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# RECORDS OF THE ZOOLOGICAL SURVEY OF INDIA

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## NOTES ON INDIAN SPECIES OF THE GENUS *APOLABIS* BURR (DERMAPTERA : CARCINOPHORIDAE)

By

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Zoological Survey of India, Calcutta

### INTRODUCTION

(With 25 Figs.)

The genus *Apolabis* was erected by Burr (1915) with *Forcinella hottentotta* Dohrn as the type. Besides, one Asiatic species, viz. *Forcinella marginalis* Dohrn and five other Ethiopian species namely *Anisolabis isomorpha* Borelli ; *Anisolabis vicina* Burr ; *Anisolabis turgida* Burr ; *Forficula laeta* Gerstaecker and *Gonolabis picea* Borelli were also included.

In India the genus is hitherto represented by two species, *Apolabis castetsi* (Bormans) and *A. ramachandrai* (Ramamurthi and David).

It is proposed to place here under the genus *Euborelli aborensis* Burr and *Thekalabis genitalis* Kapoor, both known from India.

On the basis of the shape of male parameres the genus *Thekalabis* Kapoor (1967) appears to be identical with *Apolabis* Burr (1915) and is placed as synonym of the latter.

### Genus *Apolabis* Burr

*Apolabis* Burr, 1915, *J. R. micr. Soc.*, 1915 : 538.

*Thekalabis* Kapoor, 1967, *J. nat. Hist.*, 1355 (Type species : *T. genitalis* Kapoor, 1967).

**Diagnostic characters :** Elytra abbreviated as narrow ovate flaps on mesonotum or narrowed at base but dilated in apical half and meeting along the middle line. Male genitalia with parameres three to four times longer than broad, at or near the base broadest but gradually narrowing apically with tip pointed or gently hooked.

**Type-species :** *Forcinella hottentotta* Dohrn.

**Distribution :** Oriental and Ethiopian Regions.

**Remarks :** Regarding the validity of various genera included under the subfamily Carcinophorinae there appears to be no unanimty amongst recent workers on the group. Besides the male genitalia is still considered as the sole critaria and occasionally with other morphological characteristics, for the discrimination of genera. Therefore, in

view of the prevailing confusion, it is considered desirable to follow Burr's (1915) arrangement in the present work which certainly helps in recognising most of the existing genera excepting a few extremely closely related ones in which some modifications may be necessary.

*Key to species (on ♂♂ only)*

- 1 (1). Body thickly pubescent ; elytra abbreviated in the from of narrow, ovate flaps on the sides of mesonotum ... *A. aborensis* (Burr)
- 2 (1). Body not thickly pubescent, occasionally short fine pubescence present on abdomen ; elytra abbreviated, narrowed strongly at base, in apical half dilated into broad lobes which meet along the median line
- 3 (4). Sides of abdominal segments ecarinate ; penultimate sternite posteriorly rounded ... *A. castetsi* (Bormans)
- 4 (3). Sides of certain abdominal segments with a median carina ; penultimate sternite narrowed posteriorly, feebly obtuse in middle
- 5 (6). Parameres with external and internal margin undulate and tip gently incurved ... *A. genitalis* (Kapoor)
- 6 (5). Parameres triangular, external and internal margins straight and tip straight and pointed ... *A. ramachandrai* (Ramamurthi and David)

***Apolabis castetsi* (Bormans)**

(Figs. 1-6)

*Carcinophora castetsi* Bormans in Bolivar, 1897, *Am. Soc. Ent. Fr.*, 66, 284 (♂♂, India : Madras, Kodaikanal) ; Bormans, 1900, *Das Tierreich*, 11 : 41 ; Kirby ; 1904, *Syn. Cat. Orth.*, 1 : 15.

*Psalis castetsi* : Burr, 1910, *Fauna Brit. India, Dermaptera* : 77 ; Burr, 1911, *Genera Insect.*, 122 : 31.

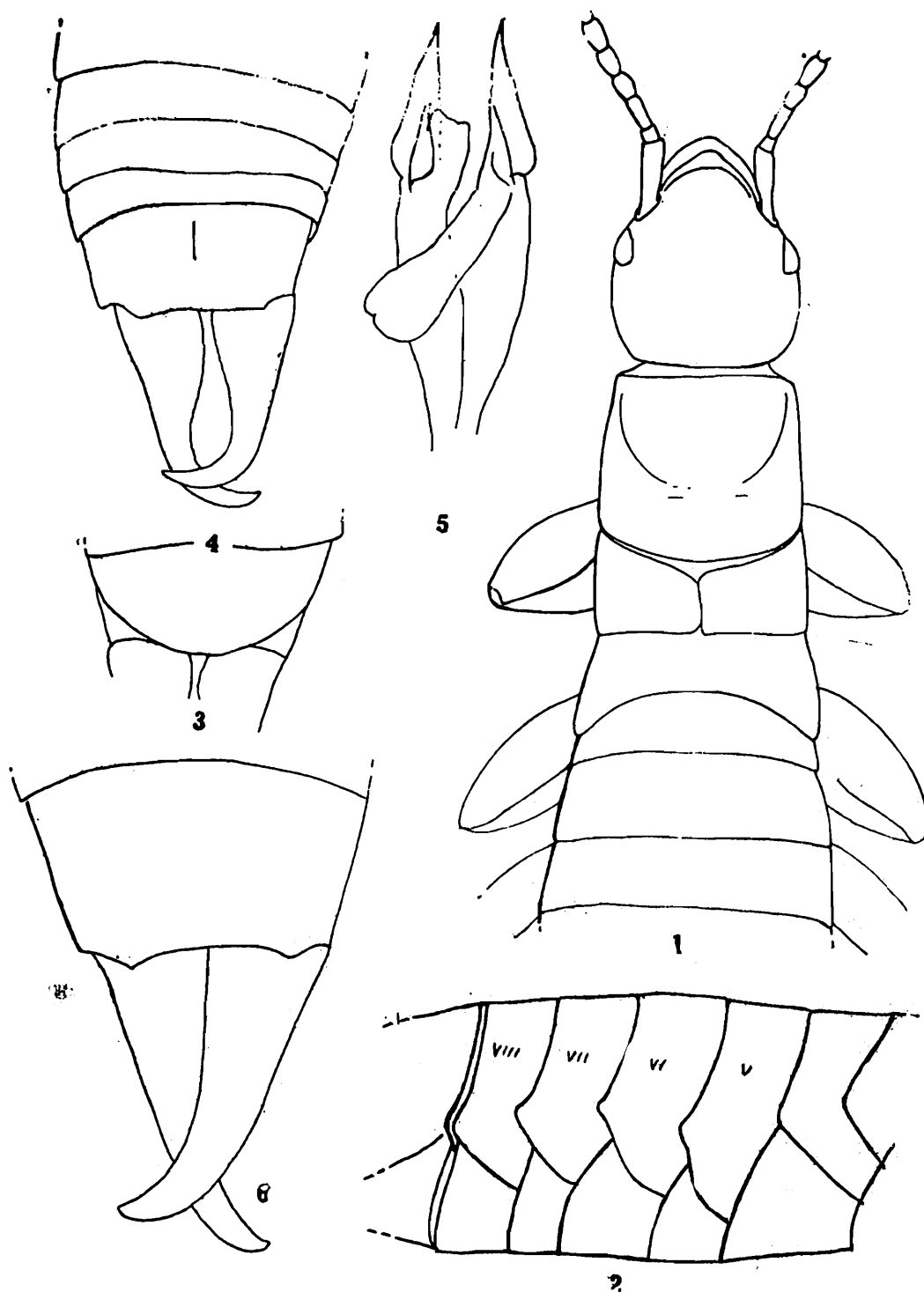
*Paralabis castetsi* : Hebard ; 1923, *Mem. Dep. Agric. India ent. ser.* 7 : 204.

*Apolabis castetsi* : Borelli, 1931, *Rev. Suisse Zool.*, 38 : 295 ; Hincks, 1954, *Mem. Inst. Franc. Afr. noire*, 40 (4) : 104 ; Ramamurthi, 1960, *Bull. Ent.*, 1 : 34, fig. 1.

*Euborellia astrusi* Burr, 1911, *J. Asiat Soc. Beng. (N. S.)* 7 : 779 (South India, Shembaganur, Madura Dist., several specimens—Types at British Museum (Natural History, London) ; Boesemann, 1954, *Zool. Verh., Leiden*, 21 : 43.

*Apolabis mnemosyne* Menozzi, 1929, *Mem. Soc. ent. Ital.*, 8 : 8, figs. 1, 2 and 3. (♂♂ ; Madura, India—Location of Types not mentioned).

♂ : General colour dark brownish black to light blackish brown ; antennae and legs yellowish brown, often shaded with black in parts.



Figs. 1-6. *Apolabis castetsi* (Bormans), ♂ ; 1. Anterior portion of body 2. Sides of abdominal segments, 3. Penultimate sternite, 4. Hind portion of body, 5. Genitalia ; ♀, 6. Ultimate tergite and forceps.

Head triangular, slightly longer than broad, frons raised, feebly punctulate, sutures faint, hind margin slightly emarginate in middle. Eyes small, about  $\frac{1}{8}$  as long as the post-ocular length. Antennae 14-segmented ; 1st stout, gently expanded apically, about as long as the distance between antennal bases ; 2nd short ; 3rd long and slender ; remaining stouter ; 4th shorter than the preceding and 5th almost equal to 3rd ; 6th onwards gradually increasing in length excepting a few pre-apical ones slightly shorter. Pronotum slightly longer than broad,

smooth, sometimes a trifle widened posteriorly, median sulcus faintly marked, hind margin subtruncate, prozona and metazona not well differentiated. Elytra abbreviated, narrowed strongly at base exposing a large transverse scutellum, posteriorly widened and meeting along the middle line, obscurely punctulate. Metanotum transverse, obscurely punctulate and finely pubescent, hind margin broadly emarginate. Prosternum about three times longer than broad, anteriorly convex, feebly narrowed between fore-coxae, hind margin truncate. Mesosternum about as long as broad, hind margin briefly convex. Metasternum transverse, slightly narrowed beyond hind coxae with hind margin truncate. Legs long, slender, tarsi with 1st segment slightly longer than the combined length of 2nd and 3rd segments. Abdomen spindle shaped, finely punctulate, convex, sides of segments 5th to 9th angulate posteriorly but ecarinate, only obscurely striate sometimes. Penultimate sternite transverse, triangular, broadly rounded posteriorly with slight emargination in middle, obscurely punctate. Ultimate tergite transverse, narrowed posteriorly, gently sloping backwards, smooth, hind margin straight in middle, oblique laterally above the bases of forceps, median sulcus faint and short. Forceps with branches subcontiguous, expanded at base, tapering apically and incurved in apical  $\frac{1}{2}$ , at base above with a blunt ridge, afterwards branches depressed, internal margin obscurely crenulate. Genitalia with parameres broadest at base, about four times longer than broad, apices acutely pointed; distal lobes without virga.

♀ : Agrees with males in most characters except that sides of abdominal segments obtuse or convex; penultimate sternite obtusely triangular posteriorly and forceps simple and straight.

*Measurements :* (in mm)

|                   | ♂ ♂     | ♀ ♀      |
|-------------------|---------|----------|
| Length of body    | 7.5-8.0 | 8.0-13.0 |
| Length of forceps | 1.4-1.5 | 1.7- 2.2 |

*Material examined :* India : Tamil Nadu : Madura Dist., Kodai-kanal, 2125 m, 1 ♂ (genitalia mounted between two coverslips and attached with the specimens), 25.xii. 1982, under stones, G. K. Srivastava ; 4 ♂ ♂ (1 ex with male genitalia mounted between two coverslips and pinned with the specimen), 4 ♀ ♀, 1 nymph, 29-30.xii. 1962, K. V. Lakhminarayna ; Borijam Lake, 2000 m, 11 ♂ ♂, 15 ♀ ♀, 15.v.1981, B. C. Saha.

*Distribution :* South India (Western Ghats).

*Remarks* : This species commonly occurs under stones on the edge of streams. It can be easily separated from other members of the genus by the smaller size and ecarinate sides of abdominal segments.

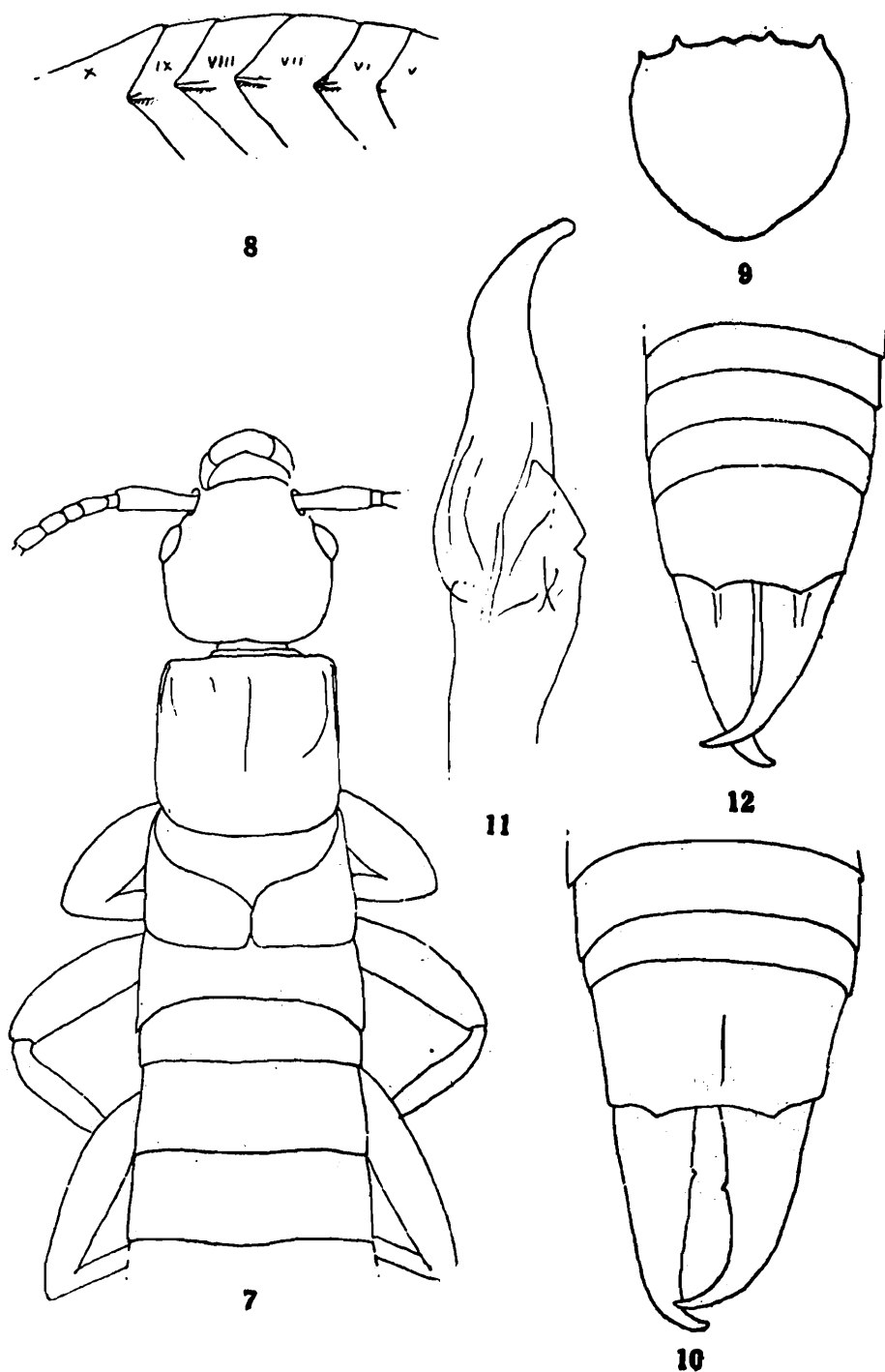
***Apolabis genitalis* (Kapoor)**

( Figs. 7-15)

*Thekalabis genitalis* Kapoor, *J. nat. Hist.*, 1 : 335, figs. 1-3 (♂ ; India, Kerala, Thekkady, 855 m—Holotype ♂ in poor condition, deposited at Indian Agricultural Research Institute, New Delhi).

♂ : General colour shining dark brownish black ; antennae with basal two segments and legs dark brown.

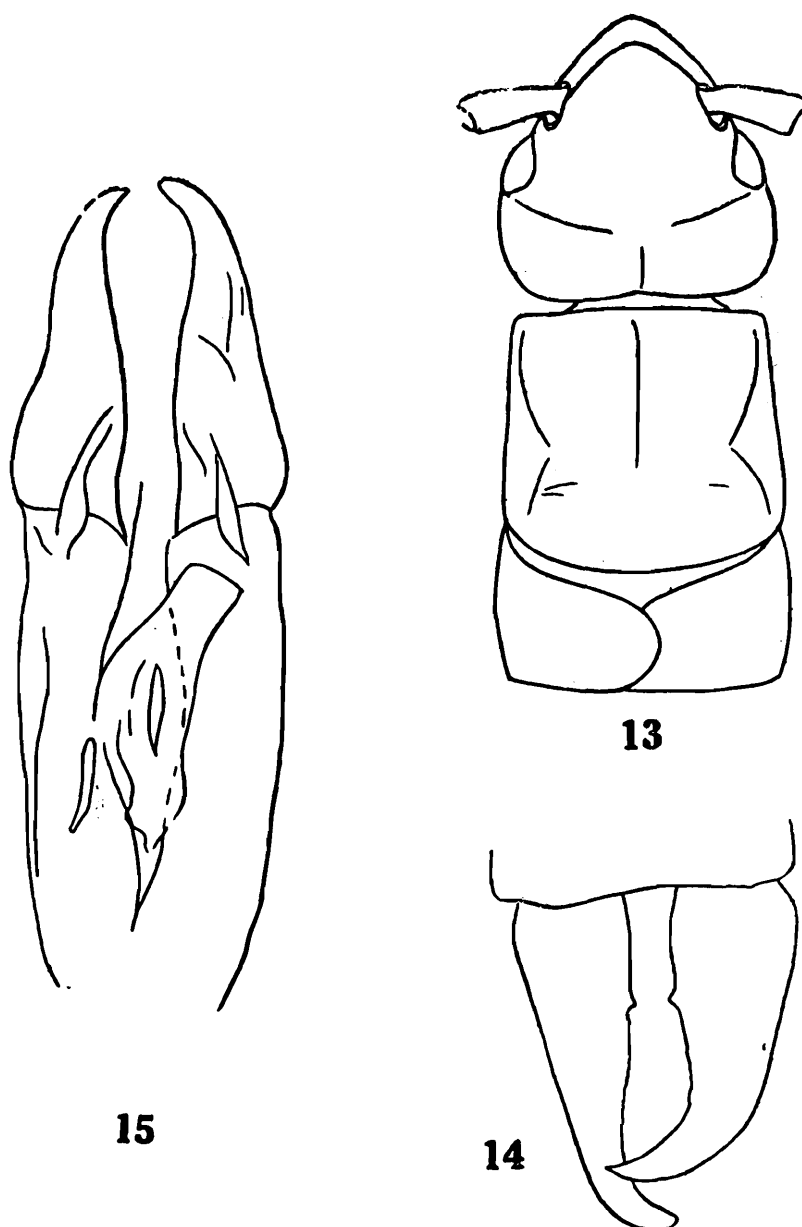
Head slightly longer than broad, smooth, frons moderately raised, sutures fine but distinct, hind margin emarginate. Eyes shorter than the post-ocular length. Antennae 17-segmented, 1st stout, gently expanded apically, slightly longer than the distance between antennal bases ; 2nd small, transverse ; 3rd long, slender, gently expanded apically ; 4th stout, only slightly longer than broad ; 5th stout, longer than 4th but equal to 3rd, remaining stout and gradually increasing in length excepting a few apical ones slightly shorter and thin. Pronotum slightly longer than broad, smooth, anteriorly straight, gently widened posteriorly with hind margin gently convex, sides depressed, median sulcus faint, prozona moderately convex and well differentiated from flat metazona. Elytra abbreviated, smooth, narrowed at base, exposing a transverse scutellum, broadened apically and meeting along the median line. Metanotum faintly punctulate with hind margin broadly emarginate. Sternal plates typical for the genus. Legs moderately long, hind tarsi with 1st segment slightly longer than the combined length of 2nd and 3rd segments. Abdomen spindle shaped, moderately convex, punctulate, covered with short yellow pubescence, on the sides of tergites above with three lobate, smooth patches arranged in the form of a triangle, sides of segments rugosely punctate, median carina present on segments 6th to 9th and faintly marked by a convexity on 5th. Penultimate sternite punctulate, obtusely triangular posteriorly. Ultimate tergite obscurely punctulate, transverse, moderately convex, hind margin between branches of forceps straight and above sinuate and oblique. Pygidium vertical, narrowed posteriorly. Forceps subcontiguous, expanded at base, tapering apically, almost straight in basal  $\frac{2}{3}$ , afterwards incurved, apices gently hooked and pointed, in basal  $\frac{1}{3}$  trigonal with a blunt ridge above, internally at basal  $\frac{1}{3}$  with a faint tooth. Genitalia with parameres broadest at base, three times longer than broad, internal



Figs. 7-12. *Apolabis genitalis* (Kapoor), ♂, 7. Anterior portion of body, 8. Sides of abdominal segments, 9. Penultimate sternite, 10. Hind portion of body, 11. A portion of genitalia showing left paramere; ♀, 12. Hind portion of body.

and external margin undulate, tip slightly incurved; distal lobes with a short chitinous rod.

♀ (nova): Agrees with males in most characters except that sides of abdominal segments convex, ecarinate, finely punctulate; ultimate tergite more strongly narrowed posteriorly and forceps simple, contiguous and straight.



Figs. 13-15. *Apolabis genitalis* (Kapoor), Holotype ♂, 13. Anterior portion of body showing head, pronotum and elytra, 14. Hind portion of ultimate tergite and forceps, 15. Genitalia.

**Measurements :** (in mm)

|                   | ♂ ♂       | ♀ ♀       |
|-------------------|-----------|-----------|
| Length of body    | 12.0-14.6 | 11.5-12.2 |
| Length of forceps | 2.0- 2.6  | 2.0- 2.1  |

**Material examined :** India : Kerala, Thekkady, 855 m, Holotype ♂ (genitalia mounted separately on a slide), 7.v.1966, V. C. Kapoor ; 4 ♂ ♂ (1 ♂ with genitalia mounted between to converslips and pinned with the specimen), 2 ♀ ♀ , 4 nymphs, 11,12,ii. 1983, G. K. Srivastava.

**Distribution :** It appears to be endemic to Western Ghats, South India.

**Remarks :** The Holotype ♂ is in poor condition and is placed on a card. Although in the original description of the species it is stated

to be apterous but re-examination reveals that abbreviated elytra are present. Figs. 13-15 are drawn from the Holotype ♂ which conform the above. Further material collected from the type locality agrees well with the Holotype.

This species appears to be closely related to *A. castetsi* (Bormans) but differs by its slightly larger size; sides of abdominal segments rugose with a longitudinal carina on 6th to 9th only; shape of penultimate sternite and the apical portion of parameres in being slightly incurved.

### ***Apolabis ramachandrai* (Ramamurthi and David)**

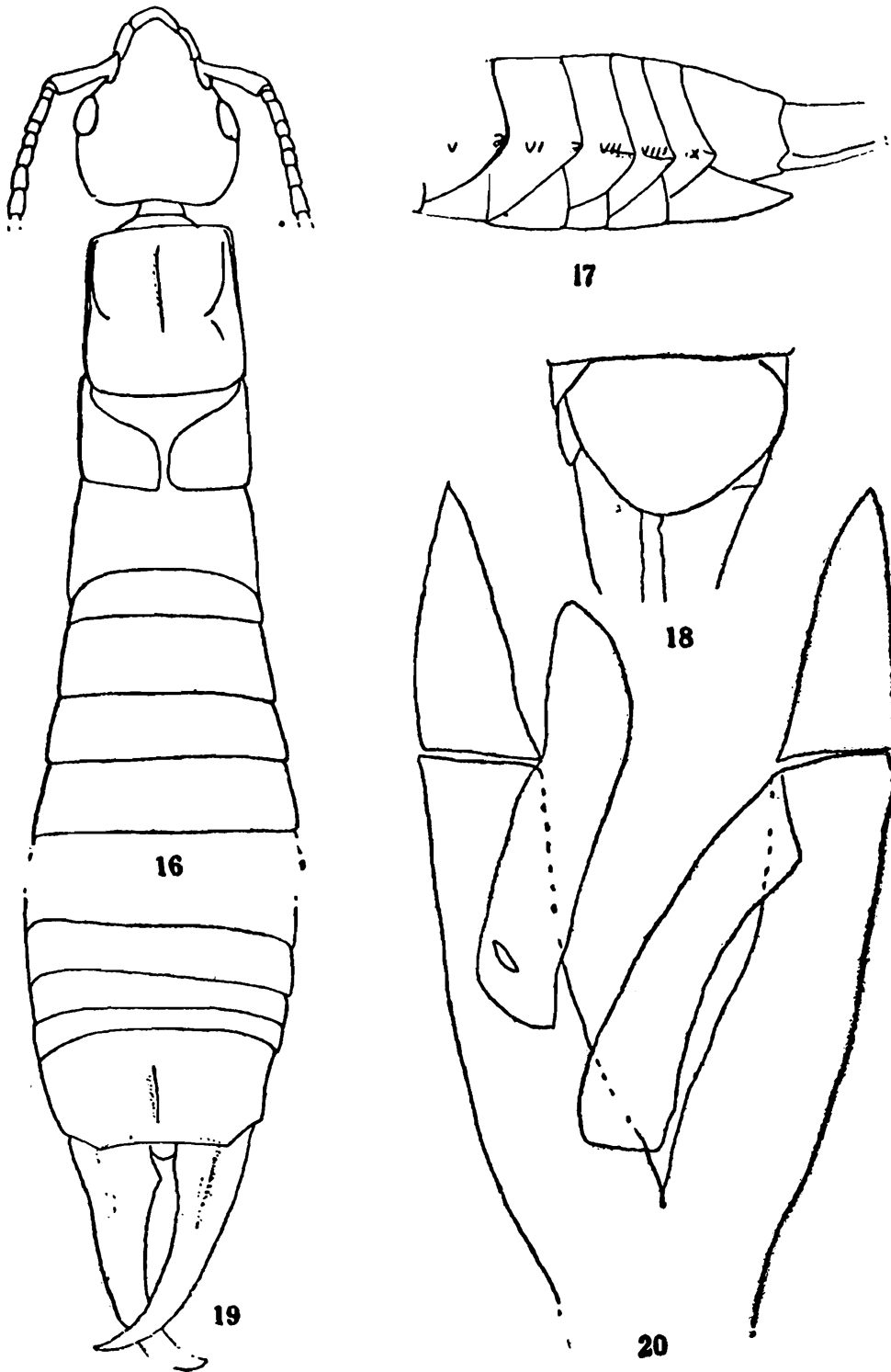
(Figs. 16-20)

*Epilabis (Cryptolabis) ramachandrai* Ramamurthi and David, 1973, *Zool. Anz.*, 190 (5-6) : 438, figs., 7, 8 (♂, India, North Malabar, Taliparamba-Type with the author).

*Apolabis ramachandrai* : Srivastava, 1978, *Bull. zool. Surv. India*, 1 (1) : 7.

♂ : General colour dark brownish black, head on frons in part, pronotum and elytra shining reddish; antennae and legs light brown.

Head longer than broad, weakly convex, micro-sculptured, sutures obsolete, hind margin emarginate. Antennae (in Holotype ♂ remaining with 15 segments on the right and 18 on the left side) 1st stout, gently expanded apically, about as long as the distance between antennal bases; 2nd short; 3rd long and slender; 4th about as long as broad; 5th slightly longer than broad but both shorter than the 3rd; 5th onwards segments gradually increasing in length and thinning. Eyes prominent, only slightly shorter than the post-ocular length. Pronotum longer than broad, gently widened posteriorly, sides and anterior margin straight, hind margin briefly rounded, prozona weakly raised, metazona weakly depressed, median sulcus faint but complete. Elytra abbreviated, near base narrowed, exposing a large transverse scutellum, posteriorly enlarged, meeting along the median line, smooth. Metasternum transverse, punctulate, hind margin broadly emarginate posteriorly. Sternal plates and legs typical for the genus. Abdomen finely punctulate, gradually enlarging posteriorly, each tergite above laterally with three smooth lobular patches, arranged into a triangle, sides of segments rugosely punctulate, segments 7th to 9th acute angled posteriorly with a faint carina and segments 5th and 6th obtuse posteriorly with a small tubercle. Penultimate sternite triangular with hind margin obtusely produced in middle posteriorly. Ultimate tergite transverse, sparsely punctulate, moderately convex, narrowed posteriorly, hind margin between the bases of forceps straight and above the branches



Figs. 16-20. *Apolabis ramachandrai* (Ramamurthi and David), Holotype ♂.  
 16. Anterior portion of body, 17. Sides of abdominal segments,  
 18. Penultimate sternite 19. Ultimate tergite and forceps,  
 20. Genitalia (fig. 20 redrawn from Ramamurthi and David).

concave and oblique. Forceps subcontiguous, dilated at base, afterwards tapering, almost straight in basal half, thence gently curved with apices pointed and hooked, at base above trigonal with a ridge present in basal  $\frac{1}{4}$ , internally left arm provided with a small tooth near base and right one with a feeble sinuation, afterwards obscurely crenulate. Genitalia with parameres roughly triangular, narrowed apically with tip pointed, distal lobes with a short chitinous rod.

♀ : Unknown.

*Measurements* : (in mm)

|                   |      |
|-------------------|------|
|                   | ♂    |
| Length of body    | 20.0 |
| Length of forceps | 4.5  |

*Material examined* : India : N. Malabar, Taliparambu, Holotype ♂ (male genitalia removed), 19.v.1923, Y. R. Rao.

*Distribution* : South India.

*Remarks* : Through the courtsey of Shri B. N. Ramamurthi the Holotype ♂, without male genitalia, was available for study.

On the basis of the shape of elytra this species comes close to *A. castetsi* (Bormans) and *A. genitalis* (Kapoor) but differs from both by its larger size and the shape of parameres which are triangular with all margins straight and tip narrowed and pointed.

### ***Apolabis aborensis* (Burr)**

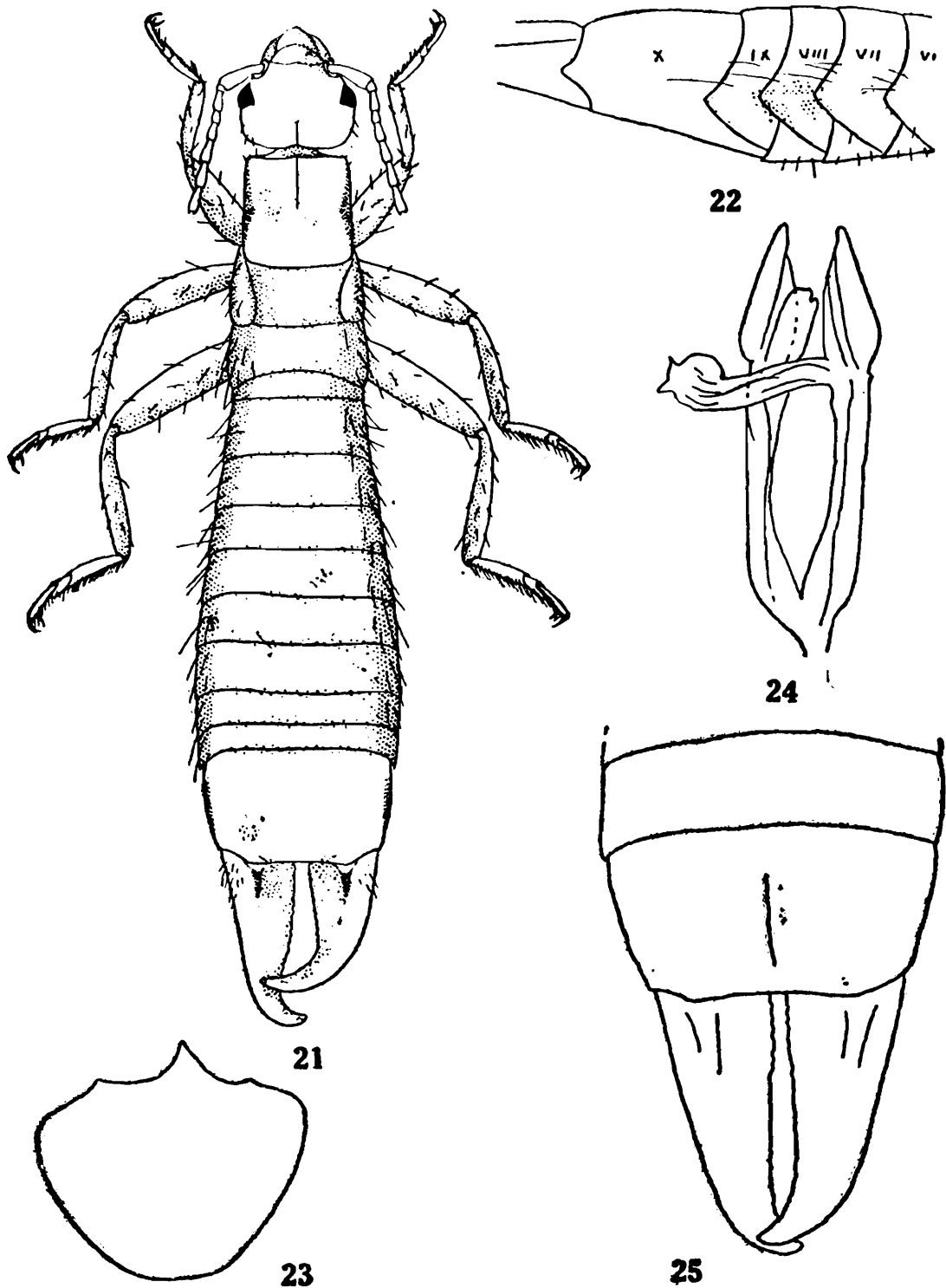
(Figs. 21-25)

*Euborellia aborensis* Burr (pars), 1913. *Rec. Indian Mus.*, 8 (2) : 137 (♂, ♀; Arunachal Pradesh, Siang Dist., Rotung, 1 nymph and 1 ♀, Janakmukh (excluding 1 ♂, Assam, Dibrugarh)—Nomotype in the Zoological Survey of India, Calcutta).

*Paralabis aborensis* : Srivastava, 1968, *Ent. Rec. J. Var.*, 80 : 292 (excluding 1 ♂, Assam, Dibrugarh and the description of male genitalia) ; Srivastava, 1971, *Ent. Rec. J. Var.*, 83 : 22 (excluding figs. B, D and F) ; Srivastava & Roychowdhury, 1975, *Newsl. zool. Surv. India*, 1 (2) : 22 (♂, ♀ ; Tripura).

♂ : General colour reddish brown, often shaded with black in parts ; antennae, sides of pronotum and legs yellowish brown. Form moderately depressed, thickly pubescent with long and short hairs.

Head about as long as broad, triangular, smooth, frons weakly raised and occiput comparatively depressed, sutures fine, hind margin straight. Eyes black, not very prominent, much shorter than the post-ocular length. Antennae 15-segmented or more, 1st stout, expanded apically, about as long as the distance between antennal bases ; 2nd short ; 3rd long and slender ; 4th and 5th, both shorter than the 3rd ; 6th almost equal to 3rd, remaining gradually increasing in length and thinning apically. Pronotum slightly longer than broad, laterally a little reflexed and parallel, posterior margin feebly rounded, disc flat, pro- and metazona weakly differentiated, median sulcus faint. Elytra present as narrow ovate flaps on the sides of mesonotum. Metanotum transverse and broadly emarginate posteriorly. Sternal plates typical for the genus. Legs normal, hind tarsi with 1st segment slightly longer than the 2nd and 3rd segments together, clad with fine pubescence and a row of thick chitinous hairs on underside. Abdomen



Figs. 21-25. *Apolabis aborensis* (Burr), Nomotype ♂, 21. Dorsal view, 22. Sides of abdominal segments, 23. Penultimate sternite, 24. Genitalia; ♀, 25. Ninth and ultimate tergites and forceps.

weakly depressed, punctate, gradually expanded posteriorly, sides of segments 7th to 9th rugosely punctate, acute angled posteriorly, an oblique carina present on the segments 7th to 9th only but carina on 9th segment sometimes weak. Penultimate sternite narrowed posteriorly with margin rounded. Ultimate tergite transverse, punctation faint and sparse, pubescence wanting, gently narrowed posteriorly with hind margin between the branches of forceps straight and above oblique and emarginate, laterally with a weak longitudinal fold, median sulcus

faint. Forceps contiguous or subcontiguous, trigonal in basal  $\frac{1}{8}$ , afterwards depressed, tapering, almost straight in basal  $\frac{1}{2}$  to  $\frac{3}{4}$ , thence incurved with right branch more strongly so, apices gently hooked and pointed. Genitalia with paramers three times longer than broad, broadest at base, narrowing apically with tip acute; distal lobes without any discernible virga.

♀ : Agrees with male in most characters except that penultimate sternite obtuse posteriorly; ultimate tergite comparatively more narrowed posteriorly and forceps almost symmetrical and less curved.

*Measurements* : (in mm)

|                   | ♂ ♂       | ♀ ♀       |
|-------------------|-----------|-----------|
| Length of body    | 12.3-14.9 | 12.0-15.9 |
| Length of forceps | 2.0- 2.5  | 2.0- 2.0  |

*Material examined* : India : Arunachal Pradesh : Siang Dist., Rotung, 427 m, Holotype ♂ (genitalia mounted between two coverslips and pinned with the specimen), 4 ♀ ♀, under the leaf stems of plantain, 24-26.xii.1911; Janakmuhi, 1 ♀, 1 nymph, 19.xi.1911, S. W. Kemp, Lohit Dist., Deopani (Roing); 2 ♂ ♂, 1 ♀, 6.iii.1969, S. K. Tandon; Tripura, Bramachera, Teliamura, 1 ♂, 2 ♀ ♀, 2 nymphs, 10.xi.1974, M. S. Shishodia.

*Distribution* : India : Arunachal Pradesh and Tripura.

*Remarks* : This species can be easily separated from the other Indian species of the genus in having body strongly pubescent and the elytra as narrow lateral, ovate flaps on mesonotum.

Besides, it is interesting that this species is confined to the Hills of NE India whereas the remaining three are endemic to Western Ghat Hills in South India.

#### ACKNOWLEDGEMENTS

I am thankful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta for providing necessary facilities during the course of present work. My thank are due to Shri B. N. Ramamurthi and the Head, Division of Entomology, Indian Agricultural Research Institute, New Delhi for allowing me to examine the Holotype ♂ of *Epilabis* (*Cryptolabis*) *ramachandrai* Ramamurthi and David and *Thekalabis genitalis* Kapoor, respectively.

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**CUMACEA OF THE ISRAEL SOUTH RED SEA EXPEDITION, 1926\***

A. RADHADEVI AND C. V. KURIAN

*Pelagic Fisheries Laboratory, (CMFRI) Cochin-682 016.*

INTRODUCTION

The cumacea collection from the Red Sea obtained by the Israel South Red Sea Expedition during 1962 consists of 91 specimens belonging to 8 species. All the specimens are from shallow depths obtained in the plankton or benthic collections. The families Bodotriidae and Nannastacidae are represented.

The paper deals with the Cumacea collected by the Israel South Red Sea Expedition during the year 1962 and received from the Hebrew University, Israel. The samples were collected from stations near Entedebir Island, Dehlaakebir Island, Harmil Island, Romia Island and Massawa channel. Representatives of only two families Bodotriidae & Nannastacidae are present in the collections.

The collection consists of 91 specimens belonging to 8 species :

Family BODOTRIIDAE

Sub family BODOTRIINAE

*Bodotria sublevis* Calman

*Bodotria scorpioides* (Montagu)

*Bodotria parva* Calman

*Cyclaspis strigilis* Hale

*Cyclaspis calmani* Hale

Family NANNASTACIDAE

*Nannastacus lepturus* Calman

*Cumella hispida* Calman

*Cumella munroi* Hale

Genus **Bodotria** Goodsir

**Bodotria sublevis** Calman

*Bodotria sublevis*, Calman (1907) *Trans. zool. soc. Lond.* **18**, **1**, p. 3, pl. 1, figs. 1-3.

*Bodotria sublevis*, Stebbing (1913) *Das Tierreich*, **39**, p. 25.

*Bodotria sublevis*, Kurian (1951) *Bull. cent. Res. Inst. Univ. Travancore*, (C), **2**, **1**, pp. 80, 81.

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\* Part of the thesis for which ph.D. degree of the Cochin University was awarded to A. Radhadevi.

*Locality* : Entedebir Island, about 3 m from high tide level 11.3.1962, 3 ♀ ♀ 1.3-1.9 mm (1 ovigerous), Romia Island, Mangrove roots, 29.3.1962, 2 ♀ ♀ (immature) 1.3-1.5 mm.

*Female* : Carapace granular, without hairs and spines. Basis of third maxilliped longer than the other segments combined together and expanded distally with three of four plumose setae. Basis of first peraeopod as long as or little shorter than the other segments combined together. Pleon longer than cephalothorax ; telsonic somite half of the fifth pleon somite and less than half of the peduncle of uropod. Peduncle without spines or serration ; exopod and endopod subequal and three fourths the peduncle ; first joint of endopod more than twice as long as second, only a single terminal spine on the first joint ; second joint also with a terminal spine and a short subterminal spine.

*Distribution* : Gulf of Siam, Trivandrum.

### ***Bodotria scorpioides* (Montagu)**

*Cancer scorpioides*, Montagu, (1804) *Trans. Linn. Soc. London*, 7, p. 70, fig. 5.

*Bodotria scorpioides*, Fage, (1951) *Faune de France*, No. 54, Paris, (2), 1, pp. 31. 33, Figs. 24-26.

*Bodotria scorpioides*, Lomakina (1958) *Opred. do faune SSSR*, no. 66, pp. 281-283, fig. 190.

*Locality* : Entedebir Island, grab collection, 5m, 20.3.1962, 3 ♂ ♂ 2 mm night plankton, 0.5m, 19.3.1962, 48 ♂ ♂ 1.8-2 mm.

*Male* : Pseudorostrum short, paired lateral carinae indistinct. Basis of first peraeopod longer than the other segments combined together, carpus equal to propodus. Fifth pleon somite much longer than telsonic somite and narrowed distally. Peduncle of uropod thrice as long as telsonic somite, with seven or eight short plumose setae and seven spines arranged in two rows ; exopod and endopod subequal, more than half the length of peduncle ; first joint of endopod more than twice as long as second, with seven spines on the inner margin ; second joint without any spines but with two unequal terminal spines ; exopod with six setae on the inner margin and two unequal terminal spines. From the previous records, the present specimen differs in the total length and nature of carapace. The specimens attain only a length of 2mm compared to 5-7 mm of the previous records. But all the other characters such as nature of eye, number of eye lenses, nature of peraeopods and uropods and the nature of the fifth pleon somite (narrowed in the distal half) exactly resemble *B. scorpioides* described by Montagu (1804) Fage (1951) and Lomakina (1958).

Superficially this has a close resemblance to *B. subtevis*, but there is marked difference in the size and nature of peraeopods and uropods. The presence of plumose setae and spines on the endopod of uropod and seven spines on the first joint of endopod shows its similarity *B. scorpioids* of previous records.

*Distribution* : British Isles, France, Norway.

### ***Bodotria parva* Calman**

*Bodotria parva*, Calman, (1907) *Trans. zool. Soc. Lond.* 18, 1, p. 5, pl. 1, figs. 16-18.

*Bodotria parva*, Stebbing, (1913) *Das Tierreich*, 39, p. 28.

*Locality* : Horizontal plankton, Massawa channel, 7-4-1962, 10 ♀ ♀ (2 ovigerous ♀ ♀ 2-2.1mm) & 5 immature ♂ ♂ 0.8-1mm.

*Ovigerous female* : Carapace one-fourth the total length, a faintly marked longitudinal ridge present on either side of the carapace ; antennal tooth not exactly rounded as in type description. Basis of third maxilliped longer than the other segments combined together, with two plumose setae on its outer terminal expansion ; basis of first peraeopod almost as long as the other segments combined together. Pleon subequal to cephalo-thorax, fifth pleon somite twice as long as telsonic somite. Peduncle of uropod slightly shorter than the last two pleon somites combined together, without spines or setae ; exopod and endopod subequal, three-fourths the peduncle, endopod with one spine on its inner edge, about two-thirds of its length and another close to the apical spine ; exopod with four or five setae on the inner margin. The adult female specimens in the present collections are longer (2-2.1mm) than the adult female recorded from bulk of Siam (1.5mm).

*Distribution* : Gulf of Siam.

### **Genus *Cyclaspis* Sars**

#### ***Cyclaspis strigilis* Hale**

*Cyclaspis strigilis*, Hale (1944) *Rec. S. Aust. Mus.*, 3, pp. 88-86, figs. 11. 14.

*Cyclaspis strigilis*, Kurian, (1951) *Bull. cent. Res. Inst. Univ. Travancore, (C)*, 2, 1, pp. 89, 90.

*Locality* : Entedebir Island, Coralline fine sand, 13.3.1962, 1 ovigerous ♀ 3.1mm, 1 immature ♂ 2.7mm.

*Ovigerous female* : Carapace one-third of the total length, with numerous oblique striae on the sides. Basis of third maxilliped and first peraeopod little shorter than the other segments combined together ; pleon segments cylindrical with articulating lateral processes.

Beduncle of uropod as long as the endopod, with seven inner marginal spines towards the posterior part; endopod slightly shorter than exopod, with nine spines on the inner margin and exopod with two spines.

*Immature male* : Striation on the carapace not as clear as in the female. Peduncle of uropod with eleven inner marginal spines; endopod with nine and exopod with four spines.

*Distribution* : Queensland, Trivandrum.

### **Cyclaspis calmani Hale**

*Cyclaspis calmani*, Hale (1944) *Rec. S. Aust. Mus.*, 8, 1, pp. 72, 112.

*Cyclaspis calmani*, Kurian (1954) *Rec. Indian Mus.*, 52, parts 2-4, pp. 281, 282.

*Locality* : Entedebier Island, Coralline fine sand, 13.3.1962 6 ♀ ♀ (immature) 1-1.6mm.

*Immature female* : Carapace finely reticulated, pseudorostrai lobes barely meet in front of the ocular lobe. Basis of third maxilliped as long as the other segments combined together, basis and merus expanded terminally with plumose setae. First peraeopod long, basis shorter than other segments combined together, propodus little longer than carpus, second peraeopod very short. Fifth pair of peraeopods not developed. Peduncle of uropod little longer than exopod or endopod and without serration. Endopod with three inner marginal spines, without apical spine; exopod little longer than endopod, with an inner marginal spine close to the apical spine.

*Distribution* : New Zealand, Andamans.

### **Genus Nannastacus Bate**

#### **Nannastacus lepturus Calman**

*Nannastacus lepturus*, Calman, (1911) *Trans. zool. Soc. Lond.* 18, 4, pp. 341, 351, figs. 1-3.

*Nannastacus lepturus*, Stebbing (1913) *Das Tierreich*, 39, p. 171.

*Locality* : Israel, horizontal plankton, Massawa channel, 7.4.1962, 1 ♂ 2mm, Harmil Island 28.3.1962, 1 ♂ 1.6mm.

*Male* : Closely resembles the type description. Peduncle twice as long as telsonic somite, highly serrated on the inner margin. Endopod with seven marginal spines.

*Distribution* : Suez Canal.

Genus **Cumella** Sars**Cumella hispida** Calman

*Cumella hispida*, Calman (1911) *Trans. zool. Soc. Lond.* **18**, **4**, pp. 341, 347, figs. 15-18.

*Cumella hispida*, Stebbing (1913) *Das Tierreich*, **39**, pp. 181-182.

*Cumella hispida*, Hale (1945) *Rec. S. Aust. Mus.*, **8**, **2**, p. 176, figs. 21.

**Locality** : Massawa channel, Horizontal plankton, 7.4.1962, 7 ♀ ♀ 1.8-2.6 mm, 1 ♂ 2 mm, Near Dehlakkebir Island, 6 mm, 26.3.1962, 2 ♀ ♀ (1 ovigerous) 2.2 & 2.3 mm Entedebir Island, outside landing bay, 6m, 26.3.1962, 2 ♀ ♀ (1 ovigerous) 2 & 2.3 mm, 7m, 2 ♀ ♀ (1 ovigerous) 1.9 & 2.4 mm.

**Ovigerous female** : Closely resembles the type description. Carapace triangular, hairs on the carapace lesser or absent when compared to the description of Calman and Hale. Carpus of fifth peraeopod very long and twice as long as merus and propodus. Peduncle of uropod as long as the telsonic somite, with four marginal spines, endopod with two marginal spines. One of the ovigerous females examined, contained 4 eggs.

**Male** : Closely resembles *C. hispida* from S. Australia. Peduncle of uropod bears five short spines on its inner serrated margin ; endopod with five spines on the inner margin ; exopod more than three-fourths as long as endopod.

**Distribution** : Gulf of Siam, S. Australia.

**Cumella munroi** Hale

*Cummella munroi*, Hale (1945) *Rec. S. Aust. Mus.*, **8**, **2**, pp. 171, 172, figs. 17, 18.

**Locality** : Entedebir Island, high tide level, 11.3.1962, immature ♀ 1.3 mm (damaged).

**Immature female** : Carapace damaged uropods & peraeopods resemble those *C. munroi* Hale. Peduncle without spines, exopod and endopod subequal, more than three-fourths the peduncle.

**Distribution** : Queensland, Moreton Bay, Green Island.

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

## SUMMARY

Very little is known about the cumacean fauna of Red Sea. The previous records are by Paulson (1875), Kossman (1880), Lomakina (1967) and Bacescu & Muradian (1975). Only eight species have been collected from Red Sea in the present investigation and they all occurred at shallow depths. All of them except *Bodotria scorpioides* have an Indo-West Pacific affinity. The specimens were obtained either in plankton or in benthic samples.

ACKNOWLEDGEMENTS

The above work was carried out in the Pelagic Fisheries Laboratory of CMFRI as part of the scheme on Cumacea sanctioned by ICAR. The authors are thankful to Dr. E. G. Silas, Director of CMFRI for providing necessary facilities for carrying out the investigation. Our thanks are due to the Hebrew University of Jerusalem, Israel who provided the above specimens for our study.

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ON HABITS OF SOME CENTRAL INDIAN LIZARDS WITH  
MORPHOLOGICAL NOTES ON EUBLEPHARIS  
HARDWICKII GRAY

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INTRODUCTION

(With 1 Plate)

During my stay in Jabalpur city, I had an opportunity to observe during summers of 1975 and 1976 the habits of two species of lizards, *Mabuya macularia* (Blyth) (family Scincidae) and *Calotes versicolor* Daudin (family Agamidae) which were common in the area. Several unrecorded observations were made particularly on the interesting subject of feeding and breeding habits.

Another species *Eublepharis hardwickii* Gray, which appears to be very rare in the area, was observed in Bandogarh National Park.

OBSERVATIONS

(i) *Mabuya macularia* (Blyth)

This skink (plate 1, fig. 2) was seen in pairs in June. The adult male could easily be distinguished by the presence of a pair of broad ventro-lateral red bands, extending around whole of anterior ventral surface in front of hind limbs. The characters of sexes were confirmed by actual examination of specimens. Once an adult female came out of the hedge when dry leaves were being removed and menacingly moved its tongue to and fro like a snake. It even bit the stick with which it was touched. However, no eggs were found nearby. A pair was captured on 25 June and kept in captivity in a large glass jar of 2 litres capacity with its mouth covered with muslin to allow circulation of air. The bottom of the jar was covered with moist sandy earth with a few pebbles to give it a natural look. Water was provided in a petridish. The female was gravid. It soon dug a hole in earth and was mostly found burried under earth while the male remained on the surface. On 28th June, three white eggs measuring 11.5 mm×8 mm were found in the earth separated from one another by a distance of about 2 cm.

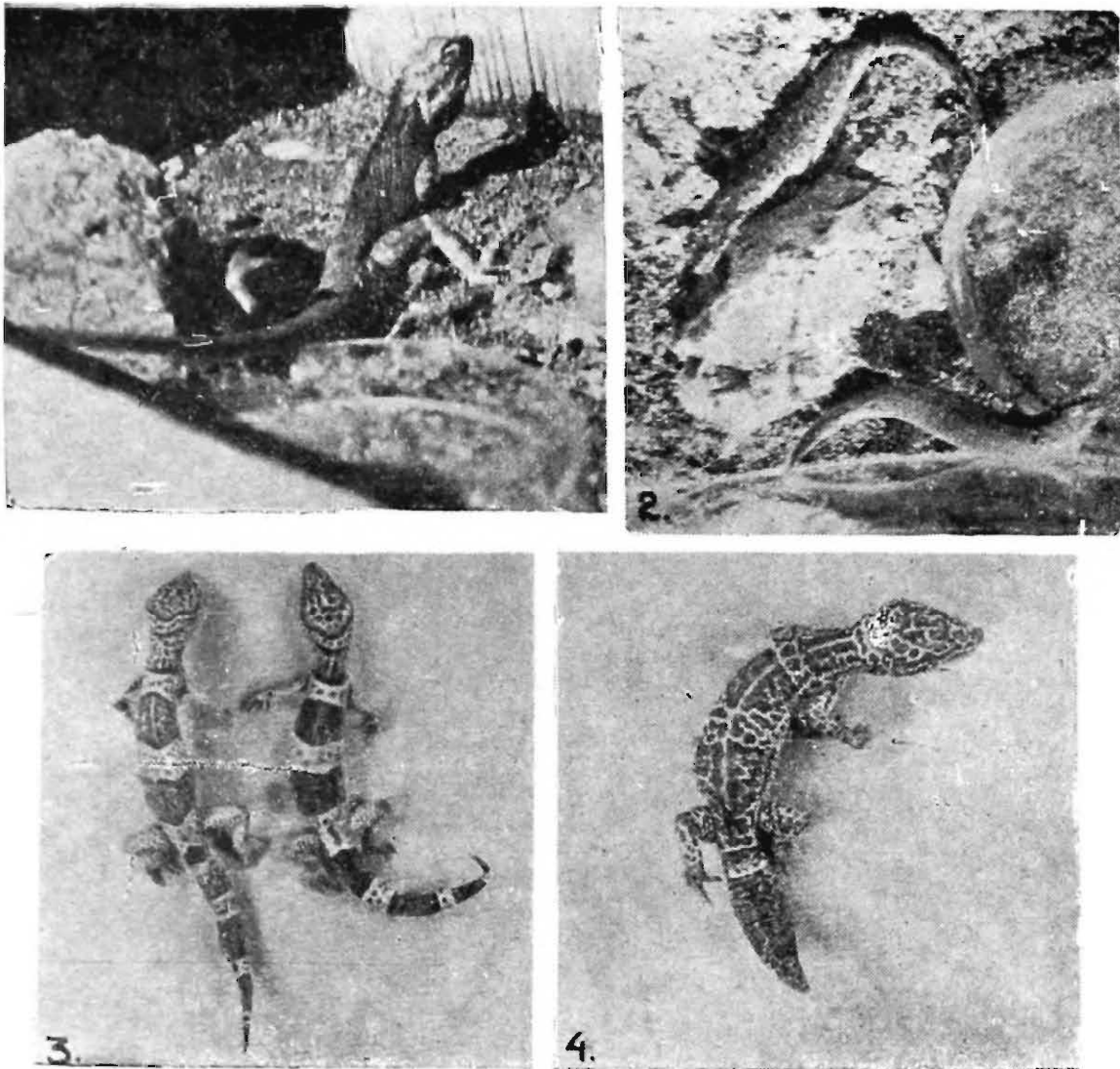
The female remained burried near the eggs but when it was disturbed the male took its place. The eggs were removed to a different spot in the same jar and placed close to one another. After about an hour they were found removed from that spot and separated from each other by a distance of a couple of centimetres. Both the specimens were found generally burried particularly during the night. Both avoided coming in close contact with each other. The female even chased the male at least once to avoid its advances. They took various kinds of insects but fed mostly on smaller Coleoptera and Orthoptera. They avoided large beetles. The female died on 7th July. Nothing is known about the cause of death except no food could be supplied to it for about 60 hours prior to death. Six enlarged eggs, *ca* 4 mm in diameter, with smaller eggs were found in the ovary showing that eggs are laid more than once in a breeding season.

The male died on 9.7.76. A single cockroach was found in its intestine and moths in the stomach which was greatly distended.

No sounds were given out by these specimens in captivity.

(ii) *Calotes versicolor* Daudin (Pl. I, fig. 1).

Asana(1931) has given an account of some of the habits of this lizard. The hedges, extending over about 9 metres in length, of a small garden were occupied by three individuals ; an adult male, a subadult male and a adult female. The adult male, was only an occasional visitor in the morning and evening to the portion of the hedge, *ca* 5 mts, occupied by the female, and separated from the other portion occupied by the sub adult by a small gate. The subadult male was not seen when the adult male was out. The adult male which was conspicuous by its brilliant colours and black throat patch was much larger than the other two. The subadult lacked the black throat patch but showed other colours of its sex. The female was the smallest. The subadult male and the female were not observed, to leave their territory. I am not aware of any work describing the mating in this lizard in natural state. Mating was observed twice on 15th and 16th June, On both occasions the male chased the female. The chase was preceded by usual courtship display. During the chase, the female was overtaken by the male which rode over it from behind, then swung to one side and appeared to turn by its hind legs the hinder quarters of the female so that genital opening was exposed for copulation which followed. On one of the occasions during the chase the female escaped and hid itself in dry leaves. The male unable to find the female was about to leave the hedge when its attention was directed by the slight movements of dry leaves about  $\frac{1}{2}$  mt behind caused by the female which was apparently following the male



Figs. 1-4. 1. male of *Calotes versicolor macularia* in captivity, 2. male and female of *Mabuya macularia* in captivity ; 3-4. three stages in the growth of *Eublepharis hardwickii* (preserved specimens).

noiselessly below the leaves. It immediately turned and after giving a swift chase over-rode the female and tried copulation. However, the female after noting the presence of the observer too close immediately freed itself from the male and ran away. The male moved away slowly with its tail slightly bent upward and with a part of the hemipenis still protruding. The copulation was apparently not fully successful. On the second occasion the copulation appeared successful and the female moved away after the act slowly with its tail bent upward at the anus. The male did not show any bending of tail.

The adult male was frequently seen at the top of a long dried bamboo in the hedge where it sometimes slept. During sleep its brilliant colours disappeared so that its colour harmonised with the surroundings. The sleeping animal could not be observed at a distance of about a metre. This is apparently an adaptation to save it from enemies when asleep. The subadult male disappeared from the hedge. It was probably picked up from the hedge by an often present crow pheasant which is known to feed on this species of lizards, or it may have left because of frequent presence of the adult male in the adjoining hedge.

In another nearby garden the following observations were made.

22.6.76. A male after seeing the female partly hidden in leaves about three metres away gradually approached the latter till it was a metre away. It started its usual display of raising and lowering its head in quick succession. This habit may possibly be a courtship display. However, this habit does not appear to be confined only to adult males *vide infra*. The display was continued for about half an hour and was followed by a sudden rush towards the female which ran away inside the hedge for about three metres closely followed by the male. It could not be ascertained whether the chase was followed by mating because of plenty of dry leaves in which the animals were hidden.

On the same date a fight between two adult males was observed for a few minutes. They appeared to bite each other. Ultimately one of them ran away. On 29.6.76. an adult female was found moving its head up and down on a heap of manure in close proximity of an adult male. The former ran away after some time. It was not pursued by the male. This shows that the habit may also be used by unwilling females to ward off male advances. No eggs were found in the heap of the manure.

In addition to this female, there was another adult female easily distinguishable by its broken tail in the same hedge which was about 20 metres long. No mating was observed with this female. However, this may show that "territory" of each adult female may possibly extend upto about 10 metres in a hedge.

## OBSERVATION IN CAPTIVITY

Three adult males, one subadult male and two adult females were kept in captivity during 3rd week (exact date unrecorded) of June, 1977 in a wooden cage (ca 75 cm×40 cm) with a glass top. The floor of the cage was covered with earth and small stones to give it a natural look, water was provided in a large petridish. The glass top of the cage allowed easy observation. They showed remarkable tolerance towards each other and there was no fight. The males were gradually removed one after the other leaving the largest male and two females together on 24.6.76. No mating was observed. The male tried to bite, if disturbed. None of the males showed their normal bright colour in captivity but at the time of feeding some exhibition of colour could be observed. On some occasions both males and females were seen with their snouts touching each other. On one occasion a female was seen on the top of the male which did not respond. Once the male stopped feeding on an insect and allowed the female to take it. On another occasion the two females got hold of one cockroach from opposite ends and shared it. Drinking was not observed. They took a variety of insects but mainly grasshoppers, cockroaches, beetles and Lepidopteras. In hot weather, they were occasionally seen lying in water kept in dish. The female hid itself when a new female was introduced in the cage for sometime. The male was seen on a few occasions sleeping with its whole body sprawled on the ground while female was always observed with its head raised. The female sometimes gave out very loud squeels. The female escaped on 30.6.75 but was located near the cage and recaptured. Next day both were taken out from the cage and kept in the garden with twine tied to their hind legs to see whether mating can be induced outside the cage. However, during the night they were attacked by a predator (possibly a cat) and were found in the morning with heads partially eaten. Testes of the males measured 15×7 mm (right) and 12×5 mm (left). There were nine eggs (about 6 mm in diameter) in the ovary of the female four of which were blackish and yellowish in part.

***Eublapharis hardwickii* Gray**

(Plate I, Figs 3-4)

Four specimens of this lizard, often called the fat-tailed lizard, were collected on 6th Sept. 1972 from shallow crevices in walls of an artificial cave in Bandogarh National Park, Rewa Dist, M. P. They were very sluggish in movements. The four specimens show three interesting stages in the development of adult colour pattern from the young.

## 1. Smallest specimen (2 Nos.)

General colour a shade or tint of greyish black with three yellowish bands on dorsal surface, the one at the level of origin of hind legs spreading on dorsal surface of legs, four white bands on the tail and one nuchal the latter spreading to lower side of the eyes. There is a lighter spinal line. One of the specimens is lighter and has whole of the surface marked with dark spots, the spots forming two lateral bands on the belly. In the darker specimen such spots harmonise with general darker colouration. The tail is ringed. Whole of the ventral surface is devoid of colour pattern, the tail is lighter or yellowish ventrally.

## 2. Medium sized specimen (1 No.)

General colour on dorsal surface is brownish black with reddish tinge. There are yellowish bands on the body as in previous specimens but they are absent on head and the tail. The tail is broader in the middle.

## 3. Largest specimen (1 No)

General dorsal colour is yellowish with black spots and ventral side of the head spotted. The bands are indistinct.

## SUMMARY

Feeding, breeding and other habits of two Central Indian lizards, *Mabuya macularius* (Blyth) and *Calotes versicolor* Daudin have been studied in the wild and in captivity and a number of unrecorded observation have been made. Morphological notes on three developmental stage of *Eublepharis hardwickii* Gray have been recorded.

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\*The identification of the genus *Eublepharis* was done according to Smith (1935) and confirmed by the Reptile section of Zoological Survey of India.



RECORDS OF MOSQUITOES COLLECTED FROM THE  
STATE OF HIMACHAL PRADESH, INDIA WITH  
ECOLOGICAL NOTES

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INTRODUCTION

Not much information has been added on the mosquito fauna of Himachal Pradesh, particularly of the higher altitudes, since the publication of monographs of Indian Anophelines (Christophers, 1933) and Culicines (Barraud, 1934) except for two subsequent publications on Anophelines (Puri, 1948 and Rao, 1981).

The present communication deals with the mosquitoes collected during a survey of haematophagous arthropods in the Himachal Pradesh, between April 1967 and September 1970 under the auspices of Indian Council of Medical Research (Rao *et al.*, 1973).

The classification and nomenclature followed in the present study are mainly based on the synoptic catalogs of the mosquitoes of the world (Stone, *et al.*, 1959 : Stone and Delfinado, 1973 and Knight and Stone, 1977). Identification is mainly done on adult characters : genitalia of males and the characters of immature stages were also taken into consideration. Ecological notes on the species collected are given. The altitudes of the localities, given in parenthesis, are only approximate.

COLLECTION RECORDS

Family CULICIDAE

Subfamily : ANOPHELINAE

1. *Anopheles gigas simlensis* (James)

*Anopheles gigas* var. *simlensis* (James, 1911). In James and Liston, *Monogr. anoph. Mosq. India.*, ed. 2 : 66 ; Christophers, 1933 : 36-37 ; Knight and Stone, 1977 : 19 ; Rao, 1981 : 270-272.

This subspecies has been recorded from western Himalaya including the foot-hills, north-west frontier region of Pakistan and Sri Lanka.

*Present records* : Kulu dist. : 2 pupae and 1 ♀ reared from larva collected from river-side pool, Bibhali (1220 m), 11 May 1967. Mandi

dist. : 1 ♀ collected from outdoor vegetation along a garden fence, Galu (1000 m), 28 March 1968. Mahasu dist. : 1 ♀ collected from a tree-hole, Pipty Rampur (1300 m), 4 June 1970. Kinnaur dist. : 1 ♀ from forest vegetation and 1 ♀ from indoor resting, Sangla (2700 m), 7 and 16 June 1970.

The present records extend its distribution from temperate to sub-alpine zone upto an elevation of 2700 m.

## 2. *Anopheles lindesayi* (Giles)

*Anopheles lindesayi* Giles, 1900, Handbook, ed. 1 : 166 ; Christophers, 1933 : 123-129 ; Knight and Stone, 1977 : 22 ; Rao, 1981 : 267-268.

A montane species recorded from India, Pakistan, Nepal, U. S. S. R. and Burma. In India, it is found in the Himalaya upto an altitude of about 3000 m.

*Present records* : Chamba dist. : 9 ♂♂ and 3 ♀♀ collected from forest vegetation and tree-holes, Banikhet (1680 m.), 9 and 11 June 1967 ; 2 ♀♀ from forest vegetation, one on 12 June 1967 and the other on 30 May 1967 at Kalatop (2450 m.) and Khalel (2120 m.) respectively. Kangra dist. : 1 ♂ along the river side vegetation, Drung (1120 m.), 2 June 1967. Kulu dist. : 1 ♀ collected from vegetation, Manali (1860 m.), 2 Aug. 1970. Mahasu dist. : 1 ♀ forest vegetation, Dhanguyi (1850 m.), 13 May 1969 ; 1 ♀ resting inside house, Ratan-nadi (2700 m.) 11 July 1970. Simla dist. : Many larvae and 1 ♂ reared from larva, collected from a water pool in a quarry, Kandaghat (1500 m.) 2 June 1970.

## 3. *Anopheles annularis* Van der Wulp

*Anopheles annularis* Van der Wulp, 1884, *Notes Leyden Mus.*, 6 : 249 ; Christophers, 1933 : 300-307 ; Knight and Stone, 1977 : 34 ; Rao, 1981 : 448-452.

This species has a wide distribution in the oriental region.

*Present records* : Bilaspur dist. : 1 ♀ resting inside cattle shed, Ballu (580 m.), 27 Mar. 1969. Kangra dist. : 1 ♀ outdoor resting, Dugadda (900 m.), 19 March 1969. Kulu dist. : 1 ♀ resting inside cattle shed, Chyala-Manali (1850 m.), 3 Aug. 1970. Simla dist. : 1 ♀ indoor resting, Nalagarh (600 m.) 9 Apr. 1969.

## 4. *Anopheles culicifacies* Giles

*Anopheles culicifacies* Giles, 1901, *Entomologist's mon. Mag.*, 37 : 197 ; Christophers, 1933 : 197-202 ; Knight and Stone 1977 : 37 ; Rao, 1981 : 365-409.

This species has been recorded from India, Sri Lanka, Burma, Nepal, Thailand, Indochina, China, Pakistan, Afghanistan, Iran and around Persian Gulf. In India, it is widely distributed.

**Present records :** Sirmour dist. : 1 ♀ collected from outdoor resting, Moginand (500 m.) 28 Apr. 1969.

### 5. *Anopheles fluviatilis* James

*Anopheles fluviatilis* James, 1902, *Scient. Mem. Offrs. med. Sanit. Deps. India.*, 2 : 31 ; Christophers, 1933 : 203-208 ; Knight and Stone, 1977 : 39-40 ; Rao, 1981 : 322-343.

The species has a wide distribution which includes India, Pakistan, Afghanistan, Nepal, Sri Lanka, Burma and other Southeast Asian countries, China, Kazakh S. S. R., Iraq, Arabia, Oman and Bahrein. It is prevalent throughout India, particularly in hilly region.

**Present records :** Kangra dist. : 1 ♂ and 1 ♀ collected inside cattle shed, one from Lad (900 m.) and other from Dugadda (900 m.) on 17 and 19 Mar. 1969 respectively. Simla dist. : 6 ♀ ♀ inside house, Manpura (500 m.) 7 Mar. 1969 ; 4 ♀ ♀ inside human dwelling, Malkumajara (500 m.) 8 Mar. 1969 ; 1 ♀ inside house, Pud-Nalagarh (600 m.) 9 Mar. 1969. Sirmour dist. : 1 ♀ resting outdoor on vegetation near hill stream, Moginand (500 m.), 28 Apr. 1969.

### 6. *Anopheles maculatus willimori* (James)

*Anopheles maculatus* var. *willimori* (James, 1903) in Theobald *Monogr. cul.*, 3 : 100 ; Christophers, 1933 : 285-287 ; Knight and Stone, 1977 : 45 ; Rao, 1981 : 455-461.

Recorded from Pakistan, India, Nepal and Burma. In India, it has been recorded along the Himalayan foothills.

**Present records :** Bilaspur dist. : 8 ♀ ♀ collected from vegetation, Ballu (750 m.) ; 2 ♀ ♀ indoor resting, Bakrol (760 m.) both on 27 Mar. 1969. Kangra dist. : 2 ♂ ♂ and 2 ♀ ♀ from shaded vegetation along a stream, Menjha (1200 m.) 3 June 1967 ; 1 ♂ river valley vegetation, Kalapur (1500 m.) 5 June 1967 ; 1 ♂, 1 ♀ from river side vegetation, Sukoh (850 m.) 6 June 1967 ; 1 ♀ outdoor vegetation, Dugadda (900 m.) 19 Mar. 1969. Kulu dist. : 1 pupa from a stream bed pool and 1 ♂ resting on the stream vegetation, Bharie (1400 m.) 9 May 1967 ; 3 ♀ ♀ inside cattle sheds, Manali (1850 m.) and Jhakadi (1600 m.) on 3 and 4 Aug. 1970. Mahasu dist. : 1 ♂, 5 ♀ ♀ collected from inside cattle shed and human dwelling at Dharampur (1300 m.), Pipty-Rampur (1300 m.), Gaura (2000 m.) on 2 and 4 June 1970 and 5 July 1970. Mandi dist. : 1 ♂, 1 ♀ from vegetation near Govt. rest house, Mandi (920 m.), 24 May 1967. Simla dist. : 1 ♂, 2 ♀ ♀ indoor resting, cattle shed, at Manpura (500 m.) and Malkumajara (500 m.) on 7 and 8 Apr. 1969.

### 7. *Anopheles splendidus* Koidzumi

*Anopheles splendidus* Koidzumi, 1920, Taiwan Kenkyujo Hokoku (Rep. Formosa Govt.) 8 : 23 ; Christophers, 1933 : 296-300 ; Knight and Stone, 1977 : 53 ; Rao 1981 : 476-477.

The species has been recorded from India, Formosa, China, French, Indo-china, Thailand, Burma, Nepal, Pakistan and Afghanistan. In India, it has been recorded from many places.

*Present records* : Mahasu dist. : 2 ♀ ♀ collected inside cattle shed Jeori (1400 m.), 2 July 1970. Simla dist. : 1 ♂ and 29 ♀ ♀ collected inside cattle sheds, Manpura (500 m.), Malkumajara (500 m.) and Pud (600 m.) on 7-9 Apr., 1969.

### 8. *Anopheles turkhudi* Liston

*Anopheles turkhudi* Liston, 1901, *Ind. Med. Gaz.*, 36 : 441 ; Christophers, 1933 : 252-257 ; Knight and Stone 1977 : 56 ; Rao, 1981 : 441-443.

The species has been recorded from India, Pakistan, Afghanistan, Israel, Iran, Saudi Arabia, Aden, Yemen, Sudan, Egypt, French Moraco, Ethiopia and Iraq. In India, It has been recorded from many places.

*Present records* : Simla dist. : 1 ♀ collected inside cattle shed, Manpura (500 m.) 7 Apr. 1969.

Subfamily : CULICINAE

### 9. *Uranotaenia* sp.

No species of this genus have so far been recorded from this region.

*Present records* : Chamba dist. : 2 ♂ ♂ collected from forest vegetation, Banikhet (1680 m.), 11 June 1969. Mahasu dist. : 1 ♀ collected from forest vegetation, Kundli (2150 m.), 16 May 1969.

### 10. *Aedes albolateralis* (Theobald)

*Aedes (Finlaya) albolateralis* (Theobald, 1908), *Rec. Ind. Mus.*, 2 : 289 ; Barraud, 1934 : 205-208 ; Stone *et al.*, 1959 : 158 ; Knight and Stone 1977 : 90.

The species has been recorded from India, Sri Lanka, Nepal, Malaya, Sumatra, China, Korea and Japan. Recorded for the first time from western himalayas.

*Present record* : Mahasu dist. : 3 ♀ ♀ reared from 5 larvae collected from a tree-hole, Pipty-Rampur (1300 m.), 4 June 1970.

### 11. *Aedes christophersi* Edwards

*Aedes (Finlaya) christophersi* Edwards, 1922, *Indian J. Med. Res.* **10** : 267 ; Barraud, 1934 : 195-196 ; Stone, *et al.*, 1959 : 167 ; Stone and Delfinado, 1973 : 298 ; Knight and Stone, 1977 : 100.

The species has been recorded from India, Pakistan and Japan. In India, it is known from Simla hills.

*Present record* : Kinnaur dist. : 1 ♀ collected from forest vegetation, Karcham (1700 m.), 19 Oct. 1967.

### 12. *Aedes niveus* (Ludlow)

*Aedes (Finlaya) niveus* (Ludlow, 1903), *In* : Theobald, *Monogr. Cul.* **3** : 193 ; Barraud, 1934 : 208-210 ; Knight and Stone, 1977 : 100.

The species has been recorded from Sumatra, Bali, Singapore Philippines and Japan. In India, it is known from Andaman Islands, West Bengal and Sunderbans.

*Present records* : Chamba dist. : 1 ♀ collected while biting on man, Surkhi-galli (1600 m.), 12 Sept. 1967. Mahasu dist. : 1 ♂, 1 ♀ collected from vegetation, Mashnu (2100 m.), 3 July 1970.

### 13. *Aedes oreophilus* (Edwards)

*Aedes (Finlaya) oreophilus* (Edwards, 1916), *Bull. Ent. Res.* **6** : 357 ; Barraud, 1934 : 192-194 ; Knight and Stone, 1977 : 101.

This is one of the commonest tree-hole breeder, recorded from Himalayas and Nilgiri hills.

*Present records* : Simla dist. : 1 ♂ collected from vegetation, Dassumajara (500 m.) 3 Apr. 1969.

### 14. *Aedes pseudotaeniatus* (Giles)

*Aedes (Finlaya) pseudotaeniatus* (Giles, 1901), *J. Bom. Nat. Hist. Soc.* **13** : 607 ; Barraud, 1934 : 178-180 ; Knight and Stone, 1977 : 102.

The species has been recorded from India, Sri Lanka and Burma. It is a common species in India.

*Present records* : Mahasu dist. : 1 ♀ from vegetation, Rampur (1300 m.), 29 Apr. 1967 ; 10 ♂♂, 13 ♀♀ inside cattle shed, Pipty-Rampur (1300 m.) and Jeori (1400 m.), 4 and 6 June 1970 and 2 July 1970. Mandi dist. : 1 ♀ inside human-dwelling, Mandi (920 m.), 21 May 1967.

### 15. *Aedes pulchriventer* (Giles)

*Aedes (Finlaya) pulchriventer* (Giles, 1901), *J. Bom. Nat. Hist. Soc.* **13** : 608 ; Barraud, 1934 : 190-200 ; Knight and Stone, 1977 : 102.

The species was originally recorded from Himalaya and subsequently from Tibet. A common tree-hole and rock-hole breeder.

*Present records* : Kinnaur dist. : 100 larvae, 50 pupae collected from rock-holes along the river side, 2 ♂♂, 1 ♀ reared from them, Wangtu (1750 m.), 30 Apr. 1967. Kulu dist. : 1 ♀ collected from river side vegetation, Bharie (1450 m.), 9 May 1967.

### 16. *Aedes shortti* Barraud

*Aedes (Finlaya) shortti* Barraud, 1923, *Bull. Ent. Res.* **13** : 405 ; Barraud, 1934 : 183-184 ; Knight and Stone 1977 : 104.

The species has been recorded from India, Pakistan, and Sumatra.

*Present record* : Chamba dist. : 2 ♀♀ collected from forest vegetation ; Kalatop (2450 m.) 9 Sept. 1967.

### 17. *Aedes thomsoni* (Theobald)

*Aedes (Christophersomyia) thomsoni* (Theobald 1905); *Genera Insectorum Dipt. Fam : Culicidae*, **26** : 19 ; Barraud 1934 : 213-215 ; Stone *et al.*, 1959 : 177 ; Knight and Stone, 1977 : 87.

The species has been recorded from western himalayas and Sri Lanka.

*Present record* : Kangra dist. : 1 ♀ collected from vegetation.

### 18. *Aedes albopictus* (Skuse)

*Aedes (Stegomyia) albopictus* (Skuse 1894), *Ind. Mus. Notes*, **3** : 20 ; Barraud, 1934 : 233-235 Knight and Stone, 1977 : 156.

This species has a wide geographical range over Oriental, Australian and parts of Palaearctic and African regions. In India, this is the commonest species of *Aedes* found in the peridomestic environment.

*Present records* : Bilaspur dist. : 1 ♂ and 1 ♀ collected around a house, Deoli (760 m.) 19 July 1970. Kangra dist. : 1 ♀ along a stream vegetation, Sukoh (920 m.), 6 July 1967 ; 2 ♂♂ and 4 ♀♀ collected while biting and hovering around a man, Dadh (1100 m.), 15 Sept. 1967 ; 1 ♀ in peridomestic area, Dharmsala (1200 m.) 17 Sept. 1967 ; 2 ♂♂ collected on vegetation, Baijnath (1000 m.) 13 Aug. 1970. Mandi dist. : 1 ♀ inside a house, Mandi (920 m.) 21 May, 1967 ; 2 ♂♂ and 15 ♀♀ collected on forest vegetation, Mandi (920 m.) 22 July 1970 ; 3 ♀♀ collected while biting on man, Mandi (920 m.) 24 May 1967.

**19. *Aedes pseudalbopictus* Borel**

*Aedes (Stegomyia) pseudalbopictus* Borel, 1928, *Arch des Inst. Pasteur d'Indochine*, 7 : 85 ; Barraud, 1934 : 235-237 ; Knight and Stone, 1977 : 163.

The species has been recorded from India, Vietnam, Malaysia, Java, Sumatra, Thailand and Burma.

*Present record* : Kulu dist. : 1 ♂ and 7 ♀ ♀ collected from roadside forest vegetation, Manali (1860 m.) 2 Aug. 1970.

**20. *Aedes subalbopictus* Barraud**

*Aedes (Stegomyia) subalbopictus* Barraud, 1931. *Indian J. Med. Res.* 19 : 225 ; Barraud, 1934 : 238-239 ; Knight and Stone, 1977 : 165.

The species has been recorded from India and Hainan Island.

*Present records* : Kulu dist. : 4 ♂ ♂ and 3 ♀ ♀ collected while hovering around and biting man, Manali (1820 m.), 6 and 8 Aug. 1970.

**21. *Aedes unilineatus* (Theobald)**

*Aedes (Stegomyia) unilineatus* (Theobald 1906), *Wellcom. trop. Res. Lab.* 2 : 70 ; Barraud, 1934 : 242-243 ; Stone *et al.*, 1959 : 188 ; Knight and Stone, 1977 : 166.

The species has been recorded from tropical Africa, Pakistan, India, Sudan, Gold Coast, Nigeria, Uganda, Kenya and Natal.

*Present records* : Mahasu dist. : 1 ♀ collected while biting man, Rampur (1200 m.), 28 Apr. 1969 ; 1 ♀ resting inside tree-hole, Pipty-Rampur (1300 m.), 4 June 1970.

**22. *Aedes vittatus* (Bigot)**

*Aedes (Stegomyia) vittatus* (Bigot, 1861), *Ann. Soc. Ent. France*, 1 : 227 ; Barraud, 1934 : 245-246 ; Knight and Stone, 1977 : 166.

The species is widely distributed in Ethiopian, Mediterranean and Oriental regions.

*Present records* : Mahasu dist. : 1 ♂ and 5 ♀ ♀ collected from outdoor and indoor resting places, Pipty-Rampur (1200 m.), Archoli (1300 m.) 27-28 June 1970 and 8 July 1970.

**23. *Aedes vexans* (Meigen)**

*Aedes (Aedimorphus) vexans* (Meigen, 1830), *Syst. Bechr. europ. Zweift. Insekt.* 6 : 241 ; Barraud, 1934 : 253-255 ; Knight and Stone, 1977 : 83.

The species is widely distributed in Holarctic, Oriental regions, Pacific Islands and Transvaal.

*Present records* : Kulu dist. : 26 ♂ ♂ and 16 ♀ ♀ collected from vegetation, Manali (1860 m.), 2 and 6 Aug. 1970. 2 ♀ ♀ inside cattle shed, Shyal (1850 m.) 8 Aug. 1970.

#### 24. *Armigeres subalbatus* (Coquillett)

*Armigeres (Armigeres) subalbatus* (Coquillett, 1898), *Proc. U. S. natn. Mus.* **21** : 502 ; Barraud, 1934 : 314-317 ; Stone *et al.*, 1959 : 213-214 ; Knight and Stone, 1977 : 172.

This species is found all over the Oriental region including India and Japan.

*Present records* : Kangra dist. : 7 ♂♂ and 1 ♀ collected outdoor and while biting on man, Baijnath (1000 m.), 13 Aug. 1970. Kulu dist. : 2 ♂♂ inside cattle shed, Shyal (1850 m.), 8 Aug. 1970. Mahasu dist. : 11 ♂♂ and 12 ♀♀ collected on vegetation and while biting on man, Jugatkhana-Rampur (1200 m.), 30 June 1970.

#### 25. *Culiseta niveitaeniata* (Theobald)

*Culiseta (Culiseta) niveitaeniata* (Theobald, 1907), *Monogr. Cul.* **4** : 272 ; Barraud, 1934 : 91-93 ; Knight and Stone, 1977 : 281.

The species has been recorded from India, Pakistan, Tibet, China and Taiwan.

*Present record* : Simla dist. : 1 ♂ collected from vegetation over a forest slope, Narkhanda (2400 m.), 3 June 1970.

#### 26. *Culex halifaxii* Theobald

*Culex (Lutzia) halifaxii* Theobald, 1903. *Monogr. Cul.* **3** : 231, Stone and Delfinado, 1973 : 327 ; Knight and Stone, 1977 : 249. The species was earlier referred to as *Culex (Lutzia) raptor* Edwards, 1922, *Indian J. Med. Res.* **10** : 275 ; Barraud, 1934 : 343.

The species has been recorded from Malaysia, India, Burma, Sri Lanka, Thailand, China, Indonesia, Phillipines, New Guinea, Australia, Nepal, U. S. S. R. and Japan.

*Present record* : Kangra dist. : 1 ♂, 1 ♀ collected from forest vegetation, Kalapur (1520 m.) 5 June 1967.

#### 27. *Culex minutissimus* (Theobald)

*Culex (Lophoceratomyia) minutissimus* (Theobald, 1907), *Monogr. Cul.* **4** : 235 Barraud, 1934 : 263-655 ; Knight and Stone, 1977 : 245.

The species has been recorded from Sri Lanka, India, Maldive Islands, Java, Borneo and China. In India, it is known from Punjab to Orissa. It has been recorded for the first time from western himalayas.

*Present record* : Kangra dist. : 1 ♂ and 1 ♀ collected from vegetation along a river stream, Drung (1100 m.), 2 June 1967.

### 28. *Culex* (*Mochthogenes*) sp.

The species of this subgenus have been earlier recorded from South India. This is the first record from North India. It's identity could not be confirmed.

*Present record* : Kangra dist. : 1 ♂ from crevices of river stream, Drung (1100 m.) 2 June 1967.

### 29. *Culex viridiventer* Giles

*Culex* (*Culiciomyia*) *viridiventer* Giles, 1901, *J. Bom. Nat. Hist. Soc.* 8 : 609 ; Barraud, 1934 : 378-380 ; Knight and Stone, 1977 : 233.

It is a common species found in the western himalayas extends upto western boundary of Nepal.

*Present records* : Bilaspur dist. : 4 ♂ ♂, 1 ♀ collected from outdoor vegetation, Ballu (750 m.) and Loharni (750 m.), 27 and 30 Mar. 1969. Chamba dist. : 13 ♂ ♂, 4 ♀ ♀ from forest vegetation, Banikhet (1680 m.) 9 and 11 June 1967 ; 3 ♀ ♀ forest vegetation, Kalatop (2450 m.), 10 and 12 June 1967 ; 19 larvae, 22 pupae from a rain water pond in forest, 2 ♀ ♀ reared from them, Kalatop (2450 m.), 9 Sept. 1967 ; 1 ♂ forest vegetation, Surkhigali (1620 m.), 11 June 1967 ; 1 ♀ resting on forest vegetation, Tindi (2500 m.), 17 Sept. 1968 ; 3 ♀ ♀ collected from vegetation, Khalel (2140 m.), 30 May 1969. Kangra dist. : 7 ♂ ♂, 6 ♀ ♀ collected from outdoor vegetation, Dadh (1080 m.), Kalapur (1520 m.) and Sukoh (920 m.), 4-6 June 1967 ; 1 ♂, 7 ♀ ♀ from vegetation, Tal (1000 m.), 18 Mar. 1969. Kulu dist. : 2 ♂ ♂, 2 ♀ ♀ river valley vegetation at Bharie (1450 m.), Hurla (1100 m.), 9 and 14 May, 1967 ; 2 ♂ ♂ from road side vegetation, Bandhrol (1350 m.), 22 Sept. 1967 ; 1 ♂, 2 ♀ ♀ from outdoor vegetation, Larji (900 m.) 21 Apr. 1969 ; 1 ♀ collected indoor resting cattle shed, Kothi (2580 m.), 23 July 1970. Mahasu dist. : 1 ♀ while biting on man, Rampur (1230 m.) 28 Apr. 1967 ; 2 ♀ ♀ collected from forest vegetation, Nogli (1000 m.), 17 Oct. 1967 ; 2 ♂ ♂ 2 ♀ ♀ collected from forest vegetation, Rohru (1500 m.), Seema (1700 m.) and Chhol (1700 m.) 7, 9 and 12 May 1969 ; 1 ♂, 2 ♀ ♀ from road side vegetation, Dhanguyi (1750 m.), Kundli (1800 m.), 13 and 16 May 1969 ; 5 ♀ ♀ outdoor, Mashnu (2100 m.) 3 July 1970. 8 ♀ ♀ indoor resting and 10 ♀ ♀ outdoor resting, Baghi (2740 m.), 7, 10-12 and 14 July 1970 ; 2 ♂ ♂, 4 ♀ ♀ collected from road side forest vegetation, Ratannadi (2700 m.), 12 July 1970. Mandi dist. : 1 ♀ from vegetation in a vegetable garden, Gutkar (1100 m.), 22 May 1967. 1 ♂ on road side vegetation, Galu (940 m.), 28 Mar. 1968. Simla dist. : 12 ♂ ♂, 3 ♀ ♀ resting along hill stream, Simla (1800 m.), 20 and 22, Apr. and 4 May 1967.

### 30. *Culex* (*Culiciomyia*) sp.

Identity of this species could not be determined for want of male specimens.

*Present records* : Chamba dist. : 2 ♀ ♀ collected from vegetation, 1 ♀ Rakh (1080 m.), 13 Apr. 1968 and 1 ♀ Dikrond (1680 m.), 5 July 1969. Kulu dist. : 1 ♀ on vegetation, Jibi (1900 m.) 13 Apr. 1969.

### 31. *Culex barraudi* Edwards

*Culex* (*Culex*) *barraudi* Edwards, 1922, *Indian J. Med. Res.* **10** : 284 ; Barraud, 1934 : 403 ; Knight and Stone, 1977 : 202.

The species has been recorded from India, Nepal, Sri Lanka, China and South east Asia.

*Present records* : Chamba dist. : 1 ♂ from stream bed vegetation, Banikhet (1600 m.) 11 July 1967 ; 1 ♀ from vegetation, Dikrond (1680 m.), 5 July 1969. Kangra dist. : 3 ♂ ♂, 3 ♀ ♀, from forest vegetation, stream side vegetation, Sidhwadi (1100 m.), Paraur (1100 m.), Sukho (500 m.), 1, 3 and 6 July 1967. Mandi dist. : 1 ♂, 3 ♀ ♀ from forest vegetation, Mandi (920 m.), 24 and 27 May 1967. Mahasu dist. : 1 ♂ 1 ♀ indoor resting cattle shed, Pipty-Rampur (1300 m.) 27 June 1970 ; Jeori (1300 m.), 2 July 1970, 2 ♀ ♀ outdoor resting, Archoli (1300 m.) and Jugatkhana (1200 m.) 28 and 30 June 1970. Simla dist. : 38 ♂ ♂, 3 ♀ ♀ from vegetation, Kandaghat (1500 m.), 2 June 1970.

### 32. *Culex bitaeniorhynchus* Giles

*Culex* (*Culex*) *bitaeniorhynchus* Giles, 1901, *J. Bom. Nat. Hist. Soc.* **13** : 607 ; Barraud, 1934 : 391-394 ; Knight and Stone 1977 : 203.

The species is widely distributed and known from several countries in Oriental, Palaearctic, Ethiopian and Australian regions.

*Present records* : Bilaspur dist. : 3 ♂ ♂, 7 ♀ ♀ from forest vegetation, Kanjota (760 m.), 20 July 1970. Kangra dist. : 3 ♂ ♂, 5 ♀ ♀ river side vegetation, Sidhwadi (1100 m.), Drung (1100 m.), Menjha (1200 m.), Bagsunag (1500 m.), 1 to 5 July 1967. Kulu dist. : 3 ♀ ♀ road side vegetation, Bandhrol (1380 m.), 22 Sept. 1967. Mandi dist. : 3 ♂ ♂ from garden vegetation, Gutkar (950 m.), 22 May 1967. Simla dist. : 1 ♂ outdoor vegetation, Dassumajara (580 m.), 3 Apr. 1969.

### 33. *Culex mimeticus* Noe

*Culex* (*Culex*) *mimeticus* Noe, 1899, *Bull. Soc. ent. Ital.* **31** : 240 ; Barraud, 1934 : 451 ; Knight and Stone, 1977 : 240.

The species is known from southern Palaearctic and Oriental regions.

**Present records :** Bilaspur dist. : 5 ♂♂, 1 ♀ from outdoor vegetation, Ballu (580 m.), 25 and 27 Mar. 1969. Chamba dist. : 15 ♂♂, 7 ♀♀ from outdoor forest vegetation, Banikhet (1600 m.), 9 and 11 July 1967 ; 2 ♂♂, 3 ♀♀ indoor resting cattle shed, Darada (1160 m.), 13 July 1967 ; 1 ♀ outdoor vegetation, Krain (920 m.) 5 Apr. 1968 ; 1 ♀ outdoor resting, Tindi (2500 m.), 17 Sept. 1968. Kangra dist. : 9 ♂♂, 10 ♀♀ from outdoor vegetation, Nagari (1100 m.), Sidhwadi (1100 m.), Drung (1100 m.), Patiar (1080 m.), Kalapur (1500 m.), Sukoh (950 m.), 31 May to 6 July 1967 ; 3 ♂♂, 2 ♀♀ from outdoor resting, Lad (900 m.), Tal (1000 m.), Dugadda (900 m.), 17 to 19 Mar. 1969. Kulu dist. : 5 ♂♂, 1 ♀ outdoor vegetation, Bharie (1450 m.), Hurla (1100 m.), Reri (1100 m.), 9, 14 and 15 May 1967 ; 4 ♂♂, 3 ♀♀ road side vegetation, Bandhrol (1350 m.), 22 Sept. 1967, Gadsa (1200 m.), 9 Oct. 1967 ; 2 ♀♀ forest vegetation, Naggar (1380 m.), 20 and 22 Apr. 1968 ; 1 ♂, 3 ♀♀ road side vegetation, Larji (1600 m.), 21 Apr. 1969 ; 5 ♂♂, 7 ♀♀ peridomestic vegetation, Shyalh-Manali (1850 m.), 6 and 8 Aug. 1970. Kinnaur dist. : 1 ♂, 5 ♀♀ from vegetation, Sangla (2700 m.), 9 June 1970. Mahasu dist. : 1 ♀ outdoor resting vegetation, Rampur (1300 m.), 2 May 1967 ; 5 ♂♂, 7 ♀♀ outdoor resting vegetation, Rohru (1600 m.), Seema (1700 m.), Chhol (1680 m.), Dhanguyi (1820 m.), 5 to 13 May 1970. 1 ♂ from vegetation, Dharmpur (1500 m.), 13 May 1970. Mandi dist. : 1 ♂, 1 ♀ outdoor forest vegetation, Mandi (920 m.), 27 May 1967. Simla dist. : 1 ♂ forest vegetation, Simla (1800 m.), 20 Apr. 1967.

#### 34. *Culex pipiens quinquefasciatus* Say

*Culex (Culex) pipiens* var. *quinquefasciatus* Say, 1823, *J. Acad. nat. Sci. Philad.* 3 : 10 ; Knight and Stone, 1977 : 216-219.

A well known cosmotropical species, widely distributed all over India upto alpine zone.

**Present records :** Bilaspur dist. : 20 ♂♂, 1 ♀ indoor resting cattle shed, Bakrol (800 m.), 28 Mar. 1969 ; 1 ♂, 1 ♀ outdoor vegetation, Kanjota (760 m.), 20 July 1970. Kangra dist. : 17 ♂♂, 12 ♀♀ all from outdoor vegetation, Nagari (1100 m.), Malan (1080 m.), Drung (1100 m.), Menjha (1200 m.), Paraur (1100 m.), Dadh (1080 m.), Kalapur (1500 m.), Sukoh (950 m.), 31 May to 6 July 1967 ; 1 ♂ from vegetation, Baijnath (1000 m.), 14 Aug. 1970. Mahasu dist. : 8 ♂♂, 6 ♀♀, outdoor resting, Nogli (1000 m.), 17 Oct. 1967 ; 6 ♂♂, 1 ♀ from outdoor and indoor resting, Dharmpur (1300 m.), 2 June 1970 ; 15 ♂♂, 17 ♀♀ inside cattle shed, Pipty-Rampur (1300 m.), Brow (1200 m.), 4, 27 to 29 June 1970 and 8 July 1970 ; 1 ♂ outdoor vegetation, Jugatkhana, 30 June 1970. Mandi dist. : 1 ♂, 1 ♀ inside rest house, Mandi (780 m.), 21 May 1967 ;

2 ♂♂, 4 ♀♀ from outdoor vegetation, Gutkar (780 m.), Mandi (780 m.), 22 and 24 May 1967. Simla dist. : 54 ♂♂, 76 ♀♀ all reared from larvae collected from stagnant water pond, Quarry-Kandaghat (1500 m.), 2 June 1970. Sirmaur dist. : 46 ♂♂, 32 ♀♀ inside cattle sheds, Beradwala (580 m.), Moginand (580 m.), 24 and 28 Apr. 1969.

### 35. *Culex* sp.

The species closely resemble *C. (C.) gelidus* Theobald, 1901 but differs by the extent of the white ring on the proboscis. The identity needs confirmation.

*Present records* : Chamba dist. : 105 larvae from rock-pools, Banikhet (1600 m.), Kalatop (2450 m.), 9 and 10 July 1967. Kulu dist. : 2 ♂♂ from forest vegetation, Bibhali (1220 m.), Hurla (1100 m.), 11 and 14 May 1967 ; 1 ♀ from vegetation, Manali (1860 m.) 2 Aug. 1970. Mandi dist. : 1 ♀ from forest vegetation, Mandi (920 m.), 27 May 1967.

### 36. *Culex theileri* Theobald

*Culex (Culex) theileri* Theobald, 1903, *Monogr. Cul.* 3 : 187 ; Barraud, 1934 : 414-416 ; Knight and Stone, 1977 : 225.

The species is known from southern and eastern Ethiopian, Southern Palaearctic and northern Oriental regions.

*Present records* : Lahul and Spiti dist. : 1 ♂ from road side vegetation, Chhetru (3300 m.), 31 July 1970. Mahasu dist. : 1 ♀ from vegetation, Rampur (1300 m.), 25 Apr. 1967. Mandi dist. : 1 ♂ from forest vegetation, Mandi (920 m.), 27 May 1967.

### 37. *Culex vagans* Wiedemann

*Culex (Culex) vagans* Wiedemann, 1828, *Aussereurop Zweifl. Ins.* 1 : 545 ; Barraud, 1934 : 416-418 ; Knight and Stone, 1977 : 227.

The species has been recorded from China, Japan, Korea, Far Eastern U. S. S. R., Manchuria, Iran and Pakistan. In India, it has been recorded from western Himalayas, Kashmir and Punjab.

*Present records* : Bilaspur dist. : 5 ♂♂, 6 ♀♀ from vegetation, Ballu (580 m.), Bakrol (580 m.), Loharni (750 m.), 25, 28 and 30 Mar. 1969 ; 7 ♀♀ inside house, Ballu (580 m.), 27 Mar. 1969. Chamba dist. : 4 ♂♂, 9 ♀♀ from forest vegetation, Banikhet (1600 m.), 9 and 11 July 1967 ; 3 ♂♂, 2 ♀♀ forest vegetation, Kalatop (2440 m.) 10 and 12 July 1967 ; 3 ♂♂, 4 ♀♀ from vegetation, Krain (590 m.), Pukhri (1150 m.), 5 Apr. 1968 ; 1 ♀ from vegetation, Tindi (2500 m.),

17 Sept. 1968 ; 4 ♀ ♀ from vegetation, Schuin (2280 m.), Khaled (2040 m.), 29 and 30 May 1969 ; 1 ♂, 1 ♀ from forest vegetation, Dikrund (2000 m.), 5 July 1969. Kangra dist. : 2 ♂ ♂, 1 ♀ from vegetation, Drung (1100 m.), Bagsunag (1500 m.), 2 and 3 July 1967 ; 10 ♂ ♂, 4 ♀ ♀ from forest vegetation, Lad (900 m.), Tal (1000 m.), 17 and 18 Mar. 1969. Kulu dist. : 4 ♂ ♂, 5 ♀ ♀ from forest vegetation, Hurla (1100 m.), Reri (1100 m.), 14 and 15 May 1967 ; 1 ♂, 1 ♀ from vegetation, Bandhrol (1350 m.), 22 Sept. 1967 ; 9 ♀ ♀ from forest vegetation, Naggar (1350 m.), 20 and 22 Apr. 1968 ; 2 ♀ ♀ from river side vegetation, Jibi (1922 m.), 13 Apr. 1969. 17 ♀ ♀ from vegetation, Larji (1600 m.), 21 Apr. 1969. Kinnaur dist. : 21 ♂ ♂, 46 ♀ ♀ from peridomestic vegetation, Sangla (2700 m.) 3 to 11 June, 1970. Lahul and Spiti dist. : 3 ♂ ♂, 6 ♀ ♀ road side vegetation, Chhetru (3300 m.) 31 July 1970. Mahasu dist. : 1 ♀ from vegetation, Nogli (1000 m.), 17 Oct. 1967 ; 7 ♂ ♂, 36 ♀ ♀ from peridomestic vegetation, Rohru (1600 m.), 5, 7 and 9 May 1969 ; 3 ♂ ♂, 2 ♀ ♀ from vegetation, Dhanguyi (1820 m.), Jeltahar (1820 m.), 13 and 17 May 1969 ; 6 ♂ ♂, 30 ♀ ♀ from forest vegetation, Mashnu (2100 m.), Gaura (2000 m.), Ratan-nadi (2700 m.), Baghi (2740 m.), on 3, 5, 12 and 14 July 1970. Mandi dist. : 1 ♀ from forest vegetation, Mandi (920 m.), 27 May 1967. Simla dist. : 2 ♀ ♀ from vegetation along a rocky stream, Simla (1800 m.), 20 Apr. 1967 ; 2 ♂ ♂ from forest vegetation, Shoghi (2000 m.), 21 Apr. 1967 ; 2 ♂ ♂, 1 ♀ from vegetation, Dassumajara (500 m.), 3 Apr. 1969 ; 4 ♂ ♂, 5 ♀ ♀ from vegetation along a forest stream, Narkhanda (2400 m.), 3 June 1970.

### 38. *Culex univittatus* Theobald

*Culex (Culex) univittatus* Theobald, 1901, *Monogr. Cul.* 2 : 29 ; Barraud, 1934 : 418-420 ; Stone, *et al.*, 1959 : 263 ; Stone and Delfinado, 1973 : 321.

The species is known from Mediterranean region, Africa, Madagascar and north west frontier provinces of India and Pakistan.

*Present record* : Mandi dist. : 1 ♂ from road side vegetation, Gutkar (780 m.), 22 May 1967.

### 39. *Culex vishnui* Theobald

*Culex (Culex) vishnui* Theobald, 1901, *Monogr. Cul.* 1 : 355 ; Barraud, 1934 : 400-402 ; Knight and Stone, 1977 : 228.

The species is widely distributed in Oriental region, Iraq, Iran, Pakistan, China, Korea, Japan, New Guinea, Thailand, Hong Kong, Java, Malaysia and Philippines.

*Present records* : Kangra dist. : 2 ♂ ♂, 4 ♀ ♀ from vegetation, Menjha (1220 m.), Dadh (1100 m.), 3 and 4 July 1967 ; 5 ♂ ♂, 5 ♀ ♀ from

vegetation, Tal (1000 m.), 18 March 1969 ; 1 ♂, 6 ♀ ♀ from inside cattle shed, Baijnath (1000 m.), 16 Aug. 1970. Kulu dist. : 1 ♂ from vegetation, Bandhrol (1350 m.), 22 Sept. 1967. Mandi dist. : 7 ♂ ♂, 11 ♀ ♀ from vegetation, Gutkar (780 m.), Mandi (920 m.), 22 and 27 May 1967. Simla dist. : 3 ♂ ♂, from vegetation, 3 ♀ ♀ from indoor resting cattle shed, Dassumajara (500 m.), 3 Apr. 1969, Manpura (500 m.) 7 Apr. 1969, Malkumajara (500 m.), 8 Apr. 1969. Sirmour dist : 4 ♀ ♀ from vegetation, Beradwala (500 m.), Moginand (500 m.) 24 and 28 April 1969.

#### 40. *Culex* (*Culex*) Sp. nov.

The species belongs to *C. (C.) vishnui* group. Its identity could not be determined for want of males.

*Present record* : Lahul and Spiti dist. : 6 ♀ ♀ from small alpine vegetation, Chhetru (3300 m.), 31 July 1970.

#### 41. *Culex pseudovishnui* Colless

*Culex* (*Culex*) *pseudovishnui* Colless, 1957 ; *Ann. trop. Med. Parasit.* **51** : 88 ; Stone, et al., 1959 : 258 ; Reuben, 1969 : 643 ; Stone and Delfinado, 1973 : 320.

The species has now been recorded throughout the Oriental region especially from India and Malaysia.

*Present records* : Kulu dist. : 2 ♂ ♂, 5 ♀ ♀ from vegetation along the river streams, Gaura (2000 m.), Manali (1820 m.), 5 and 6 Aug. 1970.

### DISCUSSION

This is for the first time an independent list of 41 species of mosquitoes collected from Himachal Pradesh has been made available since its inception as a separate state of India in 1971. It includes 8 species of *Anopheles*, 14 species of *Aedes*, 16 species of *Culex* and 3 species belonging to remaining 3 genera. Most of the species were collected from dawn to dusk from their outdoor and indoor resting habitats. Records of *An. culicifacies* and *An. fluviatilis* the chief Malaria vectors are of significance. *An. annularis* has also been recorded as a vector of local importance (vectors of Malaria in India, 1961). Though *Aedes aegypti* was not recorded during this survey, it has been reported earlier from a locality in Chamba district (Barraud, 1934). The distribution of *An. simlensis*, *An. lindesayi*, *Culex viridiventer*, *C. mimeticus*, *C. theileri*, *C. vagans* and *Culex* sp. nov. in the sub-alpine and alpine zones of this State is of considerable importance as these areas lie adjacent to Tibet and China.

## ACKNOWLEDGEMENTS

The authors are grateful to Dr. T. Ramachandra Rao, former Director, National Institute of Virology, Pune, under whose supervision and guidance the Survey was carried out. We thank the Indian Council of Medical Research (ICMR) New Delhi for making this survey possible by a generous grant specially extended for the purpose. The assistance rendered by the staff of State Government during the survey is gratefully acknowledged. Suggestions given by our colleague Dr. H. N. Kaul, Assistant Director are also gratefully appreciated.

## SUMMARY

During a survey of haematophagous arthropods in the state of Himachal Pradesh, India, between April 1967 and September 1970, 41 species of mosquitoes belonging 6 genera were collected. They are : *Anopheles gigas simlensis*, *An. lindesayi*, *An. annularis*, *An. culicifacies*, *An. fluviatilis*, *An. maculatus willimori*, *An. splendidus*, *An. turkhudi*, *Uranotaenia* sp., *Aedes albolateralis*, *Ae. christophersi*, *Ae. nivues*, *Ae. oreophilus*, *Ae. pseudotaeniatus*, *Ae. pulchriventer*, *Ae. shortti*, *Ae. thomsoni*, *Ae. albopictus*, *Ae. pseudalbopictus*, *Ae. subalbopictus*, *Ae. unilineatus*, *Ae. vittatus*, *Ae. vexans*, *Armigeres subalbatus*, *Culiseta niveitaeniata*, *Culex halifaxii*, *C. minutissimus*, *C. (Mochthogenes) sp.* *C. viridiventer*, *C. (Culiciomyia) sp.*, *C. barraudi*, *C. bitaeniorhynchus*, *C. mimeticus*, *C. pipiens quinquefasciatus*, *C. sp.*, *C. theileri*, *C. vagans*, *C. univittatus*, *C. vishnui*, *C. (Culex) sp. nov.* and *C. pseudovishnui*. The collection records of these species with ecological notes are presented.

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ON A TREMATODE (DIGENEA : CAMPULIDAE) OF A MARINE  
MAMMAL FROM ARABIAN SEA

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(With 3 Text-figures)

INTRODUCTION

A female cetacean, *Neophocaena phocaenoides* (Cuvier), was collected by some fishermen on the beach of Vasco-do-Gama, Goa, adjacent to the mouth of Zoari river on 20th February, 1980 ; its viscera and the uterus containing a foetus were collected for the present study by the author. While the studies on the foetus are being published elsewhere, the flukes recovered from the intestine of this cetacean are being reported here as *Synthesium tursionis* (Marchi, 1873) Stunkard and Alvey, 1930. This may well be the first report of this trematode from the mammal *N. phocaenoides* from the seas surrounding the Indian Peninsula.

Hafeezullah (1982) presented this study in the Fourth National Congress of Parasitology held at Aligarh Muslim University, Aligarh. The abstract of the study appeared in the Proceedings of the Congress. The present full paper has since then been greatly modified.

The material was stained with borax carmine and mounted in Canada balsam. The drawings were made with aid of a camera lucida. All measurements are in microns unless otherwise stated.

SYSTEMATIC ACCOUNT

Family Campulidae Odhner, 1926

Syn. Brachycladiidae Faust, 1926

Subfamily Synthesiinae Yamaguti, 1958

**Synthesium** Stunkard and Alvey, 1930

**Synthesium tursionis** (Marchi) Stunkard and Alvey

(Text-figs. 1-3)

1878. *Distomum tursionis* Marchi, *Atti Soc. ital. Sci. nat.*, Milano, 15 (4) : p. 104.  
1886. *Distomum longissimum* of Poirier, *Bull. Soc. philomath. Paris*, 10 (7) : p. 29.  
1896. *Distomum* (*Dicrocoelium*) *tursionis* : Parona, *Atti Soc. Lingust. Sci. nat. geogr.*, 7 (3) : p. 162.

1926. *Orthosplanchnus tursionis* : Odhner, *Ark. Zool.*, 18 : p. 4.
1930. *Synthesium tursionis* : Stunkard and Alvey, *Parasitology*, 22 (3) : p. 332.
1932. *Synthesium tursionis* : Price, *Proc. U. S. natn Mus.*, 18 (13) : p. 16.
1935. *Orthosplanchnus elongatus* Ozaki, *J. Sci. Hiroshima Univ.*, (Zool.), 3 : p. 116 (n. syn.)
1946. *Synthesium tursionis* : Ben Dawes, *The Trematoda*, Cambridge University Press, 644 pp., p. 393.
1966. *Synthesium tursionis* : Delamure and Serdyukov, *Mater. nauch. Konf. vses. Obsch. Gel'mint.*, Part 3 : p. 105.
1977. *Odhneriella elongata* : Yamaguti, *Synopsis of Digenetic Trematodes of Vertebrates*, Vol. I : p. 726.

**Material Examined** : 7 ex., 4 mature and 3 immature, on 4 slides ; host—\**Neophocaena phocaenoides* (Cuvier), the Little Indian Porpoise or Finless Black Porpoise, (Mammalia : Cetacea : Phocaenidae) ; location—Intestine ; locality—Vasco-da-Gama (Goa, Arabian Sea) ; specimens deposited—Z.S.I. Reg. Nos. W 7472/1 to W 7475/1.

**Description** : Body 6.398-14.094 mm long by 0.633-1.787 mm wide, elongate. Eye-spot pigment absent. Tegument armed with spines. Acetabulum 372-825 in diameter, spherical, situated at 2.200-3.025 mm from anterior end of body. Oral sucker 440-756 in diameter, funnel-shaped, terminal, almost equal in size to acetabulum. Mouth ventro-terminal ; prepharynx 275-592 long ; pharynx 229-550 long by 124-275 wide, elongated pear-shaped, oesophagus short, 68-75 long ; caecal bifurcation anteriorly removed from anterior margin of acetabulum, nearer to pharynx than to acetabulum ; caeca H-shaped, anterior diverticula reaching almost level of anterior margin of pharynx or beyond, posteriorly ending blindly near posterior end of body (this is discernible only in immature specimens ; in mature specimens this is not seen due to heavy distribution of vitellaria).

Testes two, 862-1375 in diameter, tandem, asteroid, deeply lobed or indented even in immature specimens, anterior one with five lobes, posterior with six, separated by intruding vitelline follicles, situated in middle of posterior half of body. Cirrus sac elongate, saccular with a long neck, containing undivided seminal vesicle (in some specimens twisted seminal vesicle looks partite), long pars prostatica surrounded by prostatic gland cells and a well developed muscular invaginated cirrus armed with spines, opening independently into genital atrium at level of posterior margin of acetabulum without uniting with the female duct. Cirral spines seen in immature specimens. Genital atrium

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\**Neomeris* Gray, 1846 is junior homonym being preoccupied by *Neomeris* Lamouroux, 1816. *Neophocaena* Palmer, 1899 is its changed generic name.

(functioning as hermaphroditic duct) long, tubular, extending from posterior margin of acetabulum dorsally to its anterior margin. Genital pore median, immediately preacetabular.

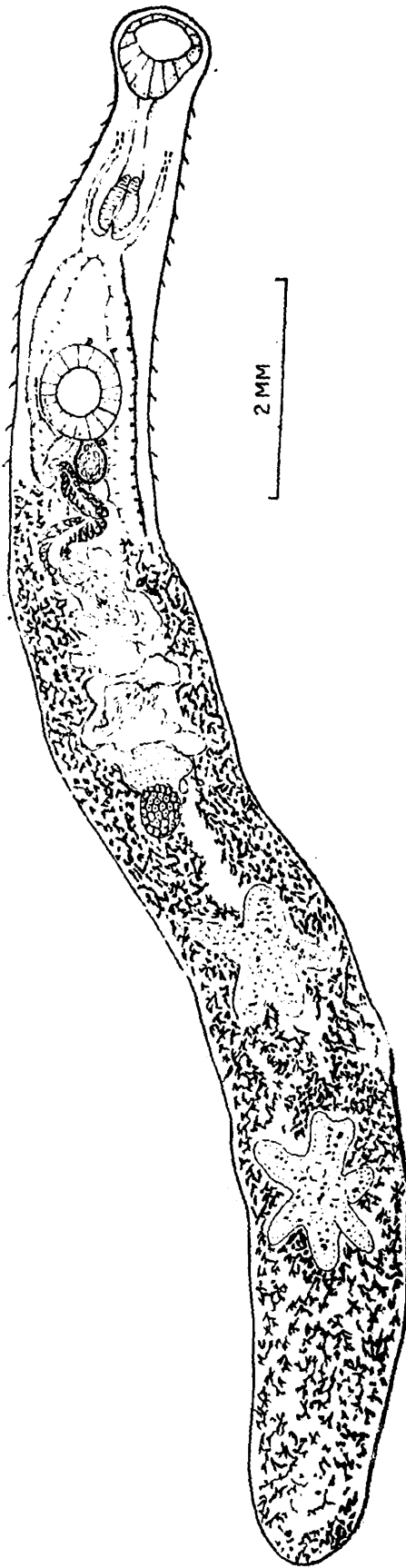


Fig. 1. *Synthesium tursionis* (Marchi, 1873), entire worm, ventral view.

Ovary globular, 371-461 in diameter, median, situated almost in middle of body, preacetabular; removed from anterior testis with few follicles of vitellarium tending to intrude between them. Vitelline reservoir near ovary; lateral vitelline ducts running anteriorly and

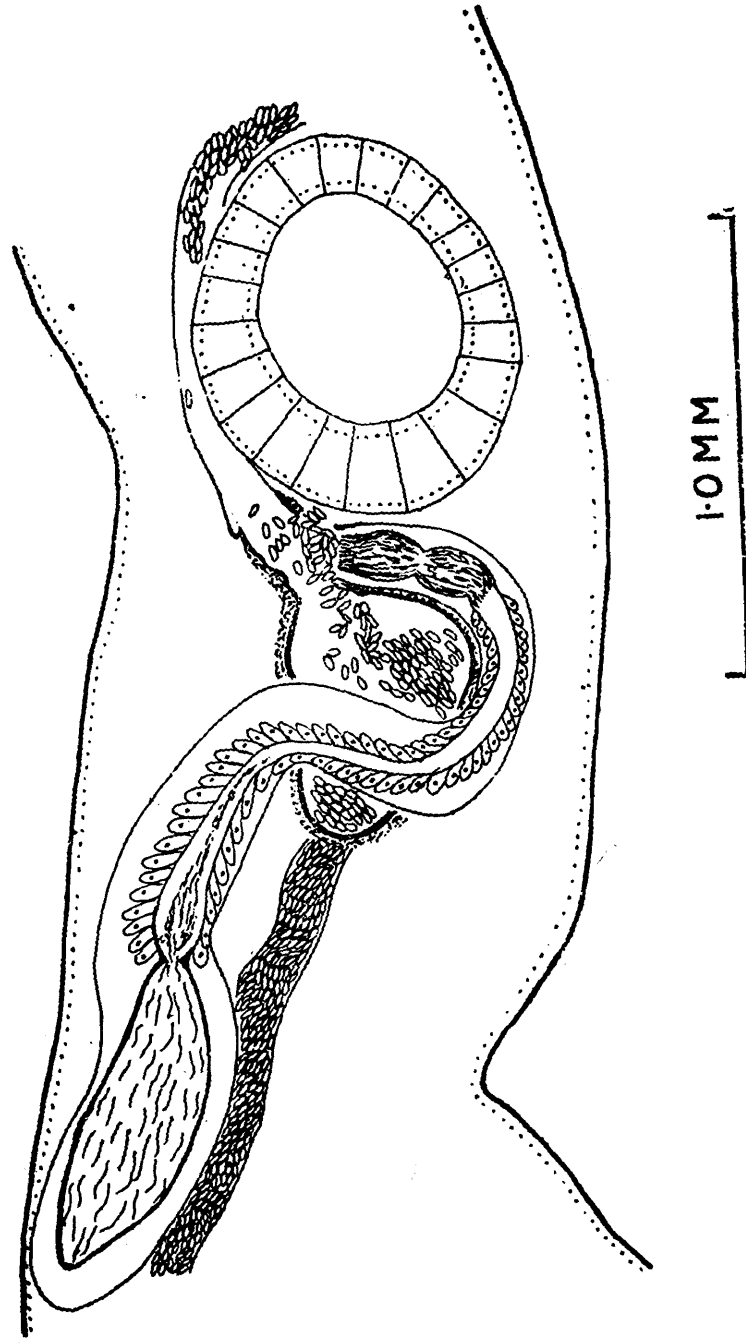


Fig. 2. *Synthesium tursionis*, acetabular region of another mature specimen showing terminal male and female ducts.

posteriorly; vitelline follicles distributed from behind acetabulum to posterior end of body, anterior extent on both sides unequal, tending to intrude between anterior testis and ovary, coalescing between testes. True seminal receptacle absent. Uterine seminal receptacle formed. Laurer's canal not seen. Mehlis' gland anterodorsal to ovary. Close coils of uterus preovarian, median; anterior terminal part differentiated into metraterm, slightly widened in immature specimens' deve-

loping into bulb-like swollen muscular structure in gravid ones densely surrounded by glandular cells, opening by a narrow anterior most part into genital atrium near posterior margin of acetabulum, unarmed. Normal eggs  $38-49 \times 28-34$ , collapsed eggs  $51-60 \times 24$ , thick-shelled, thickening or projection at anopercular pole discernible with difficulty in high power, and easily in oil immersion, triangular in cross-section.

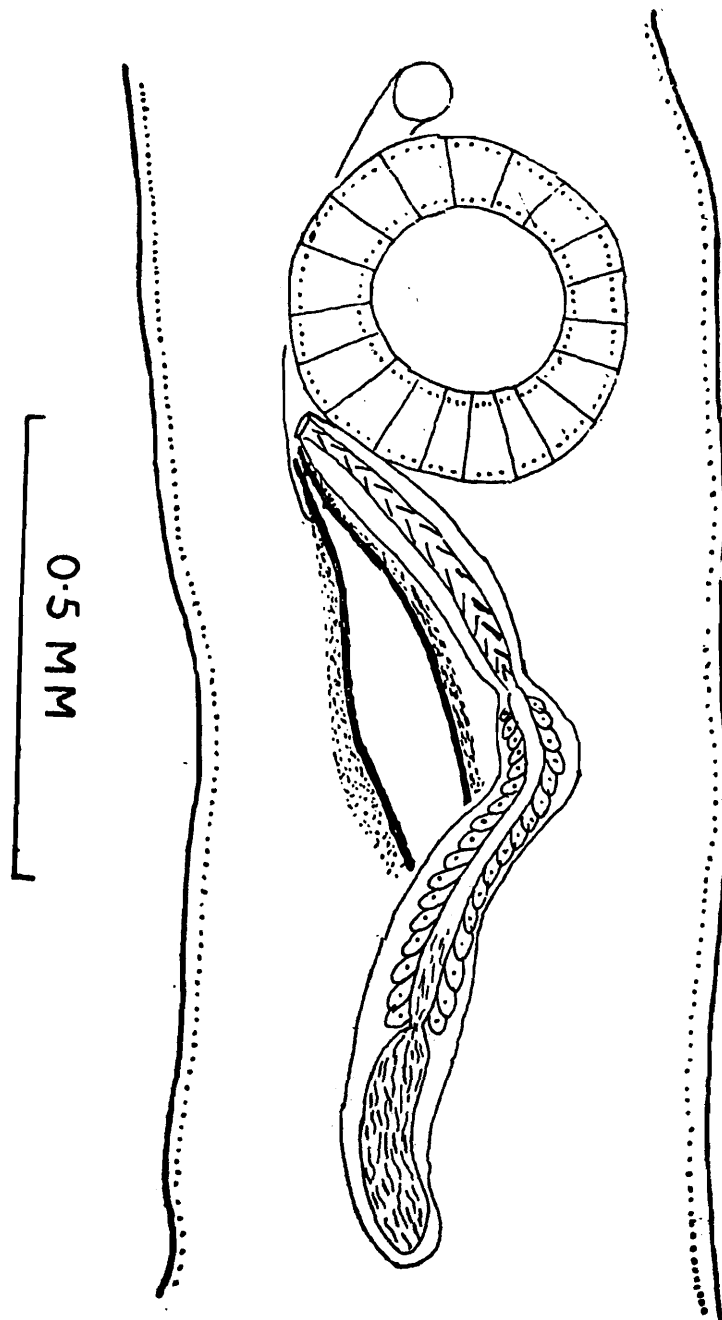


Fig. 3. *Synthesium tursionis*, acetabular region of an immature specimen showing terminal male and female ducts.

Excretory pore terminal ; excretory vesicle I-shaped.

*Remarks :* The history of the fluke *Synthesium tursionis* dates back to 1873 when Marchi described it as *Distomum tursionis* from the intestine of *Delphinus tursio* from Europe, but this description is inadequate and does not provide complete information about the species.

Poirier (1886) described *Distomum longissimum* from the same host from Europe. The description gives a fair picture of the species but nevertheless is not complete. Parona (1896) had an opportunity to restudy Marchi's original material of *D. tursionis* and compared with *D. longissimum*, concluding that the latter was identical to the former. Odhner (1910) predicted that *D. tursionis* represented a new genus of the subfamily Fasciolopsinae but he did not name a new genus. Later on, he (1926) revised his opinion and tentatively referred Marchi's species to the genus *Orthosplanchnus* Odhner, 1905 on the basis of the similarity of the copulatory organs. Stunkard and Alvey (1930) did not think it proper to include this species in *Orthosplanchnus*, *Lecithodesmus* Braun, or *Campula* Cobbold, 1858 (Syn. *Brachycladium* Looss, 1899) with which it resembles in one character or other, but proposed the genus *Synthesium* to accommodate it.

In earlier descriptions the terminal part of the uterus in *Synthesium tursionis* (Marchi, 1873) has been shown only slightly enlarged (as is the case in the immature specimens of the present material), and the cirrus and the vagina (metraterm) have both been described to be armed with spines. H-shaped gut had not been indicated. No mention of a muscular bulb-like metraterm had been made. In addition, the long genital atrium had not been described. Delamure and Serdyukov (1966) reported *Synthesium tursionis* (Marchi, 1873) in *Tur-siops truncatus* from the Black Sea with H-shaped gut.

The fully mature specimens of the present material show that an H-shaped gut is present and a well developed metraterm is differentiated in the form of muscular bulb-like structure before entering the genital atrium immediately posterior to the acetabulum. This bulb-like metraterm is lined internally with muscles, surrounded externally by gland cells and filled with eggs. The metraterm is without spines. The cirrus is muscular and is lined with spines. The male and female ducts independently open into the genital atrium.

In these characters, the present material seems to deviate from Marchi's species, but the author is inclined to attribute this dissimilarity to the inadequacies of earlier studies. Thus, judging from the general shape of the body, slightly widened metraterm in immature specimens, unequal anterior extent of vitellarium on both sides of the body, and the asteroid testes, he feels that the present material belongs to *Synthesium tursionis* (Marchi, 1873) Stunkard and Alvey, 1930.

Ozaki (1935) described *Orthosplanchnus elongatus* from the intestine of the same species of marine mammal from Japan. This species appears basically identical to the present material differing only in the

extent of the tubular genital atrium or genital sinus (at the base of which cirrus and metraterm open). The enlarged and widened metraterm invested externally with gland cells in *O. elongatus* is comparable to the bulb-like swollen metraterm densely surrounded with gland cells in the present material, the latter probably representing more advanced stage of maturity.

Yamaguti (1971) kept *O. elongatus* in the genus *Odhneriella* Skrjabin, 1915 probably because of the H-shaped gut, armed cirrus only (no spines in the metraterm) and postacetabular anterior extent of vitellaria, but it is a genus with entire or slightly indented testes (Delamure, 1955). It cannot also be placed under *Orthosplanchnus* Odhner, 1905 because in this genus the vitelline follicles extend up to anterior margin of acetabulum, the caecal bifurcation takes place near anterior margin of acetabulum, the testes are only slightly indented and seminal receptacle is present. Moreover, the species of *Orthosplanchnus* (*O. arcticus* and *O. fraterculus*) were reported from the gall-bladder of seal and walrus, whereas *O. elongatus* is the intestinal parasite of porpoise. It seems to the author that Ozaki's species is identical to *Synthesium tursionis*, which has asteroid type of deeply lobed testes, with caecal bifurcation anteriorly removed from the anterior margin of the acetabulum and H-shaped caeca, and the anterior extent of vitellaria remaining a little behind the acetabulum.

In view of the discovery of H-shaped gut and presence of spines on the cirrus only (not on the metraterm) in *Synthesium tursionis*, the gulf of difference between *Orthosplanchnus* Odhner, 1905, *Odhneriella* Skrjabin, 1915 and *Synthesium* Stunkard and Alvey, 1930 narrow down considerably.

#### SUMMARY

Since the original description of and subsequent information on *Synthesium tursionis* (Marci, 1873) Stunkard and Alvey, 1930 is inadequate with respect to many characters, a fuller account of the worm is furnished on the basis of mature and immature specimens recovered from a marine mammal *Neophocaena phocaenoides* (Cuvier) at Vasco-da-Gama, Goa. This form is the first record of this trematode from the Indian seas. *Orthosplanchnus elongatus* Ozaki, 1935 recorded from the same host from Japan, appears identical to the present material except in some variations. It has also been indicated that the discovery of the presence of H-shaped gut and spines in the cirrus only (not in the metraterm) in *Synthesium tursionis* has considerably reduced the distinctness between *Orthosplanchnus* Odhner, 1905, *Odhneriella* Skrjabin, 1915 and *Synthesium* Stunkard and Alvey, 1930.

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RECORD OF A PLUMBEOUS DOLPHIN (*SOUSA PLUMBEA*  
CUVIER) FROM DUDUYA RIVER, NORTH BENGAL, INDIA

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AND

MINTU CHOWDHURY

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(With 1 Map and 2 Plates)

INTRODUCTION

A single specimen of a dolphin was caught accidentally in fishermen's net in Duduya river, Thalsabari, near Dhupguri, Jalpaiguri district [see Map] West Bengal, (26°30' & 89°05') on December 5, 1985. The animal remained unidentified but local press apparently being unfamiliar with the animal, published notes on the same, indicating that it may be a peculiar "susu". The dolphin was kept in the river, near a bathing ghat, tied with a rope for 20 days, while it was reported to make loud sound or call, typical for cetaceans. Unfortunately the information of its capture, while it was still alive, did not reach the Zoological Survey of India. However, through the initiative of the second author (M. C.). Its photographs were taken by an officer of the Geological Survey of India (S. B. Nag) and handed over to the Director of Museum Division of G. S. I., Dr. K. K. Basu.

The photographs [Plates II, III] reached the author (A. K. G.) on the last part of December 1985, through the courtesy of Dr. K. K. Basu, after the death of the dolphin, along with notes on weight, length and width. Considering the distinctive features of its snout, colour, characteristic dorsal fin, the specimen is identified as the Plumbeous Dolphin, *Sousa plumbea* (Cuvier, 1829).

The specimen measured 2m and weighs 120 kg, with a snout 0.17× the length of body. It had a uniform plumbeous grey colour.

DISTRIBUTION

Blanford (1888) stated that the plumbeous dolphin is known from "Madras, Malabar, Karachi, Burma and Ceylon". Dussmier (in Jardine, 1837) noted that the Plumbeous dolphin is abundant in Malabar coast, frequents the shore and pursue the shoals of pilchards. Marcuzzi and Pilleri (1971) in their paper on the Zoogeography of Cetacea, considered

*plumbea* as an endemic species in India-Malaya region and quoted Hershkovitz (1966) for detailed distribution-range which extend from "Indian Ocean to the strait of Malacca in the east ; also from Malabar coast to the Arabian Sea, Red Sea and Suez Canal". Pilleri and Gihir

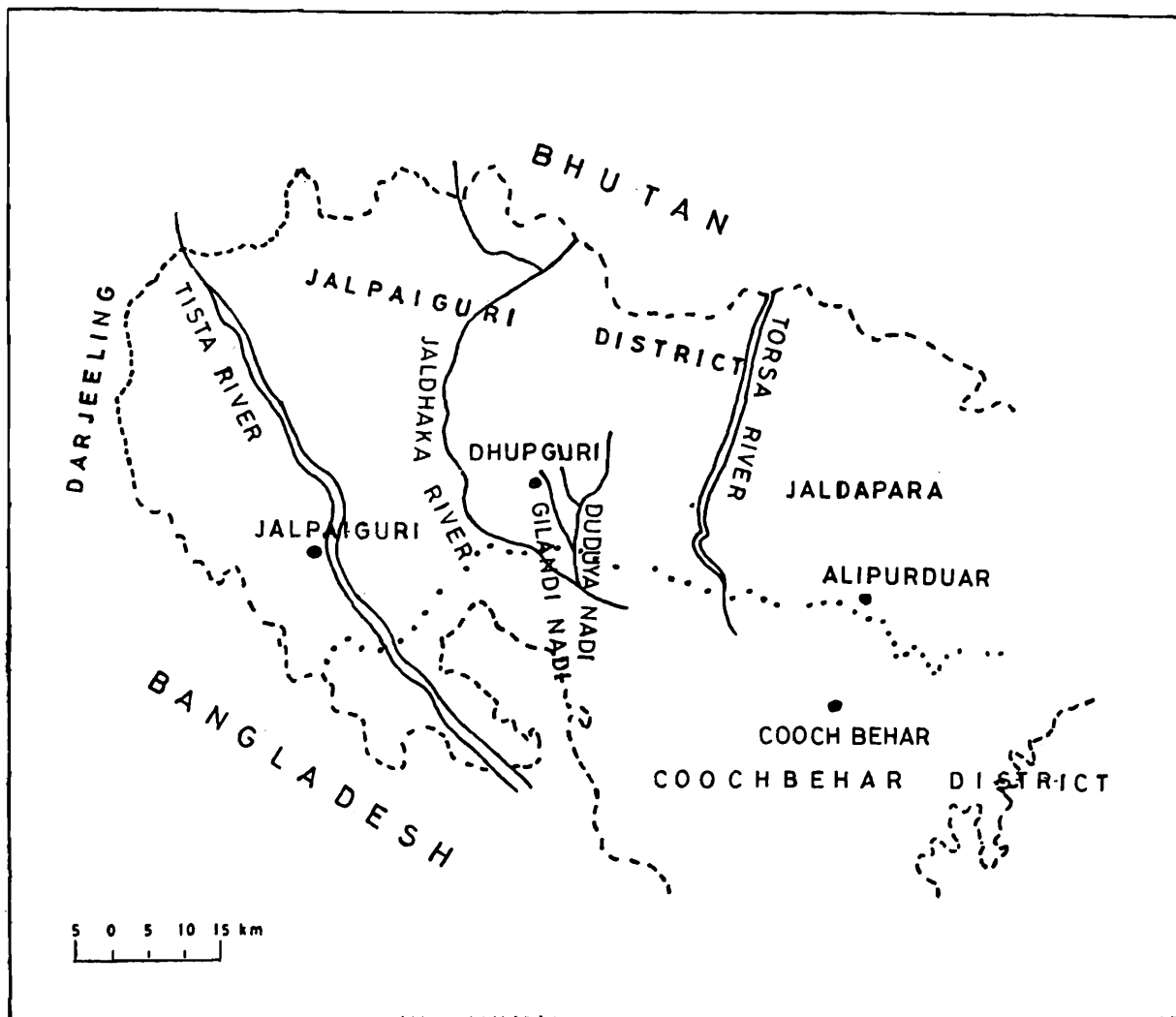


Fig. 1. Map showing Duduya River system and Dhupguri area.

(1972) while investigating Cetaceans of Pakistan observed the species to penetrate mangrove zones and also in Dubba mouth, Pitiano mouth—in wide open water and also in Khari Creek and Kudi Creek, not far away from open sea in Pakistan. Pilleri and Gihir (*op. cit.*) mentioned that while the known distribution range were Arabian Sea, the Persian Gulf, the Gulf of Aden, the Red Sea, the Suez Canal and the coast of South Africa, it is also assumed to occur in Bay of Bengal, the South China Sea and off the coast of Sarawak. Lalmohan (1982) provided description of fetus of *Sousa plumbea* from southwest coast of India.

### DISCUSSION

Considering the information available, the present record from North Bengal appear to be the first record of migration of Plumbeous dolphin in a freshwater riverine system at least 250 km., away from the coast.

Blanford (1888) has mentioned about the capability of these animals to adapt to both salt and freshwater eco-systems. However, it appears intriguing as to how the animal found its way up through the Bramhaputra River System to the Jaldhaka river and then to Duduya river in the Dhupguri area. The question of the Cetaceans getting the stranded has been discussed at length in a recent paper by Vodden (1985). Cetaceans are stated to use directional sonar, when in shallow water and may receive echoes from every direction and thus may be confused. Whether this upstream travel was caused by confusion is difficult to ascertain but rarity of record of such catch tends to support the notion.

Pilleri and Gühr (1972) have provided a brief account of their observations on swimming behaviour in Pakistan and results of osteological and taxonomical investigation of the Plumbeous Dolphin and discussed about the habitual and osteological differences between *Sousa plumbea* and four other congeneric species viz. *barmensis* Lydekker, *chinensis* Osbeck, *teuszii* Kükenthal and the most closely related *lentiginosa* Owen. It appears that out of the 20 skeletons of *plumbea* examined, only one, the type (a 3053, Mus. Nat. d'Hist. Nat., Paris) from Malabar coast, originates from India. As such the detailed osteological examination of the specimen (to be reported upon separately) will be of interest.

#### SUMMARY

A Plumbeous Dolphin, *Sousa plumbea* (Cuvier) is recorded for the first time from North Bengal in Duduya River near Dhupguri. The distribution range and existing state of knowledge on the species is discussed along with notes on the specimen reported upon.

#### ACKNOWLEDGEMENTS

The authors are thankful to the fishermen of Dhupguri for bringing the catch of the dolphin to the notice of member of the public, to Sri S. B. Nag of the Geological Survey of India, Calcutta for taking the photographs and Dr. K. K. Basu, Director, Museum Division, Geological Survey of India for kindly sending the information to the Zoological Survey of India. One of us (A.K.G) is thankful to the Director, Zoological Survey of India, for working facilities and to Dr. R. K. Ghosh and Dr. S. Chakraborti of Zoological Survey of India for kind assistance.

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Fig. 1. Plumbeous dolphin caught in Duduya River



Fig. 1. Plumbeous dolphin : anterior portion of body showing snout

ON COLLECTIONS OF FLOWER FLIES (DIPTERA : SYRPHIDAE)  
FROM SOUTH INDIA

*By*

M. DATTA AND (MRS.) M. CHAKRABORTI (MUKHERJEE)

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(With 6 Figures)

INTRODUCTION

The Syrphidae, commonly known as flower flies or hover flies include a few species which have been described as early as 1787 by Fabricius from South India (comprising Andhra Pradesh, Tamil Nadu, Karnataka and Kerala). Subsequent additions to the South Indian fauna appear to have been made by Fabricius (1805), Wiedemann (1819, 1824), Guérin-Méneville (1834), Macquart (1842), Bigot (1883), Brunetti (1908, 1915, 1923), Hervé-Bazin (1922, 1923), Cherian (1934), Vockeroth (1969), Knutson, Thompson and Vockeroth (1975), and Joseph and Parui (*in press*).

An attempt is made here to further our knowledge on the fauna of the area on the basis of the collections so far (1970-1981) accumulated in the Zoological Survey of India, Calcutta. As a result of this study, 2 species (with the asterisk) recorded here for the first time are added to 43 species belonging to 21 genera hitherto known from South India.

SYSTEMATIC ACCOUNT

Subfamily SYRPHINAE

Tribe SYRPHINI

1. *Asarkina* (*Asarkina*) *ericetorum* (Fabricius)

1781. *Syrphus ericetorum* Fabricius, *Spec. Insect.*, 2 : 425.

1923. *Asarcina ericetorum* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 63.

1975. *Asarkina* (*Asarkina*) *ericetorum* (Fabricius) : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 309.

*Diagnosis* : Datta and Chakraborti (*in press*).

*Material examined* : 1 ♂ (ZSI Reg. No. 7165/H<sub>6</sub>), Top slip, Coimbatore, Tamil Nadu, 8. xii. 1979, Coll. A. N. T. Joseph.

*Remarks* : The species has been reported to occur throughout the Oriental region and has also been recorded from Australia, Fiji, Moluccas, New Guinea and Samoa (Knutson *et al.*, 1975). The type-locality of the species is 'Africa aequinoctial'.

## 2. *Dideopsis aegrota* (Fabricius)

1805. *Eristalis aegrota* Fabricius, *Syst. Antliat.* : 243.

1923. *Asarcina aegrota* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 64.

1975. *Dideopsis aegrota* (Fabricius) : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 313.

*Diagnosis* : Datta and Chakraborti (*in press*). Male terminalia illustrated by Vockeroth (1969).

*Material examined* : 1 ♂ (ZSI Reg. No. 7166/H<sub>6</sub>), Idamalaya, Ernakulum Dist., Kerala, 18.xii.1979, Coll. A. N. T. Joseph ; 1 ♂ (ZSI Reg. No. 7167/H<sub>6</sub>), Konnakuzhi, Chalakudy, Trichur Dist., Kerala, 22.xii.1979, Coll. A. N. T. Joseph.

*Remarks* : The species has been reported to occur throughout south-east Asia and Nepal, and has also been recorded from Australia and Moluccas (Knutson *et al.*, 1975). The type-locality of the species is China.

## 3. *Episyrphus balteatus* (De Geer)

1776. *Musca balteata* De Geer, *Me'm. pour serv. His. Ins.*, 6 : 116.

1923. *Syrphus balteatus* (De Geer) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 82.

1975. *Episyrphus balteatus* (De Geer) : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 314.

*Diagnosis* : Datta and Chakraborti (*in press*).

*Material examined* : 1 ♀ (ZSI Reg. No. 7168/H<sub>6</sub>), Vazhachal, Anamalai Hills, Trichur Dist., 21.xii.1979, Coll. A. N. T. Joseph ; 2 ♀ ♀ (ZSI Reg. Nos. 7169/H<sub>6</sub>-7170/H<sub>6</sub>), Parambikulam ; Palghat Dist., Kerala, 9.xii.1979, Coll. A. N. T. Joseph.

*Remarks* : The species has been reported to be extremely common throughout the Oriental region and occurs also in Australia, Bonin islands, Ethiopian and Palaearctic regions (Brunetti, 1923 ; Knutson *et al.*, 1975 ; Datta and Chakraborti, *in press*). The species has originally been described from Europe.

#### 4. *Ischiodon scutellaris* (Fabricius)

1805. *Scaeva scutellaris* Fabricius, *Syst. Antliat.* : 252.

1923. *Ischiodon scutellaris* (Fabricius) : Brunetti, *Fauna Brit. India*. Diptera, 3 : 97.

1975. *Ischiodon scutellaris* (Fabricius) : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 315.

**Diagnosis** : Eye bare ; metasternum bare ; antennal segment 3 sub-acute apically ; wing with  $R_{4+5}$  ending well before wing apex ; upper margin of sternopleuron with distinct yellow spot ; a few short hairs anteriorly below upper patch of sternopleural hairs ; hind trochanter in male with spine-like process ventrally ; male terminalia (Vockeroth, 1969).

**Material examined** : 1 ♂ (ZSI Reg. No. 7171/H<sub>6</sub>), Mustor, Chitradurga, Karnataka, 21.xii.1980, Coll. *S. K. Gupta*.

**Remarks** : The species has been reported to have wide distribution from the south-east Asia to Japan and has also been recorded from Australia, Hawaii and Micronesia (Knutson *et al.*, 1975). The type-locality of the species is Tamil Nadu in India.

#### 5. *Sphaerophoria indiana* Bigot

1884. *Sphaerophoria indiana* Bigot, *Annls Soc. ent. Fr.* (6) 4 : 99.

1923. *Sphaerophoria indiana* Bigot : Brunetti, *Fauna Brit. India*, Diptera, 3 : 102.

1975. *Sphaerophoria indiana* Bigot : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 318.

**Diagnosis** : Datta and Chakraborti (*in press*).

**Material examined** : 1 ♂ (ZSI Reg. No. 7172/H<sub>6</sub>), Eluppara, Kottayam Dist., Kerala, 30. xii. 1970, Coll. *A. N. T. Joseph* ; 2 ♂ ♂ (ZSI Reg. Nos. 7173/H<sub>6</sub>-7174/H<sub>6</sub>), Nopokula, Mercara, Karnataka, 5.i.1981, Coll. *S. K. Gupta* ; 1 ♂ (ZSI Reg. No. 7175/H<sub>6</sub>), Londa, Belgaum Dist., Karnataka, 25. xii. 1980, Coll. *G. K. Srivastava*.

**Remarks** : The species has been reported to occur in Himachal Pradesh, Karnataka, Maharashtra, Sikkim, Uttar Pradesh and West Bengal of India, and in China, Korea, Nepal, ? Sri Lanka and eastern USSR (Brunetti, 1923 ; Knutson *et al.*, 1975 ; Datta and Chakraborti, *in press*). The type-locality of the species is 'Indes'.

#### Tribe MELANOSTOMATINI

#### 6. *Melanostoma orientale* (Wiedemann)

1824. *Syrphus orientalis* Wiedemann, *Analecta Ent.* : 36.

1923. *Melanostoma orientale* (Wiedemann) : Bruuetti, *Fauna Brit. India*, Diptera, 3 : 48.

1975. *Melanostoma orientale* (Wiedemann) : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 325.

*Diagnosis* : Datta and Chakraborti (*in press*).

*Material examined* : 2 ♀ ♀ (ZSI Reg. Nos. 7176/H<sub>6</sub>-7177/H<sub>6</sub>), Top slip, Coimbatore, Tamil Nadu, 8.xii.1979, Coll. A. N. T. Joseph ; 3 ♀ ♀ (ZSI Reg. Nos. 7178/H<sub>6</sub>-7180/H<sub>6</sub>), Nopokula, Mercara, Karnataka, 5.i.1981, Coll. S. K. Gupta ; 1 ♀ (ZSI Reg. No. 7181/H<sub>6</sub>), Muthodi, Chikmagalur, Karnataka, 31.xii.1980, Coll. S. K. Gupta ; 1 ♀ (ZSI Reg. No. 7182/H<sub>6</sub>), Belgaum Dist., Karnataka, 27.xii.1980, Coll. G. K. Srivastava.

*Remarks* : The species has been reported to occur throughout the Oriental region (Knutson *et al.*, 1975) but has so far been recorded from Arunachal Pradesh, Assam, Himachal Pradesh, Jammu and Kashmir (Palearctic part also), Meghalaya, Uttar Pradesh, Sikkim and West Bengal in India and from Bhutan, Pakistan and Sri Lanka (Datta and Chakraborti, *in press*). The type-locality of the species is 'Ind. Or.'.

## 7. *Melanostoma univittatum* (Wiedemann)

1824. *Syrphus univittatum* Wiedemann, *Analecta Ent.* : 36.
1923. *Melanostoma univittatum* (Wiedemann) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 50.
1975. *Melanostoma univittatum* (Wiedemann) : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 325.

*Diagnosis* : Datta and Chakraborti (*in press*).

*Material examined* : 2 ♂ ♂ (ZSI Reg. Nos. 7183/H<sub>6</sub>-7184/H<sub>6</sub>), Kumily, Idukki Dist., Kerala, 23.xii.1970, Coll. A. N. T. Joseph ; 1 ♂, 1 ♀ (ZSI Reg. Nos. 7185/H<sub>6</sub>-7186/H<sub>6</sub>), Takkachi, Kottayam Dist., Kerala, 22.xii.1970, Coll. A. N. T. Joseph ; 1 ♂, (ZSI Reg. No. 7187/H<sub>6</sub>), Eluppara, Kottayam Dist., Kerala, 30.xii.1970, Coll. A. N. T. Joseph ; 1 ♂, 1 ♀ (ZSI Reg. Nos. 7188/H<sub>6</sub>-7189/H<sub>6</sub>), Belgaum Dist., Karnataka, 27.xii.1980, Coll. G. K. Srivastava ; 1 ♂ (ZSI Reg. No. 7190/H<sub>6</sub>), Mudigore, Chikmagalur, Karnataka, 30.xii.1980, Coll. S. K. Gupta ; 3 ♂ ♂ (ZSI Reg. Nos. 7191/H<sub>6</sub>-7193/H<sub>6</sub>), Nopokula, Mercara, Karnataka, 5.i.1981, Coll. S. K. Gupta.

*Remarks* : The species has been reported to occur throughout south-east Asia, ? Australia, ? Fiji, Japan, ? New Caledonia and ? Samoa (Knutson *et al.*, 1975). The type-locality of the species is 'Ind. Or.'.

Tribe PARAGINI

8. **Paragus (Paragus) serratus** (Fabricius)

1805. *Mulio serratus* Fabricius, *Syst. Antliat.* : 186.  
 1928. *Paragus serratus* (Fabricius) : Brunetti, *Fauna Brit. India, Diptera*, 3 : 31.  
 1975. *Paragus (Paragus) serratus* (Fabricius) : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 327.

**Diagnosis** : Datta and Chakraborti (*in press*).

**Material examined** : 2 ♂♂, 1 ♀ (ZSI Reg. Nos. 7194/H<sub>6</sub>-7196/H<sub>6</sub>), Ernakulum, Kerala, 16.xii.1979, Coll. A. N. T. Joseph ; 1 ♂, 1 ♀ (ZSI Reg. Nos. 7197/H<sub>6</sub>-7198/H<sub>6</sub>), Parambikulam, Palghat Dist., Kerala, 9-10. xii.1979, Coll. A. N. T. Joseph ; 1 ♂ (ZSI Reg. No. 7199/H<sub>6</sub>), Top slip, Coimbatore, Tamil Nadu, 8.xii.1979, Coll. A. N. T. Joseph ; 5 ♀♀ (ZSI Reg. Nos. 7200/H<sub>6</sub>-7204/H<sub>6</sub>), Chalakudy, Trichur Dist., Kerala, 22-23.xii.1979, Coll. A. N. T. Joseph ; 1 ♀ (ZSI Reg. No. 7205/H<sub>6</sub>), Idamalaya, Ernakulum, 18.xii.1979, Coll. A. N. T. Joseph ; 1 ♂ (ZSI Reg. No. 7206/H<sub>6</sub>), Mustor, Chitradurga, Karnataka, 21.xii.1980, Coll. S. K. Gupta.

**Remarks** : The species occurs almost everywhere in India and has also been recorded from Borneo, Java, Nepal, Pakistan, Papua and Africa (Datta and Chakraborti, *in press*). The species has originally been described from Tamil Nadu.

\* 9. **Paragus (Pandasyophthalmus) rufiventris** Brunetti

1913. *Paragus rufiventris* Brunetti, *Rec. Indian Mus.*, 8 : 157.  
 1923. *Paragus rufiventris* Brunetti : Brunetti, *Fauna Brit. India, Diptera*, 3 : 34.  
 1975. *Paragus (Pandasyophthalmus) rufiventris* Brunetti : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 328 (As subspecies of *P. (P.) tibialis* (Fallén)).

**Diagnosis** : Datta and Chakraborti (*in press*).

**Material examined** : 1 ♂ (ZSI Reg. No. 7207/H<sub>6</sub>), Chalakudy, Trichur Dist., Kerala, 23.xii.1979, Coll. A. N. T. Joseph.

**Remarks** : The species occurs in Assam, Bihar, Jammu and Kashmir, Sikkim, Uttar Pradesh and West Bengal of India (Datta and Chakraborti, *in press*) and in Nepal, Pakistan and Sri Lanka (Knutson *et al.*, 1975). This has originally been described from Assam. We, however, maintain the species status as per our earlier works (Datta and Chakraborti, 1983 ; *in press*).

## Subfamily MILESINAE

## Tribe ERISTALINI

10. *Eristalinus* (*Eristalinus*) *obscuritarsis* (de Meijere)

1908. *Eristalis obscuritarsis* de Meijere, *Tijdschr. Ent.*, 51 : 250.

1923. *Eristalis obscuritarsis* de Meijere : Brunetti, *Fauna Brit. India*, Diptera, 3 : 190.

1975. *Eristalinus* (*Eristalinus*) *obscuritarsis* (de Meijere) : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 348 (As synonym of *E. laetus* (Wiedemann)).

**Diagnosis :** Eye with sparse hairs on upper part only, black spotted ; antenna orange except brownish upper margin of segment 3, arista bare ; mesonotum shining black, with long yellowish hairs ; scutellum brownish with light margin ; subscutellar fringe represented by a few hairs only ; abdomen black, with large yellow spot on tergites 2 and 3, and curved band on tergite 4 ; male terminalia (Fig. 1).

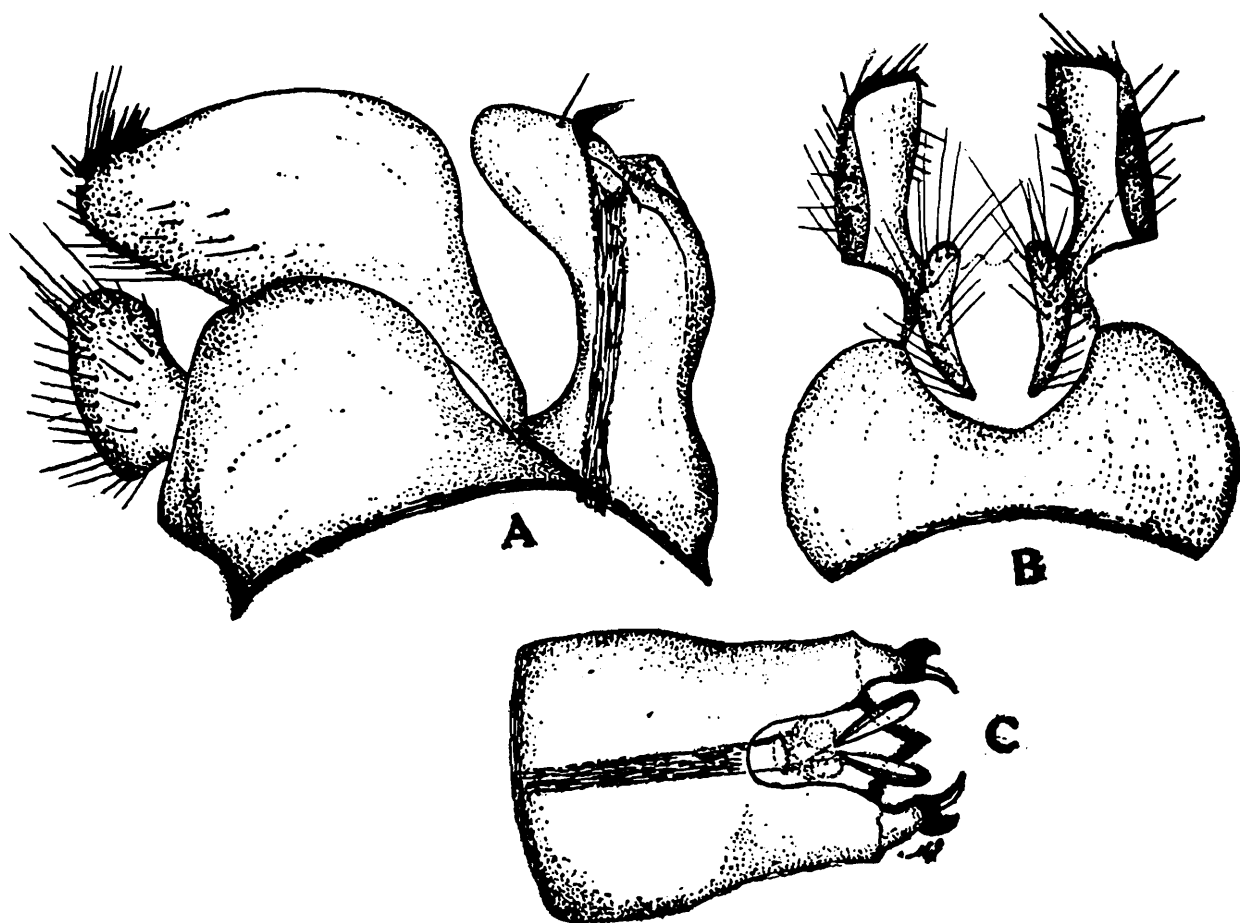


Fig. 1. *Eristalinus* (*Eristalinus*) *obscuritarsis* : A, terminalia (lateral view) ; B, tergite 9, cerci and surstyli (dorsal view) ; C, sternite 9, superior lobes and aedeagal base (ventral view).

**Material examined :** 1 ♂ (ZSI Reg. No. 7208/H<sub>6</sub>), Parambikulum, Palghat Dist., Kerala, 7.xii.1979, Coll. A. N. T. Joseph ; 1 ♀ (ZSI Reg. No. 7209/H<sub>6</sub>), Chalakudy, Trichur Dist., Kerala, 23.xii.1979, Coll. A. N. T. Joseph.

**Remarks :** The species has been reported to occur from Kashmir to Bangalore in India, and in Bangladesh, Java and Malaya (Brunetti, 1923 ; Knutson *et al.*, 1975). This has originally been described from Singapore and Bombay. The species is treated here as per Brunetti (*op. cit.*) without synonymization with *E. (E.) laetus* (Wiedemann) for difference in certain characters (Datta and Chakraborti, *in press*).

### 11. *Eristalinus (Eristalinus) quinquestriatus* (Fabricius)

1794. *Syrphus quinquestriatus* Fabricius, *Ent. Syst.*, 4 : 289.

1923. *Eristalis quinquestriatus* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 187.

1975. *Eristalinus (Eristalinus) quinquestriatus* (Fabricius) : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 349.

**Diagnosis :** Datta and Chakraborti (*in press*).

**Material examined :** 4 ♂♂, 4 ♀♀, (ZSI Reg. Nos. 7210/H<sub>6</sub>-7217/H<sub>6</sub>), Kumily, Idukki Dist., Kerala, 13-14.xii.1979, Coll. A. N. T. Joseph.

**Remarks :** The species has been reported to occur throughout the Oriental region and in Japan (Knutson *et al.*, 1975). The type-locality of the species is 'India orientali'.

### 12. *Eristalinus (Merodonoides) multifarius* (Walker)

1852. *Eristalis multifarius* Walker, *Insecta Saundersiana*, 1 : 248.

1923. *Eristalis multifarius* Walker : Brunetti, *Fauna Brit. India*, Diptera, 3 : 194.

1975. *Eristalinus (Merodonoides) multifarius* (Walker) : Knutson, Thompson and Vockeroth, *A catalog of Diptera of the Oriental Region*, 2 : 350.

**Diagnosis :** Eye bare, with two black stripes in addition to dark inner and hind border ; antenna black except orange lower side of segment 3 ; arista bare ; mesonotum dark grey, with shining four black stripes ; scutellum orange ; wing with petiolate marginal cell, hind femur conspicuously incrassated ; subscutellar fringe absent ; abdominal tergite 3 mainly orange, with a very large semicircular blackish spot on hinder half.

**Material examined :** 1 ♀ (ZSI Reg. No. 7218/H<sub>6</sub>), Parambikulam, Palghat Dist., Kerala, 10.xii.1979, Coll. A. N. T. Joseph.

**Remarks :** The species has been reported to occur in Gujarat, Meghalaya, Rajasthan and Tamil Nadu of India (Brunetti, 1923), and has also been recorded from Java, Malaya, Nepal, Sri Lanka and Viet Nam (Knutson *et al.*, 1975). This has originally been described from East Indies (most probably Meghalaya).

**\*13. *Eristalis polychromata* Brunetti**

1923. *Eristalis polychromatus* Brunetti, *Fauna Brit. India*, Diptera, 3 : 180.

1975. *Eristalis polychromata* Brunetti : Knutson, Thompson and Vockeröth, *A Catalog of Diptera of the Oriental Region*, 2 : 353 (As unplaced species of *Eristalis* Latreille).

**Diagnosis :** Eye finely haired, with dark spots ; antenna brownish orange, arista bare ; mesonotum dark grey, with 4 shining black stripes ; scutellum shining blue black ; abdominal tergites 2, 3 & 4 orange except posterior margins and median spots ; no arcuate whitish band ; male terminalia (Fig. 2).

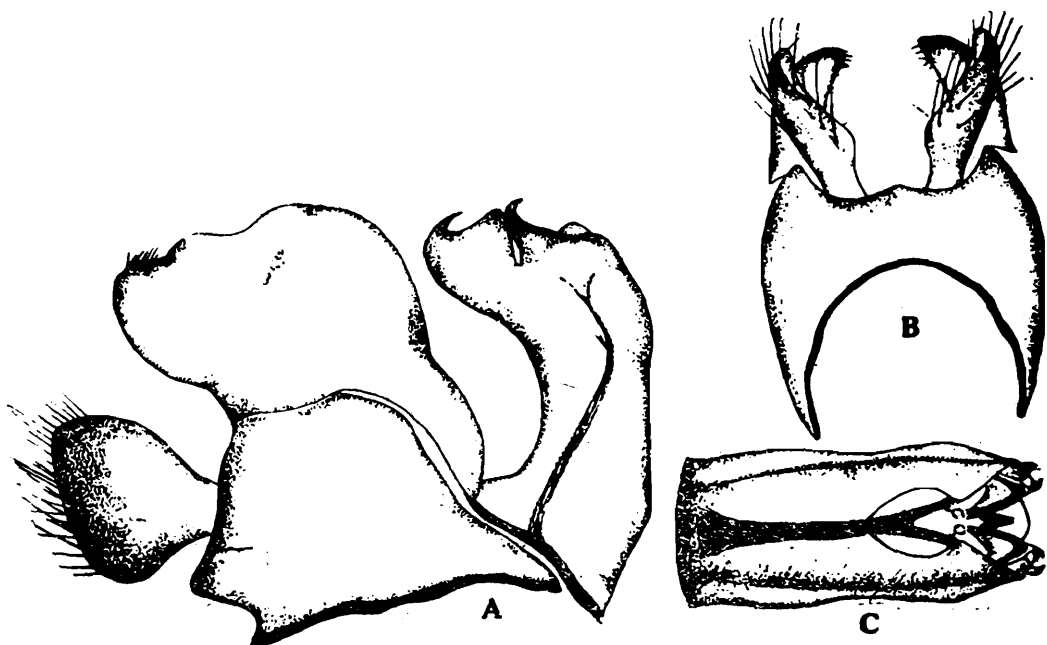


Fig. 2. *Eristalis polychromata* : A, terminalia (lateral view) ; B, tergite 9, cerci and surstyli (dorsal view) ; C, sternite 9, superior lobes and aedeagal base (ventral view).

**Material examined :** 1 ♂ (ZSI Reg. No. 7219/H<sub>6</sub>), Konnakuzi, chalakudy, Trichur Dist., Kerala, 22.xii.1979, Coll. A. N. T. Joseph.

**Remarks :** This species has so far been known only from the type-locality : Calcutta, West Bengal in India (Brunetti, 1923 ; Knutson *et al.*, 1975).

**14. *Mesembrius bengalensis* (Wiedemann)**

-1819. *Eristalis bengalensis* Wiedemann, *Zool. Mag.* (Wied.), 1 : 16.

1923. *Helophilus bengalensis* (Wiedemann) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 209.

1975. *Mesembrius bengalensis* (Wiedemann) : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 356.

**Diagnosis :** Eye bare ; antennal segments 1 and 2 black, 3 dark brown, with bare arista ; mesonotum grey with three longitudinal black

stripes ; scutellum translucent yellow, dark basally ; subscutellar fringe absent ; mid-femur in male with a tooth basally ; marginal cell open ; abdominal tergite 4 with an inverted, widely open V-mark ; male terminalia (Fig. 3).

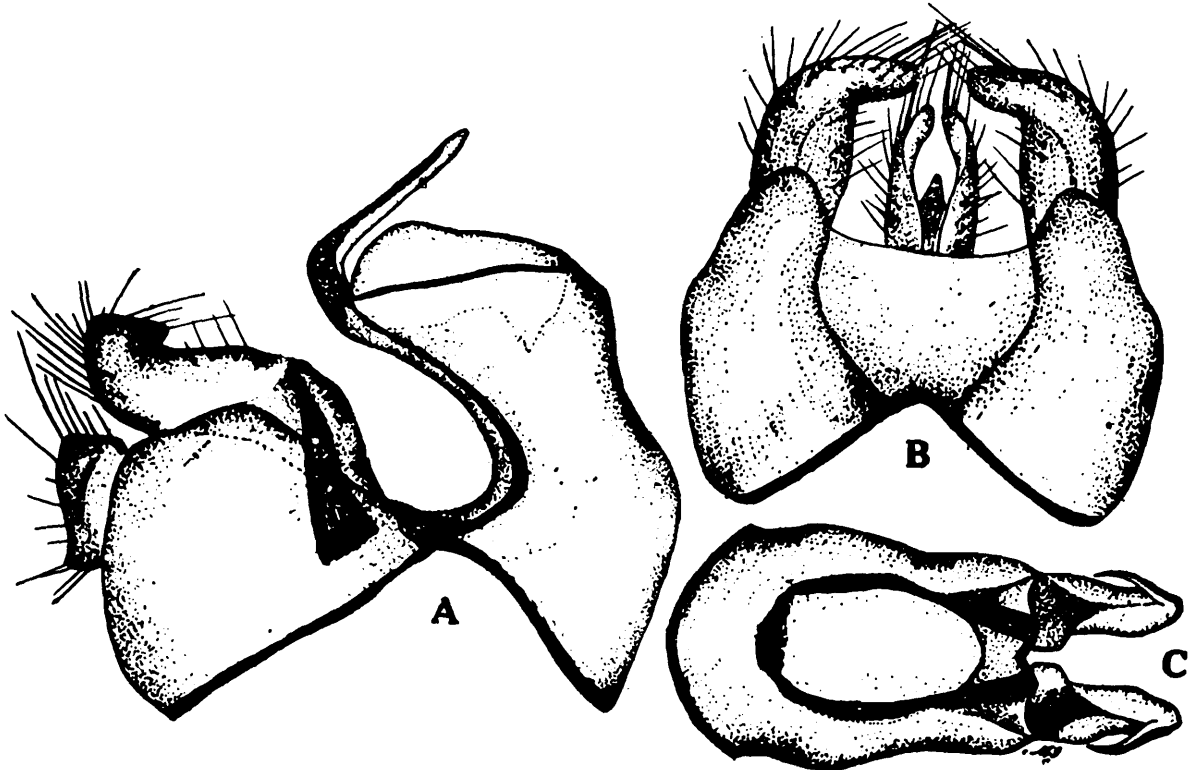


Fig. 3. *Mesembrius bengalensis* : A, terminalia (lateral view) ; B, tergite 9, cerci and surstyli (dorsal view) ; C, sternite 9, superior lobes and aedeagal base (ventral view).

*Material examined* : 1 ♂ (ZSI Reg. No. 7220/H<sub>6</sub>), Mullayarm, Tamil Nadu, 23.vi.1981, Coll. K. Mathew.

*Remarks* : The species has been reported to occur from the south-east Asia to New Guinea and northern Australia (Knutson *et al.*, 1975). This has originally been described from 'Bengal'.

### 15. *Phytomia* (*Phytomia*) *errans* (Fabricius)

1787. *Syrphus errans* Fabricius, *Manitissa Insect.*, 2 : 337.

1923. *Megaspis errans* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 199.

1975. *Phytomia* (*Phytomia*) *errans* (Fabricius) : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 357.

*Diagnosis* : Eye bare ; antenna orange, arista bare ; metathoracic spiracular patch present ; wing mainly pale brown ; marginal cell petiolate ; hind femur unarmed ; abdomen brownish orange, tergites 2, 3 and 4 with a large blackish brown triangular spot ; male terminalia (Fig. 4).

*Material examined* : 4♂♂, 1♀ (ZSI Reg. Nos. 7221/H<sub>6</sub>-7225/H<sub>6</sub>), Idamalaya, Ernakulum Dist., Kerala, 18.xii.1979, Coll. A. N. T. Joseph ; 1♂, 1♀ (ZSI Reg. Nos. 7226/H<sub>6</sub>-7227/H<sub>6</sub>), Kumily, Idukki Dist., 14.xii.1979, Coll. A. N. T. Joseph ; 1♀ (ZSI Reg. No. 7228/H<sub>6</sub>), Top slip, Coimbatore Dist., Tamil Nadu, 8.xii.1979, Coll. A. N. T. Joseph.

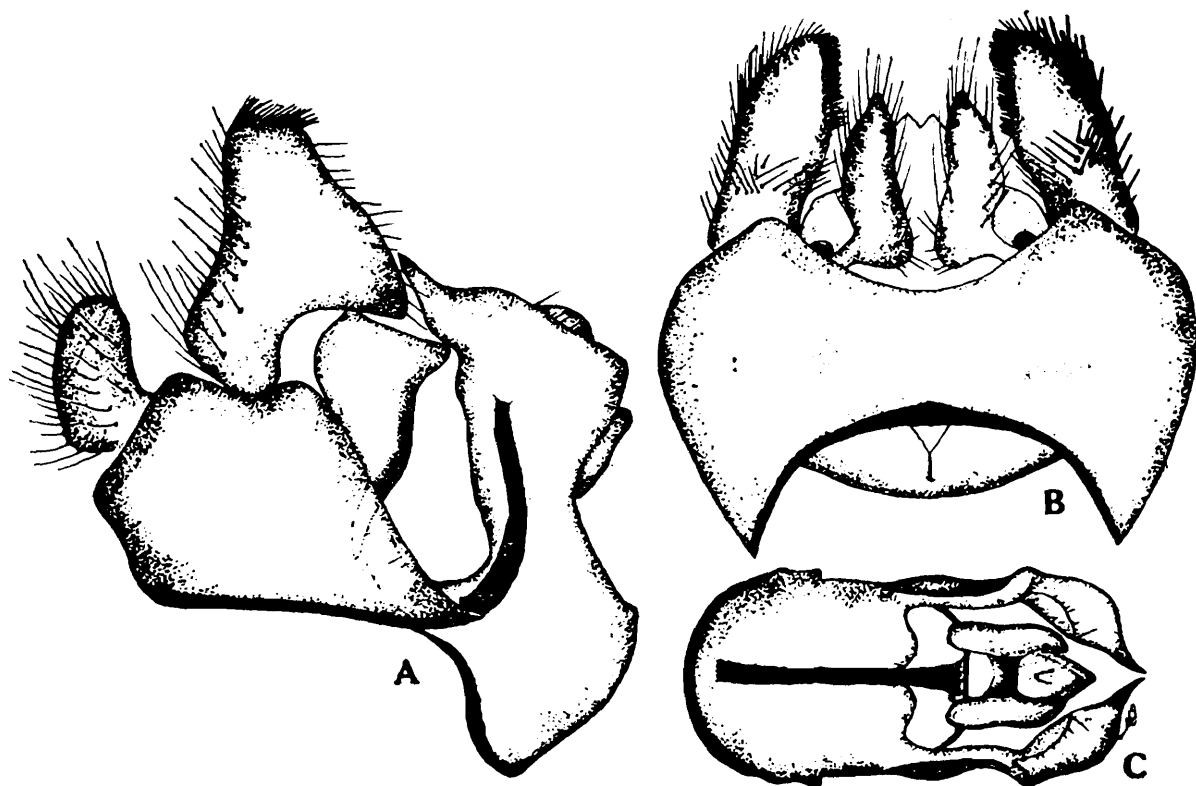


Fig. 4. *Phytomia (Phytomia) errans* : A, terminalia (lateral view) ; B, tergite 9, cerci and surstyli (dorsal view) ; C, sternite 9, superior lobes and aedeagal base (ventral view).

*Remarks* : The species has been reported to occur throughout south-east Asia, China and Japan (Knutson *et al.*, 1975). The species has originally been described from China.

### 16. *Phytomia (Phytomia) zonata* (Fabricius)

1787. *Syrphus zonatus* Fabricius, *Mantissa Insect.*, 2 : 337.

1923. *Megaspis zonatus* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 203.

1975. *Phytomia (Phytomia) zonata* (Fabricius) : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 357.

*Diagnosis* : Eye bare ; antenna black, arista distinctly hairy except distal one-third ; metathoracic spiracular pile patch present ; wing almost clear, a distinct blackish brown infuscation anteriorly, marginal cell petiolate ; hind femur unarmed, with pale yellow hairs basally on upper side ; abdomen black, tergites 3 and 4 each with two brownish yellow elongate spots.

**Material examined :** 1 ♂ with damaged abdomen (ZSI Reg. No. 7229/H<sub>6</sub>), on road to Valiyaparathodu, Kerala, 5.xii.1980, Coll. *R. S. Pillai*.

**Remarks :** The species has been reported to occur throughout the entire south-east Asia, and in Japan, Korea and Manchuria (Knutson *et al.*, 1975 ; Datta and Chakraborti, 1985). This has originally been described from China.

### 17. *Phytomia (Dolichomerus) crassa* (Fabricius)

1787. *Syrphus crassus* Fabricius, *Mantissa Insect.*, 2 : 334.

1923. *Megaspis crassus* (Fabricius) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 197.

1975. *Phytomia (Dolichomerus) crassa* (Fabricius) : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 358.

**Diagnosis :** Eye bare ; antenna black, arista hairy except distal one-third ; metathoracic spiracular patch present ; wing clear, a dark brown streak from vein 2 to 4, enclosing anterior cross-vein, a dark spot over tip of vein 3 ; marginal cell petiolate ; hind femur with a conspicuous basal tooth ; abdomen shining black, tergites 2, 3 and 4 each with a deep impression of a large circle ; male terminalia (Fig. 5).

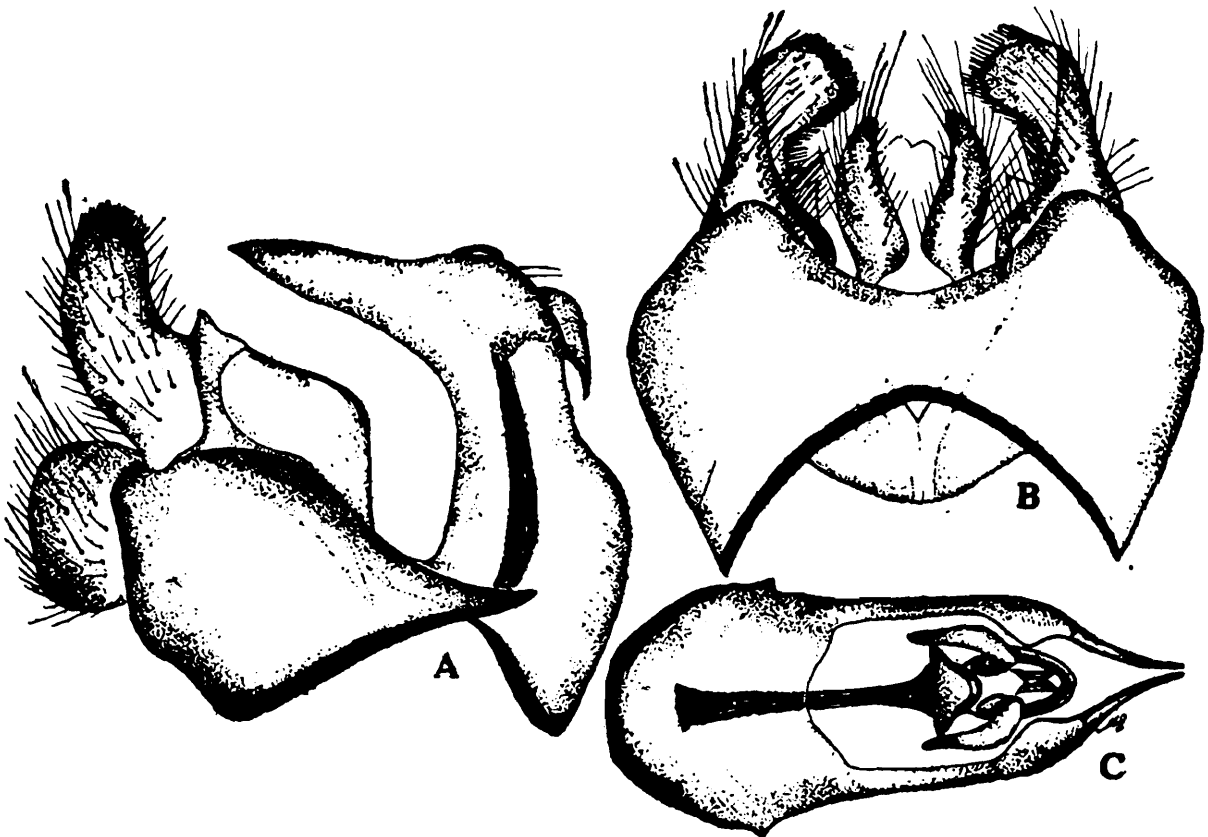


Fig. 5. *Phytomia (Dolichomerus) crassa* : A, terminalia (lateral view) ; B, tergite 9, cerci and surstyli (dorsal view) ; C, sternite 9, superior lobes and aedeagal base (ventral view).

*Material examined* : 1 ♂ (ZSI Reg. No. 7230/H<sub>6</sub>), Idamalaya, Ernakulam Dist., Kerala, 18.xii.1979, Coll. A. N. T. Joseph.

*Remarks* : The species has been reported to occur in Andhra Pradesh, Assam, Bihar, Goa, Karnataka, Kerala, Meghalaya, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal of India, and in Celebes, Laos, Malaya, Nepal, Sri Lanka and Thailand (Brunetti, 1923 ; Knutson *et al.*, 1975). The species has originally been described from Tamil Nadu in India.

### 18. *Syritta indica* (Wiedemann)

1824. *Eumerus indicus* Wiedemann, *Analecta Ent.* : 33.

1883. *Syritta rufifacies* Bigot, *Annls Soc. Ent. Fr.* (6) : 3 : 538.

1923. *Syritta rufifacies* Bigot : Brunetti, *Fauna Brit. India*, Diptera, 3 : 247.

1975. *Syritta indica* (Wiedemann) : Knutson, Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 365.

*Diagnosis* : Eye bare ; meta-episternum with a few long hairs ; hind femur greatly swollen, with a spinose ridge on outer apical ventral third, brownish orange up to two-thirds from base, rest black ; abdominal tergites 2 and 3 with orange bands ; male terminalia (Fig. 6).

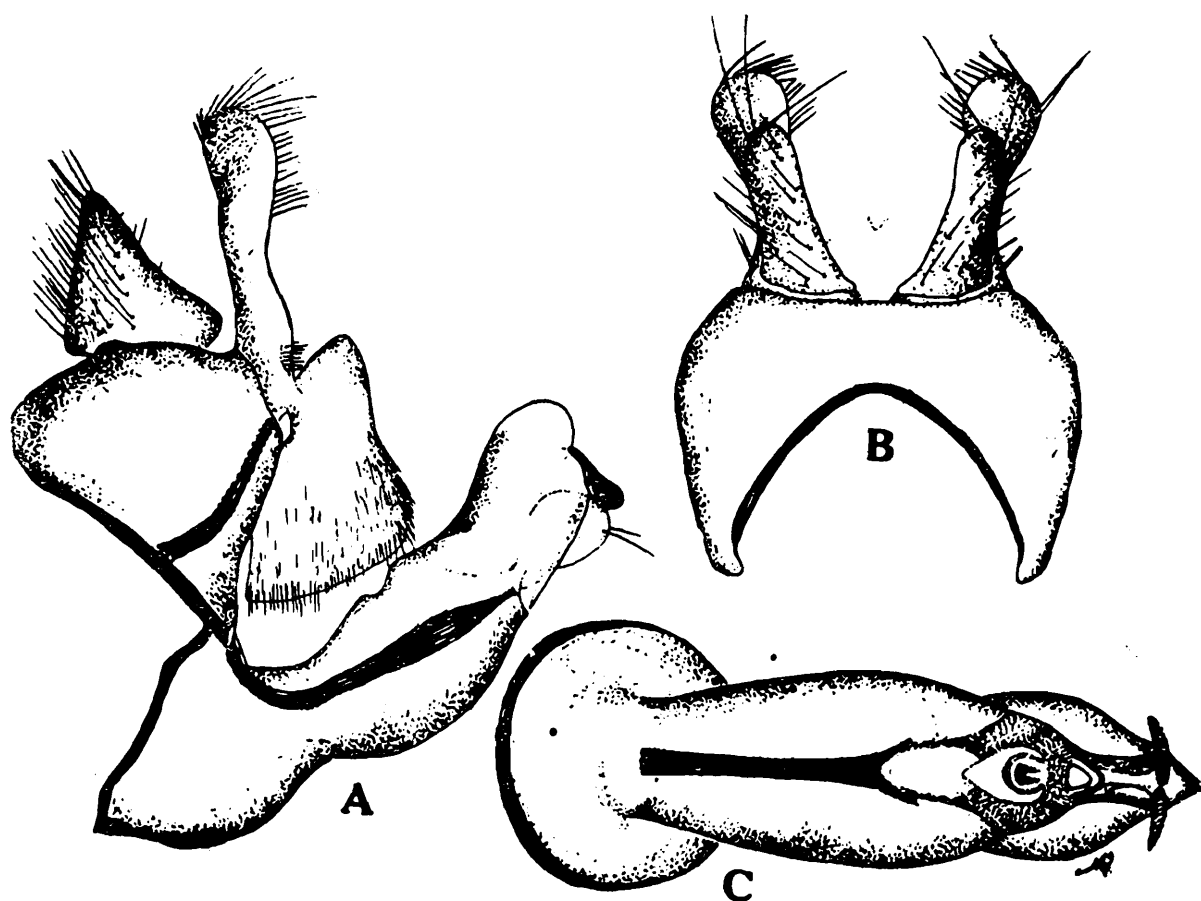


Fig. 6. *Syritta indica* : A, terminalia (lateral view) ; B, tergite 9, cerci and surstyli (dorsal view) ; C, sternite 9, superior lobes and aedeagal base (ventral view).

**Material examined :** 1 ♂ (ZSI Reg. No. 7231/H<sub>6</sub>), Chalakudy, Trichur Dist., Kerala, 23.xii.1979, Coll. A. N. T. Joseph.

**Remarks :** The species has been reported to occur in Assam, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Pondicherry, Uttar Pradesh and West Bengal of India, and in Burma, Nepal and Taiwan (Brunetti, 1923 ; Knutson *et al.*, 1975). This has originally been described from 'East Indies'.

### 19. *Syritta pipiens* (Linnaeus)

1758. *Musca pipiens* Linnaeus, *Syst. Nat. Ed.* 10 : 594.

1923. *Syritta pipiens* (Linnaeus) : Brunetti, *Fauna Brit. India*, Diptera, 3 : 245.

1975. *Syritta pipiens* (Linnaeus) : Knutson, Thompson and Voekeroth, *A Catalog of Diptera of the Oriental Region*, 2 : 365.

**Diagnosis :** Eye bare ; meta-episternum with a few long hairs ; hind femur greatly swollen, with a spinose ridge on outer apical ventral third, black with orange base, with an orange streak underside in middle ; abdomen largely black, tergites 2 and 3 each with a pair of pale yellow spots.

**Material examined :** 1 ♀ (ZSI Reg. No. 7232/H<sub>6</sub>), Top slip, Coimbatore, Tamil Nadu, 8.xii.1979, Coll. A. N. T. Joseph.

**Remarks :** The species has been reported to occur in Himachal Pradesh, Kashmir, Tamil Nadu, Uttar Pradesh and West Bengal of India (Brunetti, 1923 ; Cherian, 1934 ; Datta and Chakraborti, 1983), and in Nepal and Holarctic region (Knutson *et al.*, 1975). This has originally been described from Europe.

### SUMMARY

The paper deals with 19 species under 12 genera of the Syrphidae, including new distributional records for 2 species in South India. The male terminalia of 6 species are illustrated herein.

### ACKNOWLEDGEMENTS

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\*Not seen in original



INCIDENCE OF LARVAL TREMATODES INFECTION AND  
THEIR SEASONAL VARIATIONS IN THE FRESH  
WATER MOLLUSCS OF SOUTHERN-  
RAJASTHAN

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(With 3 Figures)

INTRODUCTION

Molluscs serve as intermediate hosts for many digenetic trematodes. Studies on the larval trematodes and their seasonal variations in the Indian aquatic molluscan are scanty.

Dubois (1929), Rees (1932), Wesenburg-Lund (1934), Rothschild (1941), Wikgren (1956), Deforest (1957), Khan (1960a, b), Radke *et al.* (1961), Larson (1961), Ewers (1964) and Basch (1966) have studied the larval trematodes infecting the different molluscan hosts. The seasonal variations of infection of larval trematodes in India have been studied by Soparkar (1921) Sewell (1922), Chatterji (1933), Ganpati and Hanumanth Rao (1959), Singh (1959), Probert (1966), Mukherjee (1966), Jain (1970, 1976), Mohandas (1974), Pandey and Agarwal (1978) and Choubisa and Sharma (1982). The present paper deals with the type of cercariae that infect the fresh water molluscs of Southern Rajasthan and their seasonal variations.

Material and Methods

During survey (from April, 1982 to March, 1983) of cercarial infection in fresh water snails of Southern-Rajasthan a rich collection of live specimens of more than 15,000 gastropods and 3,500 bivalves inhabiting the lentic and lotic habitats of five districts viz. Udaipur, Chittorgarh, Bhilwara, Dungarpur and Banswara was made in different seasons.

Molluscan species of lentic or lotic habitat, of bottom dwelling and surface-dwelling habits were maintained separately in laboratory aquaria. For examination the snails were exposed to light for cercarial infection and they were also dissected out for the presence of larval trematodes.

The larval trematodes were collected and examined according to the methods reported by Mukherjee (1980). Thus, the larvae were studied under light cover-slip pressure, both alive as well as in stained mounts. Neutral red and methylene blue were also employed for detailed study of penetration glands, gut and genital rudiments. Unstained live cercariae were studied specially for their Flame cell formulae. They were then identified following the key as given by Erasmus (1972).

## OBSERVATIONS

All molluscan species of moderate size were usually found infected. *Vivipara bengalensis*, however, revealed gigantism due to helminthic

TABLE I. Habit and habitat of molluscs with their larval trematodes.

| Class      | Molluscs                            | Habit/  | Cercariae |   |   |   |   |   | Metacercariae |    |   |   |    |  |
|------------|-------------------------------------|---------|-----------|---|---|---|---|---|---------------|----|---|---|----|--|
|            |                                     | Habitat | M         | G | E | F | X | A | P             | As | E | S | OP |  |
| Gastropoda | (A) <i>Hydrobidae</i>               |         |           |   |   |   |   |   |               |    |   |   |    |  |
|            | (i) <i>Bithynia stenothyroides</i>  | bd/o    | —         | — | — | + | — | — | —             | —  | — | — | —  |  |
|            | (B) <i>Viviparidae</i>              |         |           |   |   |   |   |   |               |    |   |   |    |  |
|            | (i) <i>Vivipara bengalensis</i>     | bd/e    | —         | — | + | + | + | — | +             | —  | + | — | —  |  |
|            | (ii) <i>Vivipara dissimilis</i>     | bd/o    | —         | — | — | + | — | — | —             | —  | — | — | —  |  |
|            | (C) <i>Thiara (Melanoides)</i>      |         |           |   |   |   |   |   |               |    |   |   |    |  |
|            | (i) <i>Melania tuberculata</i>      | bd/e    | +         | + | — | + | + | — | —             | +  | — | — | —  |  |
|            | (ii) <i>Thiara (Thiori) scabra</i>  | bd/o    | —         | — | — | — | + | — | —             | —  | — | — | —  |  |
|            | (iii) <i>Faunus ater</i>            | bd/o    | —         | — | — | + | — | — | —             | —  | — | — | —  |  |
|            | (D) <i>Lymnaeidae</i>               |         |           |   |   |   |   |   |               |    |   |   |    |  |
|            | (i) <i>Lymnaea acuminata</i>        | sd/e    | —         | + | + | + | + | — | —             | —  | — | — | —  |  |
|            | (ii) <i>Lymnaea luteola</i>         | sd/e    | —         | + | — | + | + | + | —             | —  | — | — | —  |  |
|            | (iii) <i>Lymnaea auricularia</i>    | sd/e    | —         | + | + | + | + | — | —             | —  | — | + | —  |  |
|            | (iv) <i>Lymnaea pinguis</i>         | sd/e    | —         | — | — | + | + | — | —             | —  | — | — | —  |  |
|            | (E) <i>Planorbidae</i>              |         |           |   |   |   |   |   |               |    |   |   |    |  |
|            | (i) <i>Indoplanorbis exustus</i>    | sd/e,o  | —         | — | + | + | + | + | —             | —  | — | — | +  |  |
|            | (ii) <i>Gyraulus convexiusculus</i> | sd/e    | —         | — | + | + | + | + | —             | —  | — | — | —  |  |
| Pelecypoda | (A) <i>Unionidae</i>                |         |           |   |   |   |   |   |               |    |   |   |    |  |
|            | (i) <i>Lamellidens marginalis</i>   |         | —         | — | — | — | — | — | —             | —  | — | — | —  |  |
|            | (ii) <i>Lamellidens</i> (species)   |         | —         | — | — | — | — | — | —             | —  | — | — | —  |  |
|            | (B) <i>Corbiculidae</i>             |         |           |   |   |   |   |   |               |    |   |   |    |  |
|            | (i) <i>Corbicula regularis</i>      |         | —         | — | — | — | — | — | —             | —  | — | — | —  |  |
|            | (ii) <i>Corbicula stiatella</i>     |         | —         | — | — | — | — | — | —             | —  | — | — | —  |  |

Abbreviations used : + infected ; — noninfected ; bd, bottom dweller ; e, lentice (stagnant water) ; o, lotic (running water) ; sd, surface dweller. A, amphistome ; As, aspidogaster ; E, echinostome ; F, furcocercous cercaria ; G, gymnocephalous ; M, monostome ; OP, opisthorchid ; P, plagiurchiid ; S, strigeid and X, xiphidiocercaria.

infection. Inspection of several hundred specimens of *V. bengalensis* revealed gigantism only in those individuals which were infected.

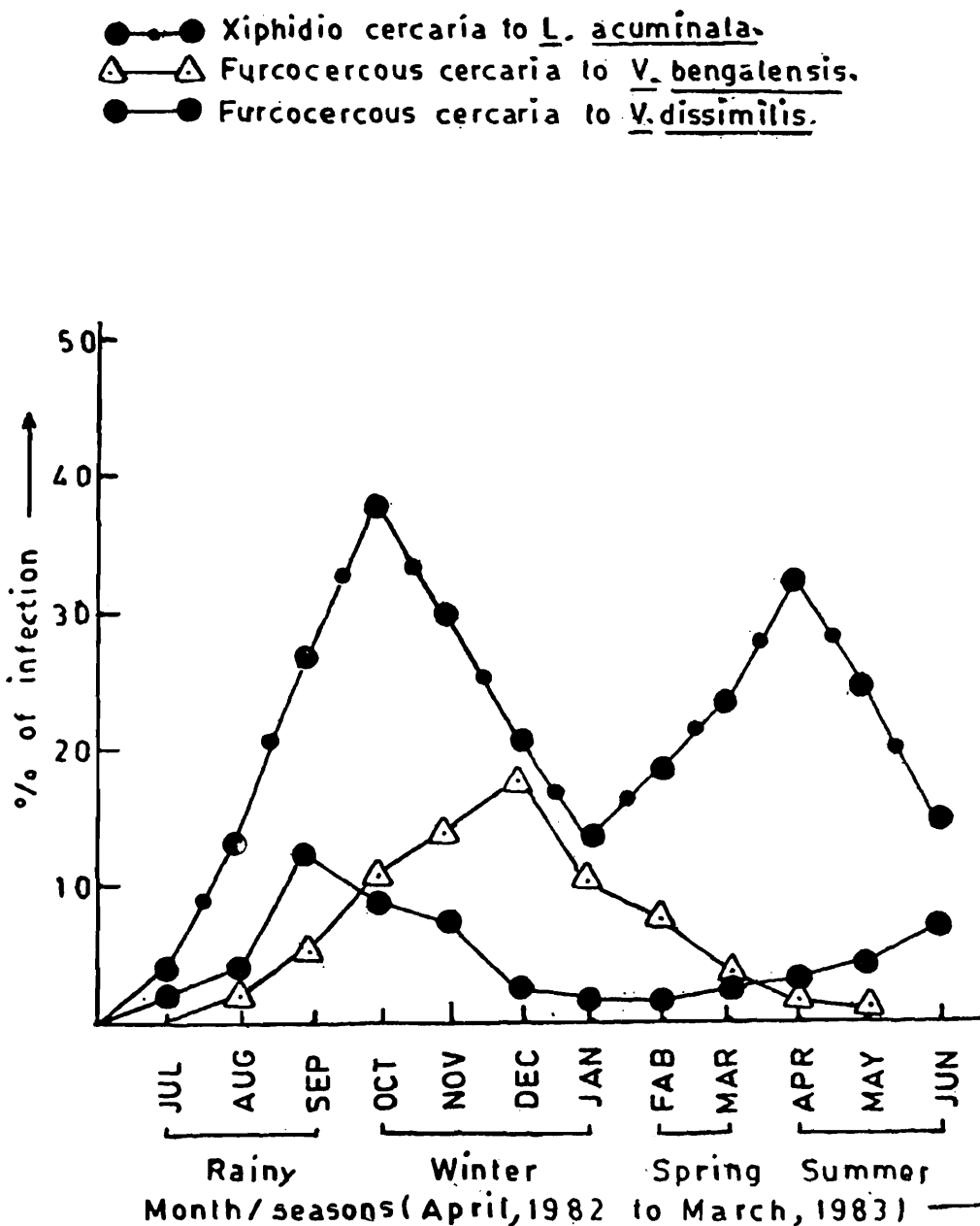


FIG. 1 GRAPH SHOWING MONTHLY (Seasonal) PERCENTAGE OF CERCARIAL INFECTION IN GASTROPODS.

Surface dwelling lentic gastropods *Lymnaea acuminata*, *L. auricularia*, *Indoplanorbis exustus* and *Gyraulus convexiusculus* revealed a fairly heavy infection of various types of cercariae. Bottom dwelling lentic molluscs *Vivipara bengalensis* and *Melania tuberculata* were found to be resistant to cercarial infection in comparison to other freshwater snails (Fig. 1). However, the incidence of infection within these molluscs in ponds was recorded slightly higher than those in lakes.

Molluscs of lotic water with bottom dwelling habit belonging to the families Hydrobiidae, Viviparidae and Melaniidae showed a very low

incidence of infection of cercariae (Table I). Unionidae, Corbiculidae indicate no cercarial infection.

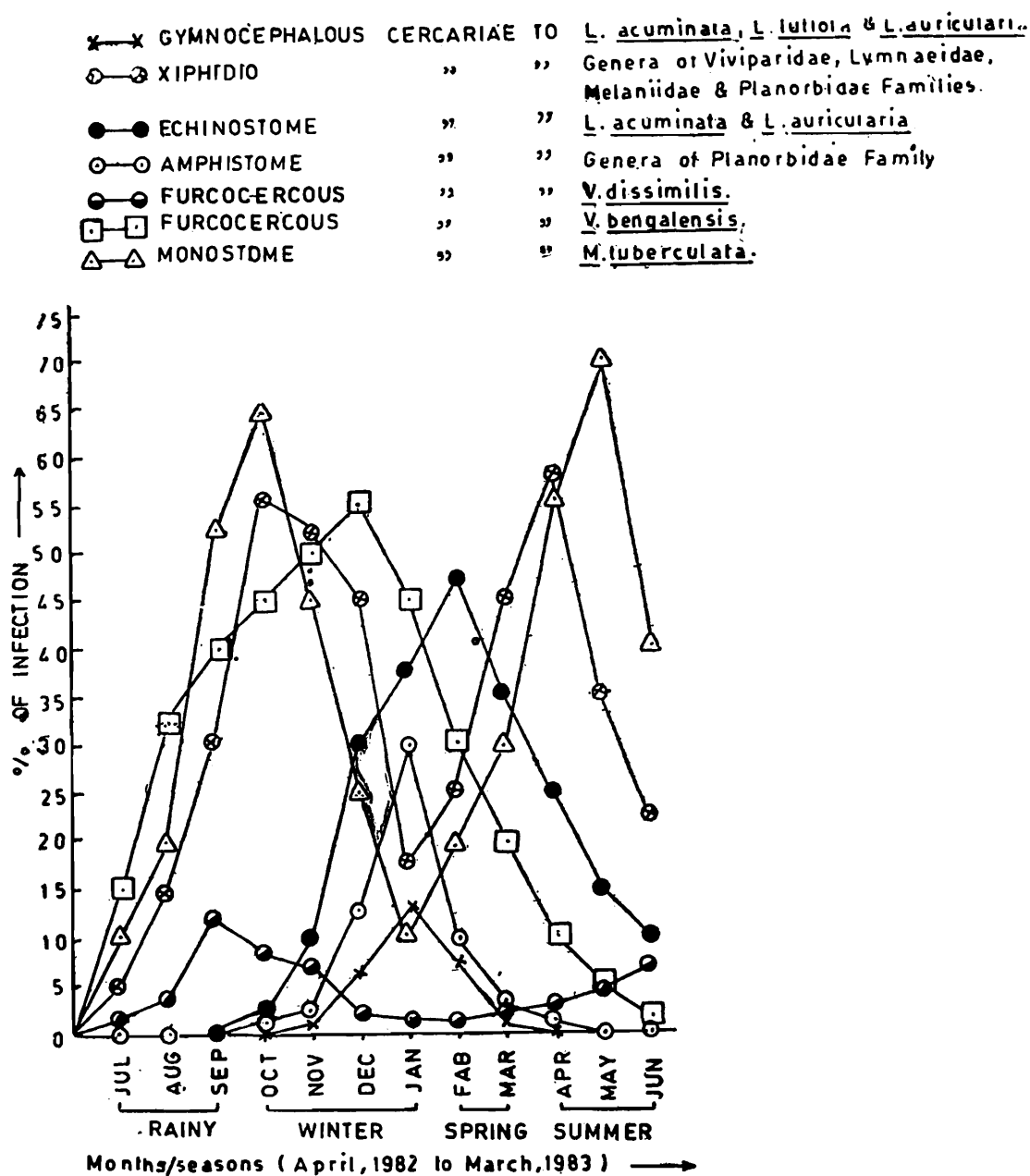


FIG. 2 GRAPH SHOWING MONTHLY (Seasonal) PERCENTAGE OF CERCARIAL INFECTION IN GASTROPODS.

### Seasonal variations in the percentage of infections :

Gastropods infected with different larval parasites, cercariae and metacercariae, showed seasonal variations in the percentage of infections and indicated in the Figs. 2 and 3.

Xiphidio and monostome cercariae showed two peak periods of cercarial infection—one in the month of May and another in the month of October. Xiphidio cercariae were recorded from the genera belonging to families Viviparidae, Melaniidae, Lymnaeidae and Planorbidae and Monostome from *M. tuberculata* only as shown in Table II.

**Viviparidae :** The species belonging to this family that have been examined for cercarial infection are listed in Table I. *V. bengalensis* was found to be infected with furco and xiphidio-cercariae throughout the year. Echinostome cercariae were also recorded from this snail in the month of January but the percentage of infection was low (5%). Another fucocercous cercaria with two pigmented eyes spots, was shed by *V. dissimilis* in the month of September and incidence of infection was 12.5%.

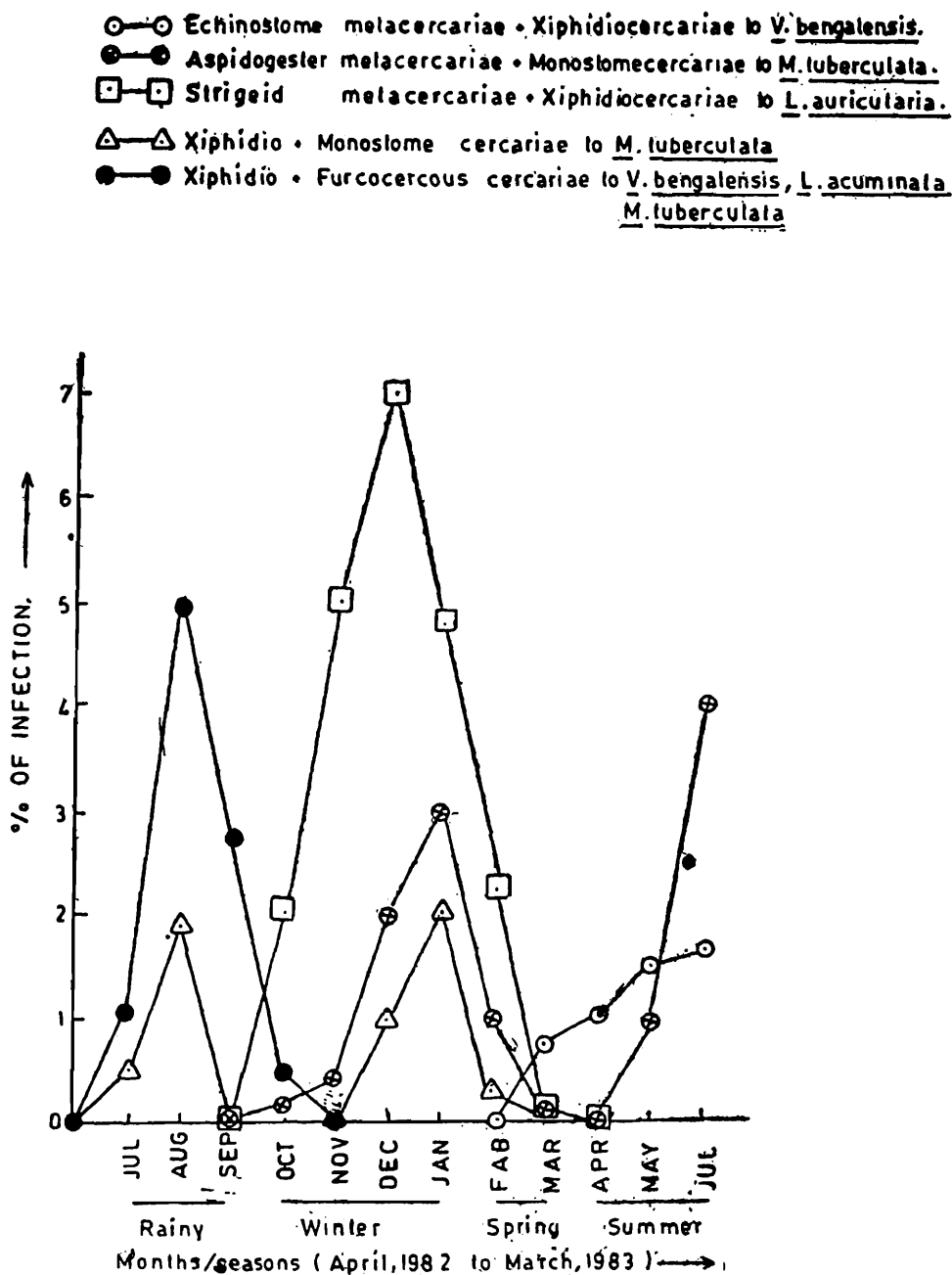


FIG. 3 GRAPH SHOWING MONTHLY (Seasonal) PERCENTAGE OF DOUBLE INFECTION IN GASTROPODS.

Besides the cercarial infection, the metacercariae of Plagiorchiid and Echinostome were also recovered from *V. bengalensis* in the summer season and the percentage of infections was 1.5% and 2% respectively.

*Melaniidae* : The monostome cercarial infection was found only in *M. tuberculata* and the infection was recorded throughout the year. Other cercariae like gymnocephalous, xiphidio and furcocercous cercariae were also shed by this snail in winter season. A rare species of furcocercous cercariae was found to infect the snail *F. ater* from the months of December to February and incidence of infection was about 0.08%.

TABLE II. Record of double infections in snail species.

| Sl. No. | Snails                | Cercarial infection |                             |
|---------|-----------------------|---------------------|-----------------------------|
| 1.      | <i>V. bengalensis</i> | (i) Xiphidio        | + Furcocercous cercaria     |
|         |                       | (ii) Xiphidio       | + Plagiorchiid metacercaria |
|         |                       | (iii) Xiphidio      | + Echinostome metacercaria  |
| 2.      | <i>L. auricularia</i> | (i) Xiphidio        | + Xiphidiocercaria          |
|         |                       | (ii) Xiphidio       | + Strigeid metacercaria     |
| 3.      | <i>L. acuminata</i>   | (i) Xiphidio        | + Furcocercous cercaria     |
|         |                       | (ii) Xiphidio       | + Echinostome cercaria      |
|         |                       | (iii) Xiphidio      | + Gymnocephalous cercaria   |
| 4.      | <i>M. tuberculata</i> | (i) Xiphidio        | + Monostome cercaria        |
|         |                       | (ii) Xiphidio       | + Furcocercous cercaria     |
|         |                       | (iii) Monostome     | + Monostome cercaria        |
|         |                       | (iv) Monostome      | + Aspidogaster metacercaria |
| 5.      | <i>I. exustus</i>     | (i) Amphistome      | + Xiphidiocercaria          |

The rarely occurring metacercariae of *Aspidogaster* in *M. tuberculata* varies in their incidence from 1% to 4% from the months of September to June (Fig. 3).

*Lymnaeidae* : Various species of snails of this family are found in abundance all over the Southern-Rajasthan after monsoon. The cercariae like gymnocephalous, furcocercous, xiphidio, echinostome and amphistome were shed by the different species of snails of this family. Three species of cercariae were found to infect *L. auricularia*, *L. luteola* and *L. acuminata*. The incidence and seasonal variation of cercarial infection in the various species of snails belonging to this family have been shown in Fig. 2.

The metacercariae of strigeid, *Tetracotyl lymnaei* (Pandey and Agrawal, 1978) were recovered from *L. auricularia* from the months of October to January and the peak of incidence (7%) of infection of this species was recorded in the month of December.

*Planorbidae* : *I. exustus* and *G. convexiusculus* are the two common species of snails of this family that are found in Southern-Rajasthan

and are generally infected with amphistome cercariae, pigmentata and diplocotylea groups of Sewell, 1922. They were found from September to late June. The maximum incidence of infection of 47.5% was recorded in these snails in the months of January and February. Other kind of cercariae like xiphidio, furcocercous and echinostome were also shed by these two species of snails.

*I. exustus* was also found to infect with metacercariae of Opisthorchiid in the months of July and August, but incidence of infection was only 3%.

**Double infection :** Usually a single snail is infected with one type of larval parasite but in some cases a snail may also shed two types of larvae. Such cases of double infections have been recorded from the snails *V. bengalensis*, *L. auricularia*, *L. acuminata*, *M. tuberculata* and *I. exustus*.

**The pattern of double infection :** One species of xiphidiocercariae either occurred with other xiphidio species or with furcocercous, exhinostome, monostome, gymnocephalous cercariae. Similarly in another combination, one monostome species occurred with another species of monostome cercariae (Table II).

The infection of cercariae and metacercariae have also been recorded from the snails like *V. bengalensis*, *L. auricularia* and *M. tuberculata*.

The incidence of double infection with two types of cercariae or with one type of carcaria and metacercaria have been shown in Fig. 3.

## DISCUSSION

On the basis of present survey it was found that the larval digenean infection in surface dwelling snails in the lentic habitats, specially in the ponds, is higher than those of the bottom dwellers in the same habitat. Bottom dwellers of the lentic habitat show a greater cercarial infection as compared to their counter parts in the lotic habitat.

Since the chances of contact of free swimming miracidia to surface dwelling snails species such as, *L. acuminata*, *L. luteola*, *L. auricularia*, *L. pinguis*, *I. exustus* and *G. convexiusculus* were higher, therefore, the above lentic species were found to be infected maximally compared to bottom dwelling species such as snails of the families Hydrobidae, Viviparidae and Melaniidae as they had little chances of contact with various species of miracidia. Running water (Lotic habitat) diminishes the chance of contact of miracidia to snails and consequently minimise the incidence of larval infections. Similar observations have also been made for cercarial infection in the snails of lotic waters (Radke *et al.*,

1961 ; Babikar *et al.*, 1984). These authors concluded that the infectivity was inversely proportional to water velocity. Further, Deforest (1957) also noted that seepage ponds and lakes (lentic habitats) had the highest percentage of infection and irrigation canals the lowest. Besides the habits and habitats, other factor such as population density of miracidia and snails also appear to govern the intensity of infection as well as cercarial incidence.

Contrary to the high incidence of infection with monostome and furcocercous cercariae in large water bodies (lakes) Xiphidiocercariae had their highest infection in the snails of small water bodies (ponds and pools) whereas amphistome, echinostome and gymnocephalous cercariae had almost equal incidence of infection in the snails of lakes as well as ponds and pools surveyed. This difference in the incidence of various larval infection in lakes and ponds may be explained on the basis of (i) the final host inhabiting and frequently visiting these water bodies, (ii) the density of miracidia, (iii) physico-chemical conditions of water, (iv) the density of snail population and (v) water agitation.

While studying seasonal variations of larval infections among various fresh water snails, Mukherjee (1966) found two peaks of cercarial infection in *I. exustus* infected with *C. indicae* XXVI. He observed first peak in the months of August and September and second in December. Mukherjee also recorded three peaks of infection with cercariae of *Gigantocotyle explanatum* and *Ceylonocotyle scoliocoelium* in *Gyraulus convexiusculus*. Mohandas (1974) and Pandey and Agrawal (1978) on the other hand have observed only two peaks of cercarial infections in a year. Mohandas (1974) found first peak in summer and second in the rainy or early winter seasons whereas Pandey and Agrawal (1978) reported first peak in August and second in May. Further, Sewell (1922) has also found two peaks of infection in Indian snails. Three peaks of cercarial infection were never observed in the present survey. Two cercariae, xiphidio and monostome were found maximum in the months of October (early winter) and in May (summer) in a year and this finding corroborates the observations of Mohandas (1974) and Pandey and Agrawal (1978) but differs from that of Mukherjee (1966).

Although like previous survey (Choubisa and Sharma, 1983) present survey has also exhibited a single peak of cercarial infection but for different cercariae and for different months viz. for furcocercous revealed the peak in the December ; amphistome and gymnocephalous cercariae in January and echinostome in February. Looking to the variability in

the cercarial infection from place to place and year to year, it is proposed that the peaks of cercarial infection with a particular snail species are not stable but vary due to change in the physicochemical factors of a particular niche.

It is interesting to note that the monostome cercariae exhibit strong host specificity as they were collected all these years only from *M. tuberculata*. No other species has shown such a stern host specificity. Further, out of 13 cases of double infection, 4 cases revealed the combination of cercariae with metacercariae (Table II). Emergence of two types of cercariae from a single snail host referred to as a case of double infection (Faust, 1917 ; Sewell, 1922 ; Porter, 1938 ; Mukherjee, 1966 ; Jain, 1977 ; Pandey and Agrawal, 1978). Sewell (1922) and Mukherjee (1966) did not consider the combinations of cercariae with metacercariae as double infection. The present authors, however, considered such infections as a cases of double infection.

#### SUMMARY

More than 15,000 gastropods and 3,500 bivalves were examined for cercarial infection. Habitat and dwelling behavior of molluscs determined their propensity for larval infection. In lentic water, the infection was maximum in the surface dwellers and minimum in the bottom dwellers. In lotic water, bottom-dwelling molluscs the cercarial infection was nominal. Double infection of various hosts is noteworthy.

#### ACKNOWLEDGEMENT

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TACHINID COLLECTIONS FROM SIKKIM AND  
DARJEELING DIST. (WEST BENGAL)

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INTRODUCTION

Tachinids are one of the important groups of Diptera because of its importance as biological control. They do parasitise other groups of insects most of which are injurious or pests. So far no consolidated work on the Tachinids of this region was done. So this work was undertaken to find out the existence of Tachinid species in this region. Specimens were collected by various survey parties of Z. S. I. previously and also by the author (1980). Though the material were not very exhaustive yet it reflects the pattern of species existing in this region. Their state wise distribution in India has also been given here.

SYSTEMATIC ACCOUNT

Family TACHINIDAE

Subfamily PHASIINAE

Genus *Hermya* Robineau-De svoidy

*Hermya beelzebul* (Wiedemann)

1830. *Tachina beelzebul* Wiedemann, *Ausereuropäische Zweiflügelige Insekten*, 2. 301.

1976. *Hermya beelzebul* (Wiedemann); Crosskey, *Bull. Br. Mus. nat. Hist. (Ent.)* Suppl. 26, 171.

*Material* : 1 ♀, Kurseong, Darjeeling dist., 4.viii.08, N. A., 1 ♂, Sukna, Darjeeling dist., 2.vii.08 N. A.

*Remark* : This species is a new record for the area. Previously reported from Assam, Himachal Pradesh, Madras.

Subfamily PROSENINAE

Genus *Dexia* Meigen

*Dexia extendens* Walker

1856. *Dexia extendens* Walker, *J. Proc. Linn. Soc. Lond.* 1 (1857) : 126.

1976. *Dexia extendens* Walker : Crosskey, *Bull. Br. Mus. nat. Hist. (Ent.)* Suppl. 26 ; 178.

**Material :** 1 ♀ & 1 ♂, Pashok, Darjeeling dist., 26.v.-14. vi.16, F. H. Gravely.

**Remark :** This species is a new record for the area. Previously reported from Assam.

### **Dexia flavida (Townsend)**

1925. *Phasiodexia flavida* Townsend, *Ent. Mitt.* 14. 251.

1976. *Dexia flavida* (Townsend) : Crosskey, *Bull. Br. Mus. nat. Hist. (Ent.) Suppl.* 26 : 178.

**Material :** 1 ♀, Darjeeling, 12.vi.14, F. H. Gravely.

**Remark :** This species is a new record for India.

### **Genus Prosenia Le Peletier & Serville**

#### **Prosenia siberita (Fabricius)**

1775. *Stomoxys siberita* Fabricius, *Systema entomologiae*, 798.

1976. *Prosenia siberita* (Fabricius) : Crosskey, *Bull. Br. Mus. nat. Hist. (Ent.) Suppl.* 26 : 181.

**Material :** 1 ♀, Siliguri, 3-4.vi.11, N. A. & S. K. 1 ♂ & 3 ♀, Kalimpong, 24.ix.80, B. C. Das.

**Distribution :** Assam, Andhra Pradesh, Madras, West Bengal.

### **Subfamily TACHININAE**

### **Genus Thelaira Robineau-Desvoidy**

#### **Thelaira macropus (Wiedemann)**

1830. *Dexia macropus* Wiedemann, *Aussereuropaische Zweifflugelige Insekten*, 2 : 375.

1976. *Thelaira macropus* (Wiedemann) : Crosskey, *Bull. Br. Mus. nat. Hist. (Ent.)* 26 : 192.

**Material :** 1 ♂, Lava, 11.ix.78, A.N.T. Joseph ; 1 ♀, Darjeeling, 25.ix.78, A. N. T. Joseph ; 1 ♀, Darjeeling, 27.ix.80, B. C. Das ; 1 ♀, Lebong, Darjeeling dist., 25.ix.78, A. N. T. Joseph.

**Distribution :** Assam, Himachal Pradesh, Kashmir, West Bengal.

### **Genus Atylostoma Brauer and Bergenstamm**

#### **Atylostoma tricolor (Mik)**

1883. *Leskia tricolor* Mik, *Verh. Zool. Bot. Ges. Wien.* 33 : 181-192.

1968. *Atylostoma tricolor* (Mik) : Mesnil & Pschora-Walcher, *Musi*, 41 (12) : 164.

**Material :** 1 ♀, Sikkim, ? , A. V. Knyvett.

**Remark :** This species is a new record for India.

Genus **Dolichocoxys** Townsend

**Dolichocoxys femoralis** Townsend

1929. *Dolichocoxys femoralis* Townsend, *Supplta ent.* 16 : 57.

1976. *Dolichocoxys femoralis* Townsend : Crosskey, *Bull. Br. Mus. nat. Hist. (Ent.) Suppl.* 26 : 195.

**Material** : 1 ♂, Darjeeling, 29.v.10, Brunetti ; 1 ♂, Darjeeling, 1.v.17, Brunetti ; 1 ♂, Darjeeling, 2.vi.17, Brunetti ; 1 ♂, Darjeeling, 6.vi.17, Brunetti.

**Remark** : This species is a new record for India.

Genus **Janthinomyia** Brauer and Bergenstamm

**Janthinomyia felderi** B & B

1893. *Janthinomyia felderi* Brayer & Bergenstamm, *Denkschr. Akad. Wiss., Wien.* 60.

1976. *Janthinomyia felderi* B & B ; Crosskey, *Bull. Br. Mus. nat. Hist. (Ent.) Suppl.* 26. 203.

**Material** : 1 ♂, Kurseong, Darjeeling dist., 10-26.ix.09, Lynch.

**Distribution** : Uttar Pradesh, West Bengal.

Genus **Servillia** Robineau-Desvoidy

**Servillia ursinoides** Tothill

1918. *Servillia ursinoides* Tothill, *Bull. ent. Res.* 9 : 50.

1976. *Servillia ursinoides* Tothill : Crosskey, *Bull. Br. Mus. nat. Hist. (Ent.) Suppl.* 26 : 209.

**Material** : 1 ♀, Ghoom, Darjeeling dist., 27.ix.78, A. N. T. Joseph ; 1 ♂, Sureil, Darjeeling Dist., 11-31.x.17, N. A. & F. G. ; 1 ♂, Senchal, Darjeeling dist., 26. vi. 18, S. Kemp.

**Distribution** : Assam, Uttar Pradesh, West Bengal.

Subfamily GONINAE

Genus **Eophyllophila** Townsend

**Eophyllophila elegans** Townsend

1926. *Eophyllophila elegans* Townsend, *Supplla ent.* 14 : 19.

1976. *Eophyllophila elegans* Townsend : Crosskey, *Bull. Br. Mus. nat. Hist. (Ent.) Suppl.* 26 : 215.

**Material** : 1 ♂, Darjeeling, 29.ix.08, Brunetti.

**Remark** : This species is a new record for India.

Genus *Meigenia* Robineau-Desvoidy*Meigenia velutina* Mesnil

1952. *Meigenia velutina* Mesnil, *Bull. Anns. Soc. ent. Belg.* 88 : 156.

1976. *Meigenia velutina* Mesnil: Crosskey, *Bull. Br. Mus. nat. Hist. (Ent.) Suppl.* 26 : 217.

*Material* : 1 ♂, Darjeeling, 28. v. 10, Brunetti.

*Remark* : This species is a new record for India.

Genus *Exorista* Meigen*Exorista japonica* (Townsend)

1909. *Tachina japonica* Townsend, *Ann. ent. Soc. Am.* 2. 247.

1976. *Exorista japonica* (Townsend): Crosskey, *Bull. Br. Mus. nat. Hist. Suppl.* 26. 223.

*Material* : 1 ♂, Rangiroom, 30.ix.76, A.N.T. Joseph ; 1 ♀, Topkhana, Kalimpong, 21.ix.80, B. C. Das.

*Distribution* : Mysore, West Bengal.

Genus *Blepharipa* Rondani*Blepharipa zebina* (Walker)

1849. *Tachina zebina* Walker, List. of specimens of dipterous insects in the collection of the British Museum. 4 : 772.

1976. *Blepharipa zebina* (Walker) ; : Crosskey, *Bull. Br. Mus. nat. Hist. (Ent.) Suppl.* 22 : 236.

*Material* : 2 ♀, Deonali, Sikkim, 23.ix.76, A. N. T. Joseph ; 1 ♂, Sukna, Darjeeling dist. 2.viii.08, N. A. ; 1 ♂, Sureil, 11-31.x.17, N. A. & F. G. ; 1 ♀, Tista Bazar, 23.ix.80, B. C. Das.

*Remark* : This species is a new record for this area. Previously recorded from Assam, Bihar, Kerala, Madras, Uttar Pradesh.

Genus *Isosturmia* Townsend*Isosturmia picta* (Baranov)

1932. *Sturmia picta* Baranov, *Neue Beitr. Syst. Insektenk* : 5. 77.

1968. *Isosturmia picta* (Baranov) : Mesnil & Pschorn-Walcher, *Musi*, 41 (12) : 153.

*Material* : 1 ♂, Kalimpong, Darjeeling Dist., 20.ix.80, B. C. Das.

*Remark* : This species is a new record for India.

Genus *Phryxe* Robineau-Desvoidy*Phryxe heraclei* (Meig.)

1824. *Phryxe heraclei* Meig. *Syst. Besch.* iv. 339.

1953. *Phryxe heraclei* Meig. Mesnil, *Fliegen palaearkt. Reg.* 64 g. 402.

**Material :** 1 ♂, Ghoom, Darjeeling dist., 27.ix.78, A. N. T. Joseph.

**Remark :** This species is a new record for India.

## SUMMARY

In the present collections subfamily Tachininae and Goniinae are well represented in almost equal proportions and only proseninae are represented slightly less in number. The total number of Tachinid species till now reported from this area stands at 36. From the present study it is revealed that 7 species are new record for India and 3 species are new record for the region. As this group is very important for biological control the findings of this species will enable us to know the natural complex of this group in relation to host species of different insect groups of this region in future.

## ACKNOWLEDGEMENTS

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A NEW SPECIES OF *LIOMYRMEX* MAYR FROM  
ANDAMAN ISLANDS  
(HYMENOPTERA : FORMICIDAE)

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(With 1 Figure)

INTRODUCTION

The genus *Liomyrmex*, described by Mayr (1865), for the reception of *Myrmica coeca* F. Smith, which was collected by Alfred Russell Wallace at Dory, New Guinea, belongs to subfamily Myrmicinae of the family Formicidae. F. Smith (1860) being unable to study the characters of palpi, placed *coeca* tentatively under *Myrmica*. Altogether eight species, mostly small sized about 2.7 to 4 mm long, have been reported under this genus, namely, *L. coecus* (Smith), *L. gestroi* (Emery), *L. aurianus* Emery, *L. carinatus* Stitz, *L. tagalanus* Menozzi, *L. froggatti* Donisthorpe, *L. major* Donisthorpe and *L. reneae* Donisthorpe. This genus is hitherto Indo-Malayan in distribution and has been reported from New Guinea, Burma, Malacca and Philippine Islands. The present record of this genus from Andaman Islands in Indian Ocean, is, therefore, the first from the Indian region.

Genus *Liomyrmex* Mayr, 1865

*Liomyrmex*, Mayr, 1865, *Reise Novara zool.* 2 (1 A) Formicidae : 23. Type-species : *Myrmica coeca* Smith Original designation.

*Laparomyrmex gestroi* Emery, 1887. *Ann. Mus. Civ. Genova* 25 : 461. Type-species *Laparomyrmex gestroi* Emery.

*Promyrma* Forel, 1912, *Rev. Suisse Zool.* 20 : 764. Type-species : *Promyrma buttelli* Emery = *Liomyrmex aurianus* Emery, 1889.

This is a distinct genus mainly characterized by 10 or 11-segmented antenna, with a well defined 3-segmented club ; eyes always absent in worker, but well developed in female ; head subquadrate, body dorso-ventrally compressed ; petiolar nodes massive and strongly transverse ; petiolar node with a short peduncle and a large keel-shaped subpetiolar process ; subpostpetiolar process heavy and lobate ; propodeal spiracle vestibular and body yellowish-red, brown to dark brown in colour.

*Worker* : Head subquadrate. Antennae 10 or 11-segmented, with well developed 3-segmented club. Eyes absent in worker, developed in

female. Palpal formula 2, 2 ; dental formula 1+3, canthus sharply inflexed before it meets the basal margin of the blade ; mandalus short and broad, lying close to ginglymus. Clypeus sharply elevated medially above the lateral areas, median area flat, lateral areas abbreviated, anterior tentorial pits close to antennal sockets.

Alitrunk dorso-ventrally compressed ; pro-mesonotal suture distinct only on the pleura to the height of spiracle ; metanotal groove distinct. Pronotum anteriorly wide, evenly narrowing towards metanotal groove. Propodeum smoothly rounded. Metasternum bearing a distinct but simple process to receive the subpetiolar process. Metanotum unarmed. Petiolar node subquadrate, much broader than long in dorsal view, its subpetiolar process large, keel-shaped, lamellate. Postpetiolar node rounded, strongly transverse, subreniform when viewed from above ; anterior subpostpetiolar process large, lobate, pendant in side view, posterior subpostpetiolar process reduced, exposing the anterior articulation of the first segment of gaster, which stimulates the posterior process in side view. Gaster broad in front, pointed towards the tip. Legs thick and short.

***Liomyrmex taylori*, sp. nov.**

(Fig. 1, a-c)

This species is allied to *Liomyrmex reneae* Donisthorpe by having subquadrate head, mandibles with 4 teeth ; maxillary and labial palpi two jointed ; alitrunk longer than broad ; pro-mesonotal suture obsolete, but it differs in following characters : Posterior border of clypeus evenly arched ; anterior border of petiolar node slightly excised, posterior border almost straight, postpetiolar node with posterior border slightly excised ; scape not extending up to the middle of the head ; first joint of the funiculus broad and as long as three following segments, and by the complete absence of punctures on the body.

*Holotype Worker* : Body length 3.7 mm. H L (head length) .84 mm ; HW (head width) .82 mm ; SL (scape length) .35 mm ; CI (cephalic index) 97 ; SI (scape index) 42 ; PW (pronotum width) .4 mm ; PNL (petiolar node length) .2 mm ; PPNL (postpetiolar node length) .2 mm ; PH (petiolar height) .35 mm ; PPH (postpetiolar height) .28 mm ; DPW (dorsal petiolar width) .31 mm ; DPPW (dorsal postpetiolar width) .35 mm ; PNI (petiolar node index) 77 ; PPNI (postpetiolar node index) 87 ; LPI (lateral petiolar index) 57 ; LPPI (lateral postpetiolar index) 71.

Body reddish-yellow, mandible dark red ; smooth and shiny. Pubescence very fine and sparse, a few long scattered yellowish hairs present on the anterior margin of clypeus, mandible, pronotum, petiolar nodes and at the apex of the gaster.

Head subquadrate, slightly narrower in front than behind, posterior angles rounded, posterior border almost straight. Mandibles strong, triangular, masticatory border armed with four teeth, first and second teeth long, stout and blunt, equal in size, very dark at its margin, the following two short and almost equal in size. Maxillary and labial palpi two segmented. Clypeus convex, anterior border almost straight, posterior border evenly arched, extending between the frontal lobes.

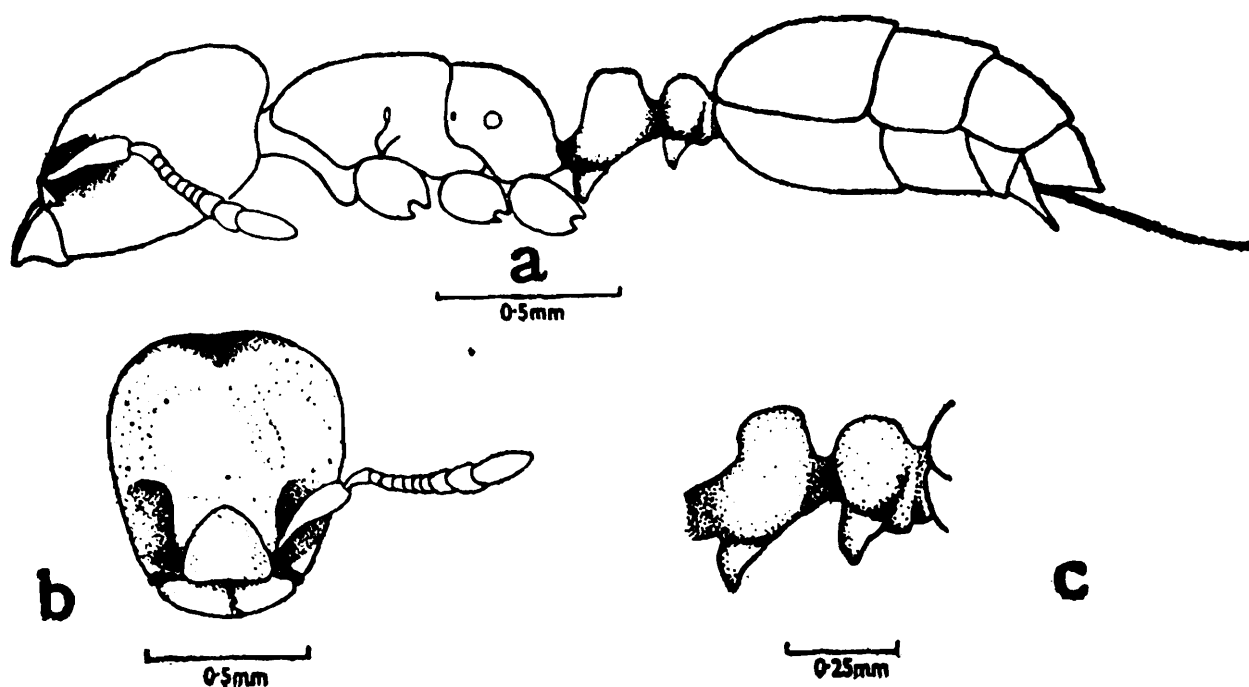


Fig. 1. (a-c). *Liomyrmex taylori* sp. nov.: (a) body, side view; (b) head, front view; (c) petiolar nodes, enlarged view.

Frontal lobes short with sharp edges, partly covering the base of the antennae; antennal foveae round, rather deep. Eyes absent. Antennae 11-segmented, scape flat at its distal end, not extending to the mid-length of the head when laid back. First segment of the funiculus broad and as long as the following three segments taken together, club three-segmented, considerably broader than the preceding segments, the last segment slightly longer than the preceding two segments taken together. Alitrunk longer than broad, slightly convex and constricted posteriorly at mesonotal-propodeal junction. Promesonotal suture obsolete, metanotal groove well defined; propodeum at the same level as promesonotum, its sides rounded and the angle between dorsal surface and declivity very gradual. Petiolar node with a short peduncle, flat above, transverse, anterior border slightly concave, posterior border almost straight, armed ventrally with a rather large translucent forwardly directed tooth. Postpetiolar node slightly convex above, broader than the node of the petiole, anterior border excised in the form of a groove, posterior border straight, comparatively larger than the petiolar lobe,

armed beneath with a short and blunt tooth. Gaster oval ; pygidium pointed ; sting well developed ; hypopygium pointed. Legs rather short ; femora incrassate, compressed at sides.

*Holotype Worker* : INDIA : S. ANDAMAN ISLANDS : Port Blair, South Point, 17.xii.1975, Coll. P. K. Maity & Party (Z. S. I.).

*Paratypes Workers* : Two examples, same data as for holotype (Z. S. I.).

### SUMMARY

This paper deals with the description of a new species of ants, viz., *Liomyrmex taylori*, sp. nov. from Andaman Islands in Indian Ocean. This is the first record of the genus from Indian region.

### ACKNOWLEDGEMENTS

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A NEW SPECIES OF OTOCEPHEIDAE (ACARI : ORIBATEI)  
FROM DARJEELING, INDIA

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(With 2 Figures)

INTRODUCTION

A new species of the genus *Dolicheremaeus* Jacot (Acari : Oribatei : Otocepheidae), viz., *D. geminus* is described from forest and tea soils in the district of Darjeeling, West Bengal, India.

The genus *Dolicheremaeus* was established by Jacot (1938) with *D. rubripedes* as the type-species from Florida, U. S. A. Balogh (1965, 1972) and Aoki (1967) considered the genus *Tetracondyla* Newell, 1956 as a junior synonym of the genus *Dolicheremaeus*. Balogh (1972) also considered the genus *Dicondyla* Aoki, 1965 as a synonym of the genus *Dolicheremaeus*. 78 species and 4 subspecies have so far been described under the genus. All measurements are in microns.

***Dolicheremaeus geminus* sp. nov.**

(Figs. 1-2)

*Female* : Colour brown to light brown ; length of the body : 877-981 ; width of the body : 445-499.

Prodorsum nearly as long as broad, laterally with irregular incomplete foveoles and medially with punctations ; lateral lamelliform expansion (*spa. l*) well developed ; lamellae slightly converging anteriorad ; tutorium weakly developed ; rostral setae uniseriate, procumbent, with pointed tips, inserted at the anterior end of *spa. l*, laterally on rostrum, 95-104 long, nearly as long as their mutual distance ; lamellar setae uniseriate, procumbent, with pointed tips, inserted inner to the rostral setae nearly the same level, 117-131 long, one and half times as long as their mutual distance ; interlamellar setae distinctly seriate with blunt tips, inserted below a thin, small, chitinous ridge, 117-131 long, nearly two and half times as long as their mutual distance ; bothridium cup-shaped, directed antero-laterad, ventral bothridial plate (*tbv*) triangular and well developed ; sensillus with thin, long stalk, uniformly thick throughout and spoon-shaped head, with an inner core, 140-153 long, directed postero-laterad ; exobothridial setae 1 pair, minute,

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19-21 long, intimate to the bothridial plate ; median prodorsal condyles (*co. pm*) absent ; lateral prodorsal condyles (*co. pl*) well developed, touching the anterior rim of lateral notogastral condyles (*co. nl*) ; a longitudinal row of scales present in the interpseudostigmatic region.

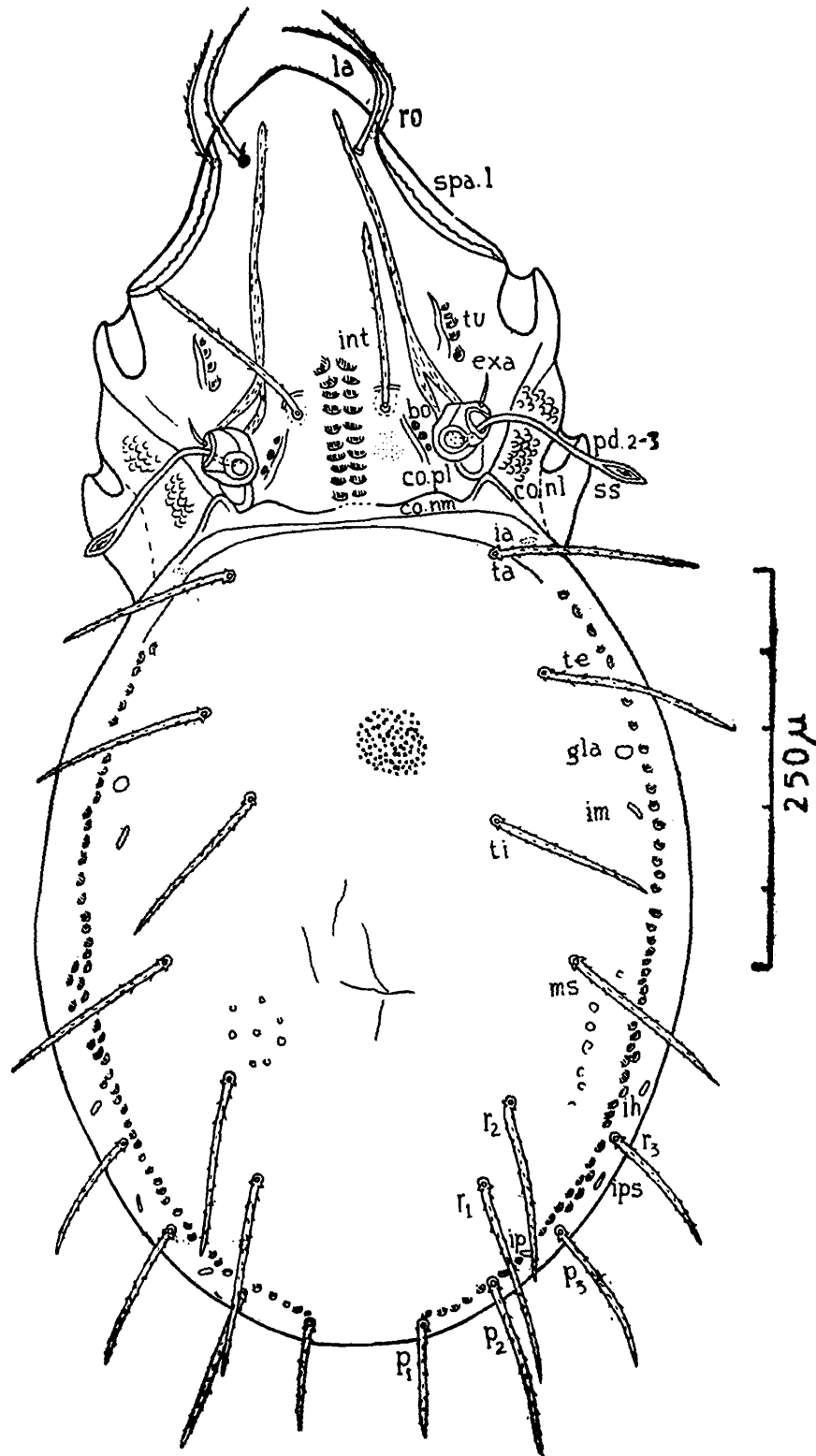


Fig. 1. *Dolicheremaeus geminus* sp. nov. (Dorsal view), *ro*=rostral seta, *la*=lamellar seta, *int*=interlamellar seta, *exa*=anterior exobothridial seta, *ss*=sensillus, *bo*=bothridium, *spa. l*=lateral lamelliform expansion, *tu*=tutorium, *pd. 2-3*=pedotecta-complex II-III, *co. pl*=lateral prodorsal condyle, *co. nl*=lateral notogastral condyle, *co. nm*=median notogastral condyle, *ta*, *te*, *ti*, *ms*, *r<sub>1</sub>*, *r<sub>2</sub>*, *r<sub>3</sub>*, *p<sub>1</sub>*, *p<sub>2</sub>*, *p<sub>3</sub>*=notogastral setae, *ia*, *im*, *ih*, *ips*, *ip*=dorsal lyrifissures, *gla*=orifice of latero-abdominal gland.

Notogaster oval, finely punctate throughout, with crack-like lines and scattered irregular foveoles posteriorly and a porous area peripherally; median notogastral condyles (*co. nm*) well developed, broadly rounded, being widely separated from each other but closely adjacent to the lateral notogastral condyles (*co. nl*) —hence the specific name;

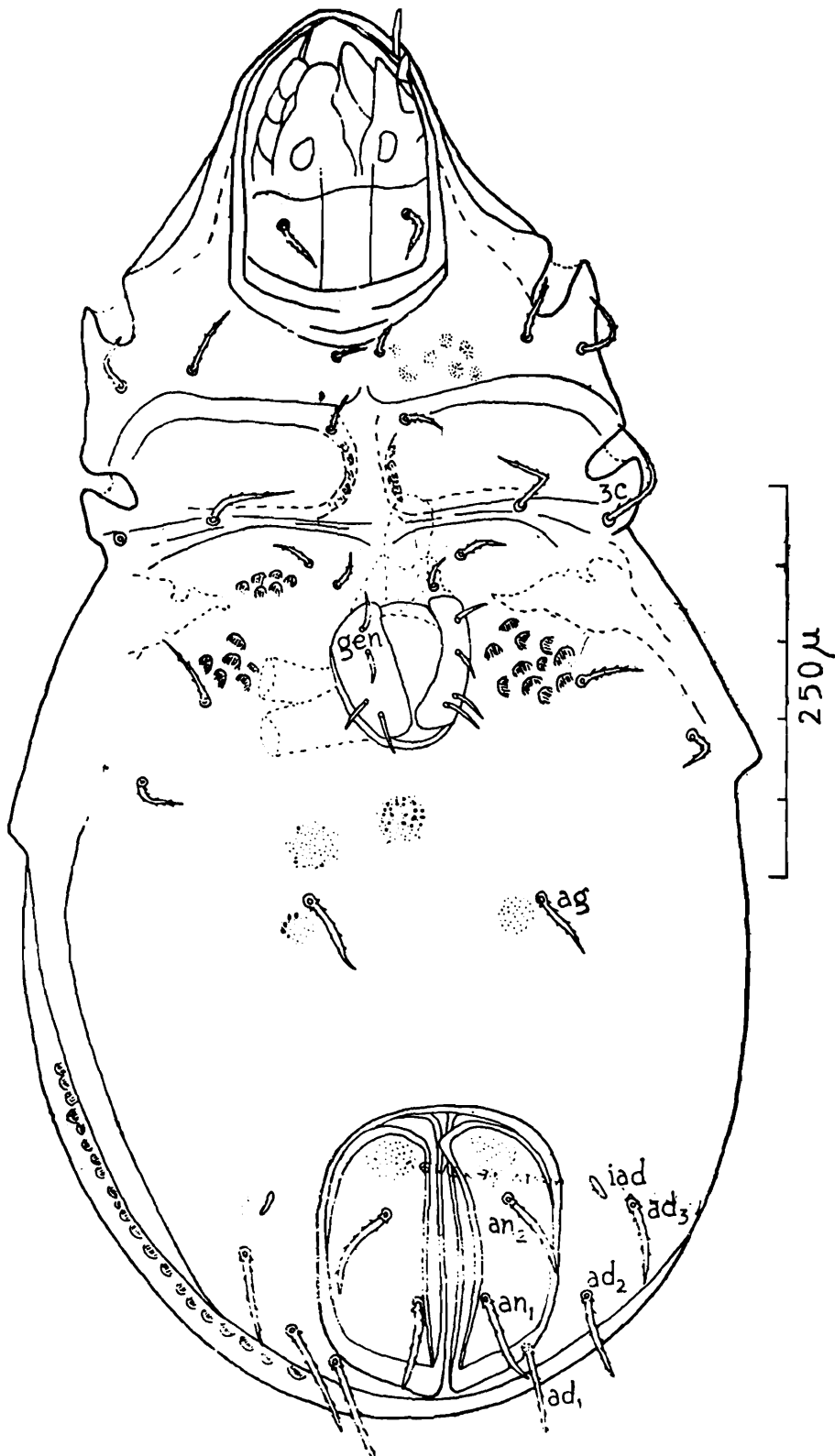


Fig. 2. *Dolicheremaeus geminus* sp. nov. (Ventral view), *an*<sub>1</sub>, *an*<sub>2</sub>=anal setae, *ad*<sub>1</sub>, *ad*<sub>2</sub>, *ad*<sub>3</sub>=adanal setae, *iad*=adanal fissure, *gen*=genital plate, *ag*=aggenital seta, *3c*=epimeral seta, *c. st*=sternal ridge.

lateral notogastral condyles (*co. nl*) tooth-like, well projected anteriorad; notogastral setae ten pairs, barbed, with blunt tips and distinct setal base, 77-140 long, ranging from 13.8-25.2 *RLN*; setae *ta* antero-lateral, *te*, *ms* dorso-lateral, *ti* mid-dorsal,  $r_1, r_2$  postero-dorsal,  $p_1, p_2, p_3$  and  $r_3$  postero-marginal; distance *ta*—*te* greater than distance *te*—*ti* and nearly half the distance *te*—*ms*; distance  $ti - ti < ta - ta < te - te < ms - ms$ ; distance  $r_1 - r_1 < r_2 - r_2$ ; distance  $p_1 - p_2 < p_2 - p_3 < p_3 - r_3$ ; notogastral fissures 5 pairs, *ia* located antero-lateral to the follicle of *ta* (indistinct in dorsal view), *im* aligned obliquely between *te* and *ms* laterally, *ih* above the insertion of  $r_3$ , *ips* between  $p_3$  and  $r_3$  more closer to  $p_3$ , *ip* between  $p_2$  and  $p_3$  nearer to  $p_2$ ; *gla* rounded, placed quite anterior to *im*, separated by a distance which is about one and half times the length of the latter.

Ventral plate punctate; each anal plate punctate, more than twice as long as broad, with two finely barbed, nearly equal setae, 54-72 long; *an*<sub>1</sub> inserted close to the inner and posterior and *an*<sub>2</sub> median and anterior part of the anal plate, separated by a distance nearly equal to the length of the former; adanal setae three pairs, faintly barbed, 54-90 long, *ad*<sub>1</sub>, *ad*<sub>2</sub> nearly equal and *ad*<sub>3</sub> shorter than either of the two, *ad*<sub>1</sub>, *ad*<sub>2</sub> postero-lateral and *ad*<sub>3</sub> medio-lateral to the anal field, distance  $ad_3 - ad_3 > ad_2 - ad_2$ ; *iad* oblique to the lateral border of anal field above *ad*<sub>3</sub>, separated by a distance from the follicle of *ad*<sub>3</sub> which is equal or slightly greater than its length; each genital plate more than twice as long as its maximum width, with 4 simple setae, 18-27 long, the posterior two setae inclined outwards and anterior two setae inclined inwards on the genital plate; aggenital setae one pair, barbed, with pointed tips, 45-68 long, their mutual distance nearly twice the maximum width of the genital plates.

Epimeral region with scaly microsculptures; epimera I and II distinctly separated, III and IV fused, sternal ridge of epimera II distinct; epimeral setae finely barbed, 20-90 long, setae *3c* longest; epimeral setal formula 3-1-3-3.

Legs monodactylous, claws curved; all legs with ultimate setae of flagelliform type (L-L-L-L).

*Holotype*: Adult ♀, INDIA: W. Bengal: Darjeeling, Darjeeling forest Div., Tonglu forest range, Palmajua forest bungalow area (from decomposed leaves of *Cryptomeria japonica*), 2300 m., 16. viii. 1977 (B. K. Mondal Coll.); paratypes: 2 adult ♀♀, data same as for holotype; paratypes: 2 adult ♀♀, INDIA: W. Bengal: Darjeeling, Pashok Tea Estate (from rotten leaves of *Thea sinensis*), 1200 m., 22. x. 1977 (B. K. Mondal Coll.); paratypes: 2 adult ♀♀, INDIA: W. Bengal:

Darjeeling, Darjeeling forest Div., Teesta Valley forest range, Pashok forest block (from soil under a plant, *Acacia catechu*), 700 m., 22. x. 1977 (B. K. Mondal Coll.) ; paratypes : 2 adult ♀ ♀, INDIA : W. Bengal : Darjeeling, Teesta Valley Tea Estate (from humus), 900 m., 23. x. 1977 (B. K. Mondal Coll.) ; deposited in the laboratory of the Department of Zoology, Presidency College, Calcutta.

This species approaches close to *Dolicheremaeus baloghi* Aoki, 1967 described from South Japan in the absence of median prodorsal condyles (*co. pm*), presence of spoon-shaped sensillus, turtorium, nature of *spa. l*, structure and position of rostral and lamellar setae, position of median notogastral condyles (*co. nm*), structure and position of lateral notogastral condyles (*co. nl*) and number of notogastral setae besides other characters. It however, deviates from the Japanese species in having slightly convergent lamellae, longer interlamellar setae, unlobed lateral prodorsal condyles (*co. pl*), broader median notogastral condyles (*co. nm*), notogastral setae with blunt tips, setae *te* much closer to *ta* than to *ms*, *gla* situated anterior to *im*, *ad<sub>3</sub>* much below the level of anterior margin of anal plates and in lacking an oblique chitinous ridge on the anal plate near the insertion of *an<sub>1</sub>*, which justifies its introduction as a new species.

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#### SUMMARY

This paper deals with the description of one new species of the genus *Dolicheremaeus* Jacot (Acari : Oribatei : Otocepheidae), viz., *D. geminus* from the soils of forests and tea estates in the district of Darjeeling, West Bengal, India.

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ON A COLLECTION OF MEMBRACIDS (HOMOPTERA :  
MEMBRACIDAE) FROM CALCUTTA AND  
ITS ENVIRONS

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INTRODUCTION

The membracidae constitutes one of the most distinct families in the Homoptera. These insects are chiefly distinguished by the great development of the pronotum, particularly its pronotal processes. The group may be diagnosed by its primary characters *viz.*, Ocelli placed between the eyes ; antennae inserted in front of head and between eyes ; pronotum prolonged backward into a hood or process of variable form.

The membracids, commonly known as tree hoppers, are homopteran insects which suck the plant sap from the shrubs and trees with the help of their piercing and sucking type of rostrum. They are also found in open fields on various weeds, grasses and similar perennial plants upon which they feed. The group is also economically important.

The eggs are laid in the slits of epidermis of short shoot in double rows. Nymphs live in the same colony and in the same shoot along with parents. 2-5 generations per year have been observed in India. Ananthasubramanian and Ananthakrishnan (1975) have dealt with the biology of this group.

The Indian Membracidae has received attention through the pioneering contribution of Distant (1908, 1916) and later, through the work of Evans (1948), Menon *et al* (1958), Ananthasubramanian and Ananthakrishnan (1975) and Dutta *et al.* (1978). Besides, valuable contributions were made by Funkhouser (1951), Goding (1903, 1926, 1931, 1934, 1939) from elsewhere.

Literature reveals that a little over 200 species belonging to 45 genera are known so far from the Indian subcontinent, of which, 80 species are recorded from North-east India, and 50 species from West Bengal (22 species from Calcutta).

The present paper provides the first consolidated account of 14 species belonging to 7 genera of membracids of Calcutta. It is based

on the available collections represented in the Zoological Survey of India, Calcutta.

The paper includes the generic description with original reference, synonymy, if any, and the subsequent references, diagnostic morphological features, taxonomic & biological remarks, if any, distributional records under each species and a running key to various taxa for easy identification of the insects.

#### SYSTEMATIC ACCOUNT

Subfamily OXYRHACHINAE Haupt, 1929

Tribe **Oxyrhachini** Distant, 1908

Genus **Oxyrhachis** Germer, 1835

1. *Oxyrhachis tarandus* (Fabricius)

2. *O. rufescens* Walker

Subfamily CENTROTINAE Spinola, 1850

Tribe **Leptocentrini** Distant, 1908.

Genus **Leptocentrus** Stål, 1866

3. *Leptocentrus leucaspis* Walker

4. *Leptocentrus substitutus* Walker

5. *L. taurus* Fabricius

Genus **Otinotus** Buckton, 1903

6. *Otinotus oneratus* (Walker)

7. *O. elongatus* Distant

Tribe **Tricentrini** Ahmed and Yasmeen, 1974

Genus **Tricentrus** Stål, 1866

8. *Tricentrius projectus* Distant

9. *T. subangulatus* Distant

Tribe **Gargarini** Distant, 1908

Genus **Gargara** Amyot & Serville, 1843

10. *Gargara confusa* Distant

11. *G. mixta* (Buckton)

12. *G. robusta* Distant

Tribe **Coccosterphini** Distant, 1908

Genus **Coccosterphus** Stål, 1869

13. *Coccosterphus decoloratus* Distant

14. *C. minutus* Fabricius

*Key to the subfamilies of the family MEMBRACIDAE*

|                                                                                                           |     |                            |
|-----------------------------------------------------------------------------------------------------------|-----|----------------------------|
| Scutellum rudimentary, entirely concealed by the pronotum, propleural and metapleural processes developed | ... | <i>Oxyrhachinae</i> Haupt  |
| Scutellum well developed and more or less uncovered ; propleural and metapleural processes absent         | ... | <i>Centrotinae</i> Spinola |

Tribe **Oxyrhachini** Distant

Head wider than long ; posterior pronotal process long and narrow, broad at base, extending beyond posterior angle of inner margin of tegmina ; wings with 3 or 4 apical cells ; tibiae dilated ; sides of the pro-and mesonotum are armed with a small lobe or tooth.

Genus **Oxyrhachis** Germar

Type-species : *Membracis taranda* Fabricius

1835. *Oxyrhachis* Germar, *Rev. ent. Silb.*, 3 : 232.

1903. *Polocentrus* Buckton, *Mon. Memb.*, : 254.

1905. *Ouranorthus* Buckton, *Trans. Ent. Soc. Lond.*, 9 : 322.

1908. *Oxyrhachis* : Distant, *Fauna Brit. Ind.*, 4 : 7.

1962. *Oxyrhachis* : Capener, *Repub. S. Afr. Dept. Agr. Tech. Ser. ent. Mem.*, 8 : 9.

1975. *Oxyrhachis* : Ananthasubramanian and Ananthakrishnan, *Rec. Zool. Surv. India*, 68 : 168.

1978. *Oxyrhachis* : Dutta, Ghosh and Das, *Eos*, 52 : 118.

Head wider than long ; mouth a little elevated ; eyes large and globate ; ocelli equidistant from each other and located above the centro-ocular line ; pronotum with the lateral angles more or less produced ; posterior process tricarinate, long, narrow, broad at base, with or without a ventral carina or keel on apical half ; wings with 3 or 4 apical cells and tegmina with 5 apical and 3 discoidal cells.

*Remark* : The genus is predominant in Oriental and Ethiopian regions.

*Key to the species of Oxyrhachis*

- |                                                                                                         |     |                           |
|---------------------------------------------------------------------------------------------------------|-----|---------------------------|
| 1. Posterior process extends beyond tips of tegmina ; ocelli equidistant from each other than from eyes | ... | <i>tarandus</i> Fabricius |
| — Posterior process just reaching tips of tegmina ; ocelli nearer to each other than from eyes          | ... | <i>rufescens</i> Walker   |

**1. *Oxyrhachis tarandus* (Fabricius)**

1738. *Membracis taranda* Fabricius, *Ent. Syst. Suppl.*, : 514.  
 1803. *Centrotus tarandus* Fabricius, *Syst. Rhynq* : 19.  
 1835. *Oxyrhachis tarandus* Germar, *Res. ent. Silb.*, **3** : 232.  
 1903. *Polocentrus rufus* Buckton, *Mon. Memb.* : 254.  
 1962. *Oxyrhachis tarandus* Capener, *Repub. S. Afr. Tech. Ser. Ent. Mem.*, **6** : 11.  
 1975. *Oxyrhachis tarandus* : Ananthasubramanian and Ananthakrishnan, *Rec. zool. Surv. India*, **68** : 169.  
 1978. *Oxyrhachis tarandus* : Dutta, Ghosh and Das, *Eos*, **52** : 118.

Head frontally piceous, vertex of head nearly twice as wide as long, sparsely covered with hairs ; ocelli equi-distant from each other and located on centro ocular line ; pronotum with a central longitudinal carination which traverses the length of the posterior process ; Posterior process extending beyond the tips of tegmina, upwardly recurved, beneath laminately ampliate and finely serrate ; tegmina dull hyaline, the veins fuscous ; legs pilose.

*Material examined* : 3 examples INDIA : West Bengal, Calcutta, 11.xii.1965, Coll. ?

*Remark* : This is a very common species abundantly found throughout India including Calcutta where it is recorded in good numbers during September and February. This species is predominant in south India but rather rare in western India. The species can easily be recognised by its large size, dark brown colour and thickly punctate body.

**2. *Oxyrhachis rufescens* Walker**

1851. *Oxyrhachis rufescens* Walker, *List. Hom.*, ii : 506.  
 1851. *Oxyrhachis rudis* Walker, *List. Hom.*, ii : 509.  
 1908. *Oxyrhachis rufescens* : Distant, *Fauna Brit. India*, **6** : 146.  
 1975. *Oxyrhachis rufescens* : Ananthasubramanian and Ananthakrishnan, *Rec. zool. Surv. India*, **68** : 171.

Head twice as broad as long ; vertex sinuate, punctate with short silvery hairs ; apical areas of posterior process slightly elevated ; ocelli convex, closer than from eyes and located above centro-ocular line ;

Pronotum thickly punctate ; anterior carina dark reddish brown ; directed outwards, then backwards ; lateral carina nearly straight ; dorso posterior carina curved forward and outwards joining anterior carina in narrow curve ; posterior process moderately laminately gibbous at base, apically upturned, just reaching tegminal apex ; legs testaceous ; abdomen dark reddish brown above, greyish tomentose below.

*Material examined* : 1 example. INDIA : West Bengal, Calcutta, 29.i.1907, Coll. ?

*Remark* : The species is also widely distributed throughout India. In Calcutta it is recorded in the month of May.

*Key to the tribes of the subfamily CENTROTINAE*

|       |                                                                                                                        |     |                |
|-------|------------------------------------------------------------------------------------------------------------------------|-----|----------------|
| 1 (2) | Hind wings with 4 apical cells                                                                                         | ... | Leptocentrini  |
| 2 (1) | Hind wings with 3 apical cells                                                                                         | ... | ... 3          |
| 3 (4) | Scutellum normal or exposed, hind trochanters armed with spines.                                                       | ... | Tricentrini    |
| 4 (3) | Scutellum partly concealed, hind trochanters unarmed.                                                                  | ... | ... 5          |
| 5 (6) | The terminal veins are coarsely or finely tuberculate ; scutellum abortive in the middle, pronotum usually tuberculate | ... | Coccosterphini |
| 6 (5) | The terminal veins not tuberculate ; scutellum complete in the middle ; pronotum not tuberculate                       | ... | Gargarini      |

**Tribe Leptocentrini**

Scutellum fully exposed ; hind wings with 4 apical cells ; frontoclypeal lobes prominent,

*Key to the genera of Leptocentrini*

|                                                                                                        |     |                          |
|--------------------------------------------------------------------------------------------------------|-----|--------------------------|
| Posterior process slender, not arcuate, base of posterior process apart from scutellum                 | ... | <i>Otinotus</i> Buckton  |
| Posterior process rather stout, arcuate, base of posterior process very close to scutellum and tegmina | ... | <i>Leptocentrus</i> Stål |

**Genus Leptocentrus Stål**

Type-species : *Centrotus altifrons* Walker

1866. *Leptocentrus* Stål, *Hem. Afr.*, 4 : 87-90.

1903. *Rabduchus* Buckton, *Mon. Memb.*, : 270.

1968. *Leptocentrus* : Capener, *Repub. S. Afr. Dept. Agr. Tech. Ser. Ent. Mem.*, 17 : 33.

Head vertical, upper margin of vertex arcuate and sinuate ; eyes hemispherical ; ocelli closer to eyes ; pronotum with anteriorly produced transverse processes ; posterior process slender, tricarinate, well separated from the scutellum and abdomen ; scutellum triangular about as wide as long, apex emarginate ; tegmina without pterostigma, with five apical cells and two discoidal cells ; hind wing with 4 apical cells ; tibiae simple.

*Remark :* The genus is predominant in oriental and Ethiopian region and abundantly found in South and Eastern India in comparison to Western India.

### *Key to the species of Leptocentrus Stål*

- |       |                                                                                                                            |     |                            |   |
|-------|----------------------------------------------------------------------------------------------------------------------------|-----|----------------------------|---|
| 1 (4) | Suprahumeral robust, strongly curved ; tip of posterior process impinging on inner angles of tegmina                       | ... | ...                        | 2 |
| 2 (3) | Body smaller in size ; posterior process less arched and more obliquely straight                                           | ... | <i>substitutus</i> Distant |   |
| 3 (2) | Body larger in size ; posterior process strongly arched, abruptly elevated from near base, passing beyond 5th apical cell. | ... | <i>taurus</i> Fabricius    |   |
| 4 (1) | Suprahumeral moderately developed, gently curved, tip of posterior process never impinging on inner margin of tegmina      | ... | <i>leucaspis</i> Walker    |   |

### 3. *Leptocentrus leucaspis* Walker

1851. *Centrotus taurus* Walker, *List. Hom.*, ii. : 602.

1858. *Leptocentrus leucaspis* Walker, *List. Hem. Suppl.*, : 158.

1975. *Leptocentrus leucaspis* : Ananthasubramanian and Ananthakrishnan, *Rec. zool. Surv. India*, 68 : 194.

Head about thrice as broad as long ; vertex arcuate and sinuate ; eyes black directed laterad ; suprahumeral moderately developed, gently curved ; ocelli slightly closer to eyes than to each other ; pronotum black, strongly punctate ; posterior process tricarinate, strongly, convexly recurved from near apex, achieving its maximum height above scutellum, then moderately arched, tip acute, touching the posterior end of 5th apical cell ; scutellum black, as broad as long, tip broadly emarginate ; tegmina ochraceous, black on costal margin and apical limbus, hind wing with 4 apical cells ; legs with tarsi yellowish.

*Material examined :* 1 example. INDIA : West Bengal, Calcutta, 15.x.1965, K. Roy Coll.

*Remark :* The species is widely distributed in India including Calcutta. It has been collected from Calcutta as early as 1907.

#### 4. *Leptocentrus substitutus* Walker

1851. *Centrotus substitutus* Walker, *List. Hom.*, II : 605.

1809. *Leptocentrus substitutus* : Distant, *Fauna Brit. India*, 4 : 29-30.

Head about three times wider than long ; basal margin of vertex convex ; ocelli black, nearer to eyes than to each other ; pronotum black ; posterior pronotal process slightly arched at base and more obliquely straight ; posterior process tricarinate above ; lateral transverse processes less prominently recurved and their apices less acute ; scutellum and sternal lateral margins chalky white and silky ; tibiae reddish brown.

*Material examined* : 1 example, INDIA : West Bengal, Calcutta, 18.iii.1907, Coll. ? ; 1 example, Calcutta, 15.x.1965, *K. Rai & Party* Coll. ; 1 example, Calcutta, 11.xi.1966, *M. M. G. & Party* Coll.

*Remark* : This species is abundantly found throughout India.

#### 5. *Leptocentrus taurus* Fabricius

1775. *Leptocentrus taurus* Fabricius, *Syst. Ent*, 675.

1908. *Leptocentrus taurus* : Distant, *Fauna. Brit. India*, 4 : 28-29.

1975. *Leptocentrus taurus* : Ananthasubramanian and Ananthakrishnan, *Rec. zool. Surv. India*, 68 : 198-201.

Head three times wider than long ; basal margin of vertex, lateral margins obliquely sloping downwards, ocelli black, nearer to eyes than to each other ; suprahumeral robust, strongly curved ; pronotum black, thickly punctate ; posterior process strongly tricarinate above, abruptly elevated from near base passing beyond 5th apical cell, apex black ; tegmina pale bronzy, ochraceous, base and apical half of costal margin black, three and a half times longer than wide ; hind wing with 4 apical cells ; scutellum as broad as long, tip narrowly emarginate ; tibiae reddish brown.

*Material examined* : 1 example. INDIA : West Bengal, Calcutta, 3.v.1910, *N. Annandale* Coll., 1 example, Calcutta, 25.ix.1912, Coll. ? 1 example, Calcutta, 15.x.1965, *S. P. Chakraborty* and *K. D. Chatterjee* Coll.

#### Genus *Otinotus* Buckton

Type-species : *Otinotus ammon* Buckton

1903. *Otinotus* Buckton, *Mon. Memb.*, 232, 269.

1927. *Convecton Funkhouser*, *Gen. Cat. Hom. Fasc.*, 1 : 348.

1975. *Otinotus* : Ananthasubramanian and Ananthakrishnan, *Rec. zool. Surv. India*, 68 : 214.

Head wider than long ; ocelli nearly equidistant from each other and from eyes ; pronotum moderately high ; posterior process emerging dorsally, horizontally from behind disc not arcuate, slightly sinuate ; scutellum triangular, wider than long ; tegmina about three times as long as wide with 5 apical and 2 discoidal cells ; hind wings with 4 apical cells ; legs simple.

*Remark* : The genus is predominant in Ethiopian & Oriental region. It is widely distributed in Western and Southern India and also known from some parts of Northern India.

### *Key to the species of Otinotus* Buckton

- |       |                                                                                                                                                                                                                           |                          |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 1 (2) | Lateral pronotal processes as seen from above somewhat slender, apically a little recurved ; tegmina pale testaceous hyaline, ochraceously opaque at base ; body rather subelongate ...                                   | <i>oneratus</i> Walker   |
| 2 (1) | Lateral pronotal processes as seen from above moderately broad, upwardly directed and apically strongly recurved ; tegmina semi hyaline, narrowly dull piceously opaque at base ; body distinctly elongate and compressed | <i>elongatus</i> Distant |

### 6. *Otinotus oneratus* (Walker)

1858. *Centrotus oneratus* Walker, *Ins. Sound. Hom.* : 78.

1908. *Otinotus oneratus* : Distant, *Fauna Brit. India*, 4 : 40.

1975. *Otinotus oneratus* : Ananthasubramanian and Ananthakrishnan, *Rec. zool. Surv. India*, 68 : 214-217.

Head nearly thrice as wide as long across the eyes ; vertex nearly twice as wide as long, ocelli almost equidistant from each other and from eyes, pronotum dark brown, with short hairs ; posterior process slender, gradually narrowing from base to apex, tricarinate weakly sinuate, tegmina thrice as long as wide, scutellum slightly broader than wide, tip emarginate, apices acute ; abdomen dark brown, hind wings with 4 apical cells ; tibiae light brown, tarsi pale white.

*Material examined* : 1 example. INDIA : West Bengal, Calcutta (Dhappa), 22.i.1911, *F. H. Gravely* Coll. ; 1 example, Calcutta Museum Compound, 14.viii.1914, Coll. ?

*Remark* : This is a very common species in India. It was recorded from Dhappa, Calcutta as early as in March, 1907 *F. H. Gravely*.

7. *Otinotus elongatus* Distant

1908. *Otinotus elongatus* Distant, *Fauna Brit. India*, 4 : 41-42.

1978. *Otinotus elongatus* : Dutta, Ghosh & Das, *Eos*, 52 : 114.

Body rather elongate and compressed ; head about thrice as wide as long ; vertex arcuate, eyes hemispherical, dark brown ocelli nearer to eyes than to each other and located on the centro ocular line. Pronotum very finely pilose ; lateral processes moderately broad, upwardly directed and apically strongly recurved, laterally carinate, apices subacute, in front these processes are much narrower in appearance ; posterior process long, sinuate, scarcely elevated above scutellum, its apex considerably passing posterior angle of inner margin of tegmina, tricarinate, the central carination continued through pronotum, tegmina semi hyaline, narrowly dull ; piceously opaque at base, narrowly elongate, somewhat compressed, legs piceous brown.

*Material examined* : 1 example. INDIA : West Bengal, Calcutta (Dhappa), 22.i.1911, F. H. Gravely Coll.

*Remark* : The species was earlier recorded for the first time from Dhappa, Calcutta during January, 1911 by F. H. Gravely.

Tribe *Tricentrini* Ahmad & Yasmeen

Scutellum normal and exposed ; hind wings with three apical cells ; a distinct pterostigma may be present or absent ; frontoclypeal lobes either partially or completely fused to the frontoclypeus on their inner margins. Hind trochanters elevated into a disc inwardly, armed with spines.

Genus *Tricentrus* Stål

Type-species : *Tricentrus convergens* Walker

1856. *Tricentrus* Stål, *Hem. Afr.* 4 : 89.

1905. *Taloipa* Buckton, *Trans. Linn. Soc. Lond. Zool.* (2) 9 : 334.

1912. *Centrotus* Matsumura, *Annot. Zool. Japan*, 8 : 90.

1975. *Tricentrus* : Ananthasubramanian and Ananthakrishnan, *Rec. zool. Surv. India*, 68 : 224.

1978. *Tricentrus* : Dutta, Ghosh & Das, 52 : 100.

Body rather ovate, head about three times wider than long, obliquely directed backwards, upper margin of vertex arcuate and sinuate, eyes subglobose ; ocelli nearer to eyes than to each other ; pronotum with posterior process longer than broad, lateral angles prominent ; posterior process moderately short, contiguous with scutellum ; tegmina with

5 apical and two discoidal cells, hind wings with 3 apical cells. Scutellum as wide as long concavely emerginate, hind trochanters elevated into a disc inwardly, armed with spines.

*Remark*: The genus is predominant in oriental and Ethiopian regions.

### Key to species of *Tricentrus* Stål

|                                                                                                                                                                                                                                    |                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| Lateral processes of pronotum longer ; apex of posterior process about reaching the posterior angle of inner margin of tegmina, scutellum with a small pale sericeous spot at each basal angle ; body shorter ...                  | <i>projectus</i> Distant    |
| Lateral processes of pronotum rather short ; apex of posterior process projecting, not impinging on tegmina and not reaching the posterior angle of inner margin of tegmina ; scutellum without such spot ; body rather longer ... | <i>subangulatus</i> Distant |

### 8. *Tricentrus projectus* Distant

1908. *Tricentrus projectus* Distant, *Fauna Brit. India*, 4 : 55.

Head about 3 times wider across extremities of eyes than length of vertex which is about twice as wide as long, ocelli nearer to eyes than to each other, pronotum punctate, ochraceously pilose, lateral processes straight, obliquely poret, centrally ridged ; posterior process robust, carinate, central carination continued through pronotum, closely impinging on tegmina. Each basal angle of scutellum with a small pale sericeous spot, tegmina sprinkled with pilosity, piceous and punctate at base, apical margin, a little paler and ochraceous brown, femora and claws black, apices of femora and the whole of the tibiae castaneous, tarsi ochraceous.

*Material examined*: 1 example. INDIA : West Bengal, Calcutta (Tollygunj), 11.xi.1916, F. H. Gravely Coll.

*Remark*: This is one of the uncommon species occurring in India. The species was recorded for the first time in Calcutta by F. H. Gravely during November, 1916.

### 9. *Tricentrus subangulatus* Distant

1908. *Tricentrus subangulatus* Distant, *Fauna Brit. India*, 4 : 55.

1978. *Otaris* (= *Tricentrus*) *subangulata* ; Dutta, Ghosh & Das ; *Eos*, 52 : 102.

Head about two and a half times wider than long, upper margin of vertex arcuate and sinuate, ocelli nearer to eyes than to each other ;

pronotum black, thickly punctate ; lateral processes very short, broad, recurved, anterior margin rounded, posterior margin almost straight, apex roundly subtruncate, posterior process also short, robust, central and lateral carination fine, apex projecting, tegmina punctate on black basal area, with a pale bronzy tint, the veins piceous, legs black, somewhat longly pilose.

*Material examined* : 1 example. INDIA : West Bengal, Calcutta, 21.v.1909, *Museum Coll.*

*Remark* : In India the species is apparently known from Calcutta.

### Tribe Gargarini distant

Scutellum partially concealed, exposed laterally at basal angles and weakly chitinised in the middle, hind wings with 3 apical cells, posterior process broad and close-fitted ; suprahumeral horns absent.

### Genus *Gargara* Amyot & Serville

1848. *Gargara* Amyot & Serville, *Hemip.* : 537.

1903. *Maerops* Buckton, *Mon. Memb.* : 268.

1975. *Gargara* : Ananthasubramanian & Ananthakrishnan, *Rec. zool. Surv. India*, 68 : 238.

1978. *Gargara* : Dutta, Ghosh & Das, *Eos*, 52 : 106.

Type-species : *Cicada genistae* Fabricius

Head about two and a half times as wide as long, vertex nearly one and a half times wider than long ; eyes subglobose, pronotum low, posterior process broadly triangular, closely fitting against scutellum, contiguous with tegmina ; scutellum triangular deeply excavated at tip, wider than long, incompletely chitinised in middle, tegmina two and a half times longer than wide with 5 apical cells and 2 discoidal cells ; hind wings with 3 apical cells, posterior trochanters without spinules.

*Remarks* : This genus closely resembles *Tricentrus* Stål, but differs by the unarmed lateral angles of the pronotum and by the absence of spinules to the posterior trochanters.

*Distribution* : This genus is known from Palaearctic, Ethiopian, Oriental, Malayan and some portions of Australasian Regions. It is commonly found in Southern India.

### Key to the species of *Gargara* Amyot & Serville

- 1 (2) Posterior process just passing apex of claval  
area, centrally and laterally carinate ...

*robusta* Distant

- |       |                                                                                        |     |                        |
|-------|----------------------------------------------------------------------------------------|-----|------------------------|
| 2 (1) | Posterior process just reaching apex of claval area                                    | ... | 3                      |
| 3 (4) | Pronotum and tarsi light brown ; pronotum thickly ochraceously pilose                  | ... | <i>mixta</i> (Buckton) |
| 4 (8) | Pronotum black ; tarsi ochraceous ; pronotum very thickly somewhat finely punctate ... |     | <i>confusa</i> Distant |

### 10. *Gargara confusa* Distant

1906. *Gargara confusa* Distant, *Fauna Brit. India*, 6 : 171.

Head about two and a half times wider across extremities of eyes than length of vertex ; vertex nearly one and a half times wider than long, ocelli slightly closer to eyes than to each other ; pronotum black, very thickly, somewhat finely punctate, the lateral angles subacutely prominent, finely carinate, scutellum wider than long, triangular, excavated at tip, the posterior process slender, unicolorous, only just reaching the posterior angle of the inner tegminal margin, tegmina, grayish opaque, the basal area black, the apical area much crowded with fuscous brown, femora black, tarsi ochraceous.

*Material examined* : 1 example. INDIA : West Bengal, Calcutta, 15.vii.1907, *Mus. Coll.*, 1 example, Calcutta, i.vii.1907, *Mus. Coll.*

*Remark* : This is rather one of the uncommon species in India. The species closely resembles *G. sikhimensis* Distant but differs by the more slender and unicolorous posterior pronotal process and comparatively smaller body.

### 11. *Gargara mixta* (Buckton)

1903. *Maerops mixta* Buckton, *Mon. Memb.* : 257.

1903. *Gargara variegata* Melichar, *Hom. Fauna. Ceylon*, p. 122.

1908. *Gargara mixta* Distant, *Fauna. Brit. India*, 4 : 65.

1975. *Gargara mixta* ; Ananthasubramanian & Ananthakrishnan *Rec. zool. Surv. India*, 68 : 240.

1978. *Gargara mixta* : Dutta, Ghosh & Das, *Eos*, 52 : 106.

Head about two and a half times wider across extremities of eyes, vertex one and a half times as wide as long, eyes reddish brown, face piceous thickly, palely pilose, ocelli slightly nearer to eyes than to each other, pronotum ochraceous brown with the lateral angles angularly prominent but not produced, the posterior process broadly triangular, robust, impinging on scutellum and tegminal, margins and about reaching the posterior angle of the inner margin of the latter. Scutellum twice as broad as long, strongly chitinised at lateral areas ; tegmina

three times longer than broad, hind wings with 3 apical cells, legs blackish upto basal half.

*Material examined* : 1 example. INDIA : West Bengal, Calcutta, 30.vi.1911, R. Hodgart Coll.

*Remark* : This is a very common species in India.

## 12. *Gargara robusta* Distant

1908. *Gargara robusta* Distant, *Fauna, Brit. India*, 4 : 61.

1978. *Gargara robusta* ; Dutta, Ghosh & Das, *Eos*, 52 : 106.

Head black, about three times as wider as long : vertex nearly one and a half time as wide as long ; eyes brown ; ocelli slightly nearer to eyes than to each other and situated on central ocular line ; pronotum black, thickly and somewhat coarsely punctate, posterior process short and robust just passing apex of claval area, centrally and laterally carinate, the central carination continues through pronotum, tegmina subhyaline, black at base on apical margin a pale brownish transverse spot near end of clavus ; black basal area of the tegmina punctate, femora black, apices of femora, tibiae and tarsi and castaneous.

*Material examined* : 1 example. INDIA : West Bengal, Calcutta (Eden Garden), 19.vii.1964, G. Pradhan & Party Coll.

*Remark* : The species is so far known from Calcutta and Kurseong in North East India.

## Tribe *Coccosterphini* Distant

Scutellum abortive in the middle ; pronotum tuberculate or not, tegminal veins coarsely or finely tuberculate ; distinct pterostigma may be present or absent.

## Genus *Coccosterphus* Stål

1869. *Coccosterphus* Stål, *Mem. Fabr.*, 8 : 67.

1903. *Phaerotus* Buckton, *Mon. Memb.* : 255.

1975. *Cocosterphus* ; Ananthasubramanian & Ananthakrishnan, *Rec. zool. Surv. India*, 68 : 254.

Type-species : *Membioracis minutus* Fabricious

Head about two and a half times as wide as long ; eyes deflexed, somewhat transverse, slightly implexed beneath the eyes, front a little elevated ; ocelli nearer to eyes than to each other, and situated on centro ocular line ; pronotum moderately convex, laterally unarmed,

gradually narrowed behind the slightly dominant lateral angles and gradually passing into the posterior process, scutellum aborted in the middle, apices spine-like ; tegmina short not extending beyond abdominal apex, gradually somewhat amplified towards apex, with 5 apical cells and 2 or 3 discoidal cells, hind wings with a 3 apical cells.

*Remark* : The genus is characterised by its pronotum behind the lateral angles gradually passing into the posterior process which has no sinus at the base, absence of produced complete scutellum, but in having mesonotum which is armed at the apex with two very distinct spines. Distant (1908) includes 5 species from India, Of these, two species viz., *C. minutus* (Fabr.) and *C. decoloratus* Distant are reported from Calcutta.

The genus is predominant in Oriental and Ethiopian regions. It is found in Southern and Eastern India including Calcutta but it rarely occurs in Western and Northern India.

#### Key to the species of *Coccosterphus* Stål

- |                                                                                                                                                                                 |     |                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------------|
| Posterior process broadly triangular, slightly elevated behind disc, apical region laminately convexly raised and strongly tuberculate, tip acuminate ; pronotum rather concave | ... | <i>minutus</i> (Fabricius) |
| — Posterior process concave at base and strongly produced before apex, the central ridge finely tuberculous ; pronotum moderately arched and a little depressed                 | ... | <i>decoloratus</i> Distant |

#### 13. *Coccosterphus decoloratus* Distant

1908. *Coccosterphus decoloratus* Distant, *Fauna. Brit. India*, 4 : 71.

1978. *Coccosterphus decoloratus* : Dutta, Ghosh & Das, *Eos*, 50 : 102.

Body small, obovate, black ; head about two and a half times as long ; eyes deflexed, front elevated, ocelli about twice as far apart from each other as from the eyes, pronotum strongly tuberculous, ridged and moderately arched, obtusely angulate before the base of the posterior process, concave at base and convexly, laminately produced before apex, the central ridge finely tuberculous ; tegmina more or less finely tuberculous variably coloured ; legs piceous, tarsi ochraceous.

*Material examined* : 1 example. INDIA : West Bengal, Calcutta Maidan, 27.iv.1911, F. H. Gravely Coll.

*Remark* : The species can be recognised by its minute size and black colour. This is an uncommon species found in India. It usually

feeds on *Boerhaavia repens* (Family Nyctaginaceae). In Calcutta, it was, recorded for the first time from Maidan area in April, 1911.

#### 14. *Coccosterphus minutus* (Fabricius)

1798. *Membracis minuta* Fabricius, *Ent. Syst. Suppl.* : 514.  
 1803. *Centrotus minuta* Fabricius, *Syst. Rhyng.* : 22.  
 1851. *Scaphula* (?) *minuta* Walker, *List. Hom. Br. Mus.*, 2 : 589.  
 1869. *Coccosterphus minuta* Buckton, *Mon. Memb.* : 149.  
 1908. *Coccosterphus minutus* : Distant, *Fauna Brit. India*, 4 : 71.  
 1975. *Coccosterphus minutus* : Ananthasubramanian & Ananthakrishnan, *Rec. zool. Surv. India*, 68 : 255.

Head about two and a half times wider than long. Ocelli nearer to eyes than to each other ; pronotum black with large tubercles and granules ; posterior process broadly triangular, a little elevated behind disc, tegmina about 2.5 times longer than wide, punctate and black, veins more or less infascate, apical area tinted with reddish brown patches ; hind wing with 3 apical cells, legs moderate, tibiae prismatic ; anterior trochanters unarmed within.

*Material examined* : 1 example. INDIA : West Bengal, Calcutta, 7.viii.1914, Coll. ?

*Remark* : The species is common in South India and rather rare in West Bengal including Calcutta where it is recorded as early as 1914.

#### SUMMARY

The paper sets out to provide a first comprehensive account on the systematics of the family Membracidae from Calcutta and its environs. It incorporates 14 species under 6 genera belonging to 5 tribes distributed over 2 subfamilies. Tribal, Generic and Specific diagnoses have also been included. Besides, running keys for the subfamilies, tribes, genera and species have been provided. List of synonymies, wherever necessary and notes on the geographical distribution have also been given for the taxa. Literature relevant to the present contribution have been furnished under references.

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## BLOOD PARASITES OF INDIAN TOADS

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(With 2 Figures and 2 Plates)

### INTRODUCTION

Though the amphibians are known to host a large number of parasites belonging to different phyla, little attention was given to study the haematozoan parasites of amphibians. During the early nineteenth century some stray reports are available viz., Shortt (1917) and Wenyon (1926) who worked on the trypanosomes and haemogregarines of Indian toads. Recently Ray (1979a, b, 1980, 1982), Tiwari & Ray (1981) and Sinha (1979) published some papers on the blood parasites of Indian toads. No consolidated work has even been undertaken on this particular aspect. In this context, a brief account on the blood parasites known so far from the Indian toads is being dealt with in the present communication.

### MATERIAL AND METHODS

Four hundred and seventy eight examples of toads comprising of 4 species viz., *Bufo melanostictus*, *B. andersoni*, *B. stomaticus* and *B. himalayanus* were collected from different parts of India and examined for blood parasites. Peripheral blood was obtained from the finger tips on alternate days and at autopsy. 'Impression' and 'Spread' preparations were made from liver, lungs, kidney and bone-marrow. Air-dried blood films and organ imprints were fixed in 100% methanol and stained with Romanowsky type of stains. For microtome section the tissue of lung, liver, kidney and spleen were fixed in Bouin's fixative, followed by general histological techniques by Pearse (1960), and stained with iron-hematoxylin and eosin.

Measurements were obtained from the camera-lucida drawing drawn on a graph paper (mm division) by counting the squares covered. The

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photomicrographs were taken with the help of "Ergavel C. Z." Microscope using Olympus PM 6 attachment camera.

### OBSERVATIONS

During the study on anuran haematozoa the author observed 5 intracellular parasites viz., *Haemogregarina nucleobisecans*, *Lankesterella bufonis*, *Pirhemocyton* sp., *Cytamoeba bacterifera*, *Toddia* sp. and 3 extracellular parasites viz., *Trypanosoma rotatorium*, *T. chattoni* and *Microfilaria* which have been enumerated in Table—I.

Among the parasites dealt with so far *Pirhemocyton* sp. and a sheathed microfilaria are recorded for the first time from Indian toads. Moreover,

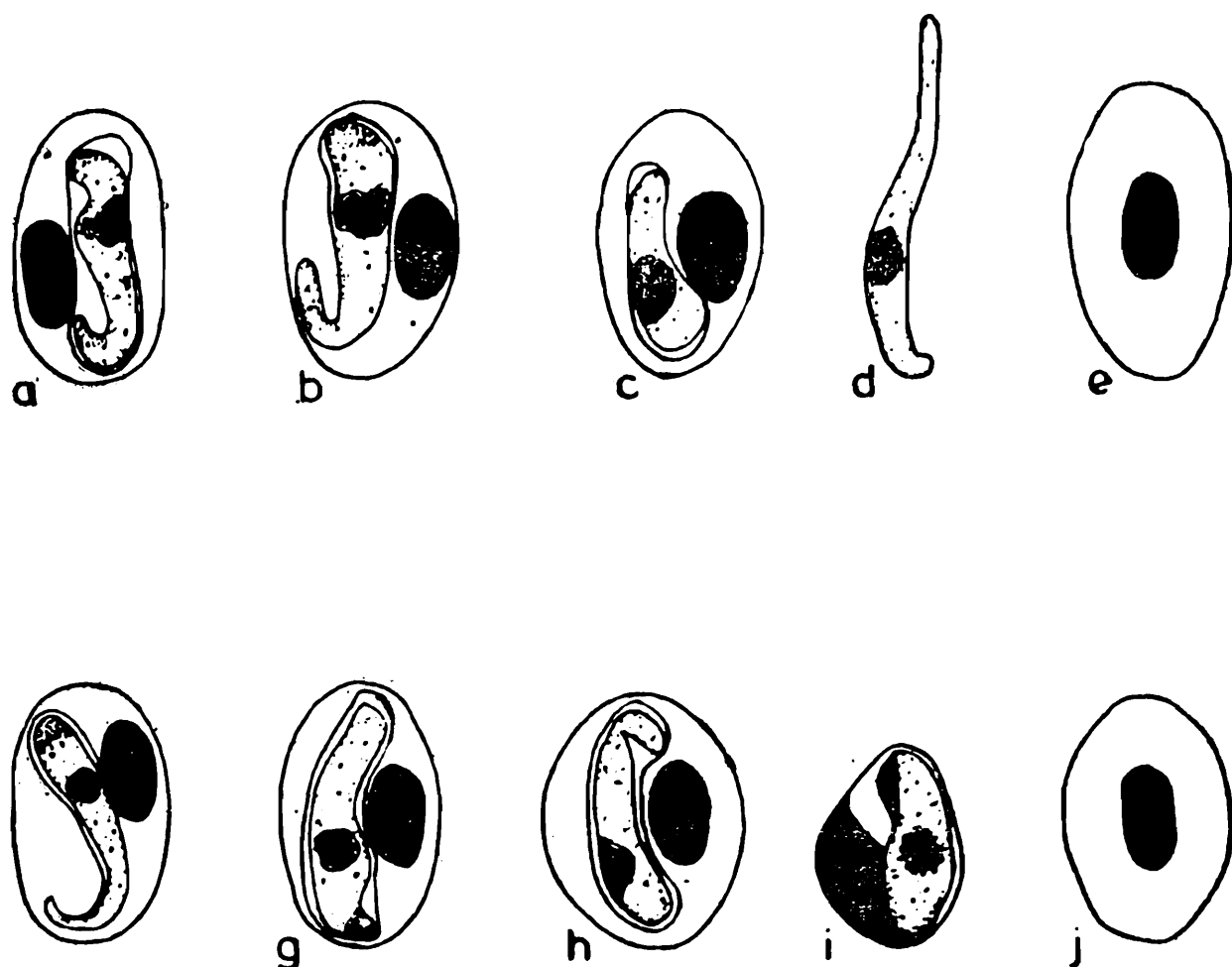


FIG. 1. HAEMOGREGARINA NUCLEOBISECANS.

10µm

Fig. 1. Camera-lucida drawings of the erythrocytic stages of *Haemogregarina nucleobisecans* from two anuran hosts.

a-d, the gametocyte stages in *Bufo melanostictus* : a & b, the longate mature form ; c, the young form ; d, the free gametocyte ; e ; the uninfected erythrocyte.

f-i, the gametocyte stages in *Bufo andersoni* ; j, the uninfected erythrocyte.

some interesting observations on those parasites have also been made. In view of this those are discussed below :

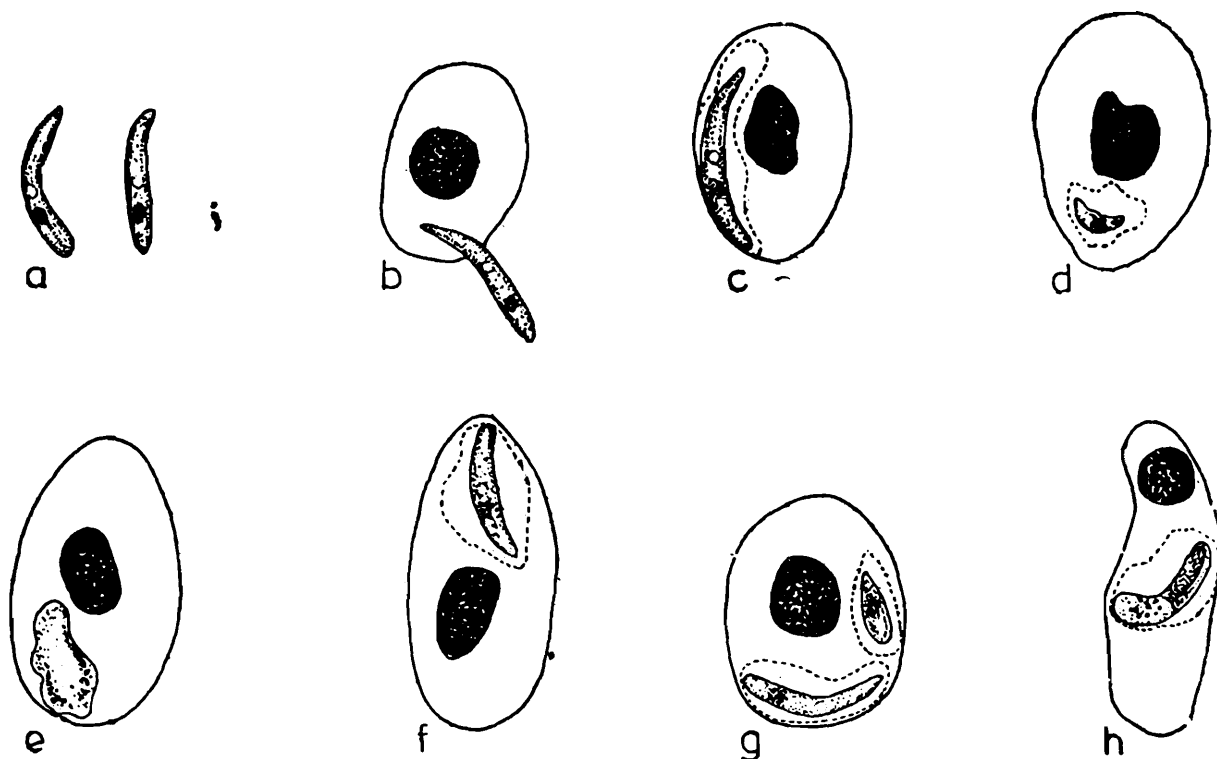


FIG.2 . LANKESTERELLA BUFONIS.

10  $\mu$ m

Fig. 2. Camera-lucida drawings of *Lankesterella bufonis* from *Bufo melanostictus*.

a, the extracorporeal sporozoites ; b, the sporozoite invading the erythrocyte ; c-h, the intracorporeal sporozoites ; g, the hypertrophied cell with double infection ; h, the infected R. B. C. became elongate with apical displacement of the cell nucleus.

### **Pirhemocyton sp.**

(Plate IV, Figs. 10, 11)

*Hosts* : *Bufo melanostictus* & *B. himalayanus*.

*Description* : These are intracorporeal small rounded bodies measuring 1.5-2.0  $\mu$ m in diameter. There is a round, central chromatin dot surrounded by thin layer of cytoplasm which sometimes becomes non-visible because the enlarged chromatin material covers the body. There may be 2-3 small associated unstained refractile globules but not always present. These globules when present, are 1-2  $\mu$ m in diameter. There is no remarkable change in the infected erythrocytes.

*Locality* : Balitha, Bankura district and Darjeeling, West Bengal.

*Occurrence* : 12, out of 343 examples of *B. melanostictus* and 4 out of 32 *B. himalayanus* were positive for *Pirhemocyton*.

TABLE—1

| Parasite                                                                       | Name of the hosts                                      | Locality                                                                | Diagnostic characters                                                                                                                                                                                                                                                                                      | Remarks                                                                                                            | References                                             |
|--------------------------------------------------------------------------------|--------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| 1. <i>Haemogregarina nucleobisecans</i><br>(Text-figs. 1a-j ; Pl.1, figs. 1-6) | <i>Bufo melanostictus</i> and<br><i>B. andersoni</i>   | Bankura & Purulia<br>District West<br>Bengal, India.                    | Sausage-shaped endoglobular parasites of erythrocytes ; gametocytes measuring $14.4 \times 2.95 \mu\text{m}$ with an average area of $28.95 \mu\text{m}^2$ ; schizogony in the hepatic cells of the liver which produces merozoites.                                                                       | This species has also been recorded from a new host, <i>Bufo andersoni</i> .                                       | Shortt (1917),<br>Wenyon (1926),<br>Ray (1979b, 1982). |
| 2. <i>Lankesterella bufonis</i><br>(Text-figs. 2a-g ;<br>Pl. 1, figs. 7-9)     | <i>Bufo melanostictus</i>                              | Balitha and<br>Kotalpur, Bankura<br>District, West<br>Bengal, India.    | Very small, slender, crescent-shaped parasites measuring 9-11.5 $\mu\text{m}$ in length and 1.0-2.5 $\mu\text{m}$ in breadth with an average of $10.6 \mu\text{m} \times 1.45 \mu\text{m}$ ; nucleus terminal or subterminal and consists of few chromatin granules ; a single vacuole situated centrally. | The report of this parasite represents a new host-parasite record from a new geographical region (Oriental realm). | Mansour &<br>Mohammed<br>(1962), Ray<br>(1979b)        |
| 3. <i>Pirhemocytos</i> sp.<br>(Pl. 1, figs. 10, 11)                            | <i>Bufo melanostictus</i> &<br><i>B. himalayanus</i>   | Balitha, Bankura<br>District and<br>Darjeeling,<br>West Bengal, India.  | Intracellular, small rounded bodies measuring 1.5-2.0 $\mu\text{m}$ in diameter ; central chromatin dot surrounded by thin layer of cytoplasm ; 2-3 small associated refractile globules may be present.                                                                                                   | This parasite has been recorded from two new hosts viz. <i>B. melanostictus</i> and <i>B. himalayanus</i> .        | Ray (1979b)                                            |
| 4. <i>Cytamoeba bacterifera</i><br>(Pl. 1, fig. 12)                            | <i>Bufo melanostictus</i> &<br><i>B. himalayanus</i>   | Balitha, Bankura<br>Districts and<br>Darjeeling, West<br>Bengal, India. | Small (3-5 $\mu\text{m}$ in diam.), amoeboid or spherical, intracorporeal red staining bodies ; cytoplasm homogeneous or granular and contains crystalline bacillus-like bodies.                                                                                                                           | This parasite has been recorded for the first time from Indian toads.                                              | Labbé (1894),<br>Ray (1979b).                          |
| 5. <i>Toddia</i> sp.                                                           | <i>Bufo melanostictus</i> and<br><i>Bufo andersoni</i> | Burdwan & Purulia,<br>West Bengal, India.                               | Red staining spherical structure (1-3 $\mu\text{m}$ in diameter) ; intracellular ; rods of a crystalline nature associated with the parasite.                                                                                                                                                              | This parasite has been recorded for the first time from the toad of West Bengal.                                   | —                                                      |

TABLE—1 (Concluded)

| Parasite                                                        | Name of the hosts                                                              | Locality                                                                                         | Diagnostic characters                                                                                                                                                                                                                                                                                                                                                                                                      | Remarks                                                                                    | References                                                                    |
|-----------------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| 6. <i>Trypanosoma</i><br>(Pl. II, figs. 1-3)                    | <i>Bufo melanostictus</i> ,<br><i>B. stomaticus</i> ,<br><i>B. andersoni</i> . | Balitha, Bankura<br>District ; Purulia, West<br>Bengal ; Bondla, Mollem<br>& Volpoi, Goa, India. | Pleomorphic haemoflagellate<br>occurring in 4 Distinct forms ;<br>body leaf-like, flattened and<br>thinned out along the convex<br>edge to form undulating<br>membrane ; cytoplasm densely<br>granular with striated myonemes ;<br>kinetoplast dot-like and situated<br>nearer to the posterior end ;<br>nucleus oval or round and situated<br>on the posterior part of the body ;<br>free flagellum long (11-16 $\mu$ m). | It constitutes<br>new host records<br>from Indian sub-<br>continent.                       | Mayer (1843)<br>Ray (1979a, b,<br>1980), Ray &<br>Choudhury<br>(1983).        |
| 7. <i>Trypanosoma</i><br><i>chattoni</i> (Pl. II,<br>figs. 4-6) | <i>Bufo melanostictus</i> ,<br><i>B. stomaticus</i> ,<br><i>B. andersoni</i> . | Volpoi, Mollem, Bondla,<br>Goa, Jalpaiguri, West<br>Bengal, India.                               | Rounded, spherical or irregular<br>body ; cytoplasm contains innu-<br>merable metachromatic granules<br>and fine vacuoles ; nucleus circular<br>and central ; kinetoplast very<br>small, circular or elliptical and<br>superimposed upon the surface of<br>the nucleus ; flagellum very short<br>either straight or curved and<br>extended to a certain length.                                                            | <i>T. chattoni</i> has<br>been recorded<br>from a number<br>of bufonid hosts.              | Mathis & Léger<br>(1911), Ray<br>(1979b, 1980),<br>Ray & Choudhury<br>(1983). |
| 8. <i>Microfilaria</i> (larval<br>nematode) (Pl. II,<br>fig. 8) | <i>Bufo melanostictus</i>                                                      | Amgram, 24-Parganas,<br>West Bengal, India.                                                      | Snake-like, sheathed, long,<br>slender measuring 95-120<br>$\mu$ m in length and 5.5-6.5 $\mu$ m<br>in width.                                                                                                                                                                                                                                                                                                              | This sheathed<br>microfilaria<br>is recorded for the<br>first time in toads<br>from India. | Ray (1979b)                                                                   |
| 9. <i>Microfilaria</i> (larval<br>nematode) (Pl. II,<br>fig. 7) | <i>Bufo melanostictus</i>                                                      | Jhargram, Midnapore,<br>West Bengal, India.                                                      | Snake-like ; unsheathed,<br>measuring 98-125 $\mu$ m in length<br>and 5-6 $\mu$ m in width.                                                                                                                                                                                                                                                                                                                                | —                                                                                          | Nandi and<br>Mandal (1977)<br>Ray (1979b)                                     |

**Remarks :** The taxonomic status of *Pirhemocyton* is doubtful even today. Previously it was grouped with the protozoa. Levine (1978, Personal Communication) opined that *Pirhemocyton* are virus inclusion bodies. Stehbens and Johnston (1966) conducted an electron microscopic studies to know the morphology of the parasite. Soltz (1971) included *Pirhemocyton* among a group termed as icosahedral cytoplasmic deoxyriboviruses (ICDV,). In absence of the proper knowledge about the biology of these parasites no name has been proposed.

#### MICROFILARIA (the larval nematode)

**Host :** *Bufo melanostictus*.

##### Sheathed form

(Plate V, Fig. 8)

**Description :** N=20. These microfilariae are sheathed, long slender measuring 95-120  $\mu\text{m}$  in length and 5.5-6.5  $\mu\text{m}$  in width. The sheath is hyaline, measuring 1.5-20  $\mu\text{m}$  in width from the body and often found free at the caudal end. The cephalic space is very small measuring 2.0  $\mu\text{m}$  in length. At the anterior end there are two rows of nuclei, 3 in each row and a gap in between them is well marked. The nuclear column consists of 4-5 rows of closely packed nuclei, more compact at the anterior half. The nuclei stained pink with Leishman's stain. The last nucleus is more or less rounded and located at the tip of the tail. The tail is 10.5-12.2  $\mu\text{m}$  in length, gradually narrowed and ending in a rounded tip. Position of the land marks : nerve ring 25.4-26.0% ; excretory pore 34.8-35.5% ; excretory cell 44.6-45.5% ; inner body 69.1-70.5% ; anus 82.8-84.5%.

**Habitat :** Blood.

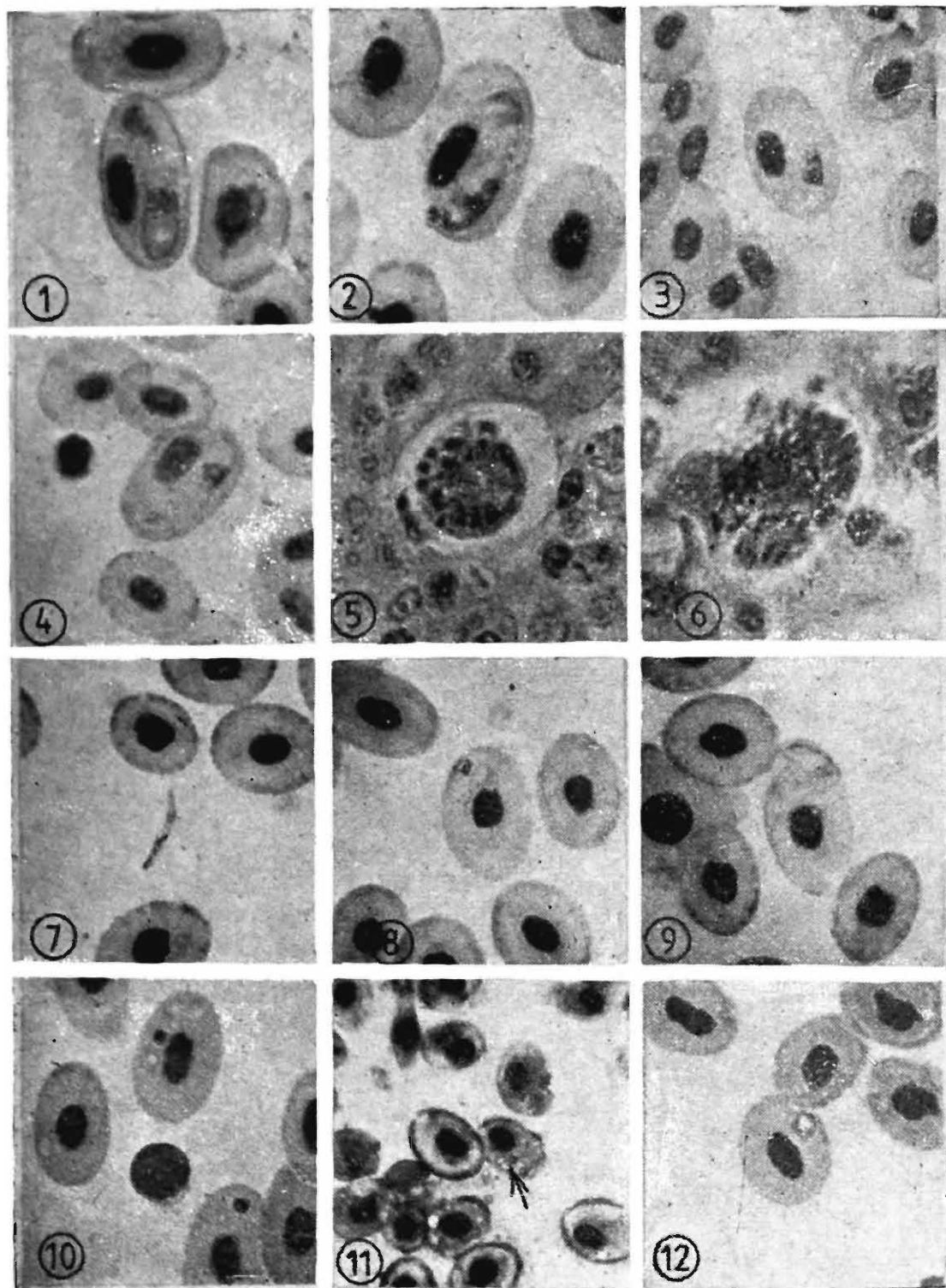
**Locality :** Amgram, 24, Parganas district, West Bengal.

**Occurrence :** In one toad out of 343 examined.

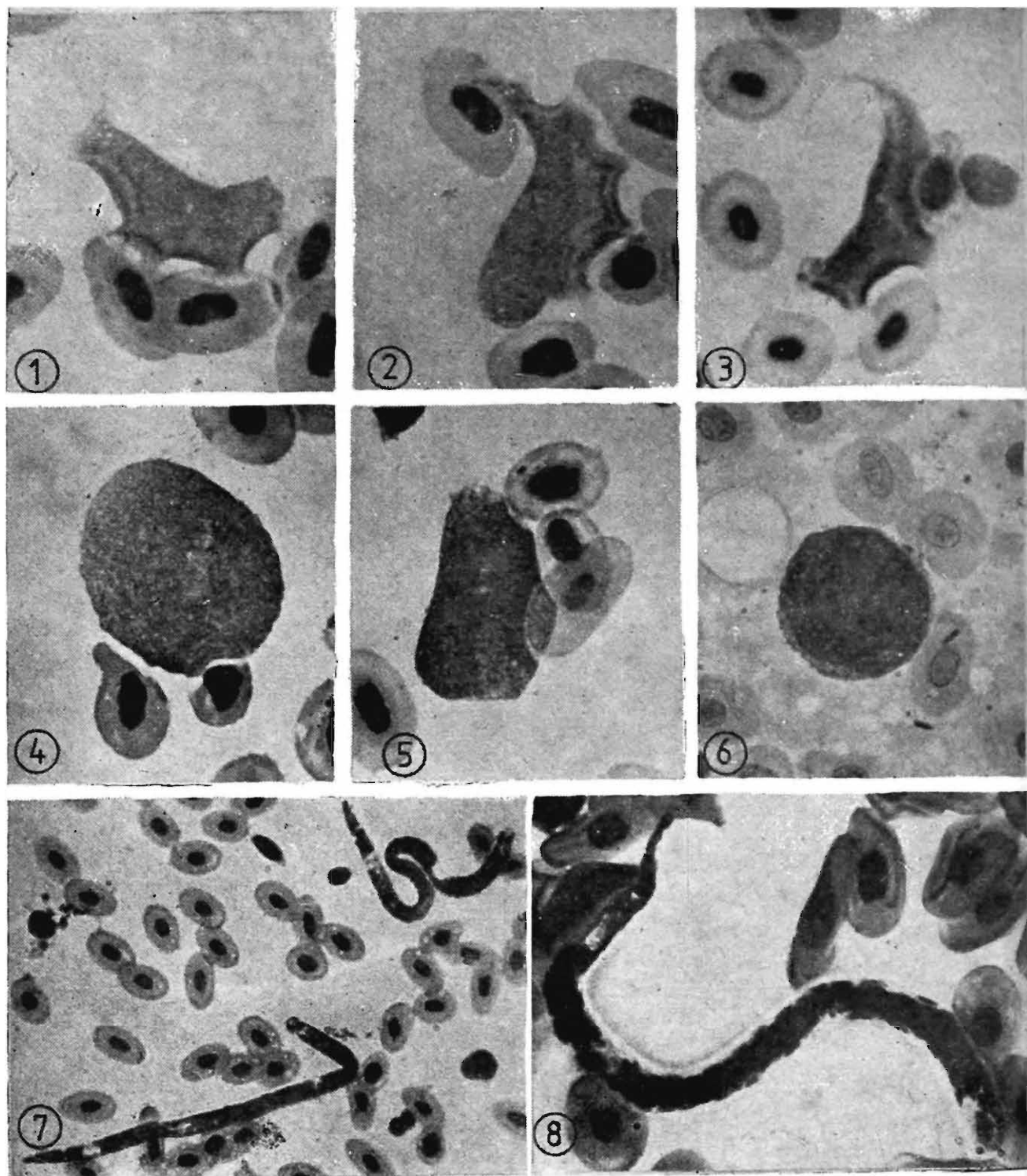
**Remarks :** Nandi and Mandal (1977) reported one unsheathed microfilaria from *Bufo melanostictus* for the first time in India. In the present investigation the author also observed an unsheathed microfilaria (Fig. 7) which well corroborates with Nandi & Mandal (1977) in all respect. Therefore, the sheathed microfilaria in *B. melanostictus* is recorded for the first time from India. The specific determination of this larval nematode is left without finding adults.

#### SUMMARY

During the survey on amphibian haematozoa, 478 examples of toads comprising 4 species viz., *Bufo melanostictus*, *B. andersoni*, *B. stomaticus*



- Figs. 1 & 2. Mature gametocytes of *Haemogregarina nucleobisecans* in the peripheral blood of *Bufo melanostictus* X 1665
- Figs. 3 & 4. Mature gametocytes of the same haemogregarine in the blood of *Bufo andersoni* X 1410
- Fig. 5. A multinucleated mature schizont in the liver parenchyma of *B. melanostictus* X 1100
- Fig. 6. A mature schizont with developing merozoites in the liver parenchyma X 1660
- Fig. 7. Free sporozoite of *Lankesterella bufonis* in the blood of *B. melanostictus* X 1130
- Figs. 8 & 9. Intracorporeal sporozoites of *L. bufonis* X 1180
- Fig. 10. *Pirhemocytan* in *Bufo melanostictus* X 1000
- Fig. 11. The arrow shows the *Pirhemocytan* in the blood of *Bufo himalayensis* X 1000
- Fig. 12. *Cytamoeba bacterifera* in the blood of *Bufo melanostictus* X 1000



- Fig. 1. *Trypanosoma rotatorium* in the peripheral blood of *Bufo melanostictus* X 1465
- Fig. 2. The same haemoflagellate in *B. stomaticus* X 1225
- Fig. 3. *T. rotatorium* in *B. andersoni* X 1200
- Fig. 4. *Trypanosoma chattoni* in the peripheral blood of *B. melanostictus* X 1225
- Fig. 5. *T. chattoni* in *B. stomaticus* X 1220
- Fig. 6. *T. chattoni* in *B. andersoni* X 1200
- Fig. 7. Photomicrographs of unsheathed microfilaria in the blood of *B. melanostictus* X 545
- Fig. 8. A sheathed microfilaria in the peripheral blood of *B. melanostictus* X 835

and *B. himalayanus* were examined of which the first 3 anuran hosts show the infection of *Trypanosoma rotatorium* (Mayer, 1843) and *T. chattoni* Mathis and Léger, 1911 in their blood. The blood and tissue stages of *Haemogregarina nucleobisecans* Shortt, 1917 have also been observed in *B. melanostictus* and *B. andersoni*. A haemococcidia viz., *Lankesterella bufonis* Mansour and Mohammed, 1962 has been recorded in a new host *B. melanostictus* for the first time from Indian subregion. Two microfilariae both sheathed and unsheathed have also been observed in the blood of *B. melanostictus*. Besides, some organisms of uncertain taxonomy viz., *Pirhemocyon*, *Toddia* and *Cytamoeba* have been found to infect *B. melanostictus*, *B. andersoni* and *B. himalayanus*. All those parasites have been enumerated in a table.

#### ACKNOWLEDGEMENTS

The author is very much thankful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta for providing laboratory facilities. Thanks are also due to Dr. Amalesh Choudhury, University of Calcutta, Dr. A. K. Mandal, Superintending Zoologist and Dr. A. K. Das, Zoologist, Zoological Survey of India for their constant guidance and encouragement during the work.

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E. C. G. CHANGES IN A GUINEAPIG INDUCED BY THE  
POISON OF THE BANDED KRAIT (*BUNGARUS FASCIATUS*)

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&  
ANITA DUTTA A. K. HATI  
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The banded krait (*Bungarus fasciatus*) is a very poisonous snake, found in the villages of West Bengal. In the venom of *Bungarus* neurotoxin, hemolysin, cholinesterase and other enzymes have been identified. Very little is however, known about the effect of the venom on the heart.

Inoculation of krait venom in the guineapigs induced striking Electrocardiographic changes, which tend to suggest that cardiotoxin may be present in the venom of banded krait. Cardiotoxin is known to be present in Cobra venom (Reid 1968).

E. C. G. done after 15 minutes of intraperitoneal injection of the venom of banded krait in a guineapig, showed elevated ST in lead II and AVF, inverted T wave and depressed ST segment, in AVL, in addition to prolonged QT interval, dissociation of P wave and AV block, all being indicative of acute myocardial injury by the venom.

Further studies are essential to know whether these E. C. G. changes are a result of direct envenomization or are secondary due to carbon di-oxide retention and acidosis from respiratory failure.

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COMMENTS ON THE SPECIES STATUS AND DISTRIBUTION  
OF *TOMOPTERNA DOBSONII* BOULENGER  
(ANURA : RANIDAE) IN INDIA

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(With 3 Figures)

The generic status of *Tomopterna* has already been evaluated by Clarke (1981) and there is no reason to regard *Tomopterna* as a subgenus of *Rana* as has been done by Dubois (1983) and Pillai (1982). The genus has four nominal species in India. A possible fifth species, *Rana* (= *Tomopterna*) *dobsonii* (described by Boulenger, 1882) was synonymized by Bhati and Shukla (1975) with *Tomopterna breviceps*. However, Pillai (1982) has continued to recognize *Rana* (= *Tomopterna*) *dobsonii* as a distinct species without mentioning anything about Bhati and Shukla's (1975) paper. Here I provide evidence in favour of Pillai (1982) regarding the species identity of *T. dobsonii*.

***Tomopterna dobsonii* Boulenger, 1882**

(Figs. 1 and 2)

*Rana dobsonii* Boulenger, 1882, Cat. Batr. Sal. British Mus. London : 82-83, pl. 3, fig. 1; 1890, Fauna British India, Rept. Batr. : 452; 1920, Rec. Indian Mus. Calcutta 20 : 105-106.

*Rana (Tomopterna) dobsonii* Daniel, 1975, J. Bombay Nat. Hist. Soc. 72 (2) : 522; Pillai, 1982, Rec. Indian Mus. Calcutta 79 : 363-365.

*Rana (Tomopterna) breviceps* Bhati and Shukla, 1975, Ann. Zool. 9 (3) : 73-75.

*Specimens examined* : BM (British Museum, London) 1947. 2. 28. 45 (Holotype, from "Mangalore, west coast of India"); CAS (California Academy of Sciences, San Francisco) 104188, from Karnataka : Mysore : South Canara : Kadunjhar Khana, 22 miles NE Udipi; 104324, from Karnataka : Mysore : South Canara : Manipal : Udipi; USNM (United States National Museum, Washington, D. C) 239424, from Andhra Pradesh : Vishakhapatnam : Wangasara; AMNH (American Museum of Natural History, New York) 40025-31, from Maharashtra ;

Satara district : Panchgani ; 62989, from Maharashtra : Bombay : Western Ghats : Khandala.

*Systematic notes* : The species *Tomopterna breviceps* is widely distributed in Pakistan, all over India, Nepal, Sri Lanka and some parts of

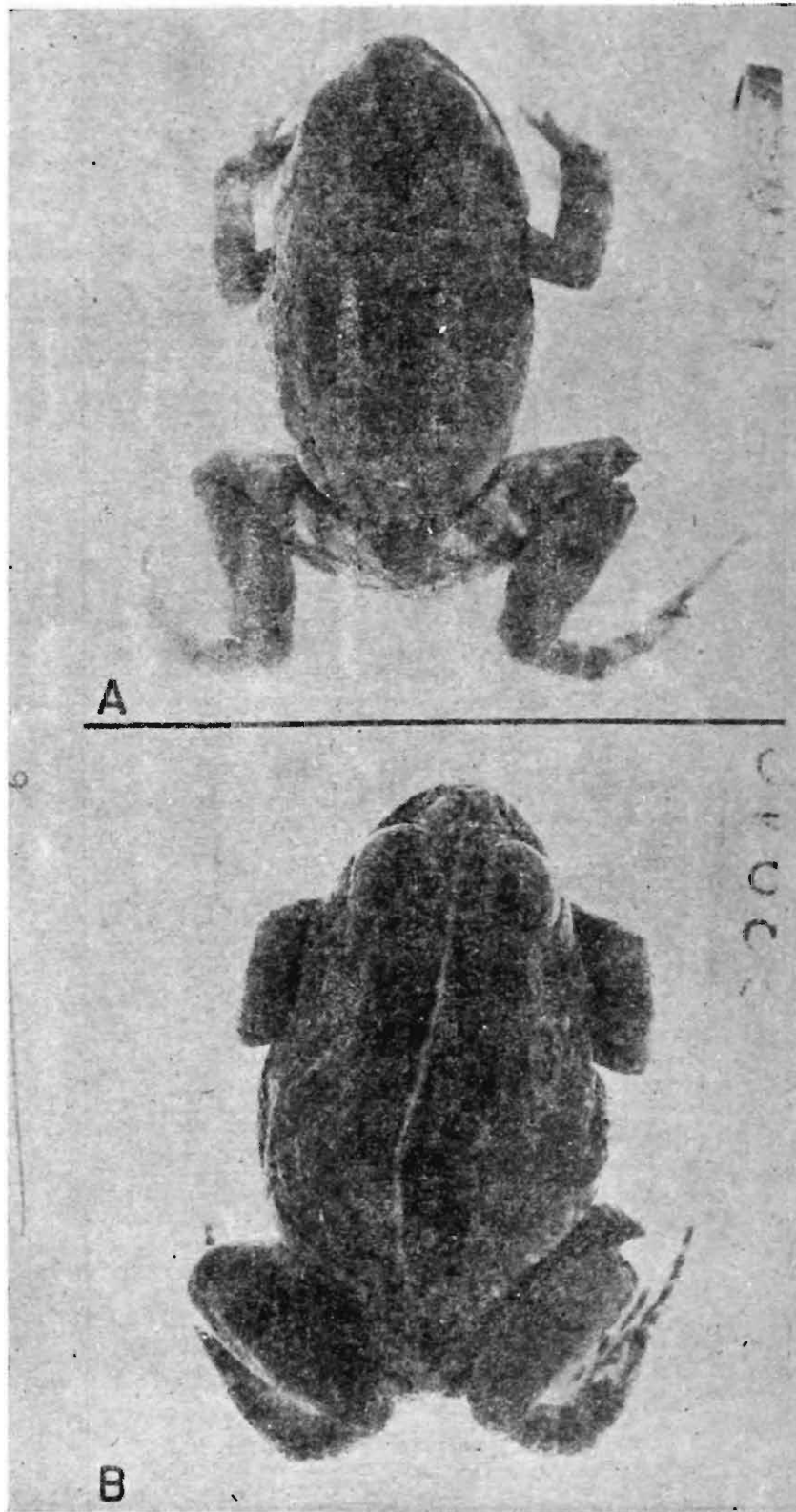


Fig. 1. Dorsal view of *Tomopterna dobsonii*, (A) without vertebral band (AMNH 40031), (B) with vertebral band (USNM 289424).

Burma and exhibits much morphological variation in color pattern, presence or absence of a mid-dorsal vertebral band from the snout to the vent, toe webbing, dorsal tubercles and the presence or the absence of a white tubercle at the joint of tibia and tarsus. Based on some of these characters, Boulenger (1882) described *Rana dobsonii* (= *Tomopterna dobsonii*) from "Mangalore, west coast of India" (=Karnataka). His description of the species is based on two specimens.

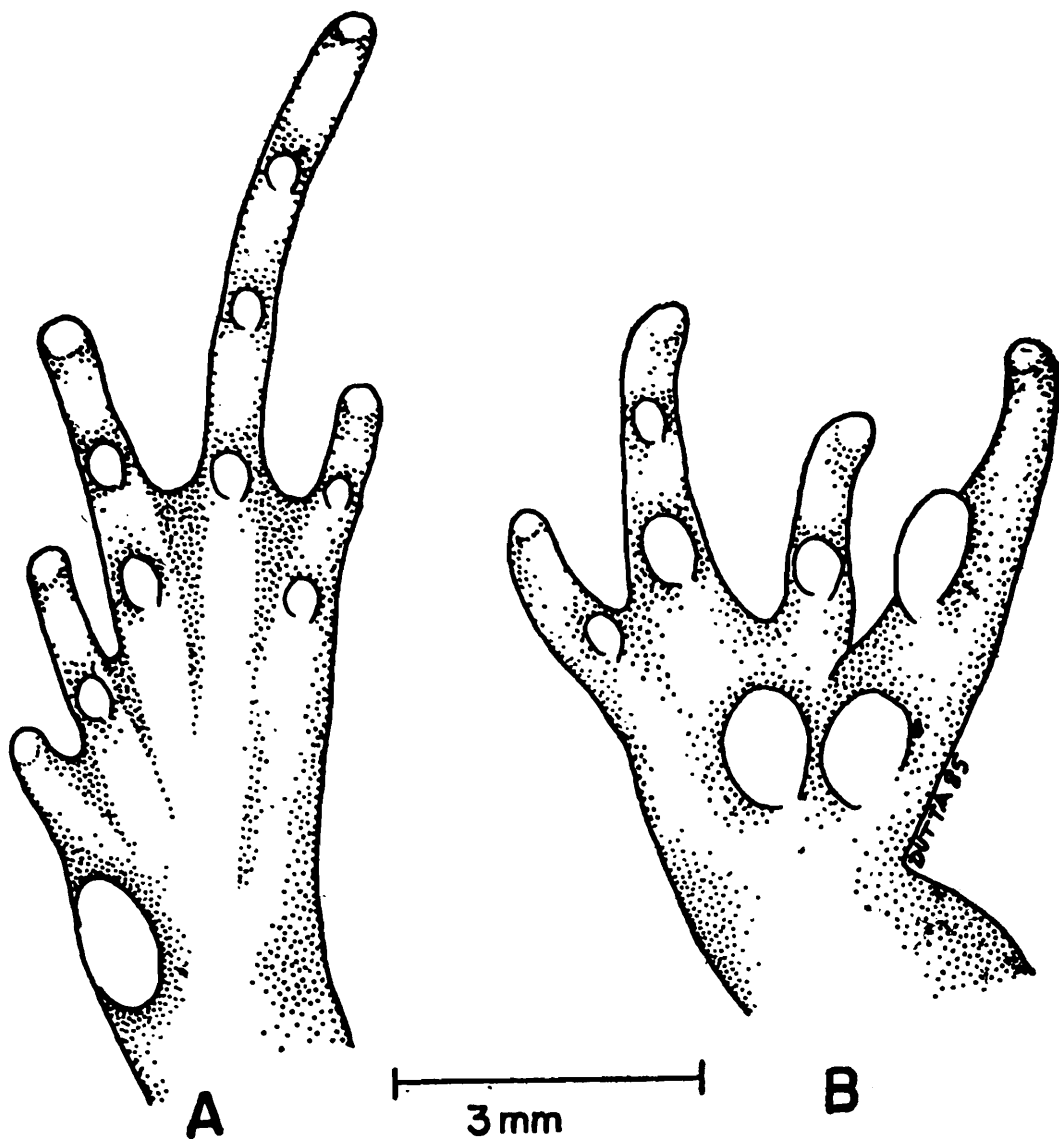


Fig. 2. (A) foot and (B) hand of *T. dobsonii*.

Until 1975, *Tomopterna dobsonii* was considered as a distinct species, but no subsequent collection was made since the type description. Bhati and Shukla (1975) collected specimens of *Tomopterna* from Dayalbagh, Agra, which were later identified by Alice G. C. Grandison of the British Museum of London as *Rana breviceps* (= *Tomopterna breviceps*). Without examining the details of characters used by Boulenger (1882) to distinguish *T. dobsonii* from *T. breviceps*, Bhati and Shukla (1975) considered *T. dobsonii* as a junior synonym of *T. breviceps*. Further, without examining the types of *T. dobsonii*, they commented

that the two specimens of *T. dobsonii* in the British Museum are "presumably aberrant" (which is not true). Though, *T. dobsonii* is closely related to *T. breviceps*, they can be easily distinguished from *T. breviceps* by their smooth dorsum, rudimentary webbings on the toes, distinct canthus rostralis, small tympanum and a black streak laterally from the tip of the snout through the nostril and the eye and covering a portion of the tympanum.

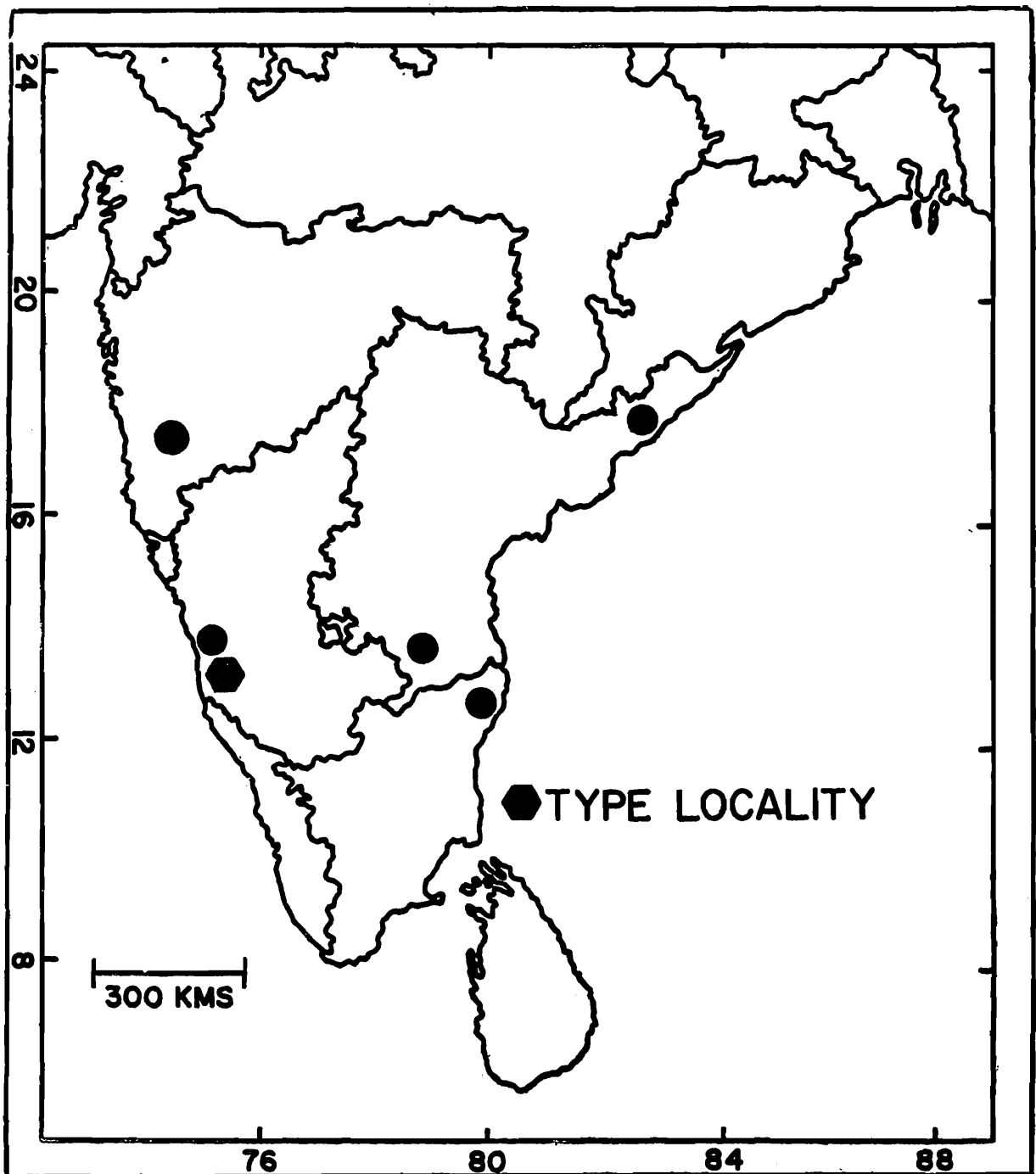


Fig. 3. Distribution map of *T. dobsonii*.

Boulenger (1882) did not mention about the dorsal pigmentation of the species. However, the illustration given by him clearly indicates that the specimens were without any pigmented patches on the dorsum. But, the specimens of *T. breviceps* possess pigmented patches whole

over the dorsum. Pillai (1982) provided a key for the identification of the species of *Tomopterna* in India. He mentioned that there is variable toe webbing ( $1/4$  to  $1/2$ ) in *Rana breviceps* (= *Tomopterna breviceps*) and the webbing on the toes of *Rana dobsonii* (= *T. dobsonii*) is rudimentary. Based on my studies with the populations of *Tomopterna* in India (unpublished data), I suspect that there is another undescribed species involved within the *T. breviceps* complex. Perhaps, this undescribed species has been confused by Bhati and Shukla (1975) to be *T. breviceps*. The diagnostic characters for *T. dobsonii* described by Pillai (1982) indicate that his description of *T. dobsonii* from Chingleput district of Tamil Nadu and Chittor district of Andhra Pradesh are probably combination of specimens of *T. breviceps*, *T. dobsonii* and the undescribed *Tomopterna* sp. which is found in sympatry with *T. breviceps*.

The specimens of *T. dobsonii* examined in the present study (excluding the type) come from close vicinity of the type locality, from the northern range of Western Ghats and only one specimen from Andhra Pradesh. If, we consider Pillai's (1982) specimens to be *T. dobsonii*, the species extends its range from the western to the southeastern India (Fig 3).

#### ACKNOWLEDGMENT

I thank Miss Alice G. C. Grandison and Barry T. Clarke of the British Museum (Natural History), London ; Richard G. Zweifel of the American Museum of Natural History, New York ; Robert C. Drewes of the California Academy of Sciences, San Francisco and George Zug of the United States National Museum, Washington, D. C. for the loan of specimens. Thanks to Darrel Frost and Rebecca Pyles for their comments on the manuscript.

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A NEW SPECIES OF THE GENUS *PUNTIUS* HAMILTON  
FROM MANIPUR

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(With 2 Figures)

MATERIALS AND METHODS

The fishes were fixed and preserved in 10% Formaline. Morphometric study of the fishes were done following the method described by Jayaram (1981). The holotype is deposited in the Fisheries Section of Manipur University-Life Sciences Department (No. MU/LSD-F 21).

DESCRIPTION

*Materials* : 7 exs ;

Holotype : from Chakpi stream and Chakpikarong (24°18'N, 93°95'E), 80 kms. south of Imphal, 16.9.1981. Total length=97 mm.

Paratypes : 1-3 from Chakpi stream at Sherou (24°24'N, 93°95'E), 72 kms south of Imphal, 20.3.1982, Total length=78.4-81.1 mm ; 4-6

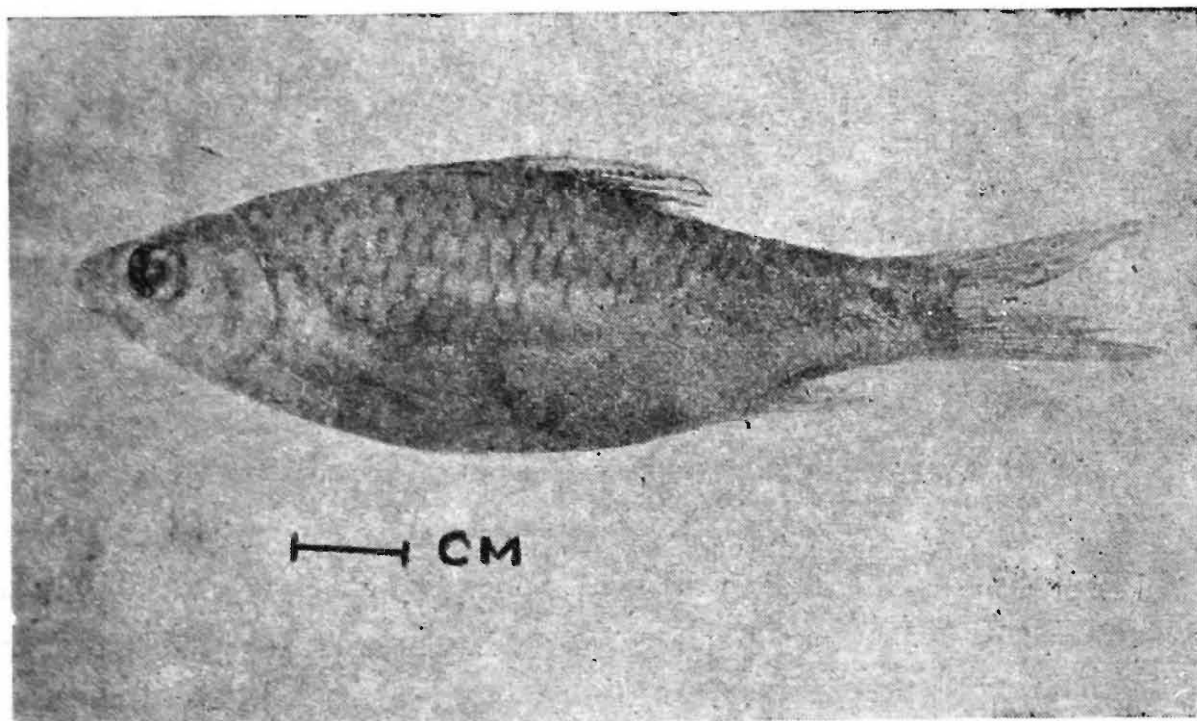


Fig. 1. *Puntius jayarami* sp. nov.

from Chakpi stream, Chakpikarong, 16.9.1981, Total length=92.0-132.0 mm.

*Local Name* : Heikak-nga or Naphet-nga.

*Characters* :

D.III, 8 ; P. 15 ; V. 9 ; A. ii, 6 ; C. 21 ; L. 1. 31-32 ; L. tr.  $4\frac{1}{2}/3\frac{1}{2}$ .

Body compressed. Dorsal profile slightly convex before dorsal insertion and straight or slightly concave after it. Abdomen edge rounded. Head short and conical. Length of head 5.1-5.9, depth of body 3.63-4.04 ; length of caudal 4.26-5.0 in total length. Height of head 1.21-1.4, length of snout 2.80-3.16, diameter of eyes 4.22-4.71 and interorbital space 2.37-2.86 in the length of head. Diameter of eyes 1.33-1.66 in the length of snout. Mouth of inferior. Lips moderate

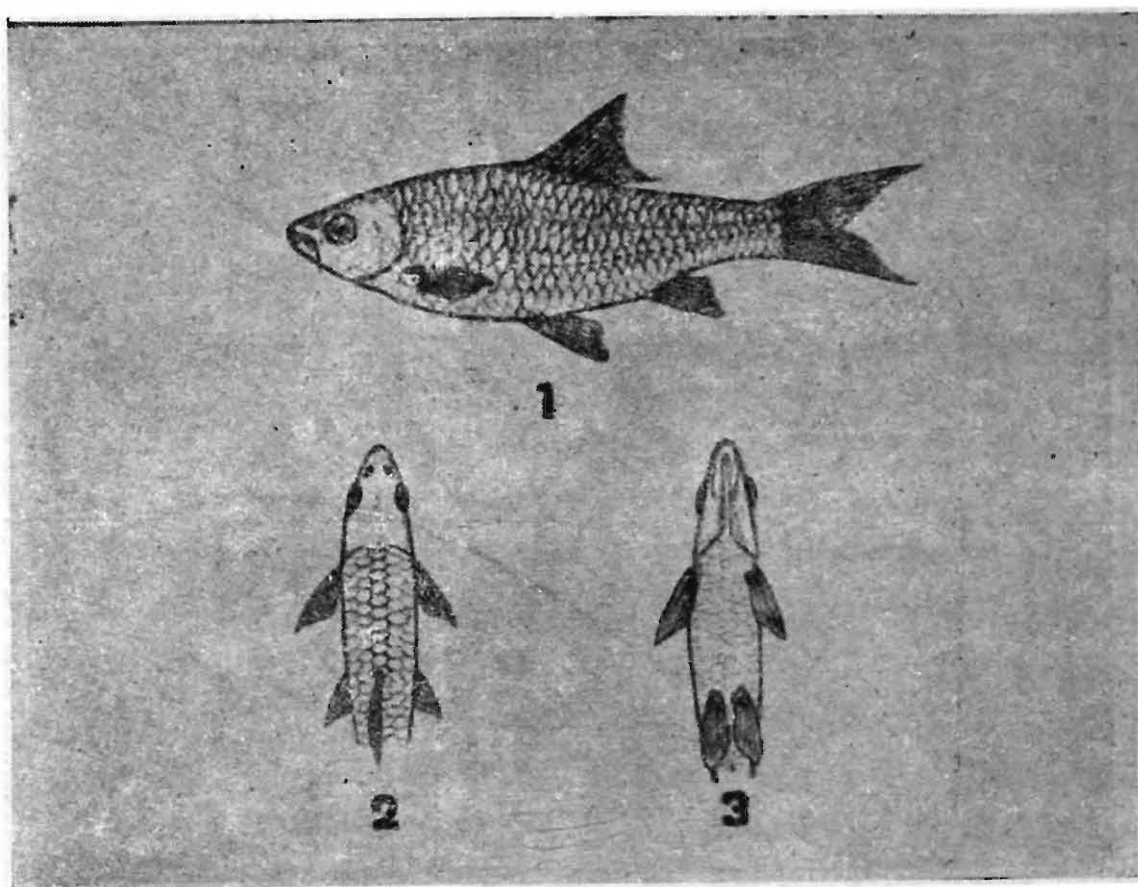


Fig. 2. 2.1. Diagrammatic representation of *P. jayarami* (side view), 2.2. Dorsal view and 2.3. Ventral view.

and continuous. *Barbels*-2 pairs, one rostral and one maxillary. Lengths of barbels approximately equals diameter of eyes. *Fins*—dorsal originates opposite 10th scale on the lateral line and is in the midway between tip of snout and base of caudal. Last osseous spine denticulated, posteriorly with antrorse teeth in a single row. Height of dorsal

(spine) 1.41-2.10 in its own length and 1.33-1.56 in the depth of body. Pectorals do not reach the origin of ventrals. Anal origin opposite 20th scale of lateral line. Caudal fin deeply forked. Fin rays brittle. Least height of caudal peduncle 1.15-1.30 in its own length. *Lateral line* complete with 31-32 longitudinally,  $4\frac{1}{2}$  between it and dorsal insertion and  $2\frac{1}{3}$ - $3\frac{1}{3}$  from it and the origin of ventrals. Predorsal scales 10. *Colour*—silvery, dark olivaceous dorsally. Fins orange. In 10% Formaline, the body is pale white and fins transparent. Tips of dorsal and caudals slightly black. *Swim bladder*—bilobed, smooth without caeca. Anterior chamber forms one third of the total length of the bladder. Posterior lobe is free. Anterior lobe and a little part of the posterior is attached to the vertebral column by a fibrous tissue. A bladder collected from a specimen of total length 132 mm. measures 23 mm. in length. Sexual dimorphism is not seen. A specimen measuring 92.0 mm. is found to contain eggs which are 0.6-0.7 mm. in diameter. *Habit*—The fish is found in Chakpi stream upto its confluent with the Imphal R. (also known as Manipur River that flows to the Burma and meets the Chindwin R.). It has a good taste. The fish is either caught by angling with the eggs of ants as baits or by cast net. The species forms a good part of game fishing with other associated fishes like *Mystus*, *Mastacembelus*, *Tor*, *Barilius* etc. The fish is found in the clear stream with rocky bed having moderate to swift current.

*Differential diagnosis* : The fish under study differs from the Borneo form *Puntius elongatus* (Seale) (= *Barbus elongatus* Seale, 1910 = *Puntius elongatus* Weber & Beaufort, 1916) in having slightly deeper body, presence of 2-4 more scales on the lateral line, shorter pectoral and

*Body measurements in millimetres :*

|                      | Holotype |      | Paratypes |      |      |       |       |
|----------------------|----------|------|-----------|------|------|-------|-------|
|                      | 1        | 2    | 3         | 4    | 5    | 6     |       |
| Total Length         | 97.0     | 78.4 | 80.0      | 81.1 | 92.0 | 110.0 | 132.0 |
| Depth of body        | 24.0     | 21.0 | 22.0      | 22.0 | 24.0 | 29.0  | 34.7  |
| Length of head       | 19.0     | 13.2 | 14.0      | 15.0 | 17.0 | 21.0  | 24.3  |
| Height of head       | 14.0     | 10.4 | 11.5      | 12.0 | 13.0 | 15.0  | 18.6  |
| Length of snout      | 6.0      | 4.5  | 5.0       | 5.0  | 6.0  | 7.3   | 8.1   |
| Diam. of eyes        | 4.5      | 2.8  | 3.0       | 3.5  | 4.9  | 4.9   | 5.7   |
| Interorbital space   | 8.0      | 4.6  | 5.0       | 6.0  | 7.0  | 7.8   | 9.7   |
| Length of dorsal fin | 17.0     | 10.0 | 11.0      | 12.0 | 15.0 | 18.6  | 19.5  |
| Height of dorsal fin | 18.0     | 13.6 | 15.0      | 16.0 | 17.0 | 19.0  | 24.0  |
| Length of caudal fin | 22.0     | 16.5 | 18.0      | 19.0 | 20.0 | 22.0  | 28.6  |
| Length of caud ped.  | 13.0     | 6.0  | 7.0       | 10.0 | 11.0 | 13.0  | 15.0  |
| Least ht. caud ped.  | 10.0     | 5.2  | 6.0       | 8.0  | 9.0  | 11.0  | 13.0  |

ventral fins ; origin of anal 3-4 scales behind. Colour spots absent on the lateral.

#### SUMMARY

A freshwater fish of the genus *Puntius* Hamilton from Chakpi stream (a tributary of the Imphal River) is described as new species. *Puntius jayarami* sp. nov. differs from the Borneo form *P. elongatus* (Seale) in its deeper body, 2-4 more scales in the lateral line, shorter pectoral and ventral fins. It also differs from the Burmese form *P. clavatus burtoni* Mukherjee in its deeper body, longer snout, lesser lateral line and predorsal scale counts.

The available literature shows that fishes of only a few parts of the Manipur State have been studied. Chaudhuri (1912) described only two species from Ukhrul District. The collection of Hora (1921) did not include fishes from Churachandpur, Ukhrul and Chandel Districts. Further works of Hora and Mukherji (1935) and Hora (1936) are mostly confined to the fish fauna of Nagaland. The reports of Menon (1952) and Menon (1954) are based on small collections from the Central Valley and its surrounding hills. Fishes of the water bodies in the farther hill areas are yet to be studied.

Chakpi stream forms an important tributary of the Imphal River (also called Manipur R. southwards) which flows to Burma and joins the Cnindwin R.). It originates from Chandél District and joins the Imphal R. at Sherou (75 kms south of Imphal). Though the stream is very rich in fish fauna, there is no report so far on its fishes. Of the collection the authors have made from the Stream from September, 1981 to March, 1982, there are 7 specimens of the new species. Their descriptions are given here.

#### ACKNOWLEDGEMENTS

The authors wish to thank Dr. K. C. Jayaram, Joint Director of the Zoological Survey of India, Calcutta, for his valuable advice and confirmation of the species. His name is associated with the name of the fish with due respect.

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## DIURNAL MOVEMENT OF ZOOPLANKTON IN LAKHOTIA LAKE

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### INTRODUCTION

Studies on diurnal variations in physico-chemical and biological factors have been carried out in Indian freshwaters by a number of workers (Ganapati, 1955 ; George, 1961 ; Krishnamoorthi and Visweswara, 1963 ; Michael, 1964 ; Verma, 1964 ; Sumitra, 1971, and Patil and Marathe, 1982). But most of the research work is centred around south and north Indian waters. In western India, Rajasthan is the largest state and inspite of the fact that the desert comprises nearly one-third of its area, there are few potential vast and varied freshwater resources, work on lakes has begun recently. Limnological studies on physico-chemical and biological Parameters contributed by Bohra (1976) and Dey and Misra (1978) are only for one season. Hence the present investigations were carried out in order to understand the diel movement of zooplankton in different seasons in a lake namely 'Lakhotia' located at Pali.

#### Lake and its environment :

Lakhotia is a man-made, rainfed, perennial lake of Pali. It is roughly triangular, having a maximum length of 1823 m in the east-west direction and breadth of 950m in the north-south direction. The maximum depth of the lake was 4.5 m. The vegetation around the vicinity of the lake consisting of xerophytic shrubs and trees, is confined mainly to the southern side. In the littoral zone an aquatic grass, *Scirpus tuberosus* grows on the eastern bank.

### MATERIALS AND METHODS

Climate : According to Weather Report, Central Arid Zone Research Institution Jodhpur (1973), there are three seasons in Rajasthan viz,  
Summer (March—June),  
Monsoon (July—October) and  
Winter (November—February).

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In order to understand the diurnal movement of zooplankton, three diurnal studies were conducted one in each season. In each study samples were collected at three hourly intervals for a period of 24 hours from surface, 1 m depth and bottom. The sampling site was chosen almost in the centre of the lake.

The surface and sub-surface water temperature was recorded with a mercury thermometer (0-50°C). Transparency was measured by a standard secchi disc of 20 cms diameter. For the collection of zooplankton, water from the surface was taken with a plastic bucket and from various depths taken with the aid of Van Dorn Sampler. In each case 50 litres of water was filtered through a nylobolting silk net (0.3mm mesh size) having a plankton collecting bottle at one end. Zooplankton thus collected in the collection bottle were transferred into polythene bottles and preserved in 4% formalin. The identification and counting was done on a counting chamber under a binocular microscope.

## RESULTS

The data on diurnal fluctuations of temperature in air and water and transparency in summer, monsoon and winter are given in Table—1.

The maximum air and water temperatures were recorded in May (summer) while minimum in January (winter). The air temperature ranged from 30.0° to 39.0°C in summer, 26.0° to 37.0°C in monsoon and 12.5° to 27.0°C in winter.

In summer, the water temperature varied from 28.4° to 32.1°C at the surface, 27.2° to 30.0°C at 1 m depth and 27.0° to 30.0°C at the bottom. The diurnal difference in water temperature between that of surface and 1m depth was in the range of 1.5° to 2.1°C during day hours and 1.0° to 1.5°C during night hours. This indicated the presence of an "epilimnional" thermal stratification in between surface and 1 m depth layers. However, isothermal conditions were observed between 1 m and bottom throughout the diel cycle.

In monsoon, the water temperature was at the maximum (32.1°C) at 1500 hrs and minimum (23.5°C) at 0300 and 0600 hrs at all depths. It was not influenced by ambient temperature during night (2100 to 0600 hrs) and during that period it was found higher than the ambient temperature. This might be due to high specific heat of water as it takes longer time to warm and cool than the air.

Like diurnal of monsoon, the water temperature in winter was not influenced by the ambient temperature during night hours and remained higher than that of ambient at all depths. During that time the

TABLE 1. Diurnal fluctuations in temperature and transparency in Lakhotia lake

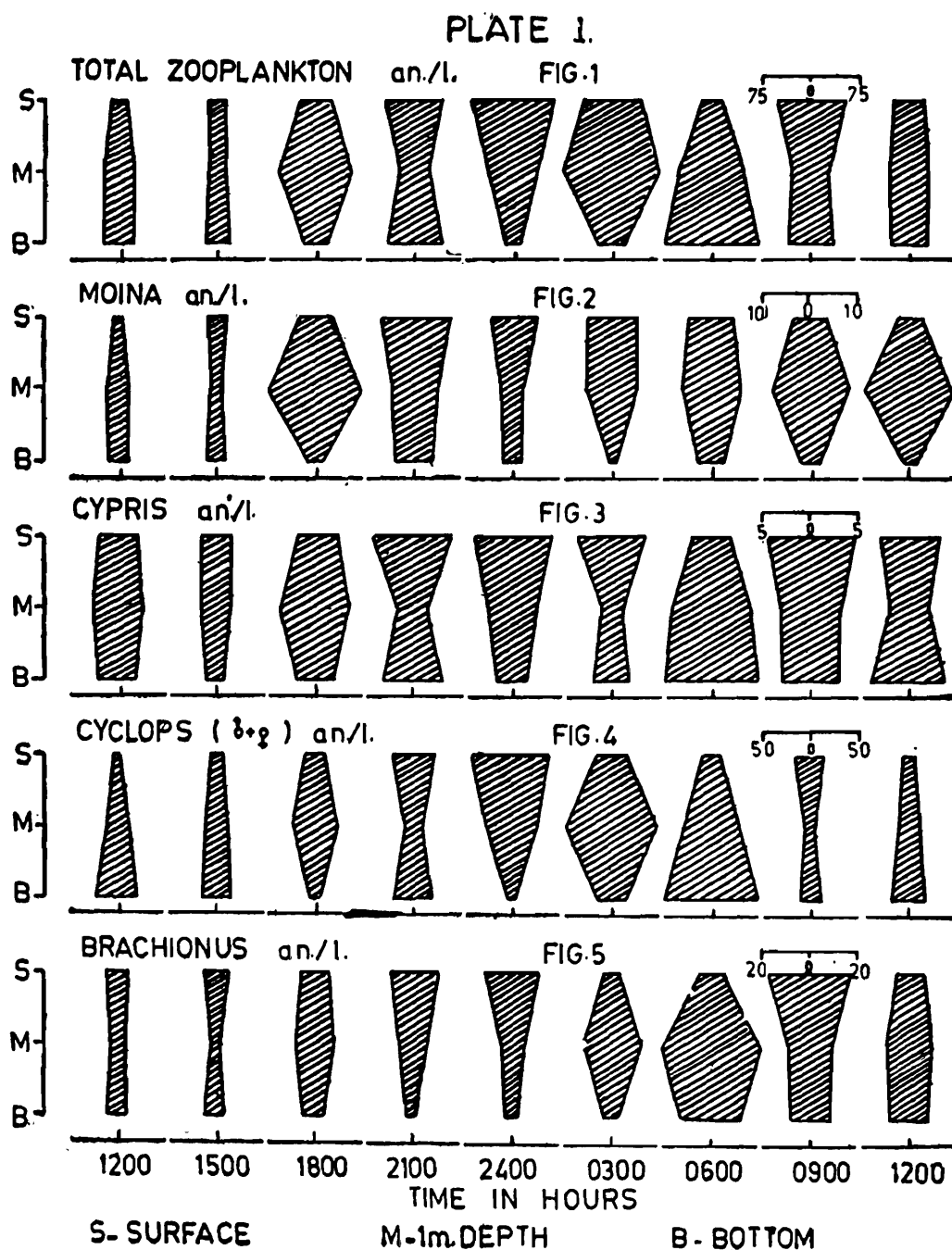
| Season                           | Parameter              | Depth | Time in hours |      |      |      |      |      |      |      |      |
|----------------------------------|------------------------|-------|---------------|------|------|------|------|------|------|------|------|
|                                  |                        |       | 1200          | 1500 | 1800 | 2100 | 2400 | 0300 | 0600 | 0900 | 1200 |
| Summer                           | Air temperature        |       |               |      |      |      |      |      |      |      |      |
| 23rd & 24th                      | (°C)                   |       | 39.0          | 38.5 | 35.6 | 32.2 | 32.0 | 30.0 | 31.7 | 36.1 | 38.5 |
| May, 1977                        | Water temperature (°C) | S     | 32.1          | 31.5 | 30.5 | 29.6 | 28.4 | 28.4 | 29.7 | 30.5 | 31.5 |
|                                  |                        | M     | 30.0          | 30.0 | 29.0 | 28.3 | 27.3 | 27.2 | 28.0 | 29.0 | 30.0 |
|                                  |                        | B     | 30.0          | 30.0 | 29.0 | 28.3 | 27.0 | 27.0 | 28.2 | 29.0 | 30.0 |
|                                  | Transparency (cms)     |       | 15            | 12   | 10   | —    | —    | —    | 17   | 20   | 16   |
| Monsoon                          | Air temperature (°C)   |       | 37.0          | 37.0 | 32.5 | 29.0 | 27.5 | 26.2 | 26.0 | 31.0 | 36.9 |
| 27th & 28th Sep-<br>tember, 1977 | Water temperature (°C) | S     | 31.0          | 32.1 | 31.0 | 30.5 | 30.0 | 29.0 | 29.0 | 29.6 | 31.4 |
|                                  |                        | M     | 30.0          | 31.6 | 30.5 | 30.0 | 29.0 | 28.5 | 28.5 | 29.0 | 30.0 |
|                                  |                        | B     | 29.5          | 31.2 | 29.5 | 29.0 | 28.5 | 28.5 | 28.5 | 29.4 | 29.9 |
|                                  | Transparency (cms)     |       | 45            | 45   | 45   | —    | —    | —    | 55   | 60   | 60   |
| Winter                           | Air temperature (°C)   |       |               |      |      |      |      |      |      |      |      |
| 25th & 26th                      |                        |       | 27.0          | 27.5 | 22.0 | 16.5 | 16.0 | 13.0 | 12.5 | 18.5 | 25.0 |
| January, 1978                    | Water temperature (°C) | S     | 19.6          | 19.0 | 19.0 | 18.0 | 18.0 | 18.0 | 17.0 | 17.5 | 18.9 |
|                                  |                        | M     | 18.6          | 18.5 | 18.0 | 18.0 | 18.0 | 17.0 | 17.0 | 17.5 | 18.0 |
|                                  |                        | B     | 17.5          | 17.4 | 17.0 | 17.0 | 17.5 | 16.0 | 16.0 | 17.0 | 17.8 |
|                                  | Transparency (cms)     |       | 55            | 45   | 40   | —    | —    | —    | 45   | 47   | 55   |

S—Surface. M—1 m depth. B—Bottom.

maximum difference between ambient and water temperature was of 5°C (Table-1).

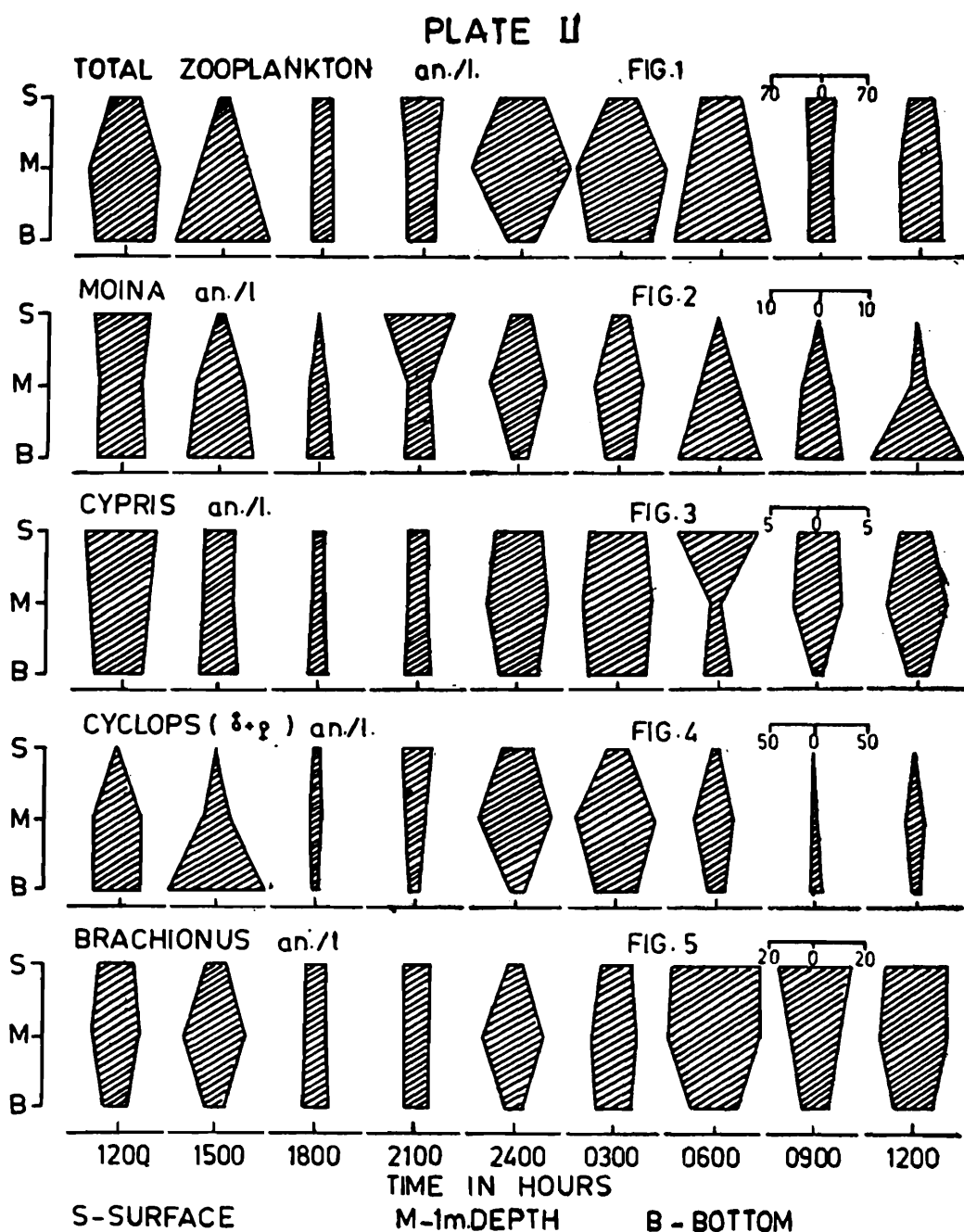
Maximum transparency was recorded during monsoon and minimum during summer diurnal. Secchi disc reading varied from 10-20 cms in summer, 45 to 60 cms in monsoon and 40 to 45 cms in winter.

The total zooplankton population during summer was at its minimum (21 an./l) at 1200 hrs at the surface and then it increased from 1500 hrs onwards, attaining a peak (131 an./l) at 2400 hrs, thus, exhibiting a characteristic diurnal pattern of decrease in day and an increase



during night hours. The minimum numbers (22 an./l) at 1 m was at 1500 hrs and maximum (145 an./l) at 0300 hrs (next day). At the bottom, minimum (28 an./l) population was recorded at 2400 hrs and maximum (145 an./l) at 0600 hrs of the following day (Plate I, Fig. 1).

During monsoon total zooplankton showed a gradual increase at the surface from 1800 hrs onwards, reaching its maximum at 2400 hrs. (Plate II, Fig. 1). The same trend was observed at the bottom from 2100 hrs which continued till the population attained its peak (0600 hrs). However, at 1 m depth, zooplankton did not show any definite trend.



In winter, the population of zooplankton was poor in comparison to that observed in the diurnal studies of summer and monsoon and showed a reverse trend of decrease during night at the surface. The minimum population was at 2100 hrs at the surface and the bottom, while at 1 m depth it was at its peak (Plate III, Fig. 1). The maximum number was observed during daytime at the surface (1500 hrs) and bottom (0900 hrs), whereas at 1 m it was at its minimum (1200 hrs).

PLATE III

FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

1200 1800 2400 0600 1200

TIME IN HOURS

S-SURFACE M-1m. DEPTH B-BOTTOM

During summer *Cyclops* sp showed an increasing trend from 1500 hrs onwards till it reached its maximum at 2400 hrs at the surface, then the population moved to 1 m and finally to the bottom at 0600 hrs (Plate I, Fig. 4). During monsoon the population of *Cyclops* sp at the surface was poor, ranging from nil to 5 an./1. It then showed a sudden increase at 2400 hrs but in the following hours it again declined, whereas at 1 m depth and the bottom a reverse trend of increase in number was observed from 2100 hrs to 0300 hrs (Plate II, Fig. 5). The

population of *Cyclops* sp during winter varied from nil to 16 an./1 at the surface, 1 to 37 an./1 at 1 m and 2 to 18 an./1 at the bottom (Plate III, Fig. 4). The population was found to be concentrated at 1 m depth during night hours and at the bottom during day time.

TABLE 2. Distribution of various genera in Lakhotia lake

| S. No. | Season  | Cladocera                                                      | Ostiacoda       | Copepoda                                      | Rotifera             |
|--------|---------|----------------------------------------------------------------|-----------------|-----------------------------------------------|----------------------|
| 1.     | Summer  | <i>Daphnia</i> sp<br><i>Ceriodaphnia</i> sp<br><i>Moina</i> sp | <i>Cypris</i> p | <i>Cyclops</i> sp*<br><i>Diaptomus</i> p      | <i>Brachionus</i> sp |
| 2.     | Monsoon | <i>Daphnia</i> sp<br><i>Moina</i> sp                           | "               | <i>Cyclops</i> sp *<br>and nauplius<br>larvae | "                    |
| 3.     | Winter  | "                                                              | "               | <i>Cyclops</i> sp*<br>and nauplius<br>larvae  | <i>Brachionus</i> sp |

\*Dominant.

*Brachionus* sp was mostly concentrated at the surface and 1 m depth from 1500 hrs of the first day to 0300 hrs of second day during summer and population varied from 6 to 34 an./1 at surface, 3 to 40 an./1 at 1 m depth and 6 to 25 an./1 at the bottom. During monsoon maximum population of *Brachionus* sp was recorded at 0600 hrs at all depths while minimum at 1500 hrs at the surface, 1800 hrs at 1 m and 2400 hrs at the bottom. In winter minimum population recorded at 2100 hrs at 1 m and bottom and at 2400 hrs at the surface. At surface and 1 m one maxima was observed but at the bottom two (1500 hrs and 1200 hrs next day).

The diurnal movement of *Moina* sp and *Cypris* sp along vertical profile of the lake in summer, monsoon and winter are shown in Plates I to III Figs. 2 to 3.

### DISCUSSION

Zooplankton showed a definite diurnal movement of an increase in population during night hours and decrease during day hours at the surface in summer and monsoon seasons. Increase at the surface during night hours is attributed to their vertical migration from 1m and bottom layers. Reduction in the zooplankton density during day time at the surface is due to their descent to 1m and bottom layers. In winter a reverse trend of an increase in population of zooplankton

during day time and decrease at night hours at the surface, was recorded. It seems that during summer and monsoon high temperature and bright sun light check the movement of zooplankton at the surface whereas in winter the surface temperature attracts zooplankton from sub-surfaces. Thus temperature and light both may be responsible for vertical movement of zooplankton. Sumitra (1971) mentioned the similar observations in her studies. Tash and Armitage (1960) reported that light, overturn, size, thermocline and gravity were important factors affecting vertical distribution of zooplankton. Michael (1964) stated that in addition to light, probably dissolved oxygen and free carbon-dioxide also effect the planktonic movements. No such correlations are evident in the present investigations (Khatri, 1981).

Zooplankton comprised of Cladocera, Ostracoda, Copepoda and Rotifera, of these Copepoda were dominant in all the seasons, while Rotifer shared dominancy during winter. *Cyclops* sp, *Brachionus* sp, and *Moina* sp exhibited a definite diurnal pattern of an increase at the surface during night and decrease during day time in all the seasons (except *Brachionus* sp in monsoon). George (1961), Michael (1964), Verma (1967), Sumitra (1971), Bohra (1976), Dey and Misra (1978) and Patil and Marathe (1982) also observed similar pattern in diurnal migration of zooplankton population, whereas Krishnamoorthy and Visweswara (1963) reported a reverse pattern—a daytime rise of daphnids and copepods to the surface and their descent to the bottom during night hours. On the other hand Andersen (1974) observed no vertical migration of Copepoda and Cladocera.

#### SUMMARY

Three diurnal studies one each in summer, monsoon and winter were conducted on zooplankton movement in a tropical lake of western Rajasthan namely 'Lakhotia'. Zooplankton population comprised of members of the Rotifera, Cladocera, Ostracoda and Copepoda out of which Copepods were dominant during all the seasons. *Cyclops* sp and *Moina* sp showed definite diurnal movement of decrease at the surface during day time and increase during night hours in all seasons, while *Brachionus* sp only during summer and winter. Light and temperature seem to be responsible for the vertical movement of zooplankton.

#### ACKNOWLEDGEMENTS

Thanks are due to CSIR, New Delhi (India) for financial assistance.

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A NEW SPECIES OF THE GENUS *KURCHATOVUS* (BONELLIDAE :  
ECHIURA) FROM THE VENEZUELA BASIN

By

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INTRODUCTION

The author received a few echiuran animals for the purpose of identification from Dr. Kevin B. Briggs, Biologist, Department of the Navy, NSTL, Mississippi, USA. These animals were collected from the Venezuela Basin during the Department's NORDA cruise in the area between 13°30'—15°08'N and 64°45'—69°12'W of the region. Three small specimens of this collection and another small specimen of the collection of the Centre Oceanologique de Bretagne (COB), Brest, France during their deep sea missions in the Atlantic belong to the genus *Kurchatovus* DattaGupta. But these specimens are different in having single clawed sabre shaped ventral hooks from the only other species of the genus namely, *K. tridentatus* DattaGupta (1977) which has 3-clawed ventral hooks. The diagnostic features of the genus are, "fully grown females extremely small in size ; proboscis absent, a rudimentary semicircular collar surrounding the mouth dorsally ; two ventral hooks, distal end clawed ; single gonoduct, gonostome lateral" (DattaGupta, 1977). Also the species of the genus *Kurchatovus* happen to be the only echiurans which feed on matters of plant origin. The original description of the type species *Kurchatovus tridentatus* was on the basis of five specimens which were found in remnants of wood in Puerto Rico Trench ; in *Thalassa* rhizome in Cayman Trench ; and in coconut husk in Yucatan Basin of the Caribbean deep sea (4580—6780m) and their gut contents indicate that they feed on the plant material in which they live (Wolff, 1979). The present animals were collected in deep sea trawls and it is not known if the animals were found in remnants of plant material but, their gut contains material of plant origin. The animals conform with the diagnostic features of the genus and owing to their single clawed ventral hooks the species has been named *Kurchatovus epeudentatus* n. sp.

***Kurchatovus epeudentatus* n. sp.**

(Fig. 1, A—E)

**Material :** Holotype female, NORDA 334—Sta 63 ; collected 8.11.81 ; type locality coordinates 13°49'N 67°55'W, depth 5000m.

*Paratypes* : 1 female, NORDA 334—Sta 88 ; collected 25.11.81 : locality coordinates 13°30'N 64°45'W, depth 3453 m ; 1 female, COB collection—BENTHEDI DS 62 ; collected 29.3.77 ; locality coordinates 12°41, 8'S 44°66, 6'E, depth 750m.

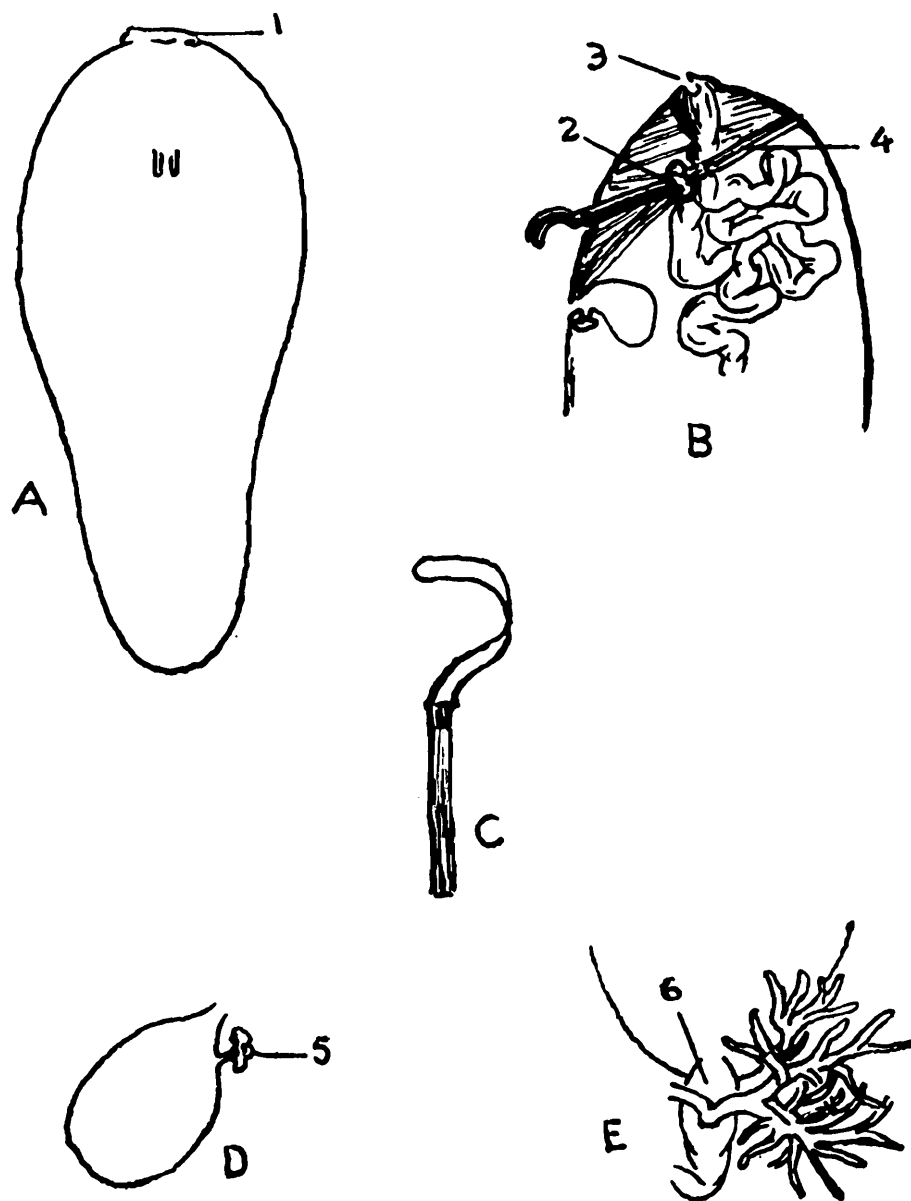


Fig. 1. A, *Kurchatorus epeedentatus*, ventral view  $\times 10$  ; B, internal anatomy of the anterior part of the body  $\times 10$  ; C, Ventral hook  $\times 10$  ; D, gonoduct ; E, anal vesicle. 1-Collar, 2-interbasal muscle, 3-mouth, 4-pair of muscles, 5-gonostome, 6-cloacal chamber.

*Holotype* and one paratype dissected, and deposited in the Indian Museum. Accession No. P 3255/1 Holotype and P 3256/1 paratype (NORDA). Paratype BENTHEDI specimen, Natural History Museum, Paris. Accession No. AS 773.

*Description* : Holotype and the two paratypes are sandy grey in colour in the preserved state. Holotype measures 6.5 mm in length and about 3mm across the broadest part. The paratype of NORDA collection is around 8.5mm in length and 3mm across the broadest part.

The paratype of BENTHEDI collection is 3mm in length and 1mm in breadth. The animals are somewhat sausage shaped with thick body wall and conspicuous papillae which are rough and irregular. Mouth is dorsally surrounded by white semicircular collar. Closely ventral to the mouth 2 ventral hooks emerge through the body wall. The bent tip of the hooks is flattened and golden brown in colour. The hook shaft is soft and flexible and yellowish white in colour. Single genital aperture is located posterior to the ventral hooks; the body wall surrounding the aperture is devoid of papillae.

Internally, the intestine is much convoluted and long; the foregut is relatively short, the pharynx and foregut is firmly attached with the body wall by a large number of mesenterial bands. Intestine is filled with organic matter of plant origin reddish brown in colour. The foregut is relatively short and the neurointestinal is single throughout. The shaft of the ventral hooks are long; strong radiating muscles connect the shafts with the ventral body wall. A strong interbasal muscle is present. Besides, a pair of stout muscles connect the tips of the shafts with the dorsal body wall. Single gonoduct is oval in shape and filled with gonads; gonostome is lateral, gonostomal lip is anular and petaloid. The anal vesicles are in the form of a few tubular branches emerging from a common duct; the two ducts join before opening into the cloacal chamber ventrally.

*Remarks:* Both *K. epeedentatus* and *K. tridentatus* are deep sea bonellids. Many oceanographic expeditions have reported on the occurrence of remains of terrestrial plants in the deep sea. The remnants of plant material are ultimately transported by various means to the great depths of canyons or trenches (Wolff, 1979) from where the two species of the genus *Kurchatovus* have been collected. Echiuran animals are detritus feeders and it does not exclude the possibility of their feeding on decomposed plant material. The author had the opportunity of examining many echiuran animals none of which have been found to feed on plant material except the two species of the genus *Kurchatovus* which could be regarded as an instance of specialization in this group of deep sea echiurans.

#### SUMMARY

*Kurchatovus epeedentatus* n. sp. has been described. The species belongs to the family Bonellidae of phylum Echiura and the animals have been collected by the biological team, Department of the Navy, NSTL, Mississippi, USA from the Venezuela Basin. The species of the genus *Kurchatovus* are small in size, lack a proboscis, and with

single gonoduct with basal gonostome. The species *epeedentatus* is characterised by single clawed sabre shaped ventral hooks in which respect the species differs from *tridentatus*, the only other species of the genus which has 3-clawed ventral hooks. The two species are the only known echiurans which feed on vegetable matter.

#### ACKNOWLEDGEMENTS

Sincere acknowledgements are made here to Dr. Kevin B. Briggs, Biologist in the Department of the Navy, Naval Ocean Research and Development Activity, NSTL, Mississippi, USA and to Dr. Michel Segonzac, Chief of the CENTOB, Brest, France for the material which is the basis of this article.

Grateful acknowledgements are made to the Director General of the Council of Scientific and Industrial Research, New Delhi, for the grant of an Emeritus Scientistship to the author and to the Director, Zoological Survey of India, Calcutta, for laboratory facilities.

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A NEW SPECIES OF *METAPONE* FOREL FROM NICOBAR ISLANDS  
(HYMENOPTERA : FORMICIDAE : MYRMICINAE)

By

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(With 1 Figure)

INTRODUCTION

The genus *Metapone* was established by Forel (1911) based on an ant from Sri Lanka. He designated *M. greeni* as type-species, under a new tribe Metaponini, provisionally under a new subfamily Promyrmicinae. This genus was considered having peculiar ponerine habits, showing close resemblance to *Cylindromyrmex* and *Simopone* on one hand and *Sima* on the other. A year later, Emery (1912) examined the type (*M. greeni*) and its larva and found that it has typical characters of Myrmicinae, which are not found in ponerine larva, hence *Metapone* is a true myrmicine ant.

Wheeler (1919) accepted Emery's opinion, but did not agree in accepting Forel's "Promyrmicinae" term. There is, in fact nothing primitive or ancestral about *Metapone*, but rather its characters are highly specialized and secondary, e.g. the shape of antennae, specially the reduction of antennal segments in male and female, reduction of palpal segments, simplified venation of the fore wings, peculiar structure of petiolar nodes and legs, and the vestigial condition of the eyes in workers.

This moderate sized ant of subfamily Myrmicinae (Family Formicidae) is mainly Indo-Australian in distribution, and it is also reported from Madagascar and Micronesia.

The following species are referable to this genus : *M. bakeri* Wheeler, 1916 from Philippines ; *M. emersoni* Gregg, 1958, Madagascar ; *M. gracilis* Wheeler, 1935, Philippines ; *M. greeni* Forel, 1911, Sri Lanka ; *M. hewitti* Wheeler, 1919, Borneo ; *M. Jacobsoni* Crawley, 1924, Sumatra ; *M. Johni* Karavaiev, 1933, Sri Lanka ; *M. Krombeini* Smith, 1947, New Guinea ; *M. madagascariensis* Gregg, 1958, Madagascar ; *M. mjobargi* Forel, 1915, Australia : Queensland ; *M. sauteri* Forel, 1912, Taiwan ; *M. tricolor* McArdney, 1949, Australia : New South Wales ; *M. truki* Smith (M. R.), 1953, Micronesia (Wheeler, 1919, Gregg, 1958).

In addition one new species is described here from Nicobar Islands in Indian Ocean. This is the first record of this genus from India.

**Genus *Metapone* Forel**

*Metapone* Forel, 1911, *Rev. Suisse Zool.*, **19** : 447 ibidem, 1912, **20** : 763.

Type-species : *Metapone greeni* Forel. Original designation.

This genus is mainly characterized by having scrobed head, 11-jointed antennae, one jointed maxillary and 3-jointed labial palpi, terminally spinose or dentate middle and hind tibiae, and metatarsi.

*Worker* : Head subrectangular scrobed, nearly one and half times as long as broad. One jointed maxillary and 3-jointed labial palpi. Eyes small and elongate. Mandibles 4 to 5 toothed, with a large basal lobe. Ocellar pits present, ocelli absent. Clypeus large, with subrectangular anterior lobe. Scape reaching to the middle of the head, flattened and apically much dilated, funiculus dilated and clubbed. Antennae 11-segmented. Dorsum of alitrunk oblong, somewhat flattened above, submargined on the sides. Promesonotal suture very indistinct and mesoepinotal suture impressed. Petiolar node subcuboidal, rather flat above, widened behind, truncated at their ends, anteriorly with a short peduncle and its ventral surface with a large longitudinal lobe, followed by a strong tooth. Postpetiolar node broader and shorter than the petiolar node bearing on its ventral side a large tooth. Gaster oval. Femora greatly dilated. Tibiae and metatarsi short and broad.

***Metapone nicobarensis*, sp. nov.**

(Fig. 1, a-c)

This species is close to *Metapone leae* Wheeler, by having body 6.1-6.6 mm long, mandible with 5 teeth, petiolar nodes mammalian vertebrae-like and female with similar wing venation, but it differs by having a distinct pointed ventral tooth on petiolar node, postpetiolar node finely longitudinally striate and with scattered punctures ; apical tooth of mandible larger than the others ; first segment of the gaster with weak scattered punctures and the female without a distinct median longitudinal groove on head.

*Holotype worker* : Body length 6.1 mm ; HL (head length) 1.4 mm ; HW (head width) 1.05 mm ; SL (Scape length) .38 mm ; CI (cephalic index) 75 ; SI (scape index) 36 ; PW (pronotum width) .59 mm ; PNL (petiolar node length) .5 mm ; PPNL (postpetiolar node length) .42 mm ; PH (petiole height) .84 mm ; PPH (postpetiole height) .63 mm ; DPW

(dorsal petiolar width) .56 mm ; DPPW (dorsal postpetiolar width) .59 mm ; PNI (petiolar node index) 94 ; PPNI (postpetiolar node index) 100 ; LPI (lateral petiolar index) 59 ; LPPI (lateral postpetiolar index) 50 ; Measurements of paratype worker similar to holotype.

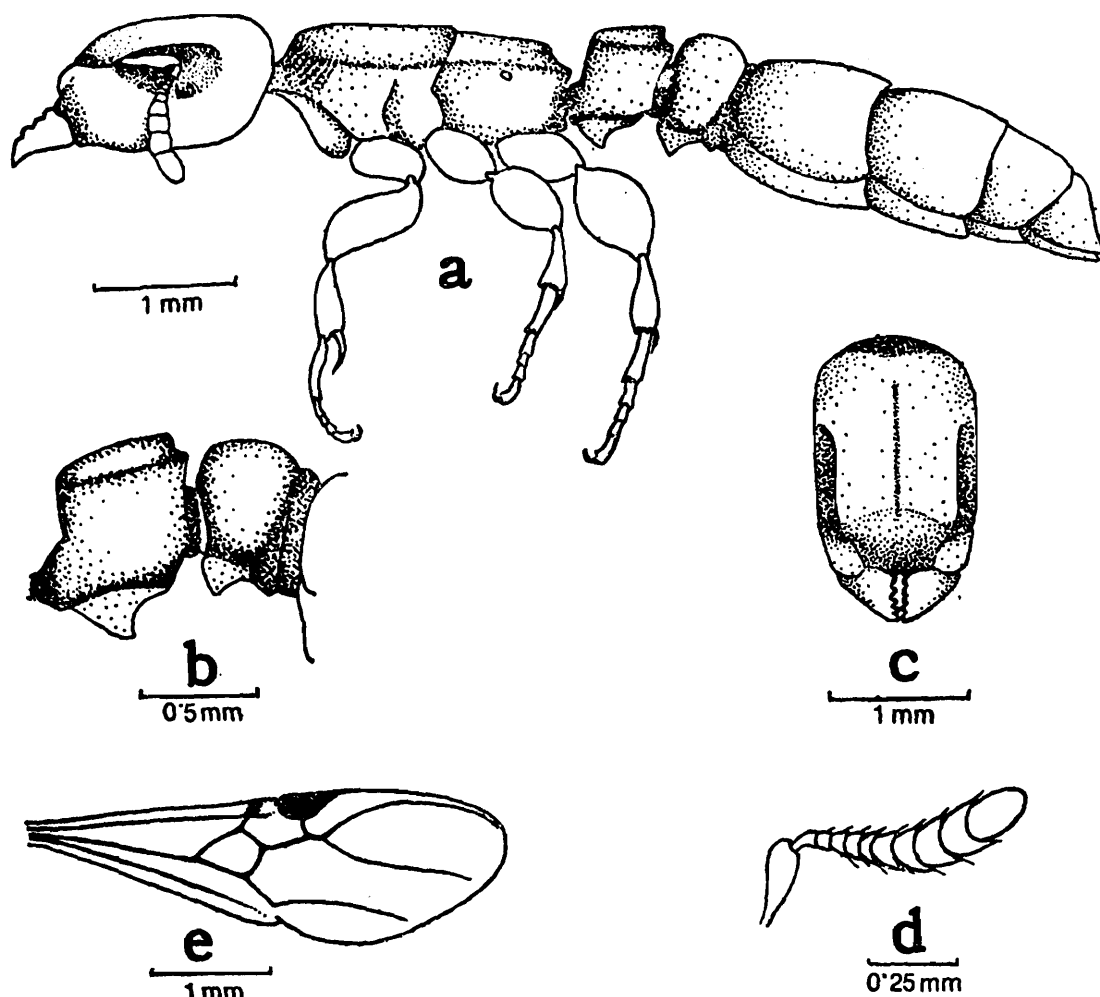


Fig. 1. (a-e) *Metapone nicobarensis* sp. nov. ; (a) body, lateral view ; (b) petiolar nodes, enlarged view ; (c) head, front view ; (d) antenna, enlarged view ; (e) forewing of female.

Head subrectangular, about 1.4x as long as wide, sides of the head straight, posterior border of the head weakly concave. Head and alitrunk in general uniformly finely longitudinally striated ; head subpolished, sparsely and coarsely punctate, posteriorly tending to be smooth, with a median longitudinal groove. Mandibles stout, their outer borders curved, the apical border oblique, with 5 teeth ; apical tooth largest in size, striatopunctate, basally sparsely punctate. Eyes small, roundish, situated at the lower posterior border of the scrobe. Clypeus rectangular, little narrow in front, raised laterally and continuous with the frontal carinae, separated behind from the head by a suture, with weak anterio-median lobe. Antennae short, flattened, scape elliptical, about 3.5x as long as broad ; funiculus flattened with distinct 3-segmented club ; first segment of the funiculus longer than broad, segments 2-7 small, apical

segment about as long as the preceding two segments taken together. Striae on the pro- and mesonotum almost as strong as on the head, tending to be weaker towards the apex of the propodeum. Petiolar nodes and gaster shiny, petiolar nodes with moderate sized sparse punctures, gaster with weak scattered punctures. Legs smooth and shiny. Alitrunk oblong, about 2.5x longer than its width, a little narrower than the head, broad anteriorly and slightly narrowed behind, the antero-lateral angles of the pronotum rounded, posteriorly at sides almost straight. Propodeum when seen dorsally, forms a gentle slope at its posterior margin. Petiolar node anteriorly as broad as propodeum, gradually widening posteriorly, with lateral blunt teeth, in dorsal view anteriorly convex, posteriorly concave, subpetiolar process stout, backwardly directed, triangular, keel-shaped, lamellate. Postpetiolar node weakly convex, a little narrow anteriorly, subpostpetiolar process with one large and one small, downwardly directed triangular tooth-like projection. Gaster oval, its first segment larger than others, sting long and stout; legs short, flattened, all the femora very broad, elliptical, apical margins of middle and hind tibiae and metatarsal segments dentate.

Body reddish-brown, except alitrunk in front and at sides blackish. Pubescence whitish-yellow, hairs moderately long and sparse; Legs with moderately thick bristle-like hairs.

*Paratype female* : Essentially similar to worker, except as follows :

Body length 8.6 mm; HL 1.26 mm; HW .91 mm; SL .31 mm; CI 72; SI 35; PW .7 mm; PNL .56 mm; PPNL .49 mm; PH .56 mm; PPH .56 mm; DPW .49 mm; DPPW .59 mm; PNI 70; PPNI 84; LPI 100; PPI 87. Head rectangular in shape without distinct median groove, its surface with moderately strong longitudinal striations and moderately deep punctures in between the striae. Eyes oval, placed on the postero-lateral side of the head, about 1.4x as long as the length of the scape. Three ocelli present. Pronotal humeri present. Scutellum broader than long, transverse at base with lateral raised margins. Pro- and mesonotum with deep and longitudinal striations. Petiolar node vertebrae-like, its base as broad as propodum and about as long as its apical width; its lateral angular process acute; the posterior corners produced in the form of two long divergent conical teeth, posterior margin evenly concave. Petiolar node with fine somewhat concentric transverse striations and moderate sized sparse punctures. Postpetiolar node oval in shape, slightly broader than long, with fine and dense longitudinal striations and coarse shallow punctures. Gaster long tubular, broader at base, gradually narrowing towards the apex, its

first segment longer than broad. First tergite mat with sparse shallow setiferous punctures ; following tergites mat and subpolished. Legs short, with posterior tibiae and metatarsi apically dentate.

*Holotype worker* and *paratypes* 1 worker & 2 females, INDIA : Nicobar Is : Rajendra Nagar, 30.xii.1975, P. K. Maity and party (Z. S. I. Calcutta).

#### SUMMARY

This paper deals with the description of a new species of ants, viz., *Metapone nicobarensis* sp. nov. from Nicobar Islands in Indian Ocean. This is the first record of the genus from Indian region.

#### ACKNOWLEDGEMENTS

The authors are thankful to Dr. R. W. Taylor, Principal Research Scientist, curator of ants, Australian National Insect Collection, for confirming the species and for valuable comments. We are thankful to Dr. B. K. Tikader, Director, Zoological Survey of India, for his interest in this work and for providing necessary facilities.

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## OBITUARY

**Prof. P. N. GANAPATI**  
(1910—1984)

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## OBITUARY

Prof. P. N. GANAPATI

(1910-1984)

It is with profound sorrow that I record here the sad demise of our beloved Professor Ponnani Narayana Ganapati, an eminent marine biologist of India, on 5th January 1984 at the age of 73. The death occurred suddenly at Bombay on his return from a 6 months private visit to the United States. Born on 15th July 1910 in a small village near Palghat in Kerala, he had a brilliant academic career to his credit. He had his early education at Ernakulum. He completed his graduation from the Presidency College at Madras in 1932 and took his M. A. degree in Zoology in 1934, M. Sc. degree in 1936 and D. Sc. degree in 1942 from the University of Madras. Later, he worked for a brief period in the Central Marine Fisheries Research Institute at Mandapam and then proceeded abroad to receive advanced research training in parasitology at the Molteno Institute of Parasitology, U. K. Cambridge for a period of over two years. After his return from England in 1949, Professor Ganapati joined the Department of Zoology at Andhra University, Waltair. A few years later, he became the Head of the Department of Zoology, succeeding his predecessor and his own teacher, Professor R. Gopala Iyer, who was also an eminent educationist and a pioneering marine biologist of the time. Professor Ganapati held this position till the date of his retirement in 1970. Since then he continued there as an Emeritus Professor and later as an Honorary Professor, guiding research of a band of dedicated workers on marine ecology. In 1978, he was invited on a short assignment by the Berhampur University at Orissa to organize the Department of Marine Sciences and initiate postgraduate and research courses of study. He was there for two years.

Although Professor Ganapati started his career as a protozoologist, after joining the Andhra University, his valuable contribution to marine biology for nearly two decades distinguished him as a pioneer in this field. He was largely responsible for organizing a systematic oceanographic research in India in collaboration with the other renowned oceanographers of the time, as Dr. E. C. LaFond and late Professor C. Mahadevan. His foresight in undertaking various research projects involving intensive investigations of the marine environment around Waltair paid rich dividends and left a landmark in the field. The work was mainly related to diverse groups of marine fauna of differ-

ent habitats on Waltair Coast, as evidenced from the list of publications appended at the end of this article. He was also in-charge of many scientific projects on marine and estuarine biology sponsored by the F. R. I., I. C. A. R., C. S. I. R., U. G. C., I. N. S. A., and other organizations. His active participation in the International Indian Ocean Expedition during the years 1958-63, has resulted in the collection of a very rich data and valuable information pertaining to the hydrography, biology and distribution of the fauna of the seas around India. With indefatigable energy and zeal for tireless work, he gave ample encouragement and valuable guidance to his students that resulted in the publication of over 250 useful research papers on diverse aspects. About 25 candidates also obtained their Doctorate Degrees under his able supervision.

Professor Ganapati is also to be well remembered for the valuable services he rendered in the development of the Department of Zoology at Andhra University. Although, the department initially had had only one wing in the Erskine College of Natural Sciences, with constant efforts he acquired a far more enviable space to accommodate all the work for teaching and research. The laboratories were well furnished with all the necessary modern equipments for zoological teaching and research. The department was maintained scrupulously clean and tidy. The whole atmosphere was kept quite conducive for learning and research. A decent museum representing a rich collection local fauna was built and an animal-house maintained. He was also responsible for the construction of a new two-storied building facing the sea exclusively for marine biological investigations. Above all, he is well remembered by his students as a good teacher, doing full justice to the subjects he taught. His devotion to departmental work was such that he used to attend office even on Sundays and other holidays. The department he developed was really his first love and he chose to settle down at Waltair even after his retirement.

My close association with Professor Ganapati for more than a decade showed that despite the high position he held and the strict discipline he maintained, he was in practice very simple, generous and kind-hearted. He always had a soft corner for people in difficulties. He particularly liked and helped diligent people. He left an indelible impression on all people, academic or otherwise, with whom he came into contact.

Professor Ganapati participated in many national and international conferences related to Zoology and Marine Biology. He was a Fellow/Member of many learned scientific societies, such as Indian National

Academy of Sciences, Indian Academy of Sciences, Zoological Society of India, Marine Biological Association of India, etc. In various capacities he served several national and international organizations as UNESCO, INCOR, SCOR, IOBC, ICAR, CSIR, ZSI, FRI and a number of Universities. To his credit, he has a good number of admirers, particularly his students, who are now occupying high positions in India and abroad.

He is now survived by his wife, two sons and two daughters.

G. C. RAO

### List of Publications of Professor P. N. Ganapati.

| <i>Author</i>                       | <i>Year</i> | <i>Title, Journal, Vol., No. P.</i>                                                                                                                                                                         |
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