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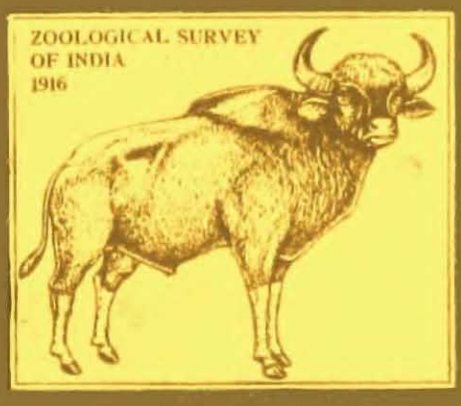

BULLETIN OF THE ZOOLOGICAL SURVEY OF INDIA

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BULLETIN OF THE ZOOLOGICAL SURVEY OF INDIA

CONTENTS

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SOME MITES ASSOCIATED WITH BIRDS' NESTS IN WEST BENGAL, WITH DESCRIPTIONS OF ELEVEN NEW SPECIES

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ABSTRACT

Twenty six species belonging to twenty three genera, eighteen families and four suborders are reported here from nests of five species of birds, *viz.* (1) *Ploceus philippinus* (2) *Passer domesticus*, (3) *Prinia inornata*, (4) *Orthotomus sutorius* and (5) *Streptopelia chinensis*. This included descriptions of eleven new species belonging to the genera *Pronematus* Canestrini, *Chelatacarus* Volgin, *Cunaxa* von Heyden, *Cheylostigmaeus* Willmann, *Stigmaeus* Koch, *Agistemus* Summers, *Spinibdella* Thor, *Bdella* Latreille, *Acheles* Oudemans and *Steatonyssus* Kolenati. Six genera and one species are reported here for the first time from India.

INTRODUCTION

The study of nest associated mites in India was initiated by Ramachandra Rao and Rajagopalan (1970) when they reported 12 species of mites from nests of six species of birds. Later, Gupta and Chattopadhyay (1979) in their study reported 18 species belonging to 16 genera, 12 families in 5 suborders which included one new species and 2 new records from India. The important contributions in this field from the other parts of the world are Moreau (1942), Hoyt (1948), Woodroffe (1953), Woodroffe and Southgate (1951), Nolan (1955), Baker *et al.* (1976), Philips & Dindal (1979), etc. The junior author, while studying the bird behaviour, collected a number of mites along with several other arthropods and arachnids. From those, the present paper is based on the collection of mites. A total of twenty six species belonging to 18 families and 4 suborders are treated, of those, 11 new species are described and illustrated, while collection records are provided for the other species. Types of all the new species are deposited in the National Collection of the Zoological Survey of India, Calcutta. The entire collection was made by the junior author. All measurements given in the text are in microns.

MATERIAL & METHODS

Nests of five birds, *viz. Ploceus philippinus* Linn. (Fam. Ploceidae), *Passar domesticus* Linn. (Fam. Ploceidae), *Orthotomus sutorius* Latham. (Fam. Musicapidae), *Prinia inornata* (Fam. Musicapidae) and *Streptopelia chinensis* Gmelin (Fam. Columbidae) were collected from village Patharkumkumi (Dist. Midnapur) during 1977-1980. In case of *P. philippinus*, the nests were hanging from *Borassus flabellifer* (Fam. Palmae). These nests were retort shaped with a long vertical entrance tube and were woven out with fine strips of sugarcane, paddy and palm leaves. Blocks

of mud were also seen inside the nest. The nests of *Passer domesticus* were collected from the ceiling of a cottage. The nesting material were dry paddy leaves and other debris with lining of feathers in most of the cases except in one instance where cotton wool was used for inner lining. The nests of *Orthotomus sutorius* were collected from bushes. Two nests were collected from a low mango branch while one was collected from a branch of a fig tree. In all cases 2-3 leaves were beautifully sewed and plastered with cob-web. In case of *Prinia inornata*, one nest was built on a corn leaf, three were built on *Lantana camara* and one was on *Vitex negundo*. In all cases grass was used as building material. The nests were dome or purse shaped with a small side entrance. Nests of *Streptopelia chinensis* was collected from mango tree and one was found in a varandah of a rejected cottage. The nests were built of flimsy pads of thin twigs. In addition, two nests were also collected from a dead tree. All the nests were collected and brought to the laboratory in polythene bags after tightly closing the mouth of the bag with rubber bands. Those were subjected to heat treatments for the extraction of mites. The specimens were preserved in 75% alcohol.

Results

Altogether 26 species belonging to 4 suborders, *viz.* Prostigmata, Astigmata, Mesostigmata and Cryptostigmata were collected and, of those, 11 were new to science. Also 6 genera and 1 species are new records for India. The majority are recorded here for the first time from the state of West Bengal. Taking an overall view, it appears that nests of *Ploceus philippinus* offered shelter to the largest number of species. A list of the species and the nests of birds from where those were collected is given in Table I. Descriptions of new species and collection records for other species are given below.

Suborder : Prostigmata

Family : Tydeidae Kramer

Genus : **Pronematus** Canestrini

1. **Pronematus bengalensis** sp. nov.

(Figs. 1-6)

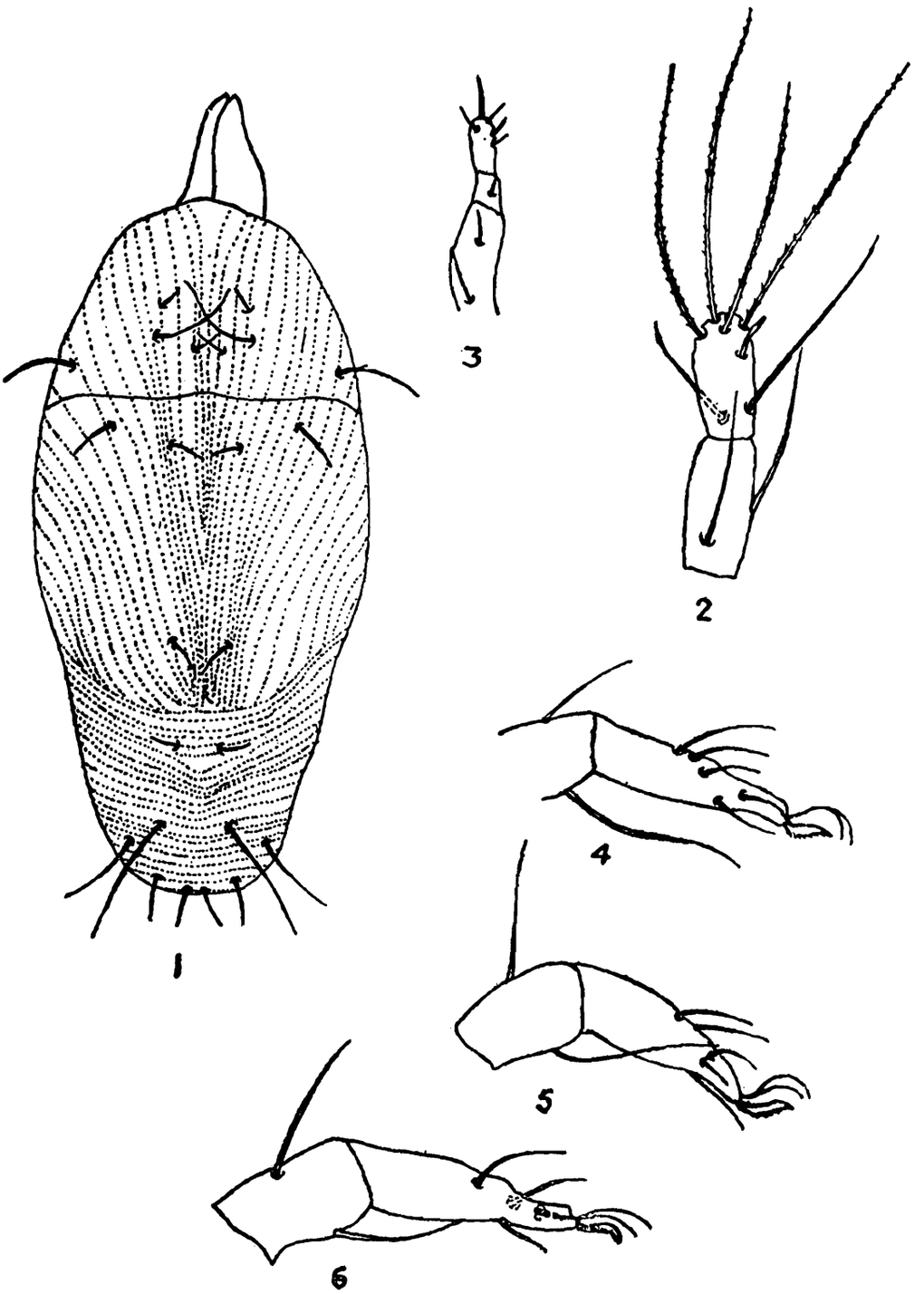
Female : Rostrum elongate, palpus elongate, setal pattern typical for the genus; terminal seta 1/2 as long as segment, striae on propodosoma longitudinal with lobes. Seta P1 7, shorter than P2 (14); P2 shorter than P3 (29). Sl-38, over $2\frac{1}{2}$ times as long as P2. Striae on hysterosoma fine, as indicated in figure. Setae D1-D3 almost of similar length (11-12); D4-20 long, D4-25 long. L1 and L2 of same length (20), L3-47 long, L4-38 long. Tarsus I slightly shorter than tibia I (20 : 13); out of 4 terminal setae, two are long (36) and the other two are of same length (25), all being serrate throughout length; solenidion I-6 long, situated more towards the anterior end of the segment; solenidion II slightly thinner but almost of same length. Ventral setae of tibia I-22 long, do not reach middle of the shorter setae of tarsus I; most of the other leg setae serrate. Length of body 291 (from tip of gnathosoma upto posterior tip of body), width 124 (maximum).

Male : Unknown.

Holotype ♀, INDIA : West Bengal : Midnapur Dist., Vill. Patharkumkumi, 5. vii. 1977, ex nest of baya, *Ploceus philippinus*, ZSI Reg. No. 3216/17.

TABLE 1.

	BIRDS				
	S. O. Passeriformes				S. O. Columbiformes
	Fam. Ploceidae		Fam. Musicapidae		Fam. Columbidae
	Ploceus philippinus (1)	*Passer domesticus* (2)	*Orthotomus sutorius* (3)	*Prinia inornata* (4)	*Streptopelia chinensis* (5)
S. O. Prostigmata Fam. Tydeidae					
1. *Pronematus bengalensis* sp. nov.	+	—	—	—	—
2. *P. indiana* sp. nov.	+	—	—	—	—
Fam. Cheyletidae					
3. *Chelatacarus ploceus* sp. nov.	+	—	—	—	—
4. *Chelacaropsis moorei*	+	—	—	—	—
Fam. Cunaxidae					
5. *Cunaxa prinia* sp. nov.	—	—	—	+	—
6. *C. capreolus*	+	—	—	—	—
7. *C. setirostris*	+	—	—	—	—
Fam. Stigmaeidae					
8. *Cheylostigmaeus midnapurensis* sp. nov.	—	—	+	—	—
9. *Stigmaeus woodi* sp. nov.	—	—	—	—	+
10. *Agistemus prinia* sp. nov.	—	—	—	+	—
Fam. Bdellidae					
11. *Spinibdella atyeoi* sp. nov.	—	—	—	+	—
12. *Bdella bakeri* sp. nov.	—	+	—	—	—
Fam. Raphignathidae					
13. *Acheles meyerae* sp. nov.	—	—	—	+	—
Fam. Tetranychidae					
14. *Eotetranychus* sp.	+	—	—	—	—
Fam. Erythraeidae					
(Undet. spp.)	—	+	—	—	—
Fam. Tarsonemidae					
15. *Tarsonemus* sp.	+	—	—	—	—
S. O. Astigmata					
Fam. Protolichidae					
16. *Protolichus* sp.	+	—	—	—	—
Fam. Acaridae					
17. *Tyrophagus putrescentiae*	+	—	—	—	—
other Acarids	+	—	—	+	—
Fam. Glycyphagidae					
18. *Glycyphagus domesticus*	+	+	—	—	—
19. *G. destructor*	—	+	—	—	—
S. O. Mesostigmata					
Fam. Phytoseiidae					
20. *Amblyseius largoensis*	+	—	—	—	—
Fam. Ascidae					
21. *Asca pseudospicata*	+	+	—	+	—
Fam. Macronyssidae					
22. *Ornithonyssus* sp.	—	+	—	—	—
23. *Steatonyssus flabellifer* sp. nov.	+	—	—	—	—
Fam. Ameroseiidal					
24. *Lasioseius* sp.	+	—	—	—	—
S. O. Cryptostigmata					
Fam. Oribatulidae					
25. *Scheloribates albialatus*	—	+	—	—	+
Fam. Parakalummidae					
26. *Protokalumma* sp.	—	—	—	—	+



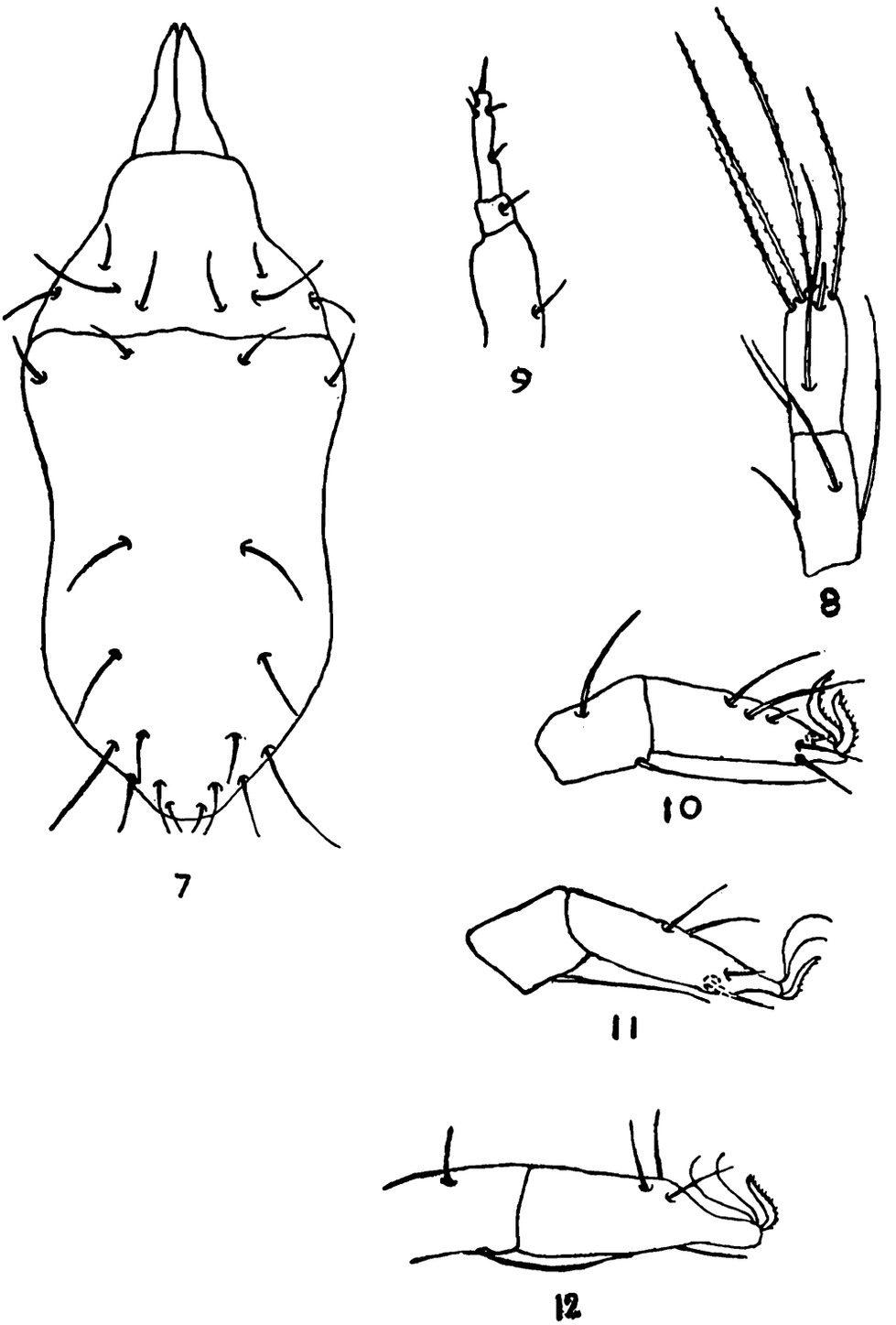
Figs. 1-6. *Pronematus bengalensis*, sp. nov. ♀ : 1. dorsal view, 2, tibia and tarsus I, 3. palpus, 4. tibia and tarsus of leg II, 5. tibia and tarsus of leg III, 6. tibia and tarsus of leg IV.

Remarks : This species differs from *P. fleschneri* Baker, in the relative lengths of tarsal setae of leg I, as well as in the relative length of tarsus and tibia of leg I.

2. **Pronematus indiana** sp. nov.

(Figs. 7-12)

Female : Rostrum elongate but not deeply cleft. Chelicera normal, distal segment of



Figs. 7-12. *Pronematus indiana* sp. nov. ♀ : 7. dorsal view, 8. tibia and tarsus of leg I, 9. palpus, 10. tibia and tarsus of leg II, 11. tibia and tarsus of leg III, 12. tibia and tarsus of leg IV.

palpus elongate, terminal setae moderately long. Propodosomal reticulations so faint that apparently it is indistinguishable. Seta P1 shorter than P2, P3 being longest, S1-36, (1½ times as long as P2); all the propodosomal setae apparently appear to be smooth. Hysterosomal striation as presented in figure. The length of D1, D2, D3, D4, D6, L1, L2, L3, and L4 are 25, 29, 27, 27, 16, 23, 34, 58 and 43, respectively. Ventral body setae short, mostly lanceolate. Tarsus I-18, tibia I-20, long, all the terminal setae long, smooth,

2 being longer (67) than the other 2 (47). Solenidion on tarsus I long, almost as long as width of the segment, setae on other legs long, appear to be smooth. Solenidion of tarsus II $\frac{1}{2}$ as long as solenidion of tarsus I. Body 285 long, 101 wide.

Holotype ♀, INDIA : WEST BENGAL : Midnapur Dist., Vill. Patharkumkumi, 5.vii. 1977, ex nest of baya, *Ploceus philippinus*, ZSI Reg. No. 3217/17.

Paratypes 2 ♀ ♀, locality same as in holotype, ex nest of sparrow, *Passer domesticus*, ZSI Reg. No. 3218/17 and 3219/17.

Remarks : This species differs from *P. mcgregori* Baker, in lacking the deep cleft on the rostrum and also in the relative lengths of the idiosomal setae.

Family : CHEYLETIDAE Leach

Genus : **Chelatacarus** Volgin

3. **Chelatacarus ploceus** sp. nov.

(Figs. 13-15)

Female : Body 433 long, 306 wide, palp tarsal claw with tooth-like projections towards tip. Two pairs of comb-like setae, each pcssesses at least 15 teeth ; sickle shaped setae 1 pair. Protegmen with fine longitudinal striations. Tegmen also striated. Propodosomal plate finely granulated, with 6 pairs of fan-shaped setae. Eyes 1 pair present between leaf-like and fan-shaped setae. Hysterosomal plate absent but setae present on small platelets ; all setae fan-like. Setae on venter short and simple. Chaetotaxy of femur, genu, tibia and tarsus of legs I-IV are respectively, I : 2-2-3-7 ; II : 2-2-2-7 ; III : 2-2-2-7 ; IV : 1-1-2-8. Genu, tibia and tarsus of leg I with long leaf-like setae, tibia and tarsus of leg II with also similar leaf-like setae, in addition, genu, tibia, tarsus of leg III and IV also with leaf-like setae, of those, the setae on tarsus of both legs are longer and double the length of setae on genu and tibia. Solenidion on tarsus I quite long, guard seta apparently absent. Claws of leg I smaller than those of legs II-IV. Length of gnathosoma 101, idiosoma-358, leg I-191, tarsus I-78.

Holotype ♀, INDIA : WEST BENGAL : Midnapur dist., Patharkumkumi, 15.vii.1977, ex nest of baya, *Ploceus philippinus*, ZSI Reg. No. 3220/17.

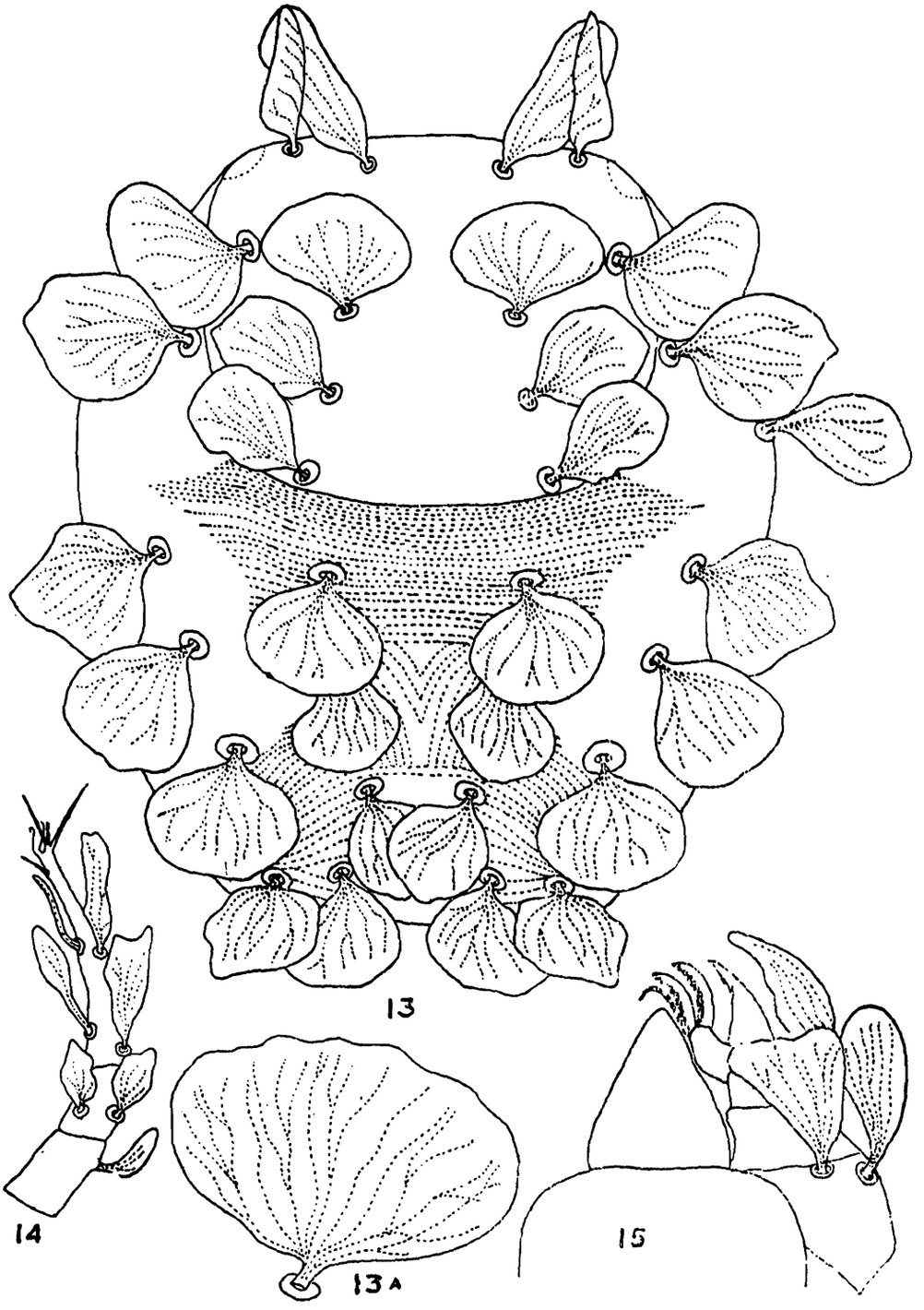
Remarks : This species is presently placed in the genus *Chelatacarus* Volgin, because like *Chelatacarus*, it has only a propodosomal plate bearing 6 pairs of setae, palp tarsus with only 2 comb-like setae, body setae fan-shaped and median hysterosomal plate absent, but unlike *Chelatacarus* it lacks teeth along the entire margin of pedipalpal claw and has only one sickle-shaped seta instead of two as in *Chelatacarus*. In spite of the differences this species is kept in *Chelatacarus* until the time further material is obtained enabling the study of the constancy of these characters. This species differs from *Chelatacarus gryphus* Summers and Price, in having only 8 pairs of setae on the hysterosoma, and also in nature of the propodosomal and hysterosomal setae.

Genus : **Chelacaropsis** Baker

4.. **Chelacaropsis moorei** Baker

Material examined : 1 ♀, WEST BENGAL : Midnapur Dist., Patharkumkumi, 15. vii. 1979, ex nest of *Ploceus philippinus*.

Remarks : Gupta and Chattopadhyay (1979) also reported this species from the nest of *Lonchura striata* and *Ploceus manyar flaviceps*.



Figs. 13-15. *Chelatacarus ploceus*, sp. nov. ♀ : 13. dorsum, 13a. enlarged view of dorsal seta. 14. distal segments of leg I, 15. gnathosoma.

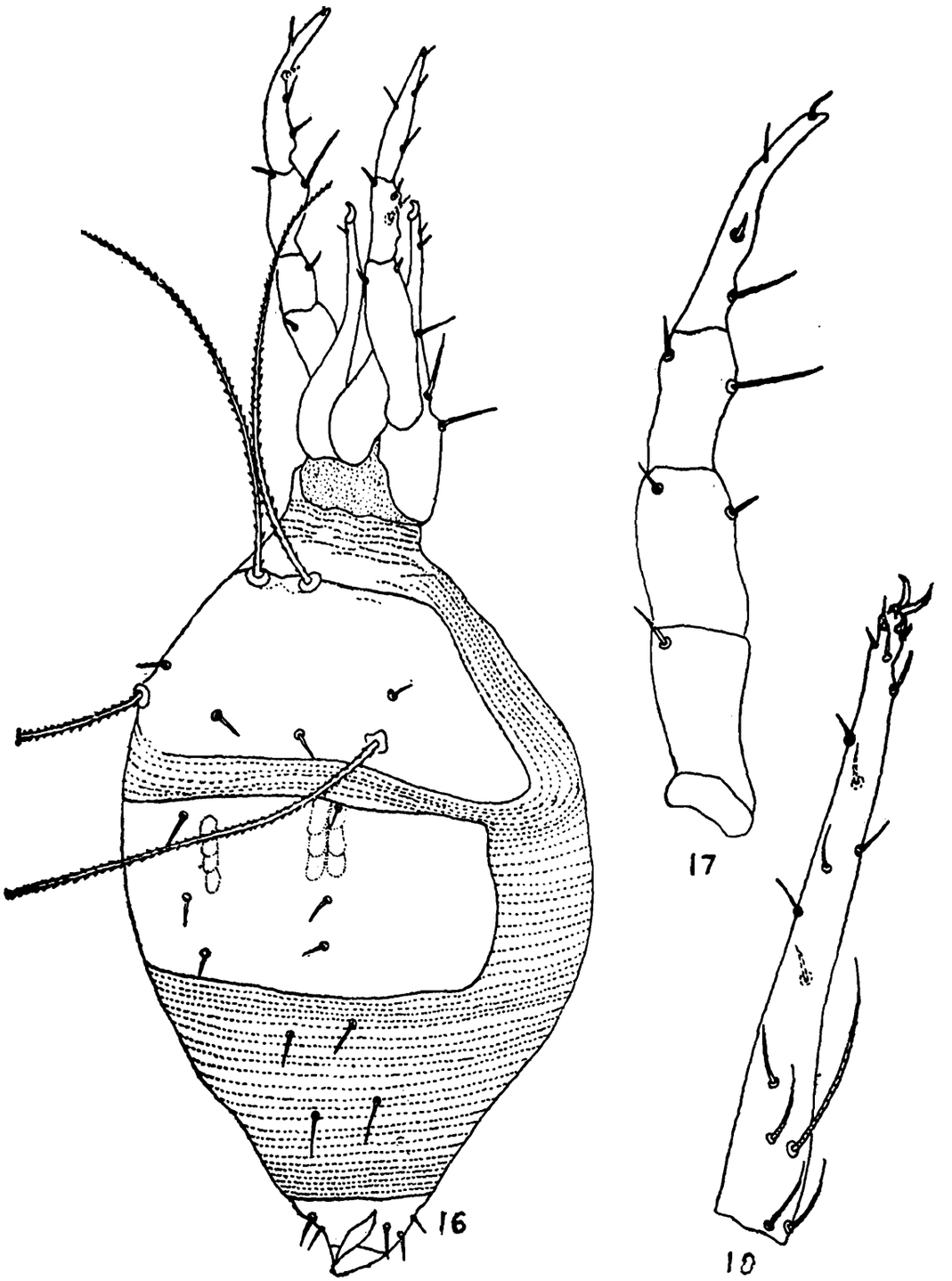
Family : CUNAXIDAE Thor

Genus : **Cunaxa** von Heyden

5. **Cunaxa prinia** sp. nov.

(Figs. 16-18)

Female : Palp 5-segmented, 146 long, extending well beyond hypostome. Chaetotaxy of palp trochanter-nil, basifemur with one inner lateral seta, telofemur with one short outer lateral seta and one sharp inner lateral seta;



Figs. 16-18. *Cunaxa prinia*, sp. nov. 16. dorsum, 17. left palp, 18. left tarsus I.

all being simple ; tibiotarsus with one long simple innerlateral seta, anterior to it one short anterodorsal seta and a short inner lateral seta, anteriorly two outer lateral setae almost of same length. Chelicera broad at base, gradually tapering distally extending almost upto half the length of palp genu ; with sickle shaped movable digit. Gnathosoma rectangular at the base, attenuate distally. Propodosoma with 2 pairs of short setae, of those, anterior pair shorter than posterior pair. Hysterosoma also with a shield having 3

pairs of setae of same length, the outer 2 pairs of hysterosomal setae on scutum. Coxal setal formula 2 : 1 : 1 : 1. Three pairs of ventral setae present between coxae II and posterior tip of body. Leg IV being longest, tarsi longer than other leg segments. Tarsi I-IV with 2 claws. Chaetotaxy of basifemur, telofemur, genu, tibia and tarsus of legs are respectively I : 1, 2, 4+1 solenidion, 4, 14+4 solenidia, II : 2, 2, 2+1 solenidion, 4+1 solenidion, 12+2 solenidia, III : 3, 4, 4+1 solenidion, 5, 8 ; IV : 0, 3, 5+1 solenidion, 3+1 duplex setae, 13. The anterior legs directed forward, posterior legs directed backwards.

Male : Unknown.

Holotype ♀, India : WEST BENGAL : Midnapur Dist., Patharkumkumi, 18.vi.1980, ex nest of *Prinia inornata*, ZSI Reg. No. 3221/17.

Remarks : This species is easily distinguished from all other known species by the character of the dorsal scutum and by the palpal chaetotaxy.

6. **Cunaxa capreolus** (Berlese)

Scirus capreolus Berlese, 1890, *Acari, Myriapoda et Scorpiones hucusque in Italia*, Fasc. 57 (9).

Cunaxa capreolus, Vitzthum, 1929, *Tierwelt Mitteleuropas*, **3** (3) : 60.

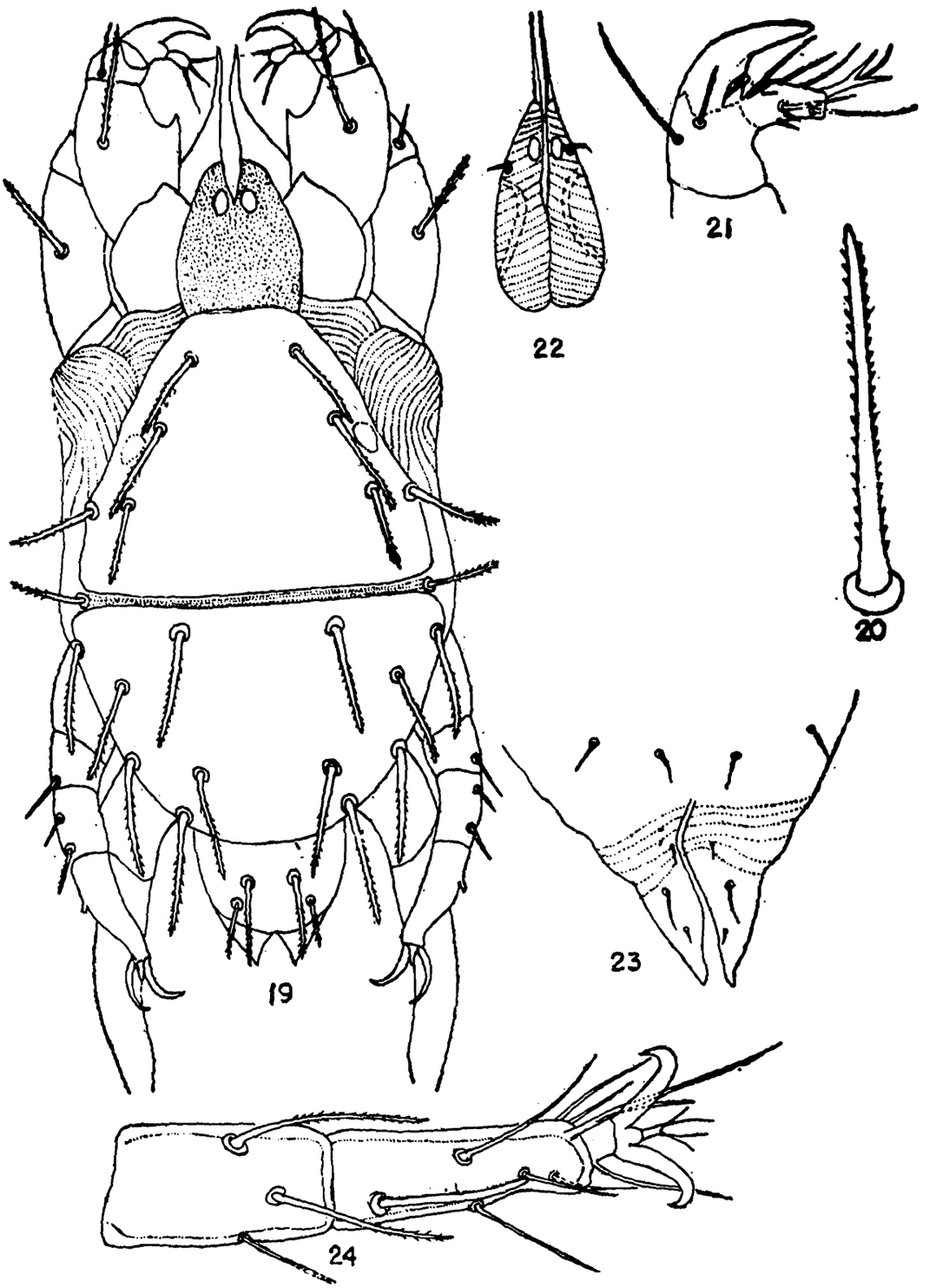
Cunaxa capreolus, Baker & Hoffman 1948, *An. Esc. Nac. Cienc. Biol. Mexico*, **5** : 231-232.

Cunaxa capreolus, Muma, 1980, *Ann. Ent. Soc. Amer.*, **53** : 324.

Female : Palpi 5 segmented, 192 long, extending beyond hypostome. Chaetotaxy of palpus : trochanter-nil, basifemur-one outerlateral simple seta, telofemur-innersurface with sabre-like hooked process projected upward, one outerlateral simple seta ; genu-inner surface with a strong spine, one anterior midventral seta and one simple outerlateral seta ; tibiotarsus-proximally with one spine-like seta outerlaterally adjacent to it one midventral seta and one long simple seta at the inner surface ; anterior to it a small seta at the distal tip ; tibiotarsus sharply hooked at the distal tip. Chelicera attenuate, broadest at base, extending beyond base of palp genu ; fixed digit absent, movable digit curved and sharply pointed. Gnathosoma subtriangular ; attenuate distally, 3 pairs of long marginal setae. Propodosoma with smooth subrectangular shield with 2 pairs of finely branched sensory setae and 2 pairs of simple setae, Hysterosoma partly covered with a rectangular shield with 4 pairs of simple setae. Posterior to gnathosomal shield fine transverse striae present ; lateral to the shield this striation pattern roughly longitudinal. Coxa I and II contiguous, coxae III and IV also contiguous. Coxal setal formula 2 : 1 : 2 : 1, 5 pairs of setae present between coxae II and distal portion of body. Leg I and II directed anteriorly, III and IV directed posteriorly. Setation of basifemur, telofemur, genu, tibia and tarsus of legs I, II, III and IV are, respectively I : 3, 3, 4+1 solenidion+1 duplex setae, 3+1 duplex setae, 19+3 solenidia ; II : 4, 4, 6+1 solenidion, 5+1 solenidion, 18+2 solenidia, III 3, 4, 4, 4, 16 ; IV : 1, 4, 5, 4+1 trichobothrium, 19. Tarsi I-IV attenuate, longer than combined length of genu+tibia ; tarsi I-IV with 2 claws and empodium. Body 710 long (from base of gnathosoma upto posterior tip of body) and 310 wide.

Material examined : 1 ♀, WEST BENGAL : Midnapur Dist., Patharkumkumi, 15.vii. 1979, ex nest of baya, *Ploceus philippinus* ; 1 ♀, same locality and habitat, 18. vii. 1980.

Remarks : This is the first record of this species from India. This species is redescribed here since the earlier descriptions are inadequate.



Figs. 19-24. *Cheylostigmaeus midnapurensis* sp. nov. ♂ : 19. dorsal view, 20. enlarged view of dorsal body seta, 21. left palpus, 22. chelicera, 23. opisthosomal region, 24. terminal segment of leg I.

7. **Cunaxa setirostris** (Hermann)

Scirus setirostris Hermann, 1804, *Mem. Apt.* P. 62.

Cunaxa setirostris von Heyden, 1826, *Isis* (Oken), 18 : 608.

Cunaxa setirostris, Baker & Hoffman, 1948, *An. Esc. Nac. Cienc. Biol. Mexico*, 5 : 237-238.

Cunaxa setirostris, Muma, 1960, *Ann. Ent. Soc. Amer.*, 53 : 324.

Cunaxa setirostris, Singh & Mukharji, 1971, *Oriental Ins.*, **5** : 488.

Cunaxa setirostris, Gupta & Ghosh, 1980, *Rec. Zool. Surv. India*, **77** : 194-195.

Material examined : 1 ♀, WEST BENGAL : Midnapur Dist., Patharkumkumi, 15. vii. 1979, ex nest of *Ploceus philippinus*.

Family : STIGMAEIDAE Oudemans

Genus : **Cheylostigmaeus** Willmann

8. **Cheylostigmaeus midnapurensis** sp. nov.

(Figs. 19-24)

Male : Basal segments of chelicera ornamented dorsally with a knob-like process in each chelicera. Rostrum apparently without process. Pedipalp robust, palp femur heavily sclerotized, mesal surface with sharp apophysis, as in figure. Palp tibial claw strong, 2 times as long as tarsus and about $1\frac{1}{2}$ times as long as tibia. Accessory claw on tibia well developed, tarsus with well developed trifid process ; the other setae present as usual. Dorsal idiosomal setae all thick, pubescent specially at tip. Propodosoma with 4 pairs and hysterosoma with 6 pairs of setae. A pair of humerals also present. The measurements of setae : vertical dorsal seta-49, preocular dorsal seta-63, being the longest. The other setae on propodosoma vary between 40-48. The length of hysterosomal setae vary between 50-60, however, their length being shorter than the distance between succeeding setae. Solenidion on tarsus I-33 long. Tarsus of leg I being longest, others of almost same length. Idiosoma -246 long, 180 wide, distance from base of rostrum upto tip of chelicera- 134, posteriormost hysterosomal seta-58. Most of the leg setae being plumose at the tip.

Female : Unknown.

Holotype ♂, INDIA : WEST BENGAL : Midnapur Dist., Pathakumkumi, 29.iv.1978, ex nest of tailor bird, *Orthotomus sutorius*, ZSI Reg. No. 3224/17.

Paratype : 1 ♂, data same as for holotype, (both holotype and paratype mounted on same slide) ZSI Reg. No. 3225/17.

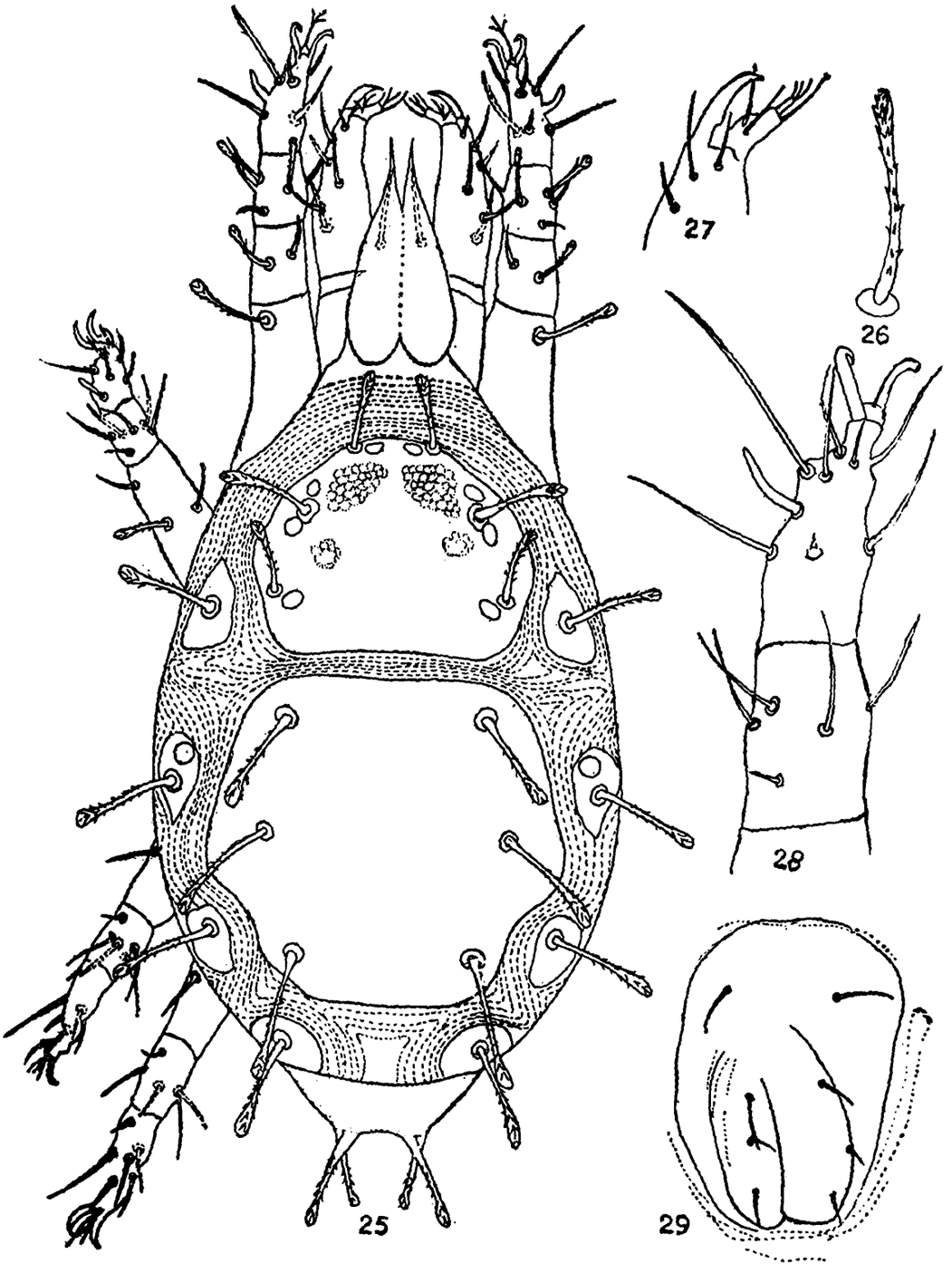
Remarks : This species is related to *Cheylostigmaeus torulus* Summers, but differs from the latter in having the palpal claw more strongly developed, in the relative length and nature of the dorsal setae, and in having a simple and sharp apophysis on the palpal femur.

Genus : **Stigmaeus** Koch

9. **Stigmaeus woodi** sp. nov.

(Figs. 25-29)

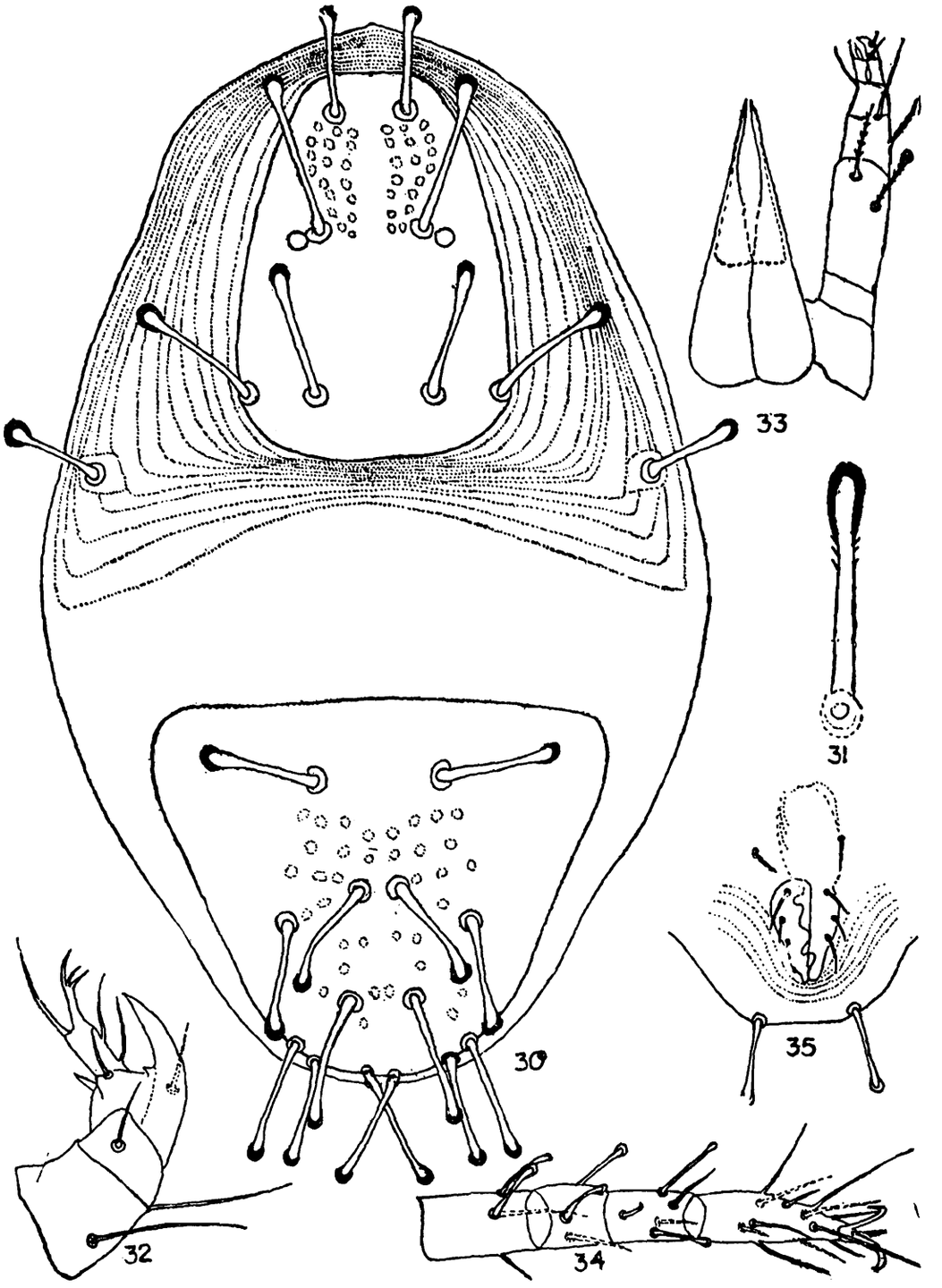
Female : Central plate characteristically shaped as in figure ; plates moderately sclerotized, propodosomal plate rugose anteriorly, rest of the plate non-reticulate with 3 pairs of setae (ae, be, ce), all being weakly serrate with spatulate tip, and measuring 39, 49 and 31, respectively. Central plate also possesses 3 pairs of setae, a, b, c, measuring 45, 45 and 47, respectively and are of similar nature as on propodosomal plate. Auxillary plates absent. Humeral plates well separated from propodosomal, non-reticulate, with humeral setae-45. Marginal plate distinct, la-45 ; lateral zonal plate as illustrated with seta lm-45. Intercalaries well separated, li-52. Setae le-27, being shorter than e (39). Ventrally, anal plate as figured. Macroseta IV spatulate, weakly serrate-27, empodial raylets pointed ; striations longitudinal between I and II pairs of legs and also between III and IV pairs of legs but transverse in the region between II and III pairs of legs ; striations ">" shaped marginally



Figs. 25-29. *Stigmaeus woodi* sp. nov. ♀ : 25. dorsal surface, 26. enlarged view of dorsal body seta, 27. palpus, 28. terminal segments of leg I, 29. opisthosoma.

and transverse in the region posterior to IV pairs of legs and upto anal plate. Length of idiosoma (from base of gnathosoma upto posterior tip of body)-358, solenidia w1-20, w2-11, kI-29, KII-22. Macroseta IV/l'-1.2, be/ce-1.4, striations longitudinal.

Holotype ♀, INDIA : West Bengal : Midnapur Dist., Patharkumkumi, 9.v.1980, ex



Figs. 30-35. *Agistemus prinia* sp. nov. ♀ : 30. dorsum, 31. enlarged view of dorsal body seta, 32. palpus, 33. chelicera and palp, 34. terminal segments of leg I, 35. opisthosoma.

nest of dove, *Streptopelia chinensis*, ZSI Reg. No. 3226/17.

Remarks : This species is similar to *Stigmaeus scabre* Summers, but can be easily distinguished from the latter by the nature of the dorsal setae.

Genus : **Agistemus** Summers

10. **Agistemus prinia** sp. nov.
(Figs. 30-35)

Female : Fairly large mite with prominent postocular body. Propodosomal plate rugose with 4 pairs of setae, all being thick,

plumose, tip spatulate with hyaline margin. Measurements of setae : vertical-49, preocular-60, postocular I-49, II-56. Area lateral to the propodosomal plate longitudinally striated and the region immediately posterior to the plate transversely striated ; humeral seta-40 long. Hysterosomal plate also rugose, with 7 pairs of setae, their length vary between 52-62. Ventrally variously striated, region beween I and II legs with longitudinal striations, posterior to that transversely striated, region between III and IV legs longitudinally striated. Three pairs of setae present in the region from base of leg I-IV ; 3 pairs of setae present on genital plate,-all being equal (18) and one pair present around it anteriorly. Leg II and I contiguous, legs III and IV also contiguous. Pedipalp with femur longest, tibial claw about $1\frac{1}{2}$ times as long as palp tarsus ; the latter with a trifid process. Cheliceral bases ornamented. Tarsus I and tibia I with solenidia, tarsus II and tibia II also with solenidia, all short and almost of equal length.

Holotype ♀, INDIA : WEST BENGAL : Midnapur Dist., Patharkumkumi, 9.iv.1979, ex nest of *Prinia inornata*, ZSI Reg. No. 3227/17.

Paratypes 2 ♀ ♀, data same as for holotype, ZSI Reg. No. 3228/17.

Remarks : This species is easily separated from all the related species by the peculiar idiosomal setae.

Family : BDELLIDAE Dugés

Genus : **Spinibdella** Thor

11. **Spinibdella atyeoi** sp. nov.

(Figs. 36-40)

Female : Body 816 long (including rostrum), chelicera almost as long as palpal femur, ves -158 long, des-229 long. Chelicera longitudinally striated ; gnathosomal base of buccal cone striated ; dorsal hysterosomal setae simple, 61 long. Dorsal idiosomal striae as represented. Propodosoma cone -shaped, dorsum striatad with 3 pairs of setae including 2 pairs of sensilla ; both being broken ; anterior sensilla separated by 51 ; posterior sensilla lie apart 138. Hystoresomal setae almost of similar length, internal humeral -77 long, external humeral -76 long. Propodosoma and hysterosome not significantly separated. Ventral idiosomal setae short, somewhat blunt, each genital plate with 5 setae, of those, 4 are in linear arrangement. Two pairs of paraanal setae present. Each claw with about 5-7 rays. Tibia I- 71 long, tarsus I- 83 long, pretarsus- 22 long, tibia IV- 40 long, tarsus IV- 112 long. Coxal setal formula : 5, 2, 3, 2. Other chaetotaxy of legs not possible to examine because those being crumpled.

Holotype ♀, INDIA : WEST BENGAL : Midnapur Dist., Patharkumkumi, 9.viii.1980, ex nest of *Prinia inornata*, ZSI Reg. No. 3229/17.

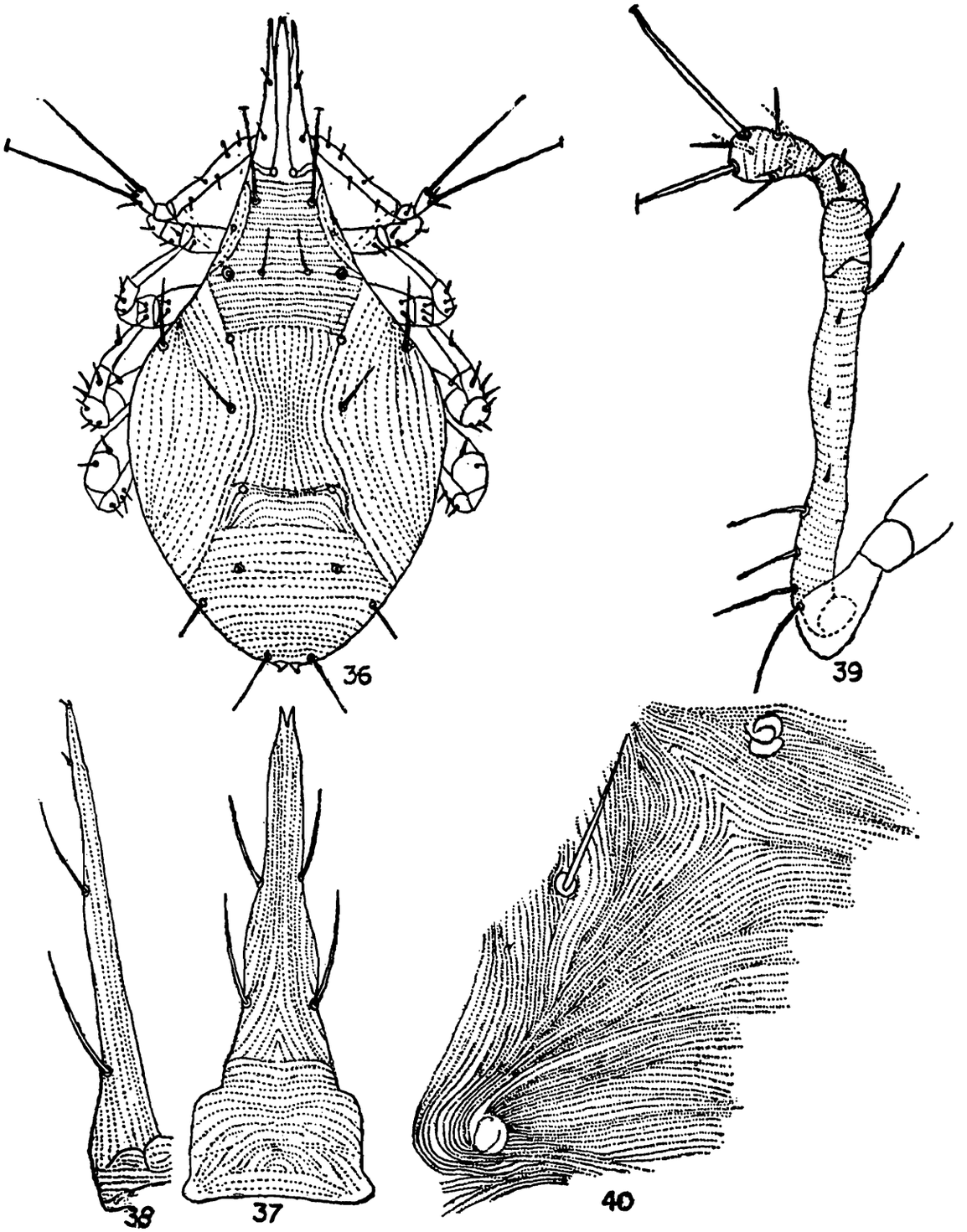
Remarks : This species differs from *Spinibdella thori* (Meyer & Ryke), in that the internal humeral seta are longer than the first interspaces.

Genus : **Bdella** Latreille

12. **Bdella bakeri** sp. nov.

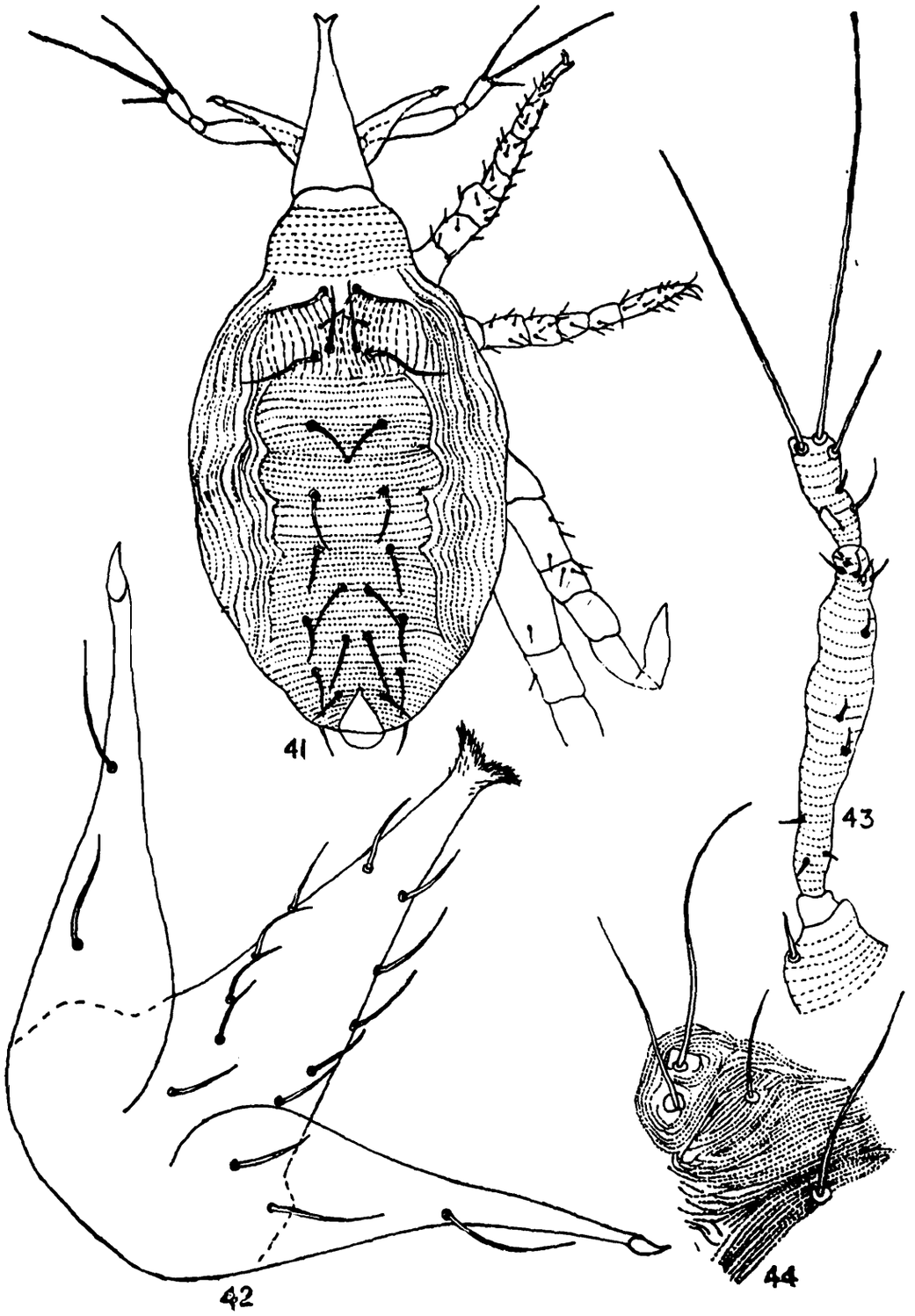
(Figs. 41-44)

Female : Body 965 long. Palpus with telofemur and genu incompletely fused, ves-147, des- 189. Chelicera with faint longitudinal striae, 229 long, setae as figured. Gnathosomal base striated ; buccal cone with longitudinal striae, dorsal hysterosomal seta -34. Dorsal idiosoma striated ; anterior sensillum -112 long, posterior sensillum- 102



Figs. 36-40. *Spinibdella atyeoi* sp. nov. ♀ : 36. dorsal surface, 37. ventral aspect of gnathosoma, 38. chelicera, 39. palpus, 40. sensillum and pseudostigmatid organ.

long, median propodosomal seta- 51 long. Hysterosomal setae all simple, internal humeral- 66 long, ventral idiosoma striated. Each genital plate with 7 setae in linear arrangement ; 5 pairs of paragenital and 3 pairs of paraanal setae. Legs with each claw at least 7 rayed, tibia I- 54 long, tarsus I- 69 long, tibia II -49 long, tarsus II- 56 long, tibia IV- 67 long. Setae of trochanter I-IV : 3, 2, 1, 1 ; basifemur : 8, 6, 4, 7 ; telofemur : 6, 6, 5, 4 ;



Figs. 41-44. *Bdella bakeri* sp. nov. ♀ : 41. dorsal surface, 42. ventral aspect of gnathosoma, 43. palp, 44. sensillum and pseudostigmatid organ.

tarsus IV with a trichoboth and a sensory seta ; tarsus II with 2 blunt sensory setae ; tarsus III also with a trichoboth.

Male : Unknown.

Hololype ♀, INDIA : West Bengal : Midnapur Dist., Patharkumkumi, 29.vi.1980,

ex nest of dove, *Streptopelia chinensis*, ZSI Reg. No. 3230/17.

Remarks : This species differs from *Bdella captiosa* Atyeo, in the striation pattern of the dorsum and in the leg chaetotaxy.

Family : RAPHIGNATHIDAE Karmer

Genus : **Acheles** Oudemans

13. **Acheles meyerae** sp. nov.

(Figs. 45-47)

Female : Body elongated, oval, length (excluding gnathosoma) 302, width 179.

Dorsum : Striated, with 4 plates. Anterior median plate bears 3 pairs of setae, of those, the anterior and posterior are of same length, median longer. Lateral plate bears 3 pairs of setae and one pair of eyes. The posterior median plate with 3 pairs of setae. Two pairs of setae present on the striated region, each on small platelets. Anteriorly, interscutal membrane with longitudinal striation, posteriorly striations are transverse. Supraanal plate with 2 pairs of setae.

Venter : 3 setae surrounding genital opening. Three pairs of setae present in the region from base of 4th pairs of legs up to anterior end of genital plate ; another 2 pairs of setae present between bases of 1st and 3rd pairs of legs ; bases of all four legs contiguous.

Gnathosoma : Penultimate segment of palp with short claw. Palpal tarsus much longer than claw with 4 blunt setae at tip (setae longer than segment). Chelicerae fused medially, movable chela stylet like. Peritreme ends in basal portion of chelicera.

Legs : First and fourth pairs of legs longer, second and third pairs of legs equal but shorter than former two pairs, each leg tarsus possesses 2 well developed claws and empodium. Tarasus I and II each with a clavate sense organ, that on tarsus III much shorter.

Male : Unknown.

Holotype ♀, INDIA : WEST BENGAL : Midnapur Dist., Patharkumkumi, 18.vi.1980, ex nest of *Prinia inornata*, ZSI Reg. No. 3231/17.

Paratype : 1 ♀, same locality and habitat, as for holotype, 19.vi.1980.

Remarks : This species differs from *Acheles aethiopica* Meyer and Ryke in the shape of the plates, in the striation pattern, and in having only two pairs of setae between the anterior median and posterior median plates.

Family : TETRANYCHIDAE Donnadieu

Genus : **Eotetranychus** Oudemans

14. **Eotetranychus** sp.

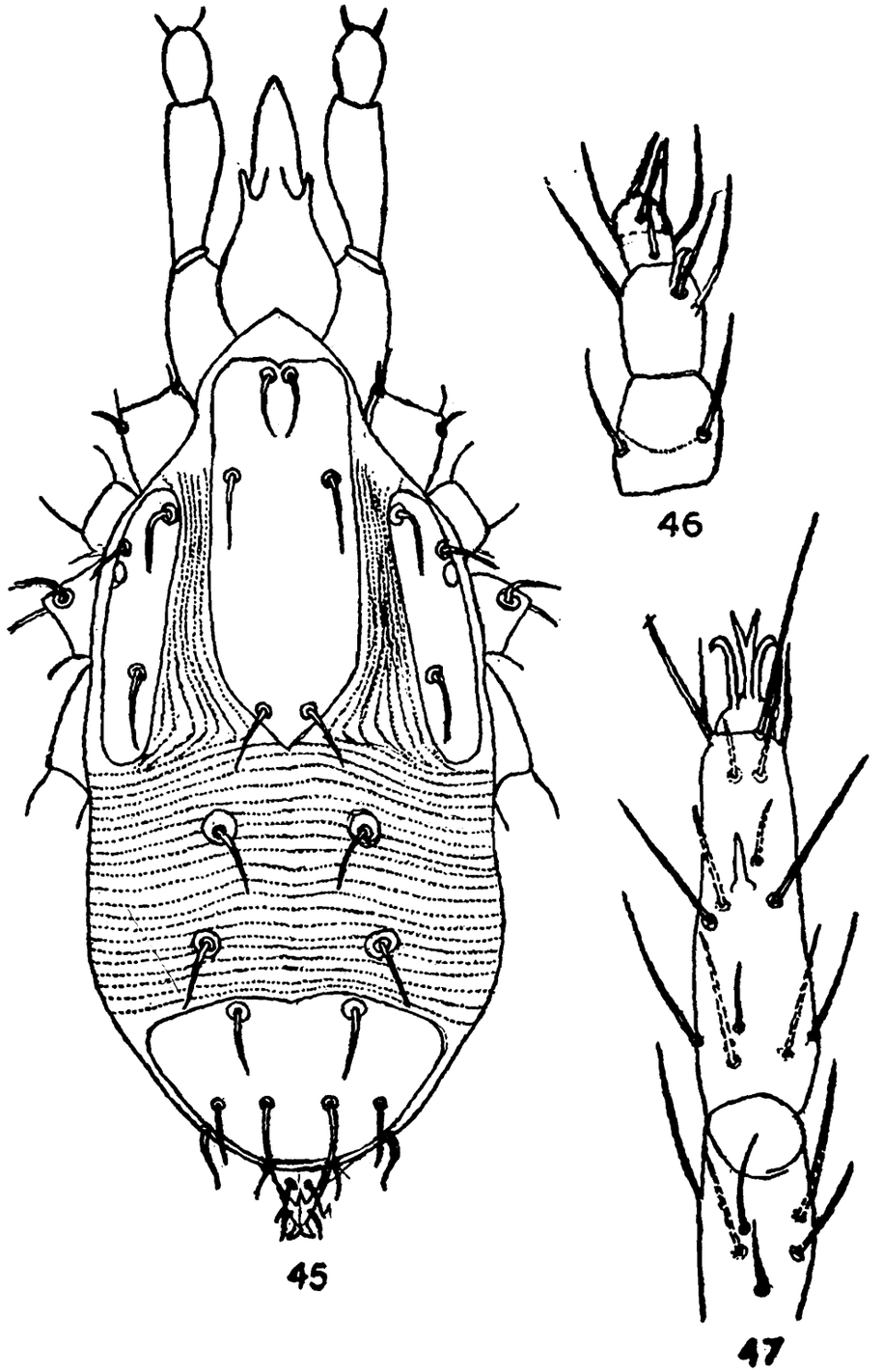
Material examined : 1 ♀, WEST BENGAL : Midnapur Dist., Patharkumkumi, 17.vii.1977, ex nest of *Ploceus philippinus*.

Remarks : This is a plant feeding species and its occurrence in bird nest is somewhat accidental. The mite might have dropped into the nest from the leaf infested with the mite.

Family : ERYTHRAEIDAE Oudemans

ERYTHRAEID MITE

Material examined : One species of erythraeid mite in several examples was collected ex nest of *Passer domesticus*, 21.v. 1979, as well as from nest of *Streptopelia chinensis*, 9.v. 1980. The identity of this species could not be determined for lack of literature.



Figs. 45-47. *Acheles meyerae* sp. nov. ♀ : 45. dorsal surface, 46. palp, 47. terminal segments of leg I.

Family : TARSONEMIDAE Kramer

Genus : **Tarsonemus** Canestrini & Fanzago

15. **Tarsonemus** sp.

Material examined : 1 ♀, West Bengal : Midnapur Dist., Patharkumkumi, 5.viii.1977, ex nest of *Ploceus philippinus*.

Remarks : Since no male specimen was available, the specific identity could not be determined.

Suborder : ASTIGMATA

Family : PROTOLICHIDAE

Genus : **Protolichus** Trouessart

16. **Protolichus** sp.

Material examined : 1 ♀, WEST BENGAL : Midnapur Dist., Patharkumkumi, 5. vii. 1977, ex nest of *Ploceus philippinus*.

Remarks : The specimen was badly damaged and its specific identity could not be ascertained.

Family : ACARIDAE Ewing & Nesbitt

Genus : **Tyrophagus** Oudemans

17. **Tyrophagus putrescentiae** (Schrank)

Acarus putrescentiae Schrank, 1718, *Enum Inst. Aust.* Indig., 521.

Material examined : 1 ♀, WEST BENGAL : Midnapur Dist., Patharkumkumi, 26. vi. 1980, ex nest of *Ploceus philippinus*.

Remarks : This species was earlier recorded from nest of *Ploceus manyar flaviceps* in West Bengal (Gupta & Chattopadhyay, 1979). This is a cosmopolitan species and occurs in varied habitats.

Genus **Acarus** Linnaeus

18. **Acarus** spp.

Material examined : 3 ♀ ♀, WEST BENGAL : Midnapur Dist., Patharkumkumi, ex nest of *Ploceus philippinus* and *Prinia inornata*.

Remarks : Because of damaged conditions and for want of sufficient literature, the specific determination could not be ascertained.

Family : GLYCYPHAGIDAE Berlese

Genus **Glycyphagus** Hering

19. **Glycyphagus domesticus** (DeGeer)

Glycyphagus domesticus De Geer, 1778, *Mem. Hist. Ins.*, **7** : 106-109.

Material examined : 1 ♀, WEST BENGAL : Midnapur Dist., Patharkumkumi, 26. vi. 1980, ex nest of *Passer domesticus*.

Remarks : This is the first record of this species from birds' nest in India. It has been reported from house, especially in damp premises (Evans *et al.*, 1961). Woodroffe (1953) and Woodroffe and Southgate (1951) also reported this species from nests of birds.

20. **Glycyphagus destructor** (Schrank)

Acarus destructor Schrank, 1781, *Enum. Inst. Aust.* Indig., 521.

Material examined : 1 ♀, WEST BENGAL : Midnapur Dist., Patharkumkumi, ex nest of *Passer domesticus*, 29. vi. 1980.

Remarks : This species is reported from bird's nest for the first time form India. It is primarily a pest of stored products and it probably infested the nest through nesting material.

Suborder : MESOSTIGMATA

Family : PHYTOSEIIDAE Berlese

Genus : **Amblyseius** Berlese

21. **Amblyseius largoensis** (Muma)

Amblyseiopsis largoensis Muma, 1955, *Ann. Ent. Soc. Amer.*, **48** : 266.

Material examined : Several ♀ ♀, ♂ ♂, and nymphs, WEST BENGAL, Midnapur Dist., Patharkumkumi, on different dates : 20. viii. 1978, 15. viii. 1979, 21. vii. 1979, 18. vii. 1980, ex nest of *Ploceus philippinus*.

Remarks : This mite normally occurs on leaves of plants and sometimes on soil. This species may have infested the nest through twigs, leaves, etc. with which the nest was built.

Family : ASCIDAE Voigtes & Oudemans

Genus : **Asca** von Heyden

22. **Asca pseudospicata** Bhattacharyya

Asca pseudospicata Bhattcharyya, 1966, *Proc. Zool. Soc. Cal.*, **19** : 34-35.

Material examined : 1 ♀, WEST BENGAL : Midnapur Dist., Patharkumkumi, 21. vi. 1980, ex nest of *Ploceus philippinus*.

Remarks : This species was described on the basis of specimens collected from bamboo leaf litter, rotten straw, soil under banana plant, etc. Earlier, Gupta and Chattopadhyay (1979) reported *A. biswasi* Bhattacharyya, in the nest of *Lonchura striata*. It contaminates nests probably through nesting material.

Family : MACRONYSSIDAE Oudemans

Genus : **Ornithonyssus** Sambon

23. **Ornithonyssus** sp.

Material examined : 2 ♀ ♀, WEST BENGAL : Midnapur Dist., Patharkumkumi, 21. v. 1979, ex nest of *Passer domesticus*.

Remarks : The specimens were damaged and, hence, the species could not be determined. However, whatever examination was made it could be inferred that it belonged to neither of the *Ornithonyssus* species known from India. It may be mentioned here that Ramachandra Rao and Rajagopalan (1970) reported *O. bursa* from the nest of *Passer domesticus* while Gupta and Chattopadhyay (1979) reported *O. bacoti* from the nest of *Lonchura striata*.

Genus : **Steatonyssus** Kolenati

24. **Steatonyssus flabellifer** sp. nov.

(Figs. 48-49)

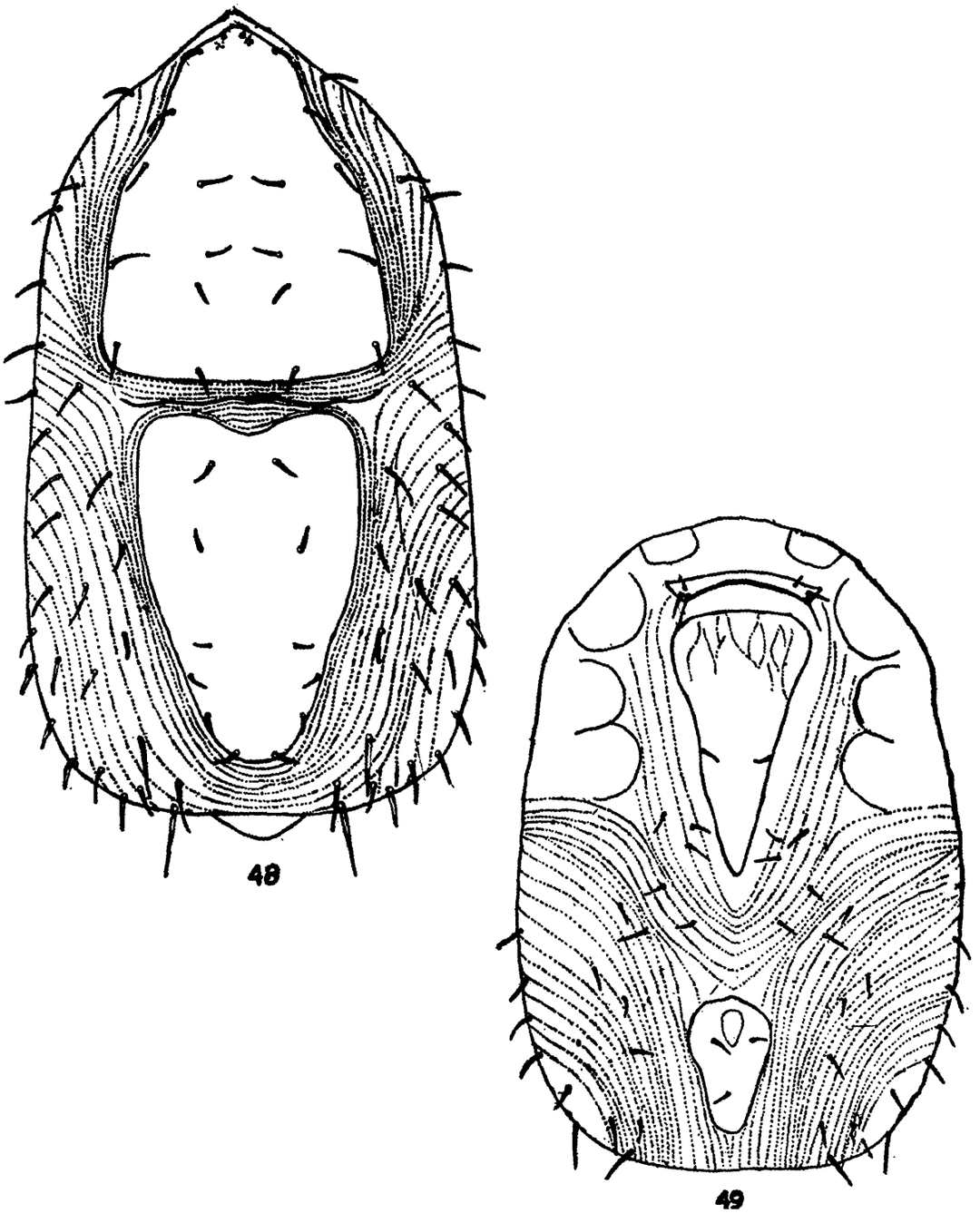
Female : Idiosoma 573 long, 443 wide. Podonotal shield-265 long, 265 wide, opisthonotal shield- 295 long, 204 wide. Between podonotal and opisthonotal shields there is transverse striations. Podonotal shield with 10 pairs of setae, measuring 15-38 long ; opisthonotal shield with 6 pairs of setae. All the setae smooth, simple, pointed. Striation in between podonotal and opisthonotal regions transverse, area lateral to the opisthonotal plate with longitudinal striations curving inwards. At least 6 pairs of setae present on the interscutal membrane on either side of the podonotal shield and over 16 pairs of setae on interscutal membrane on either side of the opisthonotal shield. Ventrally sternal shield much broader than long, posterior band sclerotized with 3 pairs of setae, posteriormost pair being longest. Genital plate-268 long, 134 wide with a pair of small setae. Anal plate 134 long, 90 wide, anterior margin slightly projected into knob like structure. Ventral surface on the either side of anal plate setose.

Legs : All legs of uniform length.

Holotype ♀, INDIA : WEST BENGAL : Midnapur Dist., Patharkumkumi, 15.vii.1979, ex nest of *Ploceus philippinus*, ZSI Reg. No. 3232/17.

Paratypes : 2 ♀ ♀, data same as for holotype, ZSI Reg. No. 3233/17. Both holotypes and paratypes are on same slide.

Remarks : This species is very close to *Steatonyssus allredi* Advani and Vazirani (1981) but is distinguished from it by the presence of 6 pairs of setae on the opisthonotal plate, instead of 5 pairs as in *S. allredi* ; the sternal shield is less wide, with setae St 3 much longer ; and in having a lesser number of setae in the region around the anal plate. The shape of the anal plate also differs and serves as a distinguishing character.



Figs. 48-49. *Steatonyssus flabellifer* sp. nov. ♀ : 48. dorsal surface, 49. ventral surface.

Family : ASCIDAE Voigts & Oudemans

Genus : **Lasioseius** Berlese

25. **Lasioseius** sp.

Material examined : 1 ♀, WEST BENGAL : Midnapur Dist., Patharkumkumi, 18.vi.1977, ex nest of *Ploceus philippinus*.

Suborder : CRYPTOSTIGMATA

Family : ORIBATULIDAE Thor

Genus : **Scheloribates** Berlese

25. **Scheloribates albialatus** Hammer

Scheleribates albialatus Hammer, 1961, *Biol. Skr. Dan. Vid. Selsk.*, **13** (1) : 94.

Material examined : 4 ♀ ♀, WEST BENGAL, Midnapur Dist., Patharkumkumi, ex nest of *Passer domesticus* ; 1 ♀, same locality, ex nest of *Streptopelia chinensis*.

Remarks : This is the first report of *Scheloribates* mite occurring in bird nest. Earlier, Nolan (1955) reported *Oribatula* (*Zygoribatula*) sp. and *Trichoribates* from nest of Prairie warbler (*Dendroica discolor*). Ramachandra Rao & Rajagopalan (1970) also reported some undetermined species of oribatid mites from the nests of *Corvus* sp,, *Passer domesticus* and *Acridetheres tristis*.

Family : PARAKALUMMIDAE Grandjean

Genus : **Protokalumma** Jacot

26. **Protokalumma** sp.

Material examined : 2 ♀ ♀, WEST BENGAL : Midnapur Dist., Patharkumkumi, 9.v.1980, ex nest of *Streptopelia chinensis*.

DISCUSSION

The results reveal that except *Protolichus* sp. and *Ornithonyssus* sp., none of the other species are true ectoparasites of birds. Most of the other mites are either scavengers or predators upon other microarthropods. The only feather mite which was collected was *Protolichus* sp. It may be mentioned that earlier studies in this regard from India (Ramachandra Rao and Rajagopalan, 1970 and Gupta & Chattopadhyay, 1979) failed to report a single feather mite from birds' nests. The most interesting feature is the variety of prostigmatid mites (8 families) that were collected in the present study and among them, besides Tarsonemidae and Tetranychidae, a majority are known to be efficient predators. As far as the references available to the authors, no report is available on the occurrence of the mites belonging to the families Bdellidae, Stigmaeidae and Raphignathidae in bird nests. Nolan (1955) reported the occurrence of Tarsonemidae in bird nests while Delfinado (1976, 1978) reported a number of species including some new ones of *Tarsonemus* and *Steneotarsonemus* from bird nests. Another interesting point is the occurrence of a good number of mites belonging to Acaridae which do normally occur in stored products. This confirms the earlier observations of Baker *et al.* (1976) but unlike the latter, no mites belonging to Pyroglyphidae causing house dust allergy was available in the present study. This study also indicates that there is a vast scope of contributing in this aspect in India as the mite fauna of bird nests is not only rich but varied. Many of those, specially the haematophagous species may be of medical and veterinary importance as vectors of different diseases. In addition to mites, various other arthropods belonging to Araneida, Hemiptera, Coleoptera, Collembola, Orthoptera, Neuroptera, Psocoptera, Thysanoptera, Isopoda, Pseudoscorpiones and Dipteran larvae were also in the collection. However, nature of their association with bird nests is yet to be established.

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REFERENCES

ADVANI, R. & VAZIRANI, T. G. 1981. Studies on ectoparasites of bats of Rajasthan and Gujarat (India). *Rec. zool. Surv. India. Occ. Paper*, **22** : 155 pp.

BAKER, E. W., DELFINADO, M. D. & ABBATIELLO, M. J. 1976. Terrestrial mites of New York II. Mites in birds nests (Acarina). J. *New York Ent. Soc.*, **84** : 48-66.

DELFINADO, M. D. 1976. Terrestrial mites of New York. V. Tarsonemidae. *J. New York Ent. Soc.*, **84** : 255-274.

DELFINADO, M. D. 1978. Terrestrial mites of New York. VI. Further notes on Tarsonemidae (Acarina). *J. New York Ent. Soc.*, **86** : 66-86.

EVANS, G. O., SHEALS, J. G. AND MACFARLANE, D. 1961. The trrestrial Acari of the British Isles. An introduction to their morphology, biology and classification. Vol. I. Introduction and biology. *British Museum (Nat. Hist.)*, 219 pp.

GUPTA, S. K. AND CHATTOPADHYAY, S. 1979. Studies on Acari associated with birds nests in Bengal, India. *Indian J. Acar.*, **3** : 77-86.

HOYT, J. S. Y. 1948. Observations on nesting associations. *Auk.*, **65** : 188-196.

MOREAU, R. E. 1942. The nesting of African birds with other living things. *Ibis*, **84** : 240-263.

MUMA, M. H. 1960. Predatory mites of the family Cunaxidae associated with citrus in Florida. *Ann. Ent. Soc. Amer.*, **53** : 321-326.

NOLAN, V. J. 1955. Invertebrate nest associates of Prairie warbler. *Auk*, **72** : 55-61.

PHILIPS, J. R. AND DINDAL, D. L. 1979. The acarine community of nests of birds of prey. *In* Recent Advances in Acarology, Voi. I., [*Ed.* J. G. Rodriguez] 559-562.

RAMACHANDRA RAO, T. AND RAJAGOPALAN, P. K. 1970. Arthropod fauna of the nests of some common birds in Poona, India, with special reference to the blood sucking forms. *J. Bom. Nat. Hist. Soc.*, **67** : 414-429.

WOODROFFE, C. E. 1953. An ecological study of insects and mites of certain birds in Britain. *Bull. Ent. Res.*, **44** : 739-772.

WOODROFFE, C.E. AND SOUTHGATE, B. J. 1951. Birds nests as a source of domestic pests. *Proc. zool. Soc. Lond.*, **121** : 55-62.

Bull. zool. Surv. India, 7 (1) : 25-32, 1985

THE SUBGENUS *ODAGMIA* ENDERLEIN (DIPTERA : SIMULIIDAE) WITH A NEW SPECIES FROM HIMACHAL PRADESH, INDIA*

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ABSTRACT

Simulium (*Odagmia*) *adventicium*, sp. nov. is described and illustrated with due cosideration on its taxonomy and zoogeography.

Himachal Pradesh is a part of the Lesser Himalaya, a massive mountainous tract with definite orographical features of the Himalayan range. It lies approximately between 30°23' N and 33°12' N latitudes and between 75°36' E and 79°05' E longitudes and rises nearly to 5000 m in the north from the uneven valleys clothed with dense tropical forests to the high residual hills with subtropical and temperate forest assemblage. There are innumerable fast-running streams and several sluggish streams, pools and side pockets besides the riverine system. The climatic condition, broadly speaking, is monsoonal : it refers to high annual range of temperature and varying humidity in different seasons of the year accompanied by moderate to heavy rainfall. Owing to its location and environment in juxtaposition, Himachal Pradesh enjoys unique Oriental fauna with the Palaearctic bias. The present paper thus clarifies the occurrence of the subgenus *Odagmia* Enderlein, a Palaearctic subgenus also in the Oriental part of Himachal Pradesh.

The type-specimens are deposited in the National Collections of the Zoological Survey of India, Calcutta.

Subfamily SIMULIINAE Newman

Tribe SIMULIINI Newman

Genus **Simulium** Latreille

Simulium (*Odagmia*) *adventicium* sp. nov.

Material available : ♂♂, ♀♀, pupa and larva (on slides and in alcohol).

Male : Length about 4.0 mm.

Head : Width more than that of thorax ; eyes holoptic and divided ; vertex black, with long dark erect hairs ; clypeus dark grey, with a coating of silvery pollinosity and dark erect hairs. Antenna (Fig. 1) 11-segmented, dark grey, with pale base of flagellomere 1 ; latter longer than other flagellomeres. Palpus (Fig. 3) dark grey.

Thorax : Scutum velvety black, with golden recumbent hairs ; scutum with a pair of bright silvery shoulder patches (Fig. 7). Scutellum dark grey, nonshiny, with golden recumbent hairs and dark erect hairs. Postnotum dark grey, nonshiny, silvery pollinose. Pleuron greyish ; pleural membrane with rather long golden hairs ; pleural tuft dark ; katepisternum dark grey, shiny, bare. Knob of haltere off-white, stem and base brown to

* Dedicated to the memory of my venerable parents.

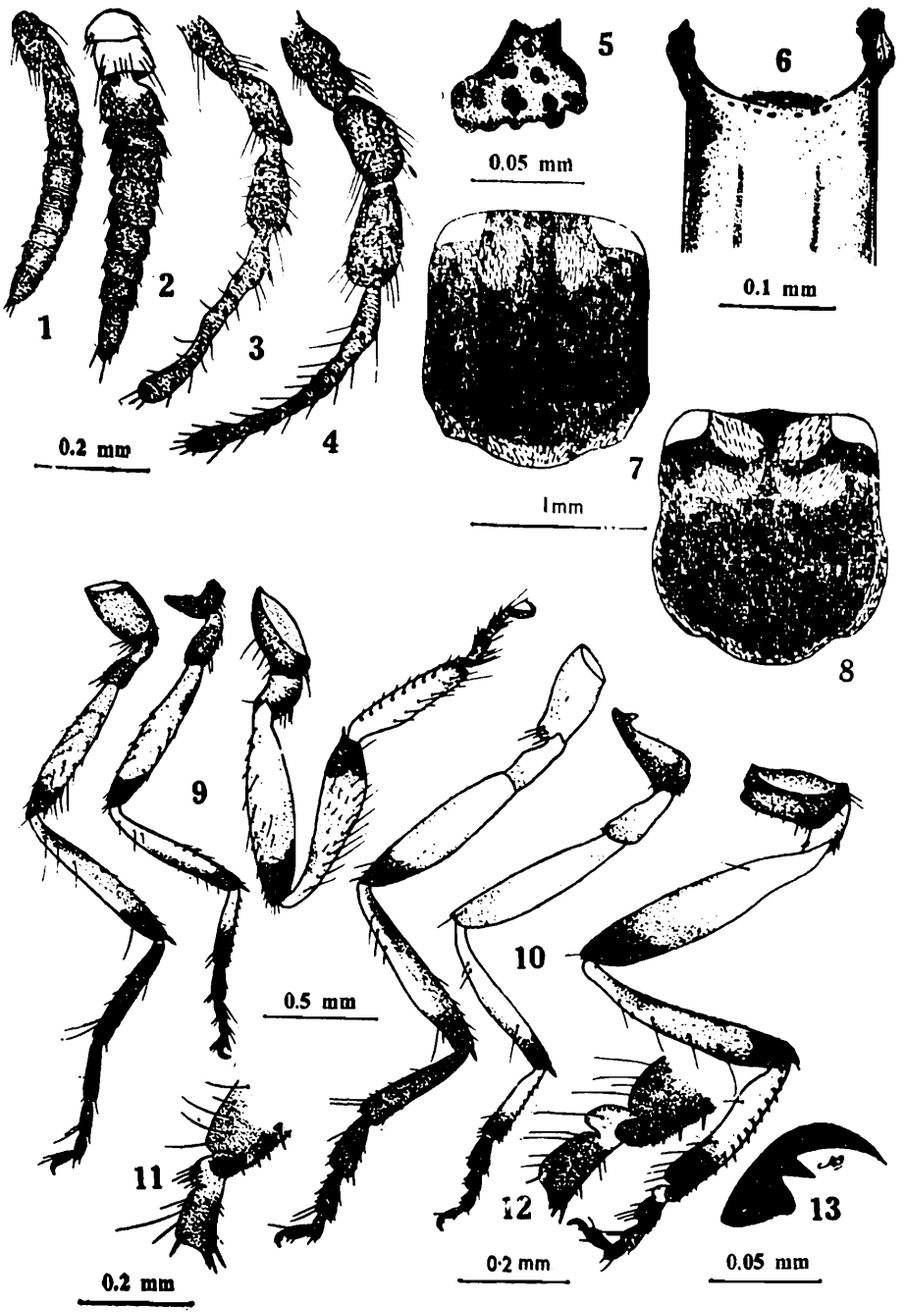
dark. *Wing-length* about 3.0 mm. Veins brownish; costa with heavy stout black spinules intermixed with erect black hairs; hair-tuft on base of costa brown but that on stem vein black; basal section of radius bare; subcosta with two or three hairs proximally; radial sector simple, with erect black hairs and R_1 with spinules as well. *Legs* (Fig. 9). Fore coxa grey; basal half of trochanter brownish and distal half grey; femur brown with greyish tip; tibia brownish with greyish distal end and a greyish patch at base, yellowish along anterior margin before greyish distal end; tarsus greyish black; tarsomere 1 rather slender, nearly 7.5 times as long as its greatest width. Middle coxa dark grey; trochanter greyish with pale base; femur brown with greyish tip; tibia brownish with greyish distal end and yellowish basally and greyish distally along anterior margin; tarsomere 1 yellowish basally; rest of tarsus greyish black. Hind coxa dark grey; trochanter grey; femur brown with dark tip; tibia brownish with dark tip and dark tinge along anterior surface; tarsomere 1 subparallel-sided, somewhat expanded, pale yellow, a little darkened towards tip; tarsomere 2 basally brown and distally greyish; rest of tarsus nearly greyish black. Calcipala (Fig. 11) much enlarged; pedisulcus deep.

Abdomen: Abdominal scale dark grey; marginal hairs golden. Dorsum greyish black; venter brownish to greyish. Segment 2 with a large silvery spot laterally and, segments 6 and 7 each with a comparatively small spot laterally. Genitalia (Fig. 14) with large, elongate and subparallel-sided distimere, nearly twice as long as basimere; basimere not noticeably produced beyond base of distimere; distimere with a single apical spinule; body of ventral plate (Fig. 15) narrow and heavily toothed apically, with a coarsely haired anteroventral process; basal arms widely divergent; median sclerite large, with deep apical cleft making it prong-shaped and with serrated edges; endoparameral organ broad basally; endoparameral hooks numerous.

Female: Length about 4.0 mm.

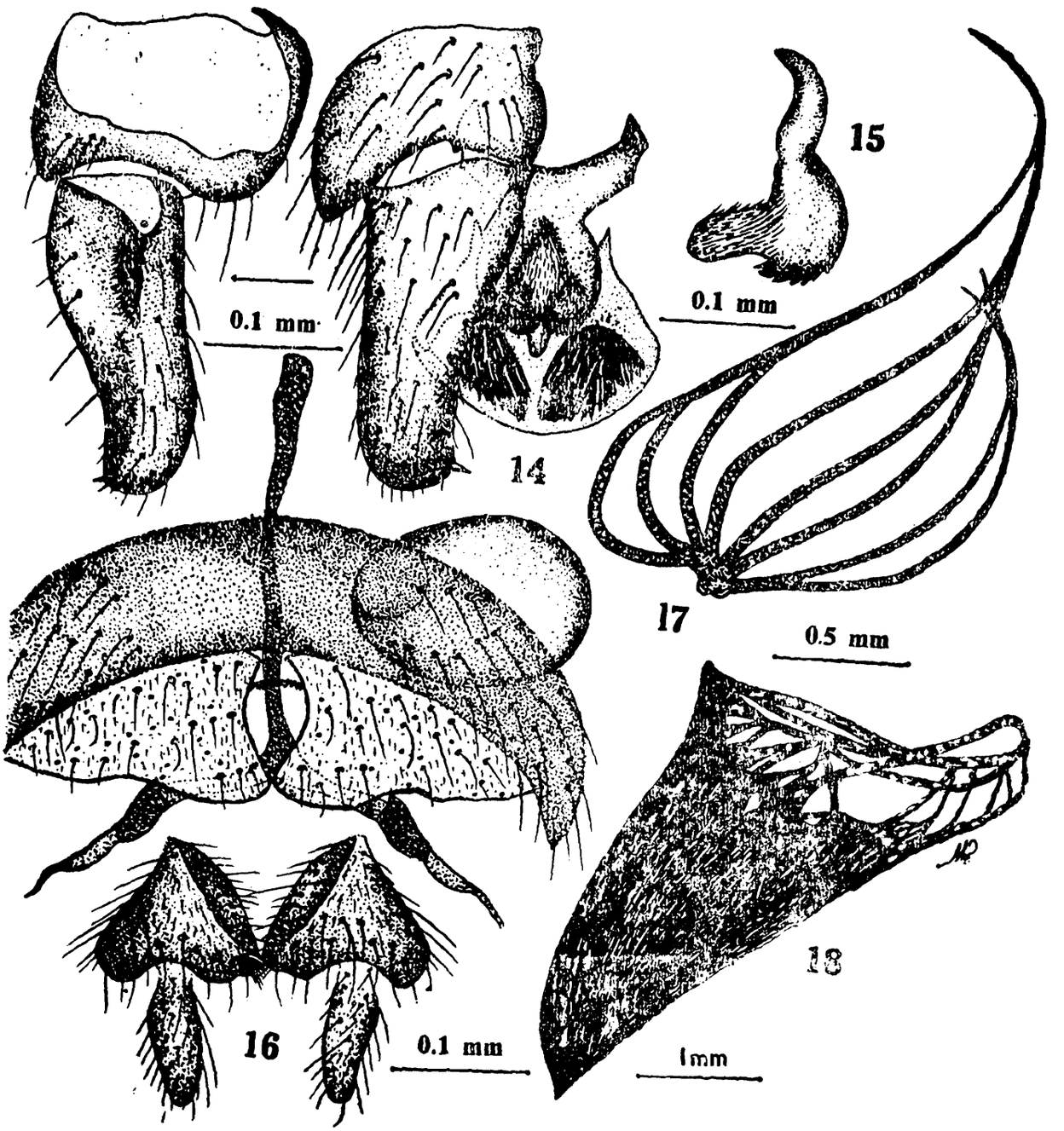
Head: Width more or less equal to that of thorax; vertex greyish black, with many golden recumbent hairs and a few dark erect hairs; frons dark grey, shiny, narrower anteriorly, with many recumbent golden hairs and a few dark erect hairs laterally; clypeus greyish, nonshiny, with golden hairs. Antenna (Fig. 2) 11-segmented, greyish black except yellowish scape, pedicel and base of flagellomere 1. Palpus (Fig. 4) as in male; sensory vesicle (Fig. 5) of segment 3 less than twice as long as wide, many pits present, mostly in clusters. Base of cibarium (Fig. 6) with some very minute denticles.

Thorax: Scutum velvety black, with golden recumbent hairs; scutum with boldly marked shiny pale grey pattern anteriorly in form of a pair of horse-shoes meeting towards mid-line and open ends directed outwards (Fig. 8). Scutellum dark grey with golden recumbent hairs and a few dark erect hairs. Postnotum dark grey, nonshiny, silvery pollinose. Pleuron greyish; pleural membrane almost entirely with rather short golden hairs; pleural tuft golden; katepisternum dark grey, shiny, bare. Knob of haltere off-white, stem and base brown to dark. *Wing-length* about 3.5 mm. Veins brownish; costa with heavy stout black spinules intermixed with erect black hairs; hair-tufts on base of costa and stem vein brown; subcosta hairy at least up to level of origin of radial sector; basal section of radius bare; radial sector simple, with erect



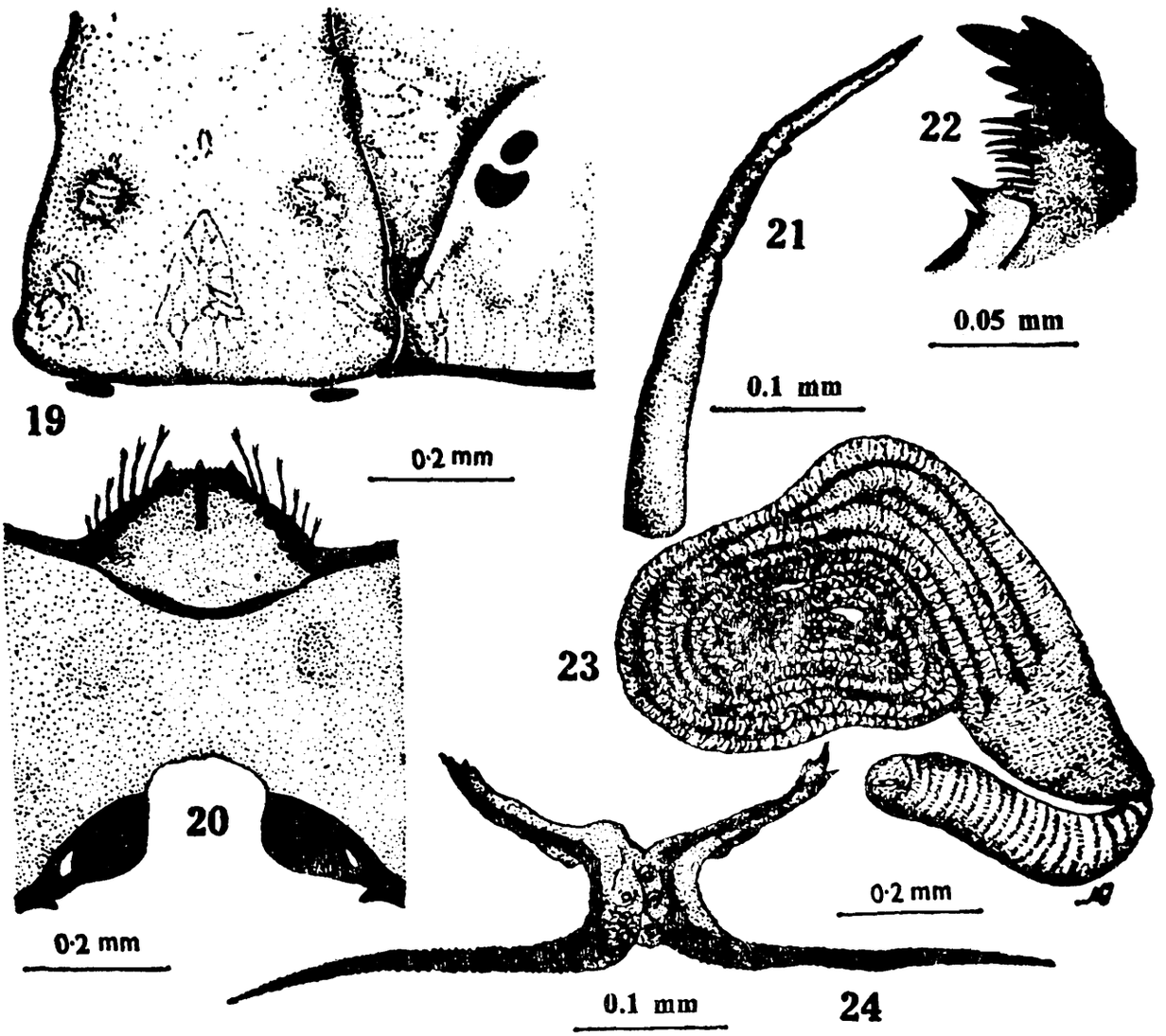
Figs. 1-13. *Simulium* (*Odagmia*) *adventicium* sp. nov. : 1, ♂ antenna ; 2, ♀ antenna ; 3, ♂ maxillary palpus ; 4, ♀ maxillary palpus ; 5, ♀ sensory vesicle ; 6, base of ♀ cibarium ; 7, ♂ scutal pattern ; 8, ♀ scutal pattern ; 9, ♂ legs ; 10, ♀ legs ; 11, calcipala and pedisulcus of ♂ hind leg ; 12, calcipala and pedisulcus of ♀ hind leg ; 13, ♀ tarsal claw

black hairs and R_1 with spinules as well. *Legs* (Fig. 10). Fore coxa, trochanter and femur golden yellow except greyish tip of last ; tibia golden yellow, with a greyish patch basally, leaving pale yellow anterior margin before greyish tip ; tarsus entirely greyish black ; tarsomere 1 dilated, nearly 5.5 times as long as its greatest width. Middle coxa greyish ; trochanter brownish ; femur golden yellow, with somewhat darkened end ; tibia golden



Figs. 14-18. *Simulium* (*Odagmia*) *adventicium* sp. nov.: 14. ♂ genitalia; 15, ventral plate (in profile); 16, ♀ genitalia; 17, pupal gill; 18, cocoon;

yellow, with dark tip and a dark tinge on posterior half of anterior margin; nearly basal two-thirds of tarsomere 1 golden yellow and rest of tarsus greyish black. Hind coxa greyish black; trochanter pale brown; femur golden yellow, gradually darkened to tip; tibia golden yellow proximally with a greyish patch on posterior margin and gradually darkened to greyish tip distally; tarsomere 1 subparallel-sided, narrow, golden yellow with darkened distal one-third; tarsomere 2 golden yellow on basal one-third and greyish black on distal two-thirds, rest of tarsus greyish black. Calcipala (Fig. 12) much enlarged; pedisulcus highly deep; claw (Fig. 13) with a small basal tooth.



Figs. 19-24. *Simulium* (*Odagmia*) *adventicium* sp. nov. : 19, larval cephalic apotome ; 20, hypostomium and postgenal cleft ; 21, antenna ; 22, tip of mandible : 23, respiratory histoblast ; 24, anal sclerite.

Abdomen : Abdominal scale greyish ; marginal hairs golden. Dorsum greyish black ; venter greyish. Segments 2-5 with yellow-white posterior edges ; distal segments yellow-white further laterally due to shining terga 6-8. Anal cerci of genitalia (Fig. 16) simple bluntly rounded lobes ; spermatheca without reticulate pattern.

Pupa : Body-length about 6.0 mm. Dorsum of head and thorax with disc-like tubercles scattered all over. Head and thoracic trichomes moderately long and simple. Gill (Fig. 17) 8-filamented, arranged in four pairs, each with a short common stalk ; gill filaments spreading basally but tips nearly approximated ; gill shorter than pupal body. Tergum 1 with 2 or 3 setae on each side ; tergum 2 with a row of 3 spinous hooklets and a few accessory setae on each side ; terga 3 and 4 each with 4 hooks and a few setae on each side ; terga 7 and 8 approximately with 6 and 8 spines respectively on

each side of mid-dorsal line. Sternum 4 with a pair of setae on each side; sternum 5 with a pair of hooks, close together, on each side near posterior margin; sterna 6 and 7 each with same number of hooks on each side but widely spaced. A pair of minute tail-hooks present. Cocoon (Fig. 18) with a short neck, loosely woven and a little fenestrate antero-ventrally, with a definite margin of thick strands, but without antero-dorsal median projection.

Larva: Length about 8.0 mm. Head (Fig. 19) with brownish cephalic apotome; head-spots pale and not at all boldly marked. Antenna (Fig. 21) basically 4-segmented, with a secondary annulation; last two segments above apical level of cephalic fan stem; entirely brownish with pale joints. Postgenal cleft (Fig. 20) small, unevenly rounded, shorter than postgenal bridge. Hypostomium (Fig. 20) with 9 pointed teeth apically; corner and median teeth moderately prominent; 7 or 8 hypostomial setae on each side; hypostomial rows divergent posteriorly from lateral margins of hypostomium. Tip of mandible (Fig. 22) with first 3 comb-teeth evenly decreasing in size, other comb-teeth very long and fine; two mandibular serrations. Respiratory histoblast (Fig. 23) with 8 filaments as in pupa. Thoracic cuticle bare. Abdomen broadest at sixth segment; abdominal cuticle bare. Ventral papillae inconspicuous. Rectal "gills" 3, without secondary lobules. Rectal scales present. Anal sclerite (Fig. 24) with anterior arms united with posterior arms individually. Accessory sclerite absent.

Material examined: Holotype ♂ (reared from pupa), INDIA: Himachal Pradesh, Vashisht, a large stream flowing down the Chandigarh-Manali Road, 1850 m., 10.x.1979. Coll. *M. Datta*. Allotype ♀ (reared from pupa), same data as holotype. *Paratypes* 4 ♂♂, 3 ♀♀ (reared from pupae), 12 pupae and 18 larvae, same data as above; 1 pupa and 2 larvae, Patlikuhl, a small stream, 1800 m., 11.x.1979, Coll. *M. Datta*.

Discussion: *Odagmia* Enderlein is a small, Palaearctic subgenus, occurring widely from Europe to Japan through Siberia and Central Asia to the east and, North Africa and the Mediterranean islands to the west. It is a main component of the *Simulium* Latreille (*s. l.*) fauna, particularly in the mediterranean area, including the Canary islands, Morocco and the Middle East. With reference to the dubious record of *Simulium* (*Odagmia*) *ornatum* Meigen by Puri (1932) from South India, Crosskey (1969) opines that this segregate in in the Old World does not extend into the Oriental Region. However, the Palaearctic subgenera *Wilhelmia* Enderlein and *Tetisimulium* Rubtzov extend eastwards to the fringes of the Oriental Region (Puri, 1933; Crosskey, 1967); both these groups are characteristic to the semi-arid areas of south-west and central Asia and of Mediterranean Europe and North Africa. Thus, on zoogeographical grounds the occurrence of *Odagmia* in Himachal Pradesh and/or in the other semi-arid parts of India is not unlikely. In the light of the definition of this subgenus (see Crosskey, 1967; 1969) the species under consideration belongs to *Odagmia* despite its certain atypical characteristics which might have eventually come up due to its abode in the Oriental-Palaearctic transitional zone. Thus, the characteristics of the cocoon and of the larva incline more to *Tetisimulium* than to *Odagmia*. The cocoon of this species is necked and fenestrate anteriorly. The head-spots of the larva are not at all boldly marked and are essentially negative as in *Tetisimulium* and in several *Simulium* (*s. str.*) species.

Simulium (*Odagmia*) *adventicium* sp. nov. in having shining female frons is closer to *S.* (*O.*) *nitidifrons* Edwards, 1920, a widespread Palaearctic species, and the three supposed species, *viz.*, *S.* (*O.*) *intermedium* Roubaud, 1906 ; *S.* (*O.*) *H-nigrum* (Abreu, 1922) and *S.* (*O*) *insolitum* (Abreu, 1922) described from the Canary islands, than to *S.* (*O.*) *ornatum* Meigen, 1818, with non-shining female frons, but obviously belongs to the *ornatum*-group. These Canary species and also *S. egregium* Séguy described from Morocco are all based on female holotype specimens. According to Crosskey (1967 ; 1969), these are seemingly conspecific with each other or even with *nitidifrons*. *S.* (*O.*) *adventicium* sp. nov. has very largely reddish yellow legs unlike "*intermedium / nitidifrons* complex" ; the latter species also differing in the following characters : flattened male fore tarsus ; marginal extension of distimere dorsally at base ; ventral plate in profile more sloped up from beak and bilaterally expanded median sclerite ; poorly developed female calcipala ; ventral pair of pupal gill filaments with comparatively large stalk ; non-necked and non-fenestrate cocoon ; and the rather boldly marked larval head-spots and the thorny anal sclerite among certain other differences. In fact, it is difficult to distinguish males of *adventicium* and *ornatum* since the ventral plates are extremely alike but the latter species differs in having dilated fore tarsus and broad uncleft median sclerite. The male of *S.* (*S.*) *spinosum* Doby and Deblock, 1957, a British species (see Davies, 1966) which is very close to *ornatum*, has narrow fore tarsus as in *adventicium* but a close examination reveals that the angle of the ventral plate with the beak in the latter species is much shorter. Dr. R. W. Crosskey (*in litt.*) informs the author that there are no stable distinctive characters by which larvae and pupae of "*intermedium / nitidifrons* complex" can be isolated from those of *ornatum* (*s. l.*). *S.* (*O.*) *adventicium* can, however, be readily recognized among all these species by its necked and anteriorly fenestrate cocoon and essentially negative larval head-spots.

The establishment of *adventicium* as a new *Odagmia* species, therefore, rests on the combination of certain unique characteristics : shining frons, extensively reddish yellow legs, much enlarged calcipala and highly deep pedisulcus in females ; slender fore tarsomere 1, lateral spots on abdominal segments 2, 6 and 7, acute angle of ventral plate, prong-shaped median sclerite with deep cleft in males ; necked and fenestrate cocoon ; and essentially negative larval head-spots.

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References

Abreu, E. S. 1922. Monografía de los Melasínidos de las islas Canarias. *Me'm. Acad. Barcelona* **17** : 1-45.

Crosskey, R. W. 1967. A preliminary revision of the black-flies (Diptera : Simuliidae) of the Middle East. *Trans. R. ent. Soc. Lond.* **119** : 1-45.

Crosskey, R. W. 1969. A re-classification of the Simuliidae (Diptera) of Africa and its islands. *Bull. Brit. Mus. nat. Hist. (Ent.) Suppl.* **14** : 1-195.

Davies, L. 1966. The taxonomy of British black-flies (Diptera : Simuliidae). *Trans. R. ent. Soc. Lond.* **118** : 413-511.

Doby, J. M. and Deblock, S. 1957. Presence de tubercles tegumentaires épineux chez la nymphe d'une forme Autrichienne de *Simulium ornatum* Meigen 1818. *S. ornatum* f. *spinosum* n. f. *Annls Parasit. hum. comp.* **32** : 328-330.

Edwards, F. W. 1920. On the British species of *Simulium* II. The early stages ; with corrections and additions to Part I. *Bull. ent. Res.* **11** : 211-246.

Meigen, J. W. 1818. *Systematische beschreibung der bekannten europaischen zweifliigeligen Insekten* **1** : 289-298.

Puri, I. M. 1932. Studies on Indian Simuliidae. IV. Descriptions of two new species from north-east India *Simulium howletti* sp. n. and *Simulium hirtipannus* sp. n., with a note on *S. ornatum* Meigen. *Indian J. med. Res.* **20** : 505-514.

Puri, I. M. 1933. Studies on Indian Simuliidae. IX. *S. equinum* var. *mediterraneum* Puri and *S. paraeguinum* sp. n. *Indian J. med. Res.* **21** : 11-16.

Roubaud, E. 1906. Insectes Diptères. Simulies nouvelles ou peu connus. *Bull. Mus. Hist. nat., Paris.* **7** : 517-522.

Bull. zool. Surv. India, 7 (1) : 33-36, 1985

A NEW SYNONYM IN INDIAN *RHINOCYPHA* RAMBUR, WITH A REVIEW OF THE SPECIES-GROUPS *FENESTRELLA* AND *BIFASCIATA* (ODONATA : CHLOROCYPHIDAE)

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ABSTRACT

R. bifenestrata Fraser is considered a synonym of *R. cuneata* Selys upon a review of the characters of the species groups 'Fenestrella' and 'Bifasciata' under the genus *Rhinocypha* Rambur.

Rhinocypha cuneata Selys originally described from Tibet, is now known to have a wider distribution in Eastern Himalaya, e. g. Mungpoo and Turzum in the Darjeeling district, Gopaldhara in Assam (Fraser, 1934) and Siki and Tahlia in Arunachal Pradesh (Lahiri, 1977, 1979). Subsequently Fraser (1922) described another species *R. bifenestrata* from Mungpoo.

While going through a fairly large collection of *R. cuneata* Selys from different parts of north Bengal and Arunachal Pradesh, a range of gradations was observed in the distinctive features laid down by Fraser (1934) for seperating the two species. A comparative study shows that, *bifenestrata* Fraser is only a synonym of *R. cuneata* Selys.

Analysis of the species-'group' characters under the genus **Rhinocypha** Rambur.

Fraser (1934) in his "Key to the Indian species of Rhinocypha" used the nature of hind wing markings for distinguishing the set of two species groups, 'Fenestrella' and 'Bifasciata'. However, a close look at various characters seperating the groups leads one to belive that Fraser incorporated his species *bifenestrata* within the 'Bifasciata' group on rather superfluous grounds, since, a resonable analysis of the character presented by this species clearly indicates its closer affinity to 'Fenestrella' group.

In this connection, it would be worthwhile to summarize the characters used by

		Fenestrella-group (*R. cuneata* Selys and its allies)	*Bifasciata*-group (*R. bifenestrata* Fraser and its allies)
1.	Origin of R_3	At subnode	At or slightly distal to subnode
2.	Wings markings	Opaque black with iridescent vitreous spots of blue, violet or emerald green	Hyaline or hind wing marked with one or more opque black bands running from costa to hinder border.
3.	Comparative broadness of wings	Hindwings considerably broader than forewings	Hind wings only slightly broader than forewings

Fraser (1934) to distinguish the two species groups mentioned above :

Amongst such distinguishing characters, the origin of R_s is clearly overlapping in nature and do not therefore, serve any useful purpose in distinguishing the two species groups. In respect of wing markings it is noticed that, while the members of *Fenestrella* group conform with each other in having a general common pattern, the members of *Bifasciata* group present a wide range of distinction in this respect. Thus, while the wings are completely hyaline in *immaculata* Selys, in *hilarye* Fraser, *trifasciata* Selys* and *bifenestrata* Fraser the wings are distinguished into hyaline (near bases) and vitreous violet (or violt-green or emerald-green) areas, such vitreous areas being marked by black bands. Such black bands in case of *hilarye* Fraser and *trifasciata* Selys are present only in hind wing, rather narrow, and are either isolated from or partially joined to one another by narrow isthmus running only along either the costal or the inner wing border. In *bifenestrata* however, nature of the black area is altogether different. Not only the forewings in case of *bifenestrata* are heavily marked with black, but in hind wing also, the black areas are so extensive and broadly contiguous along costal as well as inner wlng border that, the vitreous areas are reduced to isolated areas or spots. One thus finds it difficult to regard the black markings in the wings of *bifenestrata* as 'bands'—the only key character (couplet 3, p. 8) used by Fraser (1934) to distinguish the set of species of the two groups, '*Bifasciata*' *and* '*Fenestrella*'.

Taking into consideration the nature of wing markings of *bifenestrata* as stated by Fraser (1934) on one hand and that of the different species of the *Fenestrella* group on the other, it is further noticed that *bifenestrata* Fraser indeed shows a keen similarity with *cuneata* Selys in this respect. Their closeness was also perceived by Fraser (1934), who (on p. 33) wrote that "This species" (i.e. *R. bifenestrata*) "is, I think, more nearly related to *R. cuneata* than to *R. bifasciata*".

Regarding comparative broadness of fore and hind wings, Fraser (*loc. cit*) did not provide any morphometric data for the various species groups proposed by him under the genus *Rhinocypha* Rambur. However, in the figures of the wings of the two species provided by the author it is noticed that the fore and hind wings measures respectively 21 mm and 24 mm in case of *R. cuneata* Selys (Fig. 3, p. 10) and 22 mm and 23 mm in case of *R. bifenestrata* Fraser (Fig. 11, p. 34). It shows thereby that, the fore and hind wings are almost similar in width in case of *bifenestrata*, but in *cuneata* the hind wings are a shade wider than forewings (in the ratio of 7 : 8).

In summing up the foregoing discussion of the species 'group' and 'key' characters, it may be said that, one fails to make any sound distinction between *R. cuneata* Selys and *R. bifenestrata* Fraser upon such characters in as much as placing them in different species "groups". Both species judged resonably obviously belong to one and the same species group i. e. *Fenestrella*-group.

Material examined : 42 exs ; 41 exs, ARUNACHAL PRADESH ; 23 exs, Siang division ; 21 exs, coll. *S. K. Tandon & G. S. Arora* : 3 ♂♂, Tappi, 23. x. 1966 ; 2 ♂♂, 1 ♀, Dali village, 10. x. 1966 ; 2 ♂♂, Dulla,

* *R. bifasciata* Selys, another member of the *Bifasciata*-group mentioned by Fraser (1934) has since been suppressed under *R. trifasciata* Selys by Singh and Prasad (1976.)

29.x.1966 ; 3 ♂♂, Pading village, 11.x.1966 ; 4 ♂♂, 4 ♀♀, Bame village, 30.x.1966 ; 2 ♂♂, Dali Camp, 12.x.1966 ; 2 ♂♂, coll. *S. K. Gupta & M. Prasad* : 1 ex, on way to Bólung, 21.x.1981 ; 1 ♂, Basar, 23.x.1981 ; 14 exs, Subansiri district ; 5 exs, 28.x.1966, coll. *S. K. Tandon & G. S. Arora* : 3 ♂♂, Bridae ; 1 ♂, 1 ♀, Daporijo ; 7 exs, coll. *A. N. T. Joseph* : 1 ♂, Tipi, 6.v.1966 ; 3 ♂♂, 3 ♀♀, Tamen, 18-20.v.1966 ; 2 ♂♂, on way to Mori, Upper Subansiri district, 25.x.1981, coll. *S. K. Gupta & M. Prasad* ; 2 ♂♂, Pinjuli, Kamang division, 4.v.1966, coll. *A. N. T. Joseph* ; 1 ♂, 1 ♀, Wakro, Lohit dist. Daphabum Expedition, 1-3.xii. 1969-70, coll. *J. M. Julka* ; 1 ♂, WEST BENGAL, Reyang, 30. v. 1972, coll. *H. S. Sharma & Party.*

Measurements (in mm) and Nodal index : (for males and females respectively) ; Length of abdomen : 18.0-24.0, 17.5-21.0 ; length of hind wing : 23.0-30.0, 25.0-32.0 ; number of antenodal veins : fore wing : 15-23, 15-21 ; hind wing : 14-23, 17-20 ; number of postnodal veins : fore wing : 29-50, 26-34, hind wing : 27-43, 24-34.

Observations in respect of characters of taxonomic importance.

The nature of various characters of taxonomic importance exemplified in the specimens of *R. cuneata* Selys under study are presented below with an attempt to show how these intergrade between the descriptions of *R. cuneata* Selys and *R. bifenestrata* Fraser, provided by Fraser (1934).

Markings of forewing : Opaque area of forewings in the specimens studied shows a complete gradation from being very extensive (Plate I, figs. 3 & 4) like that of *R. cuneata* Selys (covering costal half or more than that in extent) to less than costal half (Plate I, fig. 2) and falling to narrow isthmus apical to pterostigma and following some distance from node to pterostigma (Plate I, fig. 1) as that of *bifenestrata* Fraser. Due to variability of its extensiveness the opaque area of forewing is in some specimens limited posteriorly by IR_{1+1} (Plate I, 2) or R_{1+v} (Plate I, fig.4), but in others, the opaque area extends upto MA (Plate I, fig. 1).

Extent of opaque area in hind wing : Fraser (1934) mentioned in the description of the two species that in hind wing, the opaque area extends 4-5 cells proximal to node in *R. cuneata* Selys, while the same extends 3-4 proximal to node in *R. bifenestrata* Fraser. In the specimens under study, however, it is observed that the opaque area in hind wing extends based variably upto only mode (Plate I, figs. 2 & 3) or upto 5 cells (Plate I, fig. 1) proximal to that level in costal space.

Nature of preapical vitreeous spot in hind wing : As described by Fraser (1934), the preapical spot in hindwing of *R. cuneata* Selys is oval, narrower than the middle row of vitreous spots and with its outer border in line with inner border of pterostigma. Although Fraser (*loc. cit.*) stated the nature of the pre-apical vitreous spot to be variable in *R. bifenestrata* Fraser, in the figure of wings of the species provided by the author it is found that the pre-apical spot is as wide as the middle row of vitreous spots. In the specimens under study (Plate I, figs. 1 to 4) we notice an intermediate situation in respect of the relative width of the pre-apical spot while its outer border is found to lie variably along the inner end of pterostigma or proximal to that level.

Nature of Medial row of vitreous spots : In the specimens at our disposal it is noticed that of the medial row of vitreous spots, the costal is usually separated from the two

posterior ones (Plate I, figs. 1, 3 and 4), but all three may also be isolated (Plate I, fig. 2). Here again we find a gradation of situation linking *R. cuneata* Selys and *R. bifenestrata* Fraser.

Relative breadth of fore and hind wings : In a random sample of 10 exs. of specimens under study the relative breadth of fore and hind-wing are found to be as follows : 7.0 : 6.0 (2 exs) ; 7.0 : 7.5 (1 ex) ; 7.0 : 7.7 (4 exs) ; 7.0 : 8.0 (3 exs). Therefore, the specimens at our disposal also present variable situation in respect of relative width of fore and hind wings grading into the ideal conditions of *R. cuneata* Selys and *R. bifenestrata* Fraser.

Conclusion : From the foregoing analysis of species group characters and observations in respect of characters of taxonomic importance, it becomes amply clear that *bifenestrata* Fraser can not hold a distinct identity and therefore, for fitness of things it is sunk as a synonym under *R. cuneata* Selys. However, some amplification of the existing description of *R. cuneata* Selys appear worth recording. Over and above what has already been discussed in connection with the characters of taxonomic importance, the specimens studied also present some variations in respect of body markings. Thus, labrum does not bear any marking in the specimens studied and in most of them, the hind femora are not pruinosed. The details of thoracic marking in the specimens studied differ in details from the description of either species as provided by Fraser (1934) and stand as follows : Male—Mesothoracic triangle blue, large and complete, extending as far as antealar sinus ; a posthumeral line, incomplete below and broken above to part with a small isolated upper spot ; a small upper spot just above the humeral suture ; a line on 1st lateral suture, of about half the length of post humeral line, and narrowly separated from a linear streak bordering the upper margin of mesepimeron ; some or all the foregoing markings are subject to being reduced or obsolate; a broad stripe largely covering the mesepimeron and a triangular stripe over the upper part of metepimeron ; a short fine anterior streak repesenting the antehumeral stripe of the female rarely present. Female : Markings very similar to the male, but are better defined ; the posthumeral line not broken and the upper antehumeral spot expanded into a narrow streak curved towards the antealar sinus ; in addition, a fine antehumeral line is present that extends backwards from the anterior end for variable distance.

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REFERENCES

FRASER, F. C. 1922. New and rare Indian Odonata in the Pusa collection. *Mem. Dept. Agric. India (Ent. Ses.)*, **7** : 39-77.

FRASER, F. C. 1934. The Fauna of British India including Ceylon and Burma. Odonata, **2** : xix+398 pp. Taylor and Francis, London.

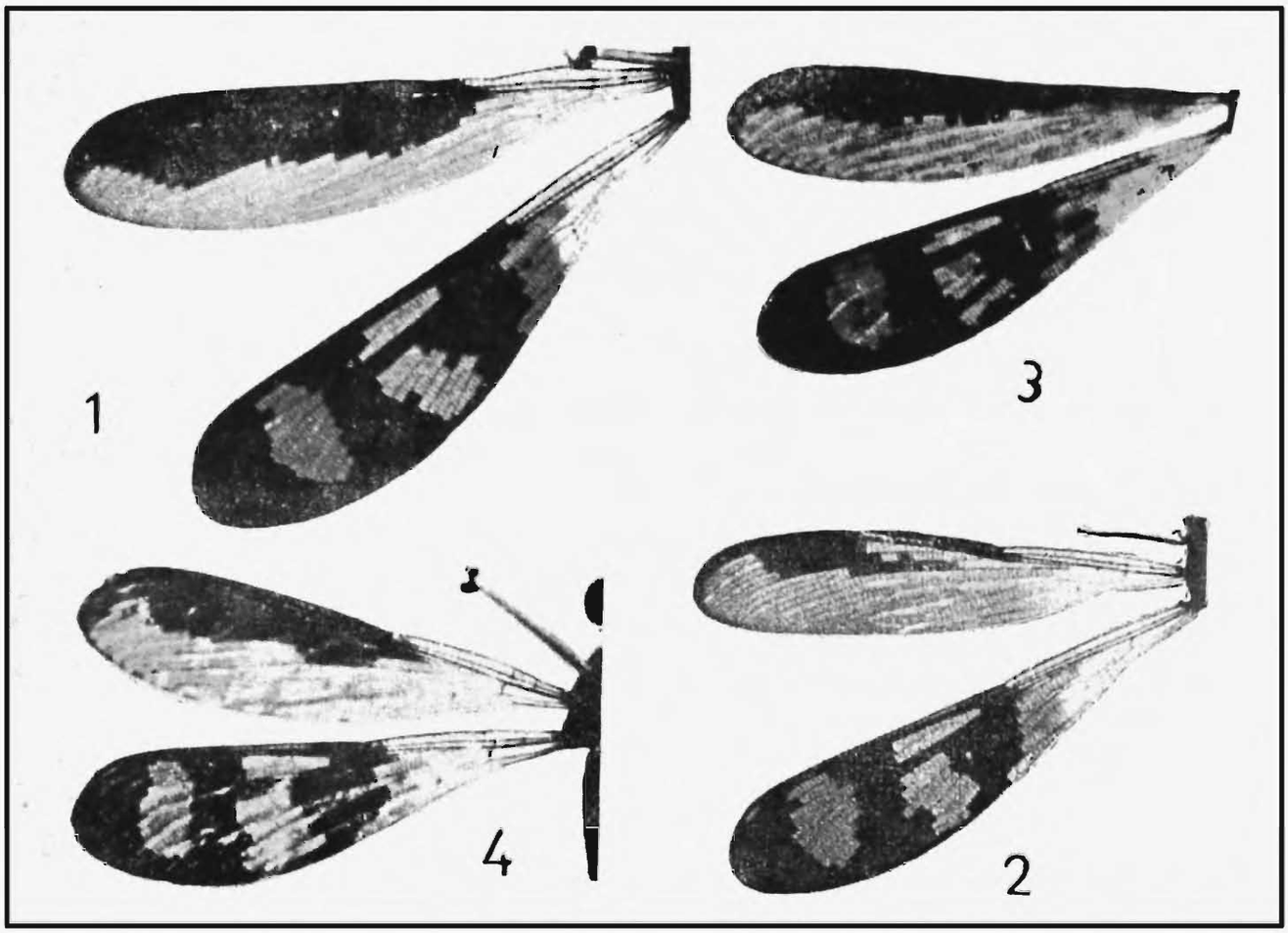
LAHIRI, A. R. 1977. New records of Odonata from Tripura and Arunachal Pradesh. *Proc. zool. Soc. Calcutta*, **30** : 45-49.

LAHIRI, A. R. 1979. Odonata (Insecta) from different states of North Eastern India. *Orient. Ins.* **13** : 119-132.

SELYS LONGCHAMPS, EDM, DE, 1853. Synopsis des Colopterygines. *Bull. Acad. r. Belg. Cl. Sci.*, (*2*), **7** : 437-443.

SINGH, A. AND PRASHAD, M. 1976. On the identity of *Rhinocypha trifasciata* and *R. bifasciata* (Odonata : Zygoptera : Chlorocyphidae). *Orient. Ins.*, **10** (4) : 553-556.

A. R. LAHIRI AND C. SINHA PLATE I



Figs. 1 to 4, photographs of fore- and hindwings of *Rhinocypha cuneata* Selys, showing variations in the extent of opaque areas.

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GENERIC RELATIONSHIP AND STATUS OF THE SCYLIORHINID SHARK, *SCYLIORHINUS (HALAELURUS) SILASI* TALWAR, 1974 (CHONDRICHTHYES : SELACHII, SCYLIORHINIDAE)

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ABSTRACT

The taxonomic status and generic relationship of the scyliorhinid shark, *Scyliorhinus silasi* Talwar, are discussed, based on re-examination of the type material and some topotypes. This species is now assigned to the genus *Cephaloscyllium* Gill.

INTRODUCTION

Talwar (1974) described *Scyliorhinus* (*Halaelurus*) *silasi* from four specimens collected off Quilon, Kerala at 300 m depth. The holotype and three paratypes, are in the respository of the Zoological Survey of India, Calcutta. Rama Rao (1975) reported this species as *Scyliorhinus natalensis* (Regan) on the basis of the same study material.

Springer (1979), in his revision of the family Scyliorhinidae, included *S. silasi* under the description of *Halaelurus quagga* (Alcock, 1899) and noted that its status was doubtful pending determination of whether or not the species had a supraorbital crest on its cranium. Smith (1980) evidently followed Springer in listing *silasi* under quagga in her *Catalogue* of the fishes of the Western Indian Ocean.

We have reexamined the type material of *Scyliorhinus silasi* and compared it with the holotype of *Scyllium quagga* Alcock, 1899 (ZSI F 751/1, 273 mm adult male). The two species are neither conspecific nor congeneric. A discussion on the status and generic relationship of *Scyliorhinus* (*Halaelurus*) *silasi* follows.

Cephaloscyllium silasi (Talwar)

(Fig. 1)

Scyliorhinus (*Halaelurus*) *silasi* Talwar, 1974, *J. mar. biol. Ass. India*, **14** (2) : 779, fig. 1 (type-locality : off Quilon, Kerala, 300m).

Scyliorhinus natalensis (*nec* Regan) Rama Rao, 1975, *J. Bombay nat. Hist. Soc.*, **72** : 218.

Halaelurus silasi : Jhingran, 1982, *Fish and Fisheries of India* : 6 (name only).

Material examined : ZSI F 6562/2, ♀, 318 mm, off Quilon, Kerala State, depth about 300 m, 3 March 1971, holotype ; ZSI F 6563/2, ♂, 360 mm, collected along with holotype ; ZSI F/6564/2, ♀, 215 mm, off Quilon, depth about 300 m, 4 March 1971, paratype ; ZSI F 6565/2, ♂, 188 mm, collected along with the second paratype ; ZSI F/7572/2, 5 exs., 151-192 mm, off Quilon (Kerala), depth about 250 mm, 4-6 February 1977.

Diagnosis : A scyliorhinid shark with a supraorbital crest on cranium ; no labial furrows along jaws (a vestigial furrow often

present at mouth angle) ; snout very broad, short, wedge-shaped ; nostrils with broad anterior nasal flaps, without barbels but with strong medial keels, reaching mouth but well separated medially ; head and body very broad and stout, head and body about as long or only slightly shorter (young) than tail ; first dorsal fin with origin above pelvic bases ; second dorsal fin about half as large at first, with its base entirely above base of anal fin ; caudal fin without a crest or enlarged denticles on its dorsal and ventral margins ; and colour pattern simple with relatively few, broad, dark dorsal saddle markings on a lighter background ; size at maturity relatively small, male adult at 360 mm.

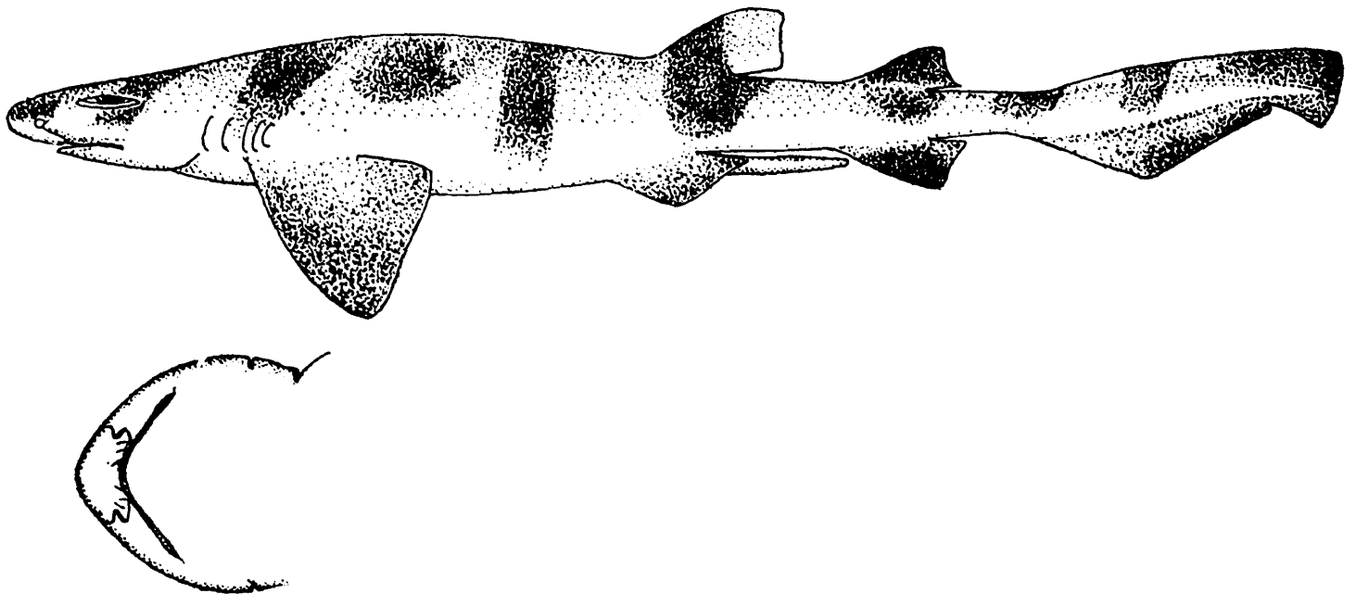

Fig. 1. *Cephaloscyllium silasi* (Talwar), paratype, 360 mm adult male.

Discussion

Scyllium quagga Alcock lacks a supraorbital crest and on this and other characters falls in the genus *Halaelurus* Gill ; it is particularly close to *H. natalensis* (Regan) and *H. lineatus* Bass, D' Aubrey & Kistnasamy, 1975, in its colour pattern, pointed snout, heavy ridges over the eyes (fomed of the pro-longed preorbital and postorbital processes), gill openings dorsolateral and well above pectoral bases, and analfin far anterior to the second dorsal fin. *Scyliorhinus silasi*, on the other hand, has a supraorbital crest on its cranium and falls in the genus *Cephaloscyllium* Gill, 1862 on the following additional characters : labial furrows vestigial, not extending onto lower jaw ; first dorsal fin about twice size of second, with its origin above pelvic bases ; head and body very broad and stout, the length of head and body from snout to vent about equal or slightly less (young) than tail from vent to caudal tip ; snout very short ; anterior nasal flaps well separated medially ; second, dorsal with base entirely above anal base. We have no evidence if this species can inflate its stomach like some other members of the genus.

Within *Cephaloscyllium C. silasi* is a very distinct species, separable from all other species by the combination of its simple colour pattern, with a few broad dark saddle markings and no small spots (see Talwar, 1974, fig. 1), wedge-shaped head in dorso-

ventral view, anterior nasal flaps broad, not attenuated, and reaching mouth, claspers very long and slender, and apparent small size (male mature at 360 mm).

ACKNOWLEDGEMENTS

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

REFERENCES

RAMA RAO, K. V. 1975. New records of off-shore fishes from the west coast of India. *J. Bombay nat. Hist. Soc.*, **72** : 218.

SMITH, M. M. 1980. A list of fishes recorded or described from the western Indian Ocean. (Unpublished manuscript).

SPRINGER, A. 1979. A revision of the cat-sharks, family Scyliorhinidae. *NOAA Tech. Rep. NMPS Circular* 422 : 1-157.

TALWAR, P. K. 1974. On a new bathypelagic shark, *Scyliorhinus* (*Halaelurus*) *silasi* (Fam. : Scyliorhinidae) from the Arabian Sea. *J. mar. biol. Ass. India*, **14** (2) : 779-783.

Bull. zool. Surv. India, 7 (1) : 41-43, 1985

DISCOVERY OF THE GENUS *CAENOSCELIS* THOMSON (COLEOPTERA : CRYPTOPHAGIDAE) FROM INDIAN REGION AND DESCRIPTION OF A NEW SPECIES FROM NEPAL

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ABSTRACT

The genus *Caenoscelis* Thomson is recorded for the first time from Indian region and a new species *C. franzi* is described from Nepal.

In Junk Catalogus Schenkling (1923) placed the genus *Caenoscelis* Thomson under the subfamily Atomariinae and listed 18 species under this genus from Europe, North and South America. Sengupta in his unpublished Ph. D. thesis (1967) retained it under the Subfamily Atomariinae and separated the genus *Caenoscelis* from other genera of Atomariinae in having 5–5–4 tarsal formula in male, antennal club two-segmented, transverse line on vertex present, sternal fittings between the mesacoxae with two separate knobs, aedeagus with articulated parameres and metatarsal and abdominal pits absent. A joint work by Sengupta and Crowson on the family Cryptophagidae (will be published elsewhere) where they treated *Caenoscelis* as a separate tribe which includes the New Zealand genus *Picrotus* Sharp (the latter genus listed by Hetschko (1930) at the end of family Cucujidae as unknown systematic position) for double knobbed meso-metasternal junctions, heteromerous male tarsi and lack of Atomariinae-type of sternal gland openings.

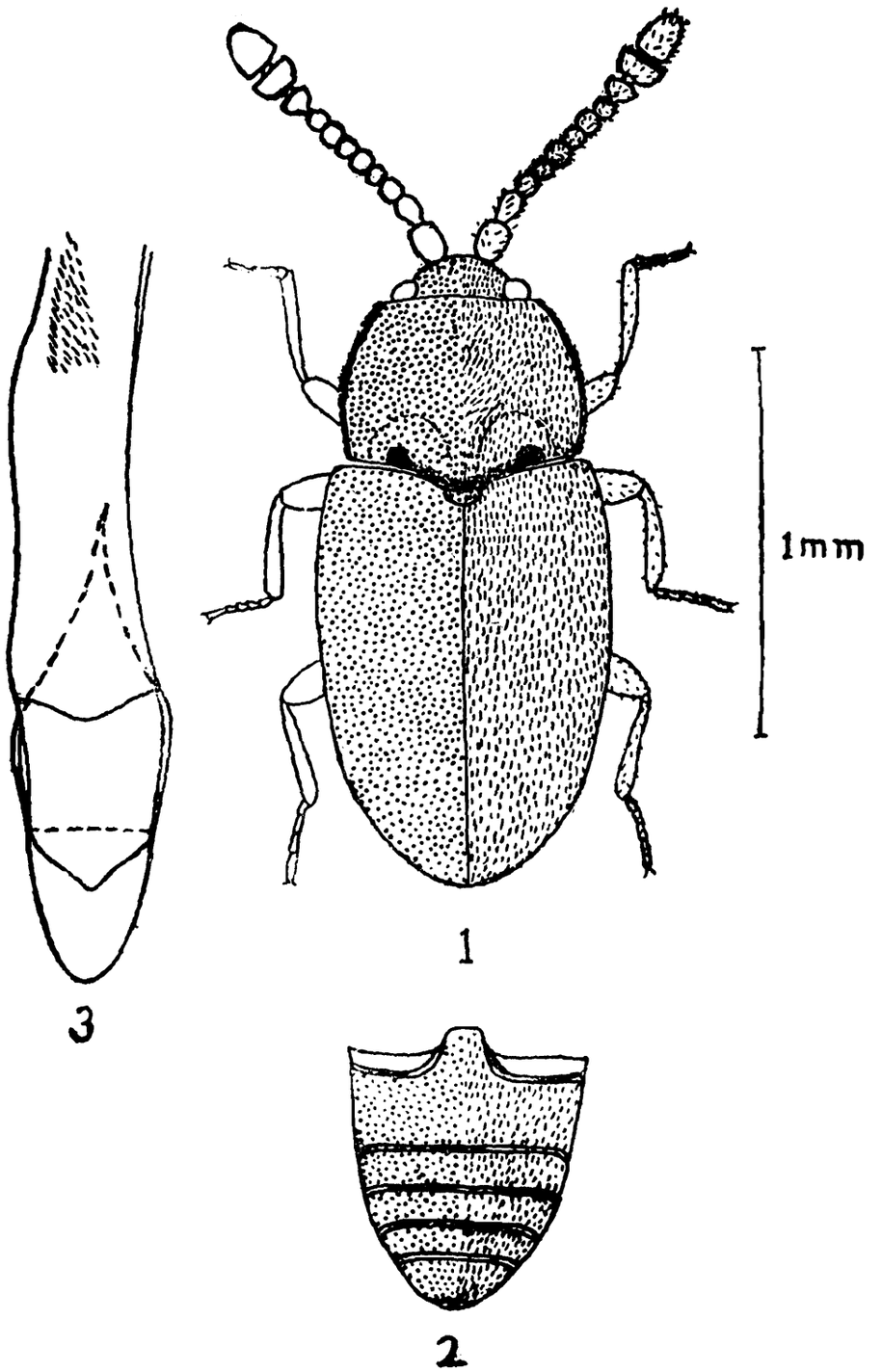
So far, this genus was unknown from Indian region, in the present study only one male specimen (which described below as a new) collected by H. Franz from Nepal. The new species is nearest to *C. ferruginea* Sahlb. but differs from the latter species in having elytral punctures fine, antennal segment 9 distinctly transverse, pronotum rather strongly narrowed in front and its punctuation distinct, strong and dense, elytral puncturation finer and less distinct than that of on elytra.

Caenoscelis franzi sp. n.

(Figs. 1-3)

General appearance small, somewhat oblong, more or less uniformly narrowed in front and less so in behind. Dorsal surface uniformly reddish brown and covered with fine, short and dense pubescence.

Head partly exposed, vertex distinctly, uniformly and densely punctured. Antennal insertion closely situated and almost exposed. Eye large and coarsely faceted. Antenna moderately large, segment moniliform, scape moderately large and slightly elongated, pedicel moderately large and slightly elongated but smaller than scape, segment 3-9 alternately



Figs. 1-3. *Caenoscelis franzi* sp. n.

large and small, segment 9 distinctly smaller than segment 10 and transverse, club 2-segmented, segment 11 distinctly longer than segment 10. Prothorax transverse, narrowed in front, less so posteriorly, lateral margin dark, finely serrated and uniformly bordered throughout, front margin almost straight, front and hind angles slightly obtuse. Pronotum uniformly convex with a pair of distinct prebasal impressions and with a pair of

depressed oblong impressions of basal half (more distinct when seen from inclined position), puncturation distinct, uniform, width of each puncture is slightly greater than the space between them, pubescence fine, uniformly projecting posteriorly, slightly inwards towards middle line. Scutellum large, transverse, its posterior margin rounded, punctured and pubescent. Elytra elongated broadest in anterior one third, and distinctly narrowed posteriorly, puncturation finer, denser and less distinct than pronotum. Pubescence uniform, recumbent and directed posteriorly. Ventrites uniformly punctured and pubescent. Aedeagus as figured (Fig. 3).

Measurements : Total length 1.66 mm ; width of head across the eyes 0.34 mm ; length of head 0.05 mm ; length of antenna 0.82 mm ; length and width of prothorax 0.45 mm ; 0.62 mm ; length and width of elytra 1.14 mm, 0.76 mm.

Holotype 1 ♂, Zentral- Nepal, Sept-Okt. 1971, lg. *H. Franz* ; *Umg Goropani W Pokhara* ; deposited in Manchester Museum.

ACKNOWLEDGEMENTS

This work was carried out in Zoological Survey of India, authors are grateful to Dr. B. K. Tikader Director, Zoological Survey of India, for laboratory facilities. We are equally grateful to Mr. Colin Jhonson of Manchester Museum from whom we borrowed the material.

REFERENCES

HETSCHKO, A. 1930. Cucujidae, in Junk and Schenkling, Coleopterorum Catalogus. Pars 109. The Hague.

SCHENKLING, S. 1923. Cryptophagidae, in Junk and Schenkling, Coleopterorum Catalogus Pars. 76. The Hague.

SENGUPTA, T. 1967. Systematic studies in Coleoptera-Clavicornia with special reference to Cryptophagidae, Languriidae and Erotylidae. (Unpublished).

Bull. zool. Surv. India, 7 (1) : 45-48, 1985

A NEW SPECIES OF *ORTHALTICA* (COLEOPTERA : CHRYSOMELIDAE : ALTICINAE) FROM INDIA

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ABSTRACT

A new species, *Orthaltica purba*, is described from Darjeeling District, West Bengal and a revised key to the Indian species of *Orthaltica* is given.

Livolia Jacoby (1903) was established on a single species, *L. sulcicollis* Jacoby, from Rhodesia. Scherer (1971) synonymized *Micrepitrix* Laboissiere with *Livolia*. Basu and Sengupta (1978) described two new species of *Livolia* from India. Scherer (1974) synonymized *Livolia* with *Orthaltica* Crotch, of which we were unware during our previous work. A new species *O. purba*, related to *O. nigripennis* Scherer, is described below from Darjeeling. A revised key to the Indian species of *Orthaltica* is also given.

Key to the Indian species of **Orthaltica**

1. Elytral interstices between eighth and ninth row of punctures sharply carinated ; prebasal transverse impression on pronotum sinuated. ... *assamensis* (Scherer)

   Elytral interstices between eighth and ninth row of punctures not carinated ; prebasal transverse impression on pronotum not sinuated. 2

2. Anterior portion of clypeus transversely raised ; antennal calli placed in front of the oblique grooves. 4

   Anterior protion of clypeus not transversely raised ; antennal calli absent or indistinct and placed behind the oblique grooves. 3

3. Antennal calli narrow, indistinct and oblique ; lateral margins of prothorax almost smooth with a few setiferous pores ; puncturation of pronotum strong, dense and uniform ; elytral interstices raised and more prominent at sides and fringed with distinct rows of pubescens. ... *dakshina* (Basu & Sengupta)

   Antennal calli absent ; lateral margins of prothorax serrated due to a series of setiferous pores ; puncturation of pronotum strong, dense and uniform ; elytral interstices almost flat and raised at sides and with a few seattered rows of pubescence. ... *purba* sp. nov.

4. Anterior raised portion of clypeus separated behind by a transvese groove ; carina on clypeus wide, oval and incomplete ; antennal calli indistict and rounded ; lateral margins of prothorax distinctly rounded and pronotum finely punctate ;

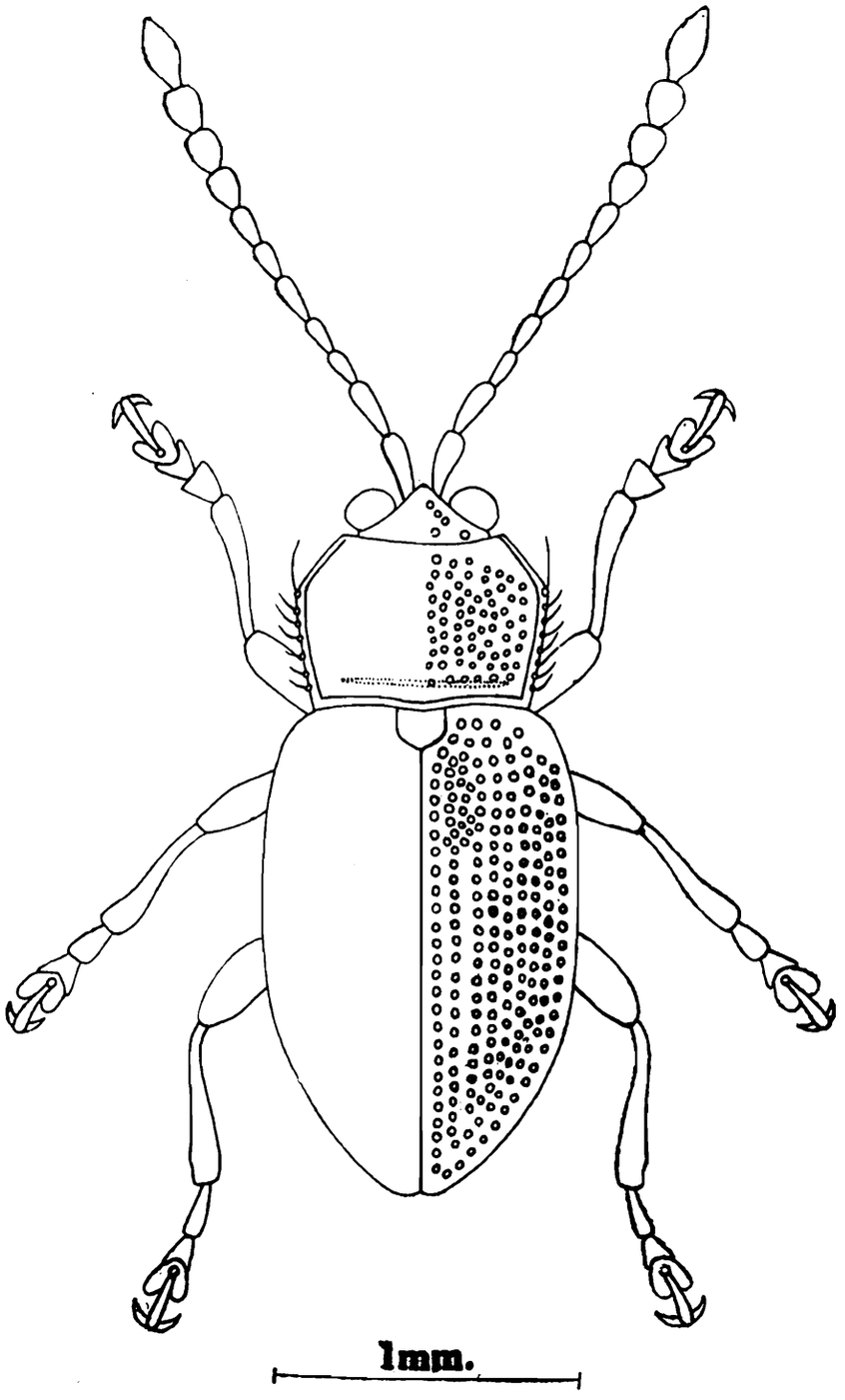

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Fig. 1. Dorsal view of *Orthaltica purba* sp. nov.

elytral interstices flat, slightly prominent at sides and sparsely pubescent. ... *bengalensis* (Basu & Sengupta)

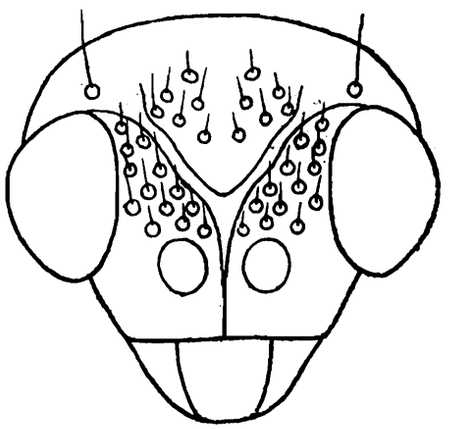
Anterior raised portion of clypeus not separated behind but triangularly continues to carina, latter short and narrow; antennal calli narrow, elongated and oblique; lateral margins of prothorax slightly rounded in front, pronotum strongly punctate; elytral interstices raised, distinctly prominent at sides and sparsely pubescent. ... *coomani* (Laboissiere)

Orthaltica purba sp. nov.

(Figs. 1-3)

Small but larger than other known Indian species, ovate, shiny, head and pronotum almost black, elytra dark brown with its suture almost black, antennae and legs reddish brown.

Head smooth, frontal area covered with strong setiferous punctures, antennal calli absent, frontal line deeply channeled, clypeal carina slender and strongly pronounced. Antennae long, extending to half of the body, scape long and thick, segment 2 as long as segment 1, segment 3 small, segment 4 longer than segment 3, segment 5 slightly longer than segment 4, segments 5-10 almost equal, segment 11 longer, segments 8-11 thicker. *Prothorax* more than one and half times broader than long, basal margin slightly sinuate, front margin inwardly curved, lateral margin slightly serrated with distinct setiferous punctures, pronotum strongly and closely punctate, pre-basal transverse impression deep and almost straight, *Scutellum* triangular, glabrous and impunctate. *Elytra* slightly broader than prothorax, humerus somewhat rounded but prominent, depression across anterior one-third distinct, each elytron with eleven rows of punctures, rows of punctures near scutellum irregular, interstices flat, slightly raised at sides, which are covered with a few rows of distinct and moderately long hairs. Ventral surface dark brown,



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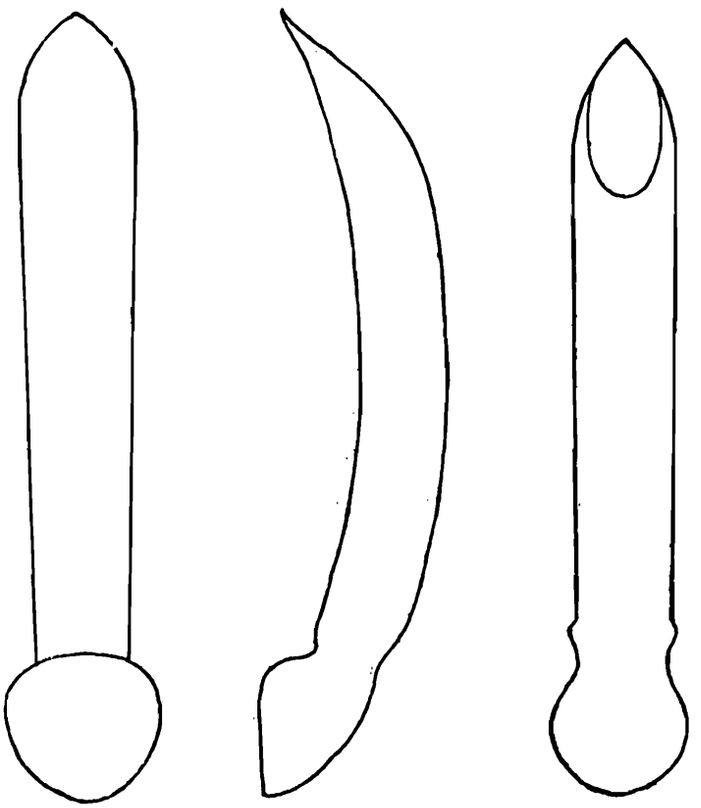

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Figs. 2-3. 2. Front view of head of *Orthaltica purba* sp. nov.
3. Ventral, lateral and dorsal views of aedeagus of *Orthaltica purba* sp. nov.

abdomen covered with strong punctures. *Aedeagus* as figured.

Measurements of the holotype : Length 2.40 mm, length of antennae 1.60 mm, width of head across eyes 0.50 mm, length of prothorax 0.55 mm, width of prothorax across middle 0.80 mm, length of elytra 1.75 mm and width of elytra accross middle 1.00 mm.

Holotype ♂, INDIA : WEST BENGAL : Darjeeling district, 3km S. of Ghum, 19. IV. 1967, Gy. Topal (In the collection of Hungarian Natural History Museum, Budapest).

Remarks : This interesting species is distinctly longer than other known species and nearest to *O. nigripennis* (Scherer) but can be easily separated by the following characters : Antennal calli absent, frontal line curved and deeply channelled, clypeal carina slender and strongly pronounced, vertex of head with fourteen setiferous punctares, antennae long and stout with its scape equal to pedicel, sides of prothorax serrated due to a series of setiferous pores, pre-basal transverse impression almost straight and deep. Head, prothorax and elytral suture nearly black.

Orthaltica bengalensis (Basu & Sengupta), Comb. nov.

Livolia bengalensis Basu & Sengupta, 1978, *Oriental Ins* **12** (4) : 483.

Distribution : India : West Bengal.

Orthaltica dakshina (Basu & Sengupta), Comb. Nov.

Livolia dakshina Basu & Sengupta, 1978, *Oriental Ins.*, **12** (4) : 485.

Distribution : India : Tamil Nadu and Orissa.

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REFERENCES

BASU, C. R. AND SENGUPTA, T. 1978. The Indian species of *Livolia* (Coleoptera : Chrysomelidae : Alticinae). *Oriental Ins.*, **12** (4) : 481-487.

JACOBY, M. 1903. A further contribution to our knowledge of African Phytophagous Coleoptera. *Trans. ent. Soc. London* **1903** : 1-38.

SCHERER, G. 1971. Das Genus *Livolia* Jacoby und seine umstrittene Stellung im system. *Ent. Arb. Mus. Frey.* **22** : 1-37, 19 figs., 4 pl.

SCHERER, G. 1974. Review of North American species of *Orthaltica* with new generic synonymy (Coleoptera : Corysomelidae : Alticinae). *Col. Bull.*, **28** (2) : 65-72.

Bull. zool. Surv. India, 7 (1) : 49-58, 1985

DEVELOPMENTAL MORPHOLOGY OF *CERVAPHIS SCHOUTENIAE* v. d. Goot (HOMOPTERA : APHIDOIDEA)

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ABSTRACT

Distinct quantitative and qualitative changes in various morphological characters occur in the development of apterous viviparous females of *Cervaphis schouteniae* v. d. Goot, which specifically infest *Microcos paniculata* in Tripura, north east India. Descriptions and key for the identification of the developmental stages have been provided. Necessary diagrams exhibiting morphological variations have also been included.

INTRODUCTION

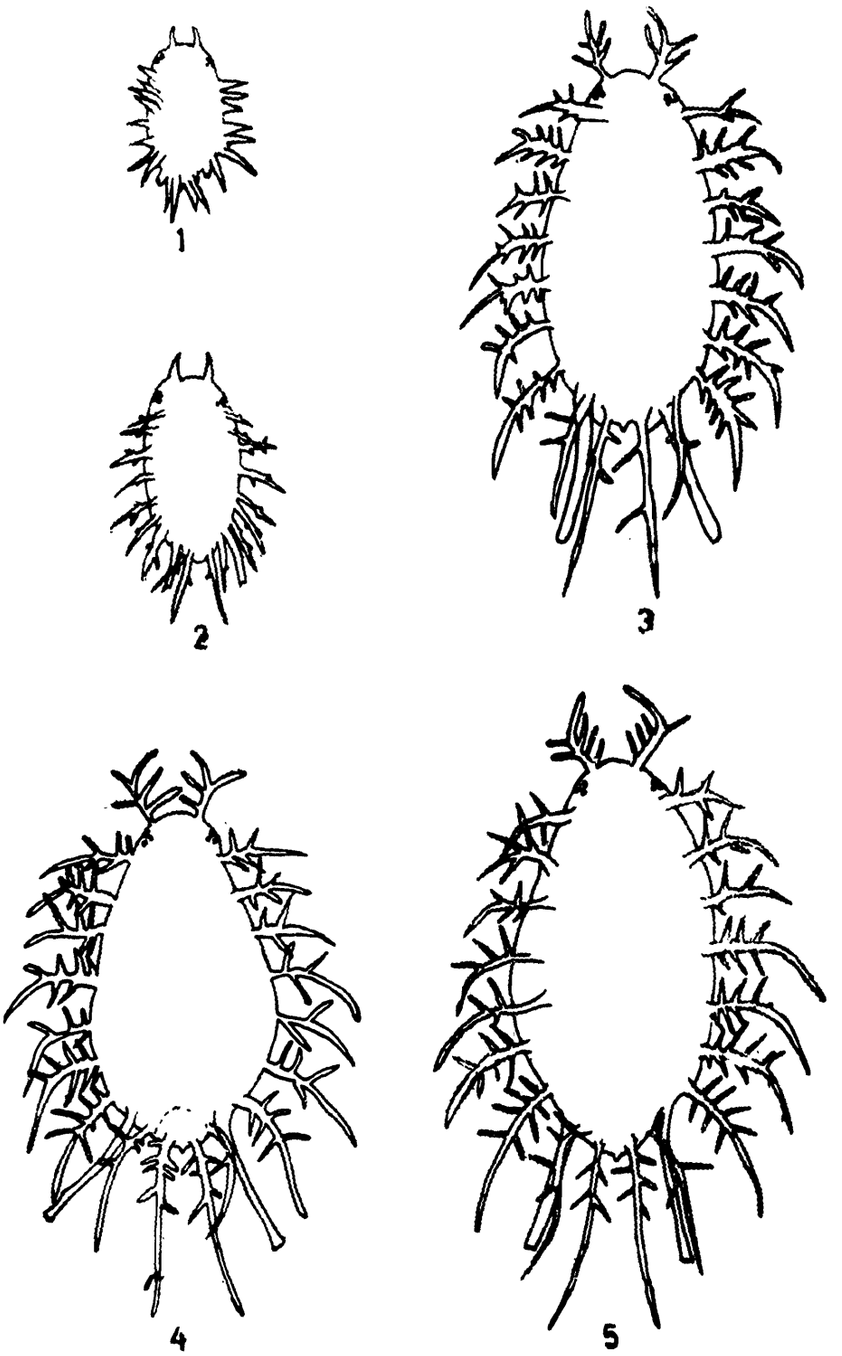
No attempt appers to have been so far made for a systematic study of the morphological variations of taxonomic importance in the developing stages of any cervaphidine aphids, which are highly restrictive in their geographical distribution and host association (Ghosh, 1982). Zoogeographically this aphid group is more prevalent in Asia, and India account for seven of the 17 species known from the world (Eastop and Lambers, 1976). Evidently, cervaphidine aphids deserve better study in this part of the world.

Cervaphis schouteniae, v. d. Goot, 1917 is one of the four species of *Cervaphis* known from India. It is known by apterous and alate viviparous female morphs only (Agarwala, *in press*) and has been known to infest some plants of Meliaceae, Sterculiaceae and Tiliaceae in India (Raychaudhuri and Chatterjee, 1980).

Present study evalutes the morphological vrriations of taxonomic importance in the developing stages of apterous viviparous females of *C. schouteniae* in order to provide identifying characters of different nymphal instars which are more commonly found in the aphid colony. This study should also prove useful in the interspecific identification in such genera whose species very often exhibit overlapping of characters in the adult stages.

MATERIAL AND METHODS

The study was conducted at Agartala, forming part of west Tripura in north east India. Five potted plants of *M. paniculata*, the specific host of *C. schouteniae* in the study area, were planted in laboratory conditions and each plant was infected with one adult apterous viviparous female collected from the natural colonies. At the end of 48 hours, 11-14 first inster nymphs were found on each potted plant. At this stage, adult apterae were removed from the newly formed colonies and from one plant all the first instar nymphs were preserved in 70% alcohol. Each of the remaining four plants with first instar nymphs



Figs. 1. First instar nymph ;
2. Second instar nymph ;
3. Third instar nymph ;
4. Fourth instar nymph ;
5. Adult apterous viviparous female ;

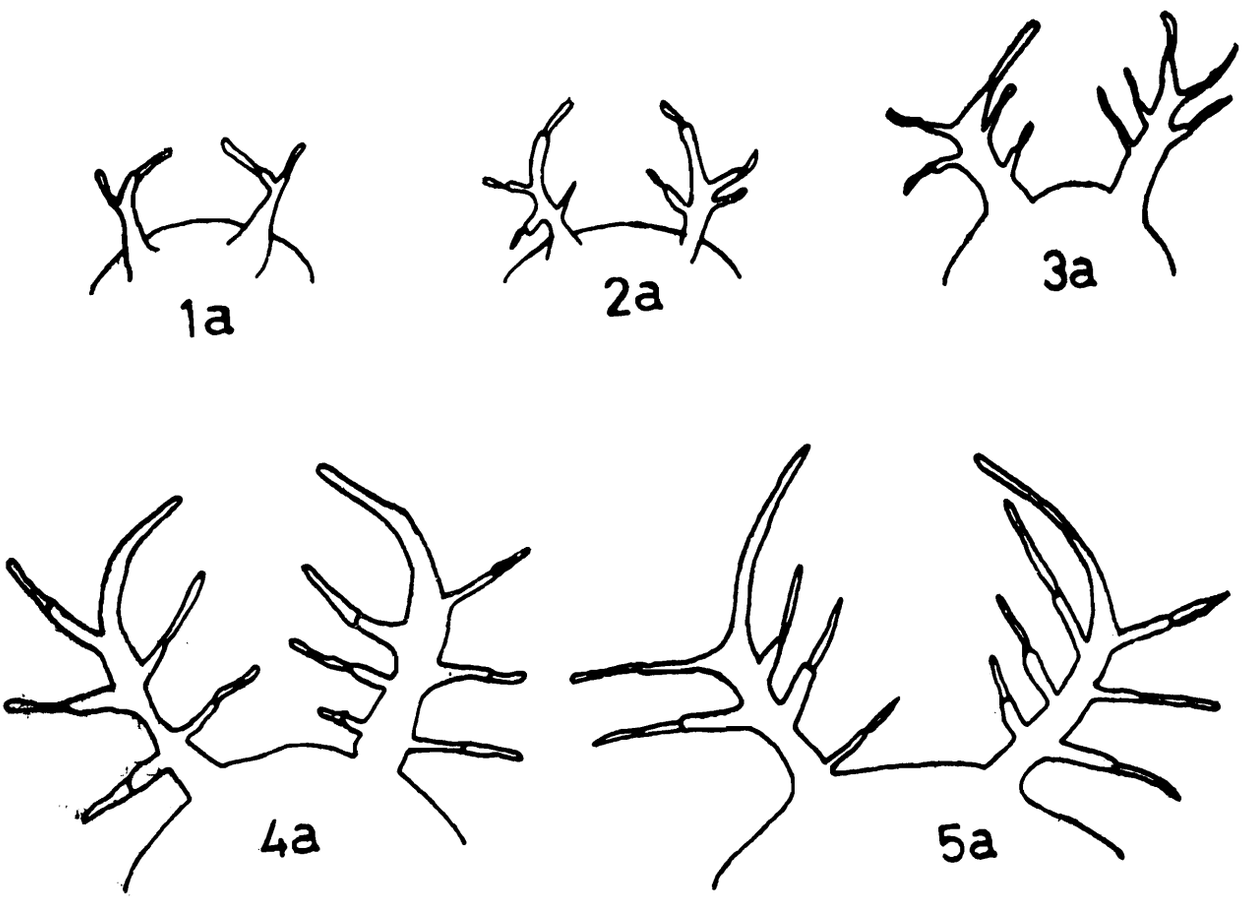
were kept undisturbed so as to study the second, third, fourth instar nymphs and adult apterae. Observations at 8 hr. intervals were taken to note the moulting of the aphids ; part of the specimens of each instar were removed and preserved in 70% alcohol.

As a result of this practice more then 10 specimens of each nymphal instar and adult apterae were obtained which formed the basis of this study. All the aphids were processed and mounted on the slides by the usual method and subjected to microscopic study for morphological and morphometric variations. All the measurements were converted 5 mm.

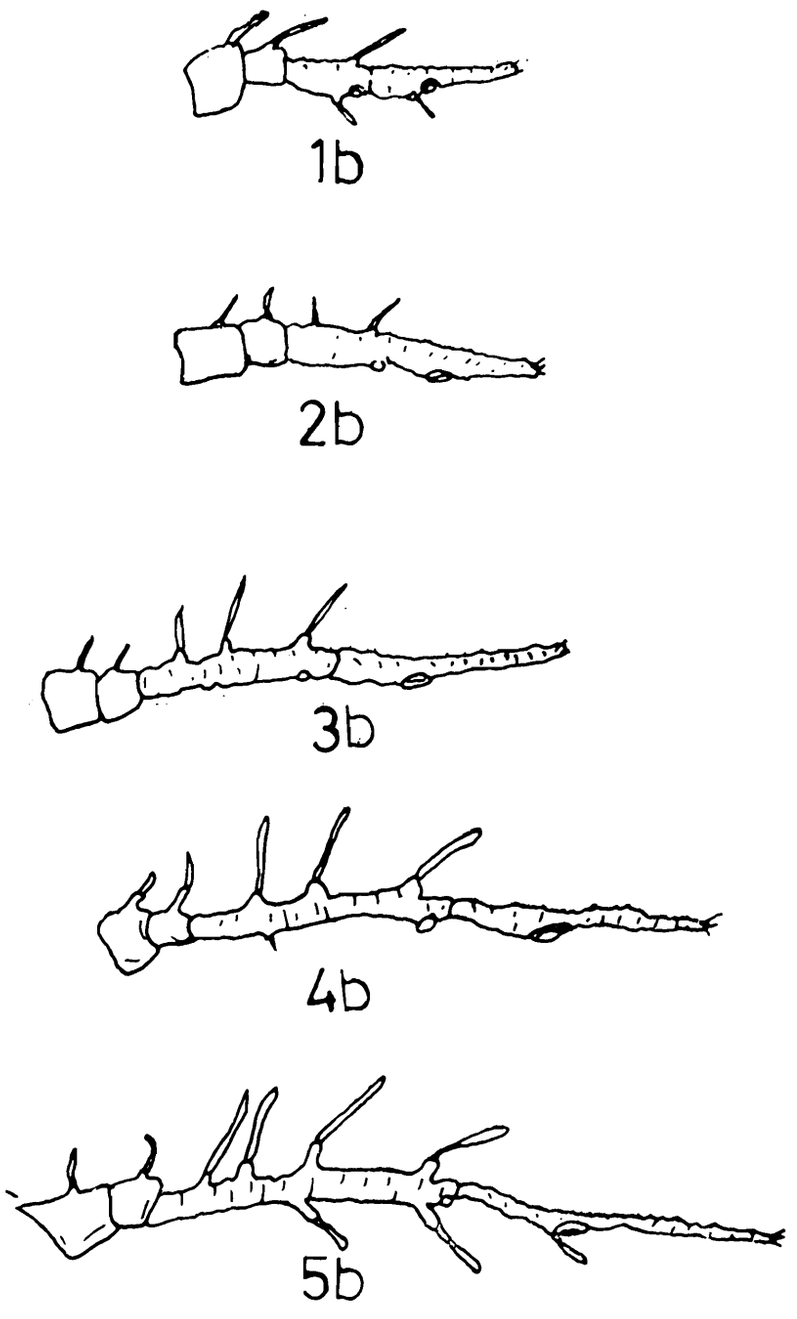
RESULTS

FIRST INSTAR NYMPHS (Figs. 1a-e)

Body pale, 0.59-0.66 mm. long and 0.26-0.3 mm. as maximum width. Head and prothorax fused (Fig. 1). Head with 3 pairs of long hairs with nearly blunt apices, placed in a row on each side of the mid-dorsal region, first two pairs have normal bases and the third pair placed on high tuberculate bases ; paired frontal processi present on each side of antennal segments 1, each processi with a broad base and a narrowing apex bearing one dagger-shaped hair directed inwards (Fig. 1a). Eyes 3-faceted. Antennae 4 segmented (Fig. 1b), 3rd and 4th segments indistinctly separated, 0.24-0.27 mm. long ; processus terminalis 0.66× bgse of last segment ; antennal hairs long with blunt apices, the longest one on segment III ; 0.05-0.06 mm. long ; primary rhinaria round and ciliated. Rostrum reaching upto middle of abdomen ; ultimate rostral segment pointed, 0.15-0.16 mm. long, twice the length of second segment of hind tarsus and without any accessory hairs. Pro-, meso- and meta-thoracic segments with two marginal processi on each



Figs. 1a-5a. Head with frontal processi : 1a-5a first instar to adult stages.



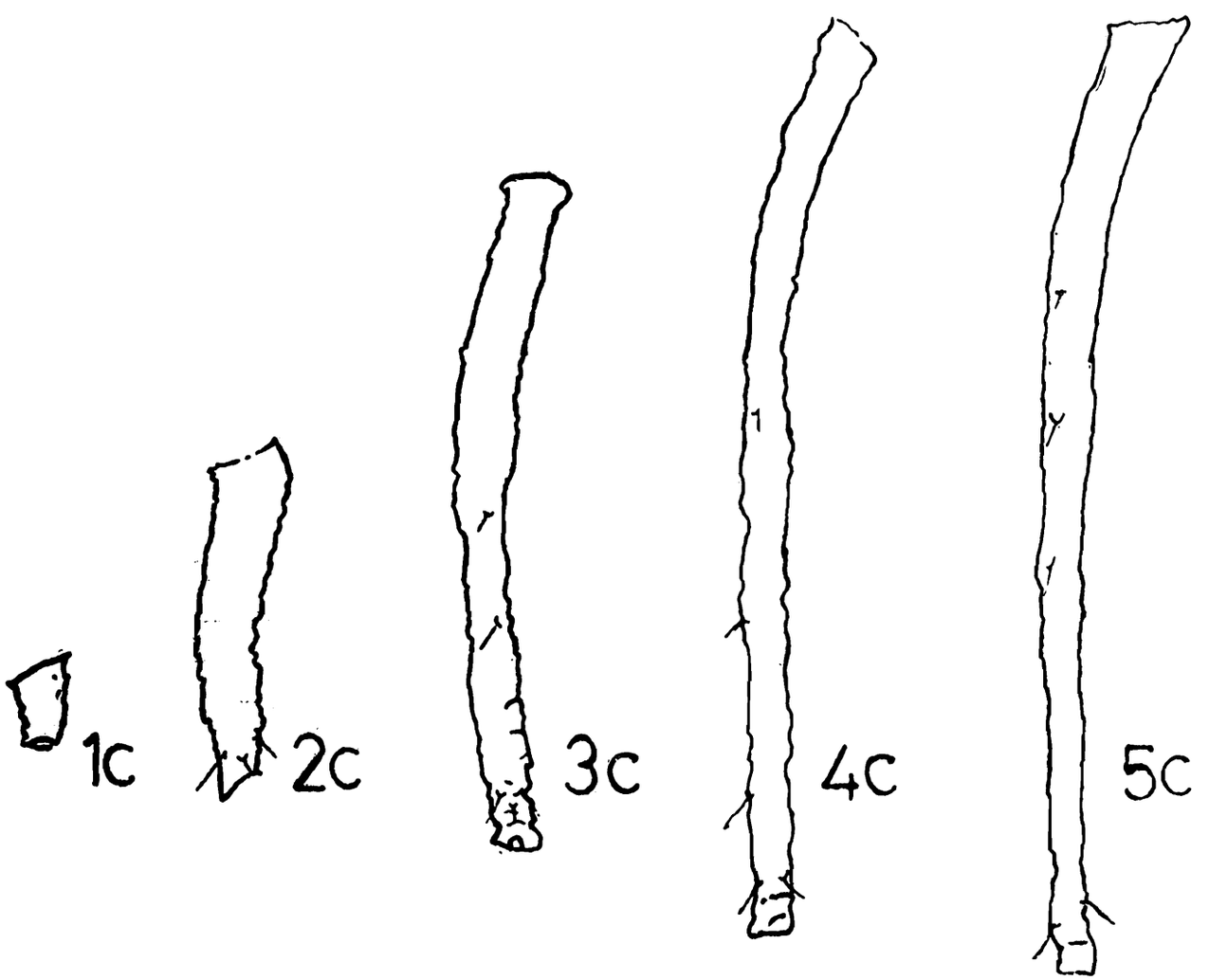
Figs. 1b-5b. Antenna : 1b-5b : first instar to adult stages.

side directed outward, each processi with a short, apical hair bifurcated at the tip. Abdominal dorsum pale and membranous ; pre-siphuncular segments with 4 pairs of marginal processi directed outward and one pair of pleural processi directed inward and downward ; post-siphuncular segments with 2 pairs of marginal processi only, the last pair longest and placed one on each side along the mid-dorsal axis of the body (Fig. 1d) ; each of the abdominal processi with a short apical hair having a bifurcated tip ; all processi with margins serrated and their surface bearing scattered spinules ; pre-siphuncular tergites each with 3-4 dorsal hairs arising from tuberculate base and deeply

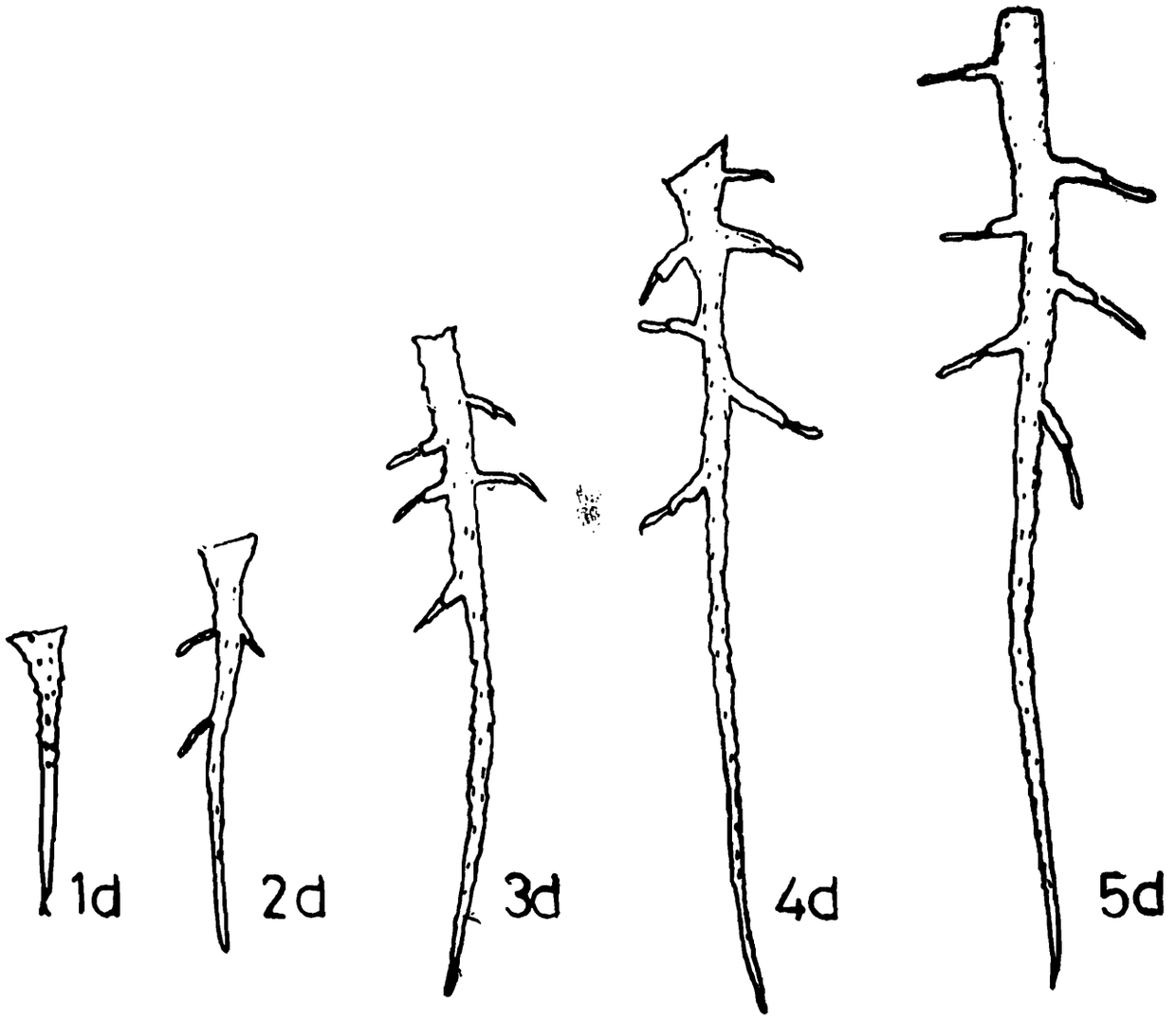
bifurcated, the bifurcated arms being directed to opposite sides (Fig. 1e). Siphunculi barrel-shaped (Fig. 1c), margins smooth, without any hair or flange, 0.06 mm. long. Caudu broadly oval with a dorsal hump. Subanal plate sub-divided and bearing a few bifurcated hairs, blunt at apices. Legs pale and stout, first tarsal chaetotaxy 2, 2, 2.

SECOND INSTAR NYMPH (Figs. 2a-e)

Body 0.68-0.74 mm. long and 0.29-0.37 mm. as maximum width. Frontal processi branched, each branch terminating in a dagger-shaped hair (Fig. 2a). Antennae 4-segmented, the separation between 3rd and 4th segments appear still indistinct (Figs. 2b), 0.28-0.30 mm. long ; p. t. about 1.90×base of last antennal segment. Ultimate rostral segment 0.14-0.16 mm. long, without any accessory hair. Each of the thoracic segments with two pairs of marginal processi, outer one of the two processi on each side directed outward and inner one directed inward and downward ; dorosal thracic hairs arising from high tuberculate bases, swollen of flattened at apices (Fig. 2e). Abdominal dorsum pale, dorsal hairs similar to the one of the thoracic tergum. Siphunculi cylindrical (Fig. 2c), 0.20-0.22 mm. long, with inner margin smooth and outer margin somewhat rugose,



Figs. 1c-5c. Siphunculus : 1c-5c : first instar to adult stages.



Figs. 1d-5d. Posterior most body processi : 1d-5d : first instar to adult stages.

bearing an apical flange and a few hairs on pre-apical portion. First tarsal chaetotaxy 4, 4, 4. Otherwise as in first instar nymph.

THIRD INSTAR NYMPH (Figs. 3a-e)

Body 0.90-1.12 mm. long and 0.48-0.85 mm. as maximum width. Antennae 4-segmented, 0.37-0.42 mm. long ; 3rd and 4th segments distinctly separated (Figs. 3b), p. t. 2.0×base of last antennal segment. Ultimate rostral segment 0.16-0.19 mm. long, without any accessory hair. Dorsal hairs on thorax and abdomen on high tuberculate bases and with spatulate apices (Fig. 3e) ; hairs on marginal processi on thorax and abdomen, dagger-shaped or swollen or flattened at apices. Siphunculi cylindrical, directed outward (Fig. 3c), 0.35-0.42 mm. long, with an apical flange and 1-2 rows of inter-connecting striae bearing a pre-apical ring of 3-4 hairs besides a few others on distal half. First tarsal chaetotaxy 5, 5, 5. Otherwise as in second instar nymph.

FOURTH INSTAR NYMPH (Figs. 4a-e)

Body 1.41-1.65 mm. long and 0.72-0.96 mm. as maximum width. Antennae 4-segmented. 0.49-0.54 mm. long ; p. t. about

2.10× base of last antennal segment (Fig. 4b). Ultimate rostral segment 0.17-0.18 mm. long, without any accessory hair. Dorsum of each thoracic and abdominal segments with numerous hairs having high tuberculate bases and swollen or spoonshaped at apices (Fig. 4e). Siphunculi 0.53-0.61 mm. long, cylindrical on basal half, coustricted near the distal 1/3rd, and swollen apicad with a flange bearing several hairs (Fig. 4c). First tarsal chaetotaxy 5, 5, 5. Otherwise as in third instar nymph.

ADULT APTEROUS VIVIPAROUS FEMALE (Figs. 5a-e)

Body 1.49-1.74 mm. long and 0.77-0.93mm. as maximum width. Antennae 5-segmented (Fig. 5b), 0.56-0.61 mm. long ; p. t. 1.33-1.60× base of last antennal segment ; flagellum finely imbricated, more so towards the apical region ; flagellar hairs long, having slightly swollen to bluntish apices, the longest one on third segment 0.06-0.07 mm. long. Ultimate rostral segment 0.18-0.20 mm. long, without any accessory hair. Hairs on dorsum of thorax and abdomen numerous, arranged in a radiating fashion, this being more prominent in the middle region of each tergite ; each hair giving out a baloon-like projection from its blunt tip (Fig. 5e). Siphunculi 0.62-0.67 mm. long, about 1.23-1.26× the length of last pair of abdominal processi, directed outward and with a prominent apical flange (Fg. 5c). Cauda broadly oval, bearing many hairs. Legs pale, femora and tibiae smooth ; hairs on legs with fine to slightly blunt apices ; first tarsal chaetotaxy 5, 5, 5.

Key to the Identification of the developmental stages of **C. schouteniae**

1.	Antennal segments III and IV not distinctly separated ; first tarsal chaetotaxy 2,2,2 or 4,4 4 ; average body length less than 1 mm.	2
	Antennal segments II and IV distinctly separated ; first tarsal chaetotaxy 5,5,5 ; average body length more than 1 mm.	3
2.	First tarsal chaetotaxy 2,2,2 ; siphunculi 0.06 mm. long, without any flange ; posteriormost processi 3.14-3.50 × length of siphunculi. ...	First instar nymph.
	First tarsal chaetotaxy 4,4,4 ; siphunculi 0.20-0.22 mm. long, with an apical flange ; posterior most processi 1.44-1.54× length of siphunculi. ...	Second instar nymph
3.	Dorsal hairs on pre-siphuncular tergites sparsely placed, never more than 20 hairs per tergite ; length of frontal processi, posteriormost body processi, antennae and siphunculi 0.20-0.26 mm., 0.37-0.42 mm., 0.35-0.42 mm. respectively. ...	Third instar nymph
	Dorsal hairs on pre-siphuncular tergites densely placed, always more than 20 hairs per tergite ; frontal processi, posteriormost body processi, antennae and siphunculi much longer.	4
4.	Antennae, siphunculi and posterior-most body processi 0.49-0.54 mm., 0.53-0.61 mm. and 0.67-0.74 mm. long respectively ; 4th segment of rostrum 0.125-0.133 mm. long. ...	Fourth instar nymph

Antennae, siphunculi and posterior most body processi 0.56-0.61 mm., 0.62-0.67 mm. and 0.77-0.18 mm. long respectively ; 4th segment of rostrum 0.133-0.148 mm. long. ... Adult apterous viviparous female

Discussion

An analysis of the morphological development from the first nymphal instar stage to the adult stage reveals a gradual transition in shape, size and number of different characters. The transition, both qualitative and quantitative, in most cases have been distinct and easy to distinguish in the preceding and succeding stages (Table 1 and Fig. 6).

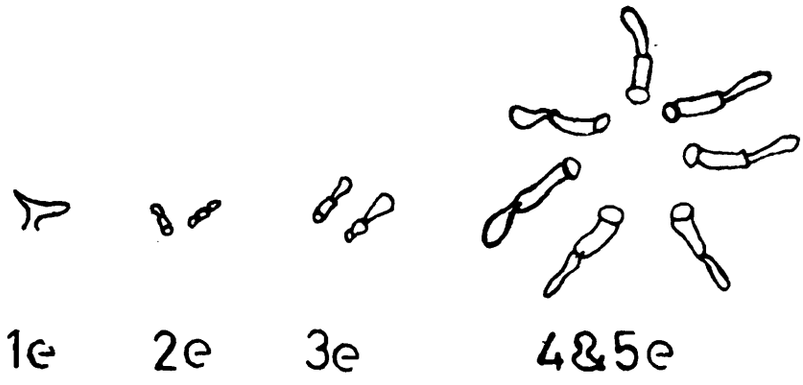


Fig. 1e-5e. Hairs on presiphuncular tergites : 1e-5e : first instar to adult stages.

TABLE 1. Measurements (average of 10 specimens) of some morphological characters of *C. schouteniae* v. d. Goot (in mm.)

Characters	First Instar			Second Instar			Third Instar			Fourth Instar			Adult apterae		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
L. Body	0.59	0.66	0.63	0.68	0.74	0.72	0.90	1.12	1.05	1.41	1.65	1.65	1.49	1.74	1.64
W. Body	0.26	0.30	0.28	0.29	0.37	0.33	0.48	0.85	0.53	0.72	0.96	0.83	0.77	0.93	0.84
L. Frontal Processi	0.11	0.14	0.13	0.15	0.16	0.16	0.20	0.26	0.23	0.31	0.37	0.34	0.32	0.38	0.36
L. Antenna	0.24	0.27	0.26	0.28	0.30	0.29	0.37	0.42	0.40	0.49	0.54	0.52	0.56	0.61	0.58
L. Ant. III	0.05	0.06	0.06	0.08	0.09	0.08	0.14	0.15	0.14	0.20	0.23	0.22	0.24	0.27	0.26
L. p. t.	0.07	0.07	0.07	0.07	0.08	0.08	0.10	0.11	0.11	0.11	0.13	0.12	0.12	0.14	0.14
L. base of last ant. segment.	0.05	0.06	0.05	0.05	0.06	0.06	0.06	0.08	0.07	0.08	0.10	0.09	0.09	0.10	0.09
U. R. S.	0.15	0.16	0.15	0.14	0.16	0.15	0.16	0.19	0.17	0.17	0.18	0.18	0.18	0.20	0.19
h. t. 2	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.08	1.00	0.09	0.08	1.00	0.09
L. Siph.	0.06	0.06	0.06	0.20	0.22	0.21	0.35	0.42	0.37	0.53	0.61	0.57	0.62	0.67	0.65
L. Post. Processi	0.18	0.22	0.20	0.29	0.31	0.31	0.43	0.53	0.48	0.67	0.74	0.70	0.77	0.83	0.83.

L. body-length of body ; W. body-width of body ; L. Ant. -lenth of antenna ; L. Ant. III-length of antennal segment III ; U. R. S.-length of ultimate rostal segment ; h. t. 2-length of second segment of hind tarsus ; L. Siph.-length of siphunculus ; L. Post. Proj.-length of posterior most body processi.

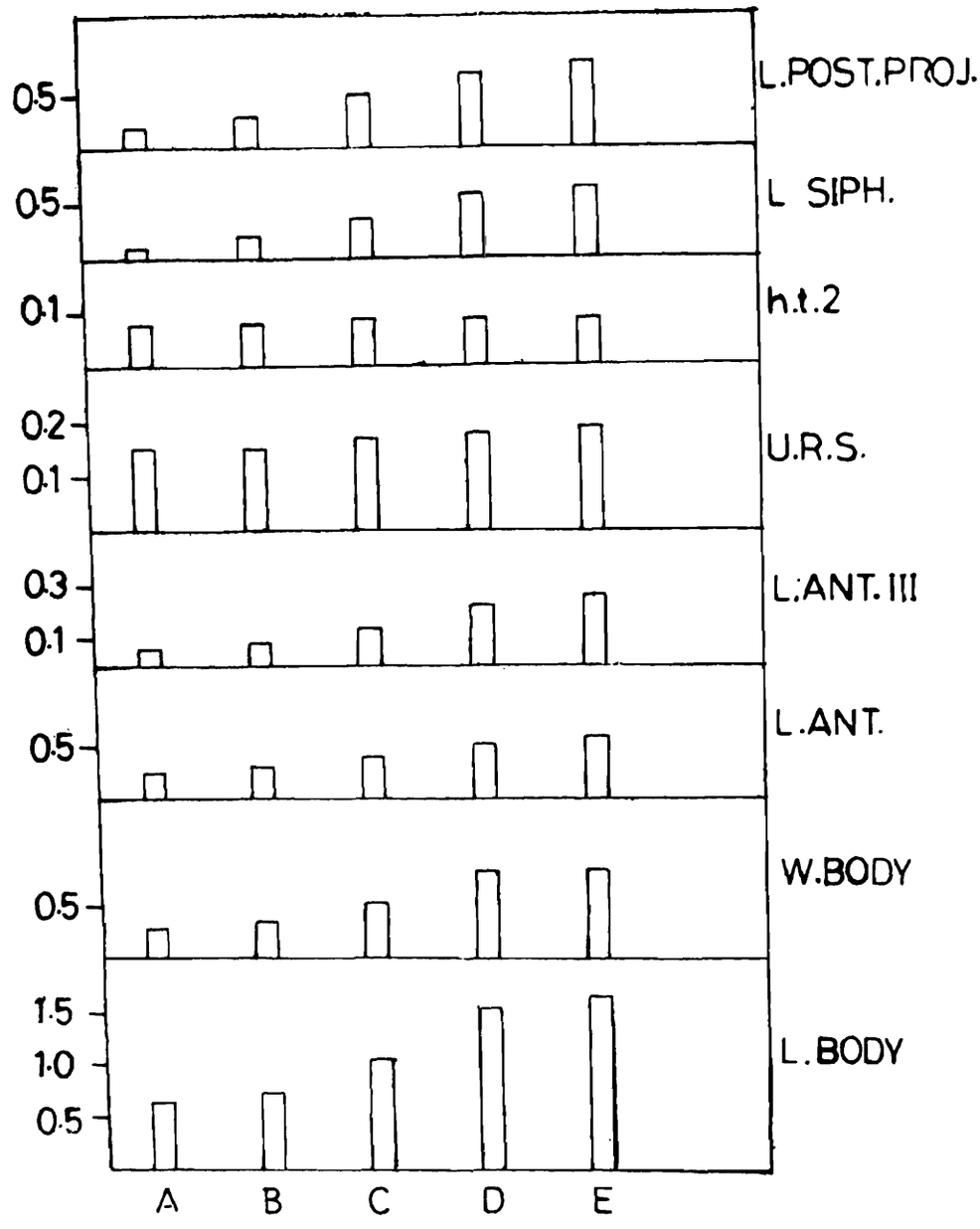


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Fig. 6. Histograph showing developmental variations in some morphological characters from first instar to adult stages.

Change in shape :

It includes siphunculi, body-processi and body hairs. Siphunculi in the first instar is barrel-shaped, without any hair or flange ; in the second instar, the shape becomes more cylindrical, an apical flange starts to appear in the form of a rim and also a few apical hairs appear ; in third instar, cylindrical siphunculi appear to be directed outward, the flange becomes more prominent and 1-2 rows of interconnecting striae develop ; in the fourth instar, the distal portion of the siphunculi becomes somewhat swollen and the flange distinctly protrudes from the apical membranous joint ; number of hairs on the pre-apical region also increases, the

shape of the siphunculi of fourth instar becomes more prominent in the adult apterae. Similarly, body processi in the first instar stage remain unbranched but these gradually become branched and in the adult stage almost bilateral symmetry exists in the number and position of projecting arms of each of the processus. First instar nymph bears small hairs, mostly with bifurcated apices. In later instars bifurcation is replaced by dagger-shaped or swollen apices or flattened tips of the hairs.

Change in size :

This includes length of body, width of body, lengths of antennae, siphunculi, frontal processi and posterior most body processi (Table 1). Among these characters, the siphunculi increases in length from first instar to adult by 11×, whereas other characters increased in length by a factor of 2.5-5.0.

Change in number :

Important among these are antennal segments, body hairs and first tarsal chaetotaxy. In the first and second instars, antennae are 4-segmented and 3rd and 4th segments remain indistinctly separated ; in the third and fourth instars, separation becomes distinct and in the adult apterae, antennae becomes 5-segmented. Body hairs are much fewer in the first and second instars and distributed irregularly on the dorsum ; from third instar stage, body hairs not only gradually increase in number but also start orienting in a radiating fashion. As a result, the adult apterae have numerous hairs on each segment and they are strongly oriented in radiating fashion, more so in the middle of the segment (Fig. 1e-5e). First tarsal chaetoraxy is 2, 2, 2 in first instar, 4, 4, 4 in the second instar and 5, 5, 5 in third and fourth instars and in the adult apterae.

The gradual but distinct qualitative and quantitative changes of different morphological characters in the developing stages of *C. schouteniae* can be projected in a histogram (Fig. 6) and are of practical use in the perfect identification of different stages of a species, particularly such species where overlapping in characters at interspecific or intraspecific level is a common phenomenon.

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REFERENCES

AGARWALA, BASANT K. Hitherto unknown alate viviparous female of *Cervaphis schouteniae* v. d. Goot from India. *Entomon* (In press).

EASTOP, V. F. AND HILLE RIS LAMBERS, D. 1976. Survey of the world's aphids. Dr. W. Junk b. v. Publishers. The Hague, 1-573.

GHOSH, A. K. 1982. Cervaphidini (Homoptera : Aphidoidea) of the world. *Oriental Ins.* **16** : 77-97.

RAYCHAUDHURI, D. N. AND CHATTERJEE, M. 1980. Subfamily Greenideinae (p. 315-358) in "Aphids of North East India and Bhutan". The Zoological Society, Calcutta, 1-522.

Bull. zool. Surv. India, 7 (1) : 59-61, 1985

REDESCRIPTION OF *PERIPOLUS NEPALENSIS* UVAROV 1942 (ORTHOPTERA : ACRIDIDAE : CALLIPTAMINAE)

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Peripolus nepalensis was described by Uvarov 1942 where he referred only those characters by which this species differs from *Peripolus pedarius* (Stål, 1878). The authors have made an attempt to redescribe the species in detail, considering the morphological characters including male genitalia.

Peripolus nepalensis Uvarov

(Figs. A-E)

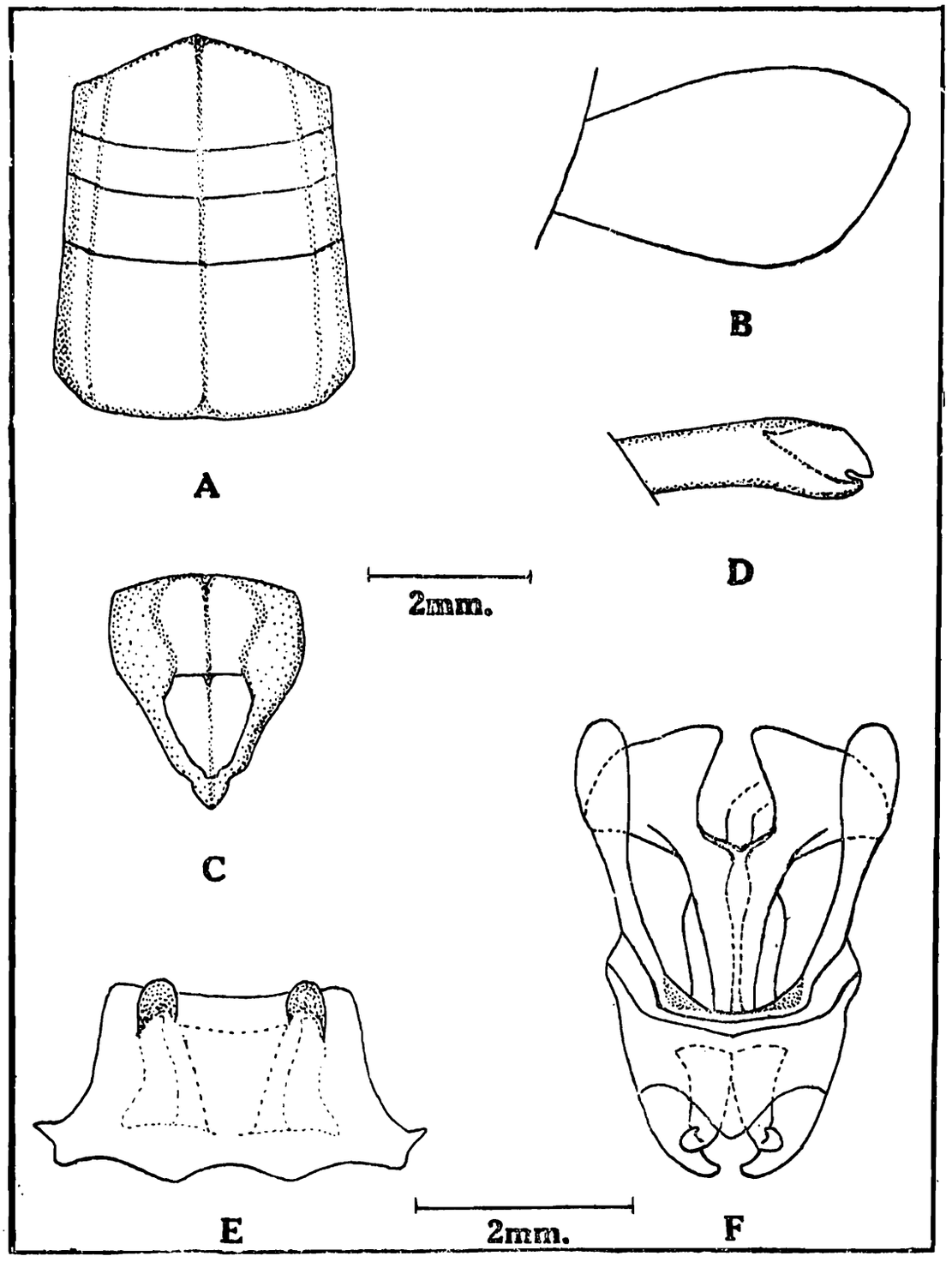
Male : Smaller than other species of the genus. Antennae filiform, a little longer than head and pronotum together, apical segments narrower and longer than basal segments of the flagellum. Frons with a few whitish hairs. Fastigium of vertex rounded anteriorly, slightly sloping forming an obtuse angle with the frons, depressed in the middle, bounded by carinulae laterally as well as posteriorly. Vertex horizontally passing smoothly into the frontal costa. Space between eyes wider than the width of the frontal costa, the latter with a depression in the middle ; fronto-lateral carinae well defined. Eyes oval, carinulae of the vertex prominent but diminishing towards occipital region of the head.

Pronotum (Fig. A) finely punctate, anterior margin narrower than the posterior one ; median carina raised, lateral carinae parallel and all the carinae traversed by three transverse sulci, the latter well spaced ; the principal sulcus placed well behind the middle ; hind margin slightly rounded, not notched in the middle. Lateral lobe of pronotum punctate, with the two dark, impunctate depressions on first and second lobes at superior margin ; inferior margin of lateral lobes beset with grey hairs. Prosternal tubercle straight and nearly conical.

Tegmina (Fig. B) lateral, abbreviated, reaching about the middle of the third abdominal segment, with the costal margin slightly produced apically ; without grey nervures and black longitudinal band.

Fore and middle pairs of legs deeply brown, hind pair of legs more or less yellow or light brown, covered with grey hairs. Upper carina of hind femur serrated, upper lobe of hind knee rounded, black, lower lobe rounded, light yellow with a small sootly patch on the antero-ventral side. Tibiae of hind legs black or dark brown basally, with the eight external and nine internal black tipped spines. Tibiae and tarsi with grey hairs.

Mesosternal lobes widely separated, with their posterior angles produced inwards. Mesosternal interspace shorter than mesosternal lobes. Metasternal lobes separated and not contiguous posteriorly.



Figs. A-F. *Peripolus nepalensis* : A, dorsal view of pronotum ; B, left tegmen ; C, supra-anal plate ; D, lateral view of cercus ; E, dorsal view of epiphallus ; F, dorsal view of endophallus. Figs. A-D of same magnification, Figs. E-F of same magnification.

Abdomen dark brown dorsally, covered with few grey hairs ; a well developed and light brown carina present on mid dorsal line of abdomen ; three last tergites brown and inflated. Supra-anal plate (Fig. C) conical with distinct posterior conical projection. Abdomen yellow ventrally, subgenital plate conical, black posteriorly and beset with grey hairs ;

cerci (Fig. D) black, long, flattened and with a subapical hook nearly equal to the apical lobe.

Phallic complex : Epiphallus (Fig. E) plate-like shield, ancorae lobiform, widely separated from each other, antero-lateral processes slightly produced, postero-lateral processes produced with their outer margin emarginate, posterior margin of the epiphallic plate concave in the middle. Endophallus (Fig. F) : Valves of cingulum widely separated, long and excurved, enveloped by a membrane except a little before their ends ; apical valves of penis moderately long, incurved, narrowing at ends, with their tips rounded. Basal valves of penis robust, expanded fan-like distally beyond their basal two-thirds, with a tuberosity near the exit of ejaculatory duct ; zygoma of the cingulum extremely narrow in the middle ; apodemes of cingulum longer, exceeding the length of basal valves of the penis, basal half narrow but distal half broader, and arch of cingulum membranous.

Measurement : Body length 20.0-22.0 mm ; Pronotum 4.5-5.0 mm ; Tegmina 3.0-4.0 mm ; Hind femur 12.0-12.5 mm ; Hind tibiae 3.5-3.8 mm.

Material examined : INDIA : Uttar Pradesh, Nainital, 1 ♂, (? date) 1974 (Mehra coll.) ; 1 ♂ (No data of collection available ; sent by Dr. N. D. Jago, London, for comparison).

Distribution : This species was originally referred to by Uvarov 1942 from Nepal (Nagarkota). At present, it is recorded from India (Uttar Pradesh, Nainital).

Remarks : The genus *Peripolus* includes two Indian species, viz., *P pedarius* (Stål, 1878) and *P. nepalensis* Uvarov 1942. The latter can be distinguished from the former by its smaller size, shorter antennae, less tectiform pronotum, relatively broader tegmina, shorter and broader hind femur with stronger denticles on the upper carina etc. as mentioned by Uvarov 1942. The present study on male genitalia differentiates *P. nepalensis* from *P pedarius* by prominent ancorae (vs. short ancorae), the postero-lateral processes produced with their outer margins emarginate (vs. postero-lateral processes greatly produced backwards with their outer margins rounded).

The species is being recorded for the first time from India.

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REFERENCES

DIRSH, V. M. 1956. The phallic complex in Acridoidea (Orthoptera) in relation to taxonomy. *Trans. R. Ent. Soc.* London, **108** (7) : 278, pl. 45, fig. 3.

JAGO, N. D. 1967. A Key, check list and synonymy to the species formerly included in the genera *Caloptenopsis* I. Bolivar, 1889, and *Acorypha* Krauss, 1877 (Orthoptera : Calliptaminae). *EOS, Madr.*, **42** : 401.

UVAROV, B. P. 1942. New Acrididae from India and Burma—*Ann. Mag. Nat. Hist.* London (11) **9** (56) : 595-596.

UVAROV, B. P. 1950. The genus *Caloptenopsis* I. Boliver and its allies (Orthoptera, Acrididae). *EOS, Madr.*, Tomo Extraord., Bolivar memorial : 386.

Bull. zool. Surv. India, 7 (1) : 63-68, 1985

REDESCRIPTION OF A GRASSHOPPER SPECIES, *PERIPOLUS PEDARIUS* STAL (ORTHOPTERA : ACRIDIDAE) FORM INDIA

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ABSTRACT

The species *Peripolus pedarius* (Stal, 1878) (Family Acrididae, Calliptaminae) is being redescribed and suitably illustrated.

Introduction

The species was described from the eastern Himalayas (probably from Assam) as *Calliptamus pedarius* Stal in 1878. It was subsequently transferred to the genus *Peripolus* Martinez (1902) as the type species by Kirby (1910). Till now it is the sole representative of the genus and of the Calliptaminae in Indian fauna. Uvarov (1927) recorded its occurrence in Sikkim. He (1942) described a species, *P. nepalensis*, from Nepal which, according to him, should have been regarded as a diminutive, dark and hairy subspecies of *P. pedarius* inhabiting higher altitude were it not that it showed apprecible difference in the shape of pronotum.

Recently a good number of examples of the species have been collected from Darjeeling. The National collection to the Zoological Survey of India also contains two authentically identified examples from Garhwal and a few examples from Darjeeling. Stal's description, as quoted by Kirby (1914), of the species is very meagre and devoid of any illusration. Hence the need for redescription. It was further facilitated by having a male type, on loan, from Dr. A. Kaltenbach of Wien. Therefore, in this account more reliable specific characters with suitable illustrations which will help its easy identification and show its distinctness or otherwise from *P. nepalensis* (also devoid of any illustration) are presented below.

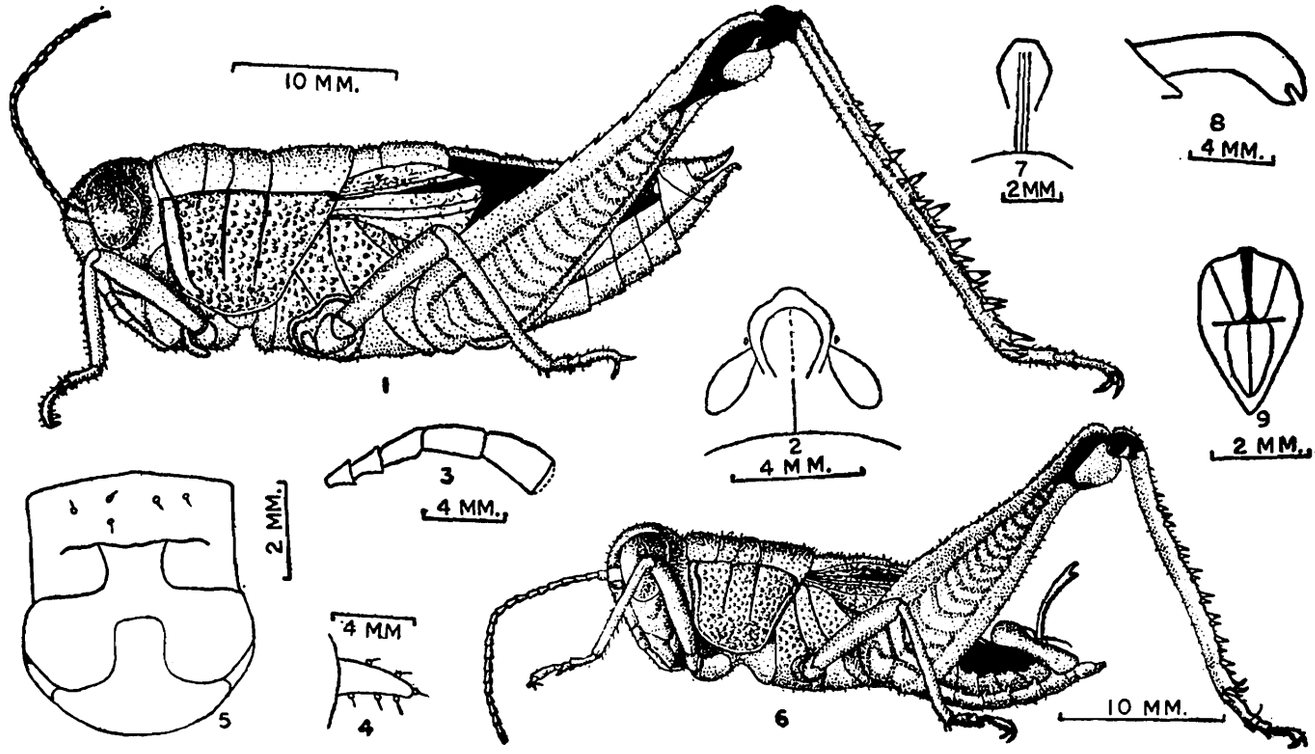
Previous distributional records : Known from Kurseong (Darjeeling), Assam and Sikkim.

Material examined : 3 ♀ ; Tadsh (alt. c. 1650 m), Darjeeling ; 31.7.59 ; *H. Khajuria* coll. 6 ♂, 8 ♀ ; Phaugri Beat House, Mirik (alt. c. 1500 m), Darjeeling (W. B.) ; 21.6.79 ; *P. Halder* coll. 7 ♂, 15 ♀ ; Singla, Darjeeling, Mar-April 1979 ; *Kulkarni* coll. 2 ♀ ; Dewal, Garhwal dist., U. P. (alte. c. 1250 m) ; 1.9.58 ; *B. S. Lamba* coll.

1 ♂ (type) bearing label as—"Typus/*Calop-*

tenus pedarius Stal det Stal/Ind. Orient/Br. v. Watt." (Type depository : *Nat. Mus. Wien* (Austria). The type nicely agrees with the specimens at our disposal.

Redescription : Females : Stout (Figs. 1. 10). Head small ; fastigium of vertex grooved, almost rounded, sloping, forming an obtuse angle with frontal ridge, from base of occiput



Peripolus pedarius, female

Figs. 1. Profile, lateral. 2. fastigium of vertex, dorsal. 3. maxililary palpus, lateral. 4. prosternal lobe, lateral. 5. meso- and metasternal lobes, ventral.

Peripolus pedarius, male

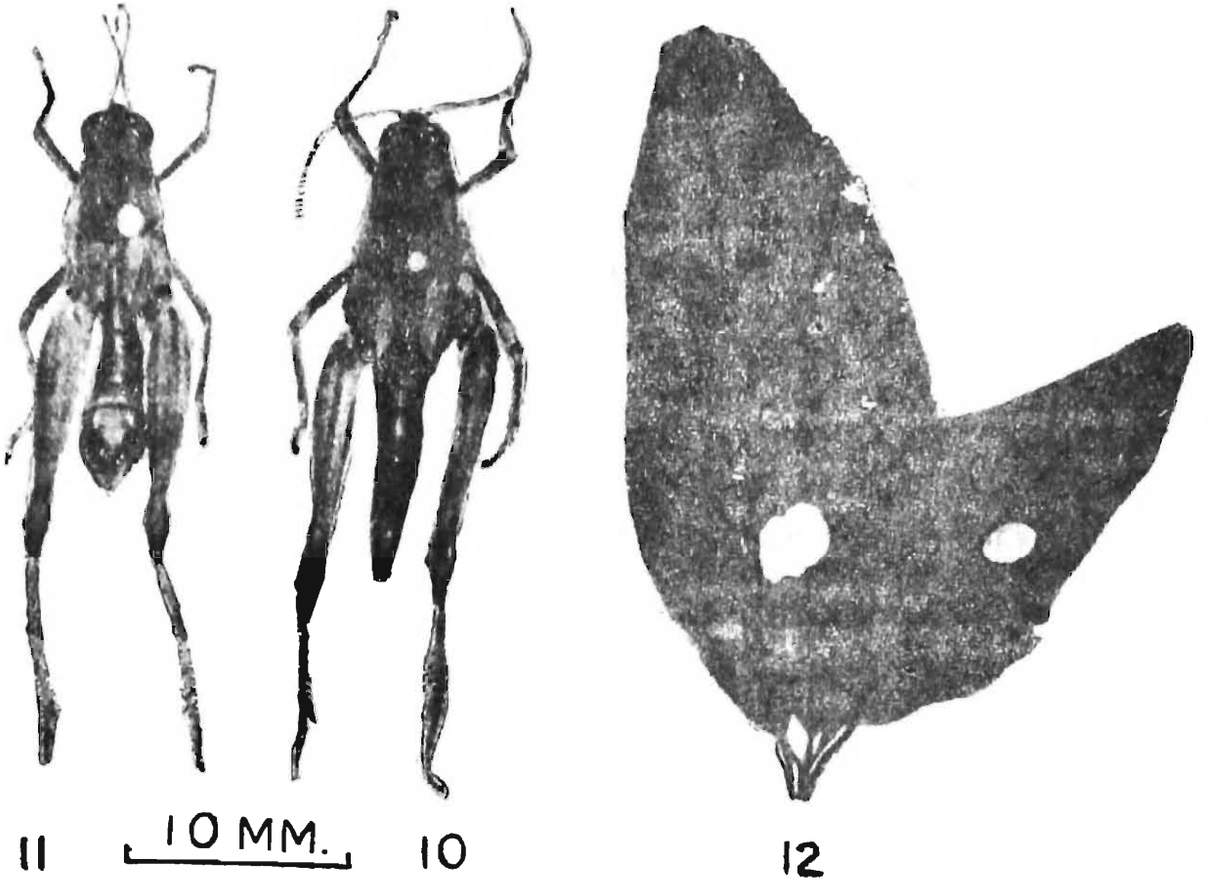
6. profile, lateral, 7. fastigium of vertex, dorsal, 8. cercus, lateral, 9, supra-anal plate, dorsal,

a median carinula extends up to end of fastigium in middle (Fig. 2) ; foveolae indistinct and not visible from above. Eyes prominent, lateral, brownish with dark facets, interocular distance less than individual diameter of eye. Lateral ocelli very much approximated to eyes. Frontal ridge prominent, flat, almost parallel, with moderate punctuation ; lateral carinae seems straight but due to heavy and coarse punctuation on clypeus sometimes obliterated. Antennae filiform, longer (19-20 mm) than head and pronotum (16-17 mm) ; scape very robust, almost double size in length and breadth of pedicel ; length of each middle joints about 3 times their width. Pronotum obtusely angulated both at anterior and posterio rmargins, intersepted by 3 transverse sulci, posterior sulci placed beyond middle, prozona (7.25-7.75) longer than metazona (5.25-5.75) ; lateral carinae moderately and gradually diverge posteriorly (9 to 9.25 mm as to 5.5-5.75 at anterior margin) ; median carina more prominent but very moderately tectiform (measured from margin of lateral ventral border of pronotal lobe to lateral carinae it's about 8 mm where as median carina about 10 mm) ; lateral lobe densely and coarsely punctuated (where as in pronotal disc, it's fine and obscure due to velvety colouration) ; strongly ascending posteriorly, traversed laterally by 3 distinct sulci, almost up to lateral border, 2nd and 3rd sulci in continuation of 2nd and 3rd transverse sulci of disc whereas 1st sulci far in front and border anterior margin of lobe (Fig. 1). Episternum prominent, longer, roughly angulated. Prosternal tubercle cylindrical, conical (Fig. 4) ; mesosternal and metasternal lobes as shown in (Fig. 5). Tegmina short, extend slightly a little longer than 1st abdominal segment, lateral, rudimentary ; veins and veinlets obscure due to dense and very rough rugolosities. Posterior leg stout, as long as abdomen ; upper carina of posterior femora serrated, medial area rosy, upper lobe smooth ; posterior tibia (23-24) slightly shorter than femora (26-27), armed with 8 external and 9 internal black tipped spines, as a whole internal spines longer than external ones ; no outer apical spine. Abdomen laterally compressed, with a median carina which is in continuation with median carina of pronotum. Supra-anal plate broadly angulated at apex, with a median groove throughout but more so at basal half and which is intersepted with a transverse sulcus ; subgenital plate almost flat, a little depressed at middle. Cerci short, slightly smaller than paraproct, broad at base which gradually taper towards apeices.

Colouration : Colour brownish mixed with dark in different grade and shape ; abdomen uniformly dark, shiny. In some examples, a median dark band extends from fastigium in front to pronotal disc behind. Pronotal disc more or less velvety. Antennae yellowish brown with apical segments a little dark. Posterior femora as a whole characteristically rosy, specially medial area, upper marginal area yellowish green ; cresent area and base of posterior tibia very dark ; posterior tibia yellowish brown ; tarsi brownish. Labial and maxillary palpi yellowish.

Pubescence : Whole body covered sparsely with white, small and thin hairs except valves of ovipositors which display moderately dense silky pubescence.

Males : Males. (Figs. 6, 11) differ from females in the following features—Size distinctly smaller. Body rather slender, a little more hairy. Fastigium of vertex (Fig. 7) differs. Scuttelum almost straight, lateral carinae not rounded but gradually diverge



Peripolus pedarius male.

Figs. 10. profile, dorsal (female). 11. profile, dorsal (male). 12. wild leaves which form natural diet (showing mode of damages).

towards middle from apex, then converge or almost straight posteriorly. Lateral carinae of frontal ridge more clear. In tegmina a more pronounced black longitudinal band in discoidal area. Pronotal disc more depressed, smooth and shiny in colouration. Upper part of last abdominal segment stout. Cerici large, laterally campressed, curved inside and bilobed at apex (Fig. 8) with a concavity in between. Supra-anal plate with 3 fine longitudinal furrows, forming 2 plates, lateral ones converge in middle of plate in a transverse sulcus ; posterior portion also grooved at middle, forming two lobes (Fig. 9) ; subgenital plate short, navicular, angulated at apex.

Colouration ; More patterned than females. In some cases there is a blackish band on vertex, separated by median carina, and extends up to groove of fastigium in front and up to end of pronotal disc. A more prominent lateral band on sides of abdomen above, intersepted by a yellowish brown band along median carina. Otherwise colouration is more or less identical to that of females.

Nymphs : The present collection contains 2 advanced female nymphs (30-31) which are easily distinguishable from their adults. The abdominal segments specially the valves of ovipositor incompletely formed ; rudiments of tegmina and wings present ; tegmina as long as metathorax, pointed at apex ; wing almost half as long as 1st thoracic

segment, more lateral and curved towards sides ; and antennae fully formed. Otherwise nymphs are identical to adults.

Measurements (in mm) : Length ♂ 26-30 (30), ♀ 40-48 ; length of head ♂ 3.2-3.75 (3.5), ♀ 5.25-5.75 ; maximum width of head ♂ 4-4.5 (4.5), ♀ 6.5-7 ; interocular distance ♂ 1.75-2 (1.7), ♀ 2.5-3 ; maximum length/ width of pronotum ♂ 6.5-7/4.9-5.25 (8/5.1), ♀ 12-13/8.75-9 ; length of tegmen ♂ 4.5-4.75 (5), ♀ 8.5-8.75 ; length of posterior femur ♂ 16.5-17 (19), ♀ 29-29.5 ; length of posterior tibia ♂ 14.5-15 (16.5), ♀ 23.5-24 (measurements of male type is given in brackets).

Remarks : It is a high altitude species, always occuring at an altitude about 1250 m or more. The present series was collected from Phaugri Beat House, Mirik, having an altitude of more than 1500 m and 70% humidity in the summer. Here the specimens were found inhabiting broad leaved bushes (Fig. 12) which form their natural diet. The occurrence of two nymphs in the collection is, perhaps, indicative of the starting of a post winter new generation in June.

Its occurrence in Garhwal district (a new record), other than the Eastern Himalayas indicates its probable distribution throughout the Himalayan range.

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REFERENCES

KIRBY, W. F. 1910. *A synonymic Catalogue of Orthoptera. Vol.* **3** *Orthoptera Saltatoria.* Part II. Locustidae vel Acrididae. IX+ 674 pp., London. (*Brit. Mus. Nat. Hist.*).

KIRBY, W. F. 1914. *The Fauna of British India including Ceylon* and *Burma.* Orthoptera (Acrididae) *vol. 1* : IX-276 pp., London.

MARTINEZ Y FERNANDEX, A. 1902. Revision Y estudio del grupa 'Calopteni' *Ann. Soc. esp. Hist. nat., Madrid,* **30** : 253-309.

STAL, C. 1878. Systema Acridiodeorum. Essai d'une Systematisation des Acridiodees. *Bih. svensk. vet. Akad. Handl., Stockholm* **5** (4) : 1-100.

UVAROV, B. P. 1927. Distributional records of Indian Acrididae. *Rec. Indian Mus.,* **29** (4) : 233-239.

UVAROV B. P. 1942. New Acrididae from India and Burma. *Ann. Mag. nat. Hist.* **9** (11) : 587-607, 7 figs.

Bull. zool. Surv. India, 7 (1) : 69-82, 1985

STUDIES ON SOME TREMATODES (DIGENEA : LECITHODENDRIIDAE) OF PISCES AND AMPHIBIA FROM EAST COAST OF INDIA

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ABSTRACT

The present study includes descriptions of two new species, viz., *Prosotocus bangaense* n. sp. and *Ganeo ankholaensis* n. sp., and report of four known species, viz., *Ganeo gobindia* Dayal and Gupta, 1953, *G. tigrinum* Mehra and Negi, 1928, *G. korkei* Bhalerao, 1936 and *G. srinagarensis* Kaw, 1950 with additional interesting informations. On re-examination of the type and paratypes of *Prosotocus kashabia* Kaw, 1944, it was found to possess genital pore on the dorsal surface of the body instead of on the ventral surface as originally described in it. So is the case with *P. indicus* Mehra and Negi, 1928 also. Differing with Fotedar (1967), *P. kashabia* is revalidated *vis-a-vis P. himalayai* Pande, 1937. *P. baughi* K. C. Pandey, 1975 is considered as a synonym of *P. kashabia*. *Ganeo gobindia* is reported from a marine fish host rather than a freshwater one. *G. tigrinum*, which is hitherto known to infect amphibians, is also reported from a marine fish. *G. lucknowensis* Gupta and Jahan, 1978, described on the basis of a single testis, is considered as a synonym of *G. tigrinum*. *G. behurai* Ghosh and Chauhan, 1982 was not compared with *G. madrasensis* Kaw, 1950, which is surely identical to the latter. *G. macrocotyle* Bilqees and Kaikobad, 1976 is not distinguishable from *G. attenuatum* Srivastava, 1933 and therefore held a synonym of the latter. *G. korkei* is reported and held valid on the basis of the grouping of the vitelline follicles in it. *G. srinagarensis* is reported with intersting variations. The genus *Ganeo* Klein, 1905 is known to possess V-or U-shaped excretory vesicle, but the new species *G. anknolaensis* is described to have transverse connections between the crenulations of the arms of V-shaped excretory vesicle like a ladder. Keys to the species of the genera *Prosotocus* Looss, 1899 and *Ganeo* Klein, 1905 with vitellaria on one side only, are also provided.

Introduction

The material for this study was collected from frogs and fishes from coastal areas of West Bengal, Orissa and Andhra Pradesh. In addition to describing two new species and reporting four known ones with interesting informations, some new facts have also been noted about others. Originally, the occurrence of vitellaria only on one side of the body was repoted as a character to distinguish species in the genera *Prosotocus* Looss, 1899, *Ganeo* Klein, 1905 and others. Later on, more species were added in both the genera with other distinguishing characters also, the character of unilateral vitellaria being common. Rao (1974), Ghosh and Srivastava (1976), Gupta (1977) and Mukherjee (1977) believe that it is an abnormal character. In this context, it may be of some interest and use for future studies to emphesise that the three independent populations of the specimens with one-sided vitellaria described below as new species in the genus *Prosotocus*, were recovered unmixed with specimens having vitellaria on both the sides.

The drawings were made with the aid of a camera lucida. All measurements are in microns unless otherwise stated.

Systematic Account

Family Lecithodendriidae (Lühe, 1901)

Subfamily Prosotocinae Yamaguti, 1958

Genus **Prosotocus** Looss, 1899

Prosotocus bangaense n. sp.

(Fig. 1)

Host : *Rana cyanophlyctis*, (Amphibia : Ranidae)

Location : Intestine

Locality : Subhash Sarobar, Calcutta

No. of specimens : 13, 1, 3 (three independent populations)

Specimens deposited : Z. S. I. Reg. Nos. W 7287/1 to W 7291/1

Description (based on 3 independent populations with measurements of 4 good specimens): Body small, 0.645-1.186 mm long, 0.516-0.731 mm wide at acetabular level, ovate. Tegument spinose. Acetabulum 122-154 in diameter, preequatorial. Oral sucker subterminal, 52-70 long, 94-115 wide, smaller than acetabulum. Sucker ratio 1 : 1.3-1.8. Prepharynx absent ; pharynx 35-42 long, 42-59 wide ; oesophagus 42-66 long ; intestinal caeca may be extending up to level of posterior margin of acetabulum.

Testes two, asymmetrical, generally caecal, left testis lying anterior to cirrus sac, 124-179 long, 95-178 wide ; right testis 165-233 long, 96-137 wide. Cirrus sac muscular, L-shaped, preacetabular ; situated towards left. Seminal vesicle internal having two loops ; pars prostatica swollen, flask-shaped, surrounded by prostatic gland cells, ductus ejaculatorious and muscular cirrus present. Genital atrium well developed and muscular ; genital pore dorsal, dextral, near margin at level of pharynx.

Ovary entire, 165-206 long, 124-137 wide, diagonally behind right testis, overlapping right caecum, smaller than testes. Receptaculum seminis dorsal to acetabulum towards right side. Vitellaria follicular, situated asymmetrically on right side only, roughly between the two testes. Uterine coils completely filling the hind body, extending up to acetabulum. Metraterm well developed and muscular, long, opening into atrium independently of male duct. Genital pore surrounded by muscular sucker. Eggs yellowish, 28-31 × 14.

Excretary vesicle V-shaped, arms reaching acetabulum. Excretory pore subterminal.

Discussion : Seven species have been described in the genus *Prosotocus* Looss, 1899 which have vitelline follicles on the right side only. They are: *P. himalayi* B.P. Pandey, 1937; *P. kashabia* Kaw, 1944. *P. partapus* Kaw, 1950 ; *P. dorsoporus* Murhar, 1960 ; *P. poroformis* Bhardwaj, 1963 ; *P. tigrinum* Bhardwaj, 1963 ; and *P. baughi* K. C. Pandey, 1975. Fotedar (1967) did not give population-wise variations in the species of *Prosotocus* in his collection. The possibility is strong that there might have been two species in his eollection of *Prosotocus* which he made from frog and toad in Kashmir in different months of the years after 1955. This becomes evident by seeing his figures 1, 2, 3 & 5 together as comared to figure 4. *P. himalayai* is characterised by the combination of characters such as unilateral vitellaria, oral sucker larger than acetabulum, ovary larger in size than testes, and extent of caeca distinctly going beyond the posterior level of acetabulum. Moreover, in *P. himalayai* the genital pore has been reported to be ventral whereas in *P. kashabia* it

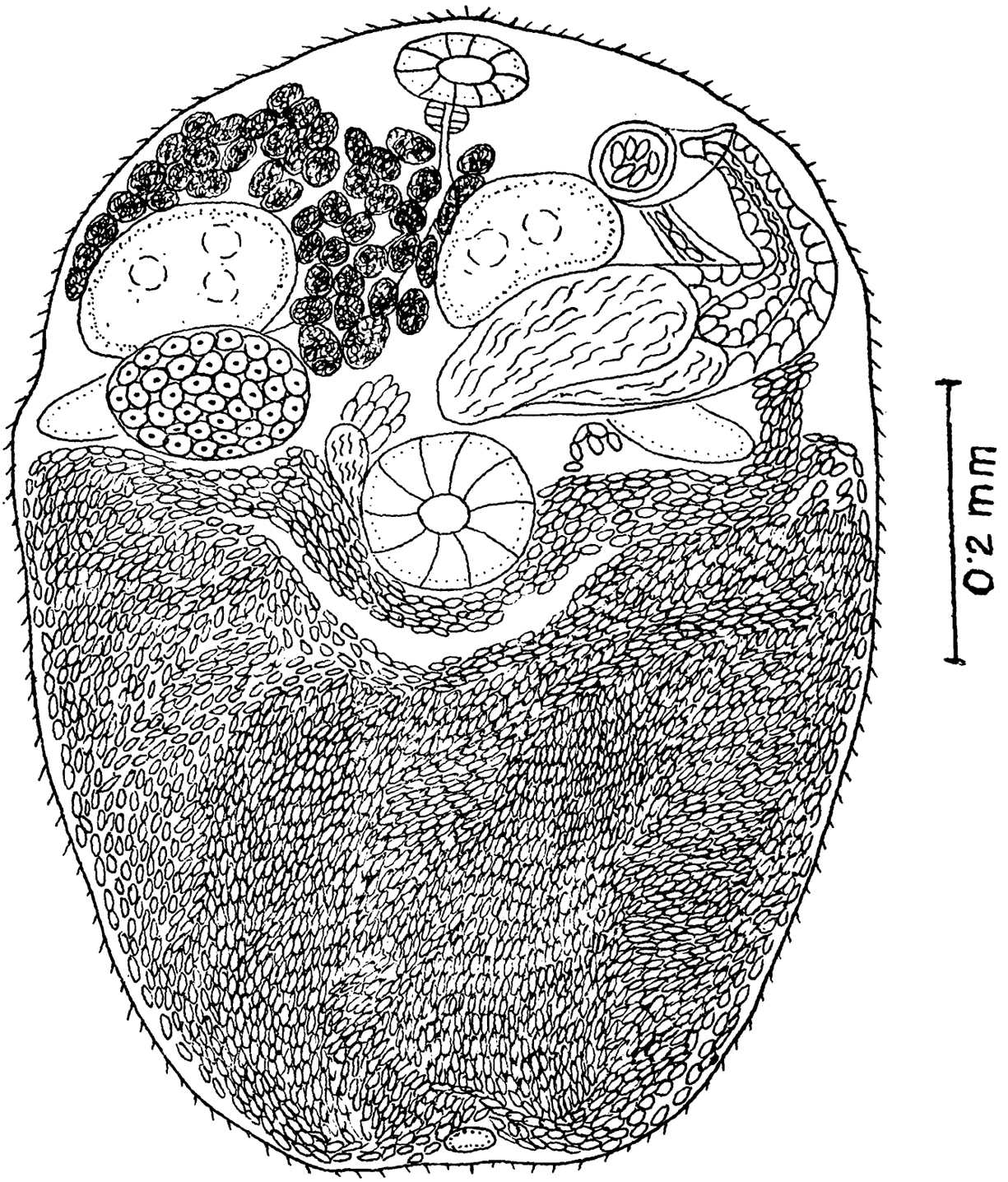

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Fig. 1. *Prosotocus bangaense* n. sp. Holotype, ventral view.

is dorsal beyond any shodow of doubt (Present paper). It seems Fotedar (1967) had mixed populations of two species. We are still inclined to consider the latter distinct from the former. Further, Fotedar (1967) did not consider Bhardwaj's (1963) paper in which to new species with unilateral vitellaria in *Prosotocus* have been described and a

key to the species of the genusprovided. In *P. baughi* K. C. Pandey, 1975, the ovary is caecal and acetabular, and the cirrus sac almost caecal. The authors feel that the differences between *P. kashabi* and *P. baughia* are to meagre to give separate species status to the latter which should be considered as a synonym of the former.

The present species keys to *P. poroformis* on the key provided by Bhardwaj (1963) in the sense that it also has a genital sucker. Other species with vitellaria on the right side only have not been reported in original descriptions to have a genital sucker. Thus, there is close resemblance between *P. poroformis* and the present species with the difference that the left testis is situated behind the cirrus sac in the former whereas in the latter it is in front of the cirrus sac. From *P. tigrinum* Bhardwaj, 1963, it differs mainly in the presence of a genital sucker, extracaecal cirrus sac, intercaecal and acetabular ovary, and in the sucker ratio. In body shape, egg size and shape and position of cirrus sac, the present form comes close to *P. himalayai* but differs from it in that the oral sucker is distinctly smaller than acetabulum, dorsrlly oriented genital pore, and presence of a genital sucker. The present form differs from *P. kashabia* in sucker ratio and presence of genital sucker. From *P. dsrsoporus* the difference is obvious, it having reverse sucker ratio.

The authors have examined the type and paratype specimens of *Prosotocus kashabia* Kaw, 1944 (Z. S. I. Helminthological Coll. No. W/5584/1) all mounted on one slide. It has been found that the species was described on the basis of a population consisting of immature and young adult specimens. That is why some of the structures like uterus and musculature around genital pore are not fully developed in them. The other most important thing about this species is that the openings of the two suckers and the genital pore lie on opposite surfaces of the body. This fact establishes that the genital opening in *P. kashabia* is dorsally located and not on the ventral side as originally described. Moreover, its position in various specimens on the same slide varies from testicular to pretesticular. The cirrus sac is well anterior to acetabulum or touches or varies from anterodorsal to posterodorsal to acetabulum. At least in one specimen there is indication of the presence of some arrangement of muscles around the genital aperture. This musculature is very weak probably because the specimen is a young adult. Comparing *P. partapus* Kaw, 1950 with *P. kashabia* Kaw, 1944 in the light of the above mentioned deviations from the original description of the latter and taking into consideration that both have been reported from Kashmir and from the same host species, there seems to be no material difference between the two, except in the orientation of the genital pore which has been described to be ventral in *P. partapus*. Unfortunately, the type or paratype speciemens of *P. partapus* are not available for checking this. It is quite likely that the genital pore in this species may also be dorsal. In that case the two species will become identical and synonymous too as Fotedar (1967) and Karyakarte (1972) have considered. It may not be out of place to mention that specimens of *Prosotocus* labelled as *P. indicus* Mehra, 1928 (Z. S. I. Helminthological Coll. No. W/4187/1) also have genital pore located on the dorsal surface of the body surrounded by a large sucker. In *P. dorsoporus* Murhar, 1960, which has been described from a different species of host frog, *Rana*

tigrina, from Nagpur, the prepharynx has not been mentioned in the description but the same character has been used for differentiation from other species described till then. Moreover, the measurement of the ventral sucker has not been given in the description for this species, but from the illustration it appears that oral sucker is larger than acetabulum. In *P. kashabia* and *P. partapus* the two suckers are almost equal.

Bhardwaj (1963) described *P poroformis* and *P. tigrinum* from the frog *Rana tigrina* from Bombay region near west coast of India, According to him, *p. poroformis* commonly occurs in this frog in the region whereas *P. tigrinum* is rare. *P. poroformis* has unilateral vitellaria, extracaecal testes and intestinal caeca reaching level of posterior margin of acetabulum or slightly beyond it. In these respects it is similar to *P. himalayai* Pande, 1937 but significantly differs from the latter in having left testis behind the cirrus sac instead of in front of it, oral sucker smaller than acetabulm, and smaller length of oesophagus. *P. tigrinum* has unilateral vitellaria, equal suckers, extra caecal testes, extracaecal cirrus sac, intercaecal ovary between right caecal end and acetabulum, and the intestinal caeca extend up to the level of posterior margin of acetabulum or slightly beyond it. Extracaecal cirrus sac, intercaecal and acetabular ovary overlapping no organ, and presence of a short prepharynx are its characteristic features.

Our species is easily distinguished from *P. himalayai*, *P. poroformis* and *P. tigrinum*. It differs from *P. kashabia* also in oral sucker distinctly smaller than acetabulum, and ovary almost of the size of testes. From *P. dorsoporus*, it differs mainly in having reverse sucker ratio i.e. oral sucker smaller than acetabulum, caecal testes, and ovary of the size of testes.

P. himalayai and *P. dorsoporus* have oral sucker larger than the acetabulum, massive postacetabular uterus and extracaecal testes but differ from each other in extent of cecal and size of the ovary with respect to that of the testes. Additionally, in *P. himalayai* the genital pore is ventral.

A close scrutiny of the literature on the species of the genus *Prosotocus* Looss, 1899 with unilateral vitellaria, as well as specimens of three species of the genus give the impression that probably all of them have broad and shallow genital atrium in which the male and female ducts open independently at different levels, the female aperture sometimes being ahead of the male aperture. Moreover, the genital pore is surrounded by weakly or moderately developed circular arrangement of muscles which has been termed as genital sucker or gonotyle. In all these three species, the genital pore has been found to be located on the dorsal surface of the body. Of these three species, two of them are known in which the genital pore was originally described to be located on the ventral surface of the body. Thus there is a need to recheck the location of the genital pore on the dorsal or ventral surface of the body and the presence or absence of a sucker around it, at least, in those species which have been reported from ranid and bufonid amphibians.

Key to species of **Prosotocus** Looss, 1899 *with unilateral vitellaria*

1. Oral sucker distinctly larger than acetabulum. 2
   Oral sucker smaller than acetabulum. 3
   Oral sucker almost equal to acetabulum. 4

2.	Caeca extend beyond level of posterior margin of acetabulum; ovary larger than testes; genital pore ventral ...	*P. himalayai* Pande, 1937
	Caeca short and preacetabular; ovary smaller than testes; genital pore dorsal. ...	*P. dorsoporus* Murhar, 1960
3.	Left testis posterior to cirrus sac; genital pore ventral ...	*P. poroformis* Bhardwaj, 1963
	Left testis in front of cirrus sac as usual; genital pore dorsal ...	*P. bangaense* n. sp.
4.	Cirrus sac extracaecal; ovary inter-caecal overlapping neither right cecum nor acetebulum ...	*P. tigrinum* Bhardwaj, 1963
	Cirrus sac and ovary caecal ...	*P. kashabia* Kaw, 1944

Subfamily Ganeoninae Yamaguti, 1958

Ganus **Ganeo** Klein, 1905

Ganeo ankholaensis n. sp.

(Fig. 2)

Host: *Rana cyanophlyctis* (Amphibia: Ranidae)

Location: Intestine

Locality: Ankhola, 24-Parganas (W. Bengal)

No. of specimens: One

Date of collection: November 17, 1977.

Specimens deposited: Z. S. I. Reg. No. W 7292/1

Description (with measurements of one good specimen): Body ovoid, 1.28 mm long, 0.97 mm wide at vitellarian level, posterior end rounded. Tegument beset with minute scale-like spines. Acetabulum 15 long, 19 wide, preequatorial. Oral sucker subterminal, 12 long, 16 wide, slightly smaller than acetabulum. Sucker ratio 1 : 1.2. Prepharynx present, 4 long; pharynx 6 long, 9 wide; oesophagus 24 long; intestinal caeca extending posteriorly a little beyoud vitellaria, not reaching posterior end of body.

Testes two, asymatrical, right testis overlapping right intestinal caecum; left testis intercecal, measuring 20 long, 28 wide; right testis 19 long, 28 wide. Seminal vesicle rather tubular, long, coiled, taking two transverse turns, 41 long, 11 wide at base, well developed, broad and rounded at base and then tapering anteriorly, surrounded by well developed prostate cells; ejaculatory duct long, opening into genital atrium; genital pore marginal, situated at about mid-oesophageal level.

Ovary entire, 15 long, 22 wide, situated behind right testis, smaller than testes. Seminal receptacle behind ovary. Vitellaria follicular, unilateral on left side only, overlapping left caecum. Uterus postovarian, describing lateral coils, filling most of hind body, extending posteriorly much beyond caecal ends. Metraterm differentiated, well developed, 13 long, opening into genital atrium idenpendently. Eggs 21-23×14-15, thick-shelled.

Excretory vasicle V-shaped, arms narrow and crenulated reaching ovary and connected transversely at crenulations with three visible or more transverse connections in a ladder-like fashion; excretory pore subterminal.

Discussion: In the type and most other species of the genus *Ganeo* Klein, 1905, the vitellaria are bilateral. Only *Ganeo* sp. Kaw, 1950 (= *G. kawi* Dwivedi and Chauhan, 1970 redescribed from the intestine of *Rana tigrinum* from Chhindwara, M. P.) reported from *Rana cyanophlyctis* from Kashmir; *Ganeo bufonis* Fotedar, 1959 (also reported from Kashmir

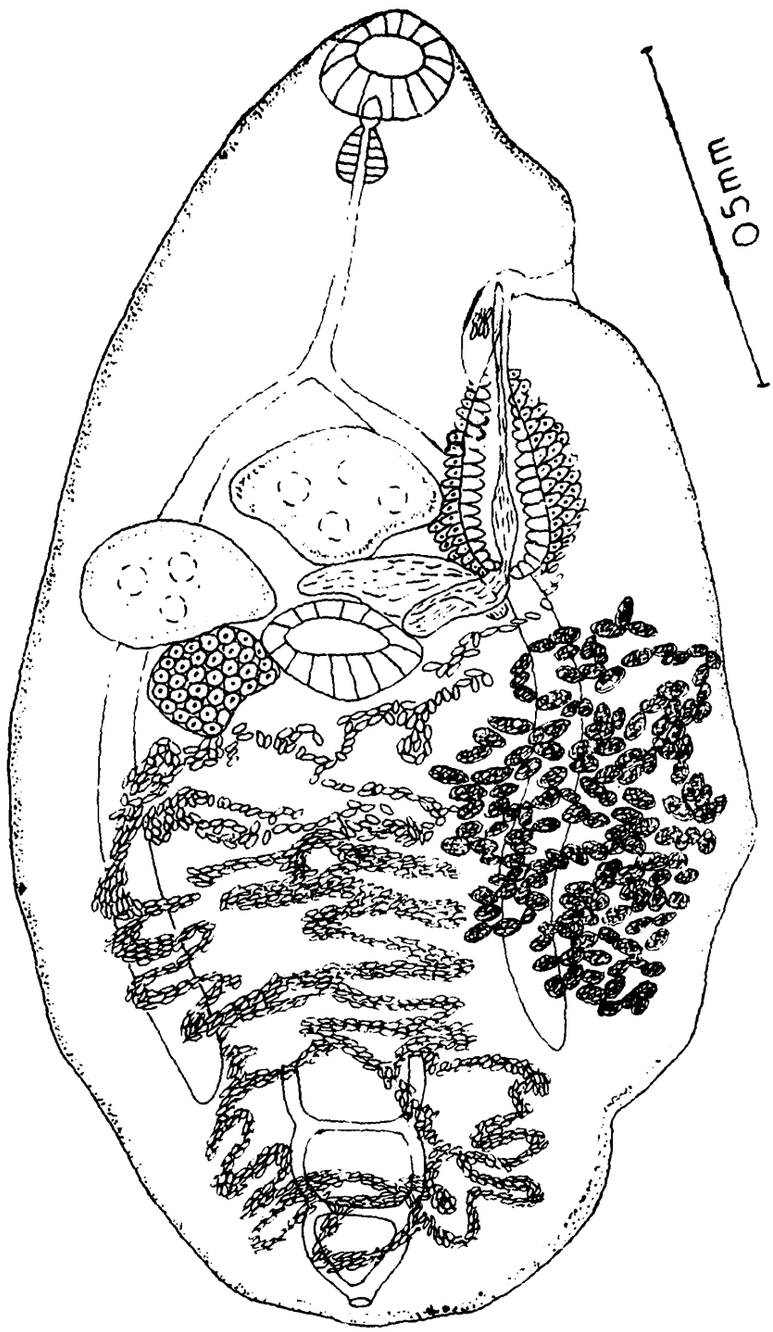

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Fig. 2. *Ganeo ankholaensis* n. sp. Holotype, ventral view.

but in *Bufo viridis*) ; *Ganeo gazipurensis* Pandey and Chakravarty, 1968 in *Rana cyanopylyctis* from U. P. ; and *G. vitellosinistrum* Dwivedi and Chauhan, 1970 from the intestine of *Rana limnocharis* from Jabalpur, M. P. have been described to posses unilateral vitellaria.

All the species of *Ganeo* with bilateral or unilateral vitellaria have been reported to have V-or U-shaped excretory vesicle with broad arms and without transverse connections. The present species is characterised by having V-shaped excretory vesicle having narrow and crenulated arms and with three

or more transverse connections at crenulations in a ladder-like fashion.

However, the present new species very much resembles *G. vitellosinistrum* in having vitellaria on the left side of the body, acetabulum slightly larger than oral sucker, and other anatomical features but differs from it in having transverse connections between the arms of crenulated V-shaped excretory vesicle, and smaller egg size. The present from also closely resembles *Ganeo bufonis* but differs from it in the more posterior extent of uterine coils going much beyond caecal ends and the presence of V-shaped excretory vesicle having crenulated arms which have transverse connections at crenulations between them in a ladder-like fashion, the acetabulum is larger than oral sucker, and the eggs are longer (27-30×12-15 in *G. bufonis*). It differes from *G. gazipurensis* Pandey and Chakraverty, 1968 in the absence of spines on the cirrus, acetabulum being larger than oral sucker, and excretory arms connected by transverse branches. Gupta and Jahan (1978), however, considered *G. gazipurensis* as a synonym of *G. bufonis*.

Key to the species of **Ganeo** Klein, 1905 *with unilateral vitellaria*

1.	Vitellaria dextral	... *G.*sp. Kaw, 1950 (=*G. kawi* Dwivedi & Chauhan, 1970
	Vitellaria sinsitral	 2
2.	Cirrus armed with spines.	... *G. gazipurensis* Pandey & Chakravarty, 1968
	Cirrus unarmed	 3
3.	Excretory arms narrow, crenulated and connected by tranverse connections	... *G. ankholaensis* n. sp.
	Excretory arms broad, not crenulated and not connected by tranverse connections	 4
4.	Suckers equal	... *G. bufonis* Fotedar, 1959
	Oral sucker smaller than acetabulum	... *G. vitellosinistrum* Dwivedi & Chauhan, 1970

Ganeo gobindia Dayal and Gupta, 1953

(Fig. 3)

Host : *Strongylura strongylura* (Pisces : Belonidae).

Location : Inestine.

Locality : Kakdwip (W. Bengal), Gangetic Deltaic area.

Number of specimens : 1, collected on February 11, 1977.

Specimens deposited : Z. S. I. Reg. No. W 7293/1.

Discussion : *Ganeo gobindia* was first described from a freshwater fish, *Wallago attu* (Bloch) from the river Gomti at Lucknow on the basis of ten specimens. This is the second record of this species but from an altogether different group of fish which is estuarine or marine form. Morphologically this specimen almost conforms to the original description of the species except that the excretory bladder is indiscernible and the testes overlap right caeum and the seminal vesicle overlaps left caecum. The eggs measure 15-26×9-13.

Ganeo tigrinum Mehra and Negi, 1928

Syn. *G. kumaoensis* Pandey, 1937

G. linganensis Li, 1938

G. puajabensis Gupta, N. K. 1045

G. lucknowensis Gupta, V. *et* Jahan 1978 (Syn. Nov.)

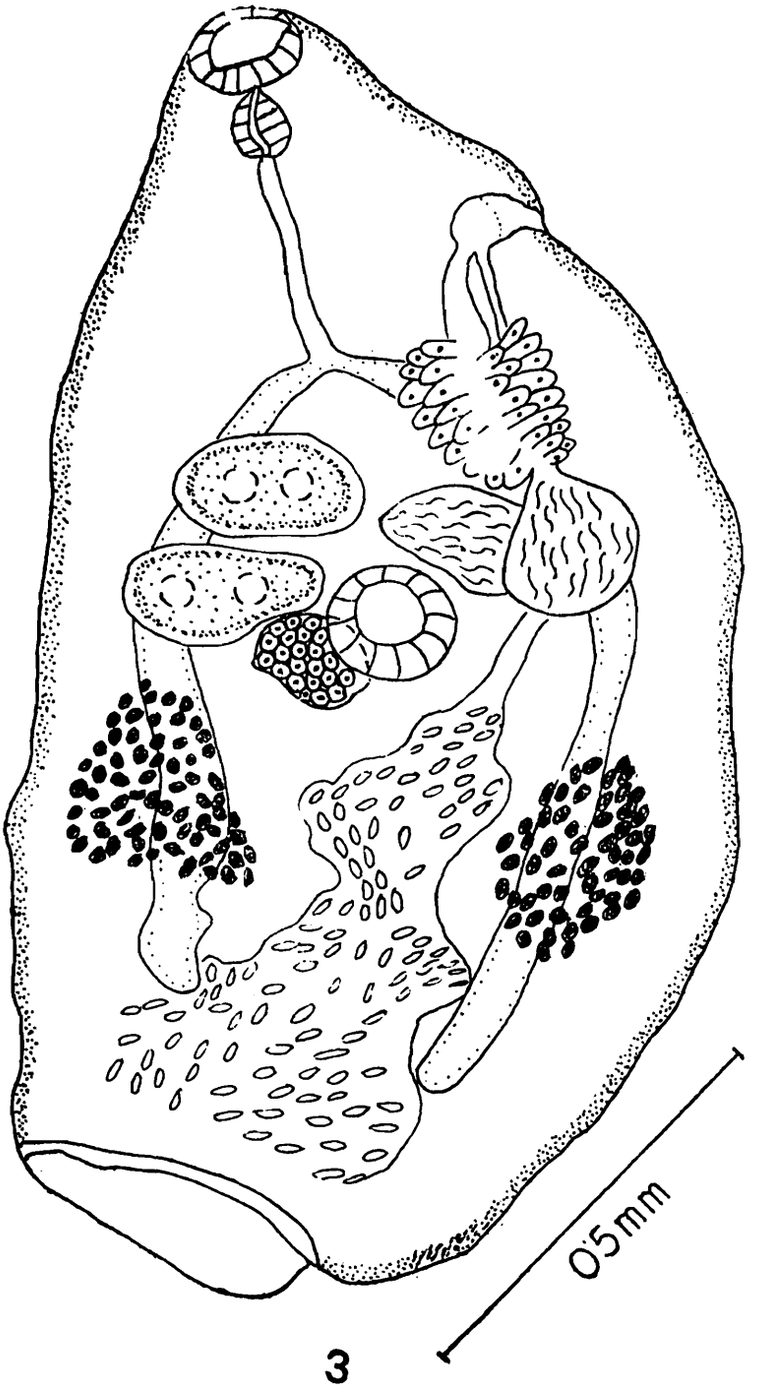

Fig. 3. *Ganeo gobindia*, ventral view.

G. gastricus Srivastava, 1933

Host : *Therapon jarbua*, (Pisces : Theraponidae).

Location : Intestine.

Locality : Machilipatnam (Bay of Bengal).

No. of specimens : 1, collected on January 22, 1975.

Specimen deposited : Z. S. I. Reg. No. W 7294/1.

Synonymity of *G. kumaoensis* Pande, 1937 and *G. lingnanensis* Li, 1938 with *G. tigrinum* as proposed by Fotedar (1959) is agreed to, but proposing synonymity of *G. attenuatum* Srivastava, 1933 with *G. tigrinum* on the plea that differentiation of metraterm and presence

of minute spines on the terminal parts of genital ducts and atrium have no taxonomic value as done by Mukherjee and Ghosh (1970) and Mukherjee (1977), is inconvincing and hence unacceptable. The differenciation of metraterm and/or presence of spines on the the terminal parts of genital ducts and atrium alongwith some other supporting characters definitely forms basis to distinguish species. In this particular case, the distinctness of *G. attenuatum* lies in the distinguishing characters such as differenciation of metraterm, presence of minute spines on the terminal male and female ducts as well as in the atrium, and posteriorly attenuated body. Bilqees and Kaikobad (1976) described a new species, *Ganeo macrocotyle* in the intestine of *Rana tigrina* from Karachi, on the basis of a single specimen. The reported aspinose body and the illustration of the species suggest that either the specimen was not in good condition or it was not carefully processed. The measurements of the suckers (oral sucker 0.12×0.15 and acetabulum 0.14×0.16) point that they are almost equal in size, which is also the case in *G. attenuatum* with which *G. macrocotyle* has been distinguished. Further, the details of the terminal parts of male and female ducts and atrium are inadequate (probably because the specimen was not good). However, the posteriorly attenuated body, almost equal suckers and equal egg size in *G. macrocotyle* and *G. attenuatum* suggest that the former is identical to the latter. Gupta, V. and Jahan (1978) described *G. lucknowensis* on the basis of a single specimen from *Bufo melanostictus* and differentiated it from *G. tigrinum* on the basis of a single testis. This is nothing but an abnormality as has been pointed out by Ghosh and Srivastava (1979) in other digenetic trematodes having two testes normally. Hence, *G. lucknowensis* is a synonym of *G. tigrinum*. We also concur with Mukherjee (1977) that *G. gastricus* Srivastava, 1933 is a synonym of *G. tigrinum*.

This first record of *G. tigrinum* from a marine fish is interesting.

Ganeo korkei Bhalerae, 1936.

(Fig. 4)

Host : *Rana cyanophlyctis*, (Amphibia : Ranidae)

Location : Intestine

Locality : Konarak (Orissa)

Number of specimens : 1, collected on 10.6.1972.

Specimens deposited : Z. S. I. Reg. No. W. 7295/1

Bhalerao (1936) had described this species on the basis of one specimen from *Rana tigrina* at Nagpur. He had collected this specimen alongwith others which were identified by him as *Ganeo tigrinum* Mehra and Negi, 1928. Since then specimens of this species were not collected by any worker. This species is apparantly characterised by the acetabulum larger than oral sucker, ovary larger than testes and follicles of vitellearium arranged in groups of five and seven on the left and right sides of the body respectively.

Only one specimen of this species was present in our collection in a population of three specimens. The other two specimens are identified as *G. tigrinum*. This is the third record of this species since it was described by Bhalerae in 1936. It rarely occurs in frogs, and whenever found, its incidence is very scanty. A large number of *Rana cyanophlyctis* and *Rana tigrina* were examined in various parts of India and in different seasons but only one specimen was found which has the characteristics of *G. korkei*.

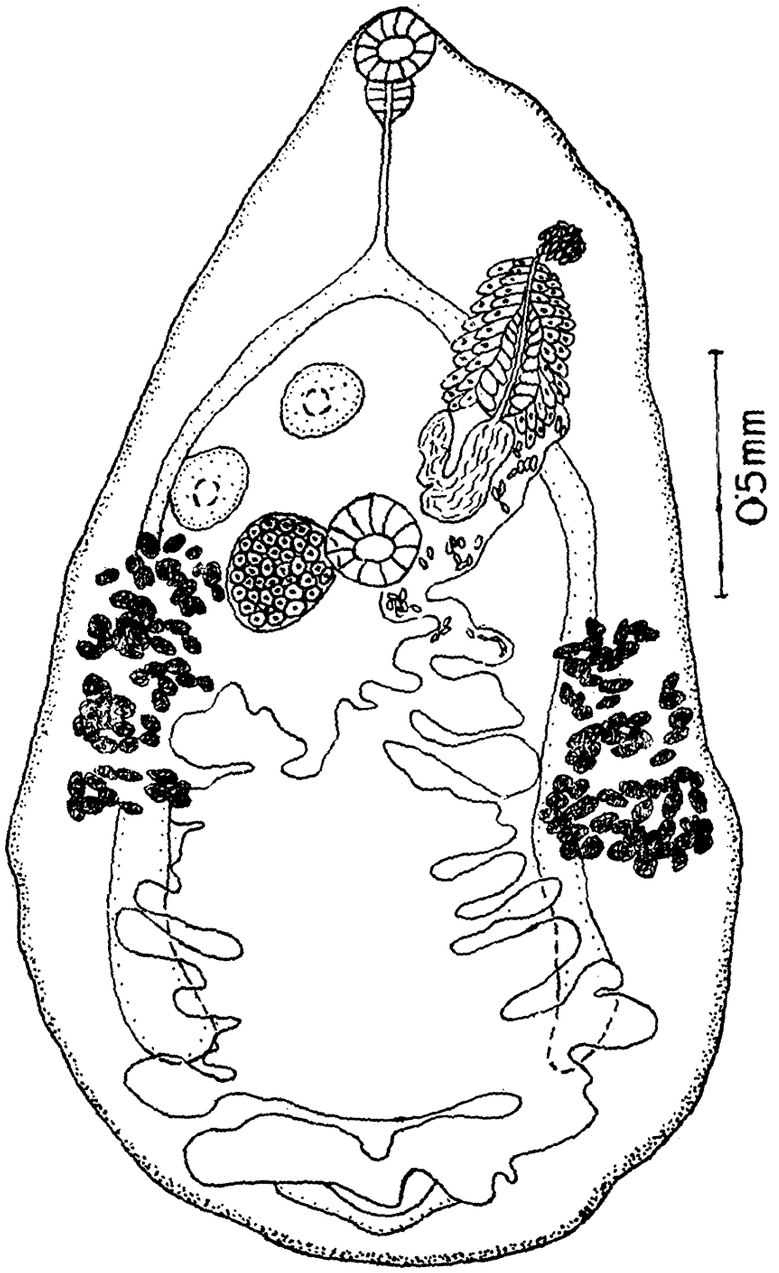

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Fig. 4. *Ganeo korkei*, ventral view.

The ovary in our specimen is larger than the testes and acetabulum, and the grouping of the vitilline follicles is demarcated although the follicles have coalesced probably due to overpressing during processing.

Nama (1974) reported one specimen of this species for the second time and made certain important observations. His most significant observations are that the ovary may be smaller than the testes and acetabulum, and the groups of vitelline follicles may not commence from immediately behind the posterior testis but, instead, they may be postacetabular. Moreover, the two testes in Nama's

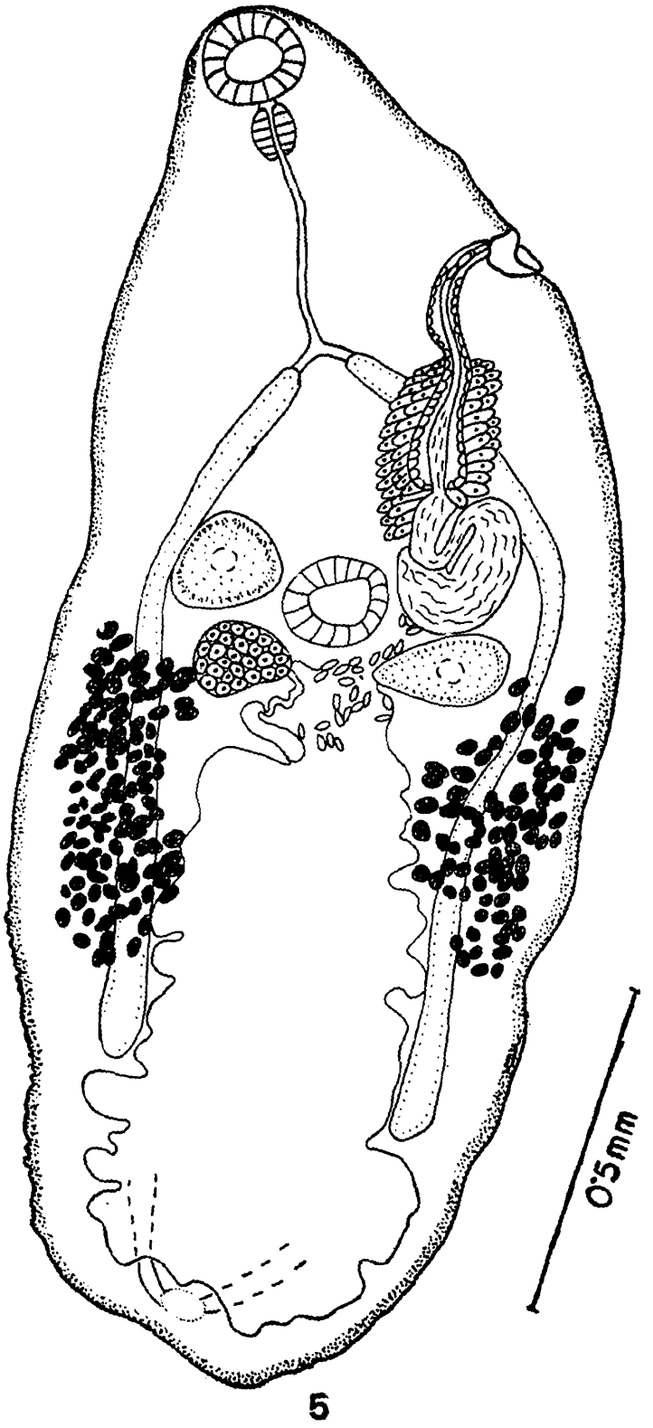

Fig. 5. *Ganeo srinagarensis*, ventral view.

specimen are almost equal He considered these dissimilarities as mere variations and thus confirmed the validity of *Ganeo korkei* Bhalerae, 1936. In the light of these observations, it is understandable that *G. korkei* may be having ovary equal to or smaller or larger than the testes as in *G. tigrinum* but the former gets certainly distinguished from the latter in the grouping of vitelline follicles on each side of the body. Ghosh and Chauhan

(1982) appear to agree with Rao and Kameshwari (1976) in synonymising *G. korkei* with *G. tigrinum* in spite of Nama's (*op. cit.*) report and Mukherjee's (1977) key to species of *Ganeo*, who recognise the validity of *G. korkei* on the basis of the grouping of the vitelline follicles. *Ganeo behurai* Ghosh and Chauhan, 1982 was not at all compared with *G. madrasensis*, which have striking morphological similarities in addition to the constant feature of unequal caeca. The authers consider *G. behurai* a sure synonym of *G. madrasensis*. The authors also agree with Rao and Kameshwari (*op. cit.*) that *G. pujabensis* is synonymous with *G. tigrinum*.

Gupta, P. D. (1977), obviously unaware of Nama's work, feels that "Bhalerae (1936) has possibly made an erroneous statement that grouped arrangement of vitelline follicles", but now it is confirmed that *G. korkei* does have vitelline follicles in groups on both the sides which may get coalesced due to excessive pressure during processing.

Ganeo srinagarensis Kaw, 1950

(Fig. 5)

Host : *Rana cyanephlyctis*, (Amphibia : Ranidae)

Location : Intestine

Locality : Nazat, 24-Parganas, (W. Bengal)

No. of specimen : 1, collected on September 15, 1978

Specimen deposited : Z. S. I. Reg No. W 7296/1

Discussion : Only one specimen of this species was present mixed with many others which were identified as *G. tigrinum*. *Ganeo srinagarensis* was originally charactarised to possess oral sucker slightly smaller than acetambulum, tests almost symmetrical and immediately postacetabular, and ovary smaller than testes lying between them in the immediately postacetabular area. The present specimen which is assigned to *G. srinagarensis* has equal sukers, tests symmetrical in disposition but lying in the acetahular region, and ovary smaller than or equal to testes and lies in the postacetabular area. The dissimilarities *vis-a-vis* original description are considered as variations only. Bilqees and Kaikobad (1976) reported this species from Karachi, Pakistan. Our reporting forms the third record of this species since it was described in 1950.

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REFERENCES

BHALERAO, G. D. 1936. Studies on the helminths of India. Trematoda III. *J. Helminth.*, **14** (4) : 207-228.

BHARDWAJ, O. N. 1963. Morphology and taxonomy of three new species belonging to the subfamily Prosotocinae Yamaguti, 1958 (Lecithodendriidae). *Proc. natn. Acad. Sci. India*, **33** B (3) : 345-354.

BIQEES, F. M. AND KAIKOBAD, S. H. 1976. Trematodes of some amphibians and reptiles in Pakistan. *Agriculture Pakist.* **27** (2) : 199-219.

DWIVEDI, M. P. AND CHAUHAN, B. S. 1970. On some digenetic trematodes. Part III. *J. zool. Soc. India*, **22** : 165-172.

FOTEDAR, D. N. 1967. On the morphology of *Prosotocus himalayai* Pande, 1937 and synonymy of the species of the genus. *Kashmir Sci.*, **4** (1-2) : 227-234.

GHOSH, R. K. AND CHAUHAN, B. S. 1982. On a new species *Ganeo behurai* sp. n. (Trematoda : Lecithodendriidae) from Madras, India. *Pranikee*, (1981), **3** : 1-6.

GHOSH, R. K. AND SRIVASTAVA, C. B. 1976. On abnormal development of vitellaria in *Astiotrema reniferum* (Looss, 1898) Looss, 1900 (Trematoda : Plagiorchiidae). *J. zool. Soc. India*, **26** (1 & 2) : 143-145.

GHOSH, R. K. AND SRIVASTAVA, C. B. 1979. On abnormal development of male genitalia in digenetic trematodes. *Bull. zool. Surv. India*, **2** (1) : 115-118.

GUPTA, P. D. 1977. Studies on the genus *Ganeo* Klein, 1905 (Trematoda : Lecithodendriidae). *Rec. zool. Surv. India*, **72** (1-4) : 281-290.

GUPTA, V. AND JAHAN, A. 1978. On two new trematode parasites of amphibia from Lucknow, *Indian J. Helminth.*, **28** (2) : 66-72.

KARYAKARTE, P. P. 1972. Observations on three species of *Prosotocus* (Trematoda : Lecithodendriidae) with a description of *Prosotocus kashabia* Kaw, 1943. *Marathwada Uuiv. J. Sci.*, **11** (4) : 361-365.

MUKHERJEE, R. P. 1977. The variability of certain characters in *Ganeo tigrinum* Mehra and Negi, 1928 and their taxonomic importance. *Dr. Eduardo Caballero y Caballero Memor. Vol.*, pp. 255-260.

MURHAR, B. M. 1960. On a new trematode, *Prosotocus dorsoporus* (subfamily Prosotocinae Yamaguti, 1958) from common Indian frog *Rana tigrina* Daud., *Bull. zool. Soc. College Sci. Nagpur*, **3** : 79-81.

NAMA, H. S. 1974. Further observations of *Ganeo korkei* Bhalerao, 1936 (Trematoda : Pleurogenetinae) *Indian Biologist*, **6** (1/2) : 55-57.

PANDEY, K. C. 1975. Studies on some known and unknown trematode parasites. *Indian J. zoot.* **14** (3), 1973 : 197-219.

RAO, L. N. 1974. A note on the synonymy of *Ganeo kawi* Dwivedi and Chauhan, 1970 with *Ganeo bufonis* Fotedar, 1959. *Curr. Sci.*, **43** (9) : 285-286.

RAO, L. N. AND KAMESWARI, M. 1976. On the synonymy of *Ganeo korkei* Bhalerae, 1936 and *Ganeo punjabensis* Gupta, 1954 with *Ganeo tigrinum* Mehra and Negi, 1928. *Curr. Sci.*, **45** (17) : 623-628.

Bull. zool. Surv. India, 7 (1) : 83-91, 1985

ECOLOGICAL ASPECTS OF COPEPOD COMPONENT OF ZOOPLANKTON PRODUCTION IN THE ESTUARINE SYSTEM OF LOWER WEST BENGAL

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ABSTRACT

Distribution of zooplankton with special reference to copepods at two stations in the lower reach of Hooghly estuary was studied over a period of one year (1980-1981). The annual fluctuations in temperature at Station I (Kachuberia, north point) and at Station II (South Sagar, south point) were within the range of 10°C. However, salinity regime varied from 1.01-24.93% at Station I and 3.73-32.03‰ at Station II. Biomass values in terms of displacement volume and wet weight were higher (3.18 ml/m³ and 1,190 mg/m³) at Station II than at Station I (1.01 ml/m³ and 366 mg/m³). The faunastic composition was more diverse at Station II. Quantitative and qualitative variation in copepod species were well pronounced at these two stations. Forty two species of planktonic copepods belonging to 18 families were recorded at Station II, whereas 18 species belonging to 5 families were recorded at Station I. Correlation among the hydrological parameters and correlation of copepod species in relation to salinity and temperature documented at both the stations have been discussed.

INTRODUCTION

Zooplankton is an important indicator of the nature of watermass as it forms an important link in the food chain of the aquatic subsystem.

The hydrobiological studies in Indian waters have been made by several authors from different parts of India, Jayarama (1951) on Bay of Bengal ; Ramamurthy (1953) on Madras coastal waters and Cheriyan (1963) on cochin water. More recently a considerable addition to this aspect was made by Pillai (1971) and Madhupratap (1976) from Cochin backwater ; Goswami and Selvakumar (1977) from Mandovi and Zuari estuaries ; Chandra Mohan (1977) from Godavari estuary and Raghunathan and Srinivasan (1983) from Ennore estuary. But the studies on plankton ecology of Hooghly estuary are still rather meagre. Dutta *et. al.*, (1954) studied the seasonal fluctuation of plankton between Palta and Diamond Harbour. Roy (1955) has given an account of plankton for small region of Hooghly, at Palta. Shetty *et at.*, (1961) studied the plankton and hydrology between Nabadwip and Frazergangue. Very recently Bhunia and Choudhury (1981, 1982) have also reported the abundance and biomass of zooplankton in the Mooriganga and Chemaguri creek of Hooghly estuary.

Sagar Island, the largest delta in the Hooghly-Matla estuarine complex embracing the Western Sector of famous deltaic Sundarbans is situated at the confluence of the river Ganga and the sea, Bay of Bengal, between 21.56 and 21.88°N latitudes and 88.08 and 88.16°E meridians.

Station I (Kachuberia, north point) is

located at the north point of Sagar Island facing Moorigana river, branching off the river Hooghly and Station II (South Sagar, South point) represents the southern extreme of the Island facing the Bay water (Fig. 1). The seasons here are well recognised, each of four months duration. The premonsoon period (March to June) is the dry season with considerably higher temperature. The South-West monsoon (July to October) is accom-

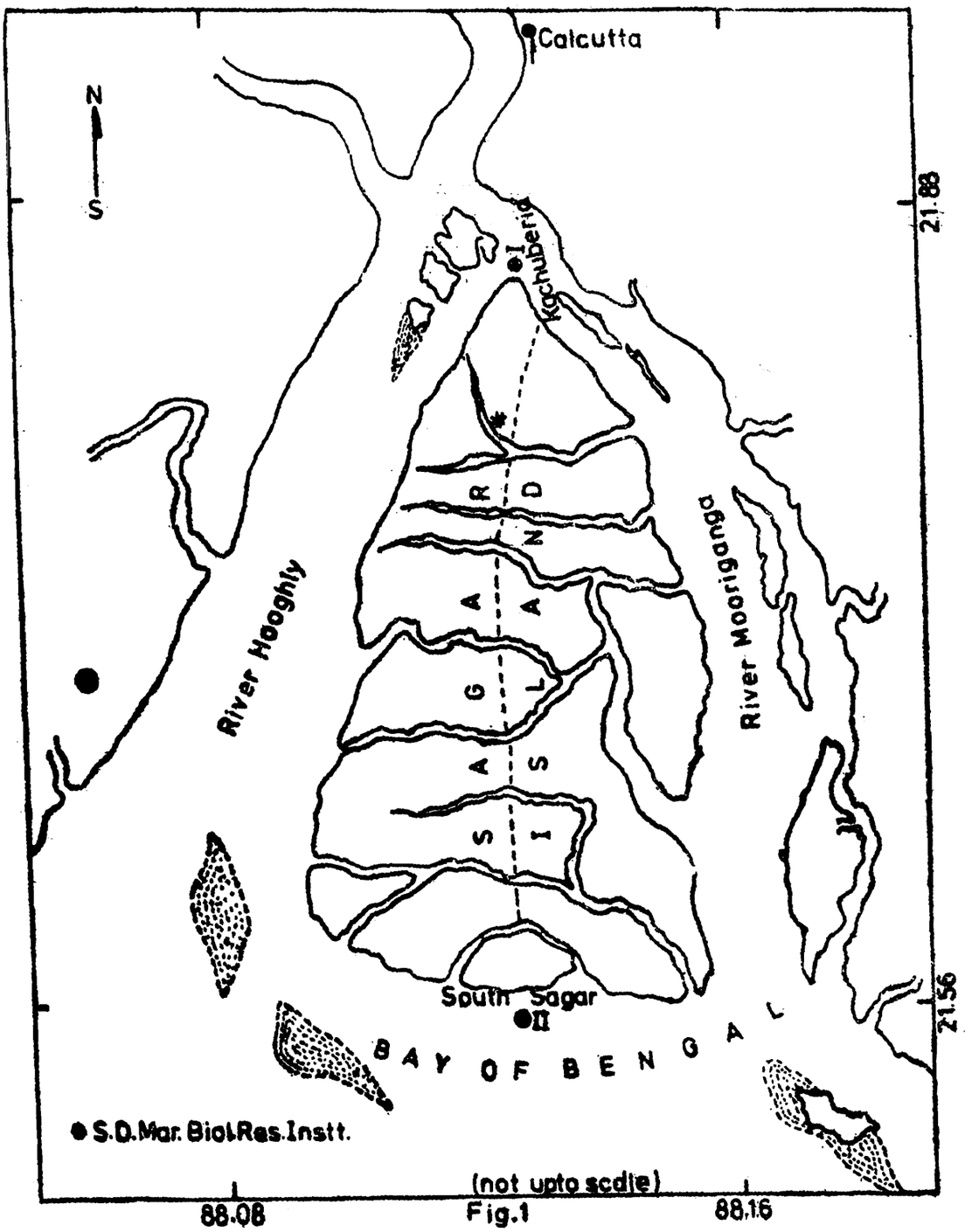

Fig.1

panied by heavy rainfall and the postmonsoon (November to February) comparises partly the winter season with comparatively lower temperature and less precipitation.

MATERIAL AND METHODS

Water samplings were made fortnightly for hydrological studies from two specified stations in the forenoon hours during flow tide from March 1980 to February 1981. The temperature (air and water) were recorded in degree centrigrade in the field. The salinity of the sample water was estimated by 'Mohr-Knudsen' method. Winkler's method was followed to estimate dissolved oxygen content, and for pH, the colour comparator disc was used in the field. Secchi disc was used to measure the transparency of water. For zooplankton sampling, plankton net, made of bolting silk no. 20 (mesh 75 μm) was used. Two hundred literes of surface water was filtered to estimate the plankton biomass. The filtered material was preserved in 4% buffered formaldehyde in sea water. Depending on the size of the sample, sub-samples were often made. When the sample was small, the whole sample was placed for counting under 'Utermohl' microscope and expressed in no/m^3. For estimating the plankton volume the displacement method was used and expressed in ml/m^3. Wet weight of the sample was estimated by absorbing all interstitial fluids with absorbent paper and then measured directly with single pan electric balance and expressed in mg/m^3.

RESULTS

Hydrology :

The temperature range were more or less same in both the stations. Higher and lower values were recorded during premonsoon season (March to June) and postmonsoon season (November to February) respectively. The fluctuation of salinity was pronounced (28.27‰) at Station II than Station I (23.9‰). The salinity values were quite high 21.89-32.03‰ at Station II while Station I showed 16.87-24.93‰ during premonsoon season, but during the monsoon period sudden decrease could be seen in salinity and minimum values were estimated 1.01-11.06‰ at Station I and 3.73-14.52‰ at Station II. The postmonsoon season showed an intermediate, 5.20-15.48‰ at Station I and 13.79-22.07‰ at Station II (Table 1).

The concentration of dissolved oxygen showed a variation range of 2.5-4.1 ml/l at Station I and 1.7-3.8 ml/l at Station II. The maximum values (4.1 ml/l and 3.8 ml/l) were observed in the same month (August) in both the stations respectively.

The pH value remained more or less stable during postmonsoon to premonsoon period, i.e., in November to June (8.1-8.3) but dropped down to 7.3 and 7.6 at Station I and II respectively during monsoon season. Secchi disc readings showed that the water was turbid almost all the time with a little exception in the postmonsoon months. Maximum readings (26 cm) was noted in the month of December at Station II and (10.5 cm) at Station I in the month of February. The correlation among the hydrological parameters showed that the salinity was negatively correlated (at 1% level) with dissolved oxygen and positively correlated (at 1% level) with pH. The relationship of dissolved oxygen with pH was also significantly high (at 1% level) and negative. The relationship between Secchi disc transparency and pH was 5% in Station I and 1% in Station II (Table 2).

TABLE 1. Monthly range of the hydrological parameters of Station I (Kachuberia) during March 1980 to February 1981.

Months	Water temp. °C	Salinity %	Dissolved oxygen ml/1	pH	Transparency cm.
March	26.0-28.2	17.05-18.48	2.5-2.7	8.0-8.1	5-10
April	29.0-30.0	18.66-23.68	2.7-2.9	8.1-8.2	5- 9
May	30.0-30.5	23.50-24.93	2.5-2.8	8.3-8.3	8- 8.5
June	31.0-31.0	16.87-17.94	2.5-2.5	8.3-8.3	4- 8
July	29.0-30.8	3.21- 9.42	3.3-3.7	7.7-8.0	4.9- 6.8
August	29.2-30.3	1.48- 2.81	3.4-4.1	7.3-7.6	8- 6
September	28.8-30.6	1.01- 6.12	3.3-3.6	7.6-7.6	4- 6
October	28.5-31.0	4.47-11.06	3.2-3.5	7.6-7.9	4- 6
November	25.8-27.0	5.20- 6.12	2.9-3.1	8.1-8.1	4.5- 9.0
December	22.9-25.0	6.49- 7.23	3.0-3.2	8.1-8.1	5- 8
January	20.0-23.0	7.77- 8.14	3.2-3.3	8.1-8.2	4- 8
February	22.0-24.5	9.06-15.48	2.9-3.1	8.2-8.2	10.5-10.0

TABLE 1. (*Contd.*) Monthly range of the hydrological parameters of Station II (South-Sagar) during March 1980 to February 1981.

March	26.5-26.8	22.43-26.36	2.5-2.7	8.2-8.3	11-16
April	27.1-29.1	23.32-27 79	1.7-2.7	8.3-8.3	9-14
May	30.1-30.1	28.68-32.03	1.9-2.8	8.3-8.3	6-14
June	30.9-31.5	21.89-31.85	2.9-3.1	8.3-8.3	8-10
July	29.8-30.5	9.32-14.52	2.9-3.3	7.9-8.1	4-10
August	29.7-30.9	3.75- 8.14	3.1-3.8	7.6-7.8	5- 7
September	31.3-31.5	4.65- 8.87	3.1-3.4	7.9-8.0	6- 7
October	29.9-31.5	11.06-11.97	3.5-3.7	7.9-8.0	4- 8
November	26.8-26.8	13.79-14.70	3.0-3.0	8.1-8.1	12-20
December	22.0-23.0	16.51-17.94	3.1-3.3	8.1-8.1	12-26
January	20.0-21.0	17.05-19.20	3.2-3.4	8.1-8.2	10-20
February	22.0-23.6	20.28-22.07	2.9-3.2	8.2-8.3	8-20

TABLE 2. Correlation among the hydrological parameters in two specified Stations.

	Station I (Kachuberia)				Station II (South Sagar)			
	Salinity	Dissolved oxygen	Transparency	pH	Salinity	Dissolved oxygen	Transparency	pH
Water temperature	0.14	-0.25	-0.49*	-0.20	0.01	-0.30	-0.74**	-0.20
Salinity		-0.95***	0.40	0.85**		-0.88**	0.37	0.95**
Dissolved oxygen			-0.30	-0.84**			-0.02	-0.77**
Transparency				0.48*				0.82**

* Significant at 5% level.

**Significant at 1% level.

Zooplankton Biomass :

The density of zooplankton during high saline premonsoon season 2,650-9,455/m^3 at Station I and 9,210-33,730 no/m^3 at Station II ; and during monsoon season 1,255-2,800 no/m^3 at Station I and 3,450-8,410 on/m^3 at Station II were encountered. During the postmonsoon the population showed an intermediate value, 2,975-5,820 no/m^3 at Station I and 10,470-18,215 no/m^3 at Station II. Biomass values in terms of displacement volume and wet weight were higher at Station II (3.18 ml/m^3 and 1,190 mg/m^3) than at Station I (1.01 ml/m^3 and 366 mg/m^3). The zooplankton showed two peaks, the primary peak was recorded during March-April and the secondary in November-December in both the stations. Among the zooplankton component copeped constituted the most predominant portion sharing 73.57-88.23% at Station I and 83.69-94.91% at Station II (Table 3).

Forty two species of planktonic copepod were observed in the surface collection from Station II and only 18 species were recorded from Station I throughout the study period.

The copepod species identified in the present investigation have been classified into four categories depending upon the salinity preference. The marine species, marine to brackish water species and brackish to fresh water species. Of the 42 species found at both the stations, 19 belonged to first category, 3 to the second category, 16 to the third category and 4 to the last category

TABLE 3. Quantitative estimation of zooplankton and copepod comprising total population, percentage (in parenthesis) and the biomass value in two different stations.

	Station I (Kachuberia)				Station II (South Sagar)			
Months	Tolal Zooplankton No/m^3	Total Copepod No/m^3 & %	Displacement Vol. ml/m^3	Wet weight mg/m^3	Total Zooplankton No/m^3	Total Copepod No/m^3 & %	Displacement Vol. ml/m^3	Wet weight mg/m^3
March	7,800	6,675 (85.57)	0.98	315	32,080	30,450 (94.91)	3.08	1,125
April	9,455	8,075 (85.40)	1.01	366	33,730	31,225 (92.57)	3.18	1,190
May	4,680	3,950 (84.40)	0.85	249	16,355	14,925 (91.25)	1.50	677
June	2,650	2,150 (81.13)	0.58	182	9,210	8,275 (89.84)	1.12	426
July	1,490	1,100 (73.57)	0.74	130	4,660	3,900 (83.69)	0.83	268
August	1,255	9, 50 (75.69)	0.76	134	3,450	3,075 (89.13)	0.87	299
September	1,310	1,025 (78.24)	0.20	87	4,015	3,700 (92.15)	0.77	156
October	2,800	2,300 (82.14)	0.72	124	8,410	7,425 (88.28)	1.01	400
November	5,820	5,125 (88.06)	0.90	288	15,945	14,400 (90.31)	1.58	674
December	5,325	4,625 (86.85)	0.86	215	18,215	16,390 (89.76)	1.68	741
January	3,595	3,125 (86.92)	0.73	133	11,005	9,750 (88.59)	1.19	465
February	2,975	2,625 (88.23)	0.69	198	10,470	9,325 (89.06)	1.10	435

TABLE 4. Grouping of the copepod species at the two stations under different salinity gradients.

Marine	Marine—Brackish	Brackish	Brackish—Freshwater
Calanus tenuicornis	*Eucalanus elongatus*	*Paracalanus parvus*	*Pseudodiaptomus annandalei*
Nannocalanus minor	*Acrocalanus gibber*	*P. dubia*	*P. binghami*
Canthocalanus pauper	*A. inermis*	*P. serratipes*	*Acartiella sewelli*
Undinula vulgaris		*Pseudodiaptomus aurivilli*	*Oithona brevicornis*
Eucalanus monachus			
Acrocalanus similis		*P. tollingeri*	
Euchaeta marina		*Labidocera acuta*	
Centropages dorsispinatus		*L. minuta*	
Pseudodiaptomus serricaudatus		*L. euchaeta*	
Temora turbinata		*L. sinilobata*	
T. stylifera		*Pontella andersoni*	
Acartia erythraea		*Acartia spinicauda*	
Tortanus gracilis		*A. centrura*	
Macrosetella gracilis		*A. plumosa*	
M. oculata		*Microsetella rosea*	
Longipedia weberi		*Oithona rigida*	
Euterpina acutifrons		*Corycaeus danae*	
Cladorostrata brevipoda			
Oncaea venusta			

(Table-4). Nineteen species of the first category were recorded mostly from Station II where high saline condition prevail almost throughout the year except the monsoon season. They migrate into estuaries during high saline conditions. Significant correlation coefficient values were worked out for copepod species in relation to salinity and temperature (Table-5). The relationship between most of the species and salinity was positive and high (significant at 5% or 1% level). *Pseudodiaptomus annandalei* and *Acartiella sewelli* showed negative correlation at Station II and were recorded in large numbers during low salinity regime. In general, most of the species showed negative correlation with water temperature. Consequently, with the increase of temperature the population density generally decreases.

Discussion

Hooghly estuary is regarded as the largest estuary in India with a dynamic ecosystems undergoing considerable variations in its physico-chemical characteristics owing to ever fluctuating salinity regime and sediment load is concerned. The spectacular influence of the South-West monsoon which brings about an erratic change both in the meteorological and hydrological conditions is an important feature.

A wide fluctuation in annual water temperature of about 10°C was encountered in this estuary and the salinity was mainly influenced by the monsoon rains and surface run off. The salinity varied from 1.01 to 32.03‰. It seems that both temperature and salinity are the important factors which

TABLE 5. Correlation of population densities of different species with water temperature and salinity at two stations.

	Station I		Station II	
	Water Temperature	Salinity	Water Temperature	Salinity
Calanus tenuicornis	—	—	-0.25	0.45*
Nannocalanus minor	—	—	-0.15	0.71**
Canthocalanus pauper	—	—	0.08	0.60**
Undinula vulgaris	—	—	-0.29	0.53**
Eucalanus elongatus	-0.40*	0.46*	-0.48*	0.45*
E. monachus	—	—	-0.14	0.60**
Paracalanus parvus	-0.24	0.53**	0.11	0.48*
P. dubia	-0.30	0.52**	0.001	0.45*
P. serratipes	-0.26	0.46*	0.16	0.46*
Acrocalanus gibber	-0.21	0.38	-0.10	0.57**
A. similis	—	—	-0.56**	0.18
A. inermis	-0.14	0.40*	-0.50*	0.42*
Euchaeta marina	—	—	0.04	0.37
Centropages dorsispinatus	—	—	-0.08	0.69**
Pseudodiaptomus aurivilli	-0.31	0.51**	0.23	0.52**
P. serricaudatus	—	—	-0.12	0.67**
P. annandalei	-0.48*	0.42*	-0.28	-0.56**
P. tollingeri	0.24	0.52**	-0.59**	0.37
P. binghami	0.22	0.50*	0.008	0.38
Temora turbinata	—	—	-0.22	0.66**
T. stylifera	—	—	0.43*	0.39
Labidocera acuta	-0.03	0.43*	0.12	0.52**
L. minuta	-0.17	0.47*	0.28	0.36
L. euchaeta	—	—	-0.18	0.33
L. sinilobata	—	—	-0.28	0.46*
Pontella andersoni	-0.34	0.45*	-0.38	0.42*
Acartia spinicauda	-0.44*	0.48*	-0.23	0.54**
A. erythraea	—	—	0.005	0.62**
A. centrura	—	—	0.19	0.46*
A. plumosa	-0.15	0.54**	0.10	0.52**
Acartiella sewelli	0.24	0.47*	-0.16	-0.43*
Tortanus gracilis	—	—	-0.17	0.38
Microsetella rosea	0.01	0.49*	-0.37	0.50*
Macrosetella gracilis	—	—	-0.36	0.56**
M. oculata	—	—	-0.26	0.34
Longipedia weberi	—	—	0.27	0.36
Euterpina acutifrons	—	—	-0.46*	0.36
Cladocalanus brevipoda	—	—	0.12	0.41*
Oithona rigida	0.11	0.50*	0.09	0.72**
O. brevicornis	—	—	0.03	0.38
Oncaea venusta	—	—	-0.23	0.49*
Corycaeus danae	—	—	-0.28	0.42*

* Significant at 5% level
** Significant at 1% level

influence the seasonal distribution of different groups of zooplankton in this area.

The water temperature and salinity range in the Hooghly estuarine system around Sagar Island varied from 20.0-31.5°C and 1.01-32.03%. respectively, but the recruitment of maximum population was recorded when the temperature range was 22.0-30.0°C and salinity of the environment was 5.00-27.79‰. Bhunia and Chowdhury (1981) from Hooghly estuary also reported maximum copepod population when the salinity was high and temperature was low.

During the present study, a total of 42 copepod species have been recorded, bulk of which were from Station II. Pillai (1971) in his account on the estuarine copepods of India has recorded 41 species from Cochin backwater and Goswami and Selvakumar (1977) recorded 49 copepods from estuarine system of Goa.

Significant correlation was found out between the number of copepod species and salinity at both the stations indicating presence of several species of marine origin. During the premonsoon months when the salinity was high in this estuarine system, neritic species viz., *Calanus tenuicornis*, *Nannocalanus minor*, *Canthocalanus pauper*, *Undinula vulgaris*, *Eucalanus monachus*, *Acrocalanus similis*, *Euchaeta marina*, *Centropages dorsispinatus*, *pseudodiaptomus serricaudatus*, *Temora turbinata*, *T. stylifera*, *Acartia erythraea*, *Tortanus gracilis*, *Macrosetella gracillis*, *M. oculata*, *Longipedia weberi*, *Euterpina acutifrons*, *Cladorostrata brevipoda*, *Oncea venusta* were recorded at Station II. Pillai *et al.*, (1973) also stated the similar findings from Cochin backwater. During monsoon months, the hydrological conditions changed and consequently the copepod species were different. *Acartiella sewelli*, *Pseudodiaptomus annandalei* were recorded as monsoonal species. Kasturirangan (1963) reported *Acartiella sewelli* preferred low saline condition. Madhupratap (1976) contends that *Pseudodiaptomus annandalei* has a wide range of salinity tolerance (0-35%.) and occur throughout the year in Cochin backwater. *Paracalanus parvus*, *P dubia*, *P. serratipes*, *Pseudodiaptomus aurivilli*, *P tollingeri*, *Labidocera acuta*, *L. minuta*, *L. euchaeta*, *L. sinilobata*, *Pontella andersoni*, *Acartia spinicauda*, *A. centrura*, *A. plumosa*, *Microsetella rosea*, *Oithona rigida*, *Corycaeus danae* were recorded as typical estuarine copepods.

One of the major features of zooplankton distribution in the tropical estuary is the contrast in abundance of zooplankton between high and the low saline periods. Comparatively a poor fauna exist during the low saline seasons when the surface run off due to heavy precipitation flood the estuaries (Rao, *et al.*, 1981). Population was diverse and abundant during high salinity regime and was comprised of estuarine, estuarine and marine and euryhaline marine forms in addition to adventitious immigrants.

The zooplankton production showed two peaks in their abundance at different places of Indian waters. Subbaraju and Krishnamurthy (1972) found the abundance in April and September at Portonovo water. Raghunathan and Srinivasan (1983) recorded two peaks (December and February) for copepod population from Ennore estuary. In the lower reaches of Hooghly estuary, Bhunia and Choudhury (1982) recorded two peaks, one in March-April and the other in November-December. The present observation also endorses the preceding report.

REFERENCES

BHUNIA, A. B. AND CHOUDHURY, A. 1981. Studies on the seasonal abundance and biomass of crustacean zoolplankton and chaetognaths in relation to ecological parameters of a tidal creek (Mooriganga) of Sagar Island (North) Sundarbans, West Bengal. *Proc. Symp. Ecol. Anim. popul. Zool. Surv. India*, pt. I : 175-183.

BHUNIA, A. B. AND CHOUDHURY, A. 1982. Some ecological considerations for zooplankton production in Chemaguri creek, Sagar Island (South), Sunderbans, Mahasagar—*Bulletin of the National Institute of Oceanography*, **15** (4) : 242-252.

CHANDRA MOHAN, P. 1977. Seasonal distribution of copepods in the Godavari Estuary. *Proceedings of the Symposium on "Warm water Zooplankton", special publication, National Institute of Oceanography*, pp. 330-336.

CHERIYAN, P. V. 1963. Studies on the salinity and temperature variations in the Port of Cochin. *J. Timber Dryers Preserv. Ass. India*, 9 : 7-21.

DUTTA, N., MALHOTRA, J. C. AND Bose, B. B. 1954. Hydrology and seasonal fluctuation of the plankton in the Hooghly estuary. *Symposium on marine and Freshwater plankton in the Indo-pacific Fish Council*, Bangcock, 35-47.

GOSWAMI, S. C. AND SELVAKUMAR, R. A. 1977. Plankton studies in the estuarine system of Goa. *Proc. Symp. "Warm water Zooplankton", Special publication UNESCO/NIO*, pp. 337-353.

JAYARAMAN, R. 1951. Observation on the chemistry of the waters of the Bay of Bengal off Madras City during 1948-1949. *Proc. Indian Acad. Sci.* 38B : 90-99.

KASTURIRANGAN, L. R. 1963. A key to the identification of the more common planktonic copepoda of Indian coastal waters, publication No. 2. Indian National Committee on Oceanic Research (C.S.I.R., New Delhi), 87 pp.

MADHUPRATAP, M. 1976. Studies on the ecology of zooplankton of Cochin backwaters. Mahasagar—*Bulletin of the National Institute of Oceanography*, **11** (1 & 2) : 45-56.

PILLAI, P. P. 1971. Studies on the estuarine copepods of India. *J. mar. biol Ass. India*, 13, 162-172.

PILLAI, P. P. QASIM, S. Z. AND KESAVANNAIR, A. K. 1973. Copepod component of zooplankton in a tropical estuary. *Indian Jour. mar. Sci.* Vol. 2, pp. 38-46.

RAGHUNATHAN, M. B. AND SRINIVASAN, M. 1983. Zooplankton dynamics and hydrographic features of Ennore estuary, Madras, Records of the Zoological Survey of India, Misc. publication, Occasional paper No. 40 : 1-31.

RAMAMURTHY, S. 1953. Hydrological studies in Madras coastal waters, *J. Madras Univ.*, **13** (B) : 148-163.

RAO, T S. S., NAIR, V. R. AND MADHUPRATAP, M. 1981. Ecological consideration on tropical zooplankton. *Proc. Symp. Ecol. Anim. popul. Zool. Surv. India*, Pt. 1 : 15-39.

ROY, H. K. 1953. Plankton ecology of the river Hooghly at Palta, West Bengal. *Ecology*. **36** (2) : 169-175.

SHETTY, H. P. C. SAHA, S. B. AND GHOSH, B. B. 1961. Observation on the distribution of plankton in the Hooghly-Mahtla estuarine system, with notes on their relation to commercial fish landings. *Indian J. Fish.*, 8 : 326-355.

SUBBARAJU, R.C. AND KRISHNAMURTHY, K. 1972. Ecological aspects of plankton production. *Marine Biology*. Vol. **14**, pp. 25-31.

Bull. zool. Surv. India, 7 (1) : 93-101, 1985

THE SETAE OF THE SUBTERRANEAN ISOPOD *NICHOLLSIA MENONI* TIWARI 1955, (CRUSTACEA, ISOPODA, PHREATOICOIDEA, NICHOLLSIDAE).

By

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ABSTRACT

24 types of setae are found on the body of *Nichollsia menoni*. These have been grouped into two major divisions i. e. macrotrichs and microtrichs. Their distribution and correlation with the possible function and subterranean mode of life is given.

INTRODUCTION

There are a number of references dealing with the setae in Isopods (Sars, 1899 ; Racovitza, 1912, 1925 ; Nordenstam, 1933 ; Needham, 1942 ; Nicholls, 1943 ; Chopra & & Tiwari, 1950 ; Menzies, 1956 ; Jones, 1968 ; John, 1968 ; Fish, 1972 ; Schmalfus, 1977 ; Gupta, 1980). In many cases the variation in the form and number of setae has been utilised for separation of species and subspecies ; e. g. in *Jaera albifrons* (Harvey & Naylor, 1968). The form and structure of setae have been correlated with the mode of life of the animal. Considering the subterranean mode of life in *Nichollsia menoni* it was thought desirable to investigate its setal armature. and to find the extent to which cavernicolous life has modified it.

The following account is the result of a more or less complete study to determine the variety and distribution of all setal types in *N. menoni* and to understand their functional morphology.

MATERIAL AND METHOD

The moulted skin as well as the animal's appendages were studied in glycerine preparations and also in lactophenol preparations. Addition of methylene blue to the medium gave better picture of the appendicular setae. All the studies were made under light microscope.

Classification :

Classification of setae has mostly been followed from those of Fish (1972).

The whole chaetotaxy of *Nichollsia menoni* has been divided into two major divisions : 1. Macrotrichs and 2. Microtrichs.

Macrotrichs :

The structure is basically similar in having a shaft wall enclosing a lumen which contains cytoplasm. On the basis of structural variations of the basic type, the setae can be classified into 4 major groups.

Group 1. *Simple macrotrichs* :

(a) Simple setae (b) Hamate seta (c) Rod setae (d) Aesthetascs (e) Acuminate seta.

Group 2. *Setulose macrotrichs* :

(a) Serrate Setae (b) Whip seta (c) Pap-

pose seta (d) Plumose setae. (e) Plumo-serrate seta (f) Brush seta (g) Brush spine.

Group 3. *Denticulate macrotrichs* :

(a) Dentate setae (b) Denticulate seta (c) Comb seta (d) Digitate setae.

Group 4. *Non-denticulate and non-setulose macrotrichs* :

(a) Cuspidate setae (b) Conate setae (c) Claw seta.

Microtrichs :

(a) Pegs (b) Triangular microtrichs (c) Multidentate hooks or spinnules (d) Setose bristles (e) Simple microtrichs.

Observations :

The terms seta, bristle and spines or cones used within each group indicate the degree of chitinization and thickening of the shaft wall. Setae are the least and spines are the most chitinized forms. The number of setae occuring within a group increases with the size of the animal, but the number of groups remains more or less constant. These groups exist as fringes, and closeset bundles. A seta has minute apical pore, which is not always terminal in position. This pore leads into a lumen which varies in prominence depending on the degree of cuticularization of the setal wall. Most of the setae have distinct lumen and an annulation dividing the seta in two equal or unequal proximal and distal halves. All the seta are built on a handle-blade pattern, the division being marked by a slight constriction or by a peculiarity in the structure at this point. This has been termed as "annulation" (Thomas, 1970). As already mentioned above, the position of annulation is variable among different setal types, but constant for a given variety.

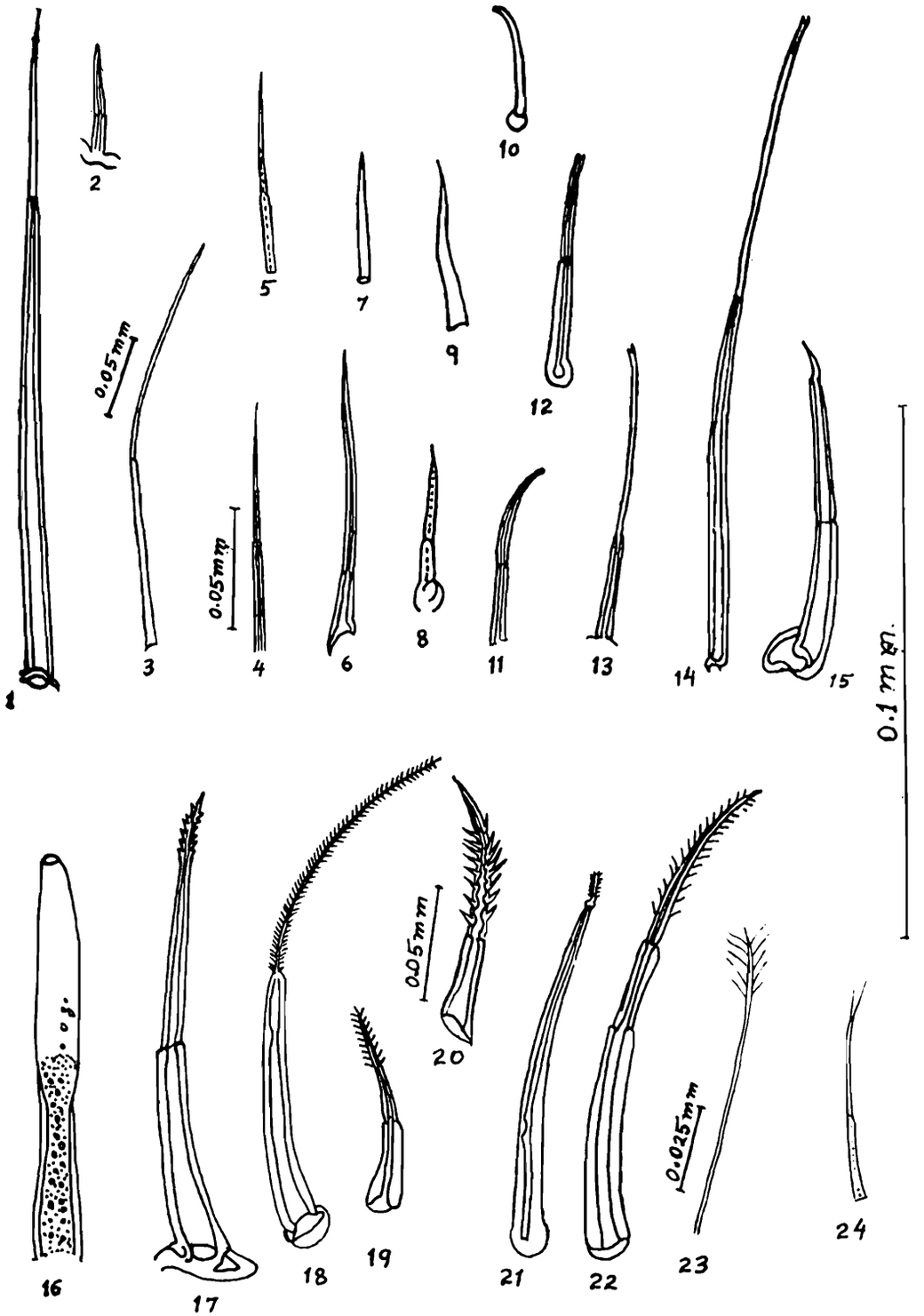
Group 1. *Simple macrotrichs* :

All the setae in this group except aesthetasc have a narrow lumen opening terminally or subterminally through a minute pore. An annulation is present about half-way along the length of the shaft. The shaft wall is without lateral projections and in all but the aesthetasc tapers gradually from a wide base to a narrow apex.

(a) *Simple setae* (Fig. 1-9) : These are flexible unmodified setae, circular in cross section, tapering gradually to a fine pointed apex and vary from 0.02 to 0.26 mm in length and 0.0015 to 0.004 mm in thickness. They occur on antenna 2, mandibular palp, maxilla 1, maxilla 2, maxilliped, pereopods, penial stylet, uropodal ramii and along the pleural edge in the abdominal region.

(b) *Hamate seta* (Fig. 10) : This is a unique hook shaped seta with a hemispherical basal region and is very small (0.034 mm in length and 0.0014 mm in breadth) compared with other setae. The tip of hamate seta is rounded and smooth, unlike other seta, the lumen becomes obliterated distally so that the hooked end is solid. This type of seta has been noticed on the peduncular segments of first and second antenna.

(c) *Rod setae* (Figs. 11-14) : These are relatively long setae, ranging from 0.035 to 015 mm in length and 0.002 to 0.007 mm in width, and taper gently from the annulation to the tip. The preannular portion of the shaft is columnar, the seta as a whole presenting a much more rod-like outline, with a blunt tip. The apices of these seta are cleft into small finger like lobes, the apical pore



Figs. 1-24. *Nichollsia menoni* Tiwari

1-9. *Simple setae* ; 10. *Hamate seta* ; 11-14. Rod setae ; 15. *Acuminate seta* ; 16. *Aesthetascs* ; 17-22. *Serrate seta* ; 23. *Pappose seta* ; 24. *Whip seta.*

being subterminal. The lumen which extends upto the pore, is conspecuous. These seta are more common than many others. They are distributed on first antenna on the distal ends of each segment either single or in groups of 2 or 3. They are also found around

the aesthetasc seta as protecting seta on the first antenna. Further they are found on antenna 2, maxilla 2, all the pereopods including gnathopods, and smaller sizes on the pleopods and outer ramii of uropods.

(d) *Aesthetascs* (Fig. 16.) : These are small seta usually 0.075 mm in length and 0.009 mm in breadth but the size varries according to the age of the animal. The annula is well marked, and distal to it the seta take on an elongated wide cylindrical tube, below the annulation the stalk is subequal to the main body i. e. the portion above the annulation of the seta. They are transparent and possess a large apical pore with a fluted margin. The body of the cylinder is thin walled while the stalk is thick.

In *Eurydice pulchra* according to Fish (1972) the annulation is absent and the stalk is very small. In *N. menoni* they occur on the distal 5 or 6 flagellar segments of the antennules. The newly hatched young possesses only one aesthetasc at the tip of the antennule. But the number increases in the adult animal. The normal function atributed to this seta is olfactory.

(e) *Acuminate seta* (Fig. 15) : This seta is not much variable from that of simple or rod seta but the only difference is that it has small terminal blade, like that of a surgical knife. The length of the seta is 0.0075 mm. It has been noticed on the distal posterior margin of basipodite, merus and dactylus of the peraeopods. Their number is very few.

Group 2. *Setulose macrotrichs* :

Setae in this group are characterised by fine setules arising from the shaft wall. The lumen does not project into these setules and their density, arrangement and stiffness varies considerably. Although all macrotrichs in this group have a terminal pore, some lack an annulation.

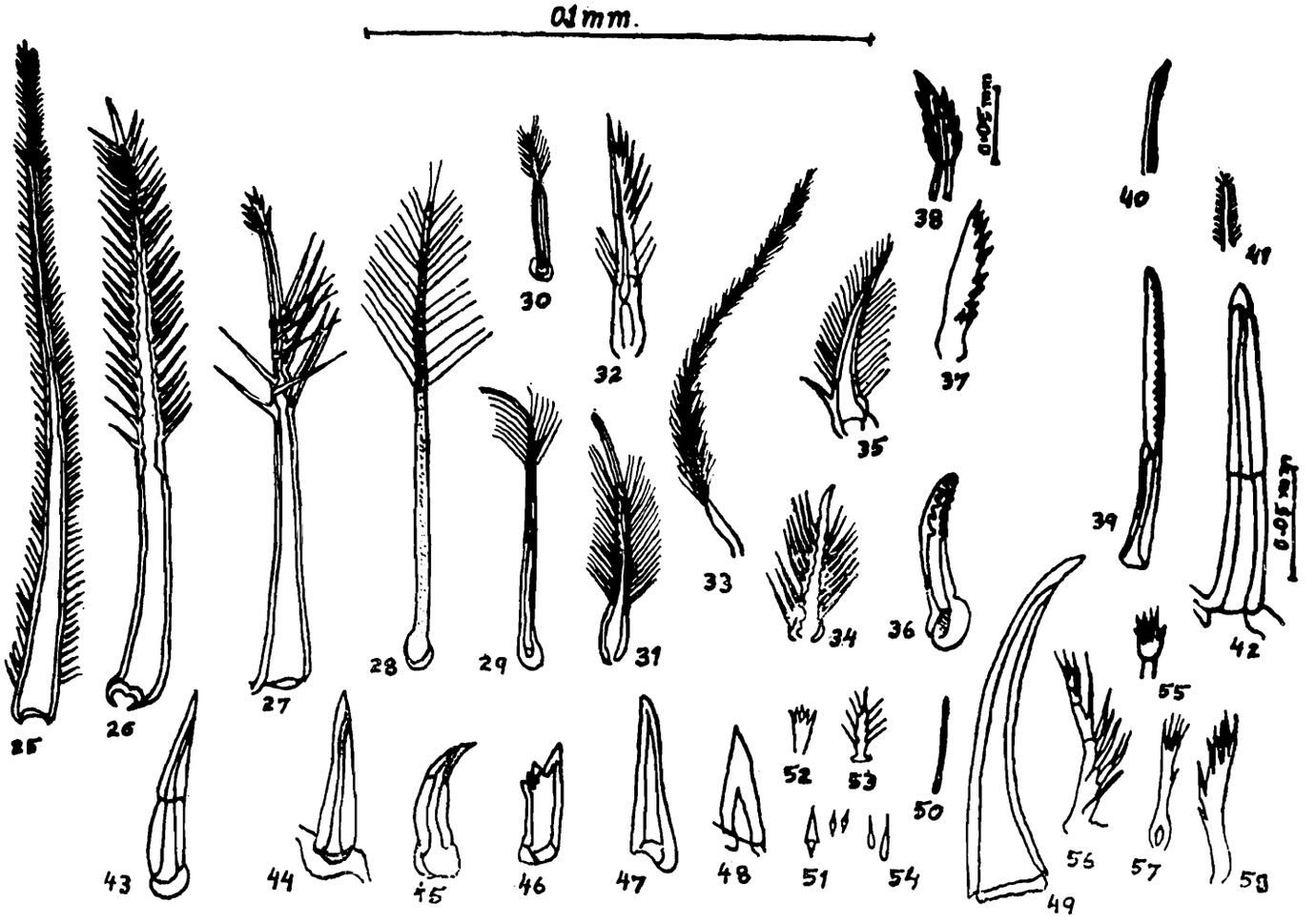
(a) *Serrate seta* (Figs. 17-22) : This type of seta has a fine pointed apex and short setules arranged in two rows usually distal to its annulation. This setal type has many varriations with the degree of serrations on the length of the seta above annulation. In some cases serration is confined to the terminal part (Fig. 17) only, while in still others only the half of the part beyond annulation is serrated (Fig. 19) while in normal course the complete portion beyond annulation is serrated. The length varies from 0.04 to 0.16 mm.

The distribution of serrated seta is confined to mandibular palp, gnathopod, other peraeopods and on the junction of the lobe of exopods in pleopods.

(b) *Whipseta* (Fig. 24) : This seta (0.035 mm long) is simple and has an annulation in the middle of the shaft and it bears two whip like fine long hairs or setules at its apex. This seta has been observed on the second peraeopod of the young, but its presence on adult is not confirmed.

(c) *Pappose seta* (Fig. 23) : The seta have extremely slender shaft and have sparsely distributed fine setules at their terminal portion. The annulation could not be detected. They are 0.085 mm in length and 0.0007 mm in breadth. They have been located on antennules only in youngs.

(d) *Plumose setae* (Figs. 25, 26, 28-32) : This type is the longest found on *N. menoni* reaching from 0.03 to 0.14 mm in length and 0.002 to 0.007 mm in breadth. Two rows of long stiff setules arise in opposite directions from the shaft wall and run from base to the apex of the seta. In such cases the annulation



Figs. 25-58. *Nichollsia menoni* Tiwari
25, 26, 28-32. *Plumose setae* ; 27. *Plumo-serrate seta* ; 33. *Brush seta* ; 34, 35. *Brush spine* ; 36-38. *Dentate seta* ; 39-40. *Denticulate seta* ; 41. *Comb seta* ; 42-45. *Cuspidate setae* ; 46-48. *Conate setae* ; 49. *Claw seta* ; 50. Pegs ; 51. *Triangular microtrichs* ; 52. *Multidentate hooks or spinnules* ; 53. *Setose bristles* ; 54. *Simple microtrichs* ; 55-58. *Digitate setae.*

has not been detected. In another type of seta the annulation is more or less demarcated by a cuticular inward thickening in the lumen of the shaft, and arrangement of setules is confined distal to the annulation (fig. 29). Plumose seta are distributed on the antennules, antenna, maxilliped, gnathopod, peraeopods and inner ramii of the uropods.

(e) *Plumo-serrate seta* (Fig. 27) : This type of seta is just like plumose seta but differs in the arrangement of setules. The long setules are arranged in the proximal half of the blade above annulation and few small setules are present in the apical region. The seta between the two setulose portions is naked and smooth. These types of setae are found on the maxillipeds and is approximately 0.1 mm in length and 0.005 mm in breadth.

(f) *Brush seta.* (Fig. 33) : These are long narrow and flexible setae with hairs around the shaft. These setae have been noticed on the margin of the molar ridge of the mandible in recently hatched young as well as adults. They are 0.07 mm in length and 0.0015 mm in breadth.

(g) *Brush spine* (Fig. 34, 35) : These are stout setae of smaller length but wider diameter with wide lumen and bulbus base. There is no annulation and shaft is armed with hairs from base to the tip. In one type there is a spine at the base of the shaft and in another type there is a terminal spine. Both the types of seta are found on the maxilliped and vary from 0.035 to 0.04 mm in length and 0.005 to 0.006 mm in breadth.

Group 3. *Denticulate macrotrichs.*

In the macrotrichs of this group serration which are a continuation of the shaft wall and are mostly in the forms of teeth, occur into two rows distal to the annulation. The lumen does not project into the teeth.

(a) *Dentate seta* (Figs. 36-38) : These are comparatively stout seta provided with blunt or conate teeth arranged in two rows. They may be long and the luman is wide. They vary from 0.035 to 0.22 mm in length and 0.005 mm in width in youngs. There is no annulation. This type of setae are found on the mandibles, maxilla 1 and maxilliped.

(b) *Denticulate seta* (Figs. 39, 40) : This seta has a smaller shaft with a long wide blade. They are 0.025 to 0.06 mm in length and 0.002 to 0.003 mm in breadth. The annulation is present. The blade has regular denticles arranged submarginally along its its whole length. This type of seta has been found on the maxilla 2 of the young and adult.

(c) *Comb seta* (Fig. 41) : This is a very small seta about 0.013 mm in length and 0.0015 mm in breadth and it gradually tapers towards its apex. There are two rows of fine serrations on the two sides of the shaft along its whole length. The lumen is almost absent. They are located on the peduncle of the antennule in youngs.

(d) *Digitate setae* (Figs. 55-58) : These are minute setae. The lumen in some is not clear, in others present. These seta terminally or subterminally develop fine finger like processes which do not appear to contain lumen extensions. This type of setae are found on the mandibles only. They range from 0.015 to 0.04 mm in length and 0.002 to 0.004 mm in width.

Group 4. *Non-denticulate and non setulose macrotrichs* :

All the macrotrichs in this group are well chitinized spines, having a thick shaft wall and narrow lumen and have wide base. An annulation is present. Apical region of the spine may be flattened and minutely ridged.

(a) *Cuspidate seta* (Figs. 42-45) : These are relatively long stoutly built setae varying from 0.03 to 0.15 mm in length and 0.006 to 0.018 mm in breadth. They are heavily cuticularized, fang like and possess a narrow lumen. The annulation is conspicuous with the shaft proximal to it becoming swollen. Their surface and outline are perfectly smooth, the lumen outline follows the outer contours of of the setal wall, except proximal to the annulation, where the lumen widens out in stages narrowing a little before it meets the integumentary canal. All these seta are fixed in elaborate sockets, their tips are rounded bearing a subterminal pore. These setae are found on the gnathopods and other peraeopods, lower margin of the telson and inner margin of the paragnath. There is a seta on the inner subterminal margin of penial stylet in males.

(b) *Conate setae* (Figs. 46-48) : These are relatively short setae always stoutly built and showing a considerable variation in size. The walls are very thick, the lumen is wide without any apical opening. The tip of the seta is very thickly cuticularized and is rounded. This type of setae are found at the inner margin of dactylus on all peraeopods and tip of outer ramii of uropods. It varies from 0.02 to 0.035 mm in length and 0.008 mm in breadth.

(c) *Claw seta* (Fig. 49) : These are elongated cones having much wide lumen which ends blindly. They are 0.07 mm to 0.11 mm in length and 0.013 mm in breadth and are found on the distalendite of maxilla-1 and end of all pereopods.

Microtrichs :

Apart from the macrotrichs described above there is a system of much smaller dimension, these have been called as microtrichs by different workers on carcinology. Their position on some of the appendages of *Nichollsia* signifies their importance. The general body surface of *N. menoni* is lacking microtrichs except few scattered macrotrichs This regressive character is the outcome of subterranean life. Here in *N. menoni* 4 types of microtrichs have been identified.

(a) *Pegs* (Fig. 50) : These type of seta are elongated fine setules which are having a more or less uniform thickness (0.00025 mm) through out their length (0.001 mm). There is no lumen. They are found on all head appendages, inner surface of the stomach and on the uropods.

(b) *Triangular microtrichs* (Fig. 51) : They are very minute in size of 0.007 mm in length and 0.0015 mm in breadth, normally arranged in crescentic rows. Some are with conical basal projection and some are with round basal projections. They are located on the the first segment of antennule, labrum, mandibular palp, maxilla, paragnath, maxilliped and along the inner margin of exopods of abdominal appendages.

(c) *Multidentate hooks or spinnules* (Fig. 52): These are small seta terminating into bifid or multifid hooks. These seta are found on the lateral ampullae of the stomach and help in tearing, puncturing and triturating the food in the stomach. They are 0.02-0.05 mm in length and 0.01 mm in width.

(d) *Setose bristles* (Fig. 53) : (0.03 mm in length). This type of seta have fine hairs on the thick, flat cuticular shaft, having both of its margins undulating. The stiff hairs arise from the elevations of the margins and form a fan like structure. This type of setae are found linearly arranged on the inner side of the bristle plates which form a part of the filter apparatus in the stomach.

(e) *Simple microtrichs* (Fig. 54) : (0.015-0.03 mm in length) These are very minute simple microtrichs of much smaller dimensions. They are found singly or in groups of 2 or more setae on the mouth parts, oral cavity, on the inner surface of the stomach and also on the inner surface of the penial stylet of male.

DISCUSSION

Although histological and experimental studies to determine the functions of the macrotrichs and microtrichs have not been carried out, it is possible to make an assessment of setal function based on distribution and morphological studies. The macrotrichs, on the basis of their presumed functions, could be of four types. Those which are

correlated with the mechanical functions are cones, comb, denticulate macrotrichs, cuspidate and conate setae. The brush spines, serrate setae and filter setae can also be included in it. They help in holding the objects, combing tearing, cutting pushing, brushing and sieving of the food material by the animal. All the plumose seta are supposed to be auditory (tactile) in function and they are concerned with the detection of the water currents. They also act as fiilter seta in some cases but their shaft is strongly built while in case of auditory the shaft is slender and attachment is more delicate and flexible and such type of seta are distributed on the proximal segments of the peraeopods and antennule and antenna and uropods. The olfactory seta are the aesthetascs which are confined to the antennules. They are no doubt chemoreceptors. The rod setae which are having terminal openings may be considered to have some sort of chemosensory functions, although they act as supporting setae around the aesthetascs. It has been found that *Nichollsia menoni* recognise its food only when it is within the reach of their antennules or sometimes below the mouth parts. The same food could not be detected although it was in touch with the long antennae. Aesthetascs have been found in almost all aquatic crustaceans, their number being variable in subterranean and surface water forms. The rod seta may also be one of the detectors of external pressure of the medium.

Like microtrichs which are also widely distributed may be shown to have different functions. All those present on the mouth parts and on the inner surface of the oral cavity have mechanical function and may have correlation with the thigmotactic behaviour of the animal. The microtrichs present inside the stomach of *Nichollsia menoni* have different mechanical function, the multidentate hooks help in tearing the food material while the setose bristles and other microsetae help in holding and filtering of the liquid food which passes to the hepatopancreas. Needham (1942) suggested that microtrichs are primarily exteroceptive and that in aquatic animals they are sensitive to movements on the surface of the body. However in *Nichollsia menoni* the microtrichs having conical basal projections are present on the inner margin of the exopods on anterior and posterior faces in the forms of crescentic rows. These crescents are arranged along the afferent canals of the exopods which indicates that they are perhaps related with the detection of nature and internal pressure of the blood in the animals.

When the setal armature of *Nichollsia menoni* is compared with the members of the family Phreatoicidae and Amphisopidae it is found that they are more profusely setose and have larger number and variety of setae (Nicholls, 1943). However there is a general tendency of reduction in the setal armature of subterranean forms of phreatoicidae. *Nichollsia menoni* is comparatively much smooth and less armed with setae, which shows that it has taken to subterranean life much earlier than members of the Phreatoicidae and Amphisopidae.

When one considers the setal armature of the foregut and mouth parts it is found that it is very much influnced by the food habit of the animal (Tiwari & Ram 1972).

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REFERENCES

CHOPRA, B. AND TIWARI, K. K. 1950. On a new genus of phreatoicid Isopod from wells in Banaras. *Rec. Indian Mus.*, **47** (3 & 4) : 277-290.

FISH, S. 1972. The setae of *Eurydice pulchra* (Crustacea : Isopoda). *J. Zool. London*, **166** : 166-177.

GUPTA, L. P. 1980. "Studies on the biology of subterranean Isopoda of the genus *Nichollsia* Chopra & Tiwari 1950 (Crustacea ; Isopoda : Phreatoicoidea) Ph. D. Thesis, Patna University, Patna.

HARVEY, C. E. AND NAYLOR, 1968. The taxonomic status of *Jaera albifrons syei* Bocquet (Isopoda, Asellota). *Crustaceana*, **14** (2) : 185-193.

JOHN, P. A. 1968. Habits, structure and Development of *Sphaeroma terebrans* (a wood boring isopod) : V+82, pls., University of Kerala Publications, Trivandrum.

JONES D. A. 1968. The functional morphology of the digestive system in the carnivorous intertidal isopod *Eurydsce*. J. Zool. Londan **156** : 353-376.

MENZIES, R. J. 1956. A study of the microscopic structure of the isopod seta. *Ann. Mag. nat. Hist.*, (12) **9** : 698-700.

NEEDHAM, A. E. 1942. Micro-anatomical studies on *Asellus*. *Quart. J. mier. Sci.*, **84** : 49-71.

NICHOLLS, G. E. 1943a. The phreatoicoidea, Part I, The Amphisopidae. *Pap. and Proc. Roy. Soc. Tasmania* (16th August, 1943).

NICHOLLS, G. E. 1943 b. The phreatoicoidea, Part II, The Phreatoicidea. *Pap. and Proc. Roy. Soc. Tasmania* (16th Nov. 1943).

NORDENSTAM, A. 1933. Marine Isopoda of the family Serolidae Idotheidae, Pseudi cotheidae, Arcturidae, Parasellidae and Stenetridae, mainly taken from the south Atlantic. *Furtner Zool. Results Swed. Antarct. Exped.* **3** (1) : 1-384.

RACOVITZA, E. G. 1912. Cirolanides (Premiere serie) *Arch. Zool. exp. gen.*, (5) **10** : 203-329.

—— 1925. Notes sur Isopodes, 12. *Arch. Zool. exp. gen.*, **62** : 35-48.

SARS, G. O. 1899. An account of crustacea of Norway 2. Isopoda, Bergen Museum.

SCHAMALFUS, H. 1977. Morphology and function of the tergal ridges in terrestrial Isopods (Oniscoidea, Isopoda, Crustacea). *Zoomorphologie*, **86** : 155-167.

THOMAS, W. J. 1970. The setae of *Austropotamobius Pallipes* (Crustacea : Astacidae), *J. Zool. London* **160** : 91-142.

TIWARI, K. K. & RAM, L. 1972. The foregut of *Nichollsia kashiense* Chopra and Tiwari 1950 (Crustacea : Isopoda : Phreatoicoidea), *J. Zool. Soc. India*, **24** (1) : 69-79.

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HAEMOGLOBIN POLYMORPHISM IN COMMENSAL SPECIES OF RODENTS IN INDIA

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ABSTRACT

The present communication reports polymorphism of haemoglobins in six species of rodents belonging to the subfamily Murinae. A composite pattern of four major bands of rodent haemoglobins was observed. Of these, three slow migrating bands are common in all the species. The fast-migrating fourth band was seen only in *Rattus rattus rufescens* (Gray). The same species of rat from Bombay and Pune region show two distinct zones of mobilities, with *R. r. rufescens* from Pune having intermediate mobility.

INTRODUCTION

Taxonomic studies on protein polymorphism in American and European rodents were initiated earlier by modern workers (Selander *et al* 1969, Yosida *et al*, 1971, Johnson, 1974, De Smet, 1978). De Smet (1978) has reported about 40% of polymorphism in various rodent proteins. The results were interesting from a chaemotaxonomic point of view.

Among the various proteins, haemoglobin (Hb) patterns of Indian commensal rodent species were studied earlier (Deoras and Pradhan, 1976 ; Pradhan, 1982). Allelic heterozygosity was seen in the haemoglobins of *B. bengalensis kok* populations from the Bombay and Pune regions of India (Pradhan, 1982). While continuing work on this subject, some additional species belonging to the same subfamily, Murinae, were taken into consideration for comparative purpose. Some interesting results were obtained and they have been reported here in the present article.

MATERIALS AND METHODS

About fifty adult rodent specimens were collected at various localities in Bombay and

TABLE 1

Table showing the sample size for each of the six rodent species collected from Bombay-Pune region.

Sl. No.	Species	Localities	No. of specimens collected
1.	*Rattus rattus rufescens* (Gray)	Pune	5
2.	*Rattus rattus rufescens* (Gray)	Bombay	13*
3.	*Rattus rattus wroughtoni* (Hinton)	Bombay	1
4.	*Rattus norvegicus* (Berkenhout)	Bombay	5
5.	*Bandicota bengalensis kok* (*lordi*) (Gray)	Bombay	17
6.	—do—	Pune	2
7.	*Bandicota indica indica* (*malabarica*) (Bechstein)	Bombay	6**
8.	*Mus* species.	Bombay	1
	Total :		50

* including two specimens with white patch on the thorasic region.

**including two with white tail tip.

Pune for the present studies. The details are given separately. The taxonomic identification was carried out with the help of Ellerman's (1960) key by one of the authors (Pradhan) at the Zoological Survey of India, Western Regional Station's Laboratory, Pune. Blood was collected in a heparinised tube directly from the heart, with a syringe. Haemoglobin was separated from the R. B. C. by the method of Wright (1974). The haemoglobin samples were run on vertical as well as horizontal paper electrophoresis, with Barbitone buffer (Make : Centron, Bombay), at pH 8.6 and molarity 0.05 μ. 5 mA current per strip was passed for nine hours. The strips were then dried in the oven and RF values for each sample were calculated immediately by the following formula :

$$RF = \frac{\text{Distance travelled by Haemoglobin}}{\text{Distance travelled by Marker (Bromophenol Blue)}}$$

Mean RF values and the S. D. of the mean for each species were calculated separately. The values were plotted on the graph and compared.

Observations and Discussions

Fig. 1 is a diagramatic representation of RF values of rodent haemoglobin samples. There are differences in the mobility of haemoglobin in almost all samples. In some cases (e. g., *R. norvegicus* from Bombay and *R. rufescens* from Pune) there was no variation. However, there are number of haemoglobin variants in *Rattus r. rufescens* and *Bandicota bengalensis*. Though Hb variants have already been reported earlier (Pradhan, 1982) in the case of *B. bengalensis* populations, this is the first time to locate Hb variants in *Rattus r. rufescens*. There is a distinct zone of separation between the two groups of variants of *R. r. rufescens*. When the average RF values alongwith S. D. are compared (Fig. 2), the differences become more clear. *R. r. rufescens* and *B. b. kok (lordi)* definitely show the occurrence of intra-sub-specific polymorphism in the haemoglobin

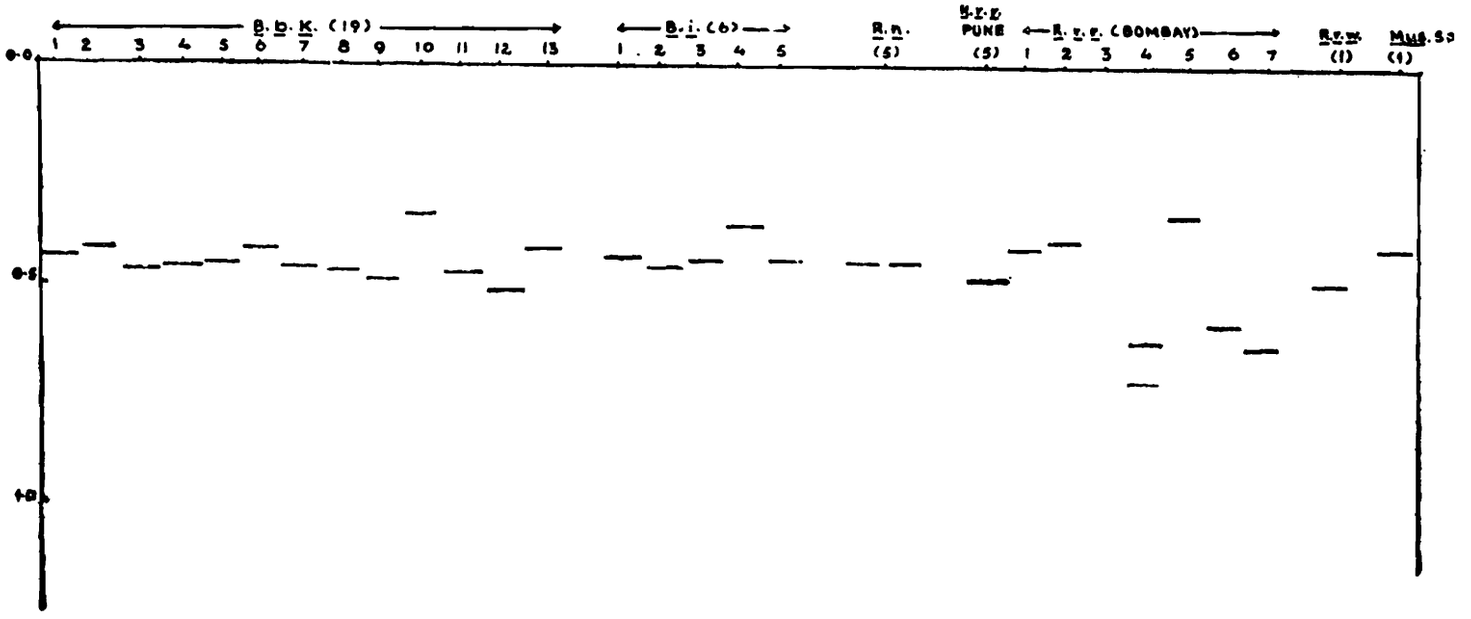

Fig. 1. Different haemoglobin patterns expressed in the terms of RF values for different species. Figures in paranthesis show the sample size.

proteins, while all the other species show one band pattern with differential mobilities. One band pattern in some of these species has already been reported earlier (Pradhan, 1982). When a composite picture for all the six species of the subfamily, Murinae, is carefully studied, it will be seen that all bands have been represented. Present observations on paper electrophoresis show that there are in all four major Hb variants in the natural populations of the six commensal rodent species belonging to the subfamily, Murinae. *Bandicota bengalensis* is the only species which represents all the three slow migrating bands. The fastest migrating band seems to be rare and is represented, at present, only in *Rattus rattus* subspecies.

The haemoglobin pattern does not seem to have any significant correlation with the colour phases seen in some of these species (*R. rattus rufescens* and *B. indica*). The Hb patterns of *R. rattus rufescens* with diamond shaped white patch on the thorasic region and *B. indica* with white tail tip seem to be similar when they are compared with those of their normal counterparts. Pradhan and Mithel (1981) have reported variation in the karyomorphology of *R. r. rufescens* with diamond shaped white patch on the thorasic region. However, it is apparently seen here that the Hb protein pattern of these peculiar specimens do not show variation in their mobilities from those of normal specimens. Like De Smet (1978) we believe that the existence of intra-subspecific haemoglobin polymorphism is a common phenomenon in the subfamily Murinae. It is quite possible that if attempts are made in future to study

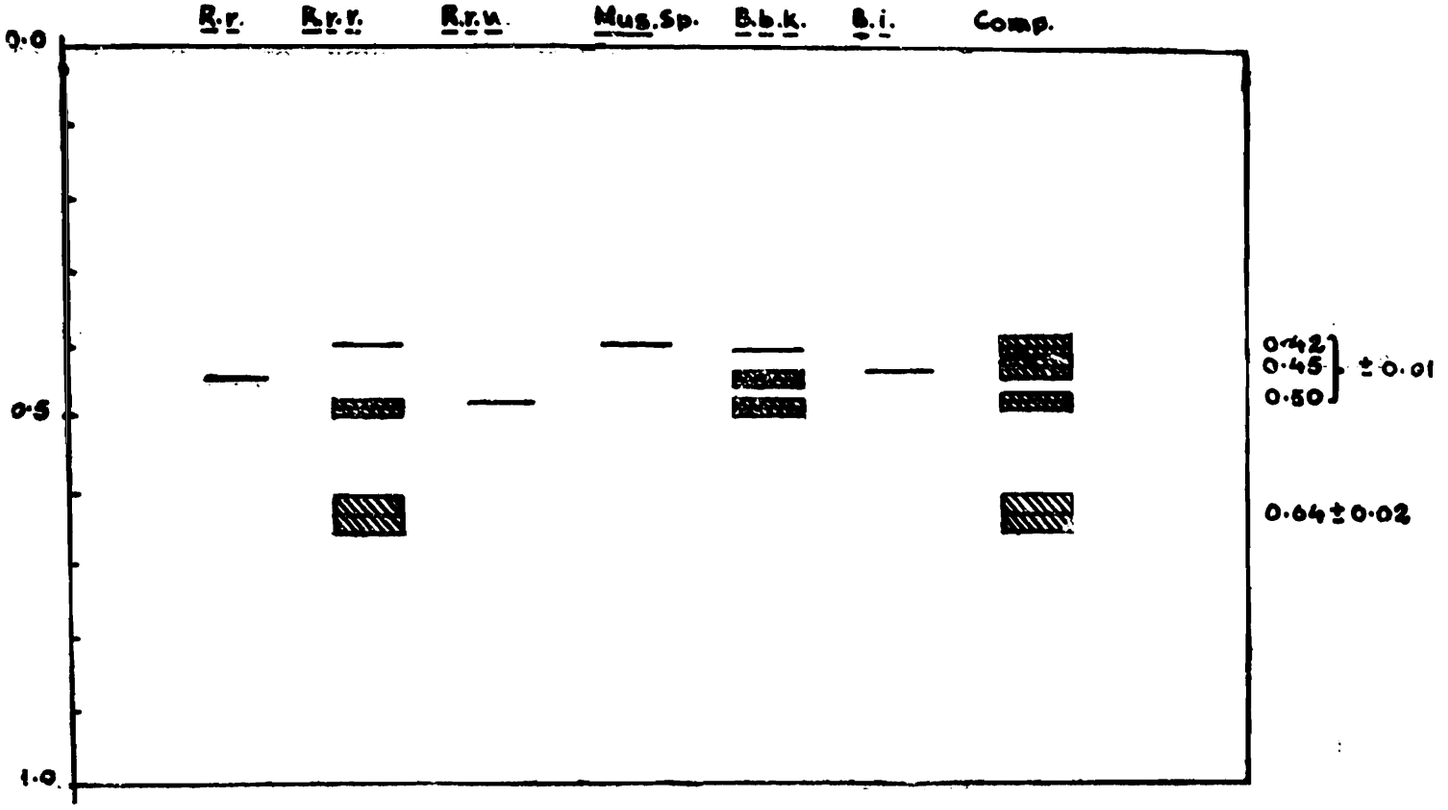

Fig. 2. Commonly occuring haemoglobin bands expressed in the terms of mean RF values with standard deviations (shaded in lines) in each of the six species. It also shows composite haemoglobin pattern for all the six commensal rodent species.

the haemoglobin patterns alone in all the Indian rodent species, the number of Hb variants moving freely in the natural populations will also increase. But, in that case, it will become easier to draw a definite line of phylogeny at a protein level. At present, attempts are already in progress to study the variations occuring even in the minor fractions of Hb patterns in these species.

ACKNOWLEDGEMENTS

The authors acknowledge their sincere gratitude to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta, for granting permission to publish this article. They are thankful to Dr. S. M. Karmarkar, Vice-Principal, R. J. College, Ghatkopar, Bombay, for providing laboratory facilities and valuable guidance and also to Dr. T. N. Ananthakrishnan, Director, Entomological Research Institute and Dr. R. K. Selander, Professor, Dept. of Biology, University of Rochester, New York for going through the manuscript critically. Thanks are also due to the authorities of Bombay and Pune Muncipal Corporations for their help in rodent collection.

REFERENCES

DEORAS, P. J. AND PRADHAN, M. S. 1976. Comparative evaluation of measurements, karyotype and protein studies ; *Pesticides* vol. X, No. 11. 36-41.

DE, SMET AND WILLEM, H. C. 1978. A comparison of the electrophoretic haemoglobin pattern of the vertebrates ; *Acta Zool. & Pathol. Antverp.* **70**. 119-131.

ELLERMAN, J. R. 1960. *Fauna of India, Mammalia* vol. *III* Part 2 Publ. Zool. Sur. of India, Calcutta: pp 884+1ii+map.

JOHNSON, M. L. 1974. Mammals. In : Biochemical and Immunological taxonomy of animals (ed.) C.A. Wright (London : Academic Press) pp 1-87.

PRADHAN, M. S. AND MITHEL, M. 1981. White patch and its ganetic control in some of the Indian rodent species. *J. Bombay nat. Hist. Soc.* **78** No 1 164-165.

PRADHAN, M. S. 1982. A comparison of the electrophoretic haemoglobin pattern of the commensal rodent species *Proc. Indian Acad. Sci. (Anim. Sci.)* **91** (2) : 159-163.

SELANDER, R.K., GRAINGER, H.W. AND SUH Y YANG 1969. Protein polymorphism and genetic heterozygosity in two European subspecies of the house mouse ; *Evolution* **23** : 379-390.

WRIGHT, C. A. 1974. Biochemical and immunological taxonomy of animals ; 1st Edition (London : Academic Press) pp. 490+xii.

YOSIDA, T. H., HATAO, K., KIMIYUKI, T. AND KAZUO, M. 1971. Karyotypes and serum transferrin patterns of hybrids between Asian and Oceanian black rats, *Rattus rattus*, *Chromosoma* **34** (1) : 40-50.

ABBREVIATIONS

R. r. r.	:	*Rattus rattus rufescens.*
R. r. w.	:	*Rattus rattus wroughtoni.*
R. n.	:	*Rattus norvegicus.*
Mus. sp.	:	*Mus* species
B. b. k.	:	*Bandicota bengalensis kok.*
B. i.	:	*Bandicota indica.*
Comp.	:	Composite haemoglobin pattern.

Bull. zool. Surv. India, 7 (1) : 107-111, 1985

CONTRIBUTIONS TO THE STUDY OF BAGRID FISHES. 18 REDESCRIPTION OF MYSTUS PELUSIUS SOLANDER, THE TYPE SPECIES OF THE GENUS MYSTUS SCOPOLI

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INTRODUCTION

Bagrid fishes of the genus *Mystus* Scopoli were previously known under the name *Macrones* Dumèril (1856) for a very long time. Since Dumeril's name was preoccupied in Insecta (Coleoptera), several other names as *Aoria* Jordan (1919), *Sperata* Holly (1939), *Aorichthys* Wu (1939) and *Macronoichthys* White and Moy Thomas (1940) were proposed. Unfortunately none of these names are available for some reason or other and hence *Mystus* Scopoli 1777, the earliest valid name was adopted. Jayaram (1962) discussed this problem in detail. Jayaram and Anuradha have discussed elsewhere (1984), the different usages of the name *Mystus*.

It may be mentioned here that though the generic name *Mystus* Scopoli (1777) was adopted, the determination of the type species of the genus was beset with many nomenclatural and zoological problems. Scopoli (1777) did not designate any particular species by name as the type. Jordan and Evermann (1917) selected *Bagrus halepensis* Valenciennes (*Mystus cirris octo capito longioribus* Gronow, No. 388) as the type species of *Mystus* Scopoli. Valenciennes (1839) gave this name *Bagrus halepensis* for the fish included by Russell (1756) in his Natural History of Aleppo. Solander (1794) gave binomial names to fishes cited by Russell in his aforesaid work and *Bagrus halepensis*

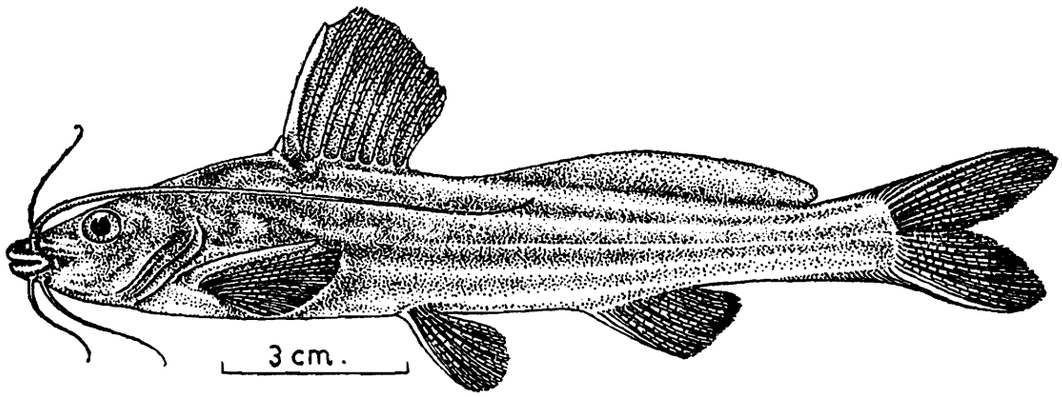

Fig. 1. Lateral view of *Mystus pelusius pelusius* Solander.

*Junior Research Fellow.

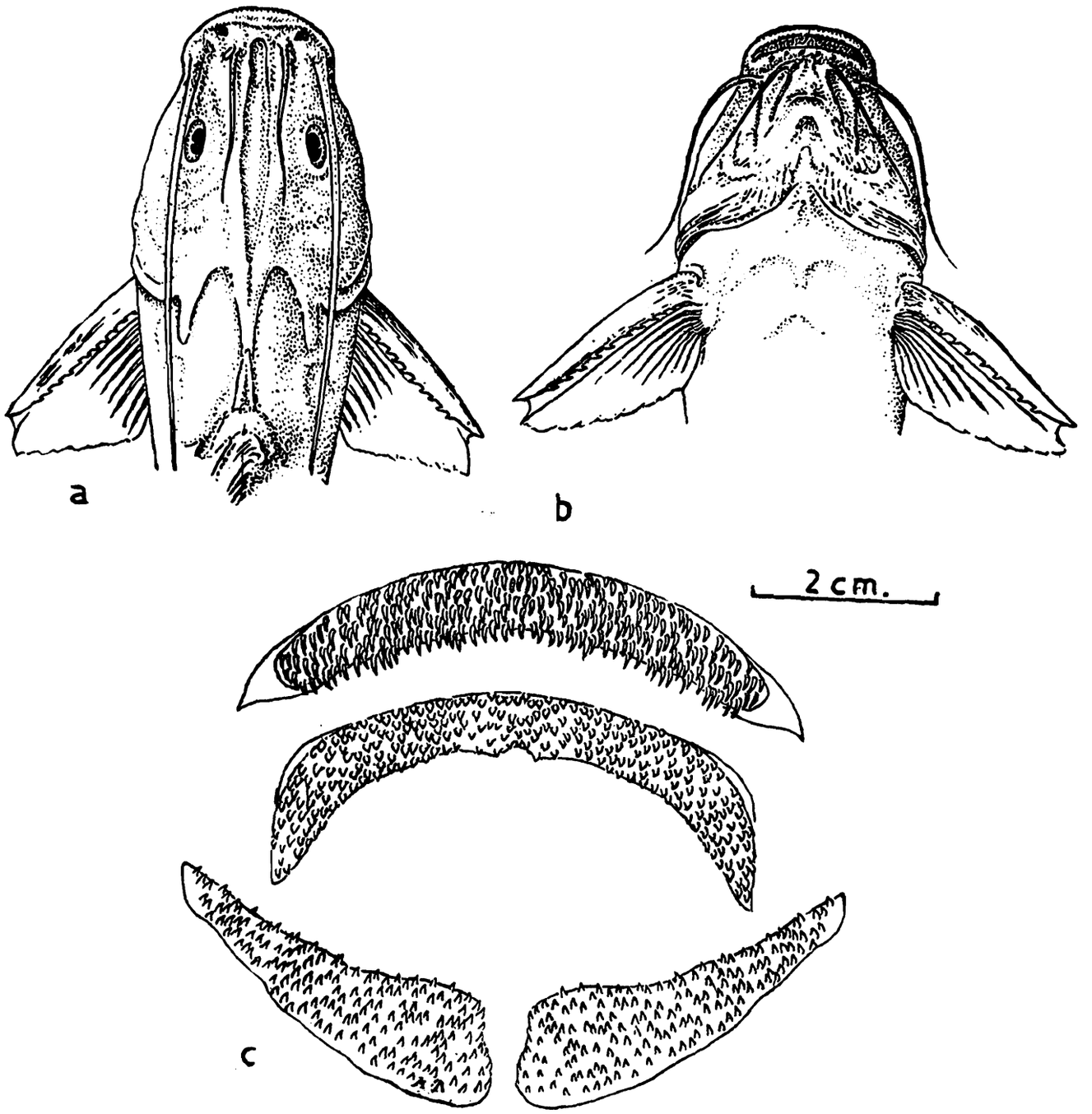

Fig. 2. (a) Dorsal view of head,
(b) Ventral view of head,
(c) Dentition.

Valenciennes was named *Silurus pelusius*. Since Solander's name and work has precedence over that of Valenciennes (1839), *Silurus pelusius*=*Mystus pelusius* becomes the type species of the genus *Mystus*.

Solander's description of *Mystus pelusius* in Russell's work (1756) is very brief. Günther (1864) described a specimen from Russell's collection present in the British Museum (Natural History) London. This

description is also poor in details and is only of a preserved, bleached 6" long specimen.

It is seen that *Mystus pelusius* which happens to be the type species of the genus *Mystus* and which appears to be common in its range of distribution (Syria, Iraq) is not very well known in literature, nor many examples have been recorded. On the other hand the genus is wide spread in India and adjacent countries and as many as 42 species are known from its entire range.

Through the kind courtsey of Dr. Munir K. Bunni, Director, Baghdad Natural History Research Centre, Baghdad, one of us (K. C. J) was able to obtain as exchange, three specimens of *Mystus pelusius* ranging from 142.8 mm to 171.2 mm in S. L. This material has been placed at our disposal as already mentioned. Since this species has not been described well, a full redescription with illustrations is presented in this paper.

DESCRIPTION

Specimens studied : Three examples from Baghdad Natural History Research centre :

One example 142.8 mm. SL, Euphrates-Faluga ; 16.4.1973.

One example 171.2 mm SL, (lean specimen), Euphrates-Faluga ; 16.4.1973.

One example 164.3 mm SL, (Albino) Tigris-Baghdad ; 6.11.1965.

Description : Body depth 19.26 (17.93-20.68) ; head length 21.46 (21.38-21.50) ; head width 16.16 (15.76-16.49) ; head depth 15.13 (14.64-15.48) ; predorsal length 35.16 (33.40-36.34) ; post dorsal length 69.93 (68.84-71.44); all as percentage of standard length. Eye 20.61 (18.85-21.81) ; interorbital space width 29.08 (28.14-29.64) ; snout length 44.18 (42.67-45.33) ; dorsal spine 90.54 (82.04-97.78) ; pectoral spine 86.82 (79.80-94.33) all as percentage of head length. Adipose dorsal fin base 34.31 (31.77-38.01) in anal fin base. Least depth of caudal peduncle 32.32 (29.46-34.0) in its length. Dorsal fin 1.7 : pectoral fin I, 8 ; pelvic fin i, 5 ; anal fin ii, 8-9 ; Caudal fin 7+8=15.

Dorsal profile gently rising to the base of rayed dorsal fin. Snout obtusely rounded. Lips thin ; lower lip studded with 4-6 sensory pores on either side of lower jaw. Mouth subterminal, gape of mouth not extending to orbit. Upper jaw slightly longer, jaws and palate with villiform teeth. Teeth on palate in a semilunar uninterrupted band. Teeth on lower jaw in a moderately curved or angular band, mesially interrupted ; band on upper jaw in a slightly curved continuous band ; teeth uniformly villiform. Barbels four pairs ; maxillary barbells reaching not beyond the pelvic fin ; nasal pair slightly beyond posterior margin of eye ; mandibular pair inserted almost at the same level ; outer mandibular barbels extending upto half of pectoral fin, inner mandibular barbels extending to opercle. In some specimens the origin and extension of the mandibular barbels are visible beneath the skin on the ventral surface. Eyes of moderate size situated at the centre of the head with a free orbital margin, not visible from below. Median longitudinal groove on head as a long single fontannel nearly reaching the base of the supraoccipital process. Occipital process reaching basal bone of dorsal fin and 4.5 times as long as broad. Cleithral process exposed and rugose, half as long as pectoral spine.

Rayed dorsal fin inserted in anterior half of head, above tip of pectoral spine. Dorsal spine smooth on the outer edge and rough

TABLE 1

	Body porportions					
	As percentage			As ratio		
	Range	Mean	n	Range	Mean	n
TL/Body depth	15.60-16.75	16.18	2	5.97-6.41	6.19	2
TL/Head length	17.32-17.48	17.4	2	5.72-5.77	5.75	2
SL/LH	21.38-21.50	21.46	3	4.65-4.68	4.66	3
SL/Body depth	17.93-20.68	19.26	3	4.84-5.57	5.21	3
SL/Width of head	15.76-16.49	16.16	3	6.06-6.35	6.19	3
SL/Head depth	14.64-15.48	15.13	3	6.46-6.83	6.61	3
SL/Predorsal length	33.40-36.34	35.16	3	2.75-3.0	2.35	3
SL/Post dorsal length	68.84-71.44	69.93	3	1.40-1.45	1.43	3
SL/Length of dorsal spine	17.65-21.97	19.75	3	4.55-5.67	5.11	3
SL/Length of Anal fin base	12.36-14.22	13.24	3	7.03-8.09	7.58	3
Snout/IOW	63.19-69.47	65.89	3	1.44-1.58	1.52	3
Adipose fin base/Anal fin base	31.77-38.01	34.31	3	2.63-3.15	2.93	3
LCPD/HCPD	29.46-34.0	32.32	3	2.94-3.39	3.11	3
LH/Eye	18.85-21.81	20.61	3	4.58-5.30	4.87	3
LH/IOW	28.14-29.64	29.08	3	3.37-3.55	3.44	3
LH/Dorsal spine	82.04-97.78	90.54	3	0.98-1.22	1.10	3
LH/Pectoral spine	79.80 94.33	86.82	3	1.06-1.25	1.16	3
LH/Length of snout	42.67-45.33	44.18	3	2.21-2.34	2.27	3
LH/Width of gape of mouth	50.81-55.74	53.84	3	1.79-1.97	1.86	3
LH/Length of max. barbel	40,34-48.93	44.96	3	0.40-0.49	0.45	3
LH/Length of nasal barbel	53.09-65.03	57.50	3	1.54-1.88	1.75	3
LH/Length of inn. mand. barbel	66.12-70.25	68.59	3	1.42-1.51	1.46	3
LH/Length of out. mand. barbel	72.62-96.88	85.50	3	0.73-1.15	0.97	3
LH/Length of dorsal fin base	56.94-68.73	62.66	3	1.45-1.76	1.61	3
LH/Length of anal fin	57.51-66.12	61.70	3	1.51-1.74	1.63	3
LH/Length of caudal peduncle	78.71-87.71	84.24	3	0.79-0.88	0.84	3
LH/Least depth of caudal peduncle	37.43-38.81	38.33	3	2.58-2.67	2.61	3

TABLE 2 Meristic counts of fin rays

	D			P			V			A			C		
SL	142.8	164.3	171.2	142.8	164.3	171.2	142.8	164.3	171.2	142.8	164.3	171.2	142.8	164.3	171.2
	I,7	I,7	I,7	I,8	I,8	I,8	i,5	i,5	i,5	ii,8	ii,8	ii,9	7	7	7
													8	8	8

on the inner edge. Adipose dorsal fin commencing immediately after rayed dorsal fin with a short interspace, smooth, high in posterior part, ending much above anal fin but not reaching caudal fin. Pectoral spine stronger than dorsal spine and serrated along inner margin with 14-18 antrose teeth. Pectoral fin not reaching pelvic fin and pelvic fin not reaching anal fin. Anal fin short, not reaching caudal fin. Caudal fin deeply forked with equal lobes. Lateral line reaching base of caudal fin.

Colour : Pale brown over body, fins and ventral surface lighter in colour. Occipital crest, head shield and cleithral process slightly rugose. 1 ex., 164.3 mm SL from Baghdad Museum is pale white with the head slightly brownish in colour. A black spot at the base of the dorsal spine is also seen in this specimen. In all the three specimens, a dark shoulder spot is visible. Other body proportions and meristic counts are presented in Tables-I & II.

Distribution : Rivers Euphrates, Tigris in Syria Iran and Iraq.

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We are thankful to Dr. B. K. Tikader, Director, Zoological Survey of India for the facilities. Dr. Gordon Howes, Fish Section, British Museum (Natural History), was kind enough to arrange sending a xerox copy of Russell's work for which we are thankful. Sri Parimal Biswas, Sr. Artist, Z. S. I. executed the drawings under our supervision and we are thankful to him for this.

REFERENCES

DUMÈRIL, A. M. C. 1856. Ichthyologie generales sur les classifications on histoire naturelle et expess commeure due plan de 1' ichthyologie analytique a la de tableuax synoptiques. *Mem. Acad. Sci. Paris*, **28** : 1-511.

GÜNTHER, A. 1864. *Catalogue of the Fishes in the British Museum*, London, **5**, xxii+455 pp.

HOLLY, M. 1939. Zur nomenklatur der Siluriden Gattung *Macrones* C. Dumeril. *Zool. Anz.*, **125** : 143.

JAYARAM, K. C. 1962. The nomenclatural status of *Mystus*, *Macrones*, *Aoria* and other names for a genus of asiatic siluroid fishes. *Proc. First All India Congr. Zool.*, (2) : 632-635.

JAYARAM, K. C. 1974. Contributions to the study of Bagrid fishes. 11. Designation of a Lectotype for *Macrones argentivittatus* Regan with notes on some bagrid species in the collections of the Natural History Museum, Genève. *Revue suisse Zool.*, **81** (4) : 785-790.

JAYARAM, K. C. & ANURADHA, C. 1984. Contributions to the study of Bagrid fishes. 17. The History and usage of the name "Mystus" *Bull. Zool. Surv. India* **6** (1-3) : 289-293.

JORDAN, D. A. AND EVERMANN, B. W. 1917. Genera of fishes from 1758-1920. Stanford University Press, Stanford. California, 576 pp.

JORDAN, D. S. 1919. New genera of fishes. *Proc. Acad. nat. Sci. Philad.*, **70** : 341-344.

RUSSELL, A. 1756. The natural history of Aleppo and parts adjacent, London, viii+266 pp. 16 pls.

SCOPOLI, J. A. 1777. Introductio ad historiam naturalem sistens genera lapidium plantarum et animalium hactenus detecta, caracteribus essentiablibus donata intribus divisa, subinde adleges naturae. Pragae, x+506 pp.

*SOLANDER, D. C. 1794. **IN** : Russell's The Natural History of Aleppo, **2**

VALENCIENNES, M. A. 1839. *Histoire naturelle des Poissons*, Paris, **14**, xxii+464 pp.

WHITE, E. I. AND MOY THOMAS, J. A. 1940. Notes on the nomenclature of fossil in fishes. Part I. Homonyms A-C. *Ann. Mag. nat. Hist.*, (ii) **5** : 502-507.

WU, H. W. 1939. On the fishes of Li-Kiang. *Sinensia*, **10** : 92-142.

*Not seen in original

Bull. zool. Surv. India, 7 (1): 113-116, 1985

OBSERVATIONS ON THE ROOSTING AND FEEDING HABITS OF PIPISTRELLE BATS AROUND CALCUTTA AIRPORT

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ABSTRACT

Some interesting observations on the roosting and feeding habits of *Pipistrellus coromandra* and *Pipistrellus mimus* have been discussed. It was observed that *P. mimus* emerges from the roost for feeding slightly earlier than *P. coromandra* and there is a definite co-relation between the time of emergence of these bats and the sunset time.

Very little is known on the different habits of the Indian Pipistrelle, *Pipistrellus coromandra* (Gray) and the Indian Pygmy Pipistrelle, *Pipistrellus mimus* Wroughton, except for some stray informations on the subject by Phillips (1922), Brosset (1962), Khajuria (1980), etc. The author, however, had the opportunity of making some interesting observations on the roosting and feeding habits of these two bats at the Calcutta Airport, during 1977-1980, which are recorded here.

The study on the roosting and feeding habits of the two species was conducted on 25 roosting sites of which 15 were of *P. coromandra* and 10 were of *P. mimus*. In addition, a common roost for both the species, with a single entrance, was also recorded, where they were found to live in separate groups in different areas. During this study, in each of the 15 roosting sites, *P. coromandra* was found to congregate in selected areas between the wall and the upper corrugated tin shed, above a false ceiling made of masonite board. *Pipistrellus mimus*, on the contrary, preferred the space between the wall and the different sign boards fixed over it. The common roosting site of the mixed colony, however, was observed to be in the same area as inhabited by *P. coromandra*. The height of the roosts above the ground varied from 6 to 9 m in the case of *P coromandra* and from 3 to 6 m for *P mimus*. The diameter of the entrance hole in the roost of *P. coromandra* varied from 4 to 6 cm as against 3 to 5 cm in that of *P mimus*. The number of individuals inhabiting a roost varied from eight to 25 (mean 18) for *P. coromandra* and six to 20 (mean 15) for *P mimus*.

Observations were made on the daily activity pattern of these bats. In the roosts, the bats were found to be inactive during the diurnal hours, but their entire colonies showed signs of activity about 20 minutes before their emergence at dusk. While emerging, the muzzle of the bat is first seen through the entrance/exit hole. It pauses in this position probably for sensing the outside environment through their smell or echolocation or both. If everything is found satisfactory, one of the bats (the 'pilot bat') comes out of the hole head first. Its wrists are then seen alongside the head. Finally it heaves its body through the narrow hole by extending its elbow joint, an instant

later it is in flight. After one or two rounds of flight the 'pilot bat' comes back to the roost again. Then the entire colony come out of the roost one after another at an interval of a minute or so. Depending on the size of the colony it takes 20 to 30 minutes for all the bats to come out of their roost for feeding. Before entering the roost it makes more than one approach, each time just touching the hole and again flying back. Finally, it inserts its head through the hole by closing the wings and then quickly crawls in. The entire process of emergence and entrance are, however, extremely rapid.

The time of emergence of these two species of bats varied according to the season. The time of sunset and sunrise have also been observed to have some relation on the times of their emergence and return to roost. It is observed that the emergence time in *P. mimus* is slightly earlier than *P. coromandra* (Table 1 and Fig. 1).

On several occasions it was observed that with the landing and take-off sounds of the heavy aircraft, these bats get disturbed in their roost and start climbing upward and sideward while the similar sounds of the small aircraft showed no effect at all. They

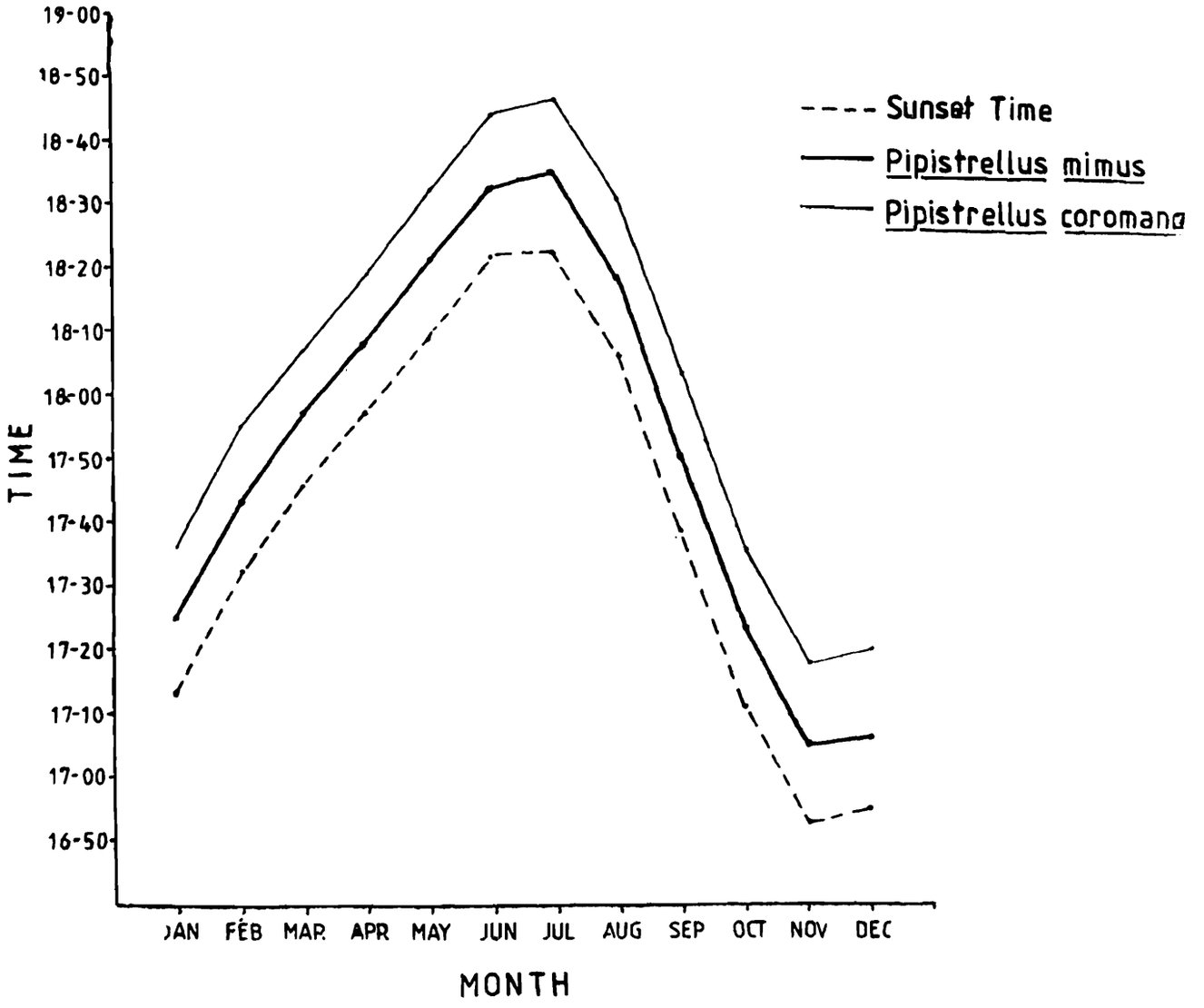

Fig. 1. Time of emergence of *Pipistrellus mimus* and *Pipistrellus coromandra* in relation to sunset time.

TABLE 1. Time of emergence of *Pipistrellus mimus* and *Pipistrellus coromandra* and the sunset-time (mean in parenthesis) around Calcutta Airport during the year 1978.

Month	Sunset Time	*Pipistrellus mimus*	*Pipistrellus coromandra*
January	17-03 to 17-24 (17-13)	17-15 to 17-35 (17-25)	17-25 to 17-47 (17-36)
February	17-24 to 17-39 (17-32)	17-35 to 17-50 (17-43)	17-47 to 18-00 (17-55)
March	17-40 to 17-51 (17-46)	17-52 to 18-02 (17-57)	18-02 to 18-12 (18-07)
April	17-51 to 18-02 (17-57)	18-03 to 18-14 (18-08)	18-13 to 18-25 (18-19)
May	18-03 to 18-16 (18-09)	18-15 to 18-28 (18-21)	18-26 to 18-38 (18-32)
June	18-17 to 18-25 (18-22)	18-29 to 18-38 (18-33)	18-39 to 18-50 (18-45)
July	18-18 to 18-25 (18-23)	18-30 to 18-38 (18-35)	18-43 to 18-50 (18-47)
August	17-55 to 18-18 (18-07)	18-07 to 18-29 (18-19)	18-20 to 18-43 (18-32)
September	17-25 to 17-54 (17-39)	17-37 to 18-06 (17-51)	17-50 to 18-19 (18-04)
October	17-00 to 17-24 (17-11)	17-12 to 17-35 (17-23)	17-25 to 17-49 (17-36)
November	16-51 to 16-59 (16-53)	17-03 to 17-11 (17-05)	17-16 to 17-25 (17-18)
December	16-51 to 17-02 (16-55)	17-02 to 17-14 (17-06)	17-16 to 17-27 (17-20)

again come to rest after a few minutes. The sound of heavy aircraft also cause disturbance in their emergence and entrance causing delay in the process by about 10 to 15 minutes. During the period of the observation, however, it was observed twice that a few bats came out of their roost during the day time for a short time, being disturbed by the sound of said aircraft.

In the study area both the species of bats were found together to feed on insects in front of the high power spotlight in front of hangers. It was observed that *P. coromandra* preferred a higher elevation for their feeding than that of *P. mimus* which even came down gliding to about one metre above the ground. Bats of both the species feeding near the runway were found to leave the area when disturbed by the sound of the heavy aircraft during take-off and landing. These bats were found in their feeding flights for about ninety minutes or so. Then they went back to their roost. After some rest of about 20 to 30 minutes they again came out for feeding. This process continued throughout the night and they finally returned to their roost roughly an hour before dawn. During winter season they did not feed throughout the night. They were found to return to their roost before midnight, probably due to the numbing effect of the low outside temperature. On some nights when the atmosphere was more chilly, these bats did not come out of their roost at all for feeding. It was also observed that different populations of these bats had their own feeding territory and found chasing out any intruder of other population.

Inside the roost both the species were found not to hang with their head downwards as in other bats, but attach themselves on the hard surface on all fours, with their head upward. In winter it was found that they roost very close to each other and sometimes one above the other. When disturbed they were found to be good runners and ran on all fours in all directions, *viz.*, backwards, sidewards and downwards.

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REFERENCES

BROSSET, A. 1962. The bats of central and western India. Part III. *J. Bombay nat. Hist. Soc.*, **59** : 707-746.

KHAJURIA, H. 1980. Taxonomical and ecological studies on the bats of Jabalpur dist., Madhya Pradesh, India. Part II. *Rec. zool. Surv. India*, Occ. paper No. 19, 69 pp.

PHILLIPS, W. W. A. 1922. Notes on the habits of some Ceylon bats. *J. Bombay nat. Hist. Soc.*, **28** : 448-452.

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A NEW SPECIES OF SPIDER OF THE GENUS *POECILOCHROA* WESTRING (FAMILY : GNAPHOSIDAE) FROM INDIA

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ABSTRACT

A new species of the genus *Poecilochroa* Westring belonging to the family Gnaphosidae, is described.

The genus *Poecilochroa* was established by Westring (1874) with *P. variana* (Koch. C. L., 1839) as a type. Since then only thirty six species have been reported from various parts of the world. Tikader (1982) in his fauna of India Vol. II reported this genus for the first time from India and described one species.

While studying the spiders of the family Gnaphosidae the authors encountered a new species of *Poecilochroa*.

The type specimen will in due course be deposited in the National Zoological Collection, Zoological Survey of India, Calcutta.

Poecilochroa devendrai sp. nov.

(Figs. 1-5.)

General : Cephalothorax and legs reddish-brown, abdomen light brownish-green. Total length 6.00 mm. Carapace 2.50 mm. long, 1.60 mm. wide ; abdomen 3.30 mm. long, 1.90 mm. wide.

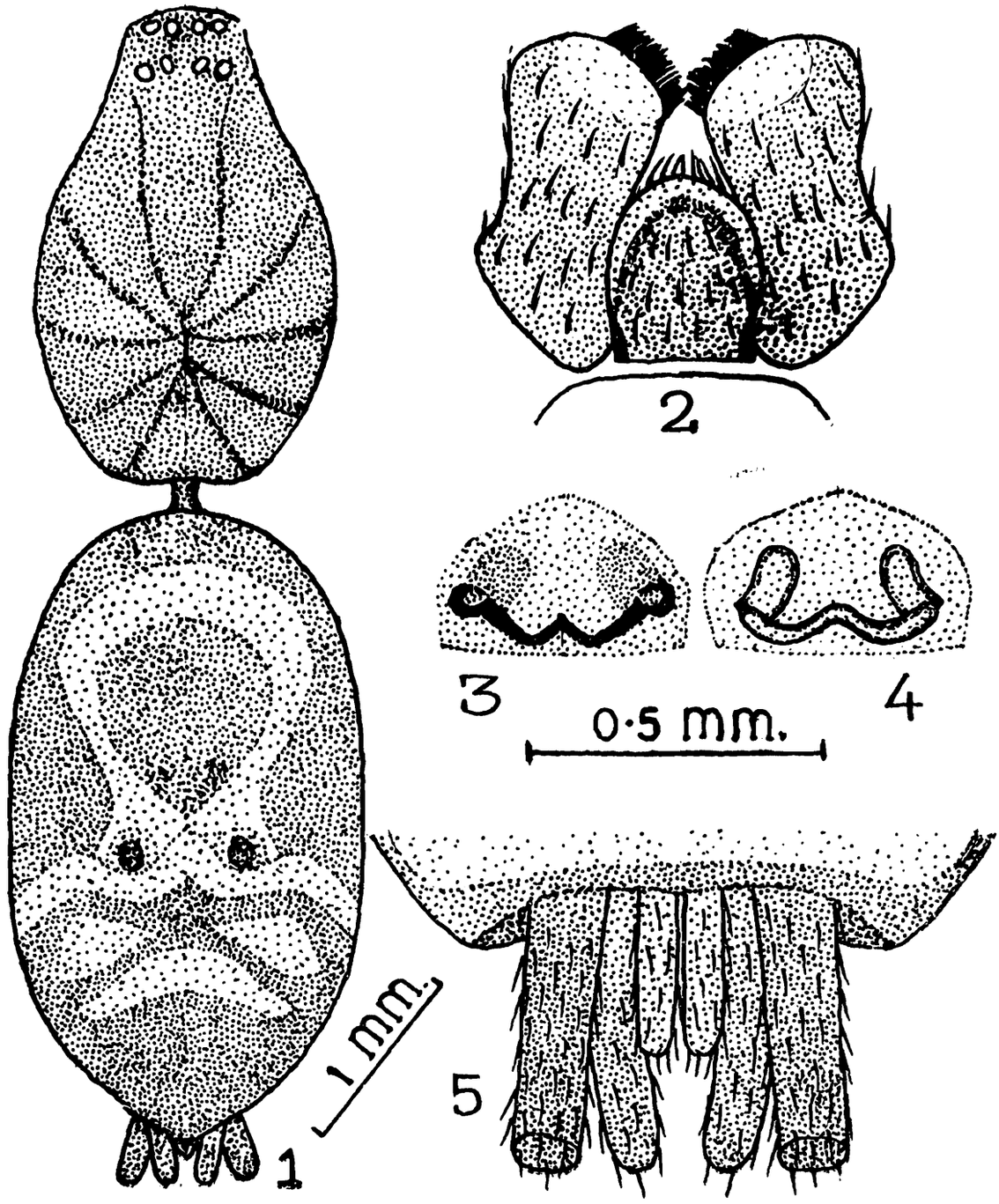
Cephalothorax : Longer than wide, narrow in front, slightly convex, posterior middle of cephalothorax provided with an conspicuous short fovea, clothed with pubescence. Radiating streaks diverge from fovea to lateral sides. Eyes pearly white except anterior medians, posterior row of eyes longer than the anterior row. Anterior row of eyes are closer together in a straight line (as seen from in front), medians slightly smaller than the laterals and closer to adjacent laterals than to each other. Posterior row of eyes slightly recurved, medians oval and slightly closer to adjacent laterals than to each other. Ocular area longer than wide and wider behind than in-front. Sternum brown, oval, pointed behind and clothed with hairs. Maxillae and labium as in Fig. 2. Chelicerae moderately strong, margins of the furrow without tooth. Legs relatively long, clothed with hairs and spines. Leg formula 4123.

Abdomen : Longer than wide, nearly elliptical, clothed with pubescence and provided with one pair of sagilla on the dorsum and with light-green patches as in Fig. 1. Ventral side same in colour as dorsal. Epigyne as in Fig. 3. Internal genitalia as in Fig. 4. Spinnerets prominent, anterior and posterior spinnerets same in length as in Fig. 5.

Holotype : Female in spirit.

Type-locality : INDIA : West Bengal ; Serampore Dist. Howrah, date 15. VII. 1919 Coll *A. Drake*.

This species resembles *Poecilochroa montana*



Figs. 1-5. *Poecilochroa devendrai* sp. nov.

1. Dorsal view of female, legs omitted. 2. Labium and maxillae.
3. Epigyne. 4. Internal genitalia. 5. Spinnerets.

Emerton but differs from it as follows : (i) Cephalothorax reddish-brown but in *P. montana* Cephalothorax brown with smoky markings and sparse white pubescence. (ii) Abdomen provided with light green patches but in *P. montana* abdomen provided with a pair of white spots near the middle of its length. (iii) Epigyne also structurally different.

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REFERENCES

BONNET, P. 1958. *Bibliographia araneorum* Toulouse, **2** (4) : 3027-4230.

CHAMBERLIN, R. V. 1922. The North American Spiders of the family Gnaphosidae *Proc. biol. Soc. Wash.*, **35** : 145-172.

COMSTOCK, J. H. 1940. *The spider Book*, New York, 329-330.

POCOCK, R. I. 1900. *Fauna of British India, Arachnida*, London.

SIMON, E. 1893. *Hist. Nat. Araig.* **1** : 317-372.

TIKADER, B. K. 1982. *Fauna of India*, Spiders : Araneae, Vol. II, Part 2, Family Gnaphosidae : 294-536.

UBICK, D. AND ROTH, V. D. 1973. Nearctic Gnaphosidae including species from adjacent Mexican states. *Amer. Arachnology*, **9** (2) : 1-12.

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AN INTERESTING OBSERVATION ON THE BEHAVIOUR OF CHAETOGNATHA IN THE COASTAL WATERS OF PURI, DURING THE TOTAL SOLAR ECLIPSE, 1980

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ABSTRACT

The effect of the total solar eclipse of 16 February, 1980, on Chaetognatha from the plankton in the coastal waters of Puri, Orissa State, was investigated and reported here, based on the zooplankton samples collected during the solar eclipse and other periods prior to and after the eclipse.

Introduction

Literature on the behaviour of zooplankton during the total solar eclipse is scanty and hence an attempt has been made to study this with special reference to Chaetognatha in the coastal waters of Puri, Orissa State on 16.2.1980. The investigation was carried out in the inshore waters of Pentakota, Puri, located on the approximate central line of the solar eclipse. At Puri, the eclipse began at 14.42 hrs and lasted till 17.00 hrs. The total eclipse was only for 137 seconds (between 15.54 and 15.56 hrs).

Material and Methods

The zooplankton samples for this study were collected in the Bay of Bengal of Puri coast by one of us (S. K.) with a Nansen standard plankton net of 50 cms diameter. The net was operated from a catamaran and towed for five minutes from a fixed station. On 15 February, 1980, the observations were initiated by collecting zooplankton and water samples, first at 18.15 hrs. The next three samples were collected on the day of the solar eclipse. First sample was collected at 0615 hrs (9 hrs and 30 minutes before the total solar eclipse), the second was collected at 15.50 hrs (during the total solar eclipse) and the third was collected at 1800 hrs (two hrs after the total eclipse). The last two samples were collected at 0630 and 1420 hrs on 17.2.1980.

The collected samples were preserved in 5% formalin and the total displacement volumes were determined following the techniques of Foxton (1957), Daniel and Premkumar (1965). The displacement volumes have been considered to be equivalent to the total biomass of the samples (Prasad, 1969). After the volume estimation, the Chaetognatha present in the samples were sorted out and identified.

Observations and Results

The volume of the plankton collected from this fixed station varied from 2.0 to 7.0 ml, and the number of specimens in the sample varied from 5 to 36 (Fig. 1). The maximum volume and the maximum number of specimens were obtained from the sample collected during the total solar eclipse (15.50 to 15.55 hrs). In the sample collected on 15.2.1980, the chaetognaths were 19 in number.

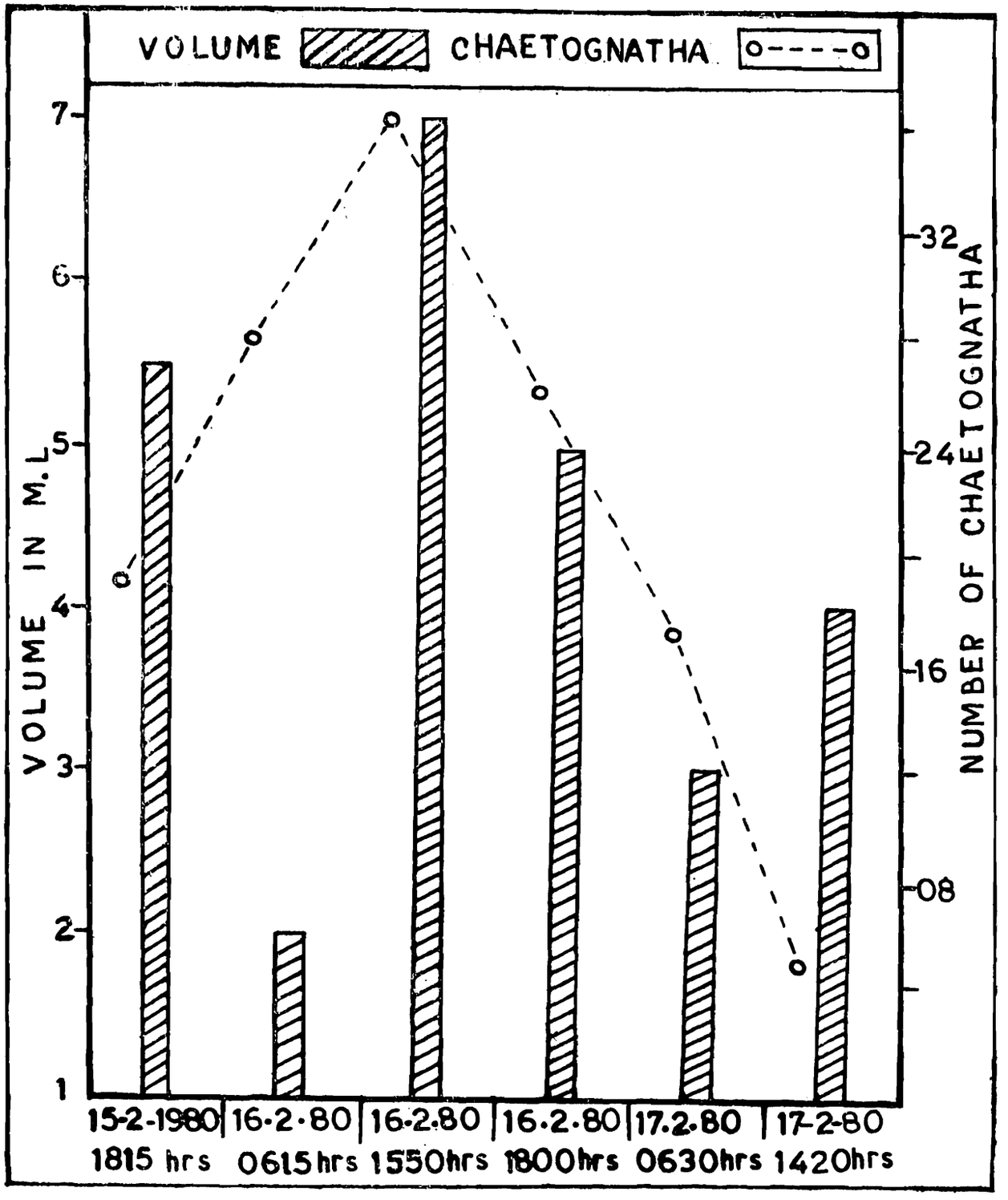

Fig. 1. Behaviour of chaetognatha and zooplankton in the coastal waters of Puri during the solar eclipse and other periods.

28 specimens were seen in the first sample collected on 16.2.1980 at 0615 hrs, 36 were in the second sample collected at 1550 hrs and 26 were in the sample collected at 1800 hrs. 17 specimens were found in the sample collected at 0630 hrs and 5 were in the sample collected on 17.2.1980 (Fig. 1).

In the samples collected, six species of

Chaetognatha, belonging to two genera, *Sagitta* Quoy and Gaimard, 1827 and *Krohnitta* Ritter-Zahony, 1910 were found. The species are *Sagitta neglecta* Aida, 1897 (57 specimens), *S. bedoti* Beraneck, 1895(32), *S. enflata* Grassi, 1881 (29), *S. pulchra* Doncaster, 1903 (8), *S. robusta*, Doncaster 1903 (4) and *K. pacifica* (Aida, 1897) (1). Among these six species, *S. neglecta* tops the list (57 specimens) in the order of abundance. *S. enflata* was found in five of the six samples collected, whereas *S. neglecta* was found in four samples, *S. bedoti* and *S. pulchra* in two samples and *S. robusta* and *K. pacifica* in only one sample.

As in the case of volume of the plankton, the number of specimens of Chaetognatha was also more (36) in the sample collected during the total eclipse and the species present in the sample were *S. enflata*, *S. neglecta*, *S. robusta* and *K. pacifica*. Total length of the specimens of *S. bedoti* varied from 5.9 to 7.9 mm. and include specimens belonging to maturity stages O, I, II, and III. Fully mature (stage IV) specimens were not found in the samples. In the case of *S. neglecta* which was more abundant than other species in the simples, the size ranged from 1.8 to 6.2 mm. Specimens of all the stages of maturity (stage O-IV) were found in the samples. Specimens of *S. enflata* measure from 2.7 to 11.0 mm. in total length and include all stages of maturity, other than fully mature forms (stage IV). Specimens of *S. pulchra* varied from 5.5 to 12.5 mm in total length and have specimens of the maturity stages O-II. Specimens of *S. robusta* measured between 3.5 and 12.6 mm in total length. All stages of maturity except stage IV (fully mature) were present. Only one specimen of *K. pacifica* was seen, measuring 3.8 mm in length belonging to maturity stage II.

Along with plankton samples, hydrographic features such as, temperature and dissolved oxygen were also recorded. The surface temperature, where the plankton samples were collected, varied from 27.0 to 28.5°C and the maximum temperature (28.5°C) was noted during the total eclipse period. The dissolved oxygen ranged between 4.3 and 5.3 Ml/L during the study and at the time of total eclipse, it was 5.0 Ml/L.

DISCUSSION

The results of this investigation show that the volume of the zooplankton and the number of specimens of Chaetognatha were at their peak in the sample collected during the total eclipse period (Fig. 1). Generally, the volume of the zooplankton samples collected during the day time will be less than the night samples. But here, the reverse has happened, despite the collection of samples was during the after-noon (1550 to 1555 hrs). As suggested by Petipa (1955), a sharp and unexpected dimming of light during a solar eclipse, perhaps activated the organisms for a rapid upward migration.

It has been a controversial issue, whether animals are guided by the directional proportions of light or by successive changes in irradiance perceived during the course of their random movement (Kinne, 1975). However, in stream insects, it has been observed that exogenous light conditions have actually been found to have a marked effect on the occurrence of nocturnal forms and it is considered that, if an endogenous rhythm exists then it is weak and influenced by environmental light conditions (Elliot, 1965 ; Holt and Walters, 1967 ; Chaston, 1968 ; Bishop, 1969 and Vinogradov, 1970). Michael (1911) has stated that each plankter tends to remain at the level of optimum light conditions ; as

the intensity of light diminishes towards the sun set, the animal follows the waning intensity towards the surface and with the onset of dawn, it descends, as the intessity of light increases with full daylight. He found that *Sagitta bipunctata* of the San Diego region exhibited a typical diurnal migration, appearing in maximum abundance at or near the surface between 6 and 8 P. M. and 4 and 6 A. M. and descending by noon to depths of 80 to 150 M.

Backus *et al.* (1965) have stated that the scattering layer and bioluminescent organisms of the ocean respond to the eclipsing sun much as they normally behave to the setting sun. Their behaviour from mid-eclipse to eclipse end resembled dawn behaviour. The response of these organisms to change from decreasing to increasing light, near mid-eclipse, was rapid. Thus, it appears, the exogenous factor of changing light largely controls the behaviour, overriding such endogenous rhythm as may exist.

In the present investigation the samples collected during the eclipse period were characterised by the dominance of chaetognaths. These are well known for diurnal migration, rising towards the surface at night and descending at dawn. This reaction is usually regarded as a reaction to light, although other factors also could be involved (Hyman, 1959). During eclipse light is reduced and that might have resulted in the upward movement of the organisms like chaetognaths. This is probably the reason for the abundance of these organisms in the sample collected during the total solar eclipse.

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REFERENCES

BACKUS, R. H., CLARKE, R. C. AND WING, A. S. 1965. Behaviour of certain marine organisms during the solar eclipse of July, 29, 1963. *Nature, Lond.*, **205** (4975) ; 989-991.

BISHOP, J. E. 1969. Light controls of aquatic insects activity and drift. *Ecology*, **50** : 371-380.

CHASTON, T. 1968. Endogenus activity as a factor in invertebrate drift. *Acta hydrobiol. Krokow*, **64** : 324-334.

DANIEL, A. AND PREMKUMAR, V. K. 1965. The distribution of the standing crop at zooplankton in the eastern sector of the Indian Ocean during July-September, 1962. *J. mar. biol. Ass. India*, **7** : 440-452.

ELLIOT, J. M. 1965. Daily fluctuations of drift invertebrates in a Dartmoor stream. *Nature, Lond.*, **205** : 1127-1129.

FOXTON, P. 1957. The distribution of standing crop of zooplankton in the Southern Ocean. *'Discovery' Rep.*, **28** : 193-235.

HOLT, C. S. AND WALTERS, T. F. 1967. Effect of light intensity on the drift stream invertebrates. *Ecology*, **48** : 225-234.

HYMAN, L. H. 1959. The Invertebrates : Smaller Coelomate groups. **5** : 1-71. McGraw-Hill Book Company, N. Y.

KINNE, O. 1975. Physiological mechanisms. *Marine Ecology*, **2** : 1-992.

MICHAEL, E. L. 1911. Classification and vertical distribution of the Chaetognatha of the San Diego region. *Univ. Calif. Publs Ecol.*, **8** (3) : 27-170.

PETIPA, T. S. 1955. Observations on zooplakton during a solar eclipse. *Dokl. Acad. Sci. USSR. Inst. Oceanogr.*, **104** : 2.

PRASAD, R. RAGHU, 1969. Zooplankton Biomass in the Arabian Sea and Bay of Bengal with a discussion on the fisheries of the region. *Proc. natn. Inst. Sci. India*, **35** : 339-437.

VINOGRADOV, M. E., 1970. Vertical distribution of the oceanic zooplankton. *Acad. Sci. USSR. Inst. Oceanogr.*, : 1-339.

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A SYNOPSIS OF THE INDIAN TABANIDAE (DIPTERA)

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ABSTRACT

This communication provides a synoptic discourse of scientific knowledge on the taxonomic and behavioural status of the Indian Tabanidae, with a bias to stimulate active research on these notorious flies of prime veterinary importance.

INTRODUCTION

The Tabanidae comprise horse flies and deer flies, and are popularly known as gadflies or gnats in India. They are generally robust colourful flies with huge brown or black eyes, sometimes having brilliant green or pink bands. Males are holoptic, whereas females dichoptic, *i.e.*, with a narrow space (frons) between two eyes which is generally provided with spot/spots (callus/calli) of specific configuration. The antennae are horn-like but the shape and segmentation generally varies in different genera. The wings are usually held wide apart at rest and are often with infuscations, bands or spots. The thorax and the abdomen may generally be striped or banded.

Adults generally take rest on trees. They breed on or near water-bodies. Nearly all are diurnal and are often most active in sunny weather. The majority of tabanids feed on vertebrate blood but some feed on nectar either exclusively or in supplement to blood. There are still a few as adults most probably taking meal of neither kind.

HISTORICAL REVIEW OF ACHIEVEMENTS

In India, tabanids are studied mainly because of their veterinary importance. Our knowledge on the Indian Tabanidae so far achieved, can be grouped under three inter-related disciplines.

Taxonomy : The Indian Tabanidae include a species which has been described from India herself as early as 1798 by Fabricius, who has later (1805) added three more species. Subsequently, in the nineteenth century, Wiedemann (1821 ; 1824), Macquart (1838 ; 1846 ; 1850 ; 1855), Saunders (1841), Walker (1848 ; 1850 ; 1854), Schiner (1868) and Bigot (1891 ; 1892) have described several species from different parts of India. With the beginning of the present century, Ricardo (1902 ; 1906 a, b ; 1909 ; 1911 a, b ; 1913 ; 1914 ; 1917) has contributed much to the Indian fauna and her outstanding contribution of 1911 is the most important source of reference till today. Besides, Brunetti (1912), Surcouf (1921), Austen (1922), Senior-White (1922 a, b ; 1924 ; 1927), Enderlein (1925), Szilády (1926), Schuurmans Stekhoven (1926 ; 1932), Kröber (1930), Basu, Menon & Sen Gupta (1952), Philip (1959 ; 1960 a, b ; 1962 ; 1970 ; 1972), Philip & Mackerras (1960), Mackerras (1962), Sen & Fletcher (1962), Chvála (1969), Stone & Philip (1974), Stone (1975), Datta & Biswas (1977), Datta & Das (1978) and Datta (1980 ; 1981) have also made

commendable works by describing and recording species occurring in India. A check-list of Tabanidae hitherto known, is provided synoptically in order to have a general idea of the faunal composition in India. For further details and better-understanding, the reader is referred to the works by Stone & Philip (1974), Stone (1975), Moucha (1976), Burton (1978), Burger (1981) and Burger & Thompson (1981) which incorporate species from India too.

Subfamily PANGONIINAE

Tribe PHILOLICHINI

Genus **Philoliche** Wiedemann

1. *amboinensis* (Fabricius, 1805)
2. *korosicsomana* (Szilády, 1926)
3. *longirostris* (Hardwicke, 1823)
4. *macquartiana* Chvála, 1969) (=*rufa* Macquart, 1850-preoccupied)
5. *taprobanes* (Walker, 1854) or ally
6. *varipes* (Ricardo, 1911)

Subfamily CHRYSOPSINAE

Tribe CHRYSOPSINI

Genus **Chrysops** Meigen

7. *designatus* Ricardo, 1911
8. *dispar* (Fabricius, 1798) (=*bifasciatus* Macquart, 1838 ; *ligatus* Walker, 1848 & *semicirculus* Walker, 1848)
9. *dubiens* Philip, 1979
10. *fasciatus* Wiedemann, 1821
11. *fixissimus* Walker, 1857
12. *flaviventris* Macquart, 1846
13. *flavocinctus* Ricardo, 1902
14. *indianus* Ricardo, 1902
15. *pellucidus* Fabricius, 1805
16. *pettigrewi* Ricardo, 1913
17. *stimulans* Walker, 1850

Genus **Melissomorpha** Ricardo

18. *indiana* Ricardo, 1906

Genus **Silvius** Meigen

Subgenus **Silvius** Meigen

19. *indianus* Ricardo, 1911

Tribe BOUVIEROMYIINI

Genus **Gressittia** Philip & Mackerras

20. *apicalis* Philip & Mackerras, 1960

Tribe RHINOMYZINI

Genus **Gastroxides** Saunders

21. *ater* Saunders, 1841
22. *ornatus* (Bigot, 1859)

Subfamily TABANINAE

Tribe TABANINI

Genus **Atylotus** Osten Sacken

23. *agrestis* (Wiedemann, 1828) (=*ditaeniatus* Macquart, 1838 & *pyrrhus* Walker, 1850)
24. *nemocallosus* (Ricardo, 1909)
25. *virgo* (Wiedemann, 1824) (=*albulus* Walker, 1850 & *puella* Walker, 1850)

Genus **Hybomitra** Enderlein

26. *himalayana* (Enderlein, 1925)
27. *hirta* (Walker, 1850)
28. *peculiaris kashmirianus* Szilády, 1926
29. *subcallosa* (Ricardo, 1911)
30. *wyvillei* (Ricardo, 1911)

Genus **Tabanus** Linnaeus

Subgenus **Tabanus** Linnaeus

31. *acallus* Szilády, 1926
32. *albocostatus* (Bigot, 1892)
33. *albofasciatus* Ricardo, 1911
34. *altermaculatus* Ricardo, 1913
35. *andamanicus* (Bigot, 1892)
36. *anderssoni* Philip, 1972
37. *attenuatus* Walker, 1848
38. *auriflamma* Walker, 1848
39. *aurisegmentatus* S. Stekh., 1932
40. *auristriatus* Ricardo, 1911
41. *avittatus* S. Stekh., 1926
42. *biannularis* Philip, 1960 (=*bicinctus* Ricardo, 1911-preoccupied)
43. *birmanicus* (Bigot, 1892)
44. *biswasi* Datta, 1980 (=*minusculus* Datta & Das, 1978-preoccupied)
45. *bombayensis* S. Stekh., 1926
46. *brunnipennis* Ricardo, 1911
47. *ceylonicus* Schiner, 1868
48. *conicus* (Bigot, 1892)
49. *consanguineus* Macquart, 1838
50. *crassus* Walker, 1850
51. *decoratus* Szilády, 1926
52. *demellonis* Senior-White, 1924
53. *diversifrons* Ricardo, 1911 (=*flaviventris* Bigot, 1892 & *ochrogaster* Philip, 1960-preoccupied)
54. *dominus* Datta & Das, 1978
55. *dorsilinea* Wiedemann, 1824 (=*macer* Bigot, 1892; *bicallosus* Ricardo, 1909 & *trichinopolis* Ricardo, 1914)
56. *excelsus* Ricardo, 1913
57. *explicatus* Walker, 1854
58. *flavicornis subflavicornis* Philip, 1970
59. *flavimedius* S. Stekh., 1926
60. *flavipus* S. Stekh., 1926
61. *frondosus* Szilády, 1926 (=*latifrons* S. Stekh., 1926-preoccupied=*paralatifrons* S. Stekh., 1928)
62. *fuscomaculatus* Ricardo, 1911
63. *gertrudae* Philip, 1960 (=*flavicinctus* Ricardo, 1911-preoccupied)
64. *griseifacies* S. Stekh., 1926 (=*flaviventris* Bigot *sensu* Ricardo, 1911)
65. *hirtipalpis* Ricardo, 1911
66. *hybridus* Wiedemann, 1828
67. *imparicallosus* S. Stekh., 1926
68. *indianus* Ricardo, 1911
69. *indifferens* Szilády, 1926
70. *inscitus* Walker, 1848
71. *joidus* (Bigot, 1892)
72. *jucundus* Walker, 1848
73. *kamengensis* Datta & Das, 1978
74. *khasiensis* Ricardo, 1909
75. *laotianus* (Bigot, 1890)
76. *lateralbus* S. Stekh., 1932
77. *laticinctus* S. Stekh., 1926
78. *leleani* Austen, 1920
79. *leucocnematus* (Bigot, 1892)
80. *leucohirtus* Ricardo, 1909
81. *leucopogon* (Bigot, 1892)
82. *limitatus* Stone, 1975 (=*limbatus* Szilády, 1926-preoccupied)
83. *manipurensis* Ricardo, 1913

84. *meghalayensis* Datta & Biswas, 1977
85. *melanognathus* (Bigot, 1890)
86. *miniatus* Datta & Biswas, 1977
87. *monotaeniatus* (Bigot, 1892)
88. *nephodes* (Bigot, 1892)
89. *nicobarensis* Schiner, 1868
90. *noctuinus* S. Stekh., 1926
91. *obconicus* Walker, 1850
92. *ochroceras* S. Stekh., 1932
93. *optatus* Walker, 1857
94. *orientalis* Wiedemann, 1824
95. *orientis* Walker, 1848 (=*consocius* Walker, 1850 ; *perlinea* Walker, 1850 ; *melanopygatus* Bigot, 1892 & *pagodinus* Bigot, 1892)
96. *oxyceratus* (Bigot, 1892)
97. *pallidiventer* S. Stekh., 1926
98. *parafuscomaculatus* S. Stekh., 1932
99. *parahybridus* S. Stekh., 1932
100. *provincialis* Ricardo, 1913
101. *rectilineatus* S. Stekh., 1926
102. *rubicundus* Macquart, 1846 (=*internus* Walker, 1848 & *monilifer* Bigot, 1892)
103. *rubidoides* Szilády, 1926
104. *rubidus* Wiedemann, 1821 (=*albimedius* Walker, 1850 ; *umbrosus* Walker, 1850 & *vagus* Walker, 1850)
105. *rubidus priscoides* S. Stekh., 1926
106. *rubiginosus* Walker, 1850
107. *rufiventris* Fabricius, 1805 (=*assamensis* Bigot, 1892)
108. *sagittipalpis* Szilády, 1926
109. *scutellus* Philip, 1970
110. *servillei* Macquart, 1838
111. *speciosus* Ricardo, 1911
112. *striatus* Fabricius, 1787 (=*hilaris* Walker, 1850)
113. *subhirtus* Ricardo, 1911
114. *sufis* Jaennicke, 1867
115. *tenebrosus* Walker, 1854
116. *triceps* Thunberg, 1827 (=*tenens* Walker, 1850-preoccupied)
117. *trinominatus* Senior-White, 1927 (=*angustus* Bigot, 1892 & *palpalis* Ricardo, 1911-preoccupied)
118. *trinominatus incertus* Szilády, 1926
119. *tuberculatus* Ricardo, 1911
120. *wallacei* Szilády, 1926
121. *wyvillei* Ricardo, 1911
122. *xanthoimus* Philip, 1960

Tribe HAEMATOPOTINI

Genus **Haematopota** Meigen

123. *adusta* Stone & Philip, 1974
124. *albimedia* Stone & Philip, 1974
125. *albofasciatipennis* Brunetti, 1912
126. *alticola* (Philip, 1959)
127. *alyta* Stone & Philip, 1974
128. *amala* Stone & Philip, 1974
129. *annandalei* Ricardo, 1911
130. *assamensis* Ricardo, 1911
131. *barri* Stone & Philip, 1974
132. *bicolor* Stone & Philip, 1974
133. *biguttata* Stone & Philip, 1974
134. *biharensis* Stone & Philip, 1974
135. *bilineata* Ricardo, 1911
136. *biroi* Szilády, 1926
137. *brevis* Ricardo, 1906
138. *cana* Walker, 1848 (=*montium* Szilády, 1926)

139. *casca* Stone & Philip, 1974
140. *chvalai* Stone & Philip, 1974
141. *cilipes* Bigot, 1890
142. *contracta* Stone & Philip, 1974
143. *cordigera* Bigot, 1891
(=*fuscifrons* Austen, 1908)
144. *crossi* Stone & Philip, 1974
145. *darjeelingensis* Datta, 1981
146. *demellonis* Senior-White, 1922
147. *dissimilis* Ricardo, 1911
148. *echma* Stone & Philip, 1974
149. *equina* Stone & Philip, 1974
150. *fasciata* Ricardo, 1911
151. *flavicornis* Szilády, 1926
152. *flavipuncta* Stone & Philip, 1974
153. *hardyi* Stone & Philip, 1974
154. *hindostani* Ricardo, 1917
155. *immaculata* Ricardo, 1911
156. *inconspicua* Ricardo, 1911
157. *indiana* Bigot, 1891
158. *javana* Wiedemann, 1821
159. *jellisoni* (Philip, 1960)
160. *kashmirensis* Stone & Philip, 1974
161. *lata* Ricardo, 1906
162. *latifascia* Ricardo, 1911
163. *limbata* Bigot, 1891
164. *litoralis* Ricardo, 1913
165. *longipennis* Stone & Philip, 1974
166. *malabarica* Stone & Philip, 1974
167. *marceli* Stone & Philip, 1974
168. *marginata* Ricardo, 1911
169. *matherani* Szilády, 1926
170. *melloi* Stone and Philip, 1974
171. *montana* Ricardo, 1917
172. *mouchai* Stone & Philip, 1974
173. *nathani* Stone & Philip, 1974
174. *nigrifrons* Datta & Biswas, 1977
175. *oporina* Stone & Philip, 1974
176. *pallida* Stone & Philip, 1974
177. *pattoni* Stone & Philip, 1974
178. *philipi* Chvála, 1969
179. *pisinna* Stone & Philip, 1974
180. *punctifera* Bigot, 1891
181. *roralis* Fabricius, 1805
182. *schmidi* Stone & Philip, 1974
183. *sikkimensis* Stone & Philip, 1974
184. *singarensis* Stone & Philip, 1974
185. *sparsa* Stone & Philip, 1974
186. *striata* Stone & Philip, 1974
187. *zophera* Stone & Philip, 1974

Genus **Hippocentrodes** Philip

188. *desmotes* Philip, 1959
189. *striatipennis* (Brunetti, 1912)

Tribe DIACHLORIINI

Genus **Cydistomyia** Taylor

Subgenus **Cydistomyia** Taylor

190. *aberrans* Philip, 1970
191. *assamensis* Philip, 1970
192. *indiana* Philip, 1970
193. *nigropictus* (Macquart, 1855)
194. *polyzona* (Szilády, 1926)

Subgenus **Tabanotelum** Oldroyd

195. *primitiva* Mackerras, 1962
196. *secunda* Mackerras, 1962

UNPLACED SPECIES OF TABANIDAE

197. *fulvescens* Brunetti, 1912

Bio-ecology : Studies on the bio-ecology or bionomics in contrast to that on taxonomy of the Tabanidae have generally been infrequent. Since the times of Lefroy (1907) and Baldrey (1911) with some brief behavioural studies, approach to know intensively of the immatures and their environs of certain species has been inducted by Patton & Cragg (1913). Subsequently, Fletcher (1916 ; 1917 ; 1920 ; 1921), Cross & Patel (1921), Isaac (1924 a, b ; 1925 ; 1932 ; 1933), Singh (1926), Patton & Evans (1929), Sen & Fletcher (1962) and Singh (1968) have enriched our knowledge on the life-history and behavioural affairs of several species of these flies. Besides, Mitzmain (1913 a) and Nieschulz (1935 ; 1936) have added much to it. Tabanids generally deposit their eggs in masses on vegetation, logs of wood and rocks overhanging water. The egg-masses in a few species are covered over with a chalky substance, apparently for protection of eggs (Patton & Evens, 1929). The incubation period varies from 4-7 days. The tabanid larvae are carnivorous and frequently cannibalistic. The larvae generally moult 7-8 times. The duration of the larval stage is very variable, depending upon the species and the larval food provision. It may range from 9 days to 7 months (Sen & Fletcher, 1962). According to Rao & Mudaliar (1935), the larval life lasts for 4-6 weeks in the Indian *Tabanus*. As the pupation time advances, the larva migrates to comparatively dry soil. The pupation period varies from 3-21 days. The adult flies emerge at very irregular intervals. While studying at Madras, Patton & Cragg (1913) have concluded that the life-cycle from the egg to the imago is completed in 4-5 months' time and there are 2 generations in a year, but according to Isaac (1925), the common species at Pusa have 3 generations per year. This is true to the Punjab Tabanidae also (Cross & Patel, 1921).

Parasitology : Tabanids are generally common during the rainy season. The adult females and sometimes the males too may be come across on the walls or window panes of the human dwelling. The females of most species are voracious blood-suckers by virtue of their stabbing and sucking mouthparts. They mainly attack cattle and other ungulates and may be very annoying to man. The feeding behaviour and its associated aspects of several species have been observed by many workers of which Patton & Cragg (1913), Mitter (1918), Cragg (1920), Cross & Patel (1921) and Isaac (1925) have made comprehensive studies on certain species. Additional information can be had from the works by Mitzmain (1913 b) and Nieschulz (1927). Tabanids have specific predilection for the site of feeding on blood. "Having selected a suitable spot on the skin of the host it inserts its mouthparts and usually takes a full meal before they are withdrawn. The meal may last as long as 3 or 4 minutes" ...(Cragg, 1920). They take many bloodmeals and the feeding is always interrupted. Of the diseases transmitted by these notorious flies, surra is the most important, mainly affecting horses and cattle. Mitzmain (1913b) for the first time has pointed out that the mode of transmission is merely mechanical. Basu (1945) has recorded the incidence of surra from different parts of India, whereas Menon (1957) has restricted his observations only on species of Rajasthan. Basu, Menon and Sen Gupta (1952) earlier have, however, clarified the occurrence of surra on the regional basis. According to Cross & Patel (1922), *nemocallosus* is the extremely efficient carrier.

It has also been suggested that *Tabanus* may carry anthrax in the same way (Roy & Brown, 1954). Bhatia (1935) and Kapur (1941) through experiments have held that *orientis* can act as a successful transmitter of rinderpest.

Regarding control measure, Cross (1917) has recommended castor oil for preventing tabanids from attacking camels. Sen (1939) has used a proprietary preparation of Pyrocide 20 (a concentrated extract of pyrethrum flowers) and a soap spreader in water for the control of certain cattle flies including tabanids.

DISCUSSION

The Indian territory mainly lies in the Oriental region and hence the tabanid fauna is essentially Oriental, but very many species are widespread. There are at present nearly 193 species and 4 subspecies but undoubtedly many more await discovery from India. On the other hand, much attention has not been paid to reveal many probable species complexes in India. Alongside the conventional taxonomic research, care should be taken to undertake morpho-anatomical studies so as to have a more refined and restrictive species concept of the Indian fauna, but unfortunately very little information is available on this subject except a few earlier works by Patton & Cragg (1913), Cragg (1920), Isaac (1924) and Sen (1931).

To determine the identity of species as well as to have a sound knowledge on their ecological bias is an essential index to possible control measures but it is admittedly true that there is lack of precise knowledge on most of the Indian species in this respect. It is thus essential to find out the site of oviposition, kind of substratum, frequency of appearance in a year and span of life of immatures, particularly larvae and of adult females, and resting place, host preference and other behavioural affairs associated with the biting activities of adult females. There is evidently enough scope for parasitological investigation in India where there are possibilities of at least mechanical, if not biological transmission of several animal diseases by tabanids as in certain other parts of the world. Despite application of chemical means suggested earlier, attempt to control these flies by biological means is a preferable one now-a-days. The most simple and inexpensive method is the collection and destruction of the egg-masses deposited on weeds, such as, *Polygonum glabrum*, *Phragmites karka*, *Lantana aculeata*, *Rumex nepalensis*, indigo plants, grass-blades etc. and other objects overhanging water (Sen & Fletcher, 1962). Alternatively, dissemination of egg parasites, mainly species of Chalcididae and Scelionidae (Hymenoptera) is quite effective (Patel, 1920 ; Fletcher, 1920 ; 1921 and Sen & Fletcher, 1962), but I know of no published records of pathogenic parasities infesting other immature stages of tabanids in India. Sen & Fletcher (1962) have also observed eggs to be eaten up by a species of *Hapaloderus* Motschulsky (Coleoptera : Cantharidae) at Pusa. According to them, these beetles may prove to be useful in reducing tabanid population.

In fine, I believe, there are needs and good prospectus for future realization of the avenues of research surmised above. This synthesis is expected to stimulate more serious research and to provide the public with more information about this important group of insects.

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References

Austen, E. E. 1922. Note on a small collection of Indian Tabanidae and other blood-sucking Diptera. *Trans. R. Soc. trop. Med. & Hyg., Lond.* **15** : 1-264.

Baldrey, F. S. H. 1911. The evolution of *Trypanosoma evansi* through the fly : *Tabanus* and *Stomoxys*. *J. trop. vet. Sci.* **6** : 271-291.

Basu, B. C. 1945. Distribution and seasonal incidence of surra in India. *Indian J. vet. Sci.* **15** : 277-279.

Basu, B. C. Menon, P. B. and Sen Gupta, C. M. 1952. Regional distribution of *Tabanus* flies in India and its relationship to the incidence of surra. *Indian J. vet. Sci. Anim. Husb.* **22** : 273-292.

Bhatia, H. L. 1935. The role of *Tabanus orientis* Wlk. and *Stomoxys calcitrans* Linn. in the mechanical transmission of rinderpest. *Indian J. vet. Sci. Anim. Husb.* **5** : 2-22.

Bigot, J. M. F. 1891. Dipteres nouveaux ou peu connus. *Bull. Soc. zool. Fr.* **16** : 74-79.

Bigot, J. M. F. 1892. Descriptions de Diptères nouveaux. *Mém. Soc. zool. Fr.* **5** : 602-691.

Brunetti, E. 1912. New Oriental Diptera I. *Rec. Indian Mus.* **7** : 445-513.

Burger, J. F. 1981. A review of the horse flies (Diptera : Tabanidae) of Sri Lanka (Ceylon). *Ent. scand. suppl.* **11** : 81-123.

Burger, J. F. and Thompson, F. C. 1981. The *Tabanus striatus* complex (Diptera : Tabanidae) : A revision of some Oriental horse fly vectors of surra. *Proc. ent. Soc. Wash.* **83** : 339-358.

Burton, J. J. S. 1978. The Tabanini of Thailand above the isthmus of Kra. *Entomol. Repr. Specialists*, Los Angeles : 1-165.

CHVA'LA, M. 1969. Einige neue oder wenig bekannte bremsen (Diptera, Tabanidae) von Nepal. *Acta ent. bohemoslovaca* **66** : 39-54.

CRAGG, F. W. 1920. Secretion and epithelial regeneration in the mid-intestine of *Tubanus*. *Indian J. med. Res.* **7** : 648-663.

CROSS, H. E. 1917. Experiments with emulsions for protecting camels against the attacks of blood-sucking flies. *Agric. Res. Inst. Pusa, Calcutta* **76** : 12 pp.

CROSS, H. E. AND PATEL, P. G. 1921. Surra transmission experiments. *Dep. Agric. Punjab, vet. Bull.* **5** : 19 pp.

CROSS, H. E. AND PATEL, P. G. 1922. A note on transmission of surra by *Tabanus nemocallosus*. *Dep. Agric. Punjab, vet Bull.* **7** : 7 pp.

DATTA, M. 1980. *Tabanus biswasi* nom. nov., a replacement name for *Tabanus minusculus* Datta and Das, 1978 (Diptera : Tabanidae). *Bull. zool. Surv. India* **3** : 123.

DATTA, M. 1981. A new species of *Haematopota* Meigen (Diptera : Tabanidae) from Darjeeling, India. *Bull. zool. Surv. India* **4** : 57-59.

DATTA, M. AND BISWAS, S. 1977. A preliminary study of the insect fauna of Meghalaya, India XII. *Proc. Indian Acad. Sci* (B) **86** : 127-133.

DATTA, M. AND DAS, B. N. 1978. Three new species of the genus *Tabanus* L. (Diptera : Tabanidae) from Arunachal Pradesh, India. *Bull. zool. Surv. India* **1** : 181-185.

ENDERLEIN, G. 1925. Studien an blutsaugenden Insekten I. *Mitt. zool. Mus. Berl.* **11** : 255-409.

FABRICIUS, J. C. 1798. *Supplementum entomologiae Systematicae, Hafniae* (=Copenhagen), 572 pp.

FABRICIUS, J. C. 1805. *Systema antliatorum secundum ordines, genera, species, Brunsvigae* (=Brunswick), 373+30 pp.

FLETCHER, T. B. 1916. Report of the Imperial Pathological Entomologist. *Rep. agric. Res. Inst. and Coll.*, Pusa 1915-1916 : 78-84.

FLETCHER, T. B. 1917. Report of the Imperial Pathological Entomologist. *Sci. Rep. agric. Res. Inst.*, Pusa 1916-1917 : 91-102.

FLETCHER, T. B. 1920. Report of the Imperial Pathological Entomologist. *Sci. Rep. agric. Res. Inst.*, Pusa 1919-1920 : 95-108.

FLETCHER, T. B. 1921. Report of the Imperial Entomologist. *Sci. Rep. agric. Res. Inst.*, Pusa, 1920-1921 : 41-59.

HARDWICKE, T. 1823. Description of *Cermatia longicornis* and of three new insects from Nepaul. *Trans. Linn. Soc. Lond.* **14** : 131-136.

ISAAC, P. V. 1924a. Papers on Indian Tabanidae III. *Mem. Dep. Agric. India ent. Ser.* **8** : 53-62.

ISSAAC, P. V. 1924b. Papers on Indian Tabanidae IV-VII. *Mem. Dep. Agric. India ent. ser.* **8** : 93-109.

ISAAC, P. V. 1925. Papers on Indian Tabanidae VIII. *Mem. Dep. Agric. India ent. Ser.* 9 : 21-28.

ISAAC, P. V. 1932. Papers on Indian Tabanidae IX. *Indian J. vet. Sci. Anim. Husb.* **2** : 278-280.

ISAAC, P. V. 1933. Papers on Indian Tabanidae X. *Indian J. vet. Sci. Anim. Husb.* **3** : 182-184.

JAENNICKE, F. 1867. Neue exotische Dipteren. *Abh. senckenb. naturforsch. Ges.* **6** : 311-408.

KAPUR, H. R. 1941. Experiments on the transmission of rinderpest through the agency of *Tabanus orientis*, with remarks on the feeding habits of this fly. *Indian J. vet. Sci. Anim. Husb.* **11** : 84-93.

KRÖBER, O. 1930. Neue Tabaniden und Zusätze bereits beschriebenen. *Zool. Anz.* **90** : 69-86.

LEFROY, H. M. 1907. A preliminary account of the biting flies of India. *Bull. agric. Res. Inst. Pusa* **7** : 21.

MACKERRAS, I. M. 1962. On some Oriental and Pacific Tabanidae. *Pacif. Insects* **4** : 101-113.

MACQUART, J. 1838. *Dipte`res exotiques nouveaux ou peu connus* **1** (1) : 5-221.

MACQUART, J. 1846. *Dipte`res exotiques nouveaux ou peu connus*, suppl. **1** : 5-238.

MACQUART, J. 1850. *Dipte`res exotiques nouveaux ou peu connus*, suppl. **4** : 309-465, 466-479.

MACQUART, J. 1855. *Dipte`res exotiques nouveaux ou peu connus*, suppl. **5** : 25-156.

MENON, P. B. 1957. The incidence of surra and tabanid flies in Rajasthan. *Indian J. vet. Sci. Anim. Husb.* **27** : 1-16.

MITTER, J. L. 1918. Note on the method of feeding of *Corizoneura* (*Pangonia*) *longirostris* Hardwicke, with a description of the mouthparts. *Indian J. med. Res.* **5** : 523-528.

MITZMAIN, M. B. 1913a. The biology of *Tabanus striatus* Fabricius. the horse fly of the Philippines. *Philipp. J. Sci.* (*B*) **8** : 197-221.

MITZMAIN, M. B. 1913b. The mechanical transmission of surra by *Tabanus striatus* Fabricius. *Philipp. J. Sci.* (*B*) **8** : 223-229.

MOUCHA, J. 1976. Horse flies (Diptera : Tabanidae) of the world : Synoptic Catalog. *Acta ent. Mus. Natl. Pragae*, Suppl **7** : 1-319.

NIESCHULZ, O. 1927. Ueber mehrfache Infektionen durch *Tabanus rubidus* Wied. *Centraalbl. Bakt.* **105** : 133-136.

NIESCHULZ, O. 1935. Über die Larvenstadien von *Tabanus rubidus* Wied. und *Tabanus striatus* Fabr. *Z. ParasitenKde* **7** : 639-656.

NIESCHULZ, O. 1936. Die Entwicklungsstadien von *Tabanus rubidus* Wied. und *T. striatus* Fabr. *Arch. Naturgesch.* (N. F.) **5** : 230-255.

PATEL, P. G. 1920. Report of the Imperial Pathological Entomologist. *Sci. Rep. agric. Res. Inst.*, Pusa 1919-1920 : 95-101.

PATTON, W. S. AND CRAGG, F. W. 1913. *A text book of medical entomology*, Christian Literature Society for India, London, xxiii+764 pp.

PATTON, W. S. AND EVANS, A. M. 1929. *Insects, ticks, mites and venomous animals, Part I. Medical.* Liverpool School of Tropical Medicine, H. R. Grubb, Croyden, X+786 pp.

PHILIP, C. B. 1959. Three new Tabanine flies (Tabanidae, Diptera) from the Orient. *Indian J. Ent.* **21** : 82-88.

PHILIP, C. B. 1960a. Malaysian Parasites XXXV. *Stud. Inst. med. Res. F. M. S.* **29** : 1-32.

PHILIP, C. B. 1960b. Malaysian Parasites XXXVI. *Stud. Inst. med. Res. F. M. S.* **29** : 33-78.

PHILIP, C. B. 1962. A review of the far eastern *biannularis* group of *Tabanus*, *Pacif. Insects* **4** : 293-301.

PHILIP, C. B. 1970. Further notes on Oriental Tabanidae (Diptera) IV. In *H. D. Srivastava Comm. Vol.* : 443-452.

PHILIP, C. B. 1972. A new *Tabanus* from south India (Dipt. Tabanidae). *Ent. scand.* **3** : 159-160.

PHILIP, C. B. AND MACKERRAS, I. M. 1960. On Asiatic and related Chrysopinae (Diptera : Tabanidae). *Philipp. J. Sci.* **88** : 279-324.

RAO, M. A. N. AND MUDALIAR, S. V. 1935. Some observations on the trypanosomes of cattle in south India. *Indian J. vet. Sci. Anim. Husb.* **4** : 362-398.

RICARDO, G. 1902. Further notes on the Pangoninae of the family Tabanidae in the British Museum Collection. *Ann. Mag. nat. Hist.* (7) **9** : 366-381.

RICARDO, G. 1906 a. Notes on the genus *Haematopota* of the family Tabanidae in the British Museum Collection. *Ann. Mag. nat. Hist.* (7) **18** : 94-127.

RICARDO, G. 1906 b. Description of a new fly of the family Tabanidae. *Proc. zool. Soc.* Lond. **1906** : 97-98.

RICARDO, G. 1909. Four new Tabanidae from India and Assam. *Ann. Mag. nat. Hist.* **3** : 487-490.

RICARDO, G. 1911 a. A revision of the species of *Tabanus* from the Oriental Region, including notes on species from surrounding countries. *Rec. Indian Mus.* **4** : 111-255.

RICARDO, G. 1911 b. A revision of the Oriental species of the genera of the family Tabanidae other than *Tabanus*. *Rec. Indian Mus.* **4** : 321-397.

RICARDO, G. 1913. New species of Tabanidae from the Oriental Region. *Ann. Mag. nat. Hist.* (8) **11** : 542-547.

RICARDO, G. 1914. A new species of *Tabanus* from India. *Ann. Mag. nat. Hist.* (8) **14** : 359.

RICARDO, G. 1917. New species of *Haematopota* from India. *Ann. Mag. nat. Hist.* (8) **19** : 225-226.

ROY, D. N. AND BROWN, A. W. A. 1954. *Entomology* (Medical & veterinary) including insecticides & insect & rat control. Excelsior Press, Calcutta, ix+ 413 pp.

SAUNDERS, W. W. 1841. Descriptions of four new Dipterous insects from central and northern India. *Trans. ent. Soc. Lond.* **3** : 59-61.

SCHINER, J. R. 1868. *Reise der österreichische Fregatte Novara, Diptera* **2** (1, B) : vi+ 388 pp.

SCHUURMANS STEKHOVEN, J. H. JR. 1926. The tabanids of the Dutch East Indian Archipelago. *Treubia* 6 (suppl.) : 1-551.

SCHUURMANS STEKHOVEN, J. H. JR. 1928. The bloodsucking arthropods of the Dutch East Indian Archipelago IX. *Zoo. Jb.* **54** : 425-448.

SCHUURMANS STEKHOVEN, J. H. JR. 1932. The bloodsucking arthropods of the Duch East Indian Archipelago X *Arch. Naturgesch.* (N. S.) **1** : 57-94.

SEN, S. K. 1931. Notes on the bionomics and anatomy of *Corizoneura longirostris* Hardwicke. *Indian J. vet. Sci. Anim. Husb.* **1** : 24-28.

SEN, S. K. 1939. The possibilities of cattle fly sprays in India. *Indian J. vet. Sci. Anim. Husb.* **9** : 339-348.

SEN, S. K. AND FLETCHER, T. B. 1962. *Veterinary Entomology and Acarology for India.* Indian Coun. Agric. Res., New Delhi, ed. i+668 pp.

SENIOR-WHITE, R. 1922a. Notes on Indian Diptera II. *Mem. Dep. Agric. India ent. Ser.* **7** : 103-107.

SENIOR-WHITE, R. 1922b. Notes on Indian Diptera III. *Mem. Dep. Agric. India ent. Ser.* **7** : 107-169.

SENIOR-WHITE, R. 1924. New Ceylon Diptera III. *Spolia zelon.* **12** : 375-406.

SENIOR-WHITE, R. 1927. *Catalogue of Indian Insects*, **12** : 1-70. Government of India, Calcutta.

SINGH, K. 1926. Surra transmission experiments. *Dep. Agric. Punjab, vet. Bull.* **16** : 20 pp.

SINGH, S. 1968. Life-history and biology of *Tabanus rubidus*. *Res. Bull. Punjab Univ. New Ser. Sci.* **19** : 113-122.

STONE, A. 1975. *A Catalog of Diptera of the Oriental Region* **2** : 43-81.

STONE, A. AND PHILIP, C. B. 1974. The Oriental species of the Tribe Haematopotini (Diptera : Tabanidae). *U. S. D. A. Tech. Bull.* **1489** : 1-240.

SURCOUF, J. M. R. 1921. Family Tabanidae, *in* Wytsman ed., *Genera Insectorum* **175** : 1-182.

SZILA'DY, Z. 1926. New and Old world horse flies. *Biol. hung.* **1** : 1-30.

THUNBERG, C. P. 1827. Tabani septendecim novae species descriptae. *Nova Acta Upsala* **9** : 53-62.

WALKER, F. 1848. *List of the specimens of dipterous insects in the Collection of the British Museum* **1** : 1-229.

WALKER, F. 1850. *Insecta Saundersiana*, or *characters of undescribed insects in the Collection of W. W. Saunders. Diptera* **1** : 1-76.

WALKER, F. 1854. *List of the specimens of dipterous insects insects in the Collection of the British Museum* **5** : 1-330.

WALKER, F. 1857. Catalogue of the dipterous insects collected at Sarawak, Borneo by Mr. A. R. Wallace, with descriptions of new species. *J. Proc. Linn. Soc. Lond., Zool.* **1** : 105-136.

WIEDEMANN, C. R. W. 1821. *Diptera exotica*, Kiliae. **1** : xix+244 pp.

WIEDEMANN, C. R. W. 1824. *Analecta entomologica ex Museo Regio Hafniensi maxime congesta*. Kiliae : 1-60.

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INFLUENCE OF SEED DIET ON FECUNDITY AND POST EMBRYONIC DEVELOPMENT OF *SPILOSTETHUS PANDURUS MILITARIS* (FABRICIUS) (HEMIPTERA : LYGAEIDAE)

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ABSTRACT

In southern part of West Bengal *Spilostethus pandurus militaris* (Fabricius) is found for major part of the year to use *Calotropis gigantea* as its principal host-plant. The role of *Calotropis* plant sap or its mature seed or any seed other than *Calotropis* (viz., sunflower seed) in the fecundity and post embroyonic development is investigated. It has come to light that rate of fecundity and development of egg enhances considerably when the bugs are kept on a combination of diet of *Calotropis* seed and its sap (from floral or vegetative parts) ; a diet with a combination of sunflower seed and water (supplied by siphon) seldom instigates egg laying but maintains steady nymphal development, whereas a diet made up purely of *Calotropis* sap precludes fecundity as well as development of latter instars ; the result indicates an obligatory association of this phytophagous-bug with *Calotropis* seed in this region.

INTRODUCTION

Majority of lygaeid bugs are seed feeders. Fecundity and post embryonic development of these bugs are affected by a number of factors *viz.* temperature, humidity, parental age and the nature of laying or moulting substrate etc., but nutrition, especially the seed of the host-plant seems to be an important controlling factor.

Kehat and Wyndham (1972) demonstrated that the availability of the nature of food has a profound effect on longevity, fecundity, and post embryonic development of *Nysius vinitor* Berg. Eyles (1964) besides indicating the host specificity among rhyparochromines demonstrated that only seeds, not leaves or stems of host-plant, supported growth and oviposition in *Scolopostethus*, *Stygnocoris* and *Drymus*. Isman (1977) showed the dietary influence of cardinolides on larval growth and development of milk-weed bug, *Oncopeltus fasciatus* (Dallas). Frings, Frings and Little (1957) showed that a substitute food for seeds reduced the fecundity of *O. fasciatus*. An investigation has, therefore, been undertaken to find out the importance of the milk-weed seeds (*Calotropis gigantea*) in controlling the post embryonic development and fecundity of the common milk-weed bug, *Spilostethus pandurus militaris* (Fabricius).

MATERIALS AND METHODS

For estimating the post embryonic development periods each specimen was reared separately in large vial (10×3 cm). Three kinds of food combinations were provided i. e.

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A. *Calotropis* sap+*Calotropis* seed

B. Sunflower seed+water (in siphon)

C. *Calotropis* sap (from floral and vegetative parts)

Developmental periods of six nymphs were observed on each such combination of food.

For observing fecundity freshly emerged pairs (♂ and ♀) were kept in small jars (10×7 cm.) on the above three different diet combinations i. e. A, B and C. Five pairs of bugs were kept on each such diet combination.

The experiments were conducted during the months of June to August under similar conditions of temperature and humidity.

Observations

Post embryonic development with successful moulting and finally metamorphosis was complete for all the specimens reared on A and B diet combinations, However, the mean developmental period of the bugs was shorter when reared on combination-A than on B. Specimens reared on combination-C never successfully moulted to 5th instar and therefore never reached adult stage ; most of these nymphs died after prolonged stadia at 3rd or 4th instar.

Mating in the pairs of the bugs kept on all the above three combinations A, B and C took place within 3 to 4 days. However, regular egg laying was found, after about a preoviposition period of ten days, in only those pairs kept on a diet combination A *Calotropis* (Seed+sap). For these pairs the oviposition period lasted for 6 to 15 days and total number of eggs laid ranged between 282 to 540. Pairs when kept on combination-B (Sunflower seed+water) rarely laid eggs, however in one such exceptional case after a preoviposition period of 38 days a female laid 30 and 12 fertile eggs on two subsequent days. Pairs kept on diet combination-C (Calotropis sap) never laid eggs despite their 26 to 32 days of longevity (Table 2).

TABLE 1 Post embryonic development of the nymphs of *S. pandurus militaris* kept on three different diet combinations (Based on six observations). (Fig. I).

Days	1st Instar	2nd Instar	3rd Instar	4th Instar	5th Instar	Total Period
			A-Calotropis (Sap+Seed)			
Mean	3.66	2.5	2.66	3.0	6.16	18.0
Range	(3-4)	(2-3)	(2-3)	(—)	(6-7)	(17-19)
±S. D.	±0.516	±0.541	±0.516	±0.000	±0.408	±0.632
			B-Sunflower seed+water			
Mean	4.33	2.66	2.5	3.66	7.0	20.16
Range	(3-7)	(2-4)	(2-3)	(3-7)	(6-9)	(18-24)
±S. D.	±1.366	±0.816	±0.547	±1.632	±1.264	±2.714
			C-*Calotropis* sap			
Mean	3.83	4.66	8.66	17.0	—	—
Range	(3-5)	(3-6)	(3-11)	(16-19)		
±S. D.	±0.752	±1.366	±3.141	±1.414		

TABLE 2 Fecundity of five pairs of *S. pandurus militaris* on three different diet combinations.

DIET COMBINATION	PAIR NUMBER					MEAN (RANGE) ± S. D. OF EGGS LAID
	1	2	3	4	5	
A-*Calotropis* (Sap+Seed)	274	521	409	282	540	405.2 (274-540) ± 126.47
B-Sunflower Seed+Water	—	—	42	—	—	8.4 (—) —
C-*Calotropis* Sap	—	—	—	—	—	— —

Discussion

The above experiments decisively show that some chemical components present in the seeds directly or indirectly control post embryonic development as well as fecundity of the milk-weed bugs, *Spilostethus pandurus militaris*. The factors seem to be more predominent in the seeds of the host-plant (*Caiotropis gigantea*) so that when included in diet it instigated faster development of nymphs and maximum egg laying within a short period. It has been demonstrated by Sweet (1964) that the seed feeding rhyparochromines when kept on lettuce and other green material produced fewer eggs in contrast to heavy production when fed on sunflower and other seeds. Johansson (1954, '58) has conclusively shown that in *Oncopeltus fasciatus* the corpora allata hormone production was controlled by seed feeding, for starving or placing the insect on diet without seeds, cuts off egg production.

As seed feeding in the present context is found to influence both oviposition as well as moulting and metamorphosis of latter stages, implication of insect hormones obtained from nonneural endocrine glands and their involvement for the onward successful post embryonic development may be ascribed. The activity of corpora allata

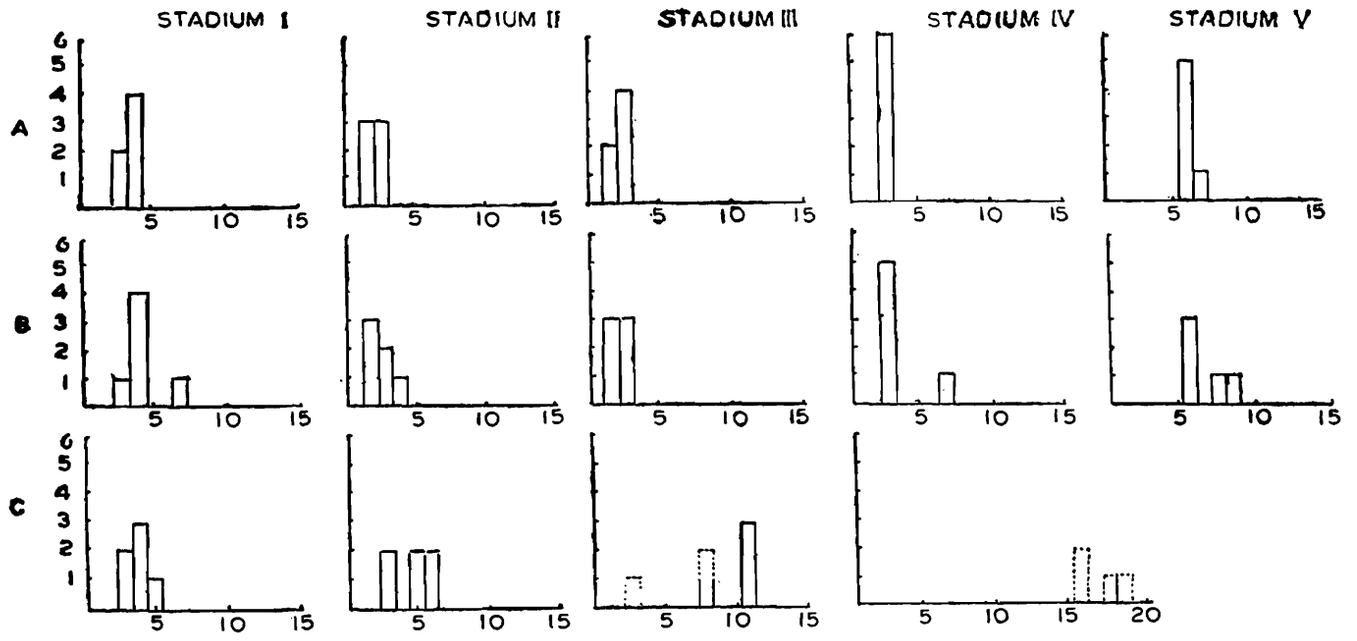

FIG. 1. Frequency distribution of duration of instars on three diet combinations (A,B,C) of S.pandurus militaris. Ordinates, number of observations; Abscissae, time in days. Dotted rectangles indicate nymphal mortality.

and maturation of oocytes are closely related with nutrition. In *Rhodnius* it has been shown that the 'Juvenile hormone' of the young larva and 'yolk forming hormone' of adult appear to be interchangable and probably identical substances (Wigglesworth, 1964). It is further demonstrated that on decapitation of a 4th instar nymph of *Rhodnius* (before critical period) no growth occurred and the nymph did not moult-although such nymph remained alive for many months (Wigglesworth, 1970).

In view of the above facts it may be presumed that seed deprivation has engendered elemination of active principle which necessarily implicate the successful completion of post embryonic development. Nevertheless, the plant sap appears to be instrumental for initiating the development but can not maintain the latter stages. Furthermore, the importance of the brain to elaborate respective trophic hormones in proper sequence and concentration may well be envisaged for elaboration of respective hormones in event of successful moulting and maturation of oocytes in adults.

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References

Eyles, A. C. 1964. Feeding habits of some Rhyparochrominae (Het. : Lyg.) with particular reference to the value of natural foods. *Trans. R. ent. Soc. Lond.*, **116** (5) : 89-114.

Frings, H., Frings, M., and Little, F. 1957. Peanuts as substitute food for large milk-weed bug. *J. econ. Ent.*, **50** : 363-364.

Isman, M. B. 1977. Dietary influence of cardinolides on larval growth and development of the milk-weed bug *Oncopeltus fasciatus* (Het. : Lyg.). *J. Insect. Physiol.*, **23** : 1183-1187.

Johansson, A. S. 1954. Corpus allatum and egg production in starved milk-weed bugs. *Nature Lond.*, **174** : 89.

Johansson, A. S. 1958. Relation of nutrition to endocrine reproductive functions in milk-weed bug *Oncopeltus fasciatus* (Dallas) (Het. : Lyg.). *Nytt. Mag. Zool.*, **7** : 1-132.

Kehat, M. and Wyndham, M. 1972. The effect of food and water on development, longevity and fecundity in the Rutherglen bug, *Nysius vinitor* (Hem. : Lyg.), *Aust. J. Zool.*, **20** : 119-130.

Sweet, M. H. 1964. The biology and ecology of Rhyparochrominae of Few England (Het. : Lyg.). *Entomologica am.* **43** : 60.

Wigglesworth, V. B. 1964. Hormone Control of growth and reproduction in Insects : review *Adv. Insect physiol.* **2** : 247-336.

Wigglesworth, V. B. 1970. Insect Hormones. University reviews in Biology. Oliver and Boyd, Edinburgh.

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FIELD NOTES ON THE ODONATA AROUND LAKE KAILANA, JODHPUR (RAJASTHAN).

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ABSTRACT

The paper reports 18 species of Odonata at Lake Kailana (Jodhpur, Rajasthan), of which seven are new locality records. Observations on their distribution pattern as well as mating and oviposition in some common species have also been included.

INTRODUCTION

Among the important factors governing the distribution, abundance and habitat selection of Odonata of any water body are its shape and size, water holding capacity, water movement, salinity and the aquatic vegetation. According to Corbet (1962), the distribution of dragonflies is normally affected by the nature of aquatic habitat available. In order to study the dragonflies of the above area, several trips were undertaken to Lake Kailana during 1979-80. It is a perennial artificial freshwater lake (Lat. 16°5' N, Long. 57°3' E), about 12 km NW of Jodhpur. It is a big water body consisting of two different reservoirs namely, Takhatsagar and Pratapsagar (Fig. 1 ; Plates II & III). Pratapsagar was brought into existence in 1893 by constructing an impoundment on the deep hilly Terrain in the NW of Jodhpur city. Later in 1937-38, the flow of flood gates of Kailana in the western basin was also dammed and the

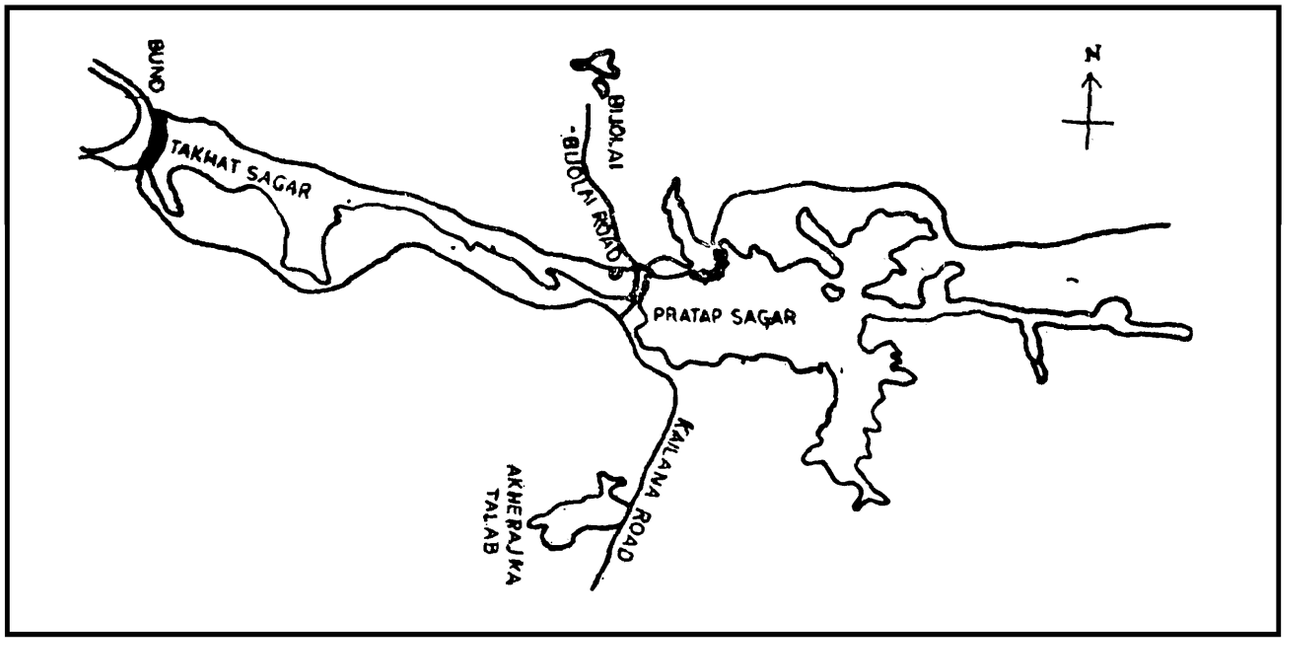

Fig. 1. Sketch map of Lake Kailana showing two parts, *viz.*, Pratapsagar and Takhatsagar.

reservoir was named Takhatsagar. Pratapsagar can retain 4.65 m. c. m. water, while the water storage capacity of Takhatsagar is 6.11 m. c. m. The rocky drainage basin of Pratapsagar has a spread of 41.40 sq. km. Takhatsagar has no independent catchment area and is fed with water from Pratapsagar, of which the bed level is 7.62 m. higher than the former. Takhatsagar also receives water from Umedsagar which is filled by a canal, carrying water from Jawai dam (Soota *et al.*, 1983). The lake is surrounded by rhyolitic rocks with scanty vegetation. Among the aquatic flora, *Hydrilla*, *Vallisnaria*, *Najas* grass, *Potamogeton* and *Chara* are the aquatic plants which form a natural habitat for the aquatic insects. Around the rocky bank, there are patches of xerophytic vegetation, of which *Acacia jacquamonti*, *A. senegal*, *Aerve persica*, *Boerhavia diffusa*, *Euphorbia caducifolia*, *Prosopis cineraria*, *Salvadora oleoides* and *S. persica* are conspicuous. It has been observed that the dragonflies in Lake Kailana are more abundant along the south-west shore line because on the north-east of the lake there is a sudden steepness of the rocky shores.

The present paper includes fields observations on the distributional pattern of dragonflies around Lake Kailana. Bose and Mitra (1976) reported 13 species and Prasad and Thakur (1981) recorded 16 species of dragonflies from Rajasthan. In the present paper, 18 species of dragonflies are being reported (Table 1). All these species are known from Rajasthan but seven species form new locality records from Lake Kailana. Some species were also reared in the laboratory by collecting their freshly laid eggs and larvae, the results of which are being published elsewhere.

The distribution of these species can be broadly classified in four groups.

(1) Along the deep shore line,

(2) Along rocky bank of lake,

(3) Away from the water near Vegetation,

(4) Species hovering over the water surface.

Along the deep shore line : Species hovering and patrolling along the shore line of the lake are *Copra marginipes*, *Psuedagrion rubriceps*, *Agriocnemis pygmea*, *Trithemis aurora*, *Ictinogomphus rapax*, *Brachythemis contaminata*, *Crocothemis servilia servilia*, *Pantala flevescens*, *Diplacodes lefebvrei* & *D. nebulosa*. Most of these species were observed either perching on the partially submerged vegetation or flying and sometimes ovipositing in the shallow water. Oviposition in *P. rubriceps*, *A. pygmea*, *C. servilia servilia*, was observed in March-April whereas *B. contaminata* has been observed to oviposit in June-July. Adults of *I. rapax* flies very fast and was observed, occasionally perching on vegetation near the bank. Oviposition could not be observed in *I. rapax* as well as *P. flevescens*. *D. lefebvrei* and *D. nebulosa* have been found in very small numbers through out their flight period, recorded from March to September. Adults of *Trithemis pallidinervis* were observed clashing and chasing each other over the open water surface, while adults of *B. contaminata* and *C. servilia servilia* were seen perched in large numbers on the submerged vegetation at the extreme western end of the lake. These preferred flying near vegetation than deep over open water surface. *P. rubriceps* and *A. pygmea* were observed flying lazily at a low level above the surface of the lake, hardly going beyond few metres from the shore line,

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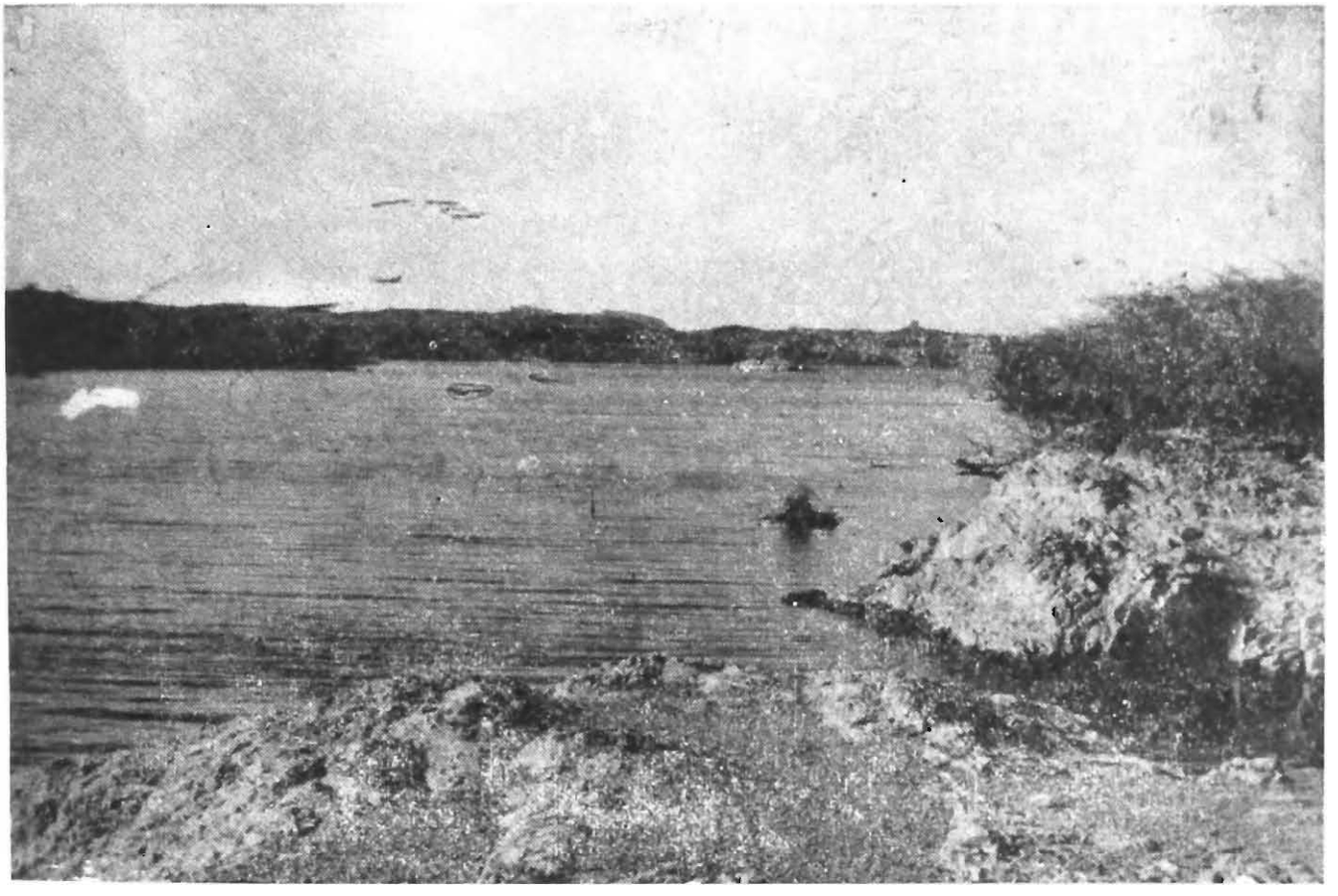
PLATE II



A view of Pratapsagar (Lake Kailana)

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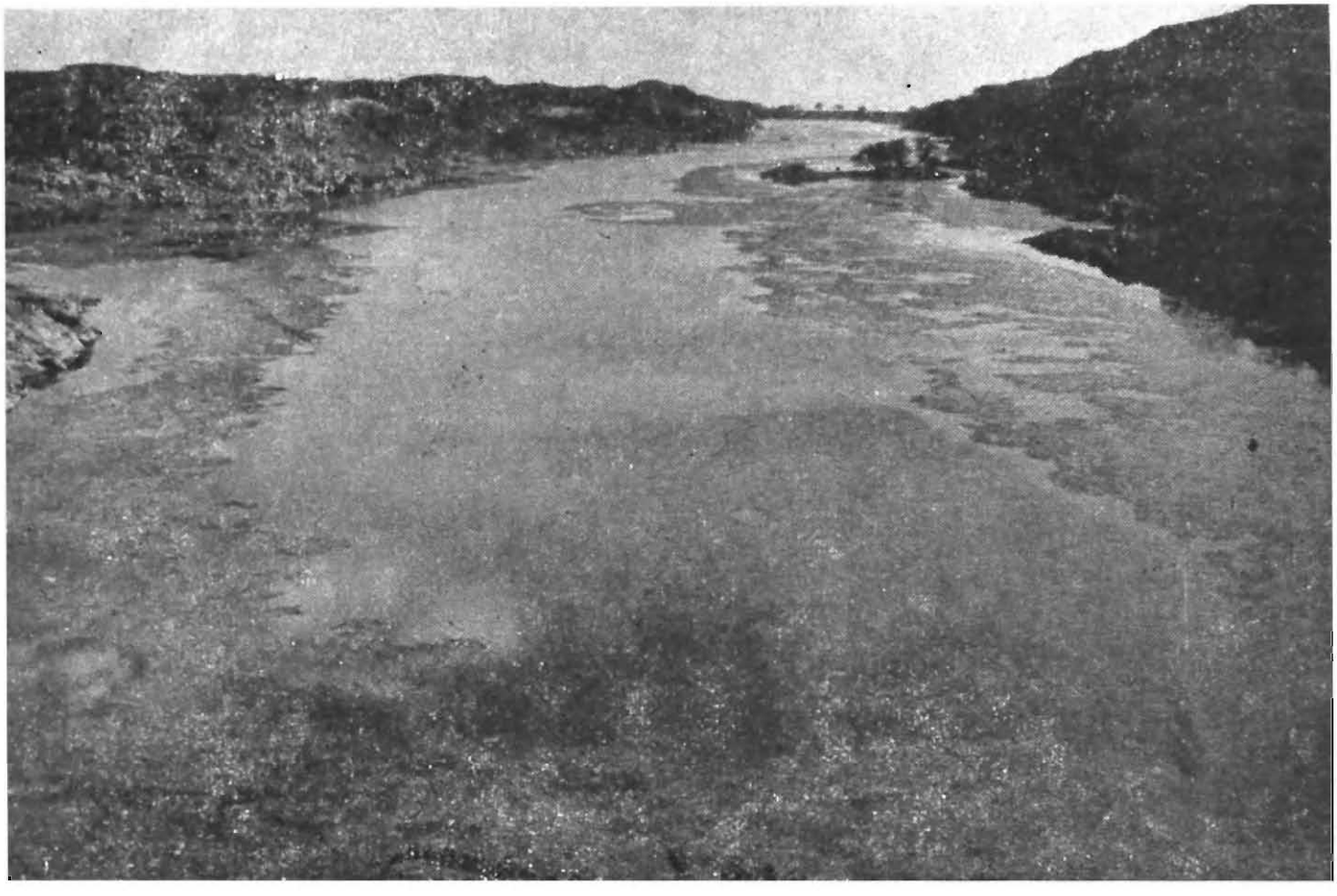
PLATE III



A view of Takhatsagar (Lake Kailana)

Females of both the species were found laying eggs on the submerged *Hydrilla* and *Potamogeton* plants during March-April. The former lays eggs by bending its abdomen over leaves in tandem. *T. aurora* have been observed to lay eggs on stones away from water lying on the lake shore. This species spends most of the time perching on rocks away from vegetation. Their flight range is 303-1000 m. (Kumar and Prasad, 1981). In *T. pallidinervis*, both the sexes were found flying in tandem and female laying eggs in the month of April. *P. flevescens* and *Trithemis fastiva* were found flying actively in May-June. Their flight period extends from March to October. According to Kumar and Prasad (1981), *T. festiva* is one of the first dragonfly which emerge with approach of the spring. *D. nebulosa* and *D. lefebvrei* have also been observed flying actively around larval habitats during April-May.

Along the rocky bank of the Lake : Very few species of Odonata were observed near the rocky bank around the lake. Mostly males of *T. pallidinervis* and *T. aurora* were found flying and perching on the boulders and vegetation near the lake shore from April to August and May to October respectively. Emergence in *T. aurora* takes place during September. Maximum density of its population has been observed during September-October. Males of *I. rapax* has been found flying from one side of the lake to other and intermittently coming over the xerophytic plants on rocky bank. But this species was hardly observed to sit on plants or stones near the shore (observed in March-April) and keeps on flying for hours together. It was recorded only in Takhatsagar, its absence in the Pratapsagar is quite interesting, which shows that its home range is very less. Oviposition could not be observed in this species. Occasionally, *Acisona panorpoides*, *Orthetrum sabina sabina* and *Bridinopyga geminata* were found flying over the rocky bank, being more active on wing during afternoon. Their flight season is from March to November.

Away from the water near vegetation : Eastern part of the lake has only few xerophytic plants. There is no vegetation along the bank of Pratapsagar. Most of the species in this area have been observed to fly along the bank and some species over the water surface. Only *C. servilia servilia*, *I. rapax* and *T. pallidinervis* were found to fly upto vegetation. *C. servilia servilia* were more active and sometimes found sitting over the *Euphorbia* spp. plants whereas other two species were simply flying from one side to other along the vegetation with frequent visits to the lake water. The zygopteran species (*C. marginipes*, *P. rubriceps*, *T. aurora* and *A. pygmea*) were observed flying largely over the water surface and submerged plants in Takhatsagar. Their flight range is very short. They have been observed hovering here and there over the vegetation around the larval habitats during March-September. Western part of the lake has trees of *Acacia* spp and *Prosopis* spp at the extreme end and xerophytic vegetation here and there. A large number of adults of *B. contaminata* and a few of *C. servilia servilia*, *T. pallidinervis*, *D. lefebvrei* and *D. nebulosa* were found flying among the trees. The other species collected include *P. flevescens* and *Orthetrum taeniolatum*.

Species hovering over the water surface : Very few species were observed flying deep over the water surface. Some species (*B. contaminata* and *C. servilia servilia*), have been found to restrict themselves to the

vegetation near the bank. But there are few species such as *I. rapax*, *T. pallidinervis*, *B. geminata*, *P. flevescens* which fly deep over the water surface right upto the other side of the lake. *B. geminata and P. flevescens* were observed from April to September and found to be more common in Takhatsagar near the bridge. Oviposition in *B. geminata* was observed in April and larvae were collected during July-August. In *P. flevescens* oviposition could not be observed, however larvae were collected in the month of September. Kumar (1973) has worked out the detailed life history of *B. geminata*. *D. lefebvrei* and *D. nebulosa*, *T. festiva* and *Orthetrum sabina sabina* also sometimes fly over water surface upto the middle of the lake. But all these species have been observed to lay eggs only along the lake shore among vegetation, water surface or near by stones.

Table 1. *List of Odonata species recorded from Lake Kailana*

(The species marked with asterisk (*) are new records).

Order : Odonata
Sub-Order : Zygoptera
Family : Platycnemidae
Sub-family : Platycneminae
*1. *Copera marginipes* (Rambur)
Family : Coenagrionidae
Sub-family : Psuedagriinae
*2. *Psuedagrion rubriceps* Selys
Sub-family : Ischnurinae
*3. *Ischnura aurora* (Brauer)
Sub-family : Agriocneminae
*4. *Agriocnemis pygmaea* (Rambur)
Sub-order : Anisoptera
Sub-family : Aeshnoidea
Family : Gomphidae
Sub-family : Ictinogomphinae
5. *Ictinogomphus rapax* (Rambur)
Super-family : Libelluloidea
Family : Libellulidae
Sub-family : Libellulinae
*6. *Orthetrum taeniolatum* (Schneider)
*7. *Orthetrum sabina sabina* (Drury)
Sub-family : Branchydiplactinae
8. *Brachydiplax sobrina* (Rambur)
Sub-family : Sympetrinae
9. *Acisoma panorpoides panorpoides* Rambur
10. *Diplacodes nebulosa* (Fabricius)
11. *Diplacodes lefebvrei* (Rambur)
12. *Crocothemis servilia servilia* (Drury)
13. *Bradinopyga geminata* (Rambur)
14. *Brachythemis contaminata* (Fabricius)
Sub-family : Tritheminae
15. *Trithemis aurora* (Burmeister)
16. *Trithemis pallidinervis* (Kirby)
17. *Trithemis festiva* (Rambur)
Sub-family : Pantaliinae
18. *Pantala flevescens* (Fabricius)

Discussion

The present observations reveal that Odonata fauna in Lake Kailana is very meagre qualitatively as will as quantitatively as compared to its size. For such a big lake 18 species cannot be attributed to be a good fauna. The limited species of Odonata may be due to less vegetation. Site selection and larval habitat preference depend on the presence or absence of a particular type of shore vegetation, which in this lake is very poor due to (i) rocky bottom which is

not suitable for rooted vascular plants (ii) absence of littoral zone at many places along the shore due to sudden steepness of the rocky shores (iii) due to poor organic material inflow from outside which are very important for plant growth. As such, aquatic vegetation is available in only restricted parts of the lake. Thus the presence of less vegetation governs the abundance of the Odonata species. This is especially important in those species which oviposit endophytically or have their larvae living amidst the upright vegetation (Kumar, 1978).

Corbet (1962) has dealt various factors in detail which are responsible for the habitat selection and oviposition in dragonflies. Of the 18 species recorded from the lake Kailana, most of the species are common in both the reservoirs Pratapsagar and Takhatsagar, with preponderance of the former (18 *vs.* 8), In fact none of the species of Zygoptera have been recorded from Takhatsagar. Also *I. rapax*, *D. lefebvrei*, *D. nebulosa*, *P. flevescens*, *B. sobrina* are restricted to only Pratapsagar. This can be attributed to the fact that water is being pumped in or out of the lake by high velocities which being responsible for the poor vegetation. This factor along with continuous disturbance in the water, leaves less scope for the dragonflies for habitat selection and oviposition. To sum up Odonata fauna of lake Kailana is very poor in comparison to other freshwater lakes in India such as Renuka lake (1km. long and 300 m. wide) in H. P., where 31 species (Kumar, 1978) have been recorded, while lake Kailana which is much bigger in size has only 18 species.

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REFERENCES

BOSE, G. AND MITRA, T. R. 1976. The Odonate fauna of Rajasthan. *Rec. zool. Surv. India*, Calcutta, **71** : 1-11.

CORBET, P. S. 1962. A Biology of Dragonflies. *Witherby Ltd.*, London.

KUMAR, A. 1973. The life history of *Bradinopyga geminata* (Rambur) (Odonata : Libellulidae). *G. K. V. J. Sci. Res.*, **5** (1-2) : 50-57.

KUMAR, A. 1978. Field notes on the Odonata around a freshwater lake in western Himalayas. *J. Bombay nat. Hist. Soc.*, Bombay, **74** (3) : 506-510.

KUMAR, A. AND PRASAD, M. 1981. Field ecology, zoogeography and taxonomy of the Odonata of western Himalaya, India. *Rec. zool. Surv. India*, (Misc. Publ.), Calcutta, *Occas. Paper No. 20* : 1-118.

PRASAD, M. AND THAKUR, R. K. 1981. Further addition to the Odonata (Insecta) fauna of Rajasthan. *Jantu*, Jodhpur, **1** : 14-16.

SOOTA, T. D., BASKARAN, S. AND SAXENA, M. M. 1983. Sponges of Lake Kailana, Jodhpur, Rajasthan and their ecology. *Geobios New Reports*, Jodhpur, **2** : 150-152.

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SCHOCHAPUS NOMEN NOVUM PRO *APUS* SCHOCH, 1868 (ROTIFERA)

ABSTRACT

Rotifer generic name *Apus* Schoch, 1868, is preoccupied by a bird genus *Apus* Scopoli, 1777. Hence, the former has been replaced by *Schochapus* nom. nov.

It is observed that generic name *Apus* has been proposed for three different genera of animals in widely separated phyla. These are :

(i) *Apus* Scopoli, 1777, for a genus of Aves ;

(ii) *Apus* Cuvier, 1798, for a genus of Crustacea, Phyllopoda ; and

(iii) *Apus* Schoch, 1868, for a genus of Rotifera ; vide Neave (1939).

Among these, *Apus* Scopoli, 1777, with its type species *Hirundo apus* Linn., is oldest and validated under plenary powers (Opinion 502) by the International Commission on Zoological Nomenclature. The Crustacean generic name *Apus* has already been substituted by *Triops* Schrank, 1803. However, no attempt seems to has been made to replace the invalid rotiferan *Apus*.

Therefore, it is put on record here that as the name *Apus* Scopoli, 1777, is preoccupied for a bird genus, the name *Apus* Schoch, 1868, is a junior homonym of the former and hence not available for the rotiferan genus. As no other synonym of the latter has come across as yet, a new replacement name is proposed here, as follows :

Phylum : Rotifera

Genus **Schochapus** Varshney nom. nov.
(Pro *Apus* Schoch, 1868)

The type-species and other requirements of this new genus will remain the same as mentioned for *Apus* by Schoch (1868).

According to the *Zoological Records* (1868) this interesting little work of Schoch (1868), though meant to be more of a popular than a scientific treatise, gives a very fair account of the general structure of the Rotifera, and, following Dujardin's classification of the Rotifers into *R. sessilia*, *R. natantia*, and *R. repentia*, proceeds to give details of some of the families of each suborder, as well as of the more remarkable genera and species. There are sixty figures, on eight plates ; and though roughly drawn, the species are almost always recognizable.

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References

CUVIER, 1798. *Tabl. Elem. Hist. nat. Anim.* : 454, 700.

NEAVE, 1939, *Nomenclator Zoologicus*, **1** : 268.

SCHOCH, 1868. *Micr. Thiere*, **2** (iii) : 21.

SCOPOLI, 1777. *Introd. Hist. Nat.* : 483.

Zoological Records, 1868 : 534.

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R. K. VARSHNEY

REVIEW

Threatened Animals of India,—By B. K. Tikader, 307 pp.-Calcutta (Zoological Survey of India), 1983. Price Rs. 150/-

This attractive and profusely illustrated book (many illustrations are in colour) is a welcome addition to the growing library of books on Indian wildlife. The subject of the conservation of Indian animals has been dealt with in recent years by many authors (and includes three publications from the Zoological Survey of India itself). What distinguishes the present publication is its distinctive style, the numerous illustrations and the excellent printing (on art paper throughout).

The work covers the higher vertebrates, viz., mammals, birds, reptiles and the Amphibia, which together include 146 species which are stated to be "threatened" with extinction. They are grouped into six categories, viz:, endangered, vulnerable, rare, threatened, out of danger and indeterminate. The character of each group is defined, and the author justifies this division on practical grounds. There is some overlapping, the category "threatened" for example, including the three which precede it.

Each speciss is illustrated with a coloured photograph or drawing, and its geographical distribution is given in a map.

Altogether, this is a welcome addition to wild life literature, and both the author and the printers deserve to be congratulated for bringing it out. It should be a very useful addition to the libraries of both the professional and the amateur enthusiasts. Let us hope that it will go a long way in fulfilling its purpose, the conservation of the threatened animals.

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M. L. Roonwal