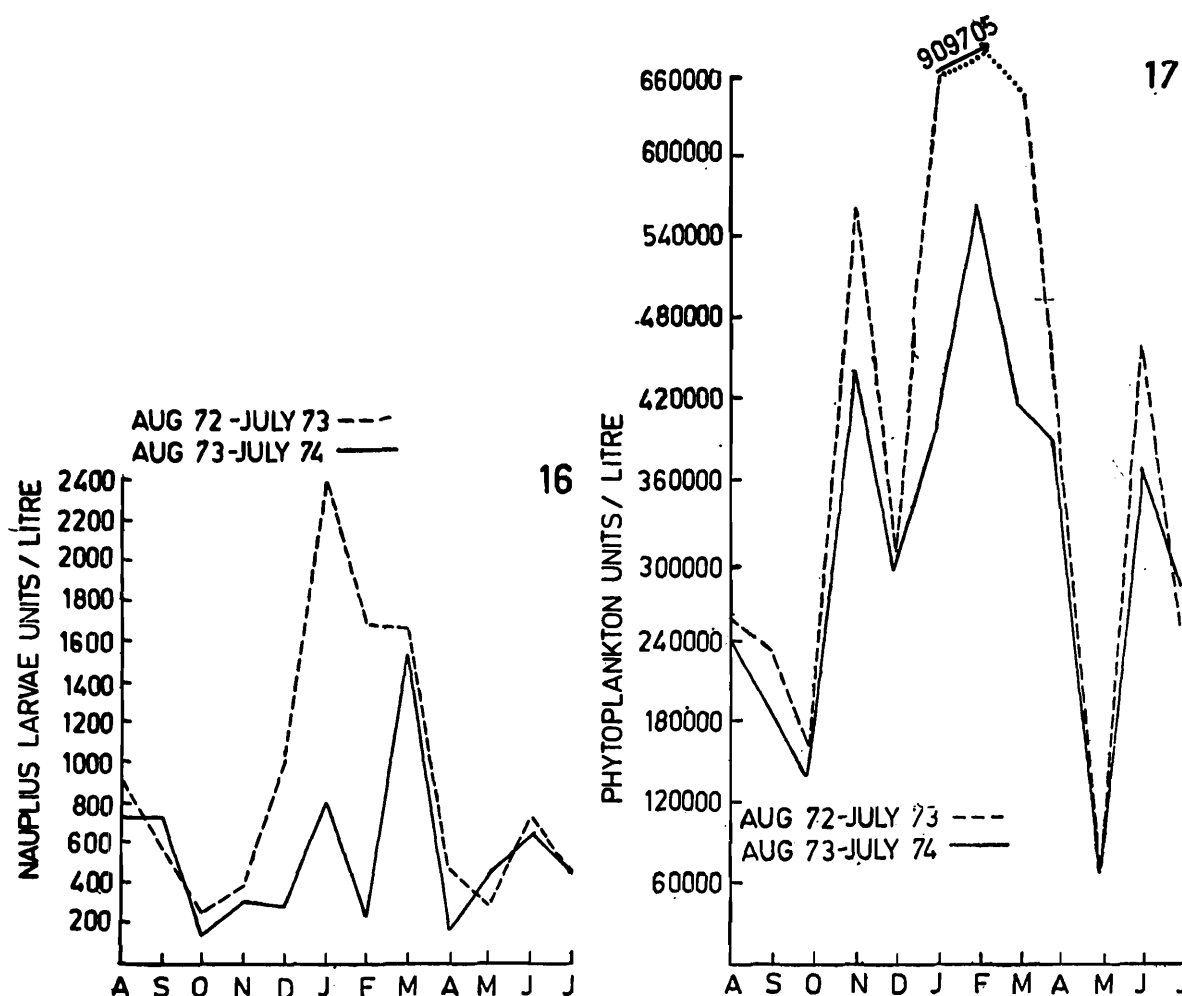
Table showing average annual percentage composition of the zoo and phytoplankton during 1972-73 and 1973-74.

Average annual percentage of	Years 1972-74	Years 1973-74
Zooplankton	0.55%	0.54%
Phytoplankton	99.45%	99.46%

C. PHYTOPLANKTON

Phytoplankton from the samples was recorded and the indentifications of the various forms were made upto genera only. During the two year study, 21 genera of algae were recorded (Table VI). Of these 5 belong to Myxophyceae, 7 to Chlorophyceae, 2 to Euglenophyceae and 7 to Bacillariophyceae. The seasonal variations in the total phytoplankton (Tables VII, VIII and fig. 17) showed a major pulse in February 1973 and one in February, 1974.

The Table showing the annual average units/litre of the phytoplankton and percentage composition of the major groups during 1972-73 and 1973-74.



Figs. 16 & 17. Seasonal variations in the nauplius larvae and phytoplankton population.

TABLE VI

Phytoplankton distribution in the tank

Name of Genera :

MYXOPHYCEAE

*Microcystis**Oscillatoria**Spirulina**Anabaena**Nostoc*

CHLOROPHYCEAE

*Eudorina**Pandorina**Pediastrum**Spirogyra**Scenedesmus**Strumastrum**Closterium*

EUGLENOPHYCEAE

*Euglena**Phacus*

BACILLARIOPHYCEAE

*Cyclotella**Fragillaria**Pinnularia**Asterionella**Navicula**Synedoa**Stephanodiscus*

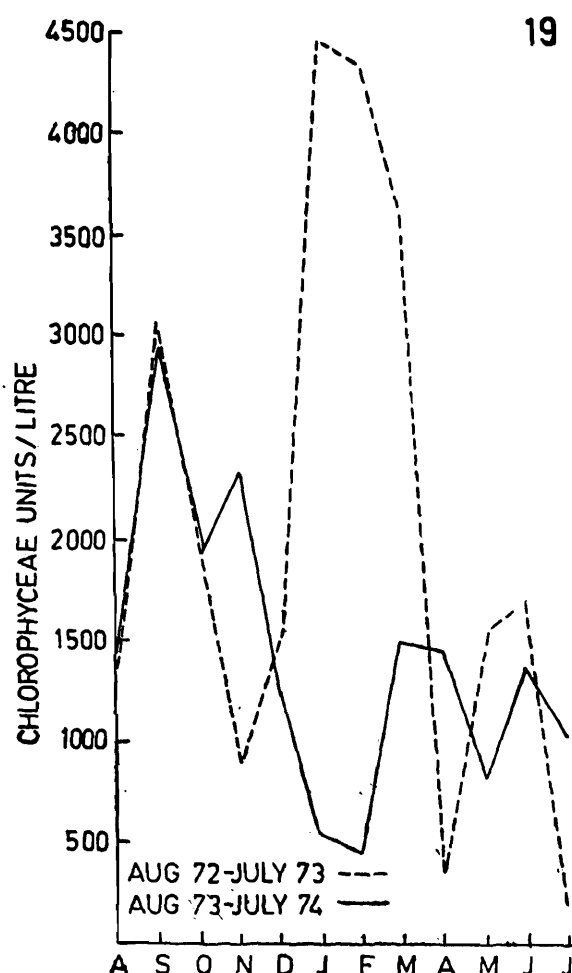
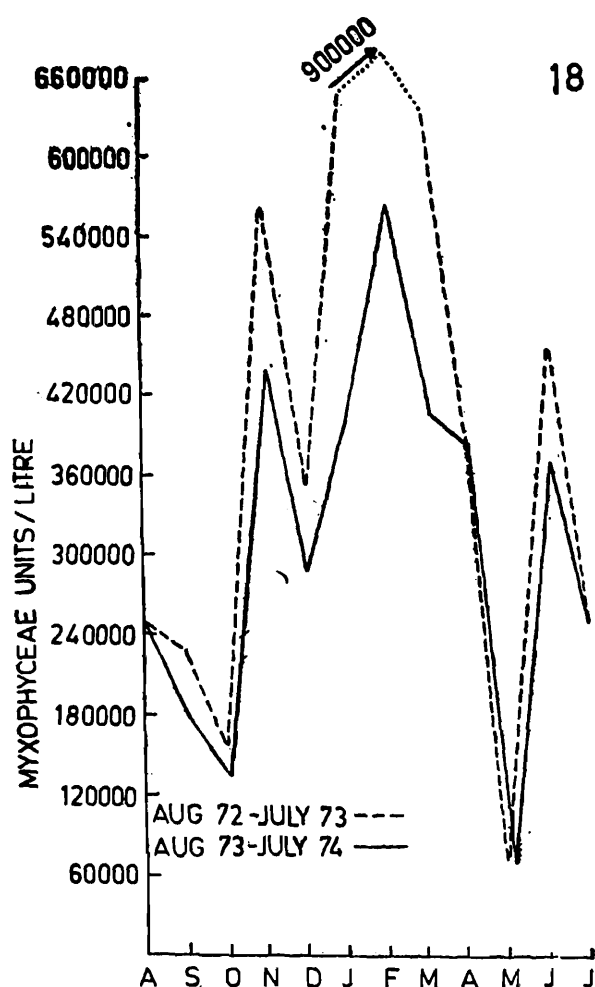
	Years	
Annual average units/litre of total	1972-73	1973-74
Phytoplankton	410208	313732
Annual average percentage of		
(a) Myxophyceae	98.9%	99.0%
(b) Chlorophyceae	0.5%	0.54%
(c) Euglenophyceae	0.3%	0.2%
(d) Bacillariophyceae	0.3%	0.3%

The data of the annual average units/litre of the phytoplankton clearly showed the abundance of the phytoplankton in the tank. The percentage composition of the various groups indicates that Myxophyceae was the dominant group and ranged from 98.9 to 99%. The Phytoplankton population during

the first year (1972-73) was better represented in the tank. Extensive increase of the phytoplankton has resulted in the decrease of the zooplankton.

MYXOPHYCEAE

It was quite interesting that myxophyceae population was very rich dominated by



Figs. 18 & 19. Seasonal variations in the Myxophyceae and Chlorophyceae population.

TABLE—VII Phytoplankton population of the tank, August 1972 to July 1973 (Units/Litre)

Name of Genera	August 72	Sept. 72	Oct. 72	Nov. 72	Dec. 72	Jan. 73	Feb. 73	March 73	April 73	May 73	June 73	July 73
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
MYXOPHYCEAE												
<i>Microcystis</i>	38520	142504	70695	187562	9686	55990	49589	32662	24813	22860	22168	39592
<i>Oscillatoria</i>	1648	17449	18824	8920	22767	448640	54125	437807	283239	10245	4289	—
<i>Spirulina</i>	211180	69472	65486	267665	239451	148007	311525	162715	78288	33750	433485	207361
<i>Anabaena</i>	—	—	—	—	—	—	—	—	1871	1515	1059	—
<i>Nostos</i>	—	—	—	—	—	—	—	—	—	—	—	—
TOTAL :	251348	229425	155005	564147	351904	651639	902371	643501	393323	68370	461001	246953
CHLOROPHYCEAE												
<i>Eudorina</i>	—	396	—	—	—	—	1210	—	—	—	535	—
<i>Pandorina</i>	—	—	—	—	—	—	201	—	—	120	91	—
<i>Pediastrum</i>	—	886	—	—	—	—	592	—	—	220	153	—
<i>Spirogyra</i>	—	—	333	270	38	795	—	—	281	300	—	—
<i>Staurastrum</i>	—	395	—	405	—	—	—	—	—	—	—	—
<i>Scenedeanus</i>	1168	1409	1561	—	1045	3046	1944	2895	—	930	838	—
<i>Closterium</i>	—	—	—	235	494	632	432	750	76	—	102	186
TOTAL :	1168	3086	1894	910	1577	4473	3379	3645	357	1560	1719	186
EUGLENOPHYCEAE												
<i>Englena</i>	1408	222	226	1380	565	453	1613	4437	1568	240	—	84
<i>Phacus</i>	432	—	360	—	188	55	157	320	—	—	244	113
TOTAL :	1840	222	486	1380	753	588	1775	4757	1568	240	244	197
BACILLARIOPHYCEAE												
<i>Cyclotella</i>	232	—	—	—	—	—	—	—	—	—	—	228
<i>Fragillaria</i>	—	111	—	—	—	508	—	—	921	—	122	—
<i>Pinularia</i>	—	—	817	—	—	—	—	817	—	—	—	257
<i>Asterionella</i>	709	—	392	—	12	110	587	—	—	—	—	—
<i>Synedra</i>	232	514	971	270	—	3205	—	—	—	—	—	580
<i>Navicula</i>	—	160	260	1245	—	—	593	375	365	—	—	—
TOTAL :	1153	785	2440	1515	12	3823	1180	1192	1286	—	122	1065
TOTAL PHYTOPLANKTON	255529	233518	159825	567952	304246	660443	909705	653095	396534	70170	463036	248401

TABLE—VIII Phytoplankton populations of the tanks August 73 to July 1974 (Units/Litre)

Name of the Genera	August 73	Sept. 73	Oct. 73	Nov. 73	Dec. 73	Jan. 74	Feb. 74	March 74	April 74	May 74	June 74	July 74
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
MYXOPHYCEAE												
<i>Microcystis</i>	60716	147412	1014	115491	52542	22085	21892	16761	18034	45401	31600	59880
<i>Oscillatoria</i>	—	—	—	1860	15192	270799	329807	284380	278280	6710	7146	—
<i>Spirulina</i>	186125	34114	60796	320644	218018	111131	244176	108782	85856	42143	331433	186306
<i>Anabaena</i>	—	—	—	—	—	—	—	—	266	463	706	—
<i>Nostoc</i>	—	—	—	—	—	—	—	495	1363	—	—	—
TOTAL :	246841	181528	131326	437995	285752	404015	565875	409923	383799	64717	370885	246185
CHLOROPHYCEAE												
<i>Eudorina</i>	—	359	—	—	—	—	—	—	—	—	113	—
<i>Pandorina</i>	—	118	332	—	171	—	—	—	—	—	80	—
<i>Pediastrum</i>	822	540	—	—	202	—	98	—	—	126	286	—
<i>Spirogyra</i>	103	—	1350	557	75	176	—	—	66	110	—	—
<i>Scenedesmus</i>	408	1219	82	1515	550	164	230	1409	1329	591	900	510
<i>Staurastrum</i>	—	650	156	249	—	—	—	—	—	—	—	—
<i>Closterium</i>	—	—	—	—	248	206	132	80	66	—	—	—
TOTAL :	1333	2936	1420	2321	1246	546	460	1489	1461	827	1379	1033
EUGLENOPHYCEAE												
<i>Euglena</i>	328	560	2470	777	258	308	273	363	109	41	153	194
<i>Phacus</i>	141	—	156	—	156	—	187	114	118	—	100	220
TOTAL :	469	560	2626	777	414	308	460	477	227	41	253	414
BACILLARIOPHYCEAE												
<i>Cyclotella</i>	208	—	—	275	—	—	—	—	—	—	—	430
<i>Fragillaria</i>	—	—	—	—	—	32	—	—	—	—	33	—
<i>Pinnularia</i>	—	—	549	—	—	—	—	148	—	190	—	400
<i>Asteriobiella</i>	91	—	254	—	231	—	84	—	—	—	—	—
<i>Navicula</i>	75	963	—	655	1038	105	—	154	—	42	—	—
<i>Synedra</i>	1369	1104	1369	1674	246	354	—	—	—	—	—	500
TOTAL :	1743	2363	217²	2604	1515	491	84	302	—	232	33	1380
TOTAL PHYTOPLANKTON	250186	187385	138044	443697	288927	405390	566879	412191	385487	62812	372550	248963

common genera such as *Microcystis*, *Oscillatoria*, *Spirulina* and *Anabaena* *Nostoc* were very few. The maximum Myxophyceae population was found in the month of February 1973-74 and minimum in May 1973-74. In other months there was a fluctuation in the number, Marked variations in their population were observed in different seasons, but a definite cycle was noticed. The major pulses were generally due to *Microcystis*, *Oscillatoria* and *Spirulina*. *Anabena* was found in large number from August to September 1972 (Fig. 18).

CHLOROPHYCEAE

The members of Chlorophyceae showed seasonal variations in their members (Fig. 19). The tank had moderate chlorophyceae population and the maximum was in January

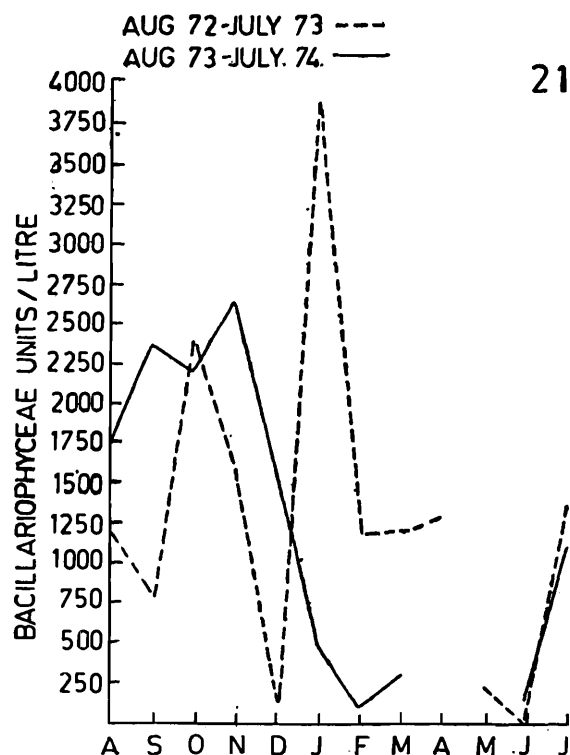
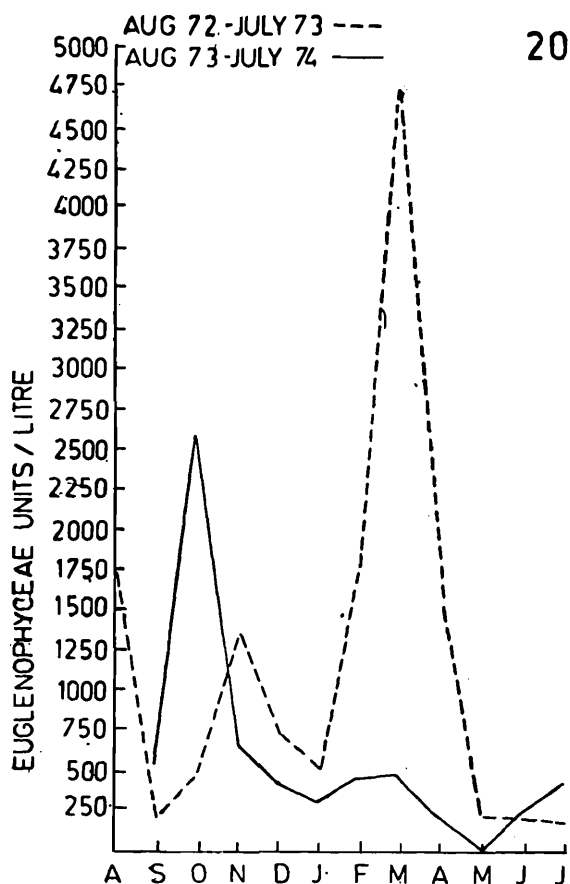
1973. The algae that contributed to chlorophyceae peak were *Scenedesmus* and *Pediastrum*.

EUGLENOPHYCEAE

The seasonal variations in Englenophyceae (Fig. 20) showed major pulse in March 1973, and in October 1973. *Englena* and *Phacus* produced the various peak periods in the tank.

BACILLARIOPHYCEAE

The members of Bacillariophyceae occurred only during certain months of the year. The diatoms showed a winter maxima in January 1973 and in November 1973 (Fig. 21). The diatoms causing pulses were *Synedra*, *Navicula* etc.



Figs. 20 & 21. Seasonal variations in the Euglenophyceae and Bacillariophyceae population.

Names of species of fish stocked in the tank.

The fry of the following fish species were released in the tank viz. (i) *Catla* (2) *Cirrhina mrigala* (3) *Labeo rohita* (4) *Cyprinus carpio*. In addition to the above fishes *Puntius stigma* and *Lebistes reticulatus* were also present in very large numbers.

The average annual fish production in the tank is as follows :

Gandhisagar tank	: 7020 kg in 1972-73
Managed by	(369 kg/h)
Fisherman's Society	: 20,735 kg. in
	1973-74 (109 kg/h)

This shows that the fish yield is quite adequate in the tank. The fish yield were more during the second year of investigation.

DISCUSSION

Comparison of the annual percentage composition of the plankton of the tank investigated showed that the tank was extremely rich in phytoplankton (99.45 to 99.46%) and the zooplankton was very much limited (0.54% to 0.55%). The major bulk of the phytoplankton (98.9 to 99.0%) was formed by Myxophyceae. The other three groups namely, Chlorophyceae, Euglenophyceae, and Bacillariophyceae together represented only (1 to 1.1%). The zooplankton was composed of Rotifera, Cladocera, Copepoda and nauplii. In the present tank rotifers and nauplii dominated the sample. The rotifers were 51.60% during the first year and 63.30% during the second. The nauplius larvae were 40.40% and 31.20% during first and the second year respectively. Cladocera ranged between 2.10% to 1.90% and Copepoda from 5.90 to 6.60%.

The present tank is used for pisciculture and is stocked heavily with fish. Every year, more than two lakhs of carp fry are released into the tank. Besides the fry some fishes of the previous stock are also present in the tank. The forage activities of this large fish population is mainly responsible for the depleted numbers of the large Zooplanktons such as Cladocera and Copepoda. Though the nauplii are present in good numbers forming 31 to 40 percent of Zooplankton, the adult copepods were limited to only about 6.60%. In the tank, the nauplii greatly exceeded the adults forming 31 to 40% of the Zooplankton. It is almost certain that this gives some measures of mortality during the life cycle but at present we can not attribute this to mortality with certainty as we have no direct evidence in the form of experimental data. As given earlier that besides the old fish stock every year more than two lakh fry of major carps like *Catla Catla*, *Cirrhina mrigala*, *Labeo rohita*, *Cyprinus carpio* are released in the tank.

The average annual yield of fish in this tank was 7020 Kg in 1972-1973 and 20,735 Kg in 1973-74. The breeding activity of the fry, fingerlings, fresh fish and *Catla catla* might be responsible for the reduced number of the adult Copepods. It is well known that the organisms choose their food on the basis of their size, abundance, edibility and the ease with which it is caught as stated by Brooks and Dodson (1965) when the environment provides a choice, the predator most consistently chooses the largest food morsel available. They have shown that in the predation by Clupeid *Alosa pseudohargenus* upon lake zooplankton in which the usual large size crustacean dominants, such as

Daphnia, *Diaptomus* are eliminated and are replaced by small sized basically littoral species. It is also likely that the low percentage of Cladocera ranging between 2.10 to 1.90 percent could have been due to predatory impact. It may be thus inferred that the forage activity of this large fish population is probably responsible for the depleted number of adult Crustaceans. This view is further supported by Kalninya (1967) who made similar observations in connection with the zooplankton utilised by fish and their fingerling. Shetty *et al* (1962) who established correlation between plankton and fisheries stated that that young of almost all fishes and many adults feed on plankton and often a direct relationship is seen between the density of plankton and number of plankton feeding fish. During the two year study of the plankton 24 species of rotifers were recorded. The major pulse was observed in November, 1972 and January 1974. This showed that rotifers showed only one pulse per year in the tank. Arora (1965-66) studied the systematics and from variations of the rotifera from Nagpur. George (1961) recorded 32 species of plankton rotifers from 30 tanks in Delhi state. Michael (1964) recorded 30 species rotifers from perennial ponds from Barrackpore and stated that six of them were dominant. George (1961) stated that *Keratella valga f. tropica* Apstein or the different species of *Branchionus* always showed numerical superiority over the other rotifers. He has reported the presence of more than two species of one genus in a single sample. The genus *Branchionus* entered into such a species composition as many as four species namely *B. calyciflorus*, *B. falcatus*, *B. quadridentatus* and *B. bidentata* were

recorded from single sample. The genus *Filinia* also showed two species. Pennak (1957) has pointed out that whenever two species of the same genus are present in a sample, one is almost always abundant than the other. He also observed that two species of the same genus appear occasionally in a single sample. In the present investigation it was observed that three genera, namely *Branchionus*, *Keratella* and *Filinia* entered into such a species composition and as many as two species of *Branchionus* viz. *B. angularis* *B. calyciflorus* were present in a single sample. The other genera showing such a species composition in a single sample were *Filinia* *Keratella*. Generally there was observed a numerical superiority of one species over the other as pointed out by Pennak (1957). When the sample contained few individuals of each composite species, then the numerical superiority of one species over the others was not observed.

Though the rotifers form a valuable food for the carp fry, only a few workers from India have studied their ecology. Alikuhni *et al.* (1955) observed the quantitative variations of rotifer from nursery tanks in Calcutta. Das and Srivastava (1956) made a few remarks on the rotifers present in a tank in Lucknow. George (1961) studied the periodicity, species composition and diurnal migration of rotifers from shallow ponds in Delhi. Michael (1964) studied the seasonal variations of some planktonic forms and the major factors influencing the growth of the loricate rotifers. He opines that those rotifers with well developed lorica (*Branchionus*, *Keratella*) usually have their maximum intensity during the summer months with peak in April or May and this

period coincided with higher total alkalinity and temperature. This was also observed by Gray (1953) and Byars (1960). The non-loricate forms such as *Asplanchna* occurred only during September October and December to February and further stated that the presence of large amount of phytoplankton and the prevalent temperature condition might have been responsible for this (Welch, 1952).

In the present investigation *Brachionus angularis*, *B. forficula*, *Keratella tropica*, *Keratella cochlearis* were observed in good numbers. The rotifers generally showed peak periods in different seasons and the peak periods were between January in case of *B. angularis* and *B. calyciflorus* and in August in *B. forficula* and *K. cochlearis*. This showed that loricated rotifers did not always show peak period in summer months in all the water bodies. George (1966) pointed out a summer periodicity (April, May) of rotifers in Delhi water but the present observation reveals that such periodicity cannot be attributed to total number of rotifers as stated by Nayar (1970). Pennak (1949, 1955) also could not notice any seasonal periodicity for the rotifers while working on North American water bodies. In the present investigation the rotifers did not show any definite seasonal periodicity and the pulses are noticed irregularly in the tank.

Brachionus calyciflorus is a cosmopolitan species and more common in warm water, it was present throughout period of investigation except in January. The presence of this species is euryplastic and can tolerate wide range of temperature. Nayar (1970) has made similar observations for this species ;

while working on the plankton ecology of Piliyani tank and college pond in Rajasthan.

Many workers have stated that the rotifera are cosmopolitan and this view is supported by large number of investigators like Rousselet (1909), Thomasson (1955), Russell (1960) Amren (1964) and Green (1964). Cosmopolitism is found common in many species of rotifera but there are considerable differences in the species list of tropical and temperate region plankton as suggested by Green (1972).

In the present study it has been found that most of the rotifer species found at Nagpur are cosmopolitan but at the same time species like *Branchionus caudatus*, *Keratella tropica* which are cosmotropical in nature are also found in the samples.

Green (1972) pointed out that in tropical region the cosmopolitan species are more than cosmotropical species because the temperature is often high at temperate latitude to enable a tropical rotifer for their substantial population and also stated that the short life cycle, small size and opportunity, pattern of life make them ideal as cosmopolitan species. The present data corroborates the view of Green (1972) as very few cosmotropical rotifers were found during the investigation.

Filinia longiseta occurred almost throughout the two years of investigation reaching a maxima in December in first year and in August in the second year. A similar occurrence has been noted for some rotifers by Nayar (1970). It can be presumed that such distribution are probably controlled by some other factors other than temperature.

Trichocerca cylindrica was recorded in both

years but its occurrence was irregular and was comparatively very poor. The reduced number of *Trichocerca cylindrica* during winter months might be due to the prevailing low temperature.

Asplanchna intermedia was sparse in the tank and its appearance was not continuous through the two years and the maximum density was noticed in December 1972. It can be concluded that there is not any specific period for the appearance of this species. It is a predatory form swallowing whole rotifers and crustaceans as colonial algae as stated by Edmondson (1959).

In the present observations *Keratella cochlearis* and *Polyarthra vulgaris* were found to be in the surface layers tolerating wide range of temperature. This is in conformity with the observations of Pejler (1957) who reported the occurrence and abundance of 39 species of rotifers in Alpine lakes, 10 subalpine lakes, numerous tanks and ponds and pointed out that *Keratella cochlearis* and *Polyarthra vulgaris* were eurythermal forms.

In all 9 species of Cladocera belonging to 9 genera were observed the tank. *Moina dubia* was found to be dominant in the present tank with maxima in August '72 and '73. Remaining Cladocerans were found in small numbers. In all total Cladoceran numbers were very much poor as compared to rotifers the reason might be due to forage activity of the fish, fry, fingerlings and adults fishes. The other probable reason for the depleted number of Cladocera might be due to the presence of excess of phosphate on concentration. Phosphate promotes the production of blue green algae which may release toxic substances in the medium and provoke high pH due to intense photosyn-

thesis during the day time which might have reduced the number of Cladoceran population in the tank. This is in conformity with the observation of Dumont (1968) who has given the same reason for the extinction of cladoceran species. This view is further well supported by O'Brien and Noyelles Jun (1972) while discussing the effect of photosynthetically elevated pH on Zooplankton mortality and pointed out that abundance of phytoplankton causes toxic effect on *Ceriodaphnia reticulata*.

Among the Copepods sp. was the dominant form and it was present throughout the two year period. It is interesting to note that the maximum intensity shown by *Cyclops* sp. in the two years, follows definite pattern, in the the tank. If the peak is in winter (November to January) in one year then in the subsequent year it is in summer or vice versa. With a present data of two years no specific reasons can be attributed to the alternatively changing seasonal peak periods of *Cyclops* sp., *Mesocyclops hyalinus* found in considerable number but the other copepod *Diaptomus* sp. was found only during certain months of the year.

The phytoplankton was quite rich and the average units/litre were 410208 in 1972-73 and 313732 in March 1973-74. The major pulse were found in February 1973-74. The myxophyceae dominated the samples and the maximum number of Myxophyceae recorded was 902371 units/litre in February 1973., 565875 units/litre in February 1974. Taking into account Myxophyceae as an indicator of the trophic status of the water body, the tank can be classified as on Eutrophic system. Eutrophic lake is rich in nutritive material such as N₂, phosphorus

and calcium (Welch, 1952) The present tank is also rich in nutritive material which shows eutrophic nature of the tank. Earlier workers have suggested many possible factors for production of algal population (bloom) in lakes and ponds. Smith (1924), Pearsall (1932), Ganapati (1940), Komorovsky (1953), Chacko and Krishnamurthy (1954), Singh (1955), George (1962), have associated the abundant growth of phytoplankton with one or more factors namely light intensity, high temperature, stagnation, high Nitrogen and Phosphate content, high pH, high carbonates and bicarbonates. Vyas and Kumar (1968) showed a direct correlation with pH and temperature.

The present tank is polluted by domestic sewage, faecal pollution and seepage of textile mill effluent from an adjoining tank. The phosphate content of the water was quite high and ranged between 2.1 to 11mg/litre and ammonia from 0.2 to 1.05. There is noticed stagnation of water in the tank as it is situated in the heart of the city and is not exposed to direct wind. The factor such as high phosphate content, stagnation, high bicarbonate values and low turbidity (good transparency) seem to be associated with the phytoplankton richness in the tank.

During the present study it was observed that phosphate content and dissolved oxygen showed a positive correlation coefficient, $r=0.63$). Similarly the correlation coefficient (r values) between total phytoplankton and phosphates ; between total phytoplankton and D. O. values were found to be 0.58 and 0.50 respectively. This showed that there was a definite correlation in the abundance of the phytoplankton and high phosphate content. The presence of rich growth of

the phytoplankton may also have been due to the reduced number of *Daphnia* and other large Cladocera (Hrbacek et al. 1961).

Lakshminarayana (1965) while correlating pH and phytoplankton density stated that relatively high pH value were observed when phytoplankton was rich. Vyas and Kumar (1968) pointed out that the summer maxima of phytoplankton correspond with high pH but the pH values were comparatively lower during the months of September (rains) and December (winter) when the maximum production of phytoplankton was attained. During the present study it was observed that maximum production of phytoplankton was in different months and the pH was relatively high and varied between 8.5 to 9.62.

The present data reveals a somewhat direct relationship of Zooplankton production. The microcrustacean generally feed on minute phytoplanktonic forms, epiphyton and also detritus. The peaks of phytoplankton and zooplankton follow one another or sometime coincided, showing direct relationship. Pahwa and Mehrotra (1966) also showed direct relationship between zooplankton and phytoplankton. Diatom showed a definite pulse in winter as was also shown by George (1966) for Delhi tank. Bush and Welch (1972) found blue green algae not very abundant and occurred in the water which is warmest. Munawar (1974) observed most of the maxima of phytoplankton in winter and minima during monsoon season. He further stated that Diatoms were the dominant group of phytoplankton in all the water bodies of Hyderabad in all the seasons. It was observed that fluctuations in turbidity dissolved oxygen, and pH were found

especially during the monsoon season as shown by (Vaas 1954, Chow 1958, Tucker 1958) who observed that variation in chemical factors of fresh water tank have generally been found to be due to effect of rain fall. The normal pattern of water level in the tank was found to be decreased in the summer months bringing about a change in the chemical factors.

The turbidity range was between 28.7 to 146mg/litre. The effect of turbidity is noticed in terms of changes in Phyto-and Zooplankton population. This observation corroborates well with the view of Jermolajev (1958) who opines that heavy turbidity is injurious to phytoplankton and zooplankton.

Carbon dioxide was not observed during the period of investigation. This could be correlated with high pH as shown by Sarker and Rai (1964) that pH of water was distinctly alkaline since CO_2 was absent and CO_3 was recorded in appreciable quantities.

In the present study it has been observed that the total hardness was always above 80 mg/litre which indicates that the tank is suitable for growth of organisms as pointed out by Swingle (1967). He states that pond water having total hardness of 50 mg/litre or above are suitable for favourable growth.

The phosphate content of the tank was high and the phytoplankton was quite rich during both the years. Thus a close relation between phosphate content and phytoplankton abundance has been noticed as stated by Tucker (1957).

Rai (1974) also stated that increase in phosphate ion concentration is related to phytoplankton yield.

Kow (1963) found direct relationship between phytoplankton and copepods and

their peaks coincided, but in the present study it is found that the peaks are not exactly coincided but follow one another showing definite relationships.

Ali (1972) has given that water having pH 6 to 9.7 are fit for fish rearing and the lethal effect start on acid side at pH 9.5. In the present tank pH was alkaline and ranged between 8.5 to 9.62. This shows that the present tank is fit for fish rearing as the pH of water was quite good excepting on one or two occasions where it is above 9.5 and this may be due to fertilization by excess of phosphate ion which results into photosynthetically high pH.

Thus, the physico-chemical factors reveal that this tank is favourable for fish rearing, if the excess of phosphate ion concentration is reduced to certain extent to minimise phytoplankton population. This tank can provoke a good yield as the food base of the tank can ensure better nourishment for suitable fish crop. It should be mentioned that during the present investigation the population of zooplankton was found to be very much less as compared to phytoplankton population and this may be due to feeding activity of the fish stock. It is suggested to increase zooplankton population in order to enhance more fish production. Though the tank is presently exploited and is under pisciculture, a better treatment of the tank such as prevention of entry of organic matter, reduction of phosphate ion concentration to certain extent is necessary to obtain a maximum fish yield.

SUMMARY

Plankton ecology of tank from Nagpur has been studied. The tank is leased to

fishermen for rearing fishes, water samples and plankton was collected once a week for a period of two years. The physical chemical factors recorded include temperature, turbidity, pH, free carbon dioxide, carbonate and bicarbonate alkalinity, chloride, total hardness, dissolved oxygen, phosphate and free ammonia.

Plankton samples were collected separately for qualitative and quantitative analysis. In the quantitative estimation, of phytoplanktonic forms were enumerated by "drop method". Total hardness, phosphate and free ammonia were recorded only during one year of investigation.

The Zooplankton composed of rotifers, cladocera, copepods and nauplius larvae. The annual percentage composition of the various groups showed that rotifers were the dominant forms. During the course of study 24 species of rotifers, 9 of Cladocera and 3 copepoda were recorded. Nauplius larvae were recorded throughout the both years. The annual % composition of various group is given.

The phytoplankton contained major groups namely Myxophyceae, Chlorophyceae, Euglenophyceae and Bacillariophyceae. The annual % composition of these groups is given. The Myxophyceae was the dominant group.

The tank is stocked with large number of fish which feed on Cladocera and Copepoda, hence their number is reduced in the Plankton samples. However the rotifers dominated in the Zooplankton.

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**A NEW *HAPLODRASSUS* SPIDER FROM INDIA
(ARANEAE : GNAPHOSIDAE)**

By

U. A. GAJBE

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

ABSTRACT

A new species of the genus *Haplodrassus* Chamberlin, 1922, belonging to family Gnaphosidae, is described.

MATERIAL

The description is based on one female specimen.

The genus *Haplodrassus* was established by Chamberlin (1922) with *H. hiemalis* (Emerton) as the type species from America. Tikader & Gajbe (1977) reported this genus for the first time from India and described two species. Tikader (1982) described two more species from India.

While studying the spiders of the family Gnaphosidae the author encountered a new species of *Haplodrassus* which is described here.

The type specimen is deposited in the National Zoological Collections, Zoological Survey of India, Calcutta.

***Haplodrassus chotanagpurensis* sp. nov.**

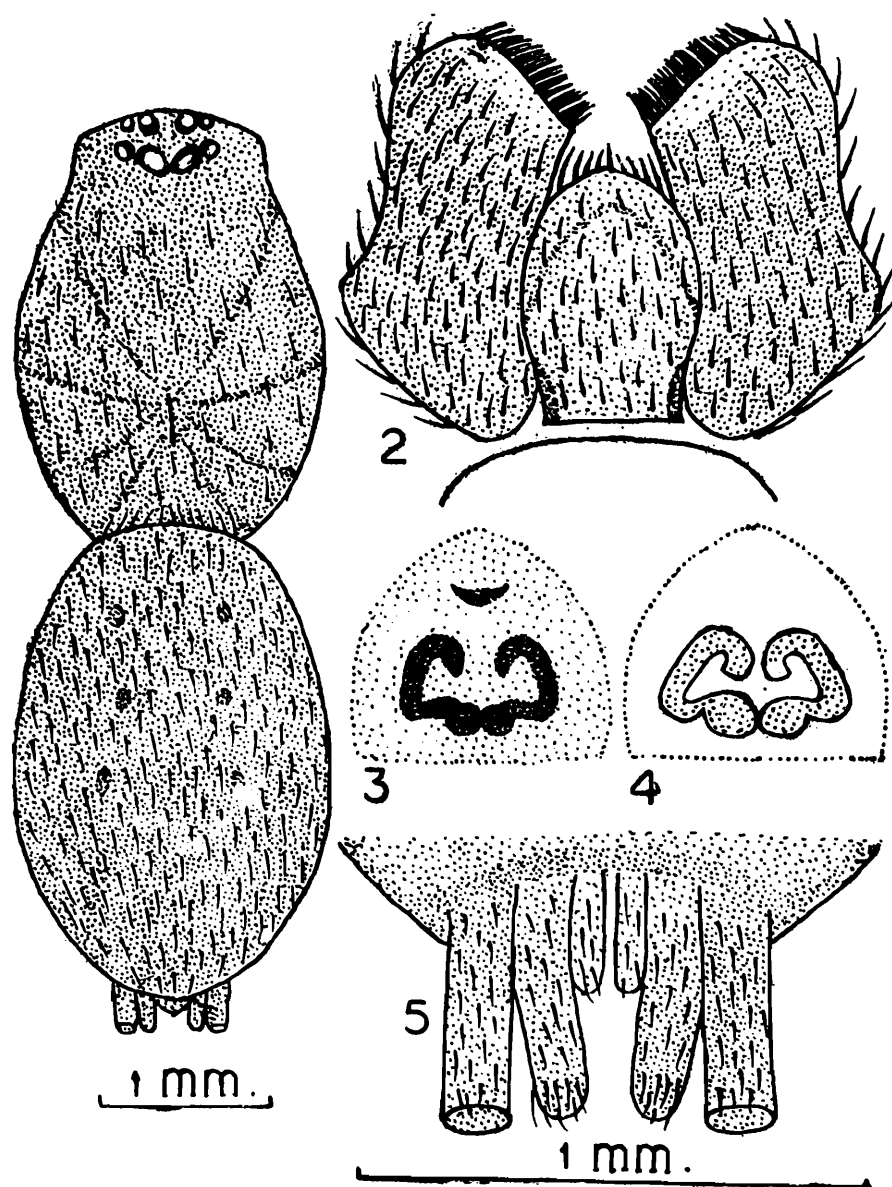
General : Cephalothorax and legs reddish brown, abdomen brown, Total length 5.30 mm. Carapace 2.50 mm. long, 1.90 mm. wide ; abdomen 2.90 mm. long, 1.90 mm. wide.

Cephalothorax : Longer than wide, broad in front, clothed with pubescence and some hairs, posterior middle provided with a conspicuous fovea. Eyes pearly white except anterior medians which are black, posterior row of eyes slightly longer than the anterior row. Anterior row of eyes slightly procurved (as seen from in front), medians slightly larger than the laterals and closer to laterals than to each other. Posterior row of eyes procurved, medians oblique, larger than the laterals and much closer to each other than

to the adjacent laterals. Chelicerae moderately strong, inner margin provided with three similar teeth and outer margin with four dissimilar teeth. Sternum heart-shaped, pointed behind, clothed with fine thick hairs. Labium and maxillae provided with scopulea, shape as in fig. 2. Legs relatively long and strong, clothed with hairs and spines. Metatarsi and tarsi I and II provided ventrally

with conspicuous scopulae and tarsi with prominent claw tufts. Legs formula 4123.

Abdomen: Longer than wide, nearly elliptical, clothed with thick mousy hairs and provided with three pairs of sagilla as in fig. 1. Ventral side much lighter than the dorsal and provided with small hairs. Epigyne as in fig. 3. Internal genitalia as in fig. 4. Spinnerets prominent, shape as in fig. 5.



Figs. 1-5. *Haplodrassus chotanagpurensis* sp. nov. 1. Dorsal view of female, legs omitted. 2. Labium and maxillae, 3. Epigyne, 4. Internal genitalia, 5. Spinnerets.

Holotype : female (Regd. No. 5147/18) in spirit, other details as above.

Type-locality : INDIA : Bihar, Chotanagpur, Singbhum District, date 10.xi.1955. Coll. A. P. Kapur.

Remark : This species resembles *Haplodrassus sataraensis* Tikader & Gajbe but differs from it as follows : (I) Inner and outer margin with three and four teeth but in *H. sataraensis* inner and outer margin with two and three teeth respectively (II) Abdomen uniform with mousy hairs and three pairs of sagilla but in *H. sataraensis* abdomen provided with chalk-white cheverons (III) Epigyne and internal genitalia structurally different.

ACKNOWLEDGEMENT

I am grateful to Dr. B. K. Tikader, former Director, Zoological Survey of India for assigning the project and constant encouragement in my research work. I am thankful to Dr. P. D. Gupta, Deputy

Director, Officer-in-Charge, Zoological Survey of India, Central Regional Station, Jabalpur for providing necessary facilities. I am also thankful to Dr. N. I. Planick, Curator, Arachnida Division, American Museum of Natural History, New York for help of literature on gnaphoside spiders.

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A NEW *RACHODRASSUS* SPIDER FROM INDIA
(ARANEAE : GNAPHOSIDAE)

By

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

ABSTRACT

A new species of the genus *Rachodrassus* Chamberlin, 1922, belonging to family Gnaphosidae, is described.

The genus *Rachodrassus* was established by Chamberlin (1922) with *R. echinus* Chamberlin as a type species from America. Platnick & Shadab (1976) in his revisionary work on genus *Rachodrassus* described two more species from America.

While studying the spiders of the family Gnaphosidae the author encountered a new species of *Rachodrassus*. This genus is being recorded for the first time from Asia.

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

The species is named after Dr. B. K. Tikader, a well known arachnologist, as a token of the high regard which the present author have for him.

Rachodrassus tikaderi sp. nov.

General : Cephalothorax and legs light

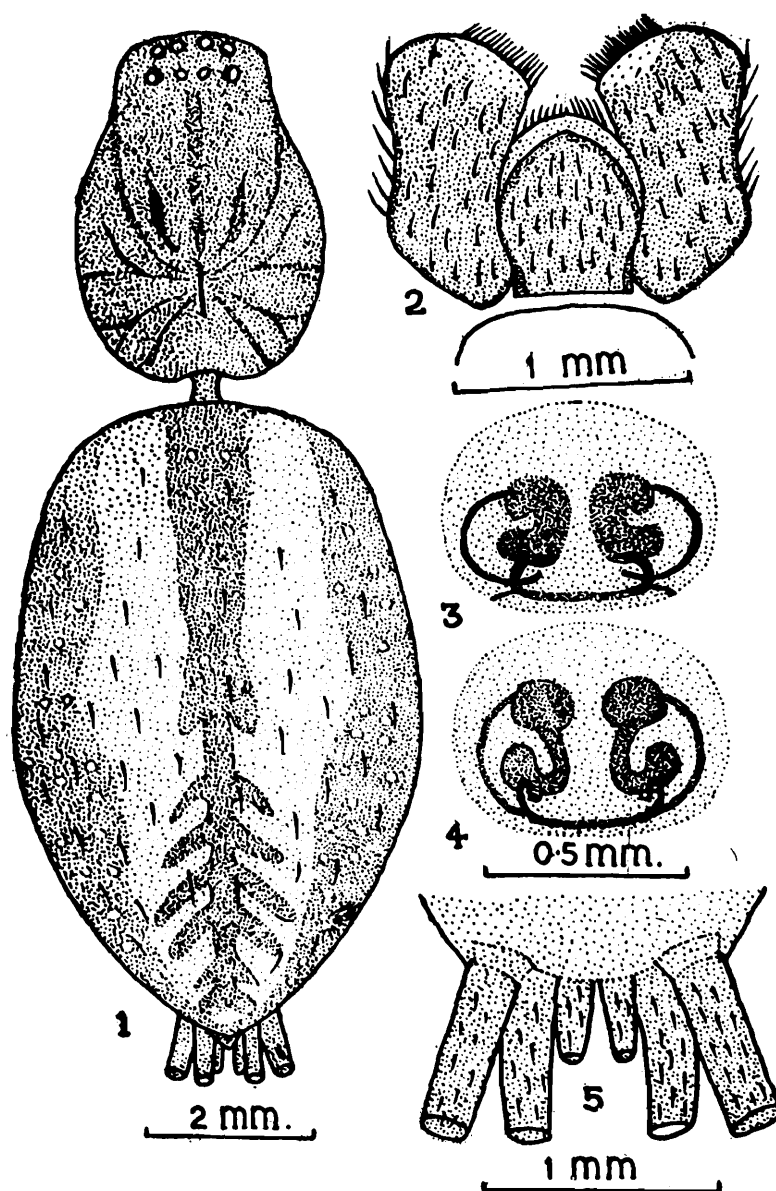
brown, abdomen light gray. Total length 12.40 mm. Carapace 4.00 mm. long, 3.00 mm. wide ; abdomen 8.00 mm. long, 5.00 mm. wide.

Cephalothorax : Longer than wide, oval, convex, widest at coxae II and III, clothed with pubescence, posterior middle of cephalothorax provided with an conspicuous fovea. Radiating streaks diverge from fovea to lateral sides of cephalothorax. Eyes rows distinctly separated, pearly white except anterior medians which are black, posterior row of eyes slightly longer than the anterior row. Anterior row of eyes slightly recurved (as seen from infront), medians smaller than the laterals and slightly closer to adjacent laterals than to each other. Posterior row of eyes slightly recurved, medians oval, smaller than laterals and closer to each other than the adjacent laterals. Median ocular quadrangle longer than broad and slightly narrow

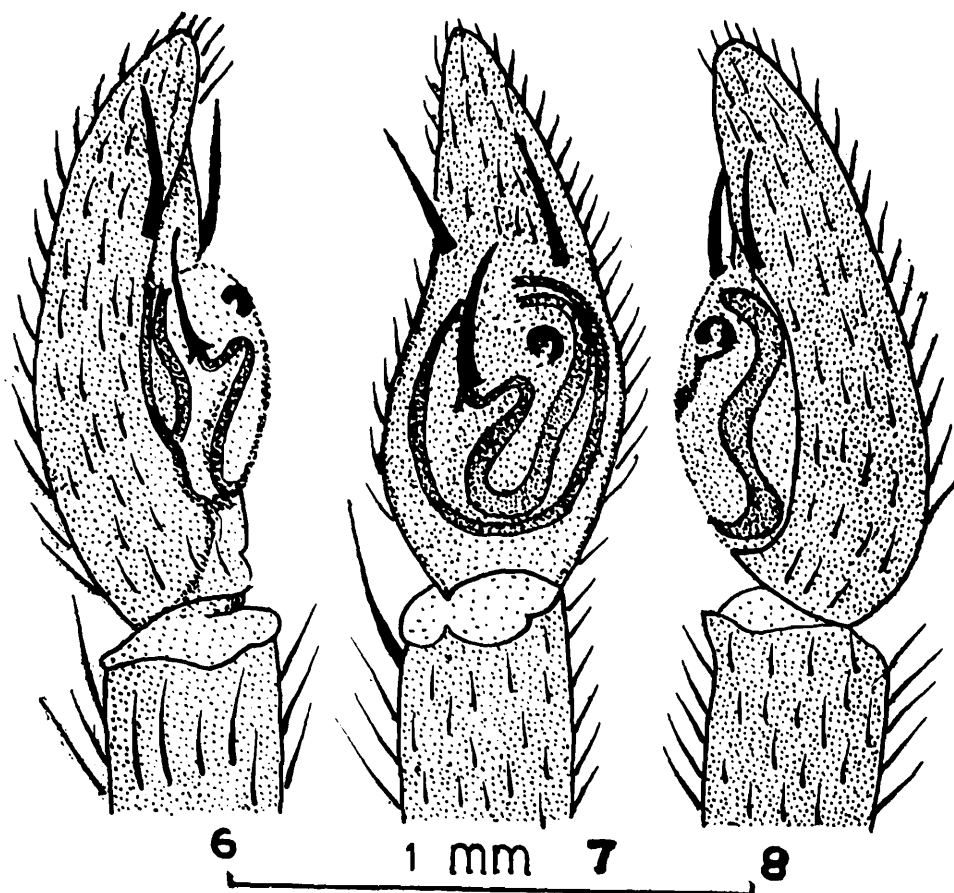
behind than in front. Clypeal height greater than diameter of anterior median eye. Sternum heart-shaped, pointed behind, clothed with hairs. Labium longer than wide, anterior end of labium and maxillae provided with scopulae, shape as in fig. 2. Chelicerae moderately strong, vertical, inner margin provided with a one small tooth and outer margin with three dis-similar teeth. Legs relatively long and thin, clothed, with hairs

and some spines, tibia IV provided with two dorsal spines, leg formula 4123.

Abdomen: Longer than wide, nearly elliptical, clothed with pubescence and some hairs. Abdomen dorsally provided with deep brown longitudinal patches and some chevron patterns as in fig. 1. Ventral side slightly lighter than the dorsal. Epigyne as in fig. 3. Internal genitalia as fig. 4. Spinnerets prominent, anterior spinnerets



Figs. 1-5. *Rachodrassus tikaderi* sp. nov. (1) Dorsal view of female, legs omitted. (2) Labium and maxillae. (3) Epigyne. (4) Internal genitalia. (5) Spinnerets.



Figs. 6-8. (6) Left male palp, pro-lateral view. (7) Left male palp, ventral view. (8) Left male palp, retrolateral view.

widely separated, Posterior spinnerets slightly longer than the others as in fig. 5. Male same in colour but slightly smaller than the female. Male palp as in fig. 6, 7, 8.

Holotype : Female, (Reg. No. 5132/18)
paratype one female, (Reg. No. 5133/18)
allotype one male (Reg. No. 5134/18) in spirit.

Type-locality : INDIA, Himachal Pradesh, Ragul Kalpa Dist. Solan, date 15. IV. 1970, Coll. K.K. Mahajan.

Remarks : This species resembles with *Rachodrassus echinus* Chamberlin but differs from it in the structure of epigyne, internal genitalia and male palp.

ACKNOWLEDGEMENT

I am grateful to Dr. B. K. Tikader, former Director Zoological Survey of India for assigned

the project, constant encouragement in my research work and for publication facilities. I am thankful to Dr. Norman I. Platnick, American Museum of Natural History, New York for help of literature on gnaphosid spiders.

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**A NEW *SCOPODES* SPIDER FROM INDIA
(ARANEAE : GNAPHOSIDAE)**

By

U. A. GAJBE

*Zoological Survey of India
Central Regional Station, Jabalpur*

ABSTRACT

A new species of the genus *Scopodes* Chamberlin, 1922, belonging to family Gnaphosidae is described.

MATERIAL

The description is based on one female and four male specimens.

The genus *Scopodes* was established by Chamberlin (1922) with *S. catharius* Chamberlin as a type species from America. Tikader & Gajbe (1977) reported this genus for the first time from India and described one species. Tikader (1982) described two more species from India.

While studying the spiders of the family Gnaphosidae the author encountered a new species of *Scopodes* which is described here.

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

The species is named after Dr. B. K. Tikader, a well known arachnologist, as a token of the high regard which the author has for him.

***Scopodes tikaderi* sp. nov.**

General : Cephalothorax and legs light reddish-green, abdomen brown. Total length 5.50mm. Carapace 2.30mm. long, 1.80mm, wide ; abdomen 3.20mm. long, 2.00mm. wide.

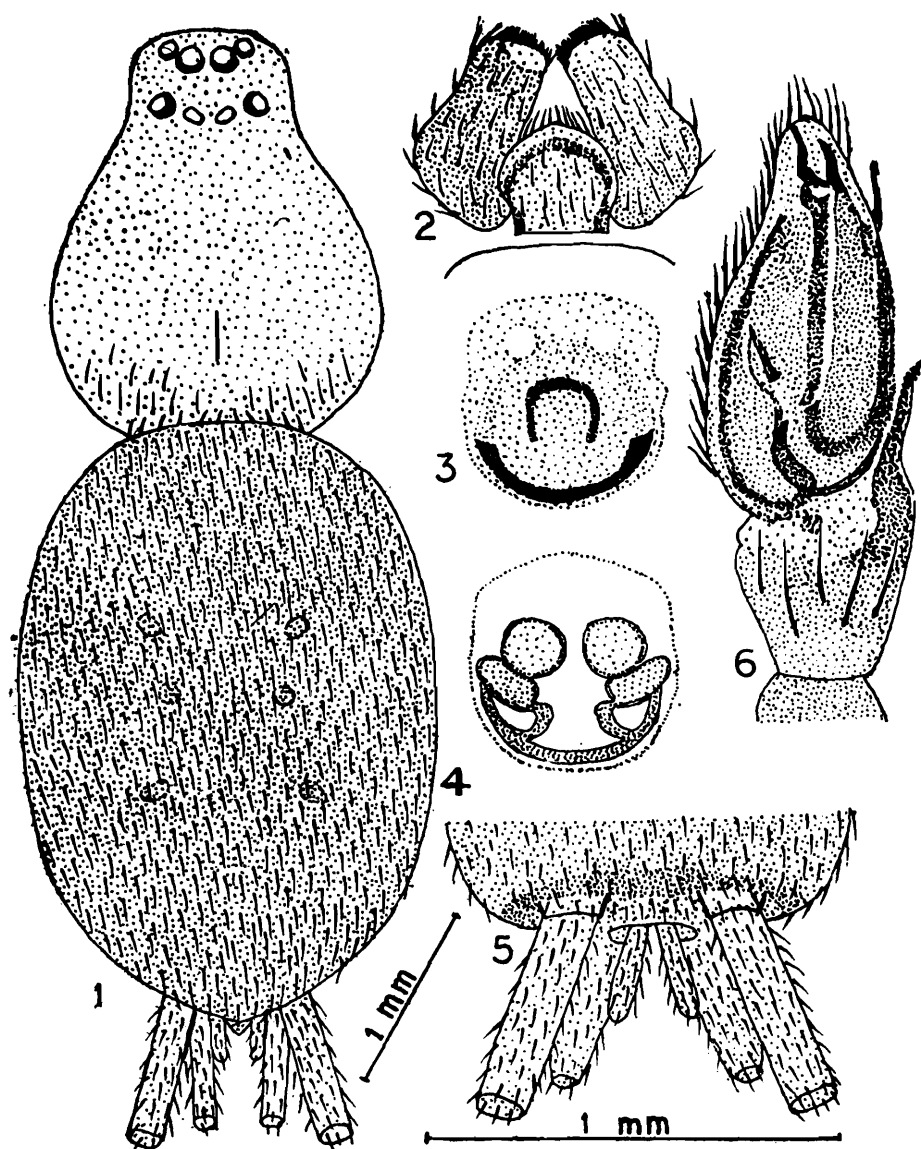
Cephalothorax : Longer than wide, convex narrow in front, cephalic region slightly high, posterior middle provided with a conspicuous fovea, clothed with pubescence and below fovea there are some spine like hairs. Eyes pearly white in colour except anterior medians which are slightly black, posterior row of eyes same in length as the anterior row. Anterior row of eyes slightly procurved, anterior medians are larger than all the eyes, circular and closer to adjacent laterals than to each other. Posterior row of eyes moderately procurved, more or less equal and equidistant from each other, medians elliptical in shape as in fig. 1. Clypeus narrow. Sternum oval, pointed behind and clothed with long spine

like hairs. Labium and maxillae longer than wide, anteriorly provided with scopulae, shape is in fig. 2. Chelicerae vertical inner margin with three bigger teeth. Legs relatively long and strong, clothed with hairs and spines, legs formula 4123.

Abdomen : Longer than wide, oval, narrowed behind, clothed with fine hairs and provided with three pairs of sagilla. Ventral side lighter than the dorsal, clothed with fine

hairs. Epigyne as in fig. 3. Internal genitalia as in fig. 4. Spinnerets very prominent, anterior spinnerets cylindrical and longer than others as in fig. 5. The colour and size of the male specimens almost like female, male palp as in fig. 6.

Holotype : female (Reg. No. 5145/18), **para-type** 3 males (Reg. No. 5146/18), **allotype** one male (Reg. No. 5146/18) in spirit other details as above. **Type-locality :** INDIA, Madhya



Figs. 1-6. *Scopodes tikaderi* sp. nov. (1) Dorsal view of female, legs omitted. (2) Labium and maxillae. (3) Epigyne. (4) Internal genitalia. (5) Spinnerets. (6) Left male palp ventral view.

Pradesh, Hatkachora near Jagadapur, Bastar district, date 2.1. 1984. coll. U. A. Gajbe, *Paratype Allotype* : INDIA, Madhya Pradesh, Orchha village, Bastar District, date 28 xii. 1983, coll. U. A. Gajbe.

Remark : This species closely resembles with *Scopodes maitraiae* Tikader & Gajbe but differs from it as follows : (I) Posterior row of eyes equal to the anterior row but in *S. maitraiae* posterior row of eyes longer than the anterior row. (II) Abdomen uniform but in *S. maitraiae* abdomen with small whitish spots. (III) Epigyne, internal genitalia and male palp also structurally different.

ACKNOWLEDGEMENT

I am grateful to Dr. B. K. Tikader, former Director, Zoological Survey of India for assigning the project and constant encouragement in my research work. I am thankful to Dr. P. D. Gupta, Deputy Director, Officer-in-Charge, Zoological Survey of India,

Central Regional Station, Jabalpur for providing necessary facilities. I am also thankful to Dr. N. I. Platnick, Curator, Arachnida Division, American Museum of Natural History, New York for help of literature on Gnaphosidae spiders.

REFERENCES

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- TIKADER & GAJBE. U. A. 1977. Studies on some spiders of the genera *Scopodes* Chamberlin, *Megamyrmecon* Reuss, *Scotophaeus* Simon and *Liodrassus* Chamberlin (Family : Gnaphosidae) from INDIA. *Rec. zool. Surv. India*. 73 : 13-22.

**A NEW *DRASSYLLUS* SPIDER FROM INDIA
(ARANEAE : GNAPHOSIDAE)**

By

U. A. GAJBE

Zoological Survey of India, Jabalpur

ABSTRACT

A new species of the genus *Drassyllus* Chamberlin, 1922, belonging to family Gnaphosidae is described.

MATERIAL

The description is based on one female specimen.

The genus *Drassyllus* was established by Chamberlin (1922) with *D. fallens* Chamberlin as a type species from America. Tikader & Gajbe (1976) reported this genus for the first time from India and described two species. Tikader (1982) described one more species from India.

While studying the spiders of the family Gnaphosidae the author encountered a new species of *Drassyllus* which is described here.

The type specimen is deposited in the National Zoological Collections, Zoological Survey of India, Calcutta.

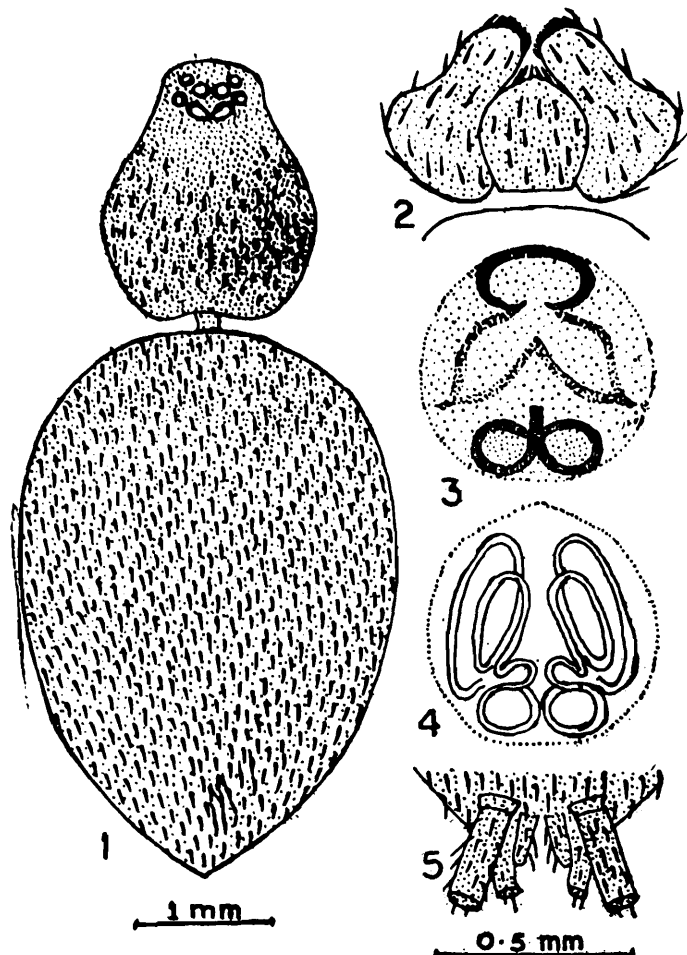
The species is named after Dr. N. I. Platnick, a well known arachnologists, as a token of the high regard which the author have for him.

***Drassyllus platnicki* sp. nov.**

General : Cephalothorax light reddish green, legs brown, abdomen light brownish green. Total length 6.20 mm. Carapace 1.90 mm. long, 1.60 mm. wide ; abdomen 4.10 mm. long, 2.90 mm. wide.

Cephalothorax : Longer than wide, narrowing in front slightly convex, posterior middle provided with an inconspicuous short fovea, clothed with very short spine like hairs. Eyes silvery whire in colour except anterior medians which are black. Posterior row of eyes slightly longer than the anterior row. Anterior row of eyes procurved (as seen from in front), medians slightly larger than the laterals and closer to adjacent laterals than to each other. Posterior row of eyes slightly procurved, medians larger than all eyes, oval, oblique and closer to each other than to adjacent laterals as in fig. 1. Sternum oval, pointed behind, clothed with hairs.

Labium and maxillae light green provided with scopulae, shape as in fig. 2. Chelicerae not very strong, vertical, inner margin provided with one minute tooth and outer margin with three moderate teeth. Legs relatively long and strong, clothed with hairs and spines. Legs formula 4123.



Figs 1-5. *Drassyllus platnicki* sp. nov. (1) Dorsal view of female, legs omitted. (2) Labrum and maxillae. (3) Epigyne. (4) Internal genitalia. (5) Spinnerets.

Abdomen : Nearly elliptical, clothed with very short fine hairs, anterior portion provided with some very short black spines. Ventral side lighter than the dorsal with fine hairs. Epigyne as in fig. 3. Internal genitalia as in fig. 4. Spinnerets as in fig. 5.

Holotype : Female (Reg. No. 5144/18) in spirit, other details as above.

Type-locality : INDIA, Maharashtra, Kachari Sawanga village, Nagpur District, date 5.iii.1984, coll. U. A. Gajbe.

Remarks : This species resembles *Drassyllus khajuriae* Tikader & Gajbe but differs from it as follows : (I) Carapace light reddish green but in *D. khajuriae* carapace light brownish green. (II) Abdomen light brownish green but in *D. khajuriae* abdomen deep brown. (III) Outer margin of chelicera provided with three teeth but in *D. khajuriae* outer margin provided with two teeth. (IV) Epigyne and internal genitalia also structurally different.

ACKNOWLEDGEMENT

I am grateful to Dr. B. K. Tikader, former Director, Zoological Survey of India for assigning the project and constant encouragement in my research work. I am thankful to Dr. P. D. Gupta, Deputy Director, Zoological Survey of India, Central Regional Station, Jabalpur, for providing necessary facilities. I am also thankful to Dr. N. I. Platnick, Curator, Arachnida Division, American Museum of Natural History, New York for help of literature on Gnaphosidae spiders.

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A NOTE ON THE ICHTHYOFAUNA OF JALGAON
DISTRICT OF MAHARASHTRA

By

D. F. SINGH AND R. H. KAMBLE

Zoological Survey of India, Pune

ABSTRACT

The ichthyofauna of Jalgaon district was surveyed by making 32 collecting stations spread over the entire district and all major rivers and lakes were visited. 1241 specimens were examined comprising of 32 genera of fishes.

INTRODUCTION

Apart from a survey of river* Tapi by CIFRI in 1959-60 (Karamchandani & Pisolkar, 1967), no attempt has been made so far to explore the fish fauna of Jalgaon district inspite of the richness of the water resources in this district.

Jalgaon district, previously known as East Khandesh, lies between 20° & 21° North latitude and 74° 55' & 76° 28' East longitude, with an area of about 7245 sq. kilometers. The district is bound by the Satpura hill range in the north while to the south lie the Ajanta and Chandor ranges. To the west of Jalgaon lie the districts of Dhule and Nasik. Only Tapi is the major river which traverses the district, flowing westwards. This river receives a number of tributaries along both its banks, the major ones being Bhokar, Purna, Vaghur,

Girna and Suki. In addition to these there are a number of perennial and seasonal ponds and lakes spread over the district.

This report is based on the following two surveys conducted by the Western Regional Station, ZSI, Pune under its intensive district survey programme :

1. Jalgaon district survey 18.1.79 to 18.2.79
2. „ „ „ 23.11.83. to 12.12.83

In all a total of 1241 specimens comprising of 32 genera of fishes have been collected. The various localities/collecting stations have been indicated in the map (fig 1).

List of Collecting Stations

A total of 32 stations were made from where fishes were collected. Cast net was commonly used. Help was also obtained from local fishermen.

* This river is also known as Tapti

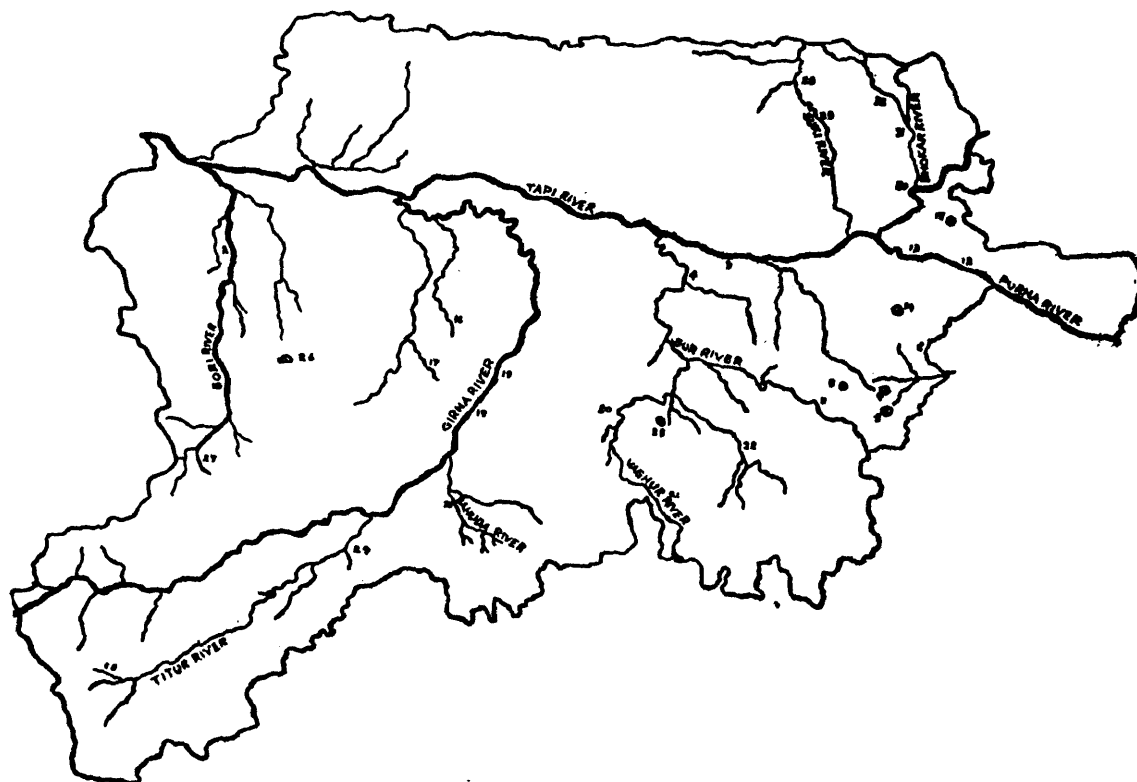


Fig. — 1
Jalgaon District Map Showing Numbered
Collecting Stations

Amalner (21°00'N, 75°00'E)	15. Paza talav, Pimpri Pancham
1. Chikli river, Gadkham	Erandol (20°55'N, 75°20'E)
2. Bori river, Phapore	16. Kugi nallah
Bhusaval (21°00'N, 75°45'E)	17. Madva nallah, Umarade
3. Tapi river, Bhusaval	Jalgaon (25°55'N, 75°30'E)
4. Vaghur river, Sakegaon	18. Girna river, Mhasavad
5. Sur river, Wadi	19. Girna river, Theka
6. Dev river, Yengaon	20. Vaghur river, Wakod
7. Rajur tank, Bodvad	Jamner (20°45'N, 75°45'E)
8. Bodvad tank, Bodvad	21. Vaghur river, Chickhede
9. Salkhambha talav	22. Waki river, Takali
Chaliskaon (20°25'N, 75°00'E)	23. Chondkhel tank
10. Nallah near Bilakhed	Pachora (20°40'N, 75°20'E)
Chopda (21°00'N, 75°15'E)	24. Titur river, Bambrud
11. Alkheda	25. Bahuda river, Lasore
Edlabad (21°00'N, 76°00'E)	Parola (20°50'N, 75°03'E)
12. Purna river, Ghodasgaon	26. Mhasva tank
13. Purna river, Khamakhede	27. Bori river, Tamasvadi
14. Hartale tank, Edlabad	Raver (11°10'N, 76°00'E)

28. Sukhi river dam, Pal
29. Sukhi river, Pal
30. Tapi river, Nimbhora
31. Bhokar river, Ambhora
32. Moravhal

The Fish Fauna

The detailed list of fishes collected during the two surveys is given below. The general classification after Greenwood et. al. (1966) has been adopted here :

- Class : Pisces
 Subclass : Teleostomi
 Order : Cypriniformes
 Family : Cyprinidae
 Subfamily : Cultrinae
 : *Chela* (*Chela*) *cachius* Ham.
 Chela spp
 Salmostoma boopsis (Day)
 S. clupeoides (Bloch)
 Subfamily : Rasborinae
 Danio aequipinnatus McClelland
 Rasbora daniconius (Ham.)
 Barilius barna (Ham.)
 B. vagra (Ham.)
 Subfamily : Cyprininae
 Puntius sarana (Ham.)
 P. ticto (Ham.)
 P. conchoni (Ham.)
 Labeo rohita (Ham.)
 L. kawrus (Sykes)
 Cirrhinna mrigala (Ham.)
 Tor tor (Ham.)
 T. mussullah (Sykes)
 T. putitora (Ham.)
 Garra gotyla gotyla (Gray)
 G. g. stenorhynchus (Jerdon)
 Family : Cobitidae
 Subfamily : Noemacheilinae
 Noemacheilus botia (Ham.)
 N. denisonii Dey

- Subfamily : Cobitinae
 Lepidocephalus (*Lepidocephali-*
 chthys) *thermalis* (Val.)
 L. (L.) guntea (Ham.)
 Order : Siluriformes
 Family : Bagridae
 Mystus bleekeri (Day)
 Family : Siluridae
 Ompok bimaculatus (Bloch)
 Order : Channiformes
 Family : Channidae
 Channa punctatus (Bloch)
 C. orientalis (Schn.)
 Channa spp.
 Order : Perciformes
 Family : Chandidae
 Chanda nama (Ham.)
 Family : Mugilidae
 Rhinomugil corsula (Ham.)
 Family : Gobiidae
 Subfamily : Gobinae
 Glossogobius giuris (Ham.)
 Order : Mastacembeliformes
 Family : Mastacembelidae
 Mastacembelus armatus (Lacep)
 M. guentheri Day

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CONTRIBUTIONS TO THE STUDY OF BAGRID FISHES 20. SYSTEMATIC
POSITION OF *MACRONES COLVILLII* GÜNTHER, 1874

By

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INTRODUCTION

Günther (1874) described *Macrones colvillii* from certain specimens 9 inches long collected from River Tigris, Baghdad by William Henry Colvill. He considered his species as closely related to *Macrones aleppensis* (Günther, 1864) (= *Bagrus haleppensis* Valenciennes, 1839 = *Silurus pelusius* Solander, 1794) and differentiated it by its having a more slender body than *pelusius*, the dorsal spine being as long as head, and the adipose dorsal fin commencing at a distance about equal to the width of base of the dorsal fin. The pulished figure of *Macrones colvillii* (pl. 8) clearly shows three narrow, white, parallel longitudinal stripes along the body which fact also Günther indicated in his description.

During the course of a systematic revision of the fishes of the genus *Mystus* Scopoli on a world wide basis [= *Macrones* Dumeril (1856) name preoccupied in Coleoptera, Insecta] it was found that the characters of *M. colvillii* agreed more or less with those of *M. pelusius* (Solander, 1794) the type species of this genus, also known from the same watershed of Tigris and nearby areas.

M. pelusius is also characterized by a slender body, dorsal spine equal to head length, adipose dorsal fin commencing at a distance nearly equal to the width of the base of the dorsal fin. Moreover, the three narrow, white, parallel longitudinal stripes along the body is typical of *M. pelusius* and this feature is also shared by *M. colvillii*. As such a doubt arose as to the validity of *M. colvillii* Günther (1874).

In order to clarify the confusing taxonomy of these two species, the type specimen of *M. colvillii* (Günther B. M (N.H) 1874. 4.28 : 6-8, 1875. 1.14 : 19-21 was borrowed from rhe British Museum of Natural History, London through the kind courtsey of Dr. Gordon Howes. The present paper clarifies the systematic positish of *M. colvillii* Günther.

TAXONOMY

The type specimen of *M. colvillii* clearly shows all the characters described by Günther and the three narrow white longitudinal stripes along the body. I have obtained specimens of *M. pelusius* (Solander) from the Baghdad Natural History Museum,

Baghdad through the kind courtesy of Dr. Munir K. Bunni and they are also characterised by a slender body, a dorsal spine as long as the head, a long adipose dorsal fin with a short interspace from the rayed dorsal fin and body with three longitudinal stripes. Comparison of the type specimen *M. colvillii* Günther clearly demonstrates that Günther's specimen is referable to *M. pelusius* and that *M. colvillii* should be merged under *M. pelusius*. A comparison of certain data between the two species as obtained from the aforesaid material is given below :

Mention should be made here of *Mystus halepensis colvillii* described by Hora and Misra (1943) from River Tigris, Baghdad. I have investigated the systematic status of this species also. It is suffice to say here that this subspecies is neither referable to *M. halepensis* (= *M. pelusius*) nor *M. colvillii sensu* Günther 1874. It represents an entirely another

species for which a new name is being given and the report being published elsewhere by Anuradha (1986).

DISCUSSION

Comparison of the body proportions and counts of the two species (Table 1) clearly justifies the conclusion of *M. colvillii* Günther 1874 being a junior objective synonym of *M. pelusius* (Solander 1794). The difference in the body depth in *M. colvillii* and the inter-orbital width is due to the fact that the specimen is lean probably due to under nourishment. Such instances of lean specimens in fishes are not uncommon as cited by Hora and Misra (1938). All other characters including the fin ray and vertebral counts intergrade with each other. *M. colvillii* Günther is thus synonymised under *M. pelusius* (Solander).

TABLE I. Comparison of *Mystus pelusius* Solander and *Macrones colvillii* Günther.

Characters	<i>Mystus pelusius</i> Baghdad Natural History Museum (3 examples)	<i>Macrones colvillii</i> British Museum (Natural History) 1874. 4.28 : 6.8 1875. 1.14 : 19.21 (1 example)
Standard Length	159.43(142.8-171.2)	172.1
Standard Length/Head length	4.66(4.65-4.68)	4.59
Standard Length/Body depth	5.21(4.84-5.57)	8.44
Head length/Eye	4.87(4.58-5.30)	4.81
Head length/Inter-orbital width	3.44(3.37-3.55)	4.26
Length of caudal peduncle/Least height of Caudal peduncle	3.11(2.94-3.39)	3.17
Snout/Inter-orbital width	1.52(1.44-1.58)	1.91
Head Length/Length of dorsal spine	1.10(0.98-1.22)	1.01
Head Length/Maxillary barbel length	0.45(0.40-0.49)	0.43
Dorsal fin	1, 7	1, 8
Pectoral fin	1, 8	1, 8
Anal fin	ii, 8-9	ii, 9
Caudal fin	7+8	7+8
Vertebrae	22+22=44	22+22=44

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I am grateful to Dr. K. C. Jayaram, former Joint Director, Zoological Survey of India, Calcutta for his guidance and for obtaining the material from London and Baghdad for my study. Dr. Gordon Howes, British Museum (Natural History), London and Dr. Munir K. Bunni, Baghdad Natural History Museum, Baghdad, were kind enough to send the specimens. The former read through the preliminary note and offered valuable criticisms. The X-ray photographs of the fishes were taken by Dr. Sanyal. Dr. B. K. Tikader, Director, Zoological Survey of India, gave laboratory facilities. I owe my thanks to all these gentlemen.

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* Not seen in original.

DESCRIPTION OF SEVEN NEW SPECIES AND ONE NEW RECORD OF
PILUMNINAE ; XANTHIDAE : DECAPODA : CRUSTACEA FROM INDIA

By

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ABSTRACT

In the present paper seven new species of the Pilumninae crabs are described. Photographs and text figures of carapace and anterior male pleopods for each specimens, where male specimen present, are included. Their relationships, affinities and differences with the other known allied species are discussed. Some other related species with inadequate description and doubtfully identified are also treated in the paper in detail.

INTRODUCTION

During the course of study of the named and unnamed Pilumninae crab material present and preserved in the collection of Zoological Survey of India, the author came across a number of species of the genera *Pilumnus* and *Parapilumnus* which are so far underscribed and inadequately described. As the publication of a comprehensive report on this material in the form of fauna is likely to take some time, the new forms along with the newly recorded from are being described in the present paper. Type specimens for the new species are deposited in the Zoological Survey of India, Calcutta.

A male young crab from Karachi, described by Alcock (1898 : 198) as a variety is redesignate here as *Pilumnus kempi* after having studied a series of crabs from Port Okha (west coast of India) and from Gulf of Suez.

The description given by Borradaile, 1902 for *Pilumnus rotundus* was based on a very young specimens and it was felt quite inadequate. After observing a large female from Sri Lanka and a small female from Ross Island (Andamans) the species has been redescribed here in detail to facilitate its easy diagnosis.

SYSTEMATIC ACCOUNT

The subfamily Pilumninae of the family Xanthidae, now comprises more than twelve genera and many named species from the temperate and tropical oceans. *Pilumnus* and *Actumnus* comprise largest number of species.

The close resemblance of the species and want of their photographs and very little knowledge of their systematic characters are main cause of the present state of disorder in them. Except slight differences of carapace nature, in the type of hairyness, granulations and the nature of distal ends of their anterior

male pleopods, these species are very alike each other. The size, shape, dimensions of carapace, nature of granulations, spination, hairiness etc are the discriminating characters now used to separate them. The splitting and grouping of the species into twelve or more genera made by the carcinologists in recent years, has been accepted here as such but there is still some overlapping or confusion. More subdivisions of genera can be made if the features like sharp, microscopic, granules or tubercles or nodules and spine etc are considered.

A list of holdings of Z.S.I., and the species recorded so far from India, has been provided. A key has been prepared for different genera of the subfamily Pilumninae and another for the Indian species of the genera *Pilumnus* and *Parapilumnus*. The species marked with asterix are newly recorded and added to Z.S.I., collection during the present study.

*Key to the Indian genera of
subfamily Pilumninae*

1. Carapace slightly broader than long, convex, regions well lobulated, covered with thin or dense tomentum and granules. Posterolateral sides concave or not. Front one third of carapace in width and separated from the inner supraorbital corner.

Actumnus Dana 1851

2. Anteriorly very broad carapace, triangular in shape, very convex, regions not at all demarcated. No indications of antero-lateral tooth present, carapace and appendages tomentose and sharp, minutely granular on upper surfaces. Orbits dorsal, entirely closed cavity, and wide apart. Front $\frac{2}{3}$ of width of carapace, six lobed. Anterolateral sides rounded and minutely granular only, no indications of teeth; posterolateral sides deeply concave for accomodating last pair of legs.

Dacryopilumnus Nobili 1906

3. Carapace quadrilateral in shape, moderately convex, surface granular, tomentose. Orbits very small and present on underside of carapace, outline of the crab is quite entire except small spinules present on anterolateral sides. Regions not defined. Front narrow, triangular, hollowed and grooved medially. Anterolateral sides evenly rounded and minutely spiny.

Caecopilumnus Borradaile 1902

4. Carapace quadrate to transversely ovate, little convex, regions demarcated, orbits normal, antero-lateral sides armed with three truncated, broad, prominent teeth except the outer orbital angle. Frontal lobes separated from inner supra-orbital angle. Rows of hairs present on frontal edge and clusters of hairs on anterior half of carapace.

Nanopilumnus Takeda 1974

5. Carapace small, slightly broader than long, thick, hexagonal, surface, hairy, roughened with fine granules, regions faintly marked. Anterolateral sides may not or may be armed with three or four low, small, spinules, including the outer orbital angle. Front less than half of carapace and not separated from the inner supra orbital angle.

Maldivia Borradaile 1902

6. Carapace broadly oval, convex, regions not well defined, surface smooth, glabrous. Anterolateral sides of carapace armed with three, shallow teeth including the outer orbital angle. Front $\frac{1}{3}$ of width of carapace, two truncated lobes but no outer lobule is marked.

Glabropilumnus Balss 1933

7. Carapace little broader than long, subcircular in shape, thick, convex, regions faintly marked, surface minutely granular and hairy. Antero lateral sides of carapace armed with small, white coloured 3-7, 8 tubercles, instead of teeth. Front $\frac{1}{3}$ or narrower, outer angle of frontal lobes not marked and not separated.

Globopilumnus Balss 1933

8. Carapace little broader than long, convex, roughly hexagonal in shape regions ill defined scantily tomentose, granular near the epibranchial regions, these granules are arranged in rows. Antero lateral sides armed with four teeth, including outer orbital angle.

Pilumnopeus A.M. Edw 1863

9. Usually small or medium sized crab, carapace subcircular, deep, not much broader than long, surface covered with transverse rows or tufts of hairs and tomentum, surface granules are less marked. Anterolateral sides usually with 3-4 teeth. Frontal lobes without any distinct outer lobules & not separated from the inner supra orbital corner.

Parapilumnus Kossman 1877

10. Carapace transversely oval, square or subquadrilateral, tomentose, thin or thick, swollen or not, deep hairy, surface sharply or plainly granular, rough, setose, regions faintly marked or plainly demarcated. Anterolateral sides shorter than posterolateral and usually armed with spines or conical teeth. Outer angle of two frontal lobes independent, dentiform, or spiniform and well separated from the inner supra orbital angle by a notch.

Pilumnus Leach 1815

11. Carapace rather thin, square in shape or subquadrilateral, surface smooth or sharply granular, hairy, regions faintly demarcated or not, the carapace and appendages covered with long, silky, soft hairs and tomentum. Front $\frac{1}{3}$ of greatest width of carapace, bilobed, deflexed, convex, outer corner of the lobes not marked off. Antero lateral sides slightly curved and armed with 2-3 spines or teeth or low lobes.

Heteropilumnus deMan 1895

12. Carapace just like *Pilumnus*, the original name of the present genus. The main diagnostic generic features which differentiate it from *Pilumnus* are, the male abdomen is slender, the last segment is much longer than the preceeding one. Distally the anterior male plepod is a straight process not 'S' like curved, tip not curved or gradually tapered.

Bathypilumnus Ng. and Tan 1984.

Pilumnus Leach

Pilumnus Leach 1814 : 21 ; Alcock 1898 : 190 ; Rathbun 1923 : 108 ; Balss 1938 : 10 ; Barnard 1950 : 262 ; Sakai 1939 : 535 ; Takeda and Miyake 1968 : 7.

Carapace and appendages are generally covered with hairs. Carapace is generally not much broader than long or transversely oval or subcircular in shape ; regions outlined or not. Surface hairy, granular or not, convex or flat. Antero lateral sides usually shorter than posterolateral and with four teeth or spines including outer orbital corner. Front usually narrow, bilobed, outer angle of each lobe forms an independent lobule separated on both sides. Orbits have one or two notches on upper and one on lower border ; the lower inner orbital angle is commonly sharp and prominent. The eye stalks are moderately long & narrow. The antennules fold transversely ; basal antenna joint is touching the front or not. The chelipeds are unequal specially in adult male or not. Fingers are short and pointed at the tips. The abdomen of the male is seven segmented ; anterior male pleopod 'S' like, curved, narrow tubular process.

Remarks : Large number of species were assigned to this genus previously, but for the sake of convenience they have been split into more than 12 genera. In the present paper 7 new species have been described and added to the existing list of Indian species.

Key to the Indian species of *Pilumnus*

A. Carapace little or more broader than the length—		
1. Entire crab covered with thick coat of hairs	...	C
2. Entire crab covered with thin coat of fine hairs	...	E

3. Entire crab is bare, almost no hairs present ... B
- B. 1. Carapace square shaped, with 3 acuminate ant. lat. teeth ... D
2. Carapace subquadrilateral with 3 spine tipped ant. lat. teeth ... *cursor*
- C 1. Hairs soft, dirty brown, long, surface sculpture not visible ... *vespertilio*
2. Hairs stiff, golden yellow, bristle like sculpture not visible. ... *kempi*
3. Hairs stiff, yellowish; small, deep crab, surface rough ... *minutus*
4. Hairs stiff, yellowish; large, deep crab, surface tubercular ... *ceylonicus*
- D. 1. lower distal half of larger palm smooth, upper edges of merii of legs spinous ... *longicornis*
2. Outer side of both palms sharply granular, Upper edges of merii of legs with one median and one distal spinules ... *woodmasoni*
- E. 1. Convex, deep, broadly oval crab ... F
2. Convex, deep, hexagonal crab ... G
3. Convex, deep, globose, subcircular crab ... H
- F. 1. Regions not defined, 3 ant. lat. spines; wrists and hands spiny ... *rotundus*
2. Regions well defined, 3 ant. lat. acuminate teeth, tubercular surface and appendages ... *karachiensis*
3. Regions well defined, 3 low, rounded teeth, granular chelae ... *alcocki*
4. Regions faintly defined, 3 acuminate teeth, minutely granular surface, chelae tubercular ... *investigatoris*
5. Regions faintly defined, 3 acuminate teeth, sharply granular all over ... *scabriusculus*
- G. 1. Regions faintly marked, smooth, hairy, 3 ant. lat. spine ... *maldivensis*
- H. 1. Regions well marked, granular, acuminate ant. lat. teeth, chelae with conical granules ... *caerulescens*
2. Regions well marked, spinous, hairy; ant. lat. spines erect; long spines on both the chelae, lower edge of larger palm bare ... *dorsipes*

Subfamily **Pilumninae**Genus (1) **Actumnus** Dana, 1851

- Actumnus arbutum* Alcock 1898
- A. asper* (Ruppell) 1830
- A. dorsipes* (Stimpson) 1858
- A. fissifrons* Alcock 1898
- A. margaroides* McGilchrist 1905
- A. obesus* Dana 1852
- A. setifer* (De Haan) 1833
- A. tessellatus* Alcock 1898
- A. tomentosus* Dana 1852
- A. verrucosus* Henderson 1893
- A. tuberculata* Mac Gil. 1905

Genus 2. **Caecopilumnus** Borradaile

- C. hirsutus* Borradaile 1902

Genus 3. **Dacryopilumnus** Nobili 1906

- **D. rathbunae* Balss 1932

Genus 4. **Glabropilumnus** Balss 1932

- G. disper* (Dana) 1853
- laevis* (Dana) 1887

Genus 5. **Globopilumnus** Balss 1933

- G. elegans* (De Man) 1887-88
- G. globosus* (Dana) 1852

Genus 6. **Maldivia** Borradaile 1902

- M. symbiotica* Borradaile 1902
- M. triunguiculata* (Borradaile) 1902

Genus 7. **Nanopilumnus** Takeda 1974

- **N. rouxii* (Balss) 1933
- **N. barbatus* (A.M. Edw.) 1873a
- **N. heterodon* (Sakai) 1934

Genus 8. **Parapilumnus** Kossmann 1877

- P. guinotae* n. sp.
- P. trispinosus* Sakai 1939
- P. indicus* n. sp.

Genus 9. **Pilumnus** Leach 1885

- P. alcocki* Borradaile 1902
- P. caerulescens* A. M. Edw. 1873a
- P. cursor* A. M. Edw. 1873a

P. longicornis Hilgendorf 1878
P. andersoni de Man 1988
P. maldivensis Borradaile 1902
P. minutus (De Haan) 1835
**P. rotundus* Borradaile 1902
P. dorsipes, Stimson 1858
P. scabrisculus Adams & White 1848
P. sinensis Gordon 1930
P. vespertilio (Fabricius) 1798
P. woodworthi Rathbun 1902
P. investigatoris n. sp.
P. ceylonicus n. sp.
P. karachiensis n. sp.
P. kempi n. sp.
P. woodmasoni n. sp.

Genus 10. **Pilumnopus** A. M. Edw. 1863
 ? = *Heteropanope* Stimpson 1858
P. indicus (de Man. 1888).
P. eucratooides (Stimson 1858).
P. leavis (Dana 1852).

Genus 11. **Heteropanope** Stimpson 1858
 ? = *Eurycarcinus* A.M. Edward 1867
E. grandidieri A.M. Edw. 1867
E. orientalis A.M. Edw. 1867
**E. maculatus* (A.M. Edw. 1867)

Genus 12. **Heteropilumnus** De Man 1195
**H. ciliatus* (Stimson 1858)
H. angustifrons (Alcock 1902)
H. beaumontii (Alcock 1900)
H. integra (Miers 1886)
H. quadrispinosa Zehntner 1894
H. setosa (A. M. Edw. 1873)

***Pilumnus ceylonicus* sp. nov.**

(Plate XIII, fig. 1)

Holotype : female, from pearl Bank, Sri Lanka,
 collected by T. Southwell, in Jan.-Feb. 1911 ;
 W-24 mm, L-18 mm ZSI. Reg. No. C3732/2.

Carapace and the appendages thickly

covered with both short and long, silky,
 golden yellow hairs and granules. Carapace
 not very board, roughly hexagonal in shape,
 more convex longitudinally than from side
 to side. Only the Meso and protogastric
 regions well demarcated and areolated.
 Anterolateral sides of carapace shorter than
 the posterolateral, and armed with three
 strong, erect, straight, white, sharp spines,
 except the outer orbital one which is tuber-
 cular. The first anterolateral spine smallest
 and last spine largest. A small subhepatic,
 blunt spine present. Inner frontal lobe
 prominent, deflexed, square shaped, free edge
 minutely granular or crenulate ; outer lobule
 distinct and well separated on both sides.
 Orbital edge crenulate, cut, with two dorsal
 notches and one gap just below the outer
 orbital corner. The side walls of the crab
 below the epibranchial region i.e. pterygosto-
 mian areas are finely granular. Chelipeds
 markedly unequal in female, all the edges of
 arm are granular, one sharp spine present on
 the upper distal edge. Inner corner of wrist
 bidentate ; outer surfaces of wrists and both
 the palms are entirely covered with scattered
 granules and thick, yellow, silky hairs, both
 short and long. The blunt, rounded, stout
 granules on the larger palm are less in number
 and arranged roughly in scattered way on
 rows and extended on the base of both the
 fingers upto a little distance. The granules
 on smaller hand are much more in number
 and sharper in nature. Fingers are white in
 colour and dactylus is very curved, like a
 birds beak. Leg joints thickly hairy, upper
 subdistal corner of all the merii of legs armed
 with a prominent, sharp, spine ; upper sur-
 face of the merus of only the last pair of legs
 and lower edges of all the merii of four pair
 of legs are granular, rough.

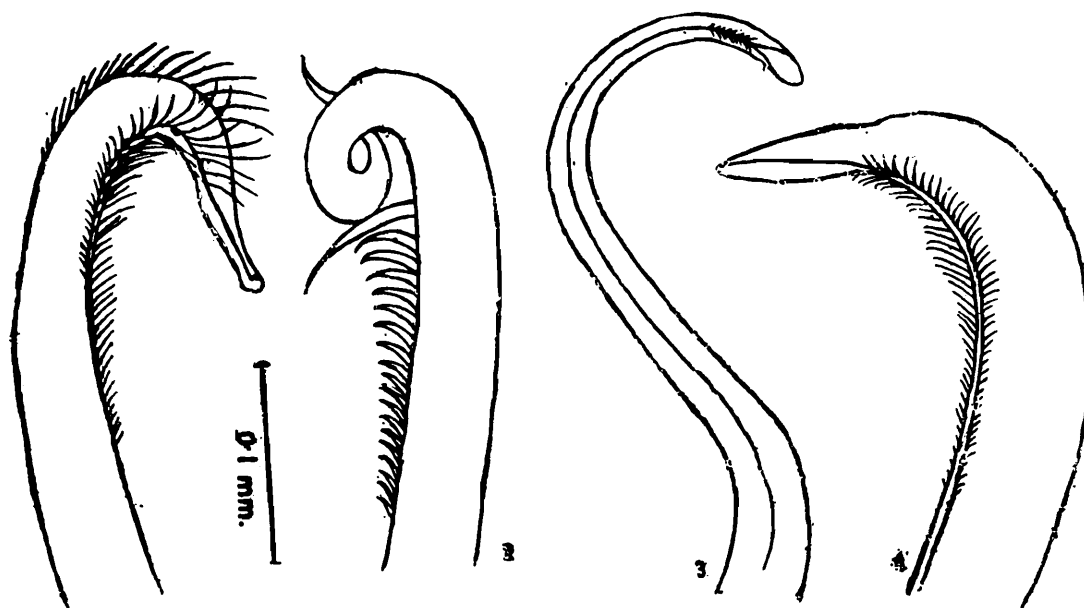
Remarks: The *P. ceylonicus* Deb, is closes to *P. orbitospinis* Rathbun 1911, but the surface of carapace of former is sharply granular under the thick, hairy coat and not smooth like the later. Lower, inner orbital corner of *ceylonicus* is rounded and not spine like as in the *orbitospinis*, *P. bleckeri* Miers 1880 and *P. parableckeri* Ng. & Tan 1984 in general appearance. It can however easily be distinguished from these by (1) presence of long and short, thick, golden yellow, silky fur (2) Sharp granular surface (3) three antero

2. *Pilumnus investigatoris* sp. nov.

(Pl. XII, fig. 4)

Holotype: One female from Camorta Is. Nicobar ; Sta. 468 collected by the research vessel "Investigator" during 1912-1913. W.-20 mm, L-14 mm, ZSI. Regd. No. C3733/2.

Carapace broadly oval, thick convex in both the directions, surface of carapace smooth to the naked eye but minutely granular and thinly hairy near the frontal and epibranchial regions. Only the gastric and cardiac regions are faintly defined.



Figs. 1-4. 1. Anterior male pleopod of *Pilumnus karachiensis* Deb, 2. same of *P. woodmasoni* Deb, 3. same of *Parapilumnus indicus* Deb, 4. same of *Pilumnus kempfi* Deb.

lateral spines & fingers which are white in colour (4) by being larger in size (5) Outer surfaces of both the wrists & chelae being fully covered with hairs and tubercles, (6) smaller chelae more tubercular. Only the merii of all the legs have a spine on upper distal corner, which are absent in *P. bleckeri* but present both in carpus and merus of *P. parableckeri*.

Anterolateral sides armed with three spines, other than the outer orbital angle and the last spine larger in size. One distinct subhepatic, tubercle present. Frontal lobes much produced, deflexed downwards, inner lobes finely crenulate and straighter on their free frontal edges. Outer lobules spine like and well separated on both sides. Entire orbital edge finely granular and cut with

two dorsal notches. One gap present just below the outer orbital spine. Inner, infra orbital corner spinate. Anterior edge of merus of external maxilliped concave. Chelipeds unequal in female, all the three edges of arm of chelae dentate and armed with two subdistal, prominent, stout spines, present only on the upper edge. Inner corner of wrist bluntly dentate, outer surfaces sharply tubercular and hairy. Similar type of hairs and tubercles present on the entire outer surfaces of smaller palm and on upper proximal half of larger palm; lower distal corner of larger palm smooth and bare. Fingers pointed at the tips and brown in colour. Leg joints stout, not much longer, upper surfaces hairy and granular. Preserved specimen in spirit, light brown in colour.

Remarks : The general formation of carapace, chelipeds and legs of the *Pilumnus Investigatoris* Deb is closely related to *P. parapilumnoides* Takeda and Miyake 1970, in which the frontal lobes are rounded, its, outer frontal lobules are triangular and indistinctly separated from supra orbital angle by a shallow depression. However the present species differs from it in having the frontal lobes rather square cut in shape, free frontal edge crenulate, outer lobule spine like and distinctly separated from the inner supra orbital edge and the front rather narrower. The anterolateral teeth of carapace in the present species are increasing in size from before backwards, a subhepatic tubercle present, greater part, i.e. 3/4 of the larger chelae is sharply granular on outer surface. The specimen on which the species is established is a female and hence the pleopod cannot be compared.

3. *Pilumnus kempi* sp. nov.

(Pl. XII, fig. 1)

Pilumnus vespertilio var. Alcock 1898 : 198.

Material examined : Holotype male, Z.S.I. Reg. No. C 4781/1 Width-35 mm, Length-24 mm, Port Okha, Coll, H. C. Roy, dt. 21-1.1953; Paratypes 2 males and 2 females, Z.S.I. Reg. No. C 4781/I; female with eggs, measures Width-23 mm, Length-17 mm, other details as Holotype.

4 males and 4 females from Dwaraka, Regd. No. C4775/I; 3 males from Pirotan Is., Port Okha, C4776/I; One male from Porbandar, C 4778/I; 3 males, 2 females from Port Okha, C 4779/I; 3 subadult females from Port Okha, C 4780/I; One female adult Loc. ?, C 1806/I; One subadult male from Karachi, C 3736/2; One male and one female from sta. 669, from corals of Andamans, C 2024/2; One female from Gulf of Suez, C 2023/2; One female from Tor, Siatic peninsula C 2022/2.

Description of male-Carapace is moderately convex in both the directions. The entire upper and outer surfaces of carapace and the appendages covered thickly and uniformly with long, golden yellow, stiff, bristle like hairs and short, soft, thick hairs of similar colour. Surface sculpture of carapace rough granular and concealed under the thick coat of hairs. Shape of crab roughly hexagonal or some what transverse, three fourth as long as wide. Regional areoles not visible through the thick, hairy coat, but well outlined and areolated on denuded carapace. Sharp granules present only on branchial and epibranchial regions only.

Front about one third of the greatest width of carapace, deflexed downwards, cut

into two prominent, flatly convex, finely crenulate, inner lobes · outer corner of each frontal lobe low, small, almost independent, but not prominent, and spine like or triangular. Upper orbital edge with two notches and lower edge with one gap just below the outer orbital corner, lower inner orbital corner is sharp. Infra orbital edge distinctly crenulate. Antero lateral sides of carapace armed with three spiniform acuminate teeth, beside the outer orbital angle, a subhepatic denticle present behind and below the outer orbital corner. Chelipeds unequal, upper edge of arm adorned with two stout, distal spines. Inner angle of wrist bidentate, each dent tubercular, blunt.

Upper and outer surfaces of the wrists, smaller palm and of all but the lower distal corner of larger hand are covered with granules, which are concealed under the hairs. In large specimen, lower side of larger palm quite bare and smooth. These granules are arranged in rows. Fingers are short, light-to dark brown in colour and pointed at tips. Upper edges of the dactylus of hand is granular and hairy. Leg joints thickly hairy and granular on their upper outer surfaces. Anterior male pleopod is a stout process like the other members of the family.

Remarks : The specimens of *Pilumnus kempi* Deb are very much distinctive in appearance and cannot be mistaken or considered as a variety or subspecies of *P. vesperilio* as it was assigned by Alcock in 1898. The specimen examined and described by Alcock (1898) is a subadult from Karachi. The adult males of Port Okha, are much larger in size and surface hairs are more thicker, denser than the young males and adult females. The hairs on juveniles are

much less thicker, rather scanty, more finer and lighter in colour than the adults and hence the young specimens can easily be mistaken for a separate species. The stiff, bristle like golden yellow, thick coat of hairs at once separate the *P. kempi* Deb, from any other known species and its nearest ally *P. vesperilio*. Distal apex and subapical spines on the anterior male pleopod of *P. kempi* are of quite different in shape, appearance and it is a sound evidence of their separate identity.

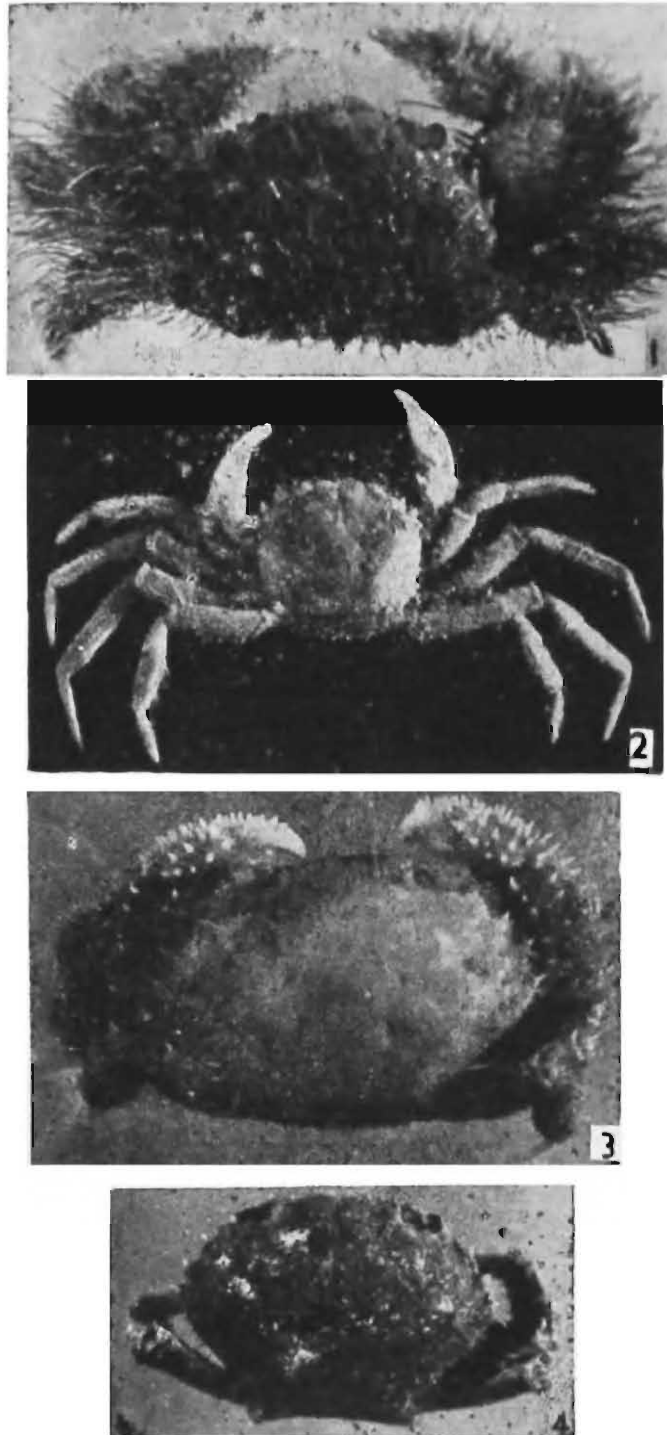
Distribution : Andamans ; Port Okha, Gujrat coast ; Karachi, Gulf of Suez ; Tor, Siatic peninsula.

4. *Pilumnus karachiensis* n. sp.

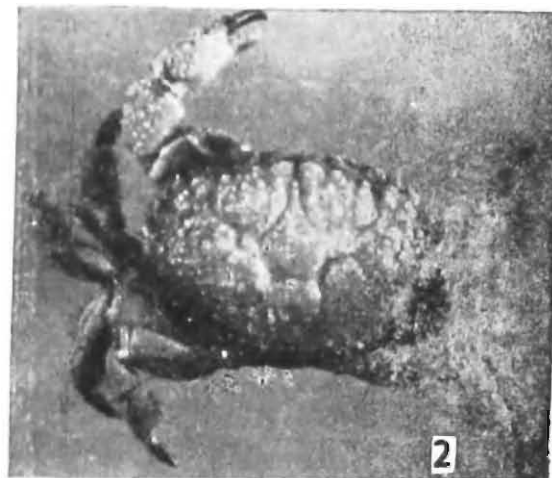
(Pl. XIII, fig. 2)

Holotype : One, male, ZSI. Reg. No. C3238/2, paratypes : two males and three females from Karachi, largest female measures W-29, L. 20mm and male W-24 mm; L-18 mm.

Carapace transversely oval in shape, very convex before backward than from side to side, thick ; regions of the entire carapace distinctly defined by broad, smooth, grooves, into convex regional areole. Clusters of sharp, prominent tubercles present on fronto-orbital and anterolateral regions and scattered, smaller granules present on other places. Upper surface of carapace covered scantily with golden yellow, silky, long fine hairs, which are more numerous and stiff on branchial regions and on appendages. Under surface of the crab tomentose. Front horizontal from dorsal aspect. Inner frontal lobes square shaped, free margins granular, outer lobule triangular and well separated on both sides. A post frontal, rounded, granular, ridge present. Entire orbital edge granular



Figs. 1-4. 1. *Pilumnus kempi* sp. nov., 2. *P. woodmasoni* sp. nov. 3. *P. rotundus* Borradaile 4. *P. investigatories* sp. nov.



Figs. 1-4. 1. *Pilumnus ceylonicus* sp. nov. 2. *P. karaachiensis* sp. nov.
3. *Parapilumnus guinotae* sp. nov. 4. *P. indicus* sp. nov.

nular and with two V shaped nothes present just below the outer orbital corner. Inner, infra orbital tooth prominent and visible from dorsal aspect. Anterolateral sides of carapace with three acuminate, granular teeth, except the outer orbital angle. A prominent, tubercular, subhepatic tooth present in between the orbital and first antero lateral tooth which is visible dorsally, and can be mistaken as antero lateral tooth.

Posterolateral sides granular and convergent. Anterior edge of merus of external maxilliped concave. Posterior edge of carapace finely and evenly crenulate. Chelipeds stout, markedly unequal in both the sexes. Upper outer side of arm of cheliped with granular, teeth present on upper, distal end. Outer surfaces of wrists and hands covered with granular ridges and smooth grooves which are more distinct on the wrists and outer, lower side of palm. These granules extended upto a little distance of the base of dactylus. Fingers short, brown and dentate on their cutting edges. Leg joints stout, upper surfaces sharply and finely granular and thickly fringed with stiff, yellow hairs. Male abdomen seven segmented, anterior male pleopod is a tubular, double curved, 'S' like process as in the other *Pilumnus* species.

Remarks : Though the geographical dimensions of the carapace of the crab is very distinct for its broadly oval and very convex carapace which is quite different from the genus *Pilumnus*, yet the presence of surface hairs, subhepatic tooth and other characters viz. the front, anterolateral teeth, anterior male pleopod etc. are very much like the genus *Pilumnus*. Regional lobulations, granular surface pattern, such as small, clusters of 3-4 granules on fronto and anterolateral sides,

and scattered, sharp, granules all over the carapace etc. are very distinctive and unlike the other known, allied species. The presence of a subhepatic tooth and two triangular teeth on upper edge of arm ; outer surface of wrist with rows of clusters of granules and smooth inter space between these clusters and lastly the nature of apex of the anterior male pleopod etc. are very much different from the allied species, *P. rotundus* Borradaile 1902.

5. *Pilumnus wood masoni* sp. nov.

(Pl. XII, fig. 2)

Material : Holotype : One male from Tuticorin, 18 km from shore ; south India, 9-10 fms. ZSI. Regd. No. C2948/2 ; Measuring 17 mm in width and 14 mm in length, collected by Dr. H. S. Rao, Feb.-March 1926

Description of male : Carapace more sub-circular or square than hexagonal in shape. Slightly convex in both the directions, regions deeply defined medially, specially the gastric and cardiac regions, where it is smooth also in touch. Hairs and sharp, minute granules present on epibranchial and posterolateral sides and also on pterygostomian regions. Front lamella, bilobed, obliquely deflexed, median suture deep, outer corner of frontal lobe very distinct and separated from the supra orbital edge. Free margin of the front finely crenulate. Orbital margins also crenulate and have fissures, two dorsal and one below the outer orbital corner. The lower inner orbital angle is prominent, tooth like, visible dorsally from above.

Antero-lateral sides shorter than the postero-lateral sides and armed with three, strong, pro-curved spines, other than the outer orbital angle. First spine larger and

last one smaller ; postero-lateral sides rough ; sharp, minutely spinulate. Pterygostomian region thickly spinulate. Eye stalk thick, long and adorned with a bundle of long hairs on upper side. Antennules long, obliquely and transversely folded. Antenna long, basal joint stands loosely on orbital hiatus and are in touch with the outer, small, frontal lobe. Inner edges of maxillipeds fringed with long bristles ; anterior edge of merus concave, its upper outer corner angular. Chelipeds in male unequal, twice as long as the length of the carapace. All the three edges of the arm crenulate ; the subterminal spine on the upper edge of arm, very prominent. Outer side of wrist sharply granular and spinulate, inner corner largely spinate. Inner side of both the palms smooth, outer side including basal part of both the fingers sharply granular. The granules arranged longitudinally ; curved, tips broad and hoofed ; cutting edges finely and evenly dentate and leaves a narrow gap when apposed. Leg joints narrow, compressed, long ; upper edges of merii of first three pairs of legs armed with two spines and granules, one stout spine on the middle and the other on distal end of merii. Only the distal spine present on the granular upper edge of merus of last legs. Legs are very long, slender, compressed, covered with the short felt and long, yellow hairs and granules ; dactylus long, rod like, hairy, apical claw brown in colour, small. Male abdomen distinctly seven segmented ; anterior male pleopod long, slender, curved process ; apex acute angular, the process is loop like coiled subapically. Preserved specimen is covered with long, yellowish, fine hairs all over except on upper anterior side of carapace where it is dark greenish

brown in colour. Fingers light brown with white tips.

The specific name wood masoni is given as a mark of recognition and respect to the renowned carcinologist J. Wood Mason for his laborious attempt to study the Indian Marine Crabs, at the very beginning of their study.

Remarks : So far the genus was represented by seven species from Andaman. The present one is an interesting species which markedly differs from the *P. longicornis*, in following characters : *P. Wood masoni* Deb is having (i) distinctly and moderately convex carapace in both directions, and in dorsal view it is sub-circular in shape. (ii) obliquely deflexed front with finally crenulate free frontal edge. (iii) Edges of orbit finely crenulate (iv) pterygostomian region sharply granular and (v) three edges of arm of cheliped adorned with a subterminal spine (vi) The upper edge with one median and one distal spine (vii) Outer side of wrists and palms sharply granular ; only the larger palm is with 4-5 longitudinal rows of granules on its outer side (viii) Loop like coiled male pleopod is also very much distinctive to be mistaken for any other known species.

***Pilumnus rotundus* Borr.**

(Pl. XII, fig. 3)

Pilumnus rotundus Borradaile 1902 : 246.

Material examined are, one large female, W-22.5 mm, L-15 mm Fornt-6mm, from Pearl Bank, Sri Lanka, collected by T. Southwell, dt. Feb. 1911 ; and one small female, W-12-mm, L-7mm. from Ross Island, Port Blair, S.W. Kemp's collection of 23-2-1915.

Description of the female : Carapace broadly oval in shape, and very convex in both the directions, regional lobules faintly outlined. Surface of carapace rough, sharply and minutely granular. Front deflexed downwards, bilaminar, convex medially, free edge of lamina oblique and crenulate. Outer corner of each lobe distinct and well separated on both the sides. Orbital edges finely crenulate, with two dorsal notches and one gap just below the outer orbital angle. Lower inner corner of orbit spine tipped. Antero lateral sides of carapace armed with three, spine tipped, triangular teeth, other than the outer orbital corner, which is low and followed by a tubercle. No subhepatic teeth present. Two, small, tubercles present on the carapace just near the inner dorsal corner of orbits.

Chelipeds in female is almost equal or so. Three edges of the arm of chelae granular, upper distal corner of arm with two strong procurved spines. Surface of the appendages covered with yellow, short, thick hairs. Outer surfaces of wrists and plams armed with scattered spines, which extended upto the middle of dactylus. The spines on wrists are much smaller and lesser in number than the same on palms. Fingers are thin, compressed, grooved and white in colour, tips pointed. Cutting edges of fingers are thin, compressed, grooved and white in colour, tips pointed. Cutting edges of fingers evenly dentate and leaves no gap when apposed. Leg joints rather narrow, upper distal corners of all the merii and carapii are spine tipped ; rest of the edges are granular, and rough.

Remarks : The present specimen is a female and much larger than the type from

Nallandu IIs. of Maldive area. The second female from Ross Is. Port Blair, is of same size of the type. The description and text figure given for the type are tallying fully with the female described above, but for only one exception. The spinule present on the middle of upper edges of merii of legs are absent in the present specimens, though the entire upper edges of merii are rough, and granular. The presence and absence of spinules on leg joints is a common phenomenon of age difference in *Pilumnus* species and hence can not be considered as species difference while other details are agreeing very well with the type.

Distribution : Pearl Bank, Sri Lanka ; Ross Island, Port Blair both are new localities, Maldives, etc.

Genus *Parapilumnus* Kossmann, 1877

Parapilumnus, Balss, 1933 : 38 ; Sakai 1939 : 544 ; Barnard 1950 : 269 ; Monod, 1956 : 254 ; Takeda & Miyake 1969 : 138.

Carapace is small or medium sized, hairy crabs, inhabitant of coral reefs, deep, and moderately convex from before backwards. Dorsal surface faintly outlined, granules are very minute and less marked ; soft, plumose, sparse tufts or rows of hairs present usually near the anterior half of the carapace. Front bilobed, and each lobe is without minute, lateral outer lobule. Anterolateral sides of carapace usually with three-four teeth which are either minute or obscure. Basal antennal segment not reached the front.

Chelipeds are unequal in male and less so in female. Male abdomen with seven separate segments and anterior male pleopods are *Pilumnus* like double curved 'S' shaped process.

Remarks : The crabs whose frontal lamina is without a lateral, small lobule is separated from *Pilumnus*, a nearest genus for easy identification. The crabs of this genus are of very small in sizes and are generally mistaken as the early, juvenile stages of the genus *Pilumnus*.

There are only few already known species of this genus present in India, and two new spp. viz. *P. indicus*, *P. guinotae* are added & described below. These crabs are inhabitants of coral reefs.

Key to the Indian species of *Parapilumnus*

1. (a) Fingers of the chelipeds ivory white in colour	...	2
(b) Fingers of the chelipeds light brown in colour	...	<i>trispinosus</i>
2. (a) Upper edge of dactylus blade like, sharp, crested, fingers grooved	...	<i>indicus</i>
(b) Upper edge of dactylus not sharp, crested and fingers not grooved	...	<i>gninotae</i>

Parapilumnus indicus sp. nov.

(Pl. XIII, fig. 4)

Material : Holotype : 1 male, measuring 10 mm in width and 8 mm in length, paratype : 2 females, width 8-9 mm ; length : 7-8 mm. ZSI. Regd. No. C2949/2 ; and C2949a/2. The specimens were collected from Port Blair, By R. P. Mullins in 1918.

Description of the male : Small, sub-circular crab with rough carapace, anteriorly covered with fine hairs. It is moderately convex in both the directions, meso-gastric area is only marked by grooves, other regions are ill defined. Antero-lateral sides shorter than the postero-lateral and cut into three, curved spines, excluding the outer orbital angle. No

sub-hepatic spine or tooth present. Postero-lateral sides moderately convergent. Front one third of carapace, convex medially and obliquely deflexed, cut into two oblique lobes, free edge sharp and smooth, outer corner of front not separated. Two shallow V-shaped notches present on upper orbital edge, one V-shaped gap present just below the outer orbital corner. Chelipeds unequal in male and almost equal in female, Upper edge of arm crenulate and with a sub-distal spine. Inner angle of wrist spinate, outer side armed with sharp spinules, granules and hairs. Outer surface of palm also sharply granular, and these granules are arranged in longitudinal rows. Fingers broad, thin and smooth, colour ivory white, cutting edges regularly and evenly dentate and leaves no gap when apposed. Both the fingers are traversed by longitudinal, broad, canal or groove leaving the upper edge of dactylus and lower edge of propodus as a sharp, thin, smooth, blade ; tips of the fingers are pointed. Lower and inner sides of palm in larger chela almost smooth and hairless, otherwise both the chelae and leg joints covered and fringed with long, yellow and short, brownish, thick fur. Leg joints compressed, upper outer sides of joints rough, hairy. Male abdomen distinctly seven jointed. Anterior male pleopod long, 'S' like curved process, apex obtusely rounded and narrowed ; opening of ciliary groove long, narrow and apical. Outer sides of sub-apical area adorned with rows of small spinous setae only.

Remarks : The main distinguishing features of *Parapilumnus indicus* Deb, are its broad, thin, smooth and canalicular fingers, the upper edge of dactylus and lower edge of propodus of the chelipeds are sharp, blade

like, thin, which is not found in any other known species of the genus. It has got some apparent similarity of shape of carapace with *Pilumnus parapilumnoides* Takeda and Miyake 1970, and with the anterior male pleopod of the later but the main canalicular, grooved fingers remain distinctive for the *P. indicus* Deb.

***Parapilumnus guinotae* sp. nov**

(Pl. XIII, fig. 3)

Material examined : Holotype female, egg laden : Off Little Aadamans, 10 fms., Marine Survey of India collection, made on 1-12-1888 Z.S.I. Reg. No. 3911/9 ; Measurements.—Width-7 mm. Length-5 mm Front-2.5 mm.

Description of female : Carapace subcircular in shape, moderately convex in both the directions, deep or thick, soft white tomentum and fine sharp granules present near the antero lateral sides of carapace, but bare and smooth medially. Only the meso gastric area is faintly outlined. Front obliquely deflexed, bilobed, lobes rounded, outer angle of each lobe not cut off or present. The regions behind the orbits and front are sunken. Antero lateral sides of carapace armed with three, erect spines, other than the outer orbital corner, orbits elongate, upper orbital edge prominent, with shallow notch ; eyes are large and exposed.

Chelipeds almost equal in female, stout, hairy and rough on outer surfaces. Upper edge of arm with two distal, prominent, spines. Inner corner of wrists not prominent. Outer surfaces of distal half of wrists and of entire palm covered with thick, long, matted hairs and gives the palm somewhat puffy, globose appearance. No. spinules are detectable under the thick hairy coat. Fingers are long, narrow, somewhat com-

pressed and quite bare but for the base of dactylus. Colour of the fingers are white, cutting edges evenly dentate, tips pointed and crossed, The hairy, puffy, globose palm with curved fingers seem to be as birds head with beak. The leg joints are compressed, narrow, except few, lank, scattered hairs ; the meri are bare, but the carpus, propodus and dactylus are thickly and profusely hairy. The tips of these hairs are club shaped.

Remarks : The *P. guinotae* Deb is an unique female crab which is assigned to the genus for its hairy nature and not having an outer, notched off tubercles of frontal lamina and upto now only few species are there under this genus. The presence of unique, puffy, globose appearance of hand with club tipped hairs on the palm of both the almost equal chelae gives the specimen a separate specific status unlike any other known species of the genus so far described.

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NOTES ON THE INDIAN SPECIES OF THE GENUS *PSEUDAGRION*
SELYS (COENAGRIONIDAE : ODONATA)

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ABSTRACT

Altogether 11 species of the genus *Pseudagrion* Selys from India are dealt with in the present paper, of which *P. andamanicum* Fraser is recorded for the first time from the main land and three others from the different parts of India.

Pseudagrionids are medium sized damselfly. Adults are commonly observed in between July to December on the sides of the perennial as well as temporary monsoon ponds. Sometimes they also occur near the still and slow running hill streams. So far, altogether 11 species under the genus *Pseudagrion* Selys are known from India (Fraser, 1933 and Davies *et al.*, 1984). Species belonging to the genus *Pseudagrion* Selys are distributed to Madagascar, India, Burma, Sri Lanka, Malaysia, Java, Sumatra, New Guinea, Australia, South China, Japan, Philippines, Fiji and Somoa (Laidlaw, 1919, Fraser, 1933 and 1957, Leifstinck, 1954, Pinhey, 1964, 1971 and 1973 and Kumar and Prasad, 1981).

In this paper a large number of specimens of the genus *Pseudagrion* Selys present in the Survey were studied and thus 8 species are recorded. Measurements (in mm), collection data, variations from the published descrip-

tions of the species, brief zoogeographical distribution (Table-I) and key for their discrimination are provided. *Pseudagrion andamanicum* Fraser is recorded for the first time from the main land i.e. Orissa while *P. decorum* (Rambur), *P. malabaricum* Fraser and *P. hypermelas* Selys are recorded from Orissa, Bihar and Gujarat respectively.

1. *Pseudagrion microcephalum* (Rambur)

1842. *Agrion microcephalum* Rambur, *Ins. Neurop.*, : 259.
1876. *Pseudagrion microcephalum* Selys, *Bull. Acad. Belg.*, (2)42 : 504 ; 1916. Laidlaw, *Rec. Indian Mus.*, 12 : 21-24 ; 1933. Fraser, *Fauna Brit. India*, 1 : 278-280 ; 1972. Mitra & Lahiri, *Entomologist's Rec. J. Var.*, 84 : 19 (Reproductive behaviour) ; 1979. Lahiri, *Oriental Ins.*, 13 : 120 ; 1982. Prasad & Ghosh, *J. Bombay nat. Hist. Soc.*, 79 : 290 ; 1982. Ram *et al.*, *Rec. zool. Surv. India*, 80 : 171 ; 1983. Mitra, *Entomologists' mon. Mag.*, 119 : 29 ; 1983. Ram *et al.*, *Notul. Odonatol.*, 2 : 15.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	28.00-29.00 mm	17.00-19.00 mm	17.00-18.00 mm
Female :	31.00 mm	21.00 mm	21.00 mm

Material : 4 ♂♂, Santragachi, Howrah (West Bengal); 22.11.1976, 24.11.1976, 28.11.1979 and 29.11.1976, coll. Raja Ram; 2 ♂♂, 1 ♀, Sheoraphully, Netaji Colony, Hooghly (West Bengal). 24.10.1975, coll. K. K. Roy and 1 ♀, Baruipur, Khadarpara, 24 Parganas (West Bengal), 25.11.1975, coll. K. K. Roy.

Remarks : Commonly observed at both permanent and temporary water bodies. Male shows a wide range of variations in the markings of head, thorax and second abdominal segment (Ram *et al.*, 1982). Postnodal nervures varies from 9 to 10 in forewings and 8 in hindwings of male and 10-11 in fore and 8-9 in hindwings of the female.

Male specimens of this species can easily be separated from other species by the presence of goblet-shaped black marking on the dorsum of the second abdominal segment.

2. *Pseudagrion andamanicum* Fraser (Fig. 1)

1924. *Pseudagrion andamanicum* Fraser, *Rec. Indian Mus.*, 26 : 411-412; 1933. Fraser, *Fauna Brit. India*, 1 : 281-282; 1933. Chhotani *et al.*, *Rec. zool. Surv. India*, 80 : 477.

Measurements :

	<i>Abdomen</i>
Male	(damaged)
<i>Forewings</i>	<i>Hindwings</i>
19.00 mm	18.50 mm

Material : 1 ♂, Ballugaon (Fishery Research Inst. Campus, Puri), Orissa, 18.3.1974, coll. R. K. Kacker.

Black humeral stripe quite thick, distinct,

and parallel to the mid dorsal carinal stripe, antehumeral black stripe also thick, dilated anteriorly and tapering towards posterior side and becomes almost pointed at the end. (as in the figure 1); wings hyaline, not faintly enfumed; 9 postnodal nervures in forewings and 7-8 in hind. Superior anal appendages brownish black, tip black. *P. andamanicum* can easily be distinguished from *P. microcephalum* and other species of the genus by having black rectangular dorsal subapical spot on second abdominal segment. This marking is connected to a narrow apical annule by a short linner neck, and to the base by a fine black line on the mid-dorsal carina (Fraser 1933).

It is recorded for the first time from the main land of India (Orissa).

3. *Pseudagrion australasiae* Selys

1916. *Pseudagrion australasiae*, Laidlaw, *Rec. Indian Mus.*, 12 : 21-23; 1919. Laidlaw, *Rec. Indian Mus.*, 16 : 192.
1933. *Pseudagrion bengalense*, Fraser, *Fauna Brit. India*, 1 : 282-284.
1954. *Pseudagrion australasiae*, Lieftinck, *Treubia*, 22 : 1-202; 1977. Lahiri, *Rec. zool. Surv. India*, 72 : 409-418; 1982. Ram *et al.*, *Rec. zool. Surv. India*, 80 : 171.

Measurements :

	<i>Abdomen</i>
Male :	28.50-32.00 mm
Female :	31.00 mm
<i>Forewing</i>	<i>Hindwing</i>
18.00-22.00 mm	17.00-21.00 mm
23.00 mm	22.00 mm

Material : 3 ♂♂, Santragachi, Howrah, (West Bengal), 11.12.1976 and 26.12.1976, coll. Raja Ram ; 1 ♂, Paikpara, Calcutta (West Bengal) 13.4.1980, coll. M. Prasad and 1 ♀, Santragachi, Howrah, 28.11.1976, coll. Raja Ram.

Variations in the head markings as well as in wing venation are quite similar as noted by Ram *et al.* (1982), except in postnodal nervures in hindwing which is 8 in number in the specimen collected from Paikpara.

Specimens of this species were very common from June to December at the permanent water bodies. Vase-shaped black marking present on the dorsum of the second abdominal segment which is dilated in the middle, can distinguish it from other species of the genus.

4. *Pseudagrion malabaricum* Fraser

1924. *Pseudagrion malabaricum* Fraser, *Rec. Indian Mus.*, 26 : 428, 494-495 ; 1933. Fraser, *Fauna Brit. India*, 1 : 284-286 ; 1983 Mitra, *Entomologists' mon. Mag.*, 119 : 29.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	32.00 mm	22.50 mm	22.00 mm

Material : 1 ♂, Hazaribagh Lake, Hazaribagh (Bihar), 15.3.1983, coll. M. Prasad.

During the course of Chhota Nagpur Hills survey in the month of March, 1983 a single male of this species was collected from a fairly big lake situated in the vicinity of Hazaribagh town. However, this specimen agrees fairly well with the published descriptions of the species. *P. malabaricum*, a very close species to *P. microcephalum*, and *P. australasiae* but separable from both the

species by superior anal appendages, which is not bifid at its apex. It is recorded for the first time from Bihar.

5. *Pseudagrion decorum* (Rambur)

(Fig. 2-9)

- 1842, *Agrion decorum* Rambur, *Ins. Neurop.* : 258.
 1876. *Pseudagrion decorum*, Selys, *Bull. Acad. Belg.*, (2)42 : 504 ; 1916. Laidlaw, *Rec. Indian Museum*, 12 : 24 ; 1933. Fraser, *Fauna Brit. India*, 1 : 286-289 ; 1953. Bhasin, *Indian For. Leaflet*, 121 : 68 ; 1981, Kumar & Prasad, *Rec. zool. Surv. India, occ. pap.*, No. 20 : 36 ; 1982. Prasad & Ghosh, *J. Bombay nat. Hist. Soc.*, 79 : 290 ; 1982. Ram *et al.*, *Rec. zool. Surv. India*, 80 : 173 ; 1983. Mitra, *Entomologists' mon. Mag.*, 119 : 29 ; 1983. Ram *et al.*, *Notul. Odonatol.*, 2 : 15.

Measurements :

	Abdomen	
Male :	28.00-31.00 mm	
Female :	27.00-27.50 mm	
	Forewing	Hindwing
	18.50-21.50 mm	18.00-20.00 mm
	18.00-22.00 mm	17.00-20.00 mm

Material ; 1 ♂, Kharda, 24 Parganas (West Bengal), 9.11.1966, coll. S. B. Roy ; 4 ♂♂, Edapatyam, Kottayam (Kerala), 3.1.1971, coll. A. N. T. Joseph ; 1 ♂, village No. 26 (Orissa). 17.9.1972, coll. S. Khera, 1 ♂, 5 kms. North West of Forest Rest House, Chandili, Korapet (Orissa), 29.11.1973, coll. D. P. Sanyal ; 1 ♂, Nale lake, Ahmadabad (Gujarat), 4.2.1975, coll. B. Dutta ; 1 ♂ (31.7.75), 1 ♂ (2.8.75), 2 ♂♂, 1 ♀ (10.8.75), 1 ♂ (24.8.75) Santragachi, Howrah (West Bengal), coll. Raja Ram ; 1 ♂, Mettapalayam, Nilgiri (Tamil Nadu), 19.12.1975, coll. A. N. T. Joseph ; 4 ♂♂ (4.10.1976), 4 ♂♂, 1 ♀ (6.10.1976), 3 ♂♂ (7.10.1976) Mahaso, Azamgarh (U. P.), coll.

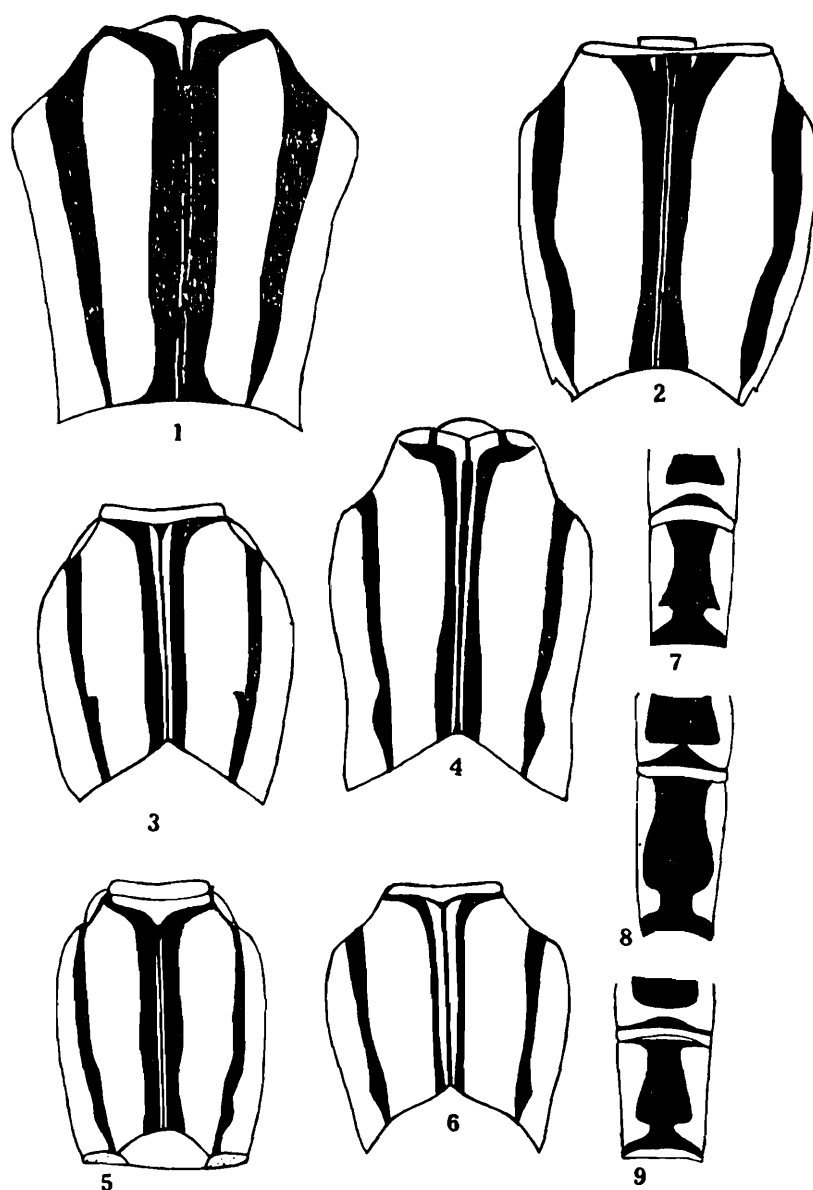


Fig. 1. Dorsal view of the thorax of *Pseudagrion andamanicum* Fraser.

Figs. 2-9. *Pseudagrion decorum* (Rambur) : 2-6, Dorsal view of the thorax showing variations in the marking ; 7-9. Dorsal view of the 1st and 2nd abdominal segments showing variations in the marking.

Raja Ram and 1 ♂, Sonawli, Gorakhpur, (U. P.), 18.10.1980, M. Prasad & D. N. Tiwari.

Adults of *P. decorum* were found common during July to October and become less in population in November and December. It becomes rare during January to March. Variations in the thorax and abdominal markings are shown in the figures 2-9. It is recorded for the first time from Orissa.

6. *Pseudagrion hypermelas* Selys

1876. *Pseudagrion hypermelas* Selys, *Bull. Acad. Belg.*, (2) 42 : 519 ; 1916. Laidlaw, *Rec. Indian Mus.*, 12 : 21, 22, 25 ; 1924, Fraser, *Rec. Indian Mus.*, 26 : 428, 498 ; 1933. Fraser, *Fauna Brit. India*, 1 : 289-292 ; 1953. Bhasin, *Indian For. Leaf.*, 121 : 68.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	25.00 mm	17.00 mm	15.50 mm

Material : 1♂, Gujarat Survey, 1973, Dachha, 17.11.1973, coll. P. T. Cherian.

prefers grassy bank of small streams and canals. It is recorded for the first time from Gujarat.

Labium reddish brown instead of white or palest brown, Prothorax black and sides pale yellowish brown in colour,

It can easily be distinguished from other species by having black face, frons and vertex; superior anal appendages bifid as seen in profile. Apex of the superior anal appendages curved like a parrot beak. It

7. *Pseudagrion spencei* Fraser

1922. *Pseudagrion spencei* Fraser, *Mem. Dept. Agric. India (Ent.)*, 7 : 47, 48; 1933. Fraser, *Fanna Brit. India*, 1 : 292-294; 1981. Kumar & Prasad, *Rec. zool. Surv. India, Occ. Pap.*, No. 20 : 36; 1982. Ram *et al.*, *Rec. zool. Surv. India*, 80 : 173-174; 1983. Ram *et al.*, *Notull. Odonatol.*, 2 : 15.

TABLE—1. Distributional Range of Indian Species of the Genus *Pseudagrion* Selys

Sl. No.	Name of the species	Indian limit	Nepal	Burma	Sri Lanka	Rest Oriental, Australian & Ethiopian Regions
1.	<i>Pseudagrion microcephalum</i> (Rambur)	Throughout the plains	—	+	+	Extending upto Australia in the east.
2.	<i>P. andamanicum</i> Fraser	South Andamans	—	—	—	—
3.	<i>P. australasiae</i> Selys	Assam, West Bengal.	—	+	—	Java and extending to Malaysia.
4.	<i>P. malabaricum</i> Fraser	Throughout Western Ghats (Kodaikanal, Palni Hills, Ootacamund, Nilgiris, Lovedale Lake, Coorg), South Kanara, West Bengal.	—	—	+	—
5.	<i>P. decorum</i> (Rambur)	Bilaspur, Sirmaur, Una, (H. P.), Dehradun, Nainital, Ootacamund, Nilgiris, Coorg, West Coast of India, West Bengal.	—	+	—	—
6.	<i>P. hypermelas</i> Selys	Madhya Pradesh, Deccan area of the Bombay, Punjab.	—	—	—	—
7.	<i>P. spencei</i> Fraser	Uttar Pradesh, Madhya Pradesh, Bihar, West Bengal, Assam, Meghalaya.	—	—	—	—
8.	<i>P. laidlawi</i> Fraser	Dehra Dun (Uttar Pradesh), Punjab.	—	—	—	Pakistan
9.	<i>P. rubriceps</i> Selys	Bilaspur, Hamirpur, Sirmaur (H. P.), Dehradun, Nainital, Pauri Tehri Garhwal (U. P.), West Bengal (widely distributed throughout continental India)	—	+	—	Java, Indo-China, Malaysia, Taiwan, Sunda Islands.
10.	<i>P. indicum</i> Fraser	Nilgiris, Coorg, Malabar	—	—	—	—
11.	<i>P. bidentatum</i> Morton	Dessa (Gujarat)	—	—	—	—

Measurements :

<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male : 21.50-24.00 mm	14.50-17.00 mm	14.00-16.00 mm

Material : 1 ♂ Santragachi, Howrah (West Bengal), 26.12.1976, coll. Raja Ram ; 4 ♂ ♂, Padrauna, Deoria (U.P.), 21.10.1980, coll. M. Prasad & D.N. Tiwari ; 2 ♂ ♂, Sonawli, Gorakhpur (U.P.), 18.10.1980, coll. M. Prasad & D.N. Tiwari, 2 ♂ ♂, Barhaj Bazar, Deoria (U.P.), 23.10.1980, coll. M. Prasad & D.N. Tiwari ; 4 ♂ ♂, Sukhpura, Ballia (U.P.), 2.11.1980, coll. M. Prasad & D.N. Tiwari ; 3 ♂ ♂ Hatia, Ranchi (Bihar), 9.3.1983, coll. M. Prasad and 1 ♂, Namkum, Ranchi (Bihar), 10.3.1983, coll. M. Prasad.

A specimen collected from Sonawli, Gorakhpur (U.P.) bears a broad black marking at the base on the dorsal side of the 8th abdominal segment which becomes narrower towards the apical end. Postnodal nervure varies from 8 to 10 in the forewing and 7 to 8 in the hind.

P. spencei can easily be distinguished from *P. hypermelas* by the presence of blue ground colour of the body of the male. Superior anal appendages with a long robust spine near base. Specimens of this species are very common during September to December on the permanent water bodies and near the grassy vegetations. Sometimes a large number of teneral specimens were observed resting on the vegetation slightly away from the water bodies.

8. *Pseudagrion laidlawi* Fraser

1922. *Pseudagrion laidlawi* Fraser, *Mem. Dept. Agric. India* (Ent.), 7 : 48-50 ; 1933. Fraser, *J. Bombay nat. Hist. Soc.*, 29 : 750-755. 1953. Bhasin, *Indian For. Leaflet*, 121 : 68 ; 1981. Kumar & Prasad, *Rec. zool. Surv. India, Occ. pap.*, No. 20 : 36.

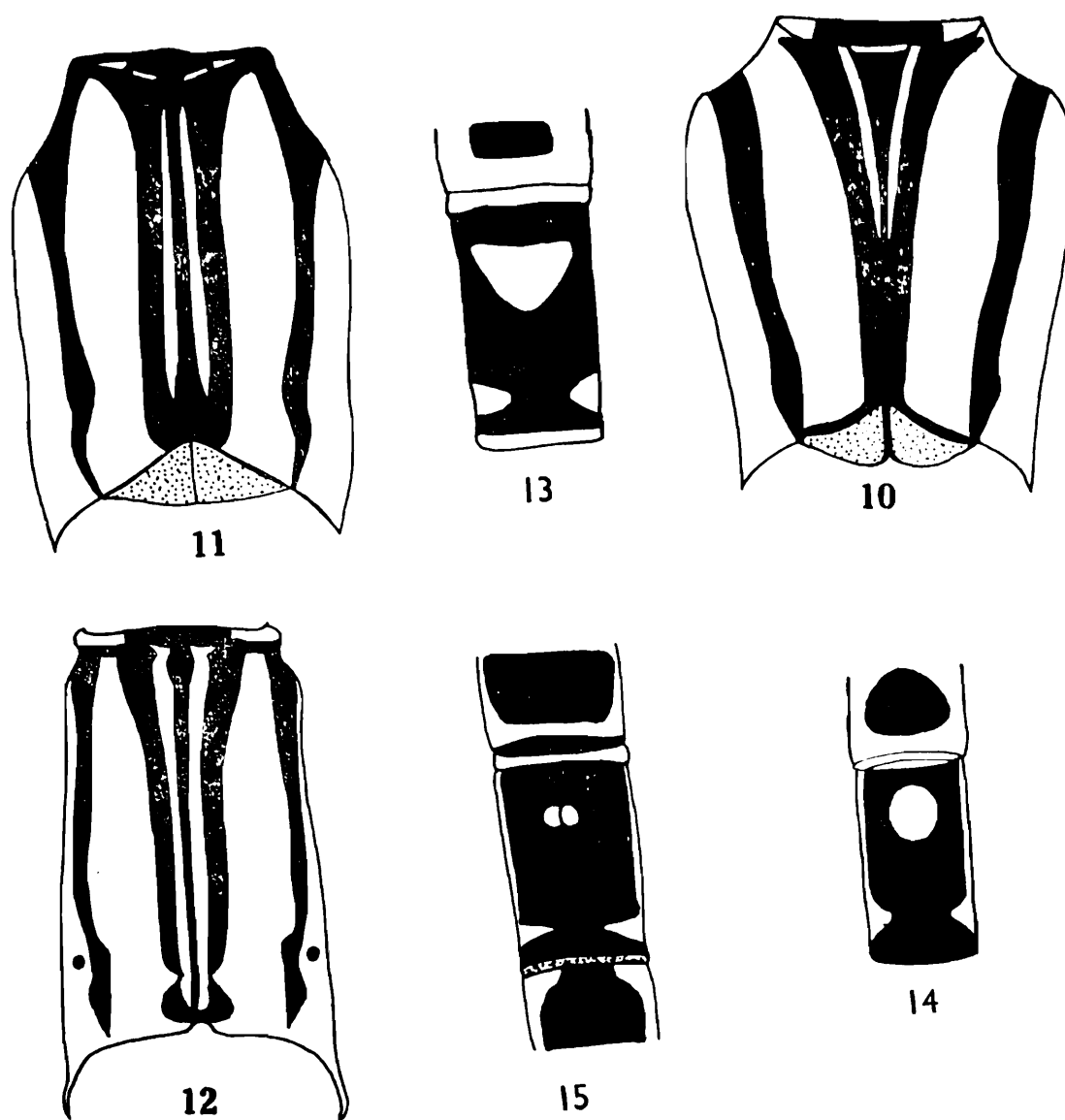
9. *Pseudagrion rubriceps* Selys
(Figs. 10-15)

1876. *Pseudagrion rubriceps* Selys, *Bull. Acad. Belg.*, (2) 42 : 510 ; 1916. Laidlaw, *Rec. Indian Mus.*, 12 : 22, 24, 25 ; 1933. Fraser, *Fauna Brit. India*, 1 : 296-299 ; 1953. Bhasin, *Indian For. Leaflet*, 121 : 69 ; 1972. Mitra & Lahiri, *Entomologist's Rec. J. Var.*, 84 : 19 ; 1979. Lahiri *Oriental Ins.*, 13 : 120 ; 1981. Kumar & Prasad, *Rec. zool. Surv. India, Occ. pap.*, No. 20 : 35-36 ; 1981. Prasad & Thakur, *Jantu*, 1 : 26 ; 1982. Ram et al., *Rec. zool. Surv. India*, 80 : 174 ; 1983. Mitra, *Entomologists' mon. Mag.*, 119 : 29 ; 1983. Ram et al. *Notul. Odonatol.*, 2 : 15.

Measurements :

	<i>Abdomen</i>
Male :	26.00-30.00 mm
Female :	28.00-30.50 mm
<i>Forewing</i>	<i>Hindwing</i>
17.00-19.05 mm	14.50-19.00 mm
21.00 mm	20.00mm

Material : 1 ♀, Titalgarh, Bolangir, 19.11.1972, coll. J.M. Julka ; 1 ♂, Dani Nala, Surat (Gujarat), 24.11.1973, coll. P. T. Cherian ; 1 ♂, Santragachi, Howrah (West Bengal), 1.7.1975, coll. Raja Ram ; 1 ♂, Santragachi, Howrah (West Bengal), 24.8.1975, coll. Raja Ram ; 1 ♂, Sheoraphully, Netaji Colony, Hooghly (West Bengal), 24.10.1975, coll. K. K. Roy, 1 ♀, Baruipur, Khadarpra, 24-Parganas (West Bengal), 25.11.1975, Coll. K.K. Roy, 1 ♂ (17.1.77), 1 ♂ (22.1.77) Santragachi, Howrah, (West Bengal), coll. Raja Ram ; 4 ♂ ♂, Paikpara, Calcutta (West Bengal) 20.4.80, coll. M. Prasad ; 2 ♂ ♂, Padrauna, Deoria (U. P.), 21.10.1980, coll. M. Prasad & D. N. Tiwari ; 2 ♀ ♀, Madumalai Sanctuary, Thappa kadu (Tamil Nadu),



Figs. 10-15. *Pseudagrion rubriceps* Selys : 10-12, Dorsal view of the thorax showing variations in the marking ; 13-15, Dorsal view of the 2nd abdominal segment showing variations in the marking.

30.1.1983, coll. G. K. Srivastava ; 3♂♂, Agricultural farm, Netarhat, Palamau (Bihar), 7.3.1983, coll. M. Prasad ; 2♂♂ Hatia, Ranchi (Bihar), 10.3.1983, coll. M. Prasad ; 2♂♂, Hatia, Ranchi (Bihar), 10.3.1983, coll. M. Prasad ; 2♂♂, Namkum, Ranchi (Bihar), 9.3.1983, coll. M. Prasad.

Segment 2 of *P. rubriceps* generally bears a goblet shaped marking on the dorsum, the cup with shallow concavity and its stem short and confluent with apical annule but single

specimen from three different localities and of different states revealed different types of marking. One specimen collected from Bihar (Hatia, Ranchi 10.3.1983) bears a marking similar to Coorg type (Fraser 1933) while a specimen taken from W. B. Paikpara, Calcutta, 20.4.84 bears a small round spot of ground colour and the 3rd specimen collected from U. P. (Deoria, 26.10.80) possesses a small rounded spot divided into two showing a trend to be completely blotted out as

recorded in Assam specimen by Fraser (1933) as shown in figures 13, 14 and 15 respectively.

10. *Pseudagrion indicum* Fraser

1924. *Pseudagrion indicum* Fraser, *Rec. Indian Mus.*, 26 : 428, 495-497 ; 1933. Fraser, *Fauna Brit. India*, 1 : 303-304.

Specimens of this species are not present in the National Collections of Zoological Survey of India. It breeds in small streams (Fraser, 1933). It can easily be distinguished from other species of the genus by the following: Face pale yellowish green; vertex and occiput black, marked with large azure blue postocular spots. Second abdominal segment with goblet shaped black marking on dorsal side, and also with a small medio-basal spot.

11. *Pseudagrion bidentatum* Morton

1907. *Pseudagrion bidentatum* Morton, *Trans. Ent. Soc. Lond.*, : 308 ; 1916. Laidlaw, *Rec. Indian Mus.*, 12 : 21-45 ; 1983. Davies and Tobin, *Odonatologica Rapid communications*, No. 3 : 86.

Key to the Indian species of the genus

Pseudagrion Selys

1. Frons reddish or reddish orange	...	2
Frons not reddish or reddish orange	...	3
2. Face and vertex reddish orange	...	<i>rubriceps</i> Selys
Face and vertex black	...	<i>bidentatum</i> Morton
3. Face, frons and vertex black	...	<i>hypermelas</i> Selys
Face, frons and vertex may be blue or green and marked with black	...	4

4. Thorax pale blue	...	<i>decorum</i> (Rambur)
Thorax sky blue or green...	...	5
5. Superior anal appendages not bifid	...	6
Superior anal appendages bifid at the apex	...	7
6. 10-11 postnodal nervure in forewings and 9 in hindwings	...	<i>malabaricum</i> Fraser
12 postnodal nervure in forewings and 10 in hindwings	...	<i>indicum</i> Fraser
7. 10th abdominal segment bigger than superior anal appendages	...	<i>australasiae</i> Selys
10th abdominal segment and superior anal appendages equal in size	...	8
8. Hindwing 14-16 mm in length	...	9
Hindwing more than 17mm in length	...	10
9. Long robust spine in the inner side of the base of superior anal appendages present	...	<i>spencei</i> Fraser
Long robust spine in the inner side of the base of superior and appendages absent	...	<i>laidlawi</i> Fraser
10. Second abdominal segment on dorsal side with black goblet shaped marking	...	<i>microcephalum</i> (Rambur)
Second abdominal segment on dorsal side with black rectangular marking	...	<i>andamanicum</i> Fraser

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OBSERVATION ON THE ABNORMALITIES IN THE PORTUNID CRAB,
PORTUNUS PELAGICUS (LINNAEUS)

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During the routine survey of Pulicat Lake, Chengalpoot District, Tamil Nadu, in connection with the studies on Portunid crabs of Tamil Nadu Coast, the author has come across an interesting female Portunid crab, *Portunus pelagicus* (Linn.), on 27th June, 1984. This is one of the dominant species and contributes substantially to the crab fishery of the Pulicat Lake area. This abnormal specimen was found among the 149 specimens collected and the same was photographed before preserving in spirit.

Out of 149 specimens collected, one female showed abnormal characters. Even though abnormality is a common phenomenon in Portunid crabs, this is the first record of abnormality found in the female of *Portunus pelagicus* (Linn.). However, abnormality in male of the same species has already been observed. James (1968) recorded two additional dactyli on the left cheliped and Hamsa (1973) noted the abnormal condition on the right cheliped.

Earlier, Sankarankutti (1951) reported the total absence of second walking leg in the right side of a male, *Thalamita integra* Dana. Further, he observed the total absence of 4th pair of antero-lateral teeth in the same specimen. Noble (1964) reported two additional thumbs on the left cheliped of *Neptunus* (*Neptunus*) *sanguinolentus* Herbst. Abnormalities in the number and size of the antero-

lateral lobes of carapace have been observed in *Lissocarcinus orbicularis* Dana (Sankarankutti and Thomas, 1964).

In the present study abnormal condition is observed in the right cheliped and the right swimming leg. The abnormal parts are slightly larger than the normal size (Figs. 1 & 2). Further, the dactylus of the right cheliped is shorter than the immovable finger (Figs. 3 & 4). The following is the brief taxonomic description which facilitates to distinguish the abnormal characters from the normal one.

Carapace normal and 45 mm in length, 97 mm in width; left cheliped normal and 109 mm in length, 35 mm in thick; right cheliped abnormal measuring 115 mm in length, 50 mm in thick (Figs. 1 & 2); length of the left dactylus and the immovable finger normal and more or less equal to each other, measuring 21 mm and 22 mm long respectively; length of the right dactylus is only 16 mm whereas the right immovable thumb is 24 mm long. This clearly shows that the thumb is 8 mm longer than the dactylus (Figs. 3 & 4). Likewise, slight differences are noticed between the right and the left walking legs. First walking leg of the right side measures 74 mm, whereas that of left one measures 70 mm long. Second and third walking legs of the right side are 74 mm and 61 mm long, whereas those of the left side measure 61 mm and 58 mm long respectively. Left swimming

leg and its dactylus normal with 48 mm and 17 mm long respectively ; right swimming leg and its dactylus slightly larger in size than those of left, measuring 55 mm and 21 mm long respectively (Figs. 1 & 2) ; the colour of the right swimming leg slightly darker than the left.

Besides these features the abdomen also shows certain variations. The abdominal segments are unequal in size ; an incision is found on the right side of the penultimate segment of the abdomen, forming an irregular edge, whereas the left side is with normal edge (Fig. 2).

In spite of the fact that there are several reports on the abnormalities of Portunid crabs (Sankarankutti, 1951 ; Sankarankutti and Thomas, 1964 ; Noble, 1964 ; James, 1968 ; Hamsa, 1973), little is known about the unequal size of the dactylus of thumb and the difference in length between the swimming and walking legs. Further, this is the first record of abnormality found in a female Portunid crab, *Portunus plagicus* (Linn.).

The unequal size of the dactylus and the immovable finger of the right cheliped may be due to some accident and regeneration of the same. It is not known whether the small movable dactylus will grow and attain the actual length, i.e., equal to the length of the immovable finger in due course. According to McVean and Findlay (1979) regeneration in crustacea, especially in crabs is very common, but the regeneration occurs when the whole of a leg is amputated but not partially as in the present study.

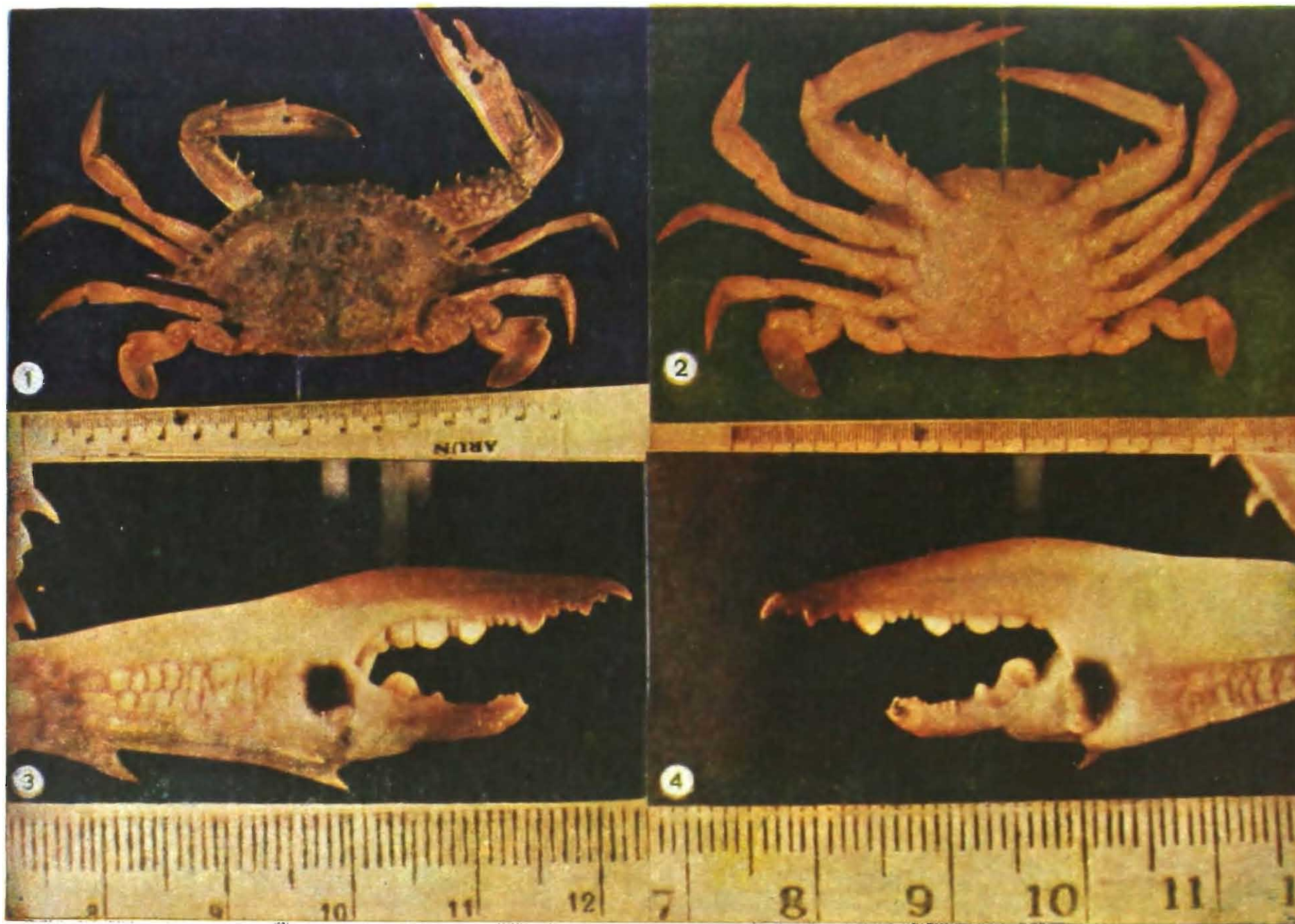
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Figs. 1 & 2. *Portunus pelagicus* (Linn.) showing abnormal conditions in the right cheliped and in the right swimming leg : 1. Dorsal view ; 2. Ventral view.

Figs. 3 & 4. Abnormal condition in the right cheliped (dactylus is shorter than immovable finger) : 3. Dorsal view ; 4. Ventral view.

ASSOCIATION BETWEEN LONGBILLED VULTURE, *GYPS INDICUS* (SCOPOLI)
AND HOUSE CROW, *CORVUS SPLENDENS* VIEILLOT

During a visit to Harike bird sanctuary in Amritsar district, Punjab, the authors observed a strange association between a long-billed vulture, *Gyps indicus* and House Crow, *Corvus splendens* on a Eucalyptus tree, growing in the campus of the Canal Rest House, Harike Pattan. It was on the 1st December, 1985 at 08.15 hrs., the authors observed the above mentioned association in the lawns of the Canal Rest House. The long-billed vulture was sitting on the top of the tree probably to bask in the sun. The vulture was besieged by three to five House Crows. The crows singly and occasionally in twos, approached and pecked at the back of the vulture, probably, to feed on ectoparasitic lice. The crows kept on flying during the process of pecking and on a few occasions, they were able to sit on the back of the vulture. The vulture appeared to be enjoying the game being relieved of lots of lice, though it would not allow the crows to sit on its back for more than a few seconds. The process continued for more than one and a quarter hours when two more longbilled vultures joined the game. The number of crows involved in the process varied between three and five. The new arrivals, likewise, were besieged by the crows and they too enjoyed the game. At about

0.9.30 hrs, the authors left for field work when this game was still continuing.

Sometimes, birds scare away intruders from their territory, particularly during breeding season, by pecking at them but in the present instance, it was not a breeding period of the crow and hence it did not appear to be a case of territorial safety or avoiding a trespasser. However, birds like mynas and crows are known to feed on ectoparasites like ticks of cattle (Whistler, 1963 ; Ali and Ripley, 1972 and Narang and Lamba, 1984). But the above mentioned process of a bird taking ectoparasites from another bird, has been observed, perhaps for the first time.

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REVIEW

THREATENED SWALLOWTAIL BUTTERFLIES OF THE WORLD BY
N. MARK COLLINS & MICHAEL G. MORRIS, 401 pp.

The well-planned, attractive and illustrated I.U.C.N. Red Data Book contains the relevant information on the threatened Swallowtails of the world. The authors have presented invaluable data on these interesting species of butterflies from all over the globe. The subject divided into several sections and parts, is concerned with up-to-date knowledge on systematics, habitat and ecology, zoogeography, threats, conservation measures, critical analysis and reviews of threatened species and also trade in Swallowtail butterflies under legislation. This is further supplemented by a couple of appendices, of which one deals with the list of Papilionidae in threatened categories and the other, with that of the members requiring future monitoring and research, apart from tables, plates etc. A brief discussion on the interrelationships of Swallowtails with man and science, on habitat alteration and des-

truction, pollution, exotic introductions, commercial exploitation, management and research, etc., is worth reading and enhances the practical utility of the book. With the publication of this book, the deficiency of our knowledge on the threatened species is much covered. It will serve as a sound reference to the world species of Papilionidae with special reference to their endangered status. This may be used extensively by the global lepidopterologists interested in the field of conservation. However, the authors have not dealt with the population structure and dynamics in the present context, but the host of information provided by them will certainly act as the baseline data for future investigation. Finally, the language, overall framing and expressions used in the book are quite lucid and comprehensive. The distinctive style and excellent printing of the book is a welcome addition to wild life literature.

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