

SARCOPHAGID FLIES (DIPTERA : SARCOPHAGIDAE) FROM ANDHRA PRADESH, INDIA

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INTRODUCTION

This paper deals with a collection of Sarcophagid flies, made by the author from Andhra Pradesh, under Collaborative Research Project and contractual Services in the Zoological Survey of India, Calcutta. A total of twelve species under five genera are dealt with. Distributional records and bionomics of the species are mentioned whenever these were not reported earlier.

SYSTEMATIC ACCOUNT

Subfamily SARCOPHAGINAE

Tribe SARCOPHAGINI

Subtribe PARAARCOPHAGINA

1. *Parasarcophaga (s.str.) albiceps* (Meigen)

1825. *Sarcophaga albiceps* Meigen, *System. Besch.*, 5 : 22.

1982. *Parasarcophaga (s.str.) albiceps* (Meigen) : Nandi, *Rec. zool. Surv. India*, 80 : 118.

Material : 5 ♂♂, Andhra Pradesh : Eturnagaram, 22.xii.1985; 3 ♂♂, Narsingapur, 22.xii.1985; 6 ♂♂, Nehru Zoological Park, 24.xii.1985; 3 ♂♂, Indira Park, 24.xii.1985; 5 ♂♂, Ananthagiri Hills, 300 m., 25.xii.1985; 1 ♂, Simachalam, 28.xii.1985; 2 ♂♂, Araku, 918 m., 30.xii.1985.

2. *Parasarcophaga (s.str.) knabi* (Parker)

1917 *Sarcophaga knabi* Parker, *Proc. U.S.natn. Mus.*, 54 : 96.

1982. *Parasarcophaga (s.str.) knabi* (Parker) : Nandi, *Rec. zool. Surv. India*, 80 : 118.

Material : 5 ♂♂, Andhra Pradesh : Eturnagaram, 22.xii.1985; 5 ♂♂, Narsingapur, 22.xii.1985; 5 ♂♂, Pakhal, 23.xii.1985; 2 ♂♂, Narsampet, 25.xii.1985; 2 ♂♂, Nehru Zoological Park, 24.xii.1985; 2 ♂♂, Indira Park, 24.xii.1985; 2 ♂♂, Ananthagiri Hills, 300 m., 25.xii.1985. 1 ♂, Vijayawada Municipal Park, 27.xii.1985; 1 ♂, Simachalam, 28.xii.1985; 3 ♂♂, Mangalagiri Temple area, 27.xii.1985; 3 ♂♂, Rajahmundry, 29.xii.1985; 6 ♂♂, Araku, 918 m., 30.xii.1985; 6 ♂♂, Simachalam Temple, 31.xii.1985.

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3. *Parasacophaga (s.str.) hirtipes* (Wiedemann)

1830. *Sarcophaga hirtipes* Wiedemann, *Ausser. Zweifl. Ins.*, 2 : 661.

1979. *Parasarcophaga (s.str.) hirtipes* (Wiedemann) : Nandi, *Oriental Ins.*, 13(1-2) : 189.

Material : 1 ♂, Andhra Pradesh, Eturnagaram, 22.xii.1985. This species is recorded for the first time from Andhra Pradesh. It can be reared from human excreta. The author has collected the specimens from bush sweeping near human excreta.

4. *Parasarcophaga (s.str.) orchidea* (Böttcher)

1913. *Sarcophaga orchidea* Böttcher, *Ann. Hist. Mus. Nat. Hung.*, 11 : 375.

1982. *Parasarcophaga (s.str.) orchidea* (Böttcher) : Nandi, *Rec. zool. Surv. India*, 80 : 119.

Material : 8 ♂♂, Andhra Pradesh : Eturnagaram, 22.xii.1985; 6 ♂♂, Narsingapur, 22.xii.1985; 12 ♂♂, Pakhal, 23.xii.1985; 10 ♂♂, Narsampet, 23.xii.1985; 4 ♂♂, Nehru Zoological Park, 24.xii.1985; 2 ♂♂, Ananthagiri Hills, 300 m., 25.xii.1985; 6 ♂♂, Mangalagiri Temple area, 27.xii.1985; 1 ♂, Vijayawada Municipal Park, 27.xii.1985; 3 ♂♂, Simachalam Temple, 31.xii.1985; 11 ♂♂, Simachalam, 28.xii.1985; 4 ♂♂, Rajahmundry, 29.xii.1985; 2 ♂♂, Araku, 918 m., 30.xii.1985.

5. *Parasarcophaga (Liopygia) ruficornis* (Fabricius)

1794. *Musca ruficornis* Fabricius, *Ent. Syst.* 4 : 314.

1982. *Parasarcophaga (Liopygia) ruficornis* (Fabricius) : Nandi, *Rec. zool. Surv. India*, 80 : 119.

Material : 2 ♂♂, Andhra Pradesh : Eturnagaram, 22.xii.1985; 2 ♂♂, Narsingapur, 22.xii.1985; 2 ♂♂, Vijayawada Municipal Park, 27.xii.1985; 1 ♂, Simachalam, 28.xii.1985; 1 ♂, Araku, 918 m., 30.xii.1985.

6. *Parasarcophaga (Liosarcophaga) brevicornis* (Ho)

1934. *Sarcophaga brevicornis* HO, *Bull. Fan. meml. Inst. Biol.*, 5 : 23.

1982. *Parasarcophaga (Liosarcophaga) brevicornis* (HO) : Nandi, *Rec. zool. Surv. India*, 80 : 119.

Material : 2 ♂♂, Andhra Pradesh : Araku, 918 m., 30.xii.1985. This is the first record of this species from Andhra Pradesh.

7. *Parasarcophaga (Liosarcophaga) dux* (Thomson)

1868. *Sarcophaga dux* Thomson, *Kongl. Sven. Freg. Eugen. Resa.*, p. 543.

1982. *Parasarcophaga (Liosarcophaga) dux* (Thomson) : Nandi, *Rec. zool. Surv. India*, 80 : 119.

Material : 1 ♂, Andhra Pradesh : Vijayawada Municipal Park, 27.xii.1985; 1 ♂, Rajahmundry, 29.xii.1985.

It is recorded for the first time from Andhra Pradesh. This species can be reared from Oyster, *Achatina fulica*, dead beetle, decaying toad, dead snake and rotten meat of different animals.

Subtribe HARPAGOPHALLINA

8. *Iranihindia futilis* (Senior-White)

1924. *Sarcophaga futilis* Senior-White, *Rec. Indian Mus.*, 26(3) : 246.

1982. *Iranihindia futilis* (Senior-White) : Nandi, *Rec. zool. Surv. India*, 80 : 118.

Material : 1 ♂, Andhra Pradesh : Narsampet, 23.xii.1985.

This species is recorded for the first time from Andhra Pradesh. It is collected from flowering plants.

9. *Iranihindia martellata* (Senior-White)

1924. *Sarcophaga martellata* Senior-White. *Rec. Indian Mus.*, 26(3) : 247.

1979. *Iranihindia martellata* (Senior-White) : Nandi, *Oriental Ins.*, 13(1-2) : 202.

Material : 1 ♂, Andhra Pradesh : Mangalagiri, 27.xii.1985.

It is recorded for the first time from Andhra Pradesh and was collected from flowering plants.

Subtribe SARCOSOLOMONINA

10. *Sarcosolomonina (Parkerimyia) rohdendorfi* Nandi

1976. *Sarcosolomonina (Parkerimyia) rohdendorfi* Nandi, *Oriental Ins.*, 10(1) : 12.

Material : 1 ♂, Andhra Pradesh : Araku, 918 m., 30.xii.1985.

This species is recorded for the first time from Andhra Pradesh and was collected from flowering plants.

Subtribe SENIORWHITEINA

11. *Seniorwhitea krameri* (Böttcher)

1912. *Sarcophaga krameri* Böttcher, *Ent. Mitt.*, 1 : 166.

1982. *Seniorwhitea krameri* (Böttcher) : Nandi, *Rec. zool. Surv. India*, 79 : 460.

Material : 2 ♂ ♂, Andhra Pradesh : Mangalagiri, 27.xii.1985.

It is recorded for the first time from Andhra Pradesh.

Subtribe HARPAGOPHALLINA

12. *Thyrosocnema (Pseudothyrosocnema) indica* Shinonaga and Lopes

1924. *Sarcophaga caudagalli* Senior-White, *Rec. Indian Mus.*, 26(3) : 227.

1975. *Thyrosocnema (Pseudothyrosocnema) indica*, Shinonaga and Lopes, *Pacif. Ins.*, 16(4) : 459.

Material : 1 ♂, Andhra Pradesh : Araku, 918 m., 30.xii.1985.

This species is recorded for the first time from Andhra Pradesh and was collected from bush sweeping.

SUMMARY

Systematic account of twelve species of Sarcophagid flies from Andhra Pradesh is given. *Parasarcophaga* (s.str.) *hirtipes* (Wiedemann), *Parasarcophaga* (*Liosarcophaga*) *dux* (Thomson), *Parasarcophaga* (*Liosarcophaga*) *brevicornis* (Ho), *Iranihindia* *futilis* (Senior-White), *Iranihindia* *martellata* (Senior-White), *Sarcosolomon* (*Parkerimyia*) *rohdendorfi* Nandi, *Senior-whitea* *krameri* (Böettcher), and *Thyrsocnema* (*Pseudothyrsocnema*) *indica* Shinonaga and Lopes, are recorded for the first time from Andhra Pradesh.

ACKNOWLEDGEMENTS

The author is grateful to Dr. Subrata Dutta, Officer-in-Charge, Krishnanagar Govt. College, for laboratory facilities. The author is indebted to The Director, Zoological Survey of India, Calcutta, to permit to work on this group under Collaborative Research Project and Contractual Services in Zoological Survey of India and also for financial help and other facilities during the survey.

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INDIAN SPECIES OF THE GENUS *AULACOBOTHRUS* BOLIVAR (ORTHOPTERA : ACRIDIDAE)

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INTRODUCTION

The genus *Aulacobothrus* Bolivar, 1902, which is predominantly an oriental one, has been little studied in recent years. There was confusion regarding the exact number of valid species of the genus in India, and their taxonomy etc. Kirby (1914) in his fauna enlisted six species from India but without providing any key and with few illustrations for their easy identification. As was usual in those days, species were described superficially and mainly on the basis of colouration, and most of the species were described on a single specimen, often on one sex only and without providing any differential characters. All these lacunae, associated with non-availability of comparable material made their study extremely difficult for Indian scientists.

Lately Bhowmik (1985) gave a list of all valid species from India till date, basing chiefly on literature. In the meantime, he (the present author) collected a good number of Gomphoceriae material and sent some interesting ones to Dr. N.D. Jago, Overseas Development Natural Resources Institute, London, for his opinion and confirmation. As a result of this study, three more interesting species described from outside India, viz., *A. inclytus* Walker, *A. sinensis* Uvarov and *A. seven-hedini* Sjostedt, are added to our fauna; besides, the description of males of *A. sinensis* and *A. jaganathi* are described for the first time. The study has clarified the systematics of other little known species. In the context of present state of our knowledge, 11 valid species of the genus now represent the genus in India.

The distributional pattern of the species of this genus in India shows that S. India (chiefly T.N.) and Orissa house maximum 5 species each, 2 species being common in both the regions. The eastern and the western Himalayas have one species each, while western, Central and Northern parts of the country remain virtually unrepresented barring perhaps the most common and wide spread species, *A. luteipes* only.

In this communication, an attempt has been made to give a preliminary working key of Indian species, based both on material studied here and literature. Such a work is not above suffering from certain imperfections but it is hoped, it will provide necessary impetus and stimulation for further fruitful works in this difficult group in future leading to much needed revision of the genus.

Measurements : All measurements are given in millimetres (mm) and of length, unless otherwise stated.

Abbreviations : States of India are abbreviated as follows :

Tamil Nadu — T. N.; Andhra Pradesh — A. P.; Himachal Pradesh — H. P.; West Bengal — W. B. etc.

SYSTEMATIC ACCOUNT

Order	Orthoptera
Family	Acrididae
Sub-family	Gomphocerinae
Genus	* <i>Aulacobothrus</i> Bolivar, 1902

Key to Indian species of AULACOBOTHRUS

1. Head and pronotum in part or entirely rugulose; lateral carinae nearly straight i.e., concavity of them hardly appreciable 2
 Head and pronotum not rugulose, almost smooth, or if punctured, then very thinly and finely so..... 3
2. Head and pronotum (as well as lateral lobes and other parts of the body generally) densely rugulose throughout; post. tibia reddish (a narrow castaneous lateral stripe may or may not run along vertex-occiput and along sides of pronotal disc) (dist. Burma. E. Nepal. Orissa).....
*sinensis* Uvarov, 1924
 Only metazona somewhat rugulose; post. tibia red, with a pale ring basad (lateral carinae of pronotum often intersected by a black band) (dist. T. N.)*strictus* Bolivar, 1902
3. Lateral carinae more or less parallel-sided, i.e., placed on dorsum of pronotal disc (Post. knees dark brown; post. femur with outer carina brownish or at least with some dark dots along upper margin; a pair of post. ocular brownish stripes may run along head and superior margin of lateral lobes) (dist. Common)*luteipes* Walker, 1871.
 Lateral carinae more or less incurved in middle of pronotal disc 4
4. Tegmen imperfectly developed, short (7.5 mm), in any case not extending beyond middle of post. femora (dist. T. N.)
*infernus* Bolivar, 1902
 Tegmen perfectly developed, as long as or longer than post. femora.... 5

* Jago (1971) treated the genus ranking it as a subgenus of the genus *Dnopherula* Karsch, 1986. This should be treated as a provisional one, since there are a lot of overlapping cases in the subgeneric level, and no clear line of demarkation could be established.

5. Middle of head and pronotum with a pale stripe..... 6
 Head and pronotum without a stripe (i.e., concolourous)..... 7
6. Paler stripe of head and pronotum, which extends up to anal field of tegmen, broad (about 1.5 mm in metazona of *female*); lateral carinae strongly convergent before 1st sulcus, then uniformly divergent; lateral pronotal lobes minutely rugulose, with oval impressions in middle of each superior border; tegmen with considerable width of area having an irregular false vein, infumate, with oblique narrow whitish stigma beyond middle; wing slightly sulphureous basad, gradually darkened towards apex (dist. Afghanistan. Bihar. Orissa. T. N.).....
 *bolivari* Uvarov, 1921
 Paler stripe over head and pronotum narrower (about 1 mm); lateral carinae not so convergent, but may be waving, approximating in middle and widely divergent behind, carinae narrowly pale; pronotal lobes not rugulose while on metazona, it's minutely so; medial area with a regular false vein; wing hyaline (dist. Maharashtra (Bombay). Manipur. Orissa. T. N.).....*decisus* Walker, 1871
7. Tegmen furnished with some sort of brownish spots..... 8
 Tegmen without any detectable sports or dots.....10
8. Wing sulphureous at about up to one fourth length at base and as far as anal margin behind; entire post. tibia (as well as lower sulcus of post. femur) bright red, its base narrowly brown and with two or three indistinct spots on sides nearing base (Tegmen with white transverse veins beyond middle) (dist. Darjeeling).....*rubripes* Navas, 1905
 Not as above..... 9
9. Wing hyaline but infumate at apex; post. tibia testaceous (dist. Orissa. H.P.).....*jaganathi* Bhowmik, 1985
 Wing wholly hyaline; post. tibia orange red in colour (dist. Karnatak. T. N.).....*collinus* Uvarov, 1929
10. Sides of head and pronotum may be furnished with a pair of post ocular wide, brown stripes; tegmen a little shorter than abdomen; wing may be a little infumate apicad; post. femoral knees dark brownish (dist. ? (tc). Orissa)..... *inclytus* Walker, 1871
 No stripe, concolourous; tegmen surpasses abdomen by about 3 mm; wing wholly hyaline; post. leg broadly testaceous throughout (i.e., its knees not darkened) (dist. China (t.c.) H.P)
 *seven-hedini* Sjostedt, 1933

***Aulacobothrus bolivari* Uvarov**
(Pl. 1, Figs. 1-2)

1921. *A. bolivari* Uvarov, *Ann. Mag.nat.Hist.*, 7 (9) : 483.

Material : 1 ♀; Dhenkikote, Orissa; 1.10.85. 3 ♂♂; Kheorjhar, Orissa; 26.9.85 and 1.10.85; H.K.B. Coll. 2 ♀♀; Joshipur, Kheorjhar dist., Orissa; 7-9.10.85; H.K.B. Coll. 1 ♂, 2 ♀♀; Badrama, Sambalpur dist. Orissa; 25.3.85. 1 ♀ (and 8 nymphs) H.P. (Mandi, Simla, Sundor Nagar); Sept. - Oct. 80; H.K.B. coll.

Remarks : The species was described on the basis of material from Chapra (Bihar), Koilapati (T.N.) and on specimens of unknown locality. Later, in 1969, Cejhan recorded it from Afghanistan (*Acta.Mus.Mor.*, 54 (Supple) : 261). It is now newly recorded from Orissa.

The specimens in hand almost entirely agree with the description given by Uvarov (op. cit) barring that they are a little smaller in size and in 2fem. specimens the tegmina do not bear and dark spot. But, in tegmina, the presence of an oblique whitish stigma and false vein in medial space are remarkable and unique. Additionally the presence of two to three oval impressions in antero - upper margin of pronotal lobes are diagnostic.

<i>Measurements</i> :	♂	♀
Body	16 - 17	23 - 24
Antenna	7 - 7.5	8
Pronotum (p)	3.25 - 3.5	4.5 - 4.75
Max. width of metazona (mp)	2.25 - 2.5	3.5 - 3.75
Ratio of p/mp	1.4	1.3
Tegmen	12.5 - 13.5	18.5 - 19
Post. femur (f)	9.5 - 10	14 - 14.5
Max. depth of post.femur (mdf)	2.5 - 2.75	4 - 4.5
Ratio of f/mdf.	4	3.4

***Aulacobothrus sinensis* Uvarov**
(Pl.1, Fig. 3, pt.2, Figs. 4-5)

1924. *A. sinensis* Uvarov, *J. Proc. Assiat. Soc. Bengal*, (n. s.), 20 (6) : 318-319.

Material : 3 ♂♂ (one with abdomen and post. legs wanting), 5 ♀♀ (and 4 ♀♀ nymphs, probably of 3rd instar stage); Harishankar, Bolangir dist, Orissa; 20.3.86; H. K. B. Coll. 1 ♀ (head and legs wanting); Mothanguri, Manas Sanctuary, Assam; 13.6.75; R. K. Ghosh Coll. 1 ♀, 1 ♀; Badrama, Sambalpur, Orissa; 26.3.86; H. K. Bhowmik coll.

Remarks : The species was described, on a single ♀ specimen, from W of Yangtsien, (8000), Yunnan, Burma and later recorded from Eastern Nepal. The present

series was collected from Orissa at the foothill of Gandharva, which is almost in a plain land, bordered mostly by agricultural lands. The specimens were collected from dry leaves of Teak and Mahua, with almost no green undergrowth, though the area was bordered by nearby winter paddy cultivation. Assam material was collected from deep jungle.

The availability of nymph in March indicates its post-winter breeding season. The species is recorded here for the first time from India-proper.

The series further provides opportunity to revise the characters of female and description of ♂ for the first time.

Additional description (♀) : Antenna decidedly shorter than head and pronotum, 20-21 segmented, 3rd to 11 segments thick, then 4-5 segments attenuated, remaining apical segments somewhat clubbed shaped, acuminate at apex. Face entirely densely rugulose. Foveolus hardly indicated (not distinct in true sense), very shallow, rugulose; bowed transverse sulcus of fastigium of vertex distinct; median carinula of vertex and occiput may or may not be indicated, its lateral carinulae may not be detectable due to dense rugulose conditions. Interocular space wide, about 3 times wider than width of frontal ridge between antennae. Prozona about one and a half times longer than metazona, more irregularly and roughly rugulose than metazona which is more densely but regularly rugulose; median carina crossed by posterior sulcus only; lateral carinae may be of variable emphasis-distinct, or sinuated, or indistinct due to heavy punctuation or rugae; in any case, it is only slightly curved in middle; narrowest area being before 2nd sulcus; lateral carinae often being interrupted, broken due to heavy punctuation, on metazona; it is, however, distinct and divergent. In basal half, tegmen may be provided with irregular and indistinct brownish spots; cells of apical half very much elongated, with brownish tinge in middle. Wing slightly greenish-yellow, infumate at apex, particularly at costal lobes. Posterior femur thick at base, attenuate at apex, its external lobes rounded; post. tibia with 9 external and 10 internal black tipped spines. Supra-anal plate tongue shaped, with broad groove and having a transverse sulcation in middle. Interspace of mesosternum more wider than its lobes, which are transverse, with rounded inner angles and concave lower margins.

♂ (previously undescribed) : Very similar to *m. m.* except smaller in size and differ in some very minor points - its prozona clearly one and a half times as long as metazona; interocular distance not more than double width of frontal ridge between antennae; temporal foveolae may be represented by a few punctuation only. Post. tibia with 8 external and 9 internal spines. Cercus conical. Antennae similar to those of females; 18-19 segmented; as long as head and pronotum taken together.

Nymphs : 21-23 mm. Easily identifiable as being immature stages of adults. All parts including genital ones and excluding tegmina are of adult-type. Median and lateral carinulae of fastigium of vertex somehow recognizable. Antennae more or less

ensiform, from 3rd to 9th joints this pattern is clear. Lateral carinae of pronotum more distinct owing to lesser punctuation of disc; on profile, regularly curved, i.e., concavity clear; median carina more low than adults. Head and face almost smooth, differing strikingly with adults.

Colouration : Agrees with original description barring presence of castaneous lateral stripes of head and pronotum; which are absent in most cases, (present in only 2 ♀♀ for this study); in one ♂, a brownish stripe exists in superior border of lateral lobes. Nymphs are also devoid of these stripes.

Measurements :	♂	♀
Body	19 - 20	25 - 26
Antenna	6 - 6.5	7.5 - 8
Pronotum (p)	3.5 - 4	4.5 - 5.25
Maxi. Width of metazona (mp)	2.5 - 2.75	3.25 - 3.75
Ratio of p/mp	1.4	1.4
Tegmen	14.5 - 15	17.5 - 20.5
Post. femur (f)	11.5 - 12	14 - 14.5
Maxi. depth of p. femur (mdf)	3.2 - 3.4	4 - 4.25
Ratio of f/mdf	3.5	3.4

Discussion : The present materials show that they are bigger in size than the measurement of the *fem.* holotype (Body 20; pronotum 4; tegmen 16; and post. femur 11). The characterization of the species that they "differ from other known species of the genus by the straight lateral pronotal keels" is not perfectly true. The lateral carinae of the species, *A. luteipes*, are truly and completely straight, than in other species of the genus. However, the coriaceous type of tegmina associated with non-expanded costal and cubital areas and entirely rugulosed body give it a unique position among Indian species.

Aulacobothrus inclytus (Walker)

(Pl.2, Fig.6)

1871. *Stenobothrus inclytus* Walker, *Cat. Derm Salt. Br.Mus.*, 5 (supple) : 83.

Material : 1 ♀; Joshipur, Orissa; 7.10.85, H. K. Coll. 1 ♀; (damaged) Rampur, Kalahandi dist., Orissa; 20.10.84; H. K. B. Coll. (1 ♀ retained in Br. Mus. nat. Hist.)

Remarks : The species was described on the basis of a unique a single ♀ specimen, of unknown habitat. The availability of 3 ♀♀ specimens from Orissa indicates that Walker's material might belong to India.

Additional description (♀) : Frontal ridge finely punctured, strongly convex in upper part, on profile. Fastigium of vertex broadly oval, though a little narrowed at apex,

deeply impressed, well margined, with bow-shaped transverse sulcus a little before middle; tricarinate, but lateral carinulae not detectable over vertex and occiput. Lateral carinae of pronotum slightly incurved at level of 1st sulcus; anterior angle of lateral pronotal lobes truncate; metazona shorter than prozona. Tegmen a little shorter than abdomen and rounded at apex; base of precostal region hardly bulging; precostal vein runs up to about half of tegminal length; costal area moderately developed, with a false vein in basal half and with 16 oblique, sinuated venilets in apical portion; medial area having a fine weak false intercalated vein. First cubital area moderately developed and with a weak longitudinal vein. Wing a little shorter than tegmen, hyaline, with infumate apex. Knees of post. femur dark-brown; post. tibia uniformly testaceous, with 11 external and 12 internal black-tipped spines.

Measurements : (1 ♀)

Body	25
Antennae (broken)	?
Pronotum (p)	5.25
Max. width of metazona (mp)	4
Ratio of p/mp	1.31
Tegmen	16.5
Post. femur (f)	15
Max. depth of post. femur (mdf)	3.5
Ratio of p/mdf	4

Discussion : The present specimen is bigger than the ♀ holotype. The colouration differs markedly from the original description. Two broad, brown stripes of head and pronotum, behind eyes, are lacking; instead, there are two, small horn-shaped colour marking in the middle of metazona, adjacent to post. sulcus, in one example (Joshipur) but in the damaged example (Rampur) even this marking is lacking.

Aulacobothrus sven-hedini Sjostedt

1933. *A. sven-hedini* Sjostedt, *Ark. for Zoologi*, 25 A (3) : 23 (1934).

Material : 2 ♀♀; Noorpur, Kangra dist., H. P. ; 14-18.10.82. 1 ♀ (and 1 fem. nymph); Sundargarh, H. P., 2.10.82. All by H. K. B.

Remarks : The species is described, on both sexes, from China, pointing out its very close resemblance to *A. gracilis* Uvarov, 1921 (*Ann. Mag. nat. Hist.*, 8(9) : 381) from S. Africa. The occurrence of the species in H. P. is very interesting and is not unlikely.

Additional description (♀); Antenna filiform, 28-29 segmented, longer than head and pronotum taken together. Fastigium of vertex pentagonal, impressed, tricarinate which

extends back over vertex and occiput. Foveolae elongated-oval, well margined. Narrowest point of lateral carinae just after first sulcus, distinctly incurved; median carina linear, distinct, raised, cut by posterior sulcus only; metazona a little shorter than prozona; lateral pronotal lobes finely rugulosed. Tegmen almost transparent; precostal region with a small expansion, and with a false vein; costal area moderately wide basad and traversed by about 15-16 oblique veinlets; medial area with a weak intercalated vein; cubital area slightly expanded; apex rounded; longer than abdomen by 3-3.5 mm and from post. femur by about 1 mm. Wing perfectly translucent; as long as tegmen. Knees of post. femur concolourous with body colour, i.e., rufo-testaceous. Post. tibia with 11 black tipped spines on both margins; a little pilose; uniform rufo-testaceous.

Nymph. 16 mm. Easily identifiable with the adult.

Measurements : (♀ only)

Body	17.5 - 20.5
Antenna	6.5 - 7
Pronotum (p)	4 - 4.25
Maxi. width of Metazona (mp)	3 - 3.5
Ratio of p/mp	1.27
Tegmen	15 - 16
Post. femur (f)	11.5 - 12
Max. depth of post. femur (mdf)	3.25 - 3.5
Ratio of f/mdf	3.5

Aulacobothrus decisus (Walker)

(Pl. 3, fig. 8)

1871. *Stenobothrus decisus* Walker, *Cat. Derm. Salt. Br. Mus.*, 5 : 80.

Material : 1 ♀ (legs wanting); Churachandpur, Manipur; 20.11.83; S. K. Gupta Coll. 1 ♀ (legs wanting); Barkuda island, Chilka Lake, Orissa; 27.9.83; H. K. B. Coll.

Remarks : The species was described from Bombay on *fem.* sex. In 1921 Uvarov synonymised *Aulacobothrus socius* Bolivar, 1902 (*Ann. Soc. ent. Fr.* 70 : 599) with it which was described from T. N., on both sexes. The availability of the species now from Manipur and Orissa extends its range of distribution. The specimens in hand agrees well with known account and is recognised by the distinguishing characters as mentioned in the key.

Aulacobothrus luteipes (Walker)

1871. *Stenobothrus luteipes* Walker, *Cat. Derm. Salt. Br. Mus.*, 5 : 82.

Material : A.P. : 2 ♂♂, 6 ♀♀; Araku valley; 6.9.83. Orissa : 5 ♂♂, 3 ♀♀

(and 1 ♂ nymph); Jenabil; 9.10.83. 5 ♂♂, 3 ♀♀ (and 1 ♀ nymph); Joshipur; 6.10.85. 5 ♀♀, Koraput (DNK Rest-House) 13-14.9.84. H. P. : 12 ♂♂, 14 ♀♀ (and 4 nymphs); different localities; Sept. 1980. All by H.K.B.

Remarks : It is one of the most common representative of the genus in India and is currently redescribed by Bhowmik (1986) from material of W.B. The long series of specimens, now in hand, however, exhibits some minor variations.

Frontal ridge slightly sulcate in *m.*; but in *fem.* always flat and convex, with sparse punctuation, at least in basal portion. Fastigium of vertex well grooved, wider than long; middle carinula sometimes very prominent, entire or starting from behind bowshaped sulcus, often separating it into two parts; lateral carinulae often not detectable over vertex, though present anteriorly. Temporal foveolae though somewhat oval, always with lower margin straight, thus sometimes giving it semi-lunar shape. Lateral carinae of pronotum though more or less straight up to 2nd transverse sulcus, variable in metazonal area - sometimes, they are straight here also, but often a little divergent; often in prozonal area also, they are somewhat flexuous in middle; but on the whole, present parallelism, i.e., concavity of them nil or practically nil, particularly in *fem.*; in *m.* they may be a little divergent at anterior margin of pronotal disc. Sometimes lateral carinae indistinct, in *m.*, in posterior border of metazona. In tegminal venation, in *fem.* costal area having about 16-17 oblique, sinuous veinlets, while in *m.* they are regularly oblique and this area more bulging and prominent, specially in middle. In *m.*, medial area may or may not have a false vein. First cubital area (or ulnar), space between cubital and post cubital veins, with a prominent false vein, having transverse, straight veinlets on both sides in *fem.*, while in *m.* this area is more pronounced and is occupied by almost 11-12 transverse (resonators) veinlets. Other *m.* tegminal specialization are radial sector truly biramous; radial and medial veins connected by a number of transverse veinlets; vanal_1 and vanal_2 nerves inconspicuous and transverse veinlets at apical two thirds.

Measurements : As given earlier by Bhowmik (1986).

Discussion : The species is highly variable as per as body-colouration is concerned. The most characteristic broad pale stripe, starting from behind eyes and running across head, superior margin of pronotal lobes and up to closed tegmina (whole central longitudinal area) may be lacking or indistinct or hardly visible in most cases. Posterior femora may be with 3 dark bands above or not; the brown knee pigment may be replaced by some blackish dots. Post. tibia testaceous often uniformly but rarely with yellowish area at base.

Aulacobothrus jaganathi Bhowmik, 1985

(Pl. 3, fig. 9)

1985. *Dnopherula (Aulacobothrus) jaganathi* Bhowmik, Bull. Zool. Surv. India, 7 (2-3) : 291-293, Fig. 1, plate v, figs 10-11.

Material : 1 ♂; Barkuda, Chilka Lake, Orissa; 27.9.83; H. K. B. Coll. 1 ♀; Kangra, H. P.; 15.10.82; HKB Coll. 1 ♀; Chauwari, Chamba, H.P.; 16.10.82.

Remarks : The species is described from Balugaon, Puri, Orissa, on *fem.* sex. The present material not only extends its range of distribution but also provides opportunity of describing the male.

Description : ♂ (previously undescribed) : Smaller in size but generally tallies with description of *fem.* with some variations.

Antenna a little longer than head and pronotum taken together. Frontal ridge differs from *fem.* by being a little deplenate (but not sulcate in real sense) in middle, resulting edged lateral carinulae. Tegmen more pronounced than *fem.*; costal vein reaches almost four fifth of total tegminal length, with 11 oblique but irregular shaped veinlets; subcostal area a little expanded and with 9 transverse veinlets; cubital area moderately developed, with six apical curved (resonator) veinlets and four insignificant ones at basal half. Supra-anal plate broadly tongue shaped, apex widely rounded. Cercus conical, spine-like, surpasses supra-anal plate; subgenital plate navicular, pilose. Posterior tibia with 11 external and 12 internal spines.

Measurements : (♂ only)

Body	16
Antenna	7
Pronotum(p)	4
Maximum width of metazona (mp)	2.5
Ratio of p/mp	1.6
Tegmen	14.5
Post. femur (f)	10
Max. depth of post. femur (mdf)	3.25
Ratio of f/mdf	3.2

Discussion : The male specimen was collected from the type locality on the same date as the types, but was not available for study at the times of the description of the species. H. P. is a new record for it.

The species seems to be very close to *A. collinus*, from which it differs in a few minor features. Study of both the species, with more examples of specimens may clear up their taxonomic status.

SUMMARY

The study of seven little known species of the genus *Aulacobothrus* (Gomphocerinae) reveals the previously undescribed male of two species, *A. sinensis* & *A. jaganathi*, with new reports of occurrence of three exotic species, *A. sinensis*, *A.*

inclytus & *A. sven-hedini*, in India; besides, some new intraterritorial records. A working key of Indian species of the genus is prepared and presented herewith, for the first time, on the basis of this study.

ACKNOWLEDGEMENTS

Sincere thanks are due to Dr. N. D. Jago, London, for confirming the identification of the species, to the Director, Z.S.I. for providing necessary facilities for this work and, last but not the least, to Mr. G. Ghosh, for typing the manuscript.

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PLATE I

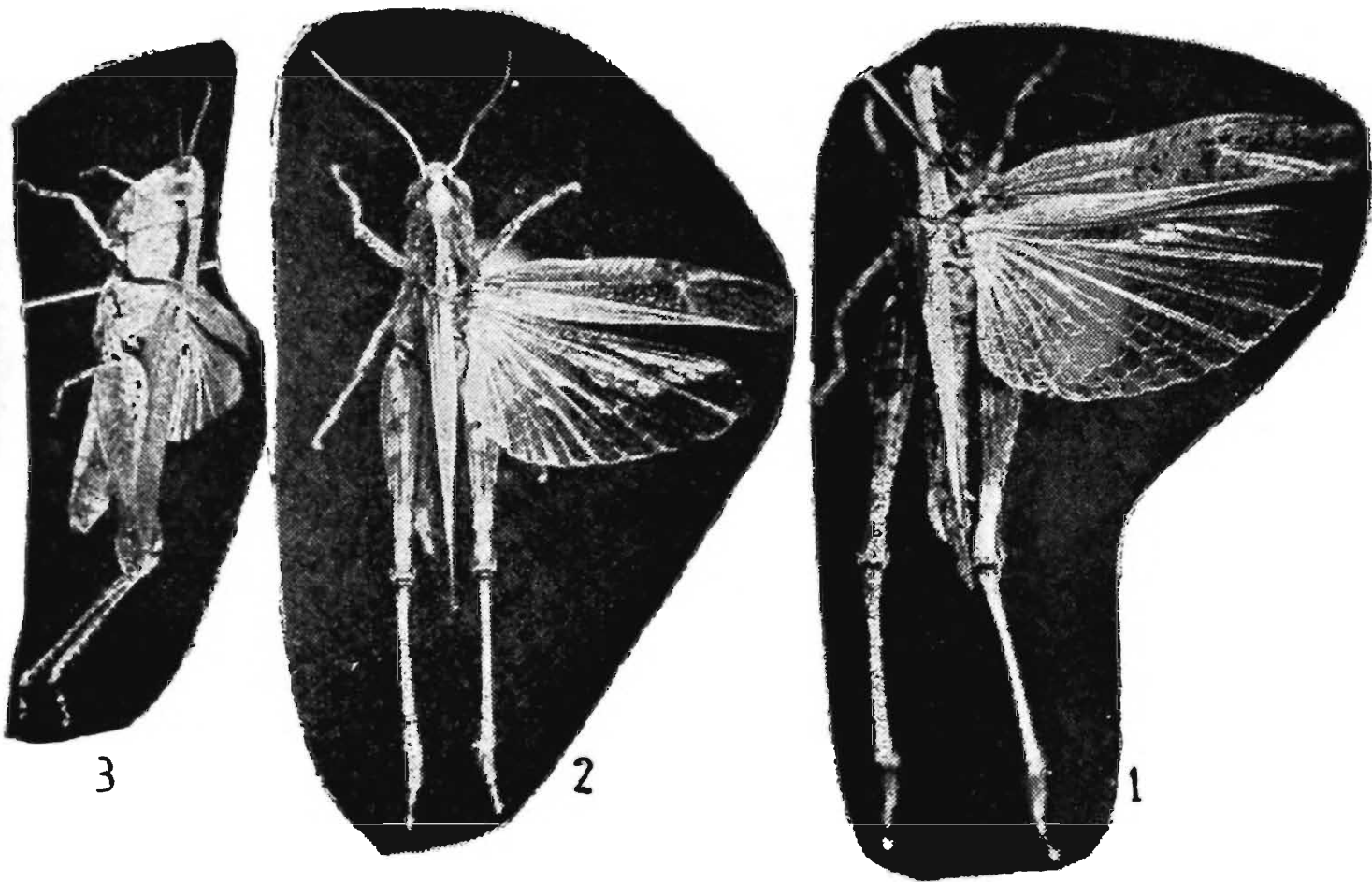


Fig. 1. *Aulacobothrus bolivari* Female.

Fig. 2. *A. bolivari* Male.

Fig. 3. *A. sinensis* Female.

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PLATE II

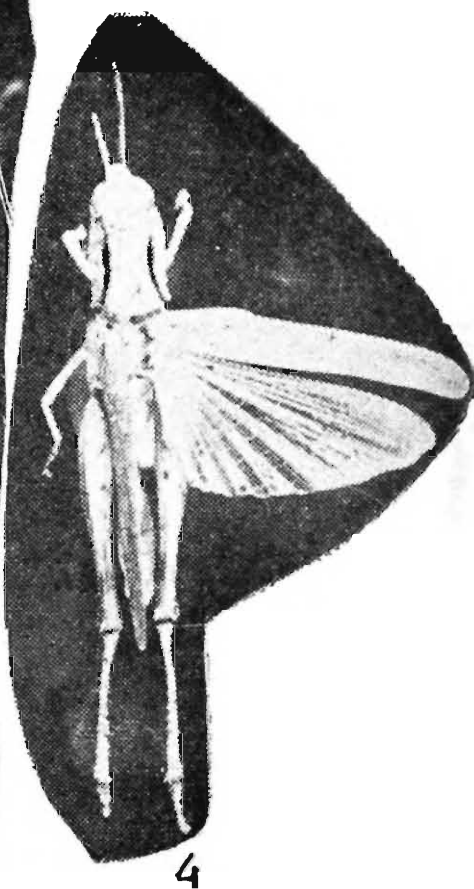
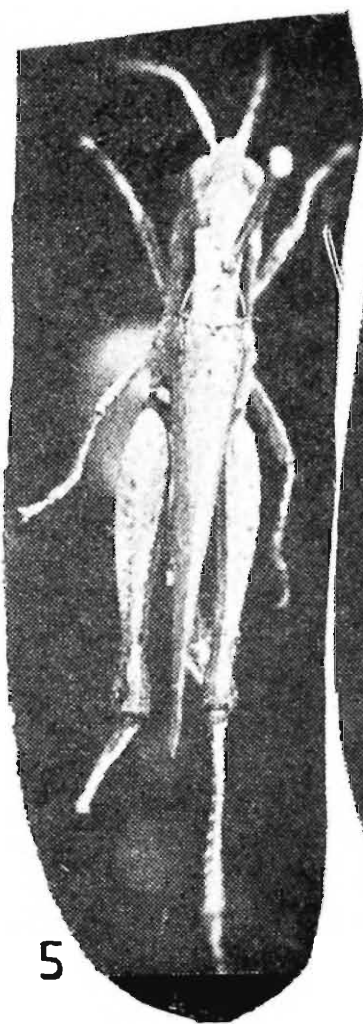
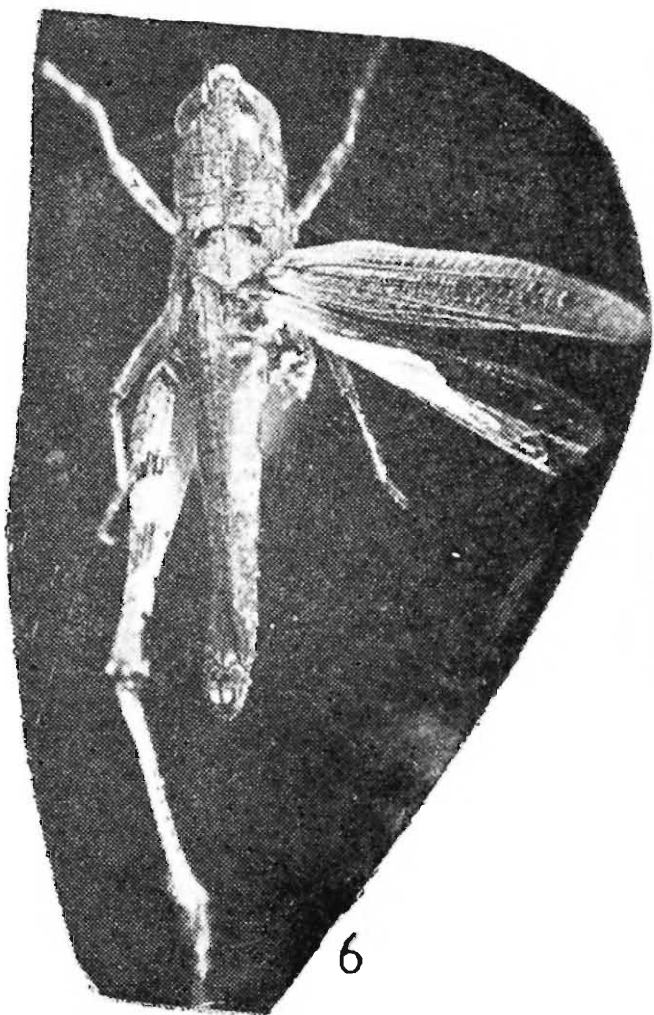


Fig. 4. *A. sinensis* Female.
Fig. 5. *A. sinensis* Male.
Fig. 6. *A. inclytus* Female

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PLATE III

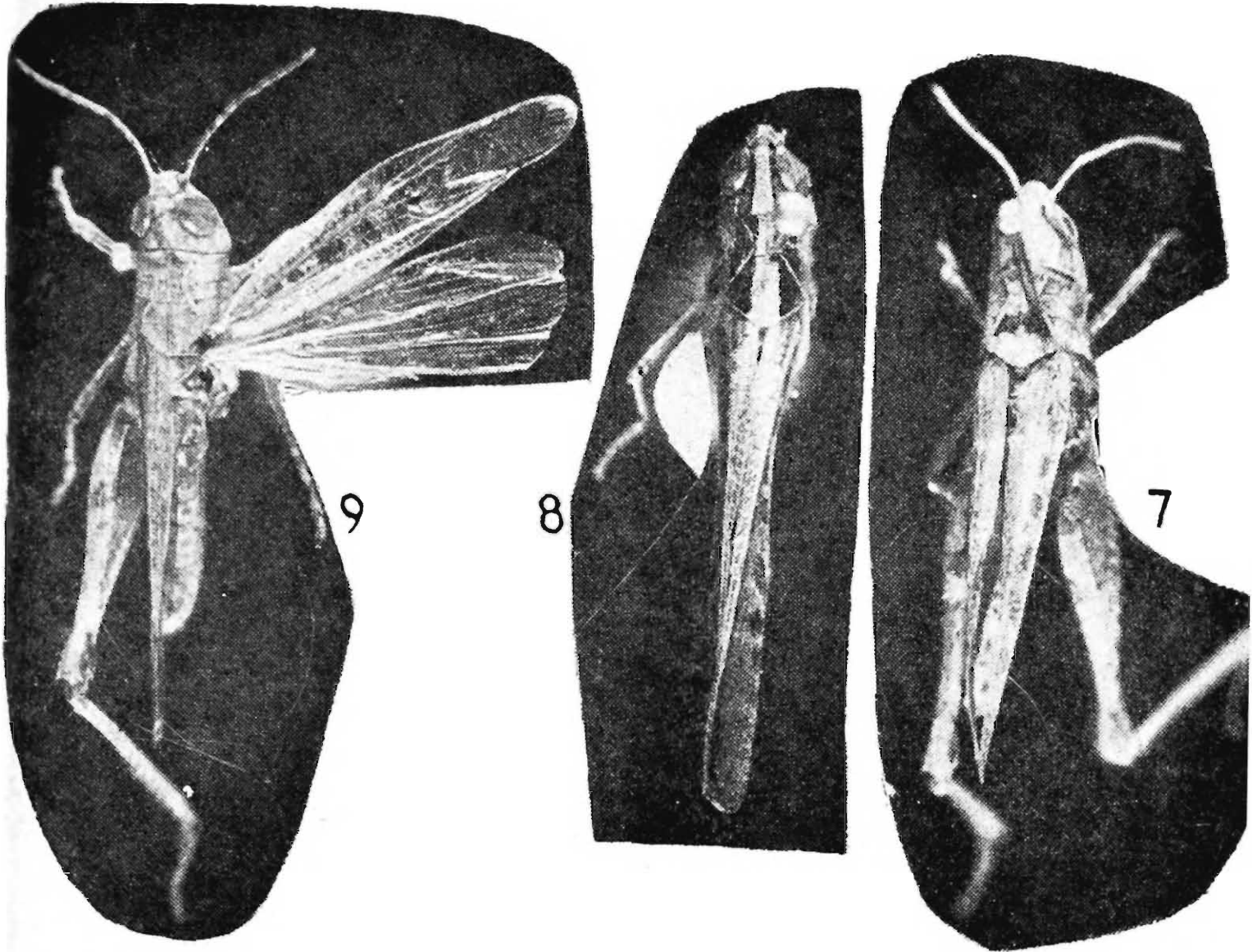


Fig. 7. *A. sven-hedini* Female.

Fig. 8. *A. decisus* Female.

Fig. 9. *A. jaganathi* Male.

CHEMOTAXONOMY OF FIVE SPECIES OF THE FAMILY CHIRONOMIDAE (DIPTERA)

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INTRODUCTION

Biochemical techniques such as paper chromatography, starch gel and cellulose acetate have been increasingly used in taxonomic studies (Wood *et al*, 1958 and Wright and Ross, 1965). Electrophoretic techniques have contributed to the solution of many taxonomic problems relating to origin (Sibley, 1960), the discovery of sibling species (Manwell and Baker, 1963 a and Manwell *et. al*, 1967), the status of species and populations (Baker, 1965), the establishment of affinities (Tashian, 1965) and the recognition of hybridization (Desmer *et al*, 1962). Davis and Lindsay (1964, 1967) initiated the use of disc electrophoresis to show that species of distinct genera have distinct electrophoretic patterns and gave a complete analysis of the use, advantage and standardized procedures applicable to molluscan systematics. It is well known that benthic communities in freshwater ecosystems are characterized by the occurrence of large populations of immature stages of many insect groups. Members of the dipteran family Chironomidae represented by their larvae and pupae form one such important group. While these organisms are of undoubted value as indicators of pollution or as fish food, our knowledge of their taxonomy, particularly in the Indian context is still limited. The general objectives of the present investigations were therefore to collect and study these organisms upon which keys could be formulated for the identification of larvae, pupae and adults.

MATERIALS AND METHODS

The five species of larvae used were *Chironomus costatus* (Johannsen) *Nilodorum stupidus* (Johannsen), *Stictochironomus affinis* (Johannsen) *Tanytus photophilus* Kieffer and *Clinotanytus fumipennis* (Kieffer): Three fractions in each species - homogenate, the haemolymph and the body wall without the haemolymph were separately used for electrophoretic studies. All fractions belonged to larvae of the same population of a given species. Five to eight different populations of 4th instar larvae of each species collected at different periods throughout the year were used for all runs.

While developing polyacrylamide gels for protein separations, Davis and Ornstein (1959) introduced the technique of disc electrophoresis which exploited to maximum advantage the mechanisms responsible for the separation of proteins. Since the original introduction of disc electrophoresis by Davis and Ornstein (1961), many variations of the method have appeared. The method followed here is one of their own improvised and modified versions (Davis, 1964; Ornstein, 1964).

RESULTS

The results obtained on the chemotaxonomic studies of the five species of larvae are presented for the three different fractions. Data on the number of discs, the Rf values, number of peaks and the percentage and densities are given for all the species.

Chironomus costatus (Johannsen)

Homogenate : This fraction had 10 discs, with the four largest peaks at Rf values of 0.184, 0.289, 0.383 and 0.528. The first three peaks had high densities of 14.88%, 17.47% and 17.61%, while the fourth peak was represented by a very faint disc with a density of only 9.39%. The disc at Rf 0.866, though not large was similar to the first peak in having a high density of 14.95%.

Haemolymph : 11 discs were seen and as in the homogenate fraction, the first four discs formed the high peaks, at Rf of 0.290, 0.374, 0.449 and 0.517. However, only the 2nd, 4th and 5th peaks with densities of 17.10%, 17.03% and 16.90% respectively, were maximum. Discs 1, 11 and 3 were next in order of decreasing density with values of 10.65%, 10.21% and 10.00%.

Body wall without haemolymph : A total of 13 discs, of which the first, second, fourth and fifth were placed at 0.267, 0.344, 0.426 and 0.574 with densities of 13.85%, 14.27%, 14.41% and 14.38% were found.

Nilodorum stupidus (Johannsen)

Homogenate : This species revealed 13 discs with distinct peaks at one, two, three, four, five, six, ten and thirteen placed at Rf values of 0.171, 0.215, 0.260, 0.333, 0.390, 0.500, 0.710 and 0.950. However, maximum densities were recorded only in the fifth, sixth, tenth and thirteenth discs with 17.59%, 10.59%, 12.71% and 13.21% respectively.

Haemolymph : 17 discs were present and the prominent peaks were one, three, four, nine and seventeen placed at 0.279, 0.395, 0.468, 0.756 and 0.970. These revealed densities of 13.71%, 10.31%, 18.03%, 11.49% and 9.32% respectively. However, disc seven at Rf value of 0.618, though lacking a high peak had a density of 11.71%.

Body wall without haemolymph : There were 18 discs, with the highest peak placed at Rf 0.438, the sixth which also had the maximum density of 15.09%. Discs one, two, three, four, five, six and eighteen in that order of peak heights were placed at

Rf values of 0.222, 0.242, 0.269, 0.317, 0.371, 0.438 and 0.973 respectively. The discs 9 and 18 showed a density above 11%. The densities of the other discs were insignificant.

Stictochironomus affinis (Johannsen)

Homogenate : Of a total of fifteen discs, one, two, three, four, eight and fifteen had prominent peaks at Rf values of 0.222, 0.313, 0.404, 0.529, 0.697 and 0.965. However maximum density was seen only at disc eight which was 15.63%, with disc fifteen following closely with 14.29%. Discs two with 11.44% and three with 10.48% were next in order of densities.

Haemolymph : This fraction had 13 discs having prominent peaks at two, three, four, five, six, seven and thirteen with Rf values of 0.286, 0.392, 0.464, 0.537, 0.649, 0.708 and 0.969. Discs two, three, four, seven and thirteen recorded high densities of 15.11%, 17.76%, 15.29%, 11.72% and 9.83% respectively.

Body wall without haemolymph : 17 discs were recorded in this fraction with discs one to seven and seventeen at Rf of 0.141, 0.213, 0.300, 0.403, 0.492, 0.567, 0.665 and 0.960 having high peaks. Discs two, three, four, seven and seventeen had densities of 11.21%, 13.39%, 13.16%, 11.18% and 12.78%. The highest peak observed for disc one which had a density of only 9.38%.

Tanypus photophilus (Kieffer)

Homogenate : There were 19 discs with high peaks at one, two, three, five, fifteen, seventeen and nineteen at Rf values of 0.122, 0.210, 0.300, 0.388, 0.782, 0.877 and 0.953. High densities were recorded only in the three discs of one, two and nineteen with 13.42%, 12.90% and 13.72% respectively.

Haemolymph : 15 discs with prominent peaks at one, two, three, four, and fifteen placed at 0.164, 0.242, 0.324, 0.436 and 0.956 and with densities of 9.52%, 10.59%, 8.63%, 14.21% and 21.63% were recorded. Disc seven, though failing to show a prominent peak had a density of 10.80%.

Body wall without haemolymph : There were 17 discs with the prominent peak at disc seventeen with an Rf of 0.983 and density of 5.94%. Discs three, seven, thirteen and fourteen at 0.350, 0.570, 0.670, and 0.808 had high densities of 12.60%, 12.75%, 10.67% and 21.96% respectively though they showed no prominent peaks.

Clinotanypus fumipennis (Kieffer)

Homogenate : 10 discs were present in this fraction with high peaks at one, two, three, eight, nine and ten placed at Rf values of 0.233, 0.324, 0.400, 0.800, 0.902 and 0.921 respectively. High densities were recorded in discs one, three and eight with 18%, 12.2% and 14.8%. Discs six at Rf 0.678 though showed a comparatively small peak had a density of 13.2%.

Haemolymph : This fraction showed 12 discs with large peaks at discs one, two, three, four and twelve at Rf 0.145, 0.216, 0.300, 0.403 and 0.950. Only the fourth and the twelfth discs showed high densities of 13.27% and 16.07% respectively.

Body wall without haemolymph : Of the 12 discs the large peaks were one, two, three, four, six and twelve at Rf of 0.171, 0.253, 0.328, 0.405, 0.558 and 0.910. Discs two, four, six and eight recorded densities of 10.86%, 14.78%, 11.60% and 11.60% being the maximum.

DISCUSSION

The values of the three fractions, homogenate, the haemolymph and the body wall without the haemolymph were compared with a view to choose that tissue fraction which would reveal the most stable results. In four of the species, the body wall without haemolymph fraction showed maximum number of discs than the other two fractions (Table I). It is not quite clear why the body wall fraction alone yielded more discs. The muscle content present in an unmixed condition should possibly be the cause as was also shown earlier for foot muscles in molluscs (Davis and Lindsay, 1967), and for fish muscle myogens (Devadasan and Nair, 1971). In the present study, peaks occurred at different levels in the three fractions even within the same species. Their densities expressed as percentages also vary likewise. It is known that heights of peaks could alter depending upon the amount of protein component, since faint bands with low densities could form a high peak by spreading (Davis and Lindsay, 1967). Thus these two parameters of peak heights and density percentages were likely to show variations. Irrespective of these differences, peaks were always located by their Rf values.

TABLE - I

Total number of discs in the three fractions of all species

	<i>Homogenate</i>	<i>Haemolymph</i>	<i>Body wall</i>
<i>Chironomus costatus</i> (Johannsen)	10	11	13
<i>Nilodorum stupidus</i> (Johannsen)	13	17	18
<i>Stictochironomus affinis</i> (Johannsen)	15	13	17
<i>Tanytus photophilus</i> (Kieffer)	19	15	17
<i>Clinotanypus fumipennis</i> (Kieffer)	10	12	12

An interesting fact emerging from the study of the peaks is that in all the five species usually the first four discs and the last disc showed prominent peaks. This being one of the pioneering investigations in the chemotaxonomic approach to chironomid taxonomy, one is prompted to suggest that the fore part of the gel and the last peak

close to the front of separation were probably the most important regions for taxonomic considerations in this group. Similar demarcations of gel regions for molluscan chemotaxonomy exist (Davis and Lindsay, 1967).

Irrespective of the species, the Rf values for a given disc were more or less the same. All the discs recorded were serially arranged and compared for the five species and for each fraction with a view to locate commonly occurring discs among the species and to relate them for possible taxonomic relationships. Even though the homogenate and haemolymph fractions were given more consideration as they showed the largest number of discs. Among the species belonging to the Tribe Chironomini (sub-family Chironominae) discs 19, 20, 23, 25 and 29 were common for all the three species. Likewise discs 3, 8, 18, 19 and 29 were common for the species of the sub-family Tanypodinae. These two sub-families Chironominae and Tanypodinae appeared chemotaxonomically different groups. When the relationship was estimated among the three species of Chironominae by the occurrence of common discs between any two species, it was seen that *Chironomus costatus* (Johannsen) had ten discs in common with *Nilodorum stupidus* (Johannsen) while it had only six discs in common with *Stictochironomus affinis* (Johannsen), whereas *Nilodurim stupidus* had nine discs common with the latter. Thus *Chironomus costatus* (Johannsen) and *Nilodorum stupidus* (Johannsen) showed more affinity with one another than with *Stictochironomus affinis* (Johannsen). This chemotaxonomic relationship shown between the genus *Chironomus* and *Nilodorum* are in confirmity with the morphotaxonomic findings. Since availability of knowhow of chemotaxonomic techniques prompted the application of the same to the present group of organisms. The results are more exploratory rather than conclusive in nature, as there are very few published works available on the chemotaxonomic studies on Chironomidae.

SUMMARY

Members of the Dipteran family Chironomidae, represented by their larvae and pupae for an important group in benthic communities of freshwater ecosystems. While these organisms are of value as fish food or pollution indicators, the knowledge of their taxonomy is limited particularly with reference to tropical latitudes. Chemotaxonomic studies were done using polyacrylamide gel electrophoretic technique. The fractions such as homogenate, the haemolymph and the body wall without the haemolymph were used separately for five species from the fourth instar larvae. The two sub-families Chironominae and Tanypodinae appeared as distinct chemotaxonomically different groups. Among the three species of Chironominae (Tribe: Chironomini) it was seen that *Chironomus costatus* (Johannsen) and *Nilodorum stupidus* (Johannsen) show more affinity with one another than with *Stictochironomus affinis* (Johannsen).

ACKNOWLEDGEMENTS

Our sincere thanks are due to Mr. Gene K. Lindsay, Museum of Zoology, University of Michigan, Michigan, U.S.A., who offered valuable help with the densitometric readings. To the Head, Department of Biological Sciences, Madurai University, Madurai - 625 021, our gratitude for offering his valuable suggestions, constant encouragement and necessary facilities.

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**TYPE-SPECIMENS OF *MURINA CYCLOTIS* DOBSON, 1872
(CHIROPTERA : VESPERTILIONIDAE) AND THEIR CURRENT
REPOSITORIES**

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INTRODUCTION

Dobson (1872) while describing his *Murina cyclotis* states, 'Besides the original specimen sent by Major Sherwill others have since been received by the Museum from Captain Elwes, Dr. Stoliczka, and Mr. Mandeli, but all have been obtained at Darjeeling' Four years afterwards, however, the same author (Dobson 1876), while cataloguing the specimens of bats in the Indian Museum, Calcutta, lists (Dobson's Catalogue Number 696) a spirit-preserved female specimen of *H.[arpiocephalus] cyclotis* of unknown locality, donor and date as the '(Type)' of *H. cyclotis* (= *Murina cyclotis*). Anderson (1881) in his catalogue of the mammals of the Indian Museum enlists (Anderson's Catalogue Number 166a) an adult female specimen of unknown history as the type of the same taxon. Wroughton (1918) states that the type-locality of *Murina cyclotis* is unknown. Both Tate (1941) and Khajuria *et al.* (1977) agree that the type-locality of *Murina cyclotis* is Darjiling.

Further, Dobson (1872, 1876, 1878), Anderson (1881) and Wroughton (1918) all agree that the type-specimen of *Murina cyclotis* Dobson, is in the Indian Museum, Calcutta. However, according to Tate (1941), the type-specimen in question is in the British Museum, London. Again, Khajuria *et al.* (1977) list the holotype of *Murina cyclotis* to be present in the Zoological Survey of India, the institution which received the entire collection of mammals from the Indian Museum.

It would, therefore, follow that the exact identity of the type-specimen of *Murina cyclotis* Dobson, including its place of origin, donor, date and the current repository are in a state of confusion. The present short communication aims at removing this confusion.

HOLOTYPE

From the statement of Dobson (1872) quoted at the very beginning, it is quite clear that the place of origin of the 'original specimen' (= holotype) of *Murina cyclotis* is Darjiling and its donor is one Major Sherwill. Blyth (1863) lists (Blyth's Catalogue Number 107A) one specimen of *Murina suilla*, preserved in spirit, sent by Major W. S. Sherwill from 'Dorjiling' (= Darjiling) in the year 1853. Dobson (1876) further lists (Dobson's Catalogue Number 698) a male specimen of *H. cyclotis* from Darjiling and

mentions Major Sherwill as the donor, 1853 as the date, and states that this specimen is the same as Blyth's (1863) No. 107A. Thus, the particulars of this specimen as are available from Blyth (1863) and Dobson (1876), are as follows : a male specimen preserved in spirit, sent by Major W. S. Sherwill from Darjiling, in the year 1853. These particulars are in conformity with the 'original specimen' of *Murina cyclotis* as given by Dobson (1872) in the original description. Contrary to these, Dobson (1876) puts no information under the columns 'How preserved' and 'Remarks' for this specimen where 'In spirit' and '(Type)' respectively would have been the legitimate entries. To make the situation worse, another specimen (Dobson's Catalogue Number 696, mentioned earlier), a female whose locality, date and donor are not known according to the author (but see below), has been listed as the type-specimen. This, obviously, is due either to printing error or to an error in the manuscript itself. The former possibility appears to be more acceptable, for one who has written that the type-specimen is from Darjiling and the donor is Major Sherwill (Dobson 1872) is not expected to express his ignorance as to the locality and donor of the same specimen only four years afterwards (Dobson 1876), especially when one refers the specimen in question to Blyth's Catalogue Number 107A against which further details of the donor, and the date are clearly mentioned. Furthermore, that there has been at least one major printing mistake (transposition of one manuscript page) in Dobson's (1876) 'Monograph of the Asiatic Chiroptera' ('Catalogue of specimens of the species of Chiroptera in the collection of the Indian Museum' forms the second part of the same book), has been detected by Dobson (1878, foot-note on page 280) himself.

The error mentioned above has been perpetuated by Anderson (1881) who states that an adult female specimen (Anderson's Catalogue Number 166a) of unknown history, is 'The type' of *H. cyclotis*, but also lists (Anderson's Catalogue Number 166c) an adult male preserved in alcohol, Darjiling as the locality, Major Sherwill as the donor and 1853 as the date, and refers it to Blyth's Catalogue Number 107A. Wroughton (1918), following Anderson (1881), also gives the type-locality of *Murina cyclotis* as unknown. Khajuria *et al.* (1977) also consider the same specimen (166a, Zoological Survey of India Registration Number 15605) as the holotype of *Murina cyclotis* Dobson. According to these last-named authors, the type-locality is, however, Darjiling, but the donor and date of this specimen are not known.

From the foregoing discussion, it can be concluded that the specimen bearing Blyth's Catalogue Number 107A, Dobson's Catalogue Number 698 and Anderson's Catalogue Number 166c –an adult male sent from Darjiling in 1853, by Major W. S. Sherwill and preserved in spirit, is the holotype of *Murina cyclotis* Dobson, 1872, and not the specimen bearing Dobson's Catalogue Number 696, Anderson's Catalogue Number 166a and Zoological Survey of India Registration Number 15605 whose place of origin, donor and date are either totally (according to Dobson 1876 and Anderson 1881) or partially (according to Khajuria *et al.* 1977) unknown (but see below).

PARATYPES

Besides the 'original specimen' (= holotype) discussed above, Dobson (1872) had before him at least three other specimens of the same taxon from three different donors, viz., Captain Elwes, Dr. Stoliczka and Mr. Mandelli*, and all from Darjiling. No doubt these three specimens were also utilised by the author in describing *Murina cyclotis*. These three specimens, therefore, are to be considered as the paratypes of *Murnia cyclotis* Dobson, 1872.

The particulars of these specimens (paratypes) are as follows (*vide* Dobson 1872, 1876; Anderson 1881; Khajuria *et al.* 1977) :-

(1) Dobson's Catalogue Number 696, Anderson's Catalogue Number 166a, Zoological Survey of India Registration Number 15605, adult female in spirit, Darjiling, Dr. F. Stoliczka or Mr. L. Mandelli, between 1863 and 1872.

(2) Dobson's Catalogue Number 697, Anderson's Catalogue Number 166b, adult unsexed, perfect skeleton prepared in 1872, Darjiling, Dr. F. Stoliczka or Mr. L. Mandelli, between 1863 and 1872.

(3) Dobson's Catalogue Number 699, Anderson's Catalogue Number 166d, adult unsexed, dried skin (mutilated specimen), Darjiling, Captain J. H. Elwes**, 1870.

Since Blyth (1863) did not list these three specimens which were available at Dobson's (1872) disposal, the dates of these specimens would naturally be between 1863 and 1872. In fact, the date of the last specimen is 1870.

TYPE-REPOSITORIES

All the primary types (holotype and three paratypes) of *Murina cyclotis* Dobson were at the Indian Museum at least up to the year 1881 (Anderson 1881). These specimens were present at the same place possibly as late as 1907 when the type-specimens of bats of the Indian Museum were loaned out to the British Museum, London, for Knud Andersen's study (Hill 1987). It might have so happened that all the four type-specimens of *Murina cyclotis* (in fact, the entire collection of *Murina cyclotis* at the Indian Museum at that time) were sent to London. The second possibility is – by judging from the data available with the specimens themselves at that time, the specimen donated by Major Sherwill was considered as 'the type' and only that specimen was sent to the British Museum.

In any case, the holotype of *Murina cyclotis* was never received back at the Indian Museum, but remained at the British Museum and was subsequently incorporated in the

* Dobson (1872) gives the spelling as 'Mandeli'

** Both Anderson (1881) and Sclater (1891) give 'H. J. Elwes' in their respective lists of donors and contributors, but Anderson (1881) while listing the specimen, gives the name as 'J. H. Elwes'

collection of that museum, bearing Registration Number BM 9.4.4.4 (Tate 1941). Incidentally, Hill (1987) reports another case of retention of Chiropteran type-material of the Indian Museum at the British Museum and subsequent incorporation in the collection of that museum (one of the syntypes of *Rhinolophus yunanensis* Dobson, 1872, BM (NH) 9.4.4.3).

Of the three paratypes of *Murina cyclotis*, only one (Dobson's Catalogue Number 696, Anderson's Catalogue Number 166a, Zoological Survey of India Registration Number 15605, an adult female preserved in spirit, obtained at Darjiling and donated by Dr. F. Stoliczka or Mr. L. Mandelli, no definite date is available but surely any year between 1863 and 1872) is present in the National Zoological Collections of India housed in the Zoological survey of India, at the moment. The other two paratypes, are not traceable in the National Zoological Collections of India. If these two specimens are not present at the British Museum (Natural History), London, these are, in all probability, to be considered as lost.

The measurements (in millimetres) of the paratype of *Murina cyclotis* present in the National Zoological Collections of India, are given below :—

External : forearm 34.1; tail 32.5; ear 14.5; tragus 7.4; tibia 16.8; foot & claw 7.8.

Cranial : total length 16.4; condylobasal length 14.8; condylocanine length 14.2; mastoid width 7.4; cranial width 7.3; zygomatic width—; least inter-orbital width 4.2; canine width—; maxillary tooth-row 5.5; molar width 5.4; mandibular length 10.3; mandibular tooth-row 5.8.

SUMMARY

It is established in this paper that the specimen regarded as 'the type' by Dobson (1876), Anderson (1881) and Wroughton (1918), and as the 'holotype' of *Murina cyclotis* Dobson, 1872, by Khajuria *et al.* (1977), is not the holotype. One of the three other specimens listed by Dobson (1876) and Anderson (1881) has been shown to be the holotype of *Murina cyclotis*. The controversy regarding the place of origin, donor and the date of acquisition of the holotype has been settled. The three other specimens mentioned above have been shown to be the paratypes of *Murina cyclotis*. The current repository of the holotype of *Murina cyclotis* is the British Museum (Natural History), London, while the Zoological Survey of India maintains one of the three paratypes, the fate of the other two paratypes being not precisely known.

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STUDIES ON SOME ECOLOGICAL IMPACTS OF THE REDUCTION IN THE FLOW OF WATER, BELOW THE IDUKKI DAMS, IN THE PERIYAR RIVER IN KERALA

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INTRODUCTION

Idukki project in Kerala is one of the major hydro-electric projects in India. The Idukki reservoir is formed by the construction of three dams across Periyar and its tributary Cheruthoni rivers (Fig. 1). The commissioning of the project in 1976 has led to the stoppage of the flow of water, below the dams, along a stretch of Periyar river, the most important of the 41 rivers flowing through Kerala. The tailrace waters that leave the power generators at Moolamattom enter the Muvattupuzha river.

Apart from the reservoir inundating 59.8 sq. kms of forest land and thereby altering the ecosystem of the area and its environs, the diversion of the waters of one river system to another naturally affects the biotic and abiotic factors of both the rivers. Not much is known from the world over, and practically nothing from India, of the cumulative ecological impacts of such major changes brought about by a hydel project. An attempt, therefore, has been made to assess some of the ecological impacts of the curtailment in the flow caused by the diversion of the waters of Periyar river.

MATERIAL AND METHODS

Data on the quantum of tailrace waters discharged into the Muvattupuzha river, which in reality is equal to the loss of water of Periyar river, since the commissioning of the project, were collected from the Kerala State Electricity Board (KSEB) and the average loss was calculated on the basis of such data. Besides data on changes in the chloride content of the Periyar river in its lower reaches during the summer seasons of the last 11 years (1973 - 1983) were procured from the records, based on daily measurements taken, of the Fertilizers and Chemicals of Travancore (FACT). These data were verified with those collected and maintained, on a daily basis, by the Travancore Cochin Chemicals (T.C.C.). Information on the major biotic life of the river for the pre-project period was gathered by systematically questioning 30 longtime inhabitants and fishermen who reside along the banks of the river in its lower reaches. Data on the year round representation, for the period from 1980 to 1983, of some of the major forms of aquatic life, were collected by making collections from the river waters and also examining catches made by fishermen. Information on the quality of water supplied to Cochin city is based on the records of the Public Health Engineering Department (PHED) of Kerala State.

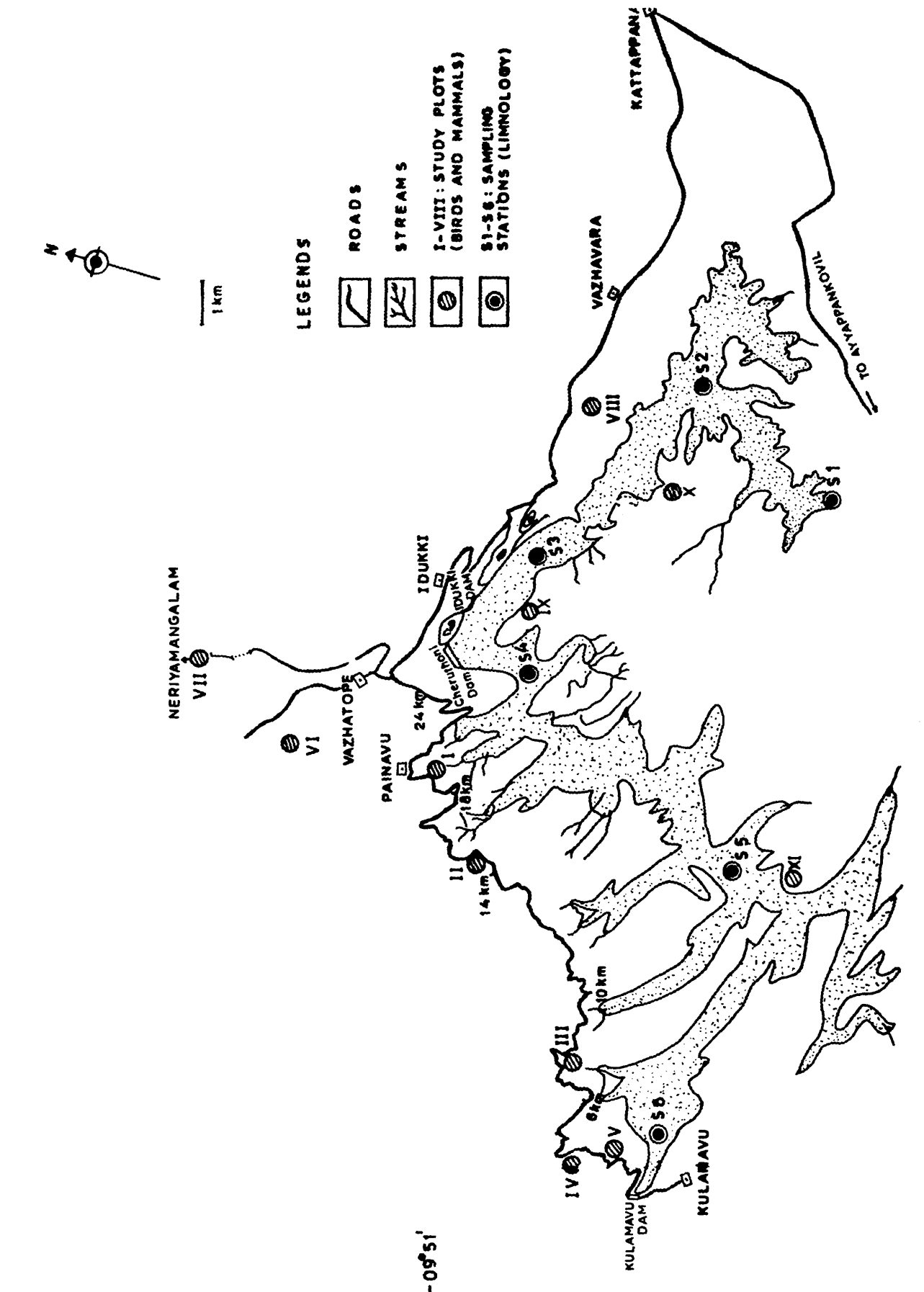


Fig. 1. Area showing Periyar and Cheruthoni the three dams and the Idukki reservoir.

RESULTS AND DISCUSSIONS

A. *Reduction in the flow and its impact on the chloride content of Periyar river*

KSEB reports that since the commissioning of the project in 1976, 200 M. cft of water, on an average, is entering the Muvattupuzha river as tailrace and hence the flow of water in a day in the Periyar river, below the Idukki dams, on an average is reduced by 200 M. cft. This average loss may not correctly represent the loss of flow in summer months as part of it would have flowed away, but for the reservoir, through floods in the rainy seasons. But the nature of the flow in this river in its upper reaches during the summer seasons even today indicates that the flow in the past would have been excellent. Since the coming up of the project the water that enters the river, below the dams, is only a negligible quantity resulting from very little seepage and what is generally called the 'sweat' of the dams. The canals and rivulets which empty their waters into Periyar, below the dams, carry only a small quantity of water during the summer months which renders the river bed dry, but for some puddles, for six months in a year, along a stretch of more than twenty kms. This obviously lowers the water table along this stretch of the river and its banks, resulting in the depletion of the flora of this area and the gradual migration and practical disappearance of much of the wild life which reportedly flourished in the area before the initiation of the project. The influx of people from the plains into this area and the resultant deforestation and habitation has only worsened the situation. The drying up of the river bed in summer also results in the disappearance of all the aquatic life from this stretch. Coconut and other plantations have come up in some stretches of the former river bed.

Earlier, a good flow used to be maintained by the river thereby helping in flushing down the brackish water received from Vembanad lake in summer. But since the commissioning of the project in 1976 the chloride content of the river from its mouth upto Malayattoor (a stretch of over 20 kms) or a little beyond has been steadily going up in the summer months.

The perusal of the data for the period from 1973 to 1975 (Table - I) indicates that the maximum chloride content of the river during summer at Alwaye (the point from which water is drawn into the FACT for industrial purposes) before the commissioning of the project was only 32 ppm (observed in April 1974) while it reached 3500 ppm on a day in February, 1983. According to the data collected by the T.C.C. it was 5000 ppm on a day in February, 1983. The extreme drought conditions that prevailed in Kerala in 1983 may partly account for this sudden increase in the chloride content in 1983 but even in April 1982 on a day it was as high as 400 ppm with an average of 370 ppm for the whole month. The comparison of the data for the April months of 1975 and 1976 (i.e. a year before and the one in which the project was commissioned) reveals that in 1975 the maximum was 15 ppm while in 1976 it was 205 ppm. The chloride content of the river for the summer seasons of the postproject period was the lowest in 1978 showing only some marginal increases when compared with the data of the preproject period, but in

TABLE - I

Table showing the Chloride content (in ppm) of the Periyar river at Alwaye during the summer months for the period from 1973-1983.*

	January			February			March			April			May		
	Maxm	Mnm	Monthly Average	Maxm	Mnm	Monthly Average	Maxm	Mnm	Monthly Average	Maxm	Mnn	Monthly Average	Maxm	Mnn	Monthly Average
1973	9	4.5	7.3	11	5	4.7	16	7	10.7	25	3	13.4	15	5	9.9
1974	13	8.5	10.5	13	9.5	11.3	15	10.5	12.2	32	13	20.1	22	18	19.5
1975	Data not available			16	9	11.1	30	10	19.6	15	12	13.6	15	8	9.6
1976	15	7	11.3	17.5	12.5	14.2	16	12.5	14.4	205	15	60	37.5	15	24.6
1977	30	25	27.5	17	11	13.5	23	12	17.5	29	12	20.7	25	7	14.6
1978	15	10	12.5	16	11	12.4	16	12.5	13.4	21.5	13	16.2	23	6.5	14.4
1979	12	10	10.7	14	12	13	15	12	13.4	40	13	24	24	11	15.5
1980	25	12	15	85	12	28.5	20	11	15	32	21	23.5	Data not available		
1981	9.5	7	8	12.5	8	9.8	55	18	45.6	36	32.5	33.8	Data not available		
1982	Data not available			19	17	18.2	38	35	274	400	370	385	Data not available		
1983	310	10	62.4	3500	360	1403	1850	660	1083.5	720	460	566.7	380	25	72.4

* The data are based on the measurements taken daily by the Fertilizers and Chemicals Travancore, Alwaye.

1978 Kerala had the highest rainfall (4524.6 mm) of the decade, commencing with the year 1973, and that many account for the reduction in the chloride content during that year.

B. Impact of the increase in the chloride content on some aquatic fauna in the lower reaches of Periyar river.

The entry of brackish water into the lower reaches of Periyar has led to the entry of some brackish water prawns, molluscs and fishes into the river during the summer season. A ray fish was observed during April 1983 at Kalady, about 20 kms upstream from the mouth of the river. Similarly *Liza macrolepis* (Smith), *Hyporhamphus xanthopterus* (Valenciennes), *Caranx sexfasciatus* Quoy & Gaimard and *Gerres filamentosus* Cuvier, all brackish water species of fishes, were available in plenty at the Alwaye stretch of the river (10 kms upstream from the estuary) in the summer months of 1982 and 1983. But *Channa striatus* (Bloch), *Nandus marmoratus* (Hamilton) and *Channa orientalis* (Schneider), the common freshwater species of fishes that were reportedly available in the area in fairly good number all the year round before 1976, if the reports of the fishermen who used to fish in this area for years are to be believed, are not seen here during the summer months in recent years. None of these species were represented in the catches made by fishermen at Alwaye in March-April, 1982–1983 from this stretch of the river. Specimens brought to the Alwaye market during the season also did not reveal the presence of these species. Similarly a species of *Perreysia*, a freshwater bivalve, that used to be available in these waters in good number all the year round before 1976, could not be collected during the summer seasons of the years from 1980 to 1983 though their dead shells were present.

Eloore-Varapuzha stretch of Vembanad lake, i.e. the area where Periyar river empties its water into the lake, and the lower reaches of the river along a stretch of nearly 2 kms have already turned into nearly barren areas for fishes during the pre-monsoon months. Mortalities were observed in summer during the period from 1980 to 1983 among the fish species of anchovies, cat fishes, pearl spot, glassy pirchlets, barbs, silver biddies, sprats and half beaks. Reduction in the discharge of the river with the result that the effluents from the factories at Alwaye entering the river do not get diluted, as in the pre-project period, can be the only possible reason for this high mortality rates among the fish species. Detailed studies conducted by Kurup (1983) on the dead specimens from these waters during the period from 1980 to 1983 revealed that they had died due to toxicity.

C. Impact of increase in the chloride content of Periyar on the industrial establishments at Alwaye.

The extraordinary rise in the chloride content of the river in the Alwaye stretch, which is the most important industrial belt of Kerala, has resulted in the total closure

and the resultant loss in production, running into crores of rupees, in factories like the F.A.C.T., T.C.C. etc. at least for some weeks in the summer months as the water could not be drawn from the river for industrial purposes due to its high chloride content. Some essential units in these factories were only run using freshwater brought from a distance of over 18 kms.

Construction of temporary bunds and the release of precious water from Bhuthathan Kettu reservoir did not entirely solve the problem, as chloride content even afterwards went upto 3000 ppm on some days in 1983.

D. Influence on the supply of water to Cochin

The increase in the chloride content of Periyar had its impact on the water supplied to Cochin city which has a population of over 6 laksh. For more than two weeks in February 1983 the chloride content of water supplied was over 500 ppm and on a day it touched 1250 ppm. The situation was partly brought under control by the release of water from the Bhuthathan Kettu reservoir. Before the chloride content was controlled the Health Department of Cochin Corporation had even considered warning people against the use of water supplied without treatment.

The Edamalayar project, proposed partially to offset the increase in the Salinity content of Periyar river brought about by the commissioning of the Idukki hydel project, is still at the take off stage and years will roll by before it is commissioned. It is yet to be seen how far the commissioning will redeem the situation.

SUMMARY

Curtailment in the flow of Periyar river caused by the Idukki hydro-electric project and some of its ecological impacts are discussed.

ACKNOWLEDGEMENTS

I am indebted to the Department of Environment, Government of India and to its former Director, the late Dr. N. L. Ramanathan for providing funds for carrying out the studies. My thanks are also due to my colleagues M/s T. N. Jayakrishnan and Shaji Thomas for helping in collecting some of the data.

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**AGONISTIC BEHAVIOUR IN *UCA (CELUCA) TRIANGULARIS*
BENGALI CRANE, 1975 INHABITING THE ADYAR ESTUARY AND
BACKWATER, MADRAS, INDIA.**

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INTRODUCTION

In *Uca* agonistic behaviour is well developed and consists of defence and offence. The agonistic behaviour is mostly exhibited in the forms of threat and combat and the structural components are well developed. The mode of expression of fighting tendencies varies from species to species and a number of other factors contribute to it. Since the burrow is the cardinal point in the life fiddlers, agonistic tendencies are better seen near the vicinity of the burrows. Both male and female fiddlers exhibit aggressive behaviour, but, in males it is more conspicuous quantitatively and qualitatively. In many cases, the behaviour is more ritualized and serves the purpose of information transfer and in some it is forceful to express physical superiority over the competitors. The maximum of aggressive activities occur during mating seasons, more precisely during courtship periods. Combat is not a prerequisite to courtship and in many situations females are not attentive to it. Crane (1975) observed that most of the aggressive behaviour but not all, whether ritualized or not is connected with reproduction and that both inter-male behaviour and courtship display serve under natural conditions as mechanisms for stimulating and synchronizing reproductive behaviour in the population as a whole.

The spectrum of agonistic activities ranges from a simple threatening posture to the physical uprooting flinging of the individual from the burrow. It is observed as inter-male behaviour (between neighbouring burrow holders between a wanderer and a burrow holder and between two wanderers) and inter-female behaviour. Christy and Salmon (1984) concluded that combat behaviour may be a tool in establishing neighbourhoods of dominance and in attainment of freedom to court the locally available females. The available literature on agonistic behaviour is meagre and mainly consists of the work of Altevogt (1955a, b: 1957), Crane (1957, 1975), Cameron (1966), Dingle (1972), Hazlett (1972), Hyatt and Salmon (1978), Christy and Salmon (1984) and Zucker, (1977). Of all the species classified under the subgenus *Celuca*, *triangularis* is considered to be the most lethargic exhibiting a low degree of social activity. Very little is known about the components of social behaviour in *triangularis bengali* and hence this work.

OBSERVATION

The agonistic components depend upon the physical status, size and hendedness in *triangularis* (and *lactea* also) of the Adyar estuary and backwater. Fights entangling an

aggressively wandering male and a burrow holder could be noted less frequently when compared with the males occupying neighbouring burrows since the former were more ritualistic and consisted of stronger components. A few encounters involving two aggressively wandering males could be seen in *lactea* only, while such a phenomenon does not occur in *triangularis*. In this aspect, *triangularis* is in conformity with the observations of Crane (1975) on *rapax*. More than 50% of the encounters became fierce fights in *lactea* while only 2% or less resulted in aggressive combat in *triangularis*. Combats between neighbours were more ritualistic in *lactea* but in *triangularis* agonistic activities were lesser to arrive at any tangible conclusion. In general, agonistic tendencies could be observed more in all the four study areas (Map 1) of the Adyar estuary and backwater in the case of *lactea* only and in *triangularis* it was incomparably less. Encounters have been observed in *lactea* and *triangularis* involving a) crabs of more or less equal size range, b) smaller wanderer and large burrow holder and c) larger wanderer and smaller burrow holder.

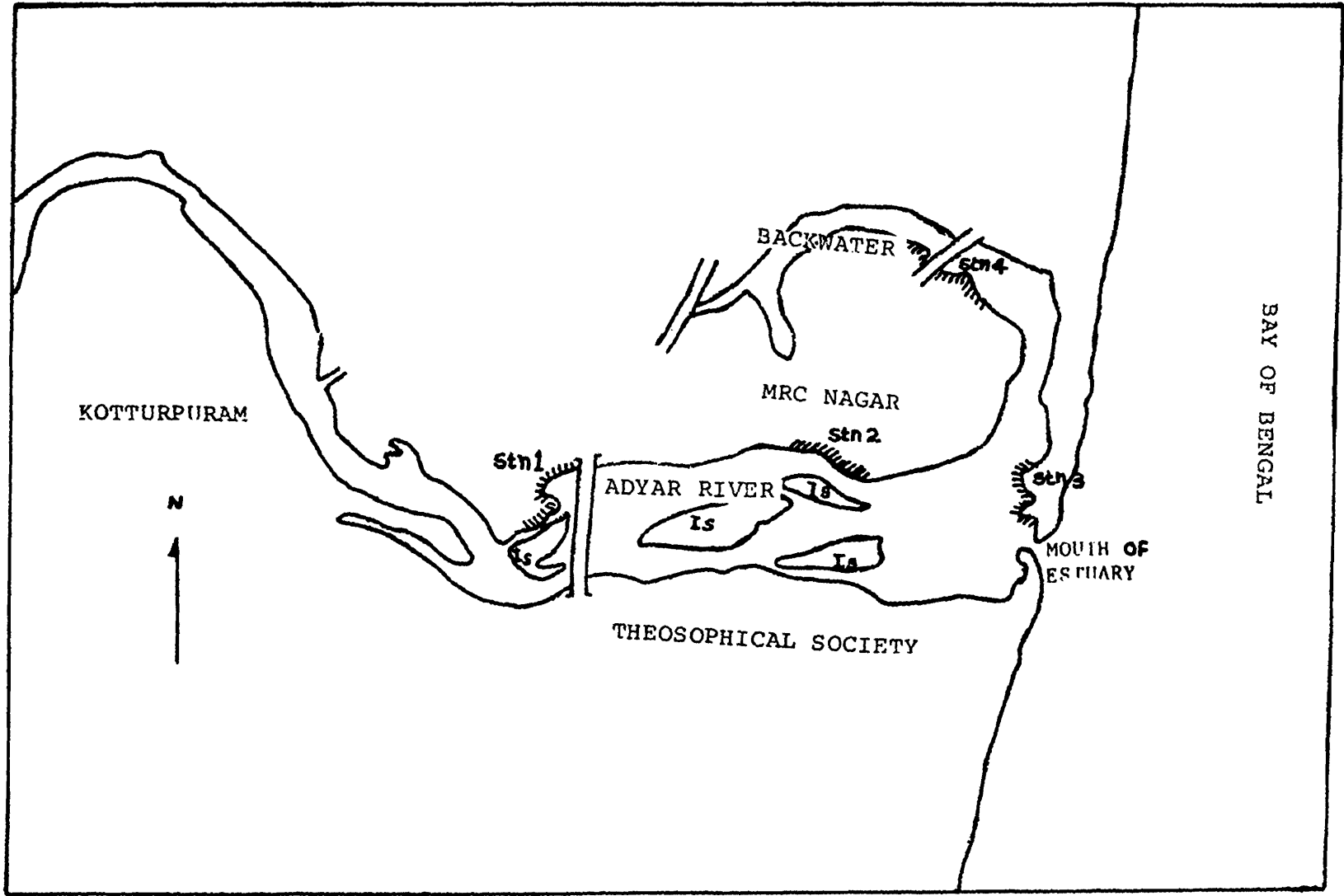
In both *lactea* and *triangularis* ritualized agonistic behaviour could be observed in crabs whose carapace width was more than 7 mm indicating the acquirement of ritualization potential at this stage. Combats between homoclaved (right and right; left and left) and heteroclaved (actor being right or left) males indicated prevalence of homoclaved (right and right) since the number of right handed animals were more.

Of the fourteen agonistic postures known in *Uca*, the male *triangularis bengali* exhibits:

1. Raised carpus - low intensity posture; 2. Forward point - moderate intensity; 3. Lunge - high intensity sudden thrust; 4. After-lunge - unpredictable and undecipherable; 5. Carpus-out - following a raised carpus; 6. Chela-out - partial withdrawal; 7. Lateral stretch - when intruder passes by (Plate 1, A); 8. Creep - after being thrown out near the burrow; 9. High-rise - more during breeding season.

Among unritualized forceful combats, manus push component (Plate 1, B) figured, more when compared with other components. Grips, fings and upsets occurred in numerically descending order. The observations are presented in Table I and II for ritualized and forceful components.

In ritualized combats, the low intensity manus rub was more a prerequisite for the other components to follow. Of the fifteen components, only five have been observed to occur with full certainty (Figure 1) and three components were overlapped. In any case, not more than eight to nine components have been observed to occur in the local populations of *triangularis bengali*. Heel and ridge component (Plate 2, A) preceded by manus rub was more, similar to the observations of Crane (1975) on *rapax* and when dactyl-slide (Plate 2, B) occurred in between manus rub and heel and ridge, ritualization terminated in 75% of the combats.



Map of Adyar River and Estuary

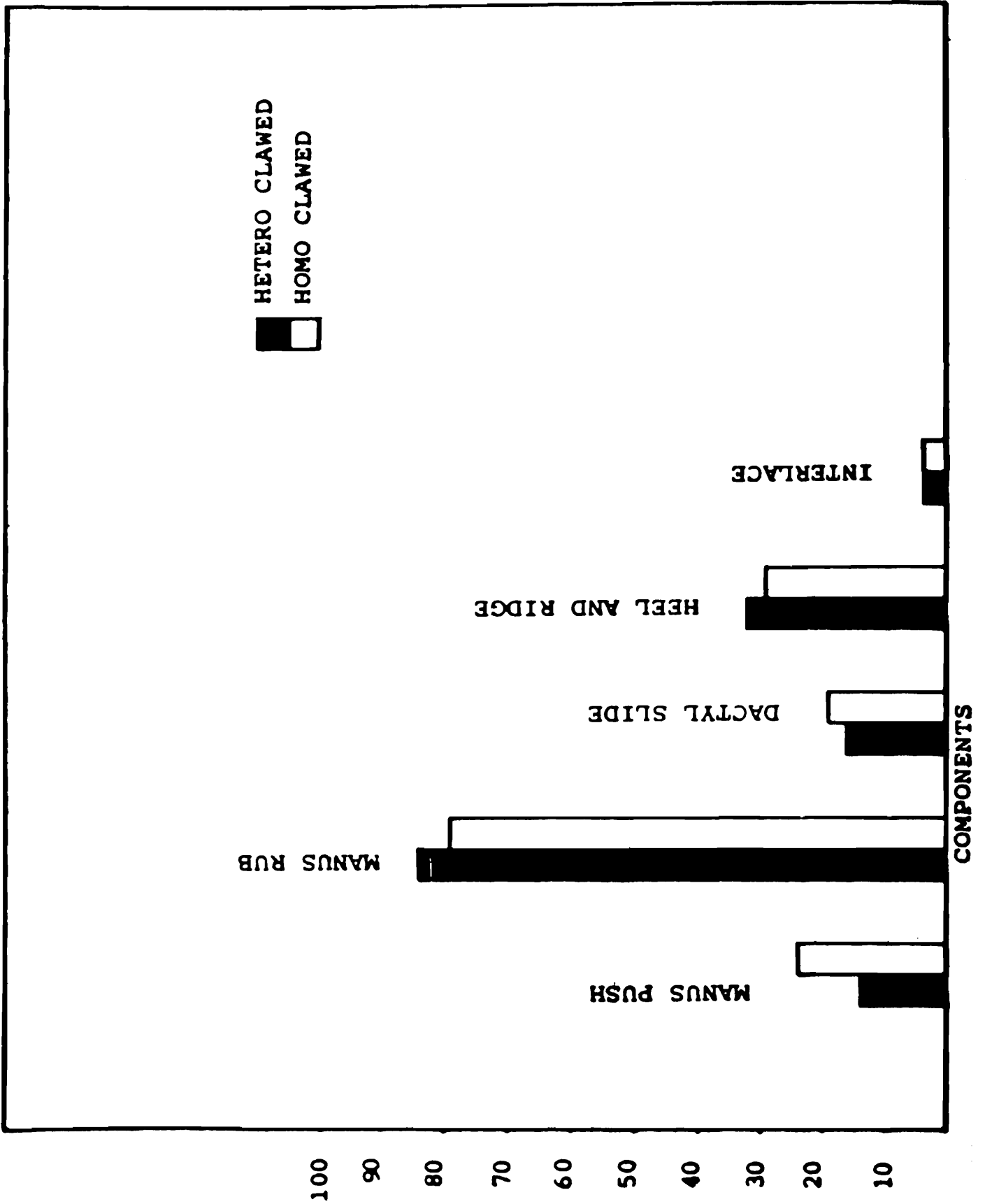


Fig. 1. Relative Frequency of Combat Components (%)

TABLE - I

Composition of 148 combats observed during 1 October - 28 November, 1984 at Adyar estuary and backwater in *Uca (Celuca) triangularis bengali*.

Sequence of components	Combats between aggressive wanderer and burrow holder		Combat between borrow holders	
	Homo Claw	Hetero Claw	Homo Claw	Hetero Claw
Manus push only	6	1	4	1
Manus push and Manus rub	4	1	9	3
Manus rub only	21	18	7	3
Manus rub + Dactylslide	7	2	6	3
Dactyl slide only	1	1	1	1
Manus rub + Dactylslide + heel and ridge	4	1	1	0
Manus push + Manus rub + heel and ridge	1	1	0	0
Manus rub + Heel and ridge	15	9	1	1
Dactylslide +	—	—	—	—
Heel and ridge only	4	1	0	1
Manus rub and Interlace	2	—	—	—
Heel and ridge + Interlace	3	2	—	—
Interlace only	—	1	—	—
Manus rub + Heel and ridge + Interlace	—	—	—	—
Dactylslide + Heel and ridge + Interlace	—	—	—	—
Manus rub + Dactylslide + Heel and ridge + Interlace	—	—	—	—
Manus rub + Dactylslide + Interlace	—	—	—	—
Dactylslide + Interlace	—	—	—	—
Total	68	38	29	13

TABLE - II
Relative percentage frequency of combats in *Uca (Celuca) triangularis bengali*

Component	Heteroclaved combats (50)	Homoclaved combats (98)	Total combats (148)
Manus push	14	24	21
Manus rub	84	79	81
Dactyl slide	16	19	18
Heel and ridge	32	29	31
Interlace	04	04	04

TABLE - III
Analysis of combat outcome in favour of burrow holders (%)

Fiddler species	When burrow holder larger	When burrow holder smaller	When more or less equal
<i>U. (C.) triangularis bengali</i>	95	59	100
<i>U. (C.) lactea annulipes</i>	100	41	74

Interlace component did not indicate any difference in hetero clawed and homoclaved fights. Heel and hollow, quite characteristic of *lactea* could not be seen to occur in *triangularis* during the entire period of observation. Tapping has not been studied due to want of facilities.

Abrupt withdrawals from ritualized and forceful fightings has been observed in 28 cases. In three combats withdrawal of the inactor into the burrow occurred due to the appearance of the lizard *Mebuya carinata* and the common crow and resumption of fight did not occur. In 7 cases abrupt withdrawal occurred for which specific reasons could not be assigned. Only in one case the actor instigated combat repeatedly even after withdrawal by the inactor and till such a time the burrow holder gave up the burrow (15 minutes approximately) the agonistic instinct did not dissipate in the aggressive wanderer. In many combats, the high intensity components were imperfect and related movements were atypical, similar to the observations of Crane (1975) in *rapax* but the dissimilarity being the delay in resumption of other activities like waving. Analysis of combat outcome presented in Table III indicates the spatial and temporal effects of competition among the wanderers and residents for the burrows. In 14 out of 216 cases of winning by the wanderers (observed over a period of one year) of larger size, the burrow was demolished immediately after evicting the residents in the case of *lactea* but such an occurrence did not happen in *triangularis*.

In interspecific fights involving *triangularis* and *lactea* most of the fights were unritualized and exhibited the presence of weak components (Plate 3A), often combats ended in manus rubs and occasionally in heel and ridge. Aggressively wandering *triangularis* tended to avoid conflicts with *lactea* when the latter were burrow holders whether smaller or larger. In the 15 interspecific combats observed between larger aggressive wanderers of *lactea* and smaller burrow holding *triangularis*, the former invariably evicted the burrow holder and demolished the burrows after eviction, in 12 cases, instantaneously.

In places where both the species occupied the neighbouring burrows, *lactea* were smaller when compared to *triangularis* (Plate 3, B). The agonistic behaviour mostly consisted of threatening postures and the few combats observed between the burrow holders indicated the benefit of size of *triangularis*.

The agonistic behaviour between females were lateral body pushes while competing for feeding places and guarding the burrows. A few fights involved the ambulatories and minor chelae and were stereotyped in components.

DISCUSSION

It is known that fighting tendencies are inbuilt in fiddlers and the extent of it varies from species to species. Agonistic expression is not for the possession of an empty burrow but to express physical superiority, more often in the presence of females. Combat behaviour is expressed more during low tide periods when both males and females are active. Reproductively active males spend more of their time in fighting and defending the site of mating, preferably breeding burrows located on the supratidal zones (Christy and Salmon 1984). The combat outcome varies from species to species and different size classes (Hyatt and Salmon, 1978; Christy, 1980). It is common occurrence that the smaller residents are ousted by the larger wanderers on the gradient where the burrows are found to be comfortable for courtship and subsequent copulation. In a number of cases, the burrow occupied by the fighting out of resident is not retained for more than a week by the winner. Hazlett (1972) inferred that in most situations, a loser in ritualized fight, particularly if the combatants have potential weapons such as large chelipeds has a better chance to reproduce, than a loser in an unritualized fight. In *triangularis*, it appears that the winner only can be the successful mate than a loser whether it be a ritualized or unritualized fight.

Christy and Salmon (1984) devised the concept of resource-defence mating systems and expressed that exhibition of agonistic tendencies is for the establishment of neighbourhoods of dominance. This holds true for both *lactea annulipes* and *triangularis bengali* of the Adyar estuary. Hyatt and Salmon (1978) indicated that the percentage outcome of combats is related to the density and size of the crabs in *pugilator*. This observation may be diluted to become a universal phenomenon, since, observations on

lactea and *triangularis* of this tropical region also confirm it. Zucker (1977) stated that the agonistic expression is the outcome of spatial intolerance. Christy and Salmon (1984) subscribed to this idea by pointing out that there exists a negative exponential relationship between inter-burrow distances and rates of aggressive interaction between neighbouring residents. The present observation on *triangularis* also suggests that establishment of territorial rights is due to the expression of combat behaviour in addition to mating success. von Hagen (1970) expressed that combat behaviour is one of the additional modifications associated with terrestrial adaptation. It indirectly may mean that the more terrestrial crabs exhibit more agonistic behaviour. The fiddler *triangularis bengali* which is more terrestrial than its counterpart *lactea annulipes* neither shows the presence of a better ritualized agonistic repertory nor the quantum of combats is more. Lack of patterns makes the agonistic encounters more efficient for survival and reproduction in dense population of *pugnax* when it occurs with *pugilator* (Aspey, 1978). In spite of the occurrence of *lactea annulipes* and *triangularis bengali* sympatrically in some areas, population density was too low to identify a similarity with the other two species of Aspey (1978), since *triangularis* lacks patterns and the intensity of combat is also low.

SUMMARY

Possession of a limited repertory of agonistic tendencies in *triangularis* has been noticed. Winner in a combat, whether ritualized or unritualized stands a better chance to copulate. The argument that a limited repertory may lead to efficient fighting does not work in *triangularis*. Inter-specific combats have been noted to be irregular in components.

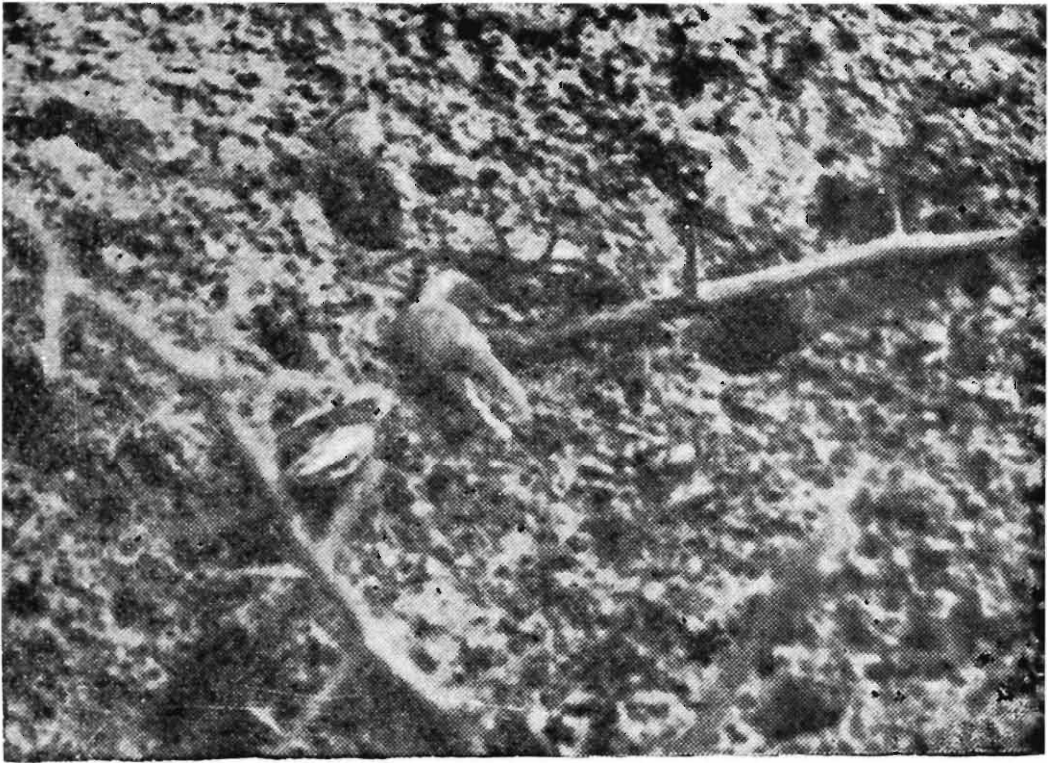
ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India, Calcutta and Joint Director, Marine Biological Station, ZSI, Madras for facilities; colleagues for help at various stages and Dr. Robert Y. George, Professor of Oceanography, Institute of Marine Biomedical Research, North Carolina University for criticism. This work has formed a part of Ph.D. thesis submitted by the author which has been approved by the University of Madras.

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A. Lateral stretch, when an intruder passes by.



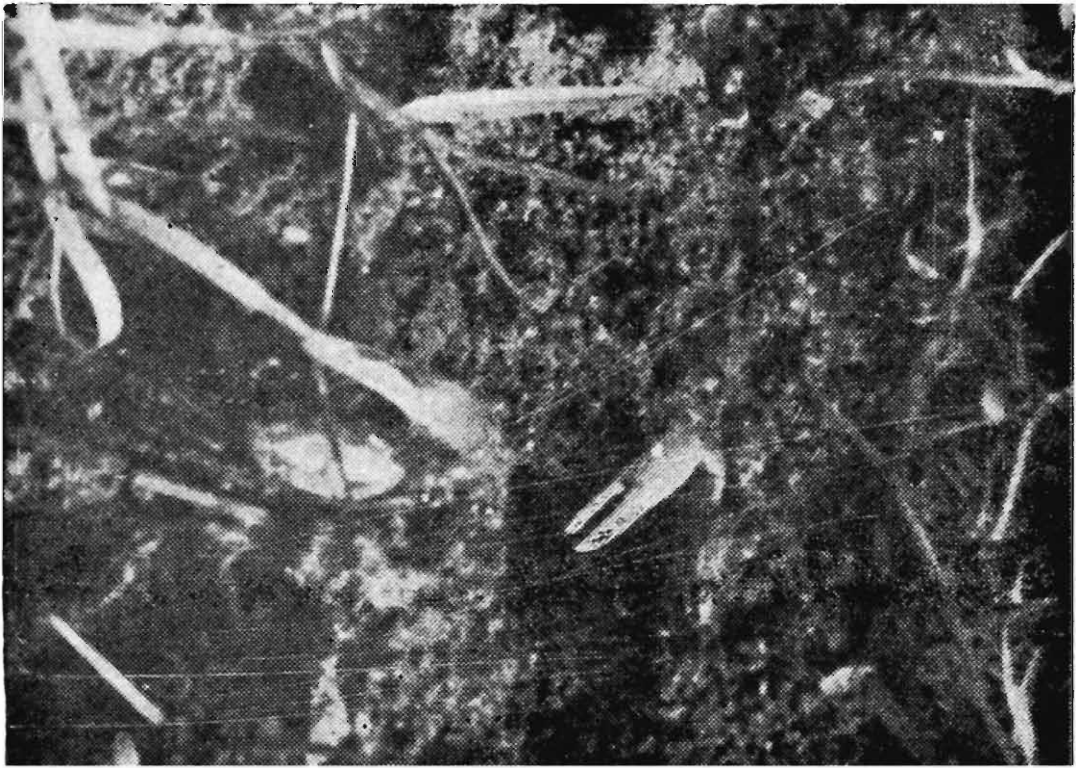
B. Manus push.



A. Heel and ridge.



B. Approach for dactyl-slide.



A. Intraspecific combat.



B. Size difference in neighbouring burrows.

ON NEW AND LITTLE KNOWN SPECIES OF *STENARES* HAGEN
(MYRMELEONTIDAE : NEUROPTERA) FROM INDIA

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Zoological Survey of India, Calcutta

INTRODUCTION

Stenares Hagen is one of the derivatives of the highly composite genus *Myrmeleon* Linn. *Stenares hyaena* (Dalman) and *S. improbus* (Walker) were described under the genus *Myrmeleon* Linn. while *S. harpyia* (Gerstaecker) was described under *Palpares* Rambur. Banks (1913) referred to seven species of *Stenares* Hagen from different regions of the world of which *S. hyaena* (Dalman), *S. improbus* (Walker) and *S. harpyia* (Gerstaecker) are known to occur in India. Later, he (1931) described one more species, *S. frazeri* from Coorg, Karnataka. The author, while studying different species of *Stenares* Hagen from the old and recent survey collections lying at Zoological Survey of India, encountered a new species from Andhra Pradesh which has been described in the paper. Besides, a key to four Indian species examined along with illustrations, a literature review of a species and the suitable references have also been incorporated. Altogether five species including the new one are reported in the paper.

Key to Indian species of the genus *Stenares*

1. Hindwing unspotted with only distinct grey cloud at apex and apical half of hind margin.....*acutus*, sp. nov.
Hind wing spotted with distinct mark at apex and apical half of hind margin.....2
2. Hind wing with a black streak along outer edge just before pterostigma and the streak not extending across*hyaena* (Dalman)
Hind wing with a brown spot before pterostigma and the spot reaching across half of the wing3
3. Larger in size, forewing measuring about 68-72 mm in length; apical mark of hindwing in the form of two streaks.....*improbus* (Walker)
Smaller in size, forewing measuring about 62-65 mm in length; apical mark of hindwing entire or partly broken.....*harpyia* (Gerstaecker)

Stenares acutus, sp. nov.

♂ : Labrum, clypeus and frons; yellow and the first one with a row of golden brown hairs; palpi : shiny black; vertex : dark brown, black-spotted and the spots

variable in size; antenna : brown; pronotum : brownish-yellow, with a median, black, longitudinal stripe and a small, rounded black spot on either side; lateral margin black; with long black hairs; mesonotum : brownish-yellow; black patches in the convex areas and on wing roots; with greyish wooly hairs; metanotum : concolorous with mesonotum and covered with wooly hairs; wings (Fig. 12) : whitish and membranous; R with brown bands specially in forewing; all other veins and crossveins pale brownish; pterostigma indistinct, whitish; greyish cloud continuing from apex to half of the hind margin in hindwing; leg; hind coxa black; femur brown; tibia yellow; tarsi black; spur of hind tibia about as long as 3 basal tarsal segments taken together; claws black; with black hairs and bristles; abdomen : brown with short white hairs; tip of abdomen as in Figs. 1-3; ectoproct (Figs. 1-2) : elongated, apex acute, with a row of black bristles on the inner and long black hairs on the outer side in addition to several rows of small hairs all throughout; aedeagus (Figs. 1 & 3) : on ventral view deeply invaginated at middle forming two lobes and with a bunch of small black hairs at middle; laterally slightly curved about middle and apex subacute.

Measurements : ♂ : Length of body (with ectoproct), 45 mm; forewing, 62 mm; hindwing, 58 mm; ectoproct, 10 mm.

Material examined : 2 ♂♂ (holotype, Reg. No. 1181/H12 Paratype, 1 ♂, Reg. No. 1182/H12), India, Andhra Pradesh, Anantagiri, 20. v. 1984, Coll. S. S. Saha.

Distribution : India, Andhra Pradesh.

Remarks : The species differs from all other Indian species by the wing markings.

Stenares hyaena clara Navas

Stenares hyaena clara Navas, 1932, *Mem. Acad. Nuovi Lineei*, (11) 16 : 951.

Remarks : The subspecies has already been redescribed by Ghosh (in press) from Orissa Survey material along with the diagrams of head, pronotum and tip of abdomen in female. So, to avoid repetition all other data concerning locality, Measurements, distribution etc. have not been referred to here. However, the photograph (Fig. 15) of both wings which has not been given in the aforesaid paper has been included here for the sake of comparison with other Indian species.

Stenares improbus (Walker)

Myrmeleon improbus Walker, 1853, *Cat. Brit. Mus. Neur.*, p. 326.

Stenares improbus, MacLachlan, 1868, *J. Linn. Soc.*, 9 : 276; Needham, 1909, *Rec. Indian Mus.*, 3 : 200; Banks, 1913, *Ann. ent. Soc. Amer.*, 6 : 190; Ghosh & Sen, 1977 *Rec. zool. Surv. India*, 73 : 317.

Measurements : 1 ♂ : length of forewing, 72 mm.; hindwing, 67 mm.; 10 ♀♀ : length of forewing, 68-72 mm.; hindwing, 65-67 mm.

Material examined : 11 exs. (♂, ♀♀) : India, Karnataka : 2 exs., Coorg, Mercara,

10. iii. 1914; 1 ex., Coorg, v. 1913; 3 exs., Coorg, 10. iii. 1914; 1 ex., Coorg, date-nil; coll. Hannington. 1 ex., Karnataka, Bangalore, date-nil, coll. Cameron. 1 ex., Maharashtra Satara : Mahabaleswar, 4200 ft., 13-14. iv. 1912; 2 exs., Satara, Medha, Yenna valley, 2300 ft., 17-23. iv. 1912; coll. F. H. Gravely.

Distribution : India : "North India", Maharashtra, Karnataka.

Remarks : Since the description of the species by Walker (1853) it has been studied by the subsequent workers but the male and female genitalia have not been taken into account. Therefore an attempt has been made to provide the male genitalic structure by the illustrations of the ventral view of the tip of abdomen (Fig. 11) and the female genitalic structures represented by the shape of spermatheca as in Fig. 10 and also tip of female abdomen as in fig. 9. Besides, the photograph of fore-and hind wings (Fig. 13) has been included. The species hitherto reported from "North India" and Karnataka is for the first time recorded for Maharashtra.

Stenares harpyia (Gerstaecker)

Palpares harpyia Gerstaecker, 1863, *Stettin. ent. ztg.*, p. 180.

Stenares harpyia, Hagen, 1866, *Ibid.*, p. 456; Banks, 1913, *Ann. ent. Soc. Am.*, 6 : 190; Ghosh & Sen, 1977, *Rec. zool. Surv. India*, 73 : 317.

Measurements : 2 ♂♂ : length of forewing, 60 mm; hindwing, 55 mm; 2 ♀♀ : length of forewing, 62-65 mm; hindwing, 59-60 mm.

Material examined : 4 exs. (♂♂, ♀♀) : India, Andhra Pradesh, Anantagiri, 20. v. 1984, coll. S. S. Saha.

Distribution : India : Tamil Nadu and Andhra Pradesh.

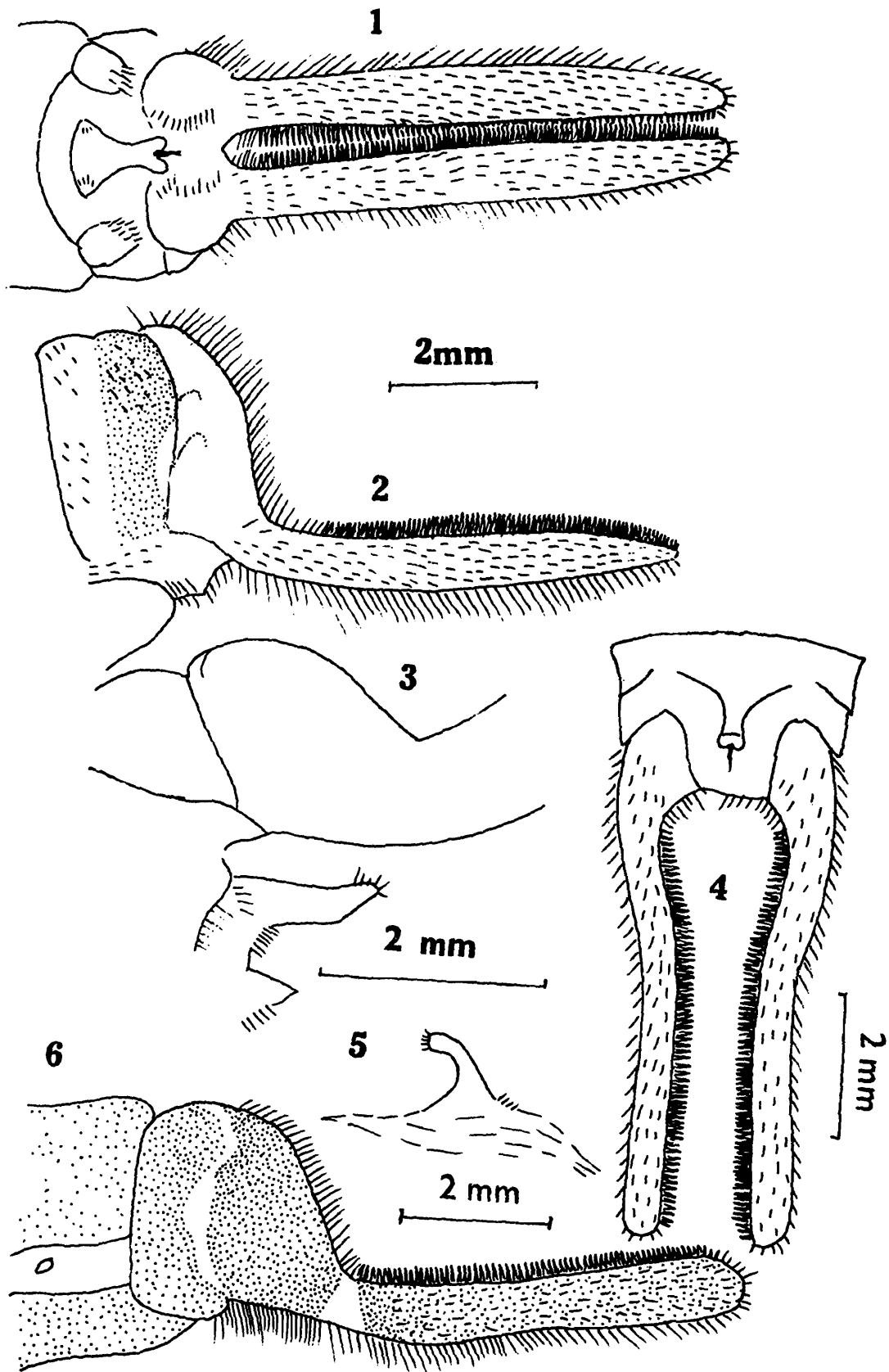
Remarks : The male and female genitalia of the species have been studied and the illustrations dealing with the genitalia in male (Fig. 5), spermatheca in female (Fig. 8) and tip of abdomen in both sexes (♂, Fig. 4 & 6, ♀♀, Fig. 7) have been provided. Besides, the photograph of fore and hind wings (Fig. 14) has been included. The species hitherto recorded from Tamil Nadu, is for the first time reported from Andhra Pradesh.

Stenares frazeri Banks

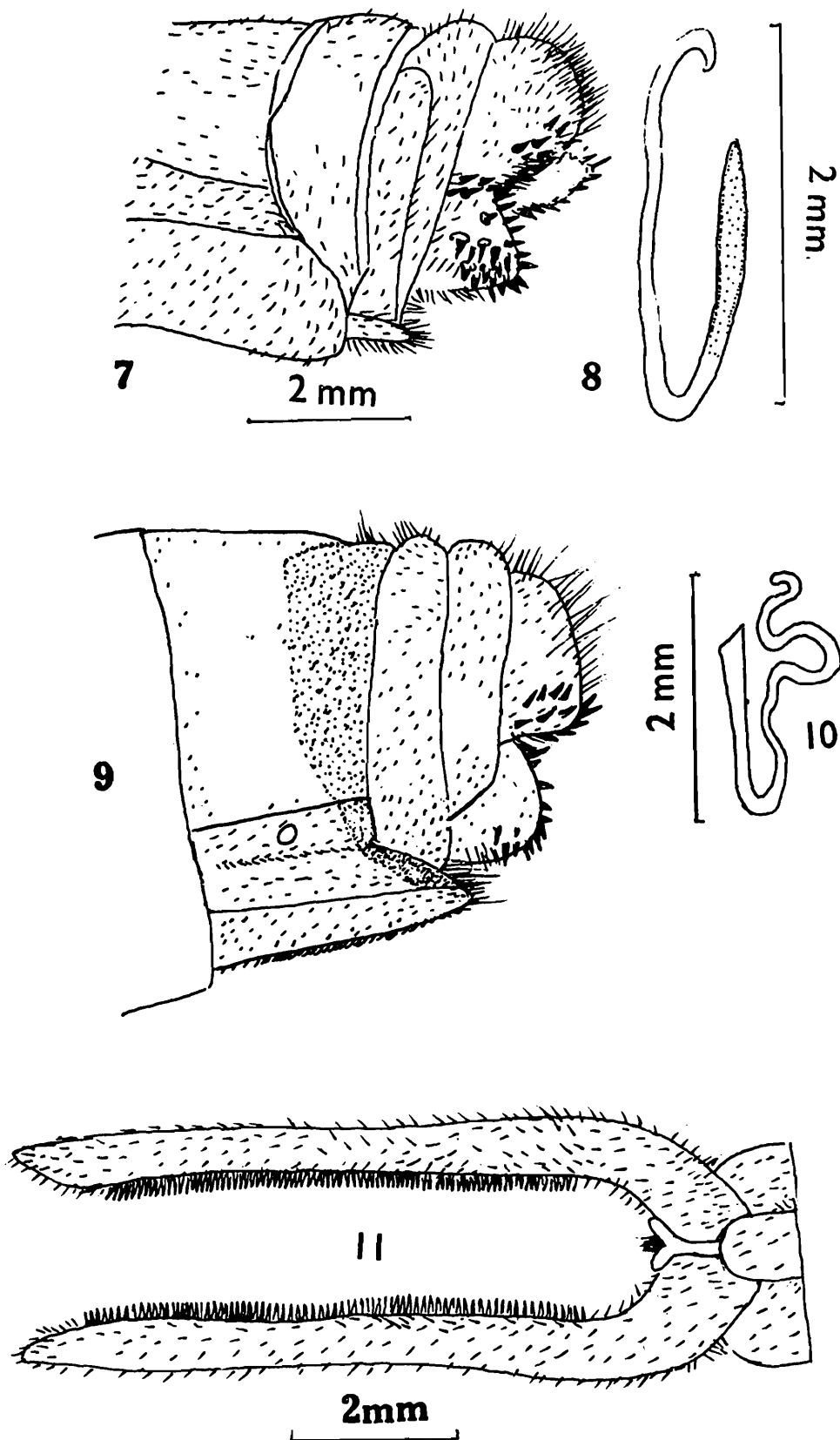
Stenares frazeri Banks, 1931, *Psyche*, 38 : 58; Ghosh & Sen, 1977, *Rec. zool. Surv. India*, 73 : 317.

Distribution : India : Karnataka.

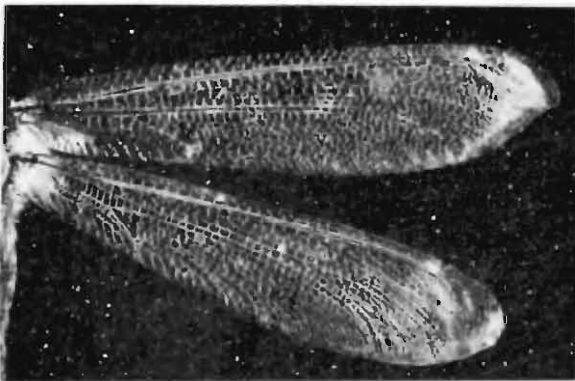
Remarks : Due to dearth of the material it has not been possible by the author to examine the species. However, it has been reviewed from literature. Banks (1931) described the species from Coorg, Karnataka. Though the species is very close to *S. improbus* (Walker) but the markings on pronotum, namely, a longitudinal median black stripe, lateral black mark on either side together with a dark dot above each at once distinguish the species from *S. improbus* (Walker).



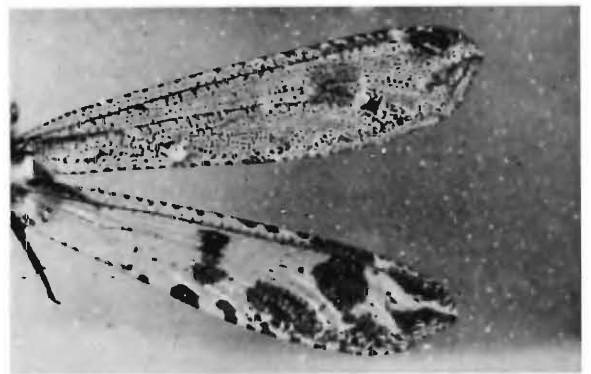
Figs. 1-6. *Stenares acutus*, sp. nov., male (1) tip of abdomen, ventral; (2) tip of abdomen, lateral; (3) tip of abdomen, lateral (magnified) showing aedeagus. *Stenares harpyia* (Gerstaecker) (4) tip of abdomen, male, ventral; (5) tip of aedeagus, lateral; (6) tip of abdomen, male, lateral.



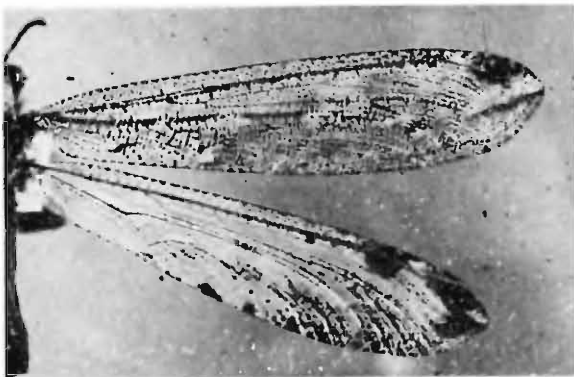
Figs. 7-11. *Stenares harpiya* (Gerstaedd) (7) tip of abdomen, female, lateral; (8) spermatheca, dorsal. *Stenares improbus* (Walker) (9) tip of abdomen, female, lateral; (10) Spermatheca, dorsal; (11) tip of abdomen, male, ventral.



12



13



14



15

Figs. 12-15. (12) *Stenares acutus*, sp. nov., fore-and hind wing; (13) *Stenares improbus* (Walker), fore-and hind wing; (14) *Stenares harpyia* (Gerstaecker), fore and hind wing; (15) *Stenares hyaena clara* Navas, fore-and hind wing.

SUMMARY

Five species including one new species of *Stenares* Hagen from India have been dealt with of which one has been reviewed from literature. A key to the species of the examined material together with a couple of new records has also been provided.

ACKNOWLEDGEMENT

The author is grateful to the Director, Zoological Survey of India, Calcutta for providing laboratory facilities.

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**SEX-RATIO OF THE CHEWING-LICE, *PIAGETIELLA* SP.
(PHTHIRAPTERA : INSECTA) OF GREY PELICAN**

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INTRODUCTION

The authors while conducting the bio-ecological studies on grey pelican (*Pelecanus philippensis* Gmelin) in Andhra Pradesh collected some arthropod ectoparasites for the first time from this host. These include ticks and chewing-lice. The latter species which appear new to Science belong to two genera viz., *Piagetiella* and *Pectinopygus* (*Epipelacanas*). Fifty specimens of the former (Fig. 1) and three males of the latter were collected from single host at Nelapattu (A.P.).

Clay (1949, 1950) recognized two ecological niches for the bird infesting Chewing-lice viz., the head & neck niche, and the abdomen and wing niche. Eichler (1963) added a third one, i.e., the gular pouch of the pelican (Fig. 2), and Emerson (1973) a fourth one in the large quills of Procellariiformes, Galliformes, Charadiiformes and Psittaciformes (see Lakshminarayana, 1986). In the present instance, the specimens of *Piagetiella* (both male and female mainly collected from the gular pouches, the parasites freely moving in and out of the pouch through the gap of the beaks, and hence some were found on the neck and feathers also. *Pectinopygus* specimens were however, collected on the feathers.

Normally, in the natural populations of the chewing-lice the females outnumber or atleast equal, to the males, and in some cases the males are practically unknown. It is assumed that in the last named cases, the females might be parthenogenic. However, there are few instances, where the males outnumbered the females as for example, *Piagetiella* in the present case.

The chewing-lice are obligatory ectoparasitic insects on birds (and mammals) and highly host-specific and seldom live outside their host body. They are passed on from one member to the other during mating, roosting, feeding, dust baths and occasionally by phoresy and to each succeeding generation by the parent birds (*vide* Lakshminarayana, 1986).

Although, the bird infesting Ischnocerophthiran lice like *Pectinopygus* are mainly feather feeders, the Amblycerophthiran lice like *Piagetiella* ingest in addition blood,

sebaceous or mucous secretions also. The damage caused to the feathers is considerable in case of heavy infestation. Further, the lacerations caused during the feeding are prone to secondary infections thereby affecting the health of the bird indirectly. They not only cause annoyance by their various activities, but also produce dermatitis in some cases. Eichler (1963) attributed various deformities in the beak and the infestation of lice was heavy (Fig. 3) also in such cases. Such birds perhaps cannot preen the lice unlike the healthier ones, and therefore have had heavy infestations. It is well known, that the higher parasitic load atleast in poultry birds reduces the rate of fecundity and lower the egg production. The same may be true in the wild also. Thus the parasite populations indirectly influence the fluctuations of the host population and so need to be paid considerable attention in the conservation programme.

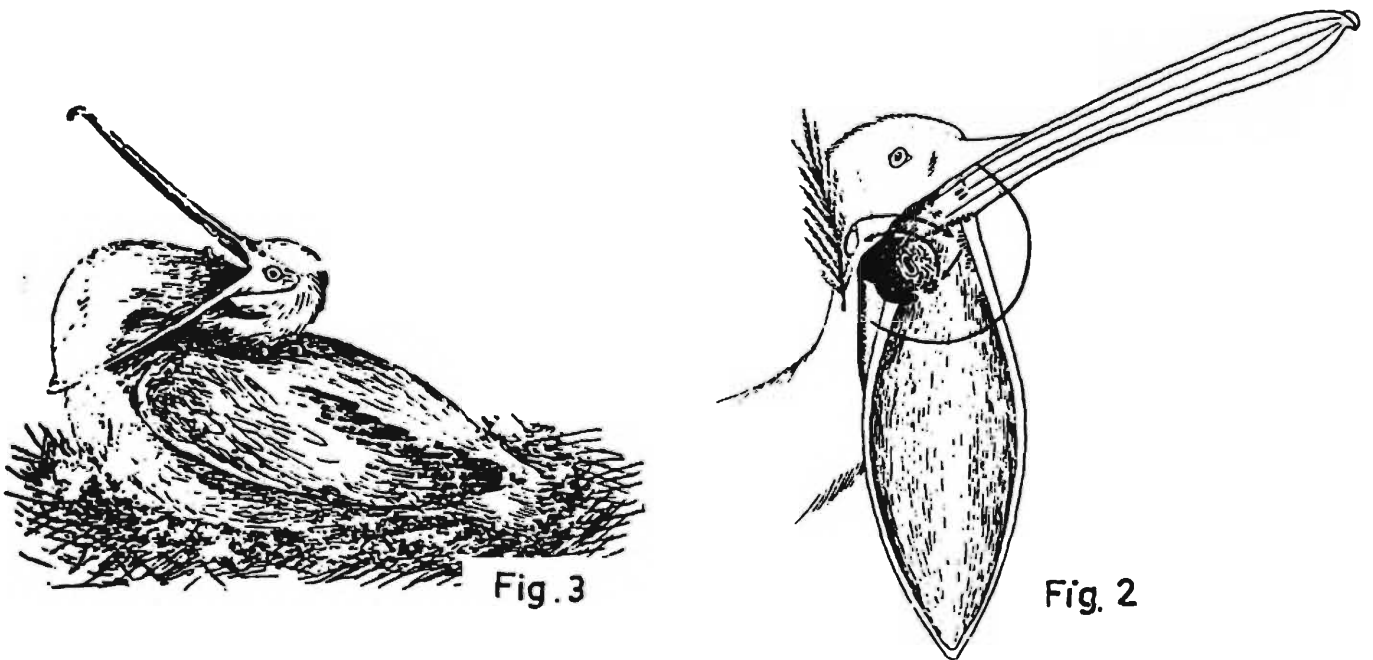
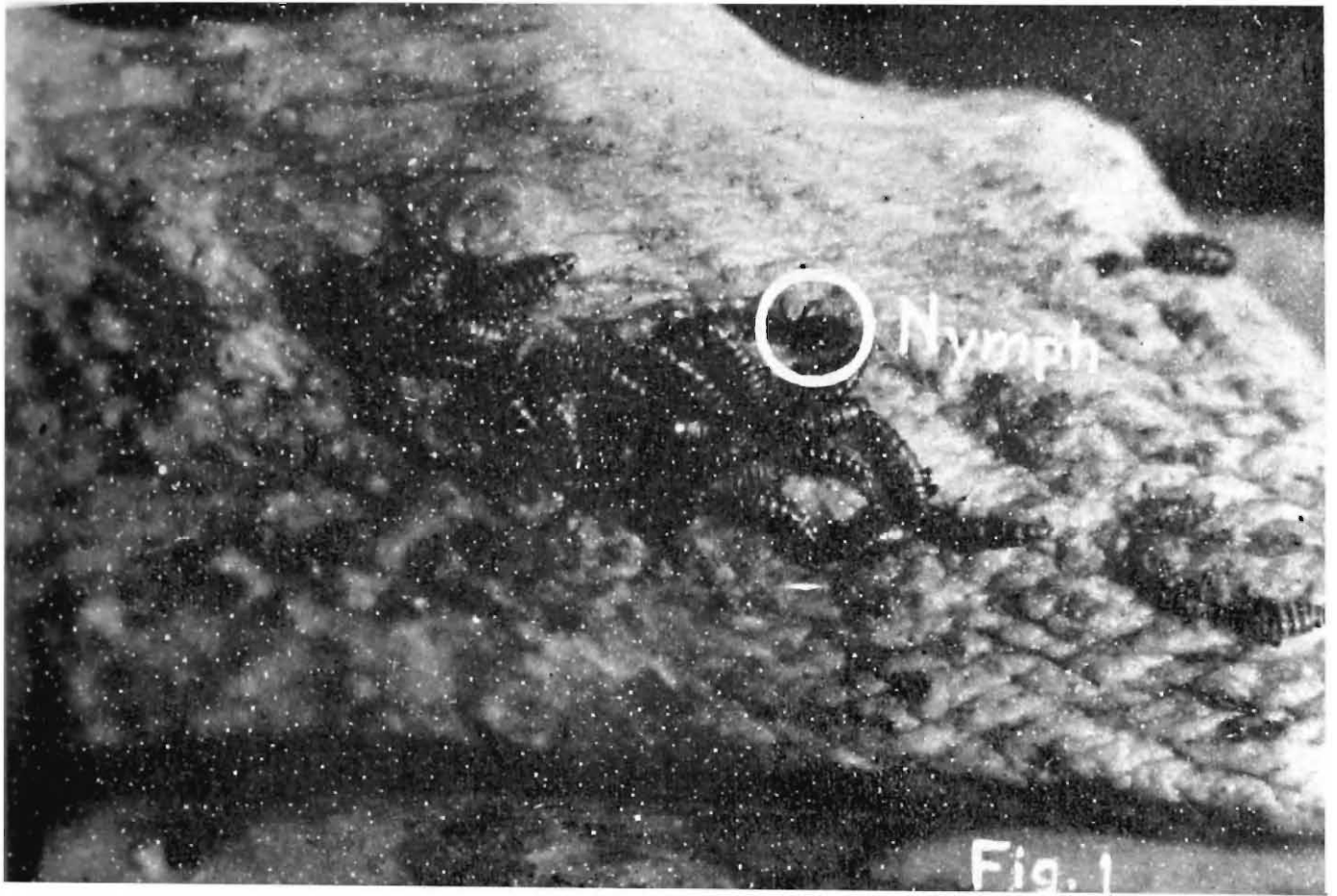
REVIEW OF LITERATURE

Hopkins (1949) emphasized that he was not aware of any instance of considerable normal excess of males over females save that of Keler (1940) where the males and females of *Trichodectes melis* were in the ratio of 1.4:1. This author further stated that usually the females are in excess over males and in such extreme instances as in *Damalinia americana*, *D. longicornis*, and *Geomydoecus scleritus*, where the male remained unknown and *D. equi* (now *Werneckiella equi*) where the male was discovered long after the discovery of the female. Hopkins (*op. cit.*) provided sex-ratios of mammal infesting lice (both chewing & sucking). From this list of 36 species/sub-species only three instances were found where males marginally outnumbered the females, while in considerable instances the sexes are nearly equal following the 50 : 50 rule as in all other bisexually reproducing species.

Recently, Marshall (1981) studied the sex-ratios in 250 species of various ectoparasitic insect groups including the chewing-lice. Marshall (1981) reviewed the literature on the subject in various ecto-parasitic insect orders. This author's results show that in general the males and females are in equal proportions with very few exceptions. The reduction in males amongst lice was attributed to the close inbreeding (**perhaps due to host specificity*) and quoted Hamilton (1967) in support of this contention in that amongst inbreeding communities the reduction in males is to be expected. Marshall (1983) further considers that the sex-ratio in natural populations may alter with numerous factors such as season, climate, host species, population density, nutritional status, position on the host body, and previous sampling of the host body and its home.

In general he concluded that the females predominate the populations. Males, however, according to him, predominated in the free living cimicids and pyralids, although the data were sparse; in the Streblids, however, the males predominated.

* italics ours.



Figs. 1-3. 1. Population of *Piagetiella* sp., *in situ* in the gular sac of *Pelecanus philippensis*; 2. The movement of *Piagetiella titan* on *Pelecanus onocrotalus* from feathers to gular sac and *vice versa* (after Dubinin, 1948, and Eichler, 1963); 3. The reaction of *Pelecanus onocrotalus* heavily infested with *Piagetiella titan* (after Dubinin, 1948, and Eichler, 1963.)

Marshall (1981) attributed the imbalance to the following causes : sampling number; sampling technique i.e., where the parasites are found both in the nest (or burrow) and the host body of which only one is examined; one sex escaping detection or capture; the short life of the male; the male being active and smaller than the female and liable to get separated from the population and lost due to predation by the host, or nutritional or climatic factors. In so far as the lice are concerned Marshall (*op.cit.*) following Hopkins (1949) opines that the males are short lived and hence the reason for the difference in sex ratio.

Fowler & Williams (1985) studied the population dynamics of the Chewing-lice (*Philopterus docophorus*, *Brueelia blagoveshtchenskyi* Balat, *Ricinws fringillae* degeen I, and *Menacanthus* sp.) and Acari on winter roosting reed bunting (*Emberiza schoeniclus*). The authors encountered two genera each of Ischnocrophthiran and Amblycerophthiran groups of lice on 324 reed buntings. The authors concluded that no birds carried more than two species at a time and the sex-ratio of adult lice are in the ratio of 52% females to 48% males. In the second half of the roosting period the nymphs predominated over the adults. Fowler & Williams (*op. cit.*) quoting Ash (1960), Askew (1971), and Baum (1968), state that because of uniform ecological conditions the lice probably breed through out the year, but considerable evidence now available indicates that population growth rates are highest during spring prior to the breeding of the host, falling drastically after the fledgling stage and subsequent moults. Therefore, one should expect predominance of nymphs over the adults during the period of rapid growth of the host, although it is not a universal rule.

DISCUSSION

In the present instance, we encountered the proportions of males and females *versus* nymphs as follows : ♂♂ 41 : ♀♀ 4 : 1 ♂ n. : 4 ♀♀ n. This clearly shows an unusual assemblage of males over females contrary to the above cases, and therefore interesting to report.

Hopkins (1949) opines that in instances where purely male populations dominate in numbers, then it is probable that these infestations are new and doomed for annihilation unless reinforced by females, or those in which the nymphs have not given rise to the females. Buxton (1941) attributed it to the injury to the females by too frequent mating by the numerous males.

We consider the following probabilities for this unusual occurrence in the light of the above observations of various authorities.

1. The chewing-lice are highly host-specific and live with in the feather cover (or hair-cover in mammal infesting forms) the micro-climatic conditions like temperature, humidity, food etc., remain uniform and the external macroclimatic fluctuations do not have so much influence on the parasite as compared to its host. But when the external

ecological conditions are not conducive, the health of the colony of the host, or individual is effected. It is likely that the host population may dwindle. Under such circumstances, the lice may be forced to resort to the production of males and therefore males outnumber females.

2. Male producing eggs might have hatched earlier than the female ones.

3. The male nymphs might be developing at a faster rate than the female nymphs as suggested by Hopkins (*op. cit.*). In the present case, the male and female nymphs are in the ratio 1 : 4 respectively, the other male nymphs being already developed.

4. Unlike the other Chewing-lice, *Piagetiella* species occupy gular pouches. The oral or gular pouch temperature may have some influence in the differential growth rates of the male and female nymphs.

5. The cytotaxonomy of the chewing-lice is not even in its infancy. Therefore, we do not know anything about the sex determining mechanism viz., whether it is by sex chromosomes (homo- or hetero-gametic); or by a single gene alleles as in mosquitoes; or by producing haploid or diploid eggs where haploids develop into males and diploids into females; or the lice have capability of both parthenogenic and sexual reproduction depending on the condition of the host and thereby alter the composition of the populations.

6. The area where the pelicanry was found was affected by a severe cyclone just before the collections were made. It was reported that along with other birds, many of the pelicans were also lost or disturbed during the cyclone. Along with the *Piagetiella* specimens only three males of *Pectinopygus* were collected at the time. It is probable, the cyclonic after effects have affected the health and vitality of the pelicans considerably. If there is increased parasite load, it further impairs the health of the host. Therefore, the parasites might have been constrained to resort to population control by drastically increasing its male population in preference to females so that control of egg production and consequent reduction of numbers in the subsequent generation is achieved.

ACKNOWLEDGEMENTS

The first two authors sincerely thank the Department of Environment, Government of India, for sanctioning the bio-ecology project on the grey pelican. They also earnestly thank the authorities of the Department of Zoology, Osmania University, Hyderabad, and the Chief Wild Life Warden, Government of Andhra Pradesh for all facilities in the laboratory and in the field. All the authors are grateful to the Director of Zoological Survey of India Calcutta, and Officer-in-Charge, Southern Regional Station, Zoological Survey of India, Madras for all facilities and encouragement in this work.

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* Original not seen

**ON A COLLECTION OF ORIBATEI (ACARI : CRYPTOSTIGMATA)
FROM SILENT VALLEY, KERALA (INDIA) WITH DESCRIPTIONS
OF SIX NEW SPECIES**

A. K. SANYAL

Zoological Survey of India, Calcutta

INTRODUCTION

During the course of investigation of faunal wealth of Silent valley, Kerala, India, by a survey party of Zoological Survey of India, soil dwelling oribatid mites were collected on which the present psaper is based. Altogether 19 species belonging to 15 genera under 14 families are treated of which 6 species are new to science and 4 genera (*Camisia*, *Gibbicepheus*, *Oppiella*, *Lauritzenia*) and 7 species are recorded for the first time from India. All measurements are in microns. The types are deposited in the National Collection of the Zoological Survey of India, Calcutta.

Family MESOPLOPHORIDAE

1. *Mesoplophora* sp.

Material examined : 1 ♀, India : Kerala, Silent valley; 10 kms north west of camp 2 at Valliyaparathodu, 24.i.1980. ex soil and litter, coll. S.K. Bhattacharyya.

Distribution : India : Kerala (new record), West Bengal.

Remarks : The specific identification was not possible as the specimen is damaged. So far, this genus was recorded from West Bengal and now it is being reported for the first time from Kerala.

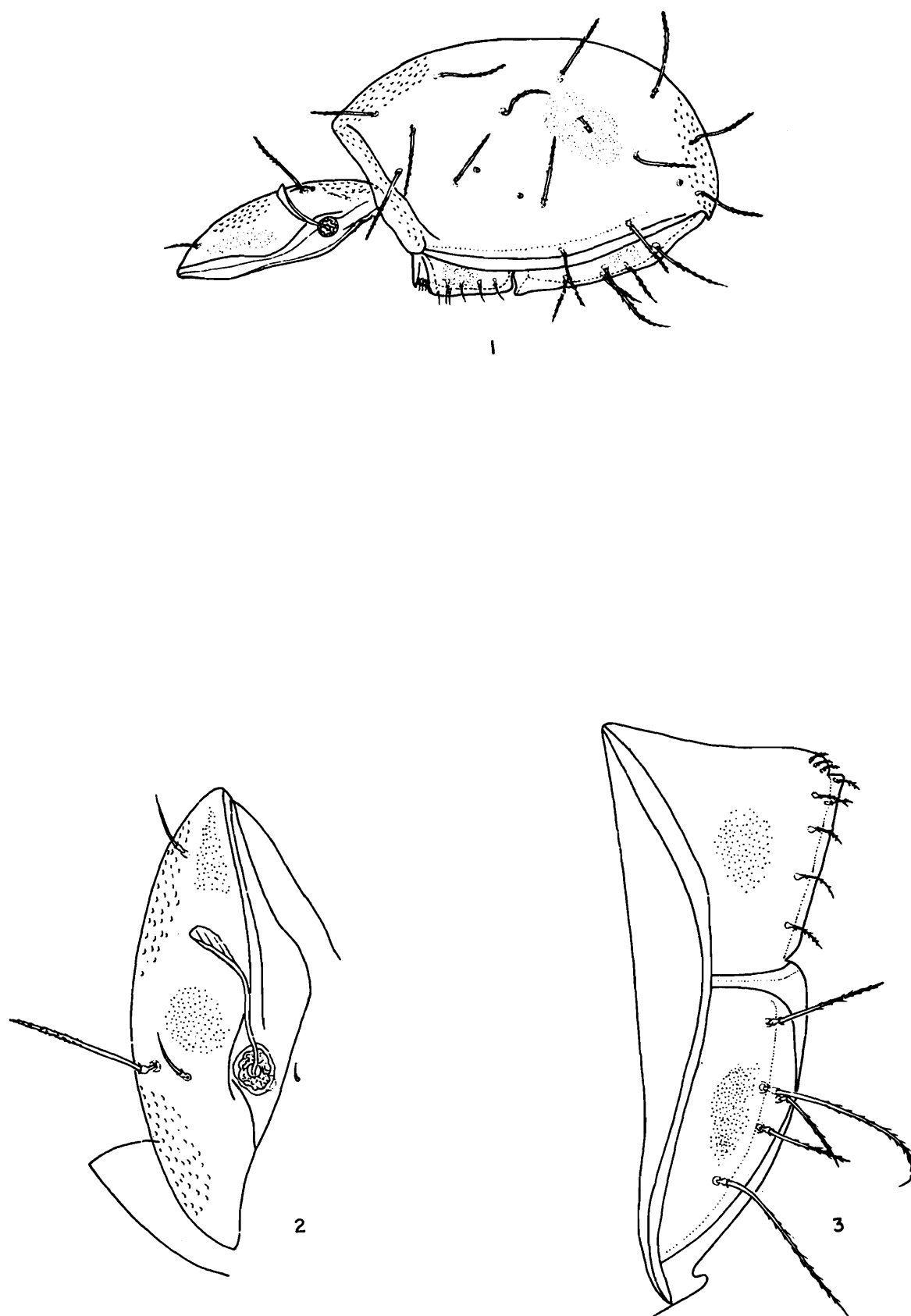
Family PHTHIRACARIDAE

2. *Hoplophthiracarus indicus* n. sp.

(Figs. 1-3)

Colour of the body light yellowish; length of the notogaster 404, height 309; length of aspis 247.

Aspis flat and narrow; distinct lateral carina arising from above bothridium and running almost parallel with lateral margin of aspis on the distal half, lateral carina touches the tip of aspis; rostral setae (29.2) slightly longer than lamellar setae, situated a little distance away from the tip of the aspis, directed outward and curved downward, smooth, thin, pointed; lamellar setae (20.9) 1/3 as long as interlamellar setae, fine, smooth, pointed; interlamellar setae long (66.8), thick, minutely barbed on its distal half, directed dorsoanteriad; sensillus (62.7) slender, weakly winding near base, head elongate and hyaline shaped; exobothridial setae very minute; fine foveolation on the dorsal surface of aspis, rest portion of aspis punctated.



Figs. 1. *Hoplophthiracarus indicus* n.sp. : Lateral view; 2. *Hoplophthiracarus indicus* n.sp. : Aspis; 3. *Hoplophthiracarus indicus* n.sp. : Genito-anal region.

Notogaster weakly convex, fifteen pairs of notogastral setae, moderately long (62.7 - 66.8), thick, barbed on their distal half, slightly bending towards anterior direction, c_3 slightly longer than c_2 , c_1 and c_3 with nearly equal distance from the anterior margin of notogaster, h_1 the longest setae, mutual distance between $h_3 - ps_4$ longer than the distance between $ps_3 - ps_4$, notogastral surface densely punctated.

Genital as well as anal plate lightly punctated, nine pairs of genital setae, four pairs placed somewhat distant from the inner margin of genital plate, two pairs close to the margin, minute, three pairs on the anterior appendage of genital plates; five pairs of setae on ano-adanal plates, all setae weakly barbed; an_1 and an_2 subequal in length and in thickness to ad_3 , ad_1 and ad_2 very long, thick, ad_2 longer than the longest notogastral setae h_1 , finely barbed.

All tarsi with one strong claw.

Holotype : ♀, India : Kerala, Silent valley, 13 kms away from Valliyaparathodu, 28.i.1980, ex soil and litter, coll. S.K. Bhattacharyya **Paratype** : 1 ♀, data same as for holotype.

Remarks : The new species bears close similarity with *Hoplophthiracarus kugohi* Aoki, 1959, in the general configuration of the body and in a number of characters. It can, however, be distinguished from Aoki's species by the absence of longitudinal striations between *in* and *la* and dense punctation of the body.

Family EUPHTHIRACARIDAE

3. *Rhysotritia ardua* (Koch)

1841. *Hoplophora ardua* Koch, *Deutschlands Crustaceen, Myriapoden und Arachniden*, 32 : 15.

1959. *Rhysotritia ardua* (Koch) : Markel and Meyer, *Zool. Anz.*, 163 : 329.

1980. *Rhysotritia ardua* : Mishra, Bhaduri and Raychaudhuri, *Sci. & Cult.*, 46 : 225; Singh and Mukherjee, 1971, *Oriental Ins.* 5(4) : 489.

Material examined : 2 ♀♀, India : Kerala, Silent valley, Valliyaparathodu, 23.i.1980, ex soil and litter, coll. S.K. Bhattacharyya; 2 ♀♀, India, Kerala, Silent valley, 10 kms North west of Valliyaparathodu, 24.i.1980, ex soil and litter, coll. S. K. Bhattacharyya; 4 ♀♀, India : Kerala, Silent valley, 13 kms away from valliyaparathodu, 28.i.1980, ex soil and litter, coll. S.K. Bhattacharyya.

Distribution : India : Kerala (new record), Orissa, Uttar Pradesh.

4. *Rhysotritia ardua* (Koch) var. *otaheitensis* Hammer

1972. *Rhysotritia ardua* (Koch) var. *otaheitensis* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, 19(3) : 12.

1981. *Rhysotritia ardua* (Koch) var. *otaheitensis* : Sanyal, *Progress in Soil Biology and Ecology in India* (ed. G.K. Veeresh), *UAS Tech. Series No. 37* : 109; Sanyal, 1982, *J. Soil Biol. Ecol.*, 2(1) : 10.

Material examined : 1 ♀, India : Kerala, Silent valley, 10 kms. away from Valliyaparathodu on Palghat Road, 25.i.1980, ex soil and litter, coll. S.K. Bhattacharyya; 1 ♀, India : Kerala, Silent valley, 13 kms away from valliyaparathodu, 28.i.1980, ex soil and litter, coll. S.K. Bhattacharyya.

Distribution : India : Kerala (new record), West Bengal.

Family CAMISIIDAE

5. *Camisia* sp.

Material examined : 1 Protonymph, India : Kerala, Silent valley, 10 kms north west of camp 2 at Valliyaparathodu, 24.i.1980, ex soil and litter, coll. S.K. Bhattacharyya.

Distribution : India : Kerala (new record).

Family HERMANNIIDAE

Genus *Phyllhermannia*

Key to the Indian Species of the genus *Phyllhermannia*

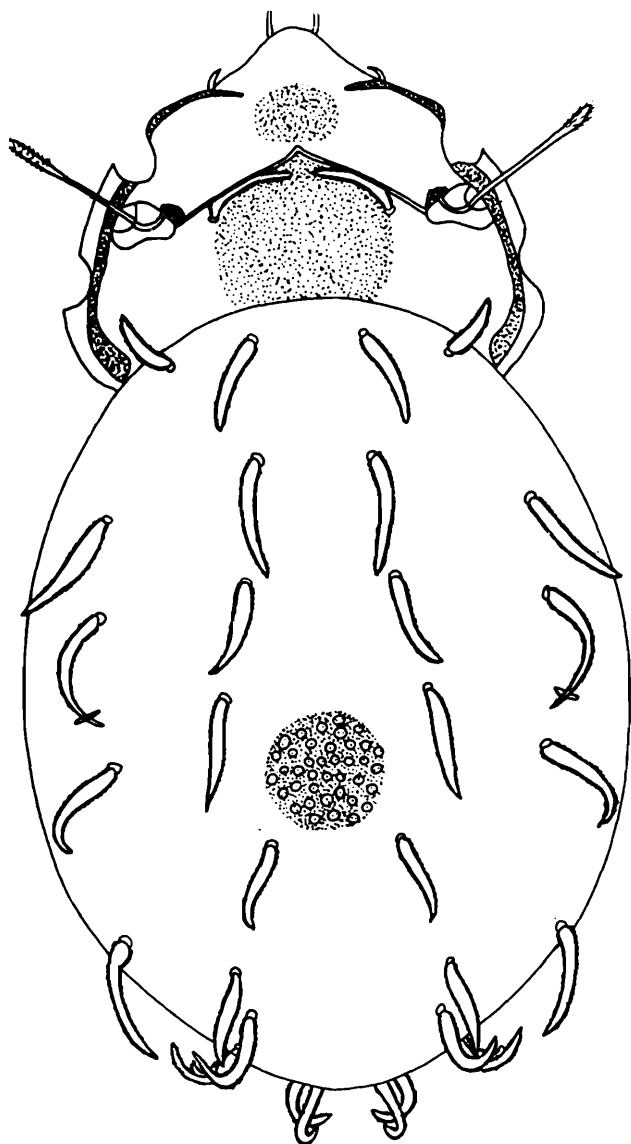
1. Body foveolated with punctation; chitinized ridge above the interlamellar setae*foveolatus* n. sp.
 Body punctated; chitinized ridge below or in between the interlamellar setae2
2. Chitinized ridge below the interlamellar setae, notogastral setae 16 pairs; genital setae 9 pairs.....*punctatus* n.sp.
 Chitinized ridge in between the interlamellar setae; notogastral setae 15 pairs; genital setae 18 pairs..... *berlesei* Mondal

6. *Phyllhermannia foveolatus* n.sp.

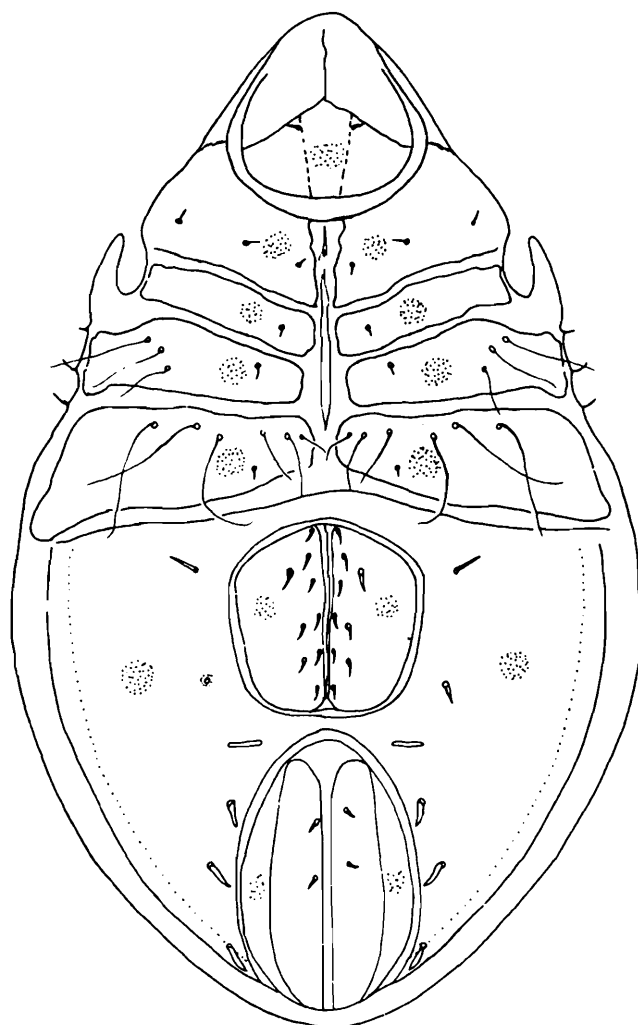
(Figs. 4-5)

Colour blackish brown; length of the body 840, width of the body 470.

The whole surface of prodorsum punctated, specially posterior part more densely punctated, prodorsum broader than long, one round shaped hump above the first leg; rostrum conical, rostral setae smooth, thin, pointed, slightly shorter than their mutual distance (29); lamellar setae (20.5) situated on the lateral side of the prodorsum, very thin, smooth, pointed; interlamellar setae situated below the chitinized arch between the pseudostigmata, sword like, pointed, margins rough, long(71), half as long as to their mutual distance; a strong ridge on either sides lateral to the pseudostigmata; pseudostigmatic organ (120) rod shaped, stem compressed, tip with fine bristles, less than half as long as to their mutual distance.



4



5

Figs. 4. *Phyllhermannia foveolatus* n. sp. : Dorsal view; 5. *Phyllhermannia foveolatus* n. sp. : Ventral view.

Notogaster oval, foveolated and punctated; notogastral setae sixteen pairs, long (45.8 - 91.7), narrowly leaf shaped, curved, tips pointed, margins rough, d_2 , e_2 and f_2 curved inward, ps_1 and ps_2 curved inward like hook, h_1 , h_2 and ps_2 curved outward, setal pores luminous.

The whole ventral surface densely punctated; hypostome rounded; hypostomal setae situated in the middle of the infracapitulum, minute, smooth; apodemata distinct, chitinized, median ridge prominent; epimeral setal formula 3-1-4-7, setae $3a$, $3b$, $3c$, $4a$, $4b$, and $4c$ very long (max. 95), fine, smooth, other setae minute, smooth; genital plate smaller than anal plate, nine pairs of genital setae, six on the inner margin and other three on the middle of the genital plate, minute, smooth; aggenital setae two pairs, one near anterior part and the other near posterior part of genital field, minute, stiff, smooth; adanal fissures distinct, situated obliquely in front of anal field; adanal setae three pairs, short, thick, smooth; anal setae two pairs, minute, smooth, placed on the inner margin of anal plate.

Legs monodactylous, foveolated and punctated; few setae long, leaf like, others string like.

Holotype : ♀, India : Kerala, Silent valley, near Valliyaparathodu camp, 22.i.1980, ex. soil and litter, coll. S.K. Bhattacharyya. *Paratypes* : 2 ♀♀, data same as for holotype.

Remarks : The new species is well in accord with the description and diagrams of *Phyllhermannia gladiata* Aoki, 1965 by the general body shape, presence of hump on the prodorsum, number and shape of notogastral setae. But it differs from *P. gladiata* by the absence of a ridge on the base of the prodorsum and the ridge on the anterior part of notogaster and by the presence of thin arch on the middle of prodorsum, apically compressed barbed pseudostigmatic organs, inwardly curved posterior notogastral setae and notogastral foveolation. The species also shows some resemblance to the Indian species *P. berlesei* Mondal, 1984 in general body shape and shape of the notogastral setae. But it can easily be separated from Mondal's species in the absence of ridges on the prodorsum and notogaster, in the presence of barbed sensilla, 16 pairs of notogastral setae and 9 pairs of genital setae.

7. *Phyllhermannia punctatus* n.sp.

(Figs. 6-7)

Colour of the body blackish brown; length of the body 840, width of the body 483.

Prodorsum punctated, area between interlamellar setae and anterior border of hysterosoma more densely punctated; the margin of prodorsum above the first leg round shaped like a hump; rostral setae smooth, thin, pointed, slightly shorter than their mutual distance (33.4); lamellar setae (10.4) situated just above the hump, smooth, thin, pointed, about four times smaller as to their mutual distance (87.7); interlamellar

setae sword like, apex pointed, margins rough, about half the length of their mutual distance (133.7); a thin arch between the interlamellar setae; pseudostigmatic organ long (127.0), rod like, stem compressed at the tip with fine bristles, less than half of their mutual distance; one semilunar shaped chitinized ridge on the posterior part of prodorsum.

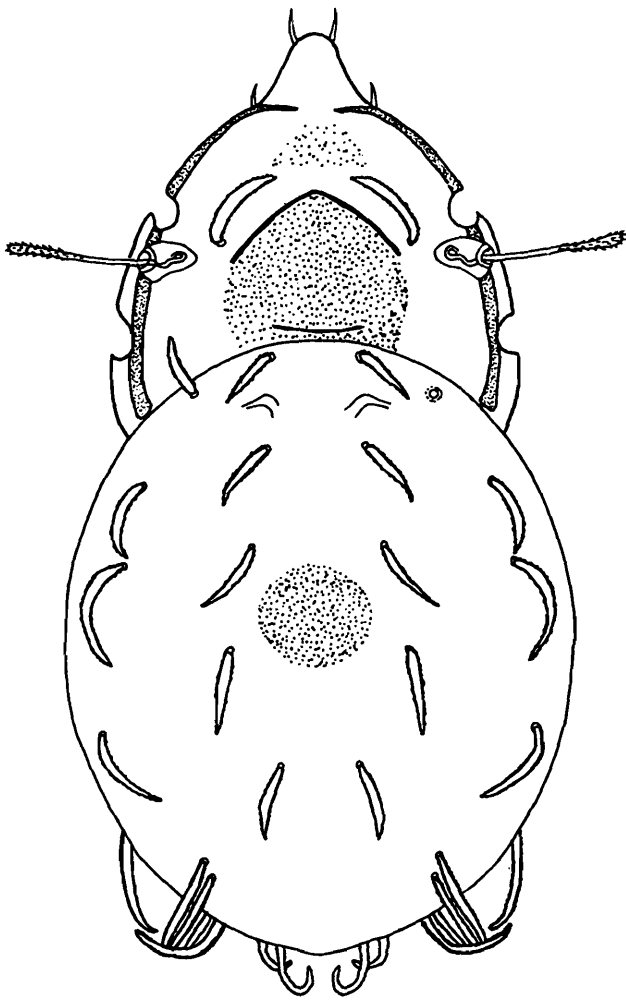
Notogaster oval shaped, punctated, a pair of chitinized ridge on the anterior part of notogaster, notogastral setae sixteen pairs, long (41-90), sword like, pointed tips, d_2 , e_2 and f_2 curved, tips of ps_1 and ps_2 curved inward like hook, h_1 , h_2 and ps_3 outwardly curved; setal pores prominent.

The whole ventral surface densely punctated, hypostome rounded; a chitinized ridge on the infracapitulum; hypostomal setae minute, smooth, situated on the middle of the infracapitulum; apodemata distinct, chitinized; median ridge prominent; epimeral setal formula 3-1-4-7, setae $3a$, $3b$, $3c$, $4a$, $4b$ and $4c$ long (Max. 91), fine, smooth; other setae minute, smooth; genital plate smaller than anal plate (188); genital setae nine pairs, six minute setae on the inner line, three others on the middle, comparatively long, smooth, pointed; aggenital setae two pairs, one near the distal part of the genital field, other near middle of the posterior part of epimeral plate IV, minute, smooth, pointed; adanal fissures distinct, situated obliquely in front of anal field; adanal setae three pairs, short, thick, smooth, pointed; two pairs anal setae, minute, smooth, situated on the inner line and middle of anal plate.

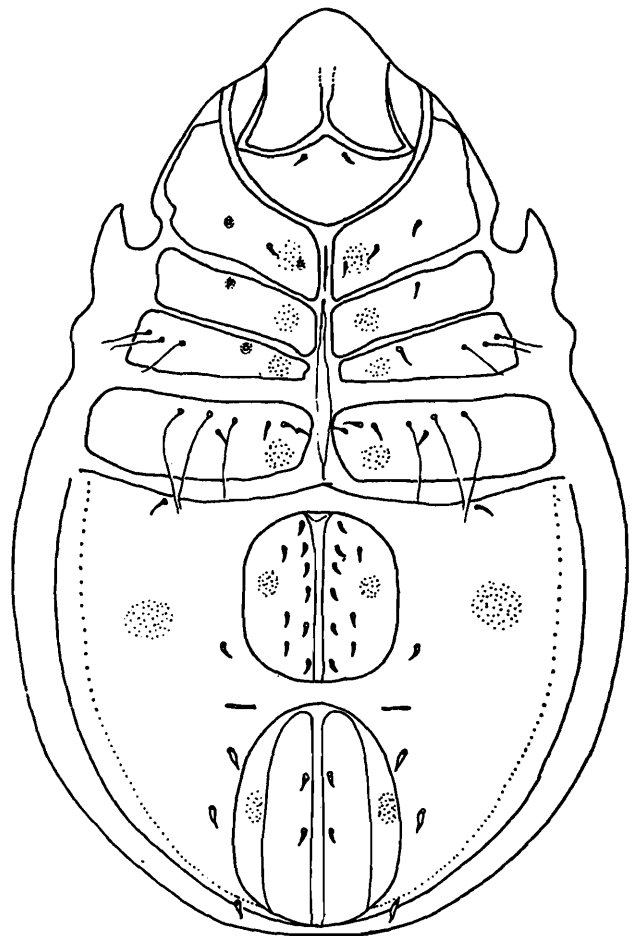
Legs monodactylous, densely punctated; long and minute setae of notogastral type.

Holotype : ♀, India : Kerala, Silent valley, 13 kms away from Valliyaparathodu, 28.i.1980, ex. soil and litter, coll. S.K. Bhattacharyya. *Paratypes* : 1 ♀, Kerala, Silent valley, near Valliyaparathodu camp, 22.i.1980, ex. soil and litter, coll. S.K. Bhattacharyya; 2 ♀♀, Kerala, Silent valley, 10 kms north west of camp 2 at Valliyaparathodu, 24.i.1980, ex. soil and litter, coll. S.K. Bhattacharyya.

Remarks : The species shows resemblance to *Phyllhermannia gladiata* Aoki, 1965 by general body shape, presence of hump on the prodorsum, ridge on the base of the prodorsum, number and shape of notogastral setae and small semilunar shaped ridge on the anterior part of notogaster. But it differs from *P. gladiata* by the presence of thin arch on the middle of prodorsum, apically compressed barbed pseudostigmatic organ, inwardly curved posterior notogastral setae and notogastral punctation. The species also resembles *P. foveolatus* n.sp. in a number of characters but clearly differs from that in the presence of interlamellar setae above the chitinized arch, absence of semilunar shaped ridge on prodorsum and absence of foveolation on the body. Further, the new species are similar to the Indian species *P. berlesei* Mondal, 1984 in general body shape, body punctation and shape of notogastral setae. It can, however, be separated from *berlesei* by the characters like shape of the ridges on prodorsum and notogaster, barbed sensillus, 16 pairs of notogastral setae and 9 pairs of genital setae.



6



7

Figs. 6. *Phyllhermannia punctatus* n. sp. : Dorsal view; 7. *Phyllhermannia punctatus* n. sp. : Ventral view.

Family CARABODIDAE

8. *Gibbicepheus sisiri* n.sp.

(Figs. 8-9)

Colour light brown; length of the body 564, width of the body 326.

The whole body surface finely punctated; prodorsum broad, flat; lamellae broad, width greater than rostral setae, distal part with two elongated light protions; rostral setae small (12.5); lamellar setae a little smaller than rostral setae, situated on the antero-lateral portion of lamella, fine, smooth, directed anteriorly; interlamellar setae long (62.7), directed outwardly, fine, smooth; bothridium cone shaped; sensillus erect to inclinate, filiform, aciculate.

Notogaster almost flat, broad; two fine longitudinal crest on the middle of hysterosoma; two more thick ridges situated latero-medially on the hysterosoma; one marginal ridge encircling the whole hysterosoma; fourteen pairs of notogastral setae, small (max. 34), fine, smooth, four pairs on the median crest, one pair near dorsosejugal suture, three pairs on latero-medial ridge, two pairs on marginal ridge, four pairs in postero-marginal position.

Hypostome round; one pair of setae in the middle of infracapitulum, fine, smooth; epimeral plates distinct, dark coloured; epimeres touching the lateral margin of the body; epimeral setal formula 3-1-3-3, setae fine, smooth; four pairs of genital setae, minute, fine, smooth; anal setae two pairs, minute, pointed; three pairs of adanal setae, fine, smooth, posterior two pairs of adanal setae in postanal position; adanal fissures distinct, situated obliquely away from the base of ad_3 .

All legs monodactylous.

Holotype : ♀, India : Kerala, Silent valley, 10 kms north west of camp 2 at Valliyaparathodu, 24.i.1980, ex soil and litter, coll. S.K. Bhattacharyya.

Remarks : The new species can easily be differentiated from all other species under the genus by the combination of minute, fine, smooth setae, fine longitudinal crest on the middle of notogaster, thick median ridge on the hysterosoma and dense punctation of the body.

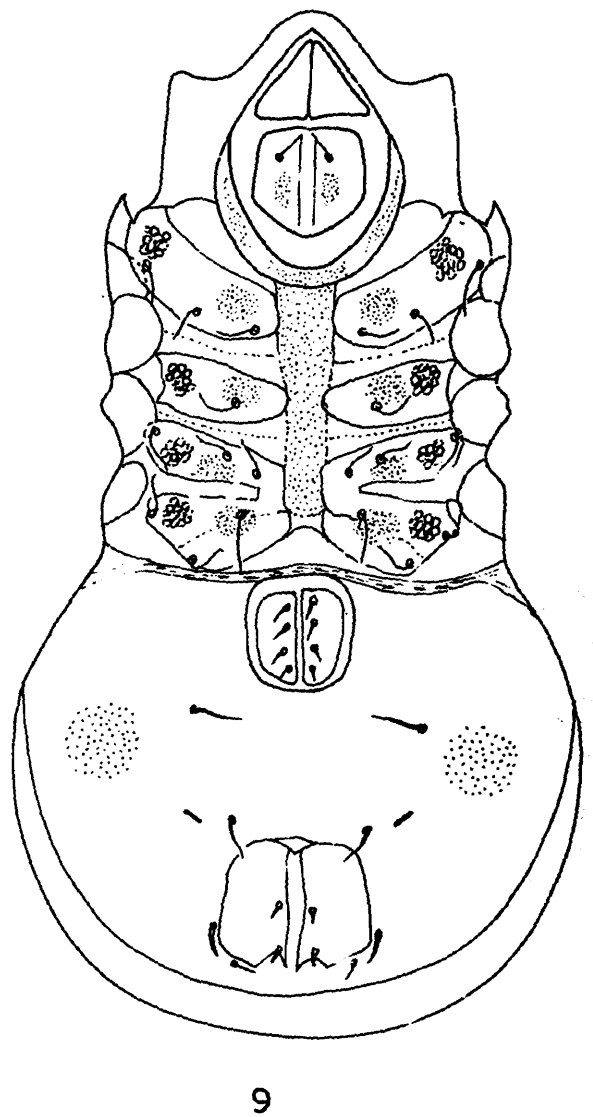
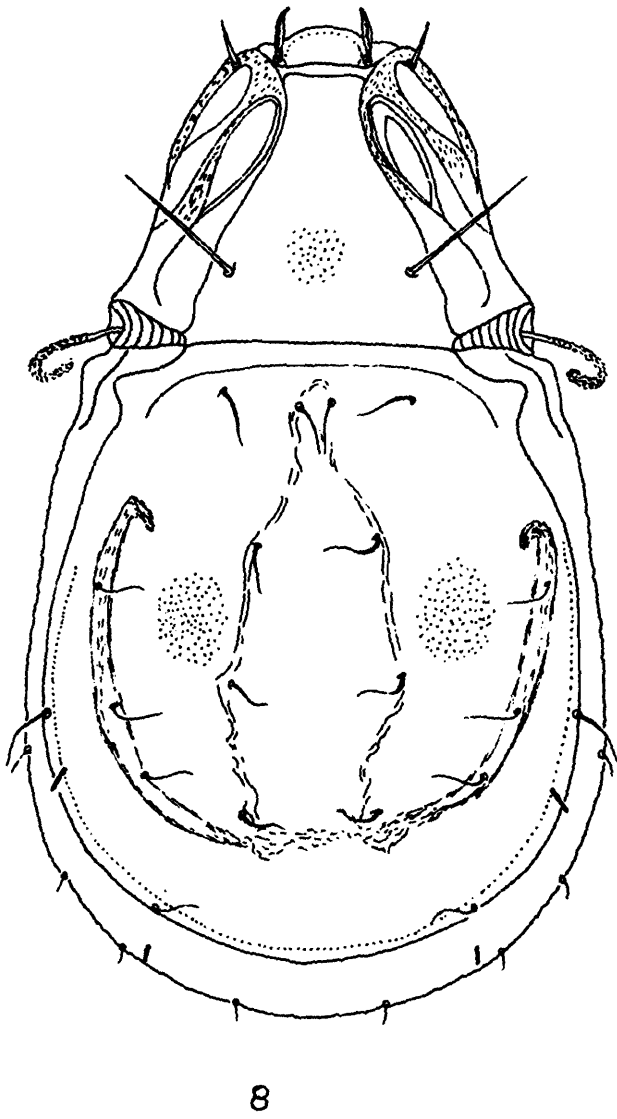
Family TECTOCEPHEIDAE

9. *Tectocephus velatus* (Michael)

1880. *Tegeocranus velatus* Michel, *Journ. Roy. Micr. Soc.*, 3 : 190.

1895. *Tectocephus velatus*, Berlese, *Acari, Myriapoda et Scorpiones hucusque in Italia reperta*, 77.

1906. *Tectocephus velatus*, Pearce, *Journ. Roy. Micr. Soc.*, 270; Chakrabarti *et al.*, 1979. *Acarology News letter*, 8 : 4; Mishra *et al.*, 1980, *Sci. & Cult.*, 46 : 226.



Figs. 8. *Gibbicepheus sisiri* n. sp. : Dorsal view; 9. *Gibbicepheus sisiri* n. sp. : Ventral view.

Material examined : 2 *fem.fem.*, India : Kerala, Silent valley, Valliyaparathodu, 18.i.1980, ex soil and litter, coll. S.K. Bhattacharyya; 1 *fem.*, Silent valley, 13 kms away from Valliyaparathodu, 28.i.1980, ex soil and litter, coll. S.K. Bhattacharyya.

Distribution : India : Kerala (new record), Orissa, Sikkim, West Bengal.

Family OTOCEPHEIDAE

10. *Dolicheremaeus renukae* n.sp.

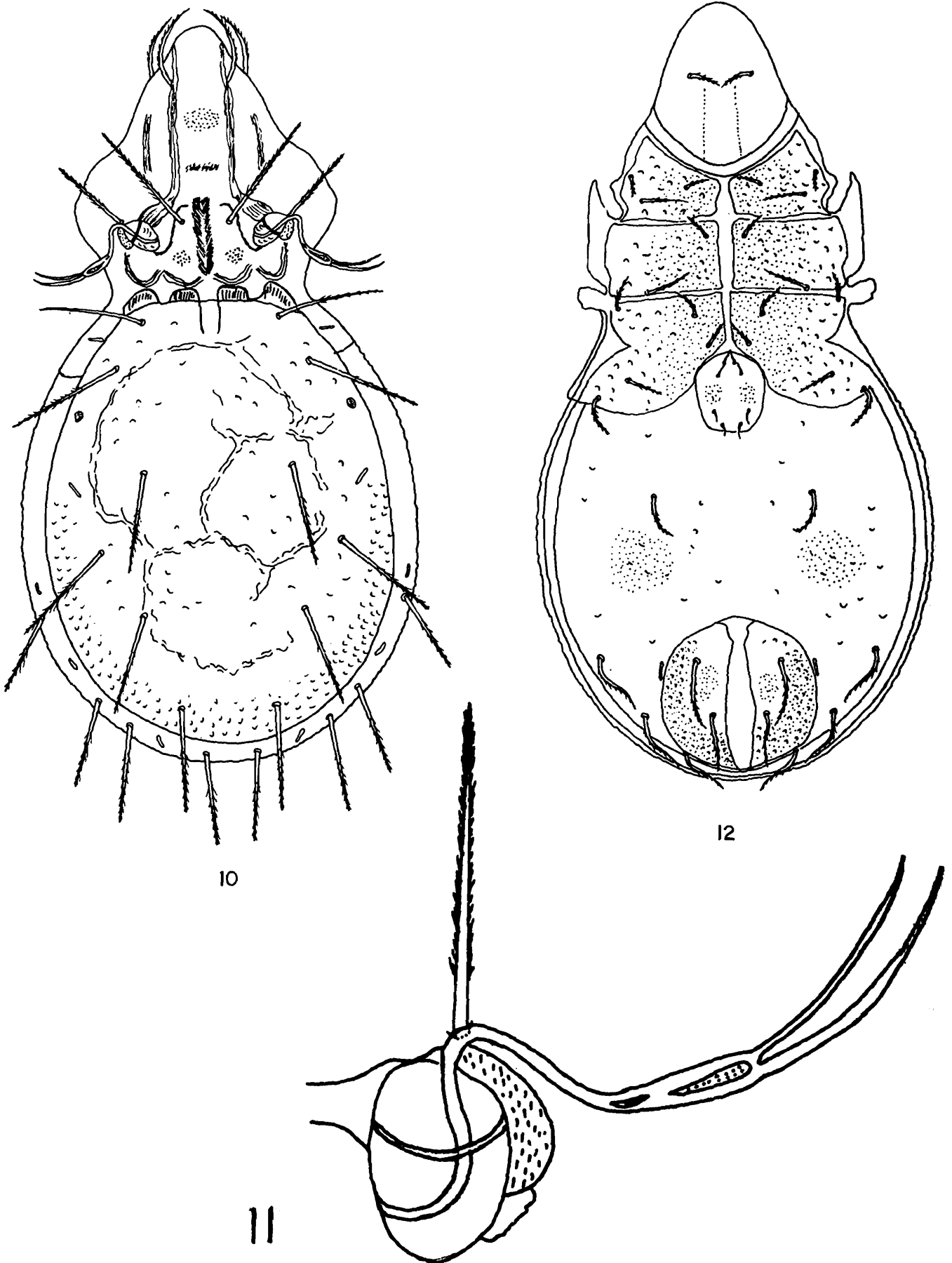
(Figs. 10-12)

Colour dark brown; length of the body 809, width of the body 457.

Prodorsum longer than broad, densely punctated, lateral margins of prodorsum without angular tooth; lamellae mostly parallel, roughly sculptured, a weakly chitinised ridge on the outer side of lamellae; rostral setae (76.1) arise from postero-lateral margin of rostrum, curved, conspicuously barbed on the outer side, tips fine extending slightly beyond the anterior margin of rostrum; lamellar setae (81) similar to that of rostral setae; interlamellar setae long (124), situated close to bothridium, stiff, erect, minutely barbed, slightly longer than twice their mutual distance; dorsal pseudostigmatic plates well developed covering the pseudostigmata, ventral pseudostigmatic plates round; sensillus (171) with fusiform head and long pointed bifurcate apex, smooth, stem strongly elbowed near the base; exopseudostigmatic setae placed antero-lateral to ventral pseudostigmatic plate on each side, long (90.4), stiff, erect, minutely barbed, extend beyond the postero-lateral margin of prodorsum; median prodorsal and lateral condyles large, well chitinized, inner postero-median part of prodorsum with two longitudinal rows of scale like sculptures.

Notogaster longer than broad, dorsally punctate, irregular foveolation on the posterior part; indistinct double lined interrupted longitudinal ridges on the median portion of notogaster, lateral notogastral condyles (*Co.nl*) triangular, projected anteriorly, median notogastral condyles (*Co.nm*) well developed, almost rectangular; ten pairs of notogastral setae, long, stiff, erect, minutely barbed; setae *ta*, *te*, *ti*, *ms*, *r*₁ and *r*₂ longer (123.7) than other notogastral setae (100.2); distance $te-ti > ta-te$ and $te-ms < ms-r_1$; mutual distance $ta-ta < te-te$ and $ti-ti < ms-ms$; five pairs of notogastral fissures, *ia* located in between *ta* and *te*, *im* in between *te* and *ti* and posterior to *gla* being separated from this for a good distance, *ih*, *ips* and *ip* situated anterior to *r*₃, *p*₃ and *p*₁ respectively.

Hypostome anteriorly rounded, hypostomal setae situated somewhat in the middle of the infracapitulum, relatively long and minutely barbed; the whole ventral surface punctated and foveolated; epimeral setae finely barbed, arranged in the formula 3-1-3-3, antiaxial row of setae longer than para axial row; genital plate smaller than anal plate, four pairs of genital setae, equal in length, five times smaller than the anal setae, smooth; aggenital setae barbed; anal setae two pairs, anterior pairs longer than posterior pairs (158), minutely barbed; adanal fissures distinct, situated parallaly on either side of the anal plate; adanal setae three pairs, minutely barbed.



Figs. 10. *Dolicheremaeus renukae* n.sp. : Dorsal view; 11. *Dolicheremaeus renukae* n.sp. : Sensillus; 12. *Dolicheremaeus renukae* n.sp. : Ventral view.

Legs monodactylous.

Holotype : ♀, India : Kerala, Silent valley, 13 kms away from Valliyaparathodu, 28.i.1980, ex soil and litter, coll. S.K. Bhattacharyya, *Paratype* : 1 ♀, data same as for holotype.

Remarks : The new species shows some resemblance to *D. coronarius* Chakraborti *et al.*, 1981 in the presence of longitudinal ridges on the notogaster but all other major characters are dissimilar in two species. Further *renukae* is well in accord with *D. cuspidata* Wallwork, 1962 in the form of lamellae and rostral, lamellar, notogastral and ventral setae. But the shape of sensilla, long exopseudostigmatic setae and longitudinal ridges on the notogaster distinctly recognise *D. renukae* as a new species.

11. *Dolicheremaeus keralaensis* n.sp.

(Figs. 13-15)

Colour dark brown; length of the body 945, width of the body 438.

Prodorsum longer than broad, punctated, lateral margins of prodorsum without angular tooth; lamellae parallel, thin, touching the rostrum; rostral setae (92) originated from postero-lateral margin of rostrum, directed outward and strongly curved inward, unilaterally feathered on the outer side, tips very fine; lamellae almost parallel, a weakly chitinized ridge on the outer side of lamellae; lamellar setae (125.4) similar to that of rostral setae, tips meeting each other; interlamellar setae twice the length of their mutual distance (66.8), straight, smooth, tips fine, situated close to bothridium; dorsal pseudostigmatic plates cover most of pseudostigmata, well developed, almost rounded ventral pseudostigmatic plates; sensillus (142) spindle shaped, smooth, mid-portion slightly expanded, stem strongly elbowed near the base; exopseudostigmatic setae clearly visible, minute (21), situated antero-lateral to ventral pseudostigmatic plate on each side; prodorsal condyles broadly rounded, chitinized, two longitudinal rows of scaly structures on the inner postero-median part of prodorsum.

Notogastral surface covered with dense punctation, distinct foveolation and indistinct broken ridges; lateral notogastral condyles (*Co.nl.*) well developed and somewhat rounded, median notogastral condyles (*Co.nm.*) relatively small and rounded; notogastral setae ten pairs, *ta*, *te*, *ti*, *ms* and *p*₃ weakly barbed, *p*₁, *p*₂, *r*₁ and *r*₂ long (146), flagelliform, sometimes tips curved, others setiform (83.6); distance *te-ti* > *ta-te* and *te-ms* < *ms-r*₁; mutual distance *ta-ta* < *te-te* and *ti-ti* < *ms-ms*; notogastral fissures *ia* and *im* aligned obliquely, the latter placed immediately above *gla*, *ih* and *ips* located anterior to *r*₃, *ip* between *p*₂ and *p*₃.

Hypostome anteriorly rounded, hypostomal setae situated in the middle of the infracapitulum, smooth; the whole ventral surface finely punctated and foveolated; epimeral setae smooth, tips fine, arranged in the formula 3-1-3-3, anti-axial row of setae smaller than para-axial row; genital plate smaller than anal plate, four pairs of genital

setae, equal in length, smooth; aggenital setae smooth; aral setae two pairs, smooth; adanal fissures distinct, situated obliquely on either side of the anal plate, adanal setae three pairs, smooth, tips fine.

Legs monodactylous.

Holotype : ♀, India : Kerala, Silent valley, 13 kms away from Valliyaparathodu, 28.i.1980, ex soil and litter, coll. S.K. Bhattacharyya, *Paratypes* : 2 ♀♀, data same as for holotype.

Remarks : *D. keralaensis* is closely related to *D. capreolata* Wallwork, 1962 in general body shape and size, finely barbed rostral and lamellar setae, flagelliform tips of r_1 and p_2 and shape of the epimeral setae. But it differs from *D. capreolata* by the presence of smooth and long interlamellar setae, barbed *ta*, *te*, *ti*, *ms*, r_3 and p_3 , broken ridge on the notogaster, smooth adanal setae and in the shape of the sensillus.

12. *Dolicheremaeus aurita* Aoki

1965. *Dolicheremaeus aurita* Aoki, *Nature and Life in Southeast Asia*, 4 : 175.

Material examined : 3 ♀♀, India : Kerala, Silent valley, Valliyaparathodu camp, 23.i.1980, ex. soil and litter, coll. S.K. Bhattacharyya; 1 ♀ Silent valley, 10 kms north west of valliyaparathodu camp, 24.i.1980, ex soil, coll. S.K. Bhattacharyya; 6 ♀♀, Silent valley, 13 kms away from Valliyaparathodu, 28.i.1980, ex soil and litter, coll. S.K. Bhattacharyya.

Distribution : India : Kerala (new record).

Family OPPIIDAE

13. *Oppia arcualis* (Berlese)

1913. *Dameosoma arcuale* Berlese, *Redia*, 9 : 89.

1967. *Oppia arcualis*, Balogh and Mahunka, *Acta zool. Hung.*, Budapest, 23 : 45.

1968. *Oppia arcualis*, Hammer, *Biol. Skr. Dan. Vid. Selsk.*, 26(2) : 5.

Material examined : 1 ♀, India : Kerala, Silent valley, 10 kms north west of Valliyaparathodu camp, 24.i.1980, ex soil, coll. S.K. Bhattacharyya.

Distribution : India : Kerala (new record).

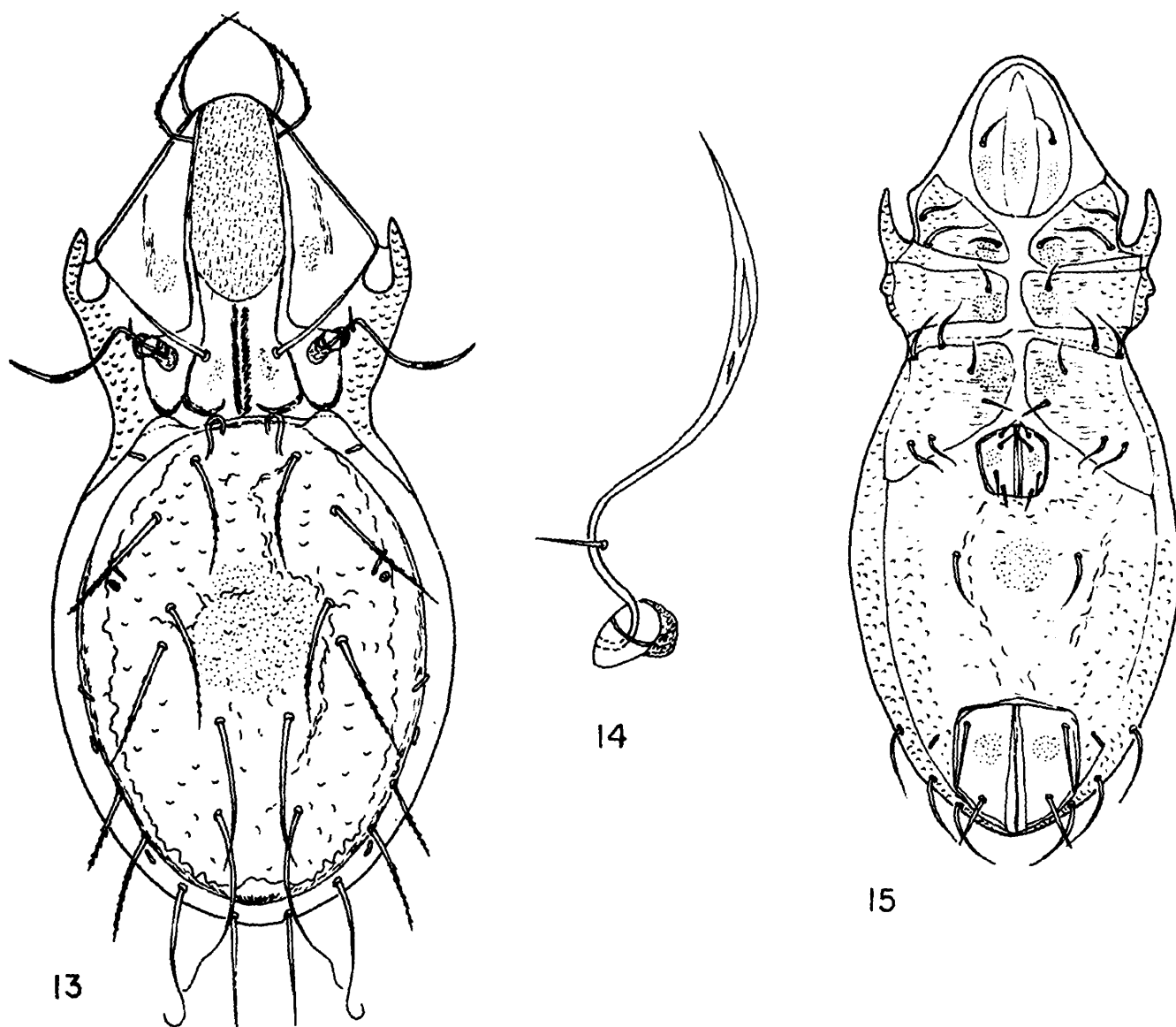
14. *Oppiella nova* (Oudemans)

1902. *Eremaeus novus* Oudemans, *Ent. Ber.*, 1 : 36.

1937. *Oppiella nova*, Jacot, *Journ. N.Y. Ent. Soc.*, 45 : 356.

Material examined : 2 ♀♀, India Kerala, Silent valley, 10 kms away from Valliyaparathodu on Palghat Road, 25.i.1980, ex leaf litter, coll. S.K. Bhattacharyya.

Distribution : India : Kerala (new record).



Figs. 13. *Dolicheremaeus keralaensis* n.sp. : Dorsal view; 14. *Dolicheremaeus keralaensis* n.sp. : Sensillus; 15. *Dolicheremaeus keralaensis* n.sp. : Ventral view.

Family CHAUNOPROCTIDAE

15. *Caloppia minor* Balogh

1958. *Caloppia minor* Balogh, *Rev. Zool. Bot. Afr.*, **58**(1-2) : 11.

Material examined : 1 ♀, India : Kerala, Silent valley, around Valliyaparathodu camp, 29.i.1980, ex leaf litter and soil, coll. S.K. Bhattacharyya.

Distribution : India : Kerala (new record).

Family ORIBATULIDAE

16. *Scheloribates elegans* Hammer

1958. *Scheloribates elegans* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **10**(1) : 77.

Material examined : 7 ♀♀, India : Kerala, Silent valley, 10 kms north west of Valliyaparathodu camp, 24.i.1980, ex soil, coll. S.K. Bhattacharyya.

Distribution : India : Kerala (new record).

Family HAPLOZETIDAE

17. *Lauritzenia longipluma* Hammer

1958. *Lauritzenia longipluma* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **10**(1) : 83.

Material examined : 2 ♀♀, India : Kerala, Silent valley, 10 kms northwest of Valliyaparathodu camp, 24.i.1980, ex soil, coll. S.K. Bhattacharyya; 1 ♀, Silent valley, 13 kms away from valliyaparathodu, 28.i.1980, ex litter and soil, coll. S.K. Bhattacharyya.

Distribution : India : Kerala (new record).

Family MOCHLOZETIDAE

18. *Unguizetes clavatus* Aoki

1967. *Unguizetes clavatus* Aoki, *Nat. Life Southeast Asia*, **5** : 195.

1977. *Unguizetes clavatus*, Chakrabarti, Bhaduri and Raychaudhuri, *Sci. & Cult.*, **43**(4) : 180.

Material examined : 1 ♀, India : Kerala, Silent valley, 8 kms southeast of Valliyaparathodu camp, 23.i.1980, ex soil and decaying leaves, coll. S.K. Bhattacharyya; 1 ♀, Silent valley, 3 kms south of Valliyaparathodu camp, 28.i.1980, ex grass and soil, coll. S.K. Bhattacharyya; 2 ♀♀, Silent valley, around Valliyaparathodu camp, 29.i.1980, ex decomposed wood, coll. S.K. Bhattacharyya.

Distribution : India : Kerala (new record), West Bengal.

Family GALUMNIDAE

19. *Galumna flabellifera orientalis* Aoki

1965. *Galumna flabellifera orientalis* Aoki, *Nat. Life Southeast Asia*, **4** : 187.

1975. *Galumna flabellifera orientalis*, Deb and Raychaudhuri, *Annot. Zool. Japan*,

48 (3) : 170; Haq and Prabhoo, 1976, *Entomon*, 1 (2) : 136; Haq and Adolph, 1980, *Indian J. Acar.*, 5 : 57.

Material examined : 3 ♀♀, India : Kerala, Silent valley, around Valliyaparathodu camp, 29.i.1980, ex decomposed wood, coll. S.K. Bhattacharyya.

Distribution : India Kerala, West Bengal.

SUMMARY

Nineteen oribatid species belonging to fifteen genera from Silent valley, Kerala, India are treated in this paper. It includes the adequate descriptions of six new species viz., *Hoplophthiracarus indicus*, *Phyllhermannia foveolatus*, *P punctatus*, *Gibbicepheus sisiri*, *Dolicheremaeus renukae* and *D. Keralaensis*. *Camisia sp.*, *D. aurita*, *Oppia arcualis*, *Oppiella nova*, *Caloppia minor*, *Scheleribates elegans* and *Lauritzenia longipluma* are recorded for the first time from India.

ACKNOWLEDGEMENTS

The author is grateful to the Director, Zoological Survey of India, for laboratory facilities and highly indebted to Dr. A.K. Bhaduri, Vidyasagar College, Calcutta for helping with valuable papers and suggestions.

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**FURTHER CONTRIBUTION ON THE PSYLLIDS (INSECTA :
HOMOPTERA) OF ASSAM AND MEGHALAYA WITH
DESCRIPTION OF NEW SPECIES**

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INTRODUCTION

Till date, only ten Psyllid species have been reported from the states of Assam and Meghalaya of North Eastern India by Mathur (1975) and Lahiri and Biswas (1979 a, b). In course of further surveys in these states a few more Psyllid species could be unearthed and the same have been reported in the present paper. These include two species new to science and another three, which were earlier not known in the area under study. Relevant collection data, biological information and morphological notes of taxonomic importance have been provided in the text together with keys for identification of the species studied.

SYSTEMATIC ACCOUNT

Key To The Subfamilies Of The Family PSYLLIDAE

1. Frons clearly visible as a small sclerite and bearing the front ocellus at its extremity Pauropsyllinae (Genus *Paurocephala* Crawford)
Frons visible only as a narrow border around front ocellus2
2. Head proper deeply cleft in front; proximal tarsus of hind leg bearing single claw Ciriacreminae (Genus *Mesohomotoma* Kuwayama)
Head proper not cleft in front, although the divergent genal cones may give the impression of a cleft; proximal tarsus of hind leg clawless or bearing a pair of claws3
3. Media and cubitus forming a common (cubital) stem at base in forewing; proximal tarsus of hindleg bearing a pair of claws.....
.....Psyllinae (Genus *Psylla* Geoffroy)
In forewing, cubital stem absent, radius, media and cubitus arising from a common point; proximal tarsus of hindleg clawless
.....Trioziinae (Genus *Trioza* Foerster)

Subfamily PAUROPSYLLINAE

1. *Paurocephala phalaki* Mathur

1975. *Paurocephala phalki* Mathur, *Psyllidae of the Indian subcontinent*, p. 58.

Specimens examined : India : Assam : Jatinga, 3 ♂♂, 6 ♀♀, 20-25. ix. 1978, ex 'Fig tree', coll. S. Biswas.

Measurements (in mm, for males and females respectively) : Length of body : 2.00, 2.00; length of forewing : 2.10, 2.00 - 2.10; length of antennae : 0.85, 0.80; width of head with eyes 0.50, 0.60; width of vertex between eyes : 0.20, 0.25.

Present find of this species at Jatinga extends its distribution to middle Assam from Teesta village, West Bengal, the type locality. Specimens studied agree well with the description of the species provided by Mathur (1975) except being a little larger in size. The nymphs were noticed on the undersurface of tender leaves, frequented by adults. The leaves thus infected, bore very fine powdery secretion and were deformed in shape.

Distribution : Eastern India : West Bengal and Assam.

Subfamily CIRIACREMINAE

2. *Mesohomatoma lutheri* (Enderlin)

1918. *Udamostigma lutheri* Enderlin, *Zool. Jb.*, 41 : 484.

1925. *Mesohomatoma lutheri* (Enderlin) : Crawford, *Proc. Hawaii. ent. Soc.*, 6 : 32.

Specimens examined : India : Assam : Jatinga, 5 ♂♂, 2 ♀♀, 4 nymphs, 20-25. ix. 1978, ex 'small shrub', coll. S. Biswas.

Measurements (in mm, for males and females respectively) : Length of body : 2.94-3.16, 2.27-3.88; length of forewing : 3.83-3.94, 4.30-4.55; length of antennae : 2.16-2.27; 2.22-2.50; width of head with eyes : 0.66, 0.63 - 0.72; width of vertex between eyes : 0.38, 0.38-0.44.

The species is recorded here for the first time from Assam. Specimens under study, but for a little variation in size, agree well with the description of the species provided by Mathur (1975). They were noticed to infest the stems of host plants from tips nearly to the ground. the agile nymphs as well as freshly emerged adults were covered with whitish secretion.

Distribution : India : Maharashtra, West Bengal, Assam. Outside India : Molucca, Ceylon.

Subfamily PSYLLINAE

Key To The Species Of The Genus *Psylla* Geoffroy

1. Hind tibiae with 4 apical spines; antennae 1.50 mm or more in length..
.....*Shillongensis* sp. nov.
- Hind tibiae with 5 apical spines; antennae 1.20 mm or less in length...2
2. Hind tibiae with a basal spur. In forewing, Cu₁ equidistant from media and inner wing margin at the point of maximum width of the 1st cell...
.....*simlae* complex

Hind tibiae without a basal spur. In forewing, Cu_1 nearer media than inner wing margin at the point of maximum width of the 1st cell
 *murrayi* Mathur

3. *Psylla murrayi* Mathur

1935. *Psylla murrayi* Mathur, *Indian Forest Rec.*, 1 : 62.

Specimens examined : India : Meghalaya : Shillong, 1 ♂, 4 ♀♀, 11 nymphs, 15. iv. 1978, ex *Helicia erratica* HKF, coll. S. Biswas.

Measurements (in mm, for males and females respectively) : length of body : 1.75-2.50, 2.75-3.20; length of forewing : 2.75-3.00, 2.50-3.00; length of antennae : 0.83-0.94, 0.86-0.90; width of head with eyes : 0.44-0.52, 0.50-0.52; width of vertex between eyes 0.25-0.27, 0.25-0.27.

This species, earlier reported from Shillong by Lahiri and Biswas (1979a, b) is recorded here from a new host plant. Its nymphs are found in open galls. The specimens studied exhibit a range of proportionately larger body parts and a few examples vary further from the description of the species provided by Mathur (1975) in having black intersegmental joints.

Distribution : India : Meghalaya, Uttar Pradesh.

4. *Psylla shillongensis* sp. nov. (Plate I)

Specimens examined : Holotype ♂, India : Meghalaya : Shillong, 15. iv. 1978, coll. S. Biswas (Regd. No. 1188/H₁₅); Paratype ♂, mounted on slide, body parts dissected, other date same as Holotype (Regd. No. 1189/H₁₅).

Measurements (in mm) : Length of body 2.88-3.10; length of forewing 2.44-2.90; length of antennae 1.50 - 1.60; width of head with eyes 0.77-0.85; width of vertex between eyes 0.41-0.50.

Colouration : Yellowish, thorax comparatively darker on dorsum; hind margin of occiput and anterior margin of thorax on either side narrowly black; third antennal segment black at apex, subsequent segments somewhat similar, but apical black area progressively greater in extent from fourth segment onward; two apical segments completely black. Wings hyaline, transparent.

Structure : Robust in built. Head (Fig. a) large, slightly broader than thorax, moderately deflexed, pubescence restricted to genal cones; vertex twice as broad as long, swollen a little on either side of the median suture, posterior margin arcuate; frons visible in front as a small sclerite bearing anterior ocellus; genal cones moderately large, about 0.22 mm long, smaller than vertex in length, sparsely hairy with moderately long hairs, contiguous at base, divergent apically, obtusely rounded at apex.

Antennae (Fig. b) long, ten segmented, basal two segments robust, cylindrical,

remaining segments slender. Second and penultimate segments are subequal and smaller than the rest; first segment a little longer than the second, third segment longest; fourth to eighth segments are subequal to each other, each being a little shorter than the third segment in length; terminal segment a little longer than the penultimate segment and with two unequal spines at apex.

Thorax finely reticulate, moderately large and arched. Prescutum large, a little broader than long, broadest in the middle, anterior and posterior margins subrounded, lateral margins subtriangular; scutum broad, nearly twice as broad as long, subequal in length to prescutum, gradually sloping and subrounded both anteriorly and posteriorly, with a pair of prominent submedian ridges; scutellum small, a little broader than long but more broad anteriorly; postscutellum of metathorax moderately large.

Legs. (Fig. c) quite long, pubescent with moderately long hairs besides minute points arranged in rows; femora of fore- and middle legs shorter than tibiae, hind femur almost as long as hind tibia, all tibiae with a comb of setae at apex; hind tibiae with a moderately large basal spur and four black tooth like spines at apex, basal tarsal segment of hindleg smaller than apical, bearing one tooth like spine at apex, apical tarsal segment ending in a pair of claw like spines; meracanthus long, slender and acutely pointed.

Forewings (Fig. d) large, hyaline, transparent, a little more than twice as long as broad, thickly beset with minute points, elongate ovate, rounded at apex; basal vein a little longer than radius, Rs quite long and a little undulated; R nearly twice as long as R_1 and nearly one and a half times as long as cubital petiole; pterostigma small, narrowed apically; first marginal cell a little broader than, but subequal in length to second marginal cell; Cu_1 nearer to media than inner wing margin at the point of maximum width of 1st cell; veins armed with small setae, anterior margin with longer setae.

Hindwings (Fig. e) also large, membrane thickly beset with minute points, costal margin armed with a few simple hooked setae in the basal third.

Abdomen longer than broad, finely and sparsely pubescent and also beset with minute points.

Genitalia : Male genital segment smaller than abdomen. Anal valve simple, pyriform, about 0.25 mm long, longer than parameres, gradually narrowed apically, truncate at apex, anterior margin straight, posterior margin convex basally, outer surface thickly beset with minute points and sparsely so with moderately long setae; parameres (Fig. f) about 0.20 mm long, almost even in width; ending in a sharp, black, incurved point, outer surface with small scattered setae, inner surface with longer setae; hypandrium simple, of usual shape, bearing simple sparse setae; aedeagus (Fig. g) quite long; sperm pump as figured (Fig. h).

Biology : Poorly known, only two males of this apparently rare species having been collected from an unknown host plant.

Comparison : *P. shillongensis* comes close to *P. viburni* Loew in having a small basal spur to hind tibiae, femora shorter than tibiae in fore and middle legs and few other characters. But it differs from the same in having hind femur almost as long as hind tibia, tibia and basal tarsal segment with four and one apical spines respectively, details of wing venation, shape of the genal cones and that of male genitalia, besides being larger in size.

Distribution : Eastern India : Meghalaya.

5. *Psylla simlae* complex (Plates II & III)

Specimens examined : India : Meghalaya : Shillong, 7 ♂♂, 4 ♀♀, and 2 nymphs, 25.vii.1978, ex '*Bauhinia purpuria*' coll. A. R. Lahiri; Assam : Jatinga, 6 ♂♂, and 8 nymphs, 20 - 25.ix. 1978, ex '*Bauhinia sp.*' coll. S. Biswas.

Measurements (in mm, for males and females respectively) : Length of body : 2.25 - 2.40, 2.70-2.80; length of forewing : 1.90-2.00, 2.20-2.30; length of antennae : 1.00-1.05, 1.05-1.15; width of head with eyes : 0.55 - 0.60; width of vertex between eyes : 0.35, 0.40.

Text figures of specimens studied (adults of either sex as well as nymphs) clearly indicates them to be very close to *P. nr. simlae* Crawford described by Mathur (1975) in general body features. They also agree in having same host plant (*Bauhinia* spp.). However the adults under study in particular, differ from Mathur's *nr. simlae* Crawford in having longer body and also in respect of black markings. While specimens collected from Jatinga are almost unmarked with black (restricted to narrow strips at apposed edges of genae), the shillong specimens are more extensively marked with black than what was described by Mathur (1975) for '*nr. simlae*'. Thus, in Shillong specimens, genae save at extreme bases, antennae but for basal three segments, a narrow stripe across hind margin of occiput with a forwardly directed variable median projection and all abdominal sutures are black, so also are the dorsal plate and the tip of ventral plate of female genitalia, the parameres and the distal half of subgenital valve of male genitalia.

Mathur (1975) having not been satisfied in their identity had placed his specimens only as '*nr. simlae*' Crawford. Taking into consideration Mathur's observation and variations noted in course of present study, it appears reasonable that *P. simlae* Crawford is probably a widely distributed polytypic species composed of populations differing in size as well as in markings.

Biology : The nymphs are found along the mid-rib on upper surfaces of leaves covered with very thin whitish powdery secretion, apparently causing no serious injury to the host plant. The adults lay their eggs within the folded and newly emerging tender leaves and sometimes also use such situation as shelters.

Distribution : India : Uttar Pradesh, Meghalaya, Assam.

Subfamily TRIOZINAE

Key To The Species Of The Genus *Trioza* Foerster

Radial sector long, greatly deflexed and extending almost upto the end of second marginal cell; genal cones largs, about three fourth as long as total length of vertex and occiput*gigantea* complex

Radial sector short, curved to costa and extending at most upto the base of second marginal cell; genal cones short and only about one third as long as the total length of vertex and occiput... *heptaphleuruma* sp. nov.

6. *Trioza heptaphleuruma* sp. nov.

(Plate - IV)

Specimens examined : Holotype ♂, India : Meghalaya : Shillong, 15.iv.1978, ex. 'Heptaphleuruma hypoleucum', coll. S. Biswas; Allotype ♀, same data as Holotype; (Holotype and Allotype Mounted on slide, Regd. No. 1190/H₁₅); Paratypes, 1 ♂, 2 ♀♀; data same as Holotype (1 ♂ and 1 ♀ dissected and mounted on slides, Regd. No. 1191/H₁₅; 1 ♀ in tube, Regd. No. 1192/H₁₅).

Measurements (in mm, for males and females respectively) : Length of head 3.00-3.35, 3.50; length of forewing 3.65-3.90, 3.10-4.00; length of antennae 1.40, 2.40-2.50; width of head with eyes 0.70 0.75, 0.70; width of vertex between eyes 0.40-0.45, 0.45.

Colouration : Males black with antennae, occiput, legs but for the femora and beneath abdomen pale brown; females yellowish all over.

Structure : Head (Fig. a) large, sparsely pubescent with long setae; vertex twice as long as broad, finely rugulose, a little swollen on either side of the middle line, gently descending forwards on either side, with a deep foveal impression at the base of each antenna, posterior margin gently arcuate; anterior ocellus visible from above; postocellar region a little elevated; genal cones short, subtriangular, divergent forwards, subacute at apex, with some of the apical setae longer than the rest. Eyes moderately large.

Antennae (Fig. b) long, slender and imbricate except the basal two robust and subequal segments which are smaller than other segments, third segment longest, fourth segment a little less than half the length of third segment and subequal to segments fifth, seventh and eight, sixth segment about half the length of third segment, ninth and tenth segments subequal in length, each being about one third the length of third segment; third to seventh segments each bearing a subapical setae on either side, ninth and tenth segments each bearing only a single subapical setae; four sensoria present, one each on third fourth, sixth and eighth segments.

Thorax large, sparsely pubescent with moderately long hairs, reticulate; prothorax as wide as, and synthorax much wider than the head. Prothorax strongly convex with a foveal impression on either side; prescutum large, a little broader than long, broadest in the middle, gradually narrowed and arcuate both anteriorly and posteriorly, but more markedly so anteriorly, angulated laterally; scutum large, about twice as broad as long, broadest before middle; angulated laterally, a little smaller than the prescutum in length, but nearly twice as broad as the latter; scutellum small, trapezoidal, broadened anteriorly with prominent antero-lateral angles.

Legs (Fig. c) large, densely beset with moderately long hairs as well as thick points arranged in transverse rows; femora shorter than tibiae, tibiae with apical comb of setae, hind tibiae with three to four very weak basal spurs and three robust apical spines; tarsal segments subequal in length.

Forewings (Fig. d) long, almost thrice as long as broad, transparent and hyaline, broadest at about middle, subacute at apex; R, M and Cu arising at the same point; cubitus about two-third as long as the basal vein and almost thrice as long as radius; second marginal cell almost as long as, but wider than first marginal cell; outer wing margin armed with closely spaced microscopic setae from base up to the termination of radius; membrane marked by clouding of points at three narrowly triangular spaces on the inner wing margin, one each being at about the middle of the two marginal cells, the third in the intervening space.

Hindwings (Fig. e) much smaller than the forewings; membrane uniformly beset with minute points; outer wing margin in basal third armed with a few small simple setae.

Abdomen moderately large, rugulose, sparsely beset with moderately large setae ventrally.

Genitalia : Male genital segment smaller than abdomen; anal valve (fig. f) about 0.40 mm long, sides gently convergent anteriorly, anterior margin almost straight, posterior margin broadly and convexly rounded, outer surface along the lateral margins bearing a few long setae; parameres (fig. f) about 0.60 mm long, slender, sides gently converging to apex, apical fourth curved inwards, the apex ending in a robust black tooth, outer surface sparsely beset with small setae, the inner surface beset with closely set longer setae; hypandrium small, semicircular, sparsely beset with small hairs; aedeagus as shown in (Fig. g).

Female genitalia (Fig. h) smaller than abdomen, rugulose and sparsely pubescent, more densely so in distal half with hairs of different size. Dorsal plate longer than ventral, gradually sloping caudally, acutely pointed at apex, circum-anal ring quite long, composed of a single row of pores and encircled with a row of regularly spaced small setae; ventral plate broad at base, subacute at apex; ovipositor acutely pointed at apex.

Biology : Nymphs of *T. heptaphleuruma* sp. nov. was noticed to heavily infest the young shoots of its host-plant.

Comparison : *T. heptaphleuruma* sp. nov. comes very close to *T. zambolinae* Crawford in colouration, wing venation and some of the general structures, but differs from the same in being larger in size and in detail body features specially genitalia.

Distribution : Eastern India : Meghalaya.

7. *Trioza gigantea curta* Mathur

1975. *Trioza gigantea curta* Mathur, Psyllidae of the Indian subcontinent, : 375; Lahiri and Biwas, 1979, *Bull. zool. Surv. India*, 2 : 66.

Specimens examined : India : Meghalaya : Sumer crossing, G. S. Road, 1 ♂, 1 ♀, ex "Schima wallichii", coll. A. R. Lahiri.

Measurements (in mm, for males and females respectively) : Length of body : 1.83-2.22, 1.61-2.11; length of forewings 3.05, 3.05-3.22; length of antennae : 0.86-1.00, 0.83-0.94; width of head with eyes : 0.38-0.52, 0.30-0.52; width of vertex between eyes; 0.22-0.27, 0.19-0.30.

From Meghalaya this subspecies was first reported from Shillong by Lahiri and Biswas (1975a). Further collection suggest however that the subspecies is of common occurrence in many parts of Khasi hills.

Distribution : Eastern India : Meghalaya and West Bengal.

ACKNOWLEDGEMENT

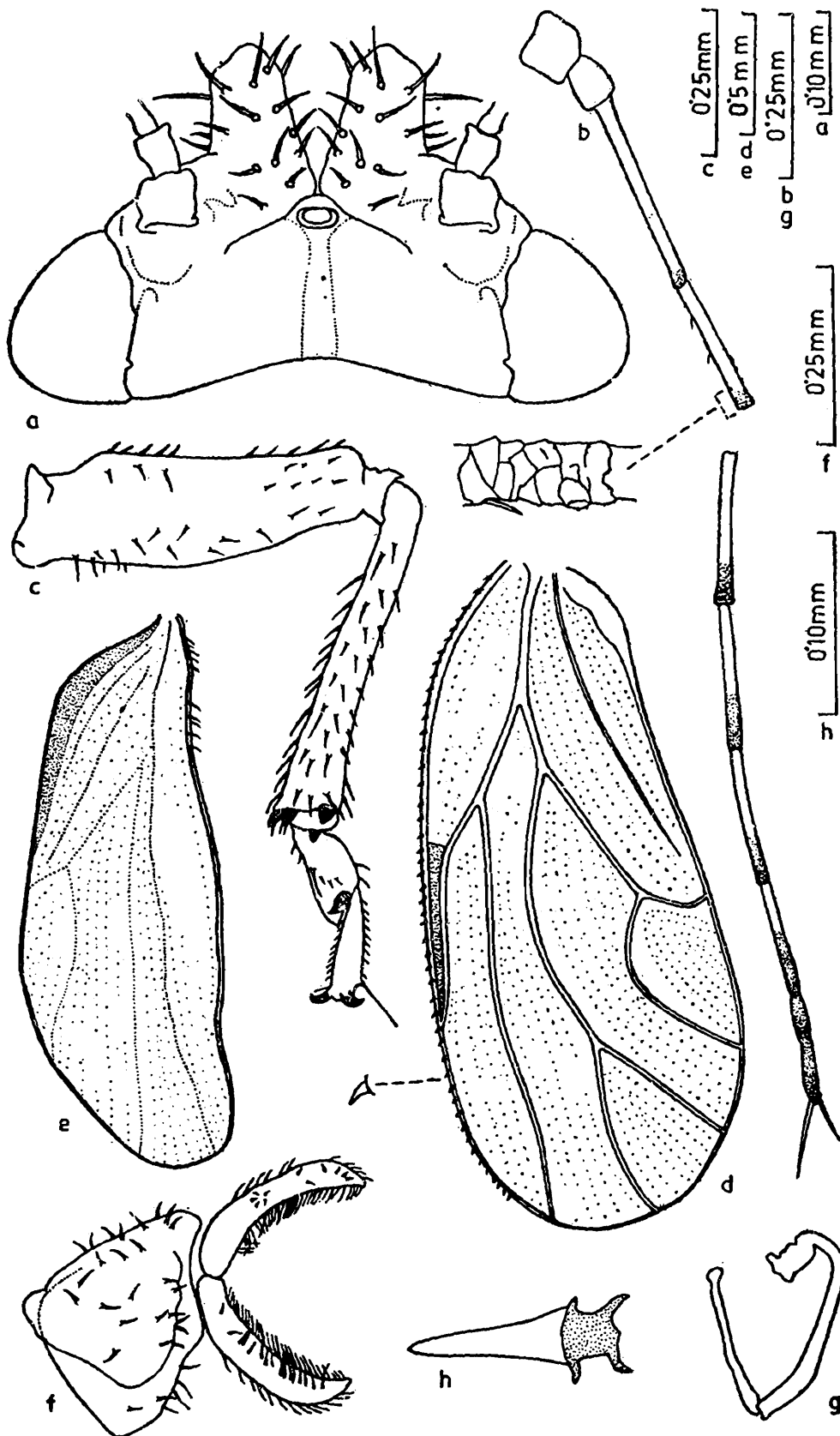
The authors are thankful to the Director, Zoological Survey of India, Calcutta, for providing opportunity to-do this work.

SUMMARY

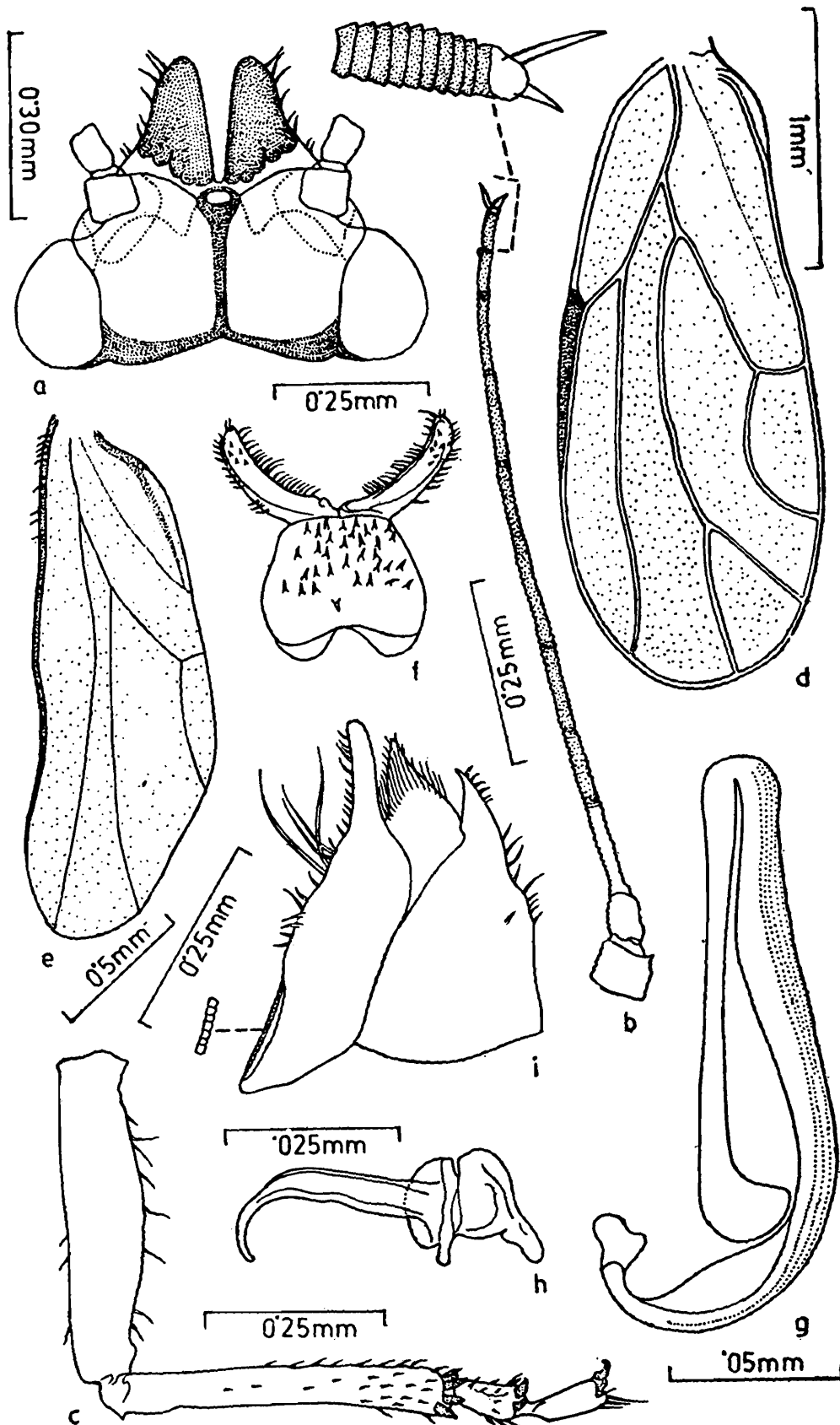
Two Psyllid species, viz. *Psylla shillongensis* and *Trioza heptaphleuruma* have been described from the states of Assam and Meghalaya in North Eastern India together with the report of occurrence of another five Psyllid species in these states. Newly recorded species are three, viz. *Paurocephala phalaki* Mathur, *Mesohomatoma lutheri* (Enderlin) and *Psylla simlae* complex.

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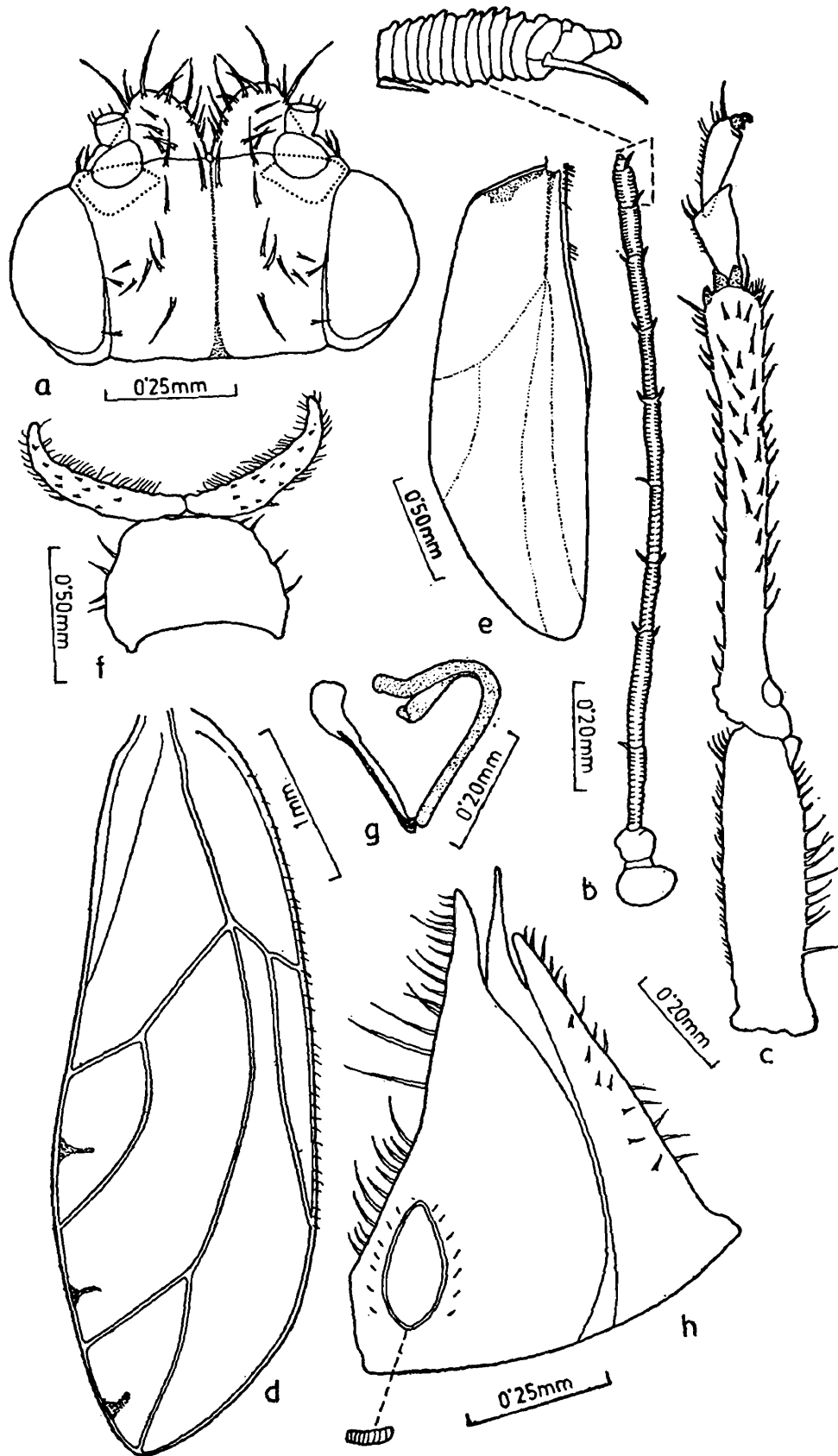
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Psylla shillongensis Sp. nov., Male ; a- head, in dorsal view ;
b- antenna ; c- hind leg ; d- forewing ; e- hindwing ; f- anal
valve and parameres ; g- aedeagus ; h- sperm pump.



Psylla simlae Complex ; a- head, in dorsal view ; b- antenna ;
 c- hind leg ; d- forewing ; e- hindwing ; f- male, anal valve
 and parameres ; g- male, aedeagus ; h- male, sperm pump ;
 i- female genitalia in lateral view.



Trioza heptaphleuruma sp. nov. ; a- head, in dorsal view ;
 b- antenna ; c- hind leg ; d- forewing ; e- hindwing ; f- male,
 anal valve and parameres ; g- male, aedeagus ; h- female
 genitalia in lateral view.

**DIGENETIC TREMATODES OF MARINE FISHES OF INDIA
(SUPERFAMILY HEMIUROIDEA : FAMILIES LECITHASTERIDAE
AND BUNOCOTYLIDAE)**

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INTRODUCTION

This paper is based on 135 specimens on 47 slides. They belong to 9 species from 8 genera and 2 families of the superfamily Hemiuroidea Looss, 1899. The material was collected from the marine fishes of the Bay of Bengal (Bay of Bengal proper including Coromandel coast, Palk Bay and Gulf of Mannar) and Arabian Sea. It includes the description of a new species; two known species are reported for the first time from India; some important synonymies have been suggested; *Neotheleterum* Gibson and Bray, 1979 is accepted; and some known species are reported with interesting remarks. The classification of Hemiuroidea as given by Gibson and Bray (1979) has been adopted here.

MATERIALS AND METHODS

The specimens were recovered alive from hosts and were studied in that condition first. Later on, they were allowed to relaxe in normal saline. When completely relaxed, they were killed and fixed in AFA keeping them between glass slide and cover glass and applying a bit more pressure with the tip of a needle. After complete fixation, they were removed in AFA, washed in 70% alcohol to remove excess of AFA, and then stored in small glass vials in 70% alcohol. In the laboratory, these specimens were processed for staining, dehydration and final mounting. They were overstained with alcoholic Borax carmine. The overstained material was then differentiated in acid alcohol to the desired shade of staining. They were then treated with ammonia alcohol to neutralise the traces of acid in the material. The specimens were then dehydrated with various grades of alcohol. After giving a slight touch in xylol, these specimens were submerged in a small pool of clove oil in cavity blocks for attaining transparency. They were then mounted on clean slides in Canada balsam and dried.

The specimens will be deposited with the National Collections of the Zoological Survey of India, Calcutta for registration. All measurements are in micrometres (μm) except otherwise stated. The diagrams have been made with the aid of a camera lucida.

SYSTEMATIC ACCOUNT

Superfamily	HEMIUROIDEA Looss, 1899
Family	LECITHASTERIDAE Odhner, 1905
Subfamily	LECITHASTERINAE Odhner, 1905

Genus 1. *Lecithaster* Lühe, 19011. *Lecithaster indicus* Srivastava, 1935
(Fig. 1)

Host : A clupeid fish, (Family Clupeidae).

Location : Stomach.

Locality : Machhilipatnam (Bay of Bengal).

No. of Specimens : 1, on slide; collected on 24.1.1975.

Discussion : Srivastava (1935) described this species from Allahabad (River Ganges) in the intestine of *Clupea ilisha*, a clupeid migratory fish. The present single specimen collected at Machhilipatnam (Bay of Bengal) from the stomach of an unidentified clupeid fish broadly agrees with Srivastava's description.

Genus 2. *Aponurus* Looss, 19072. *Aponurus drepani* n. sp.
(Fig. 2)

Host : *Drepane punctatus* (L.), spotted drepane, (Family Drepanidae).

Location : Stomach.

Locality : Tuticorin (Gulf of Mannar).

No. of Specimens : 4, on 4 slides; collected on 22.1.1965.

Description : Body 1.14 - 1.61 mm long, 0.29 - 0.42 mm wide at acetabular level, with almost round ends, sometimes slightly tapering posteriorly. Tegument moderately thick, smooth. Acetabulum 192 - 225 long, 203 - 225 wide, spherical, at 359 - 548 from anterior end of body. Oral sucker 87 - 115 long, 91 - 115 wide, spherical, subterminal. Sucker width ratio about 1 : 2.1. Prepharynx absent; pharynx 27-38 in diameter (distinct in holotype and one paratype only), spherical, slightly overlapped by posterior portion of oral sucker; oesophagus wide; caeca simple, reaching almost to posterior end of body.

Tests 2, 77-91 in diameter (measurements on holotype and one paratype only, obscured in others by coils of uterus), globular, entire, oblique with dextral anterior most, equatorial. Seminal vesicle 122 long, 70 wide (in holotype only, in others not clearly seen), pyriform or bulb-shaped, anterodorsal to acetabulum, placed obliquely; pars prostatica long, curved, surrounded by well-developed prostate cells. Sinus sac 80 long, 52 wide (distinctly seen in holotype only), oval, muscular, extending posteriorly to slightly beyond caecal bifurcation, opening at base of oral sucker, enclosing hermaphroditic duct.

Ovary 66-105 long, 70-157 wide, globular, in one specimen transversely elongate, entire, medium, immediately posterior to hind testis. Seminal receptacle blind, 91 in diameter, dorsal to posterior testis. Vitellarium comprising of 7 rounded lobes, usually in

groups of 4 and 3 in one paratype 6 lobes, arranged around a central one in stellate fashion, all lobes separate, posterior to ovary. Uterus voluminous, extending to posterior end; metraterm present. Eggs $21-25 \times 7-14 \mu\text{m}$, numerous, dark.

Excretory vesicle Y-shaped, arms uniting dorsal to pharynx; excretory pore terminal.

Discussion : Three species in the genus have been reported from India. They are *A. breviformis* Srivastava, 1939, *A. bengalensis* Srivastava, 1939 (synonym of *A. intermedius* Manter, 1934) and *A. orientalis* Ahmad, 1981. *Aponurus drepani* n. sp. resembles *A. breviformis* in sucker width ratio and egg size, but differs from it in having a more anterior genital pore, a pars prostation curved and longer than the seminal vesicle and in the position and size of the seminal receptacle. From *A. orientalis* it differs in the prebifurcal position of the genital pore, in having a pars prostatica curved and longer than the seminal vesicle and in having much smaller eggs (in *A. orientalis* the eggs are $30-35 \times 17-19 \mu\text{m}$). From all other species of the genus, the present form differs in one or more of the following characters: the sucker width ratio, egg size, the position of the genital pore, the posterior extent of the uterus and the disposition of the testes.

Subfamily HYSTEROLECITHINAE Yamaguti, 1958

Genus 3. *Hysterolecitha* Linton, 1910

3. *Hysterolecitha sigani* Manter, 1969
(Fig. 3)

Hosts : *Platax tiera* Forskal, Rounded batfish, (Family Ehippidae); *Siganus oramin* (Schneider), Whitespotted spinefoot, (Family Siganidae); and *Scatophagus argus* (Linnaeus), Spotted butterflyfish, (Family Scatophagidae).

Location : Stomach.

Localities : Tuticorin (Gulf of Mannar); Tuticorin (Gulf of Mannar) and Karwar (Arabian Sea) respectively.

Number of specimens : 6 + 14 + 20 respectively, total 40, on 19 slides.

Specimens deposited : Z. S. I. Reg. Nos. W 7568/1 to W 7586/1.

Description (measurements on 5 specimens only) Body 1.764-4.2 mm long, 0.42-0.876 mm wide, elongate with both ends rounded. Tegument smooth. Acetabulum 274-516 long, 271-492 wide, spherical, situated at 0.480-0.948 mm from anterior end of body. Oral sucker 119-216 long, 137-271 wide, spherical or subspherical, subterminal. Preoral lobe 13-15 wide. Sucker width ratio 1: 1.83-2.28. Prepharynx indistinct; pharynx 30-104 long, 60-125 wide, globular, muscular, slightly overlapped by oral sucker; oesophagus short; 'Drusenmagen' present near bifurcation; caeca reaching almost posterior end of body.

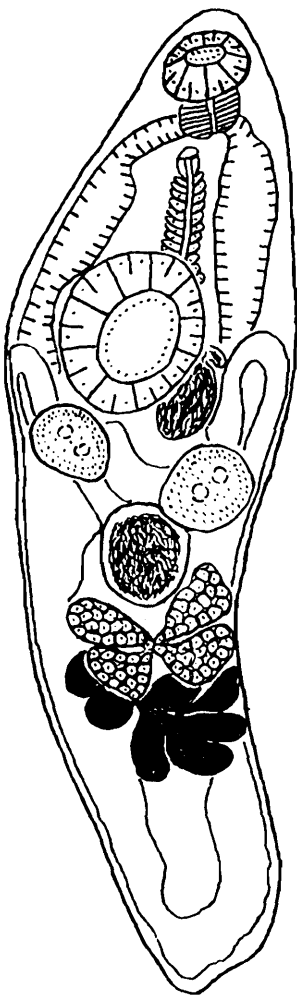


Fig.1

0.5mm

1.0mm



Fig 3

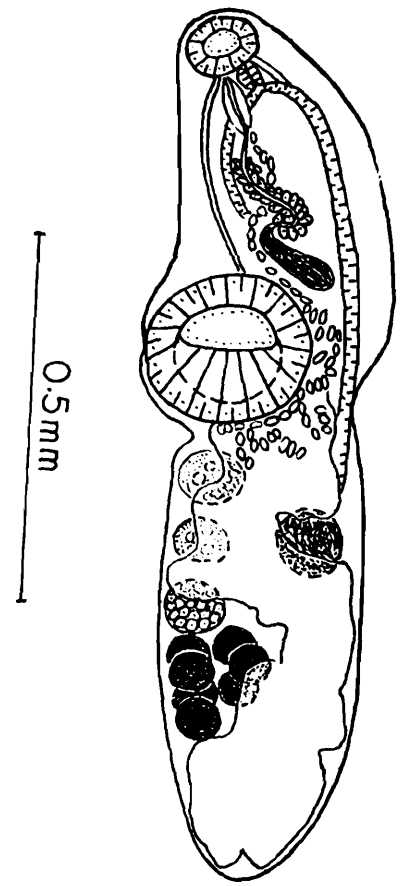


Fig.2

0.5mm

Fig. 1. *Lecithaster indicus* Srivastava, 1935. Entire worm; Fig. 2. *Aponurus drepani* n. sp. Entire worm. Fig. 3 *Hysterolecitha sigani* manter, 1969. Entire worm.

Testes 125-274 long, 135-272 wide, subglobular or transversely elongate, entire or slightly indented, diagonal, postacetabular, separated by uterine coils. Seminal vesicle sac-like or tubular, preacetabular or slightly overlapped by anterior border of acetabulum; pars prostatica short, surrounded by well-developed prostatic gland cells; sinus sac wide, globular, large immediately postbifurcal; hermaphroditic duct wide, appearing to be divided into 3 regions, protrusible, opening into genital atrium. Genital pore wide, immediately postbifurcal.

Ovary 164-360 long, 143-297 wide, median, subglobular, near posterior end of body. True seminal receptacle absent but uterine seminal receptacle present. Vitellarium digitate, in two masses, right one with 3 lobes and left with 4; lobes club-shaped immediately postovarian. Uterus voluminous, extending short of posterior end of body. Eggs 21-24 × 9-12 µm.

Excretory vesicle bifurcating posterior to acetabulum, branches reuniting dorsally to pharynx.

Discussion : Manter (1969) described this species from New Caledonia from *Siganus* sp., from Green Island and Moreton Bay, Queensland, Australia from *Siganus rivulatus*, from Green Island, Queensland, Australia from *Abudefduf palmeri*, and Green Island, Queensland, Australia from *Micracanthus strigosus*. As the species is reported for the first time from India, its full details have been provided above.

Subfamily TRIFOLIOVARIINAE Yamaguti, 1958

Genus 4. *Trifoliovarium* Yamaguti, 1940

4. *Trifoliovarium triacanthi* Bilqees, 1973

Syn. *T. triacanthusi* Gupta, V. and Ahmad, 1976

Host : *Triacanthus brevirostris*, Short nose tripod, (Family Triacanthidae).

Location : Stomach.

Localities : Puri, Machhilpanam, Kakinada (Bay of Bengal), Turicorin (Gulf of Mannar) and Calicut (Arabian Sea).

No. of Specimens : 3+5+10+3+3 respectively, total 24 on 7 slides

Specimens deposited : Z. S. I. Reg. Nos. W 7598/1 to W 7604/1.

Discussion : Yamaguti (1940) proposed the genus *Trifoliovarium* for specimens from the fish *Acanthocephala limbata* from Maisaki, Japan with *T. acanthocephalae* as the type species. Its ovary was described as possessing three lobes, but later on the same author (1971) emended this in a foot note (p. 322) stating that the ovary actually has four lobes.

Gibson and Bray (1979) confirmed this after examining the type material of *T. acanthocephalae*. Bilqees (1973) described a second species *T. triacanthi*, from the fish *Triacanthus brevirostris* from Karachi (Arabian Sea), differentiating it from the type

species mainly by the presence of a relatively larger ventral sucker (Sucker width ratio 1: 1.4), a shorter posterior extent of the seminal vesicle with respect to the ventral sucker, and a smaller egg size (32-39 x 17-20 μm) in the Japanese species and 20-25 x 11-13 μm in the Pakistani species).

Gupta, V. and Ahmad (1976), obviously unaware of Bilquees' work, described *T triacanthusi* from the fish *Triacanthus strigilifer* from Puri (Bay of Bengal). The description of this species fully agrees with that of *T triacanthi*. Therefore, *T triacanthusi* is conspecific with *T triacanthi*. This synonymy has also been indicated by Gibson and Bray (1979).

Gupta, A. N. and Sharma (1975) proposed that *Cladolecithotrema* Ichihara, 1970 is synonymous with *Trifoliovarium* Yamaguti, 1940, but Gibson and Bray (1979) do not agree with this synonymy and showed that the two genera are distinct. The author concurs with them.

Subfamily PROLECITHINAE Yamaguti, 1971

Syn. *Follicovitellotrematinae* Gupta, A. N. and Sharma, 1972

Genus 5. *Prolecitha* Manter, 1961

Syn. *Lobatovitelliovarium* Yamaguti, 1965

Follicovitellosum Gupta, A. N. and Sharma, 1972

Cryptodiscus Srivastava and Sahai, 1978 (New Syn.)

5. *Prolecitha obesa* Manter, 1961

Syn. *P. beloni* Nagaty and Abdel Aal, 1962

P. fusiforme (Yamaguti, 1965) Gibson and Bray, 1979

P. indicum (Gupta, A. N. and Sharma, 1972) Gibson and Bray, 1979

Cryptodiscus indicus Srivastava and Sahai, 1978 n.syn.

Host : *Belone strogylura*, Needlefish, (Family Belonidae) and *B. crocodila*, Giant Needlefish, (Family Belonidae).

Location : Stomach.

Localities : Rameswaram (Palk Bay) and Tuticorin (Gulf of Mannar) respectively.

No. of Specimens : 8 + 1 respectively, total 9 on 3 slides; collected on 2.3.75 & 14.3.75 by Dr. T. D. Soota.

The material was studied by Hafeezullah (1980) without Accession Numbers.

The synonymins of *Follicovitellosum* Gupta, A. N. and Sharma, 1972 and *F indicum* Gupta, A. N. and Sharma, 1972 with *Prolecitha* Manter, 1961 and *P. obesa* Manter, 1961 respectively, following Gibson and Bray (1979), have already been discussed by Hafeezullah (1980) in the light of the Indian material.

All the above 9 specimens are mounted in lateral, ventrolateral or dorsolateral views due to the peduncle on which the ventral sucker is borne. This protuberance is retractile. In partially or fully retraced condition, the edges of the ventral sucker are likely to be covered by portions of body parenchyma of the protuberance itself. This situation may be encountered in various conditions depending upon the state of contraction of the peduncle. This explains the situation probably encountered by Yamaguti (1965) in *Lobatovitelliovarium fusiforme* and Srivastava and Sahai (1978) in *Cryptodiscus indicus*, and as such there is no special musculature associated with the ventral sucker.

As regards the male duct, the ovoid seminal vesicle is continued as a short aglandular duct which then widens as it proceeds almost dorsoventrally. This wide pars prostatica is surrounded by a dense, compact layer of prostate cells and opens into a large sucker-like genital atrium. It is very difficult to make out if an ejaculatory duct is differentiated at all. This difficulty arises due to the thick and compact layer of prostate cells. Most probably, neither is differentiated. A short metraterm is formed and opens into the sucker - like genital atrium separately, and thus no hermaphroditic duct is formed. This contradicts the opinion given by Gibson and Bray (1979) in parentheses on page 107. It is believed that materials of Manter (1961), Yamaguti (1965), Gupta A. N. and Sharma (1972) and Srivastava and Sahai (1978) are similar to those reported here.

Srivastava and Sahai (1978: p. 50), while giving the generic diagnosis of *Cryptodiscus*, state that they are 'intestinal parasites of marine teleosts', whereas they have reported their genus from a cartilaginous fish *Dasyatis urnak*. While such cases are not uncommon, it seems to be an accidental host or the latter might have fed upon the teleost fish which serves as the normal host for this fluke under consideration. Furthermore, they (1978: p. 48, 50) have described *Cryptodiscus indicus* as the type species of their genus *Cryptodiscus*, whereas in the abstract (p. 39) they have mentioned *Cryptodiscus madrasensis* as the type species.

Family BUNOCOTYLIDAE Dollfus, 1950

Subfamily OPISTHADENINAE Yamaguti, 1970

Genus 6. *Neotheletrum* Gibson and Bray, 1979

6. *Neotheletrum frontilatum* (Manter, 1969) Gibson and Bray, 1979.

Hosts : *Siganus oramin* (Schneider), Whitespotted spinefoot, and *Siganus Javus* (Linnaeus), Streaky spinefoot, (Family: Siganidae).

Location : Stomach.

Localities : Tuticorin (Gulf of Mannar), Keelakkarai (Palk Bay) and Karaikal (Coromandel coast, Bay of Bengal).

No. of Specimens : 44, on 11 slides.

Specimens deposited : Z. S. I. Reg. Nos. W 7587/1 to W 7597/1.

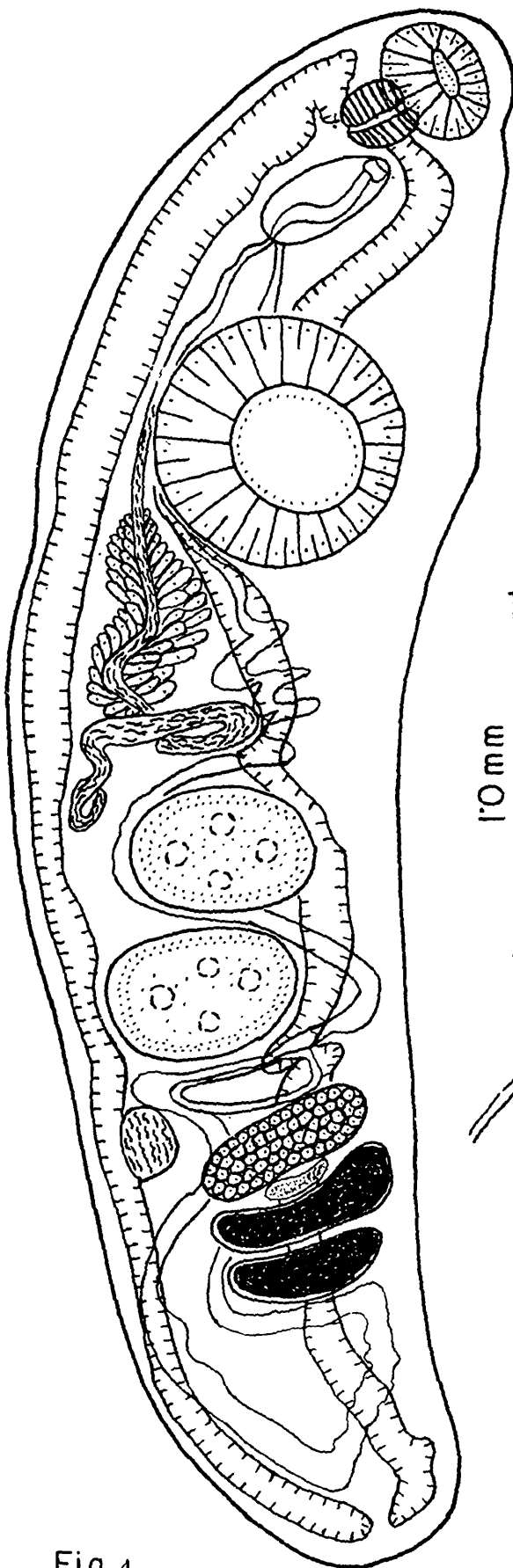


Fig. 4

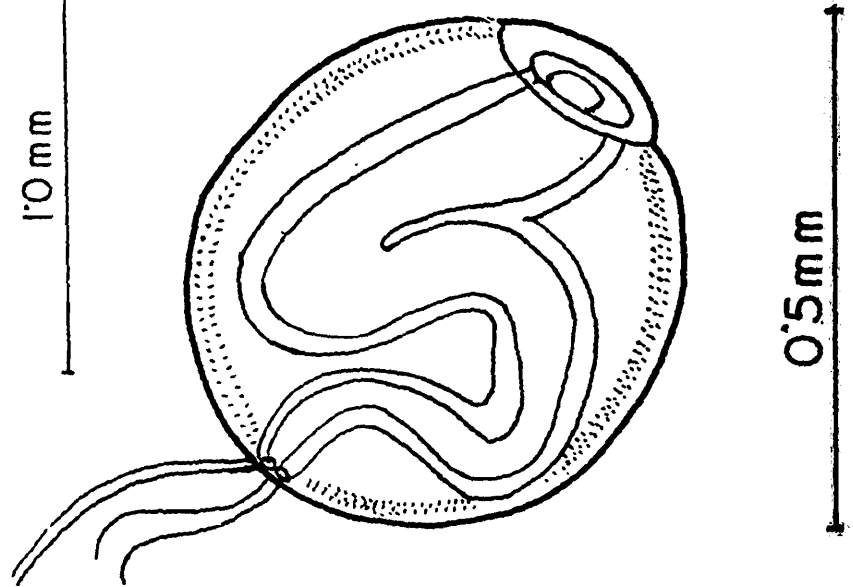


Fig. 5

Fig. 4. *Neopisthadena habei* Machida, 1980. Entire worm; Fig. 5. *Neopisthadena habei* Machida, 1980. Hermaphroditic pouch enlarged.

Discussion : Full details of this species were reported by Hafeezullah and Dutta (1980) on the basis of specimens from Chiria Tapu, Andamans (vide Z. S. I. Reg. Nos. W 7272/1 to W 7274/1) in the genus *Hysterolecithoides* Yamaguti, 1934. Gibson and Bray (1979) have given good reasons for considering it as the type species of a new genus *Neotheletrum*. The author is convinced by their reasoning and therefore concurs with them.

Genus 7. *Neopisthodena* Machida, 1980

7. *Neopisthadens habei* Machida, 1980

(Figs. 4 & 5)

Host : *Kyphosus cinerascens* Forskal, Ashen drummer, (Family Kyphosidae).

Location : Stomach.

Locality : Tuticorin (Gulf of Mannar).

No. of specimens : 12, on 2 slides; collected on 19.11.75.

The details of the above specimens agree fairly well with the description of the species as given by Machida (1980) from the same species of host from Ki Peninsula, Japan. However, as this is the first record from India and the second from the world, full details are provided here.

Description : Body 5.0-9.75 mm long, 1.2-1.96 mm wide at acetabular level. Tegument thick, unspined. Sides almost parallel, ends rounded. Acetabulum 692-1075 long, 708-1108 wide, globular, situated at 0.966-1.608 mm from anterior end of body, opening circular. Oral sucker 250-383 long, 350-550 wide, subterminal, withdrawn in anterior part of body. Sucker width ratio about 1:1.6. Prepharynx absent. Pharynx 167-242 long, 184-309 wide, wider than long, may be slightly overlapped by hind portion of oral sucker. Oesophagus short (contracted in all specimens) followed by caecal bifurcation. Proximal parts of caeca form shoulder, then turning posteriorly, extending to posterior end of body.

Testes two, 358-500 long, 508-875 wide, transversely oval, tandem, posterior to acetabulum, in middle-third of body, separated by coils of uterus. Seminal vesicle long, narrow, tubular and coiled anterior to testes. Pars prostatica long, narrow and curved posterior to ventral sucker, surrounded by well-developed prostatic gland cells. Aglandular part of pars prostatic straight entering into sinus-sac in preacetabular region. Sinus-sac oval, muscular, containing muscular and coiled hermaphroditic duct, opening just behind caecal bifurcation into shallow genital atrium. Genital cone or sinus organ absent.

Ovary 508-1016 long, 192-383 wide, kidney-shaped or transversely elongate, situated in anterior part of posterior-third of body, post-testicular. Blind seminal vesicle present, antero-dorsal to and shorter than ovary. Vitellaria compact, two separate masses, transversely elongate, parallel to each other, postovarian. Mehlis' gland well developed,

situated between ovary and anterior viteline mass. Post-vitelline region of body filled with coils of uterus, anteriorly forming metraterm entering sinus-sac along with aglandular pars prostatica to form hermaphroditic duct, whose anterior part is funnel-shaped. Eggs $30-43 \times 10-14 \mu\text{m}$.

Excretory vesicle I-shaped, bifurcating behind acetabulum, branches uniting dorsally to oral sucker; excretory pore terminal.

Discussion : Although the present specimens agree well with the description of *Neopisthadena habei* Machida, 1980, they do not agree to have papillae along the border of the oval opening. Similarly, the semicircular fold behind acetabulum in Machida's species is not present in the present material. As such, these two structures do not seem to form important parts of generic diagnosis of *Neopisthadens* Machida, 1980.

SUMMARY

Seven species of digenetic trematodes of marine fishes of the Bay of Bengal and Arabian Sea are reported here. They belong to the families Lecithasteridae Odhner, 1905 and Bunocotylidae Dollfus, 1950 in the superfamily Hemiuroidea Looss, 1899. Of these species, *Aponurus drepani* is new to science. *Hysterolecithoides sigani* Manter, 1969 and *Neopisthadena habei* Machida, 1980 are reported for the first time from India. *Lecithaster indicus* Srivastava, 1935, *Trifoliovarium triacanthi* Bilqees, 1973, *Prolecitha obesa* Manter, 1961 and *Neotheleterum frontilatum* (Manter, 1969) are reported and commented upon. *Cryptodiscus* Srivastava and Sahai, 1978 and *Trifoliovarium triacanthusi* Gupta, V and Ahmad, 1976 are considered new synonyms of *Prolecitha* Manter, 1961 and *Trifoliovarium triacanthi* Bilqees, 1973 respectively. *Neotheleterum* Gibson and Bray, 1979 is recognised.

ACKNOWLEDGEMENTS

Thanks are due to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta, for providing library and laboratory facilities. Thanks are also due to Dr. A. K. Ghosh, Scientist 'D' for showing interest in the present study.

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AMPHIBIA OF MAHARASHTRA WITH DESCRIPTION OF A NEW SPECIES OF TORRENT TOAD, *ANSONIA*

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INTRODUCTION

This paper embodies the results of study of a large collection of Anurans (Amphibia) which accumulated over the years in the Western Regional Station, Zoological Survey of India, Pune. The collection was made available to us through the courtesy of Dr. R.H. Kamble, Scientist of that Station for whom a new species is being named.

There does not seem to be any serious study of Amphibians of Maharashtra. Daniel (1963, 1963a, 1975) has presented a Field guide to most of the families of Amphibia from Western Ghats with special reference to species found in the plains and hill areas of Salsette Island and Bombay City and the ghats to the southeast of the city. A list of 22 species of Amphibians occurring in Maharashtra was also given by Daniel (1974) in the Maharashtra State Gazetteer. Yazdani and Mahabal (1976) have also merely listed 11 species of anurans occurring in Poona District.

We have, in all, examined 223 examples of frogs and toads falling under 4 families, 6 genera and 13 species out of which one species of *Ansonia* is described as new. Three more species namely *Bufo beddomii*, *Microhyla rubra* and *Rana keralensis* deserve mention as new records to this part of the country. Record of the rare toad *Bufo beddomii* has extended its known range of distribution much northwards. *Microhyla rubra* which was hitherto not known north of Malabar (Kerala) in Western India now enjoys a more extensive distribution. *Rana keralensis*, (better known as *R. verrucosa* in literature) has a wider distribution in Western India, north of Kerala and Tamilnadu.

Color indicated is in the preserved state. Notes are given where necessary. References to detailed description are indicated under each species.

The authors are thankful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta for the facilities and encouragement. Thanks are due to Dr. R. H. Kamble, Scientist B, Western Regional Station, Pune for the promptness with which the material was made available for study.

LIST OF AMPHIBIANS FROM MAHARASHTRA

The following families, genera and species are represented in the material studied :

Class	Amphibia
Order	Anura
Family	Bufoidea

Genus (1) *Ansonia* Stoliczka

1. *Ansonia kamblei* sp. nov.

Genus (2) *Bufo* Laurenti

2. *Bufo beddomii* Gunther; 3. *Bufo stomaticus* Lutken; 4. *Bufo melanostictus* Schn.

Family Ranidae

Genus (3) *Rana* Linn.

5. *Rana hexadactyla* Lesson; 6. *Rana cyanophlyctis* Schn.; 7. *Rana tigerina* (Daud);
8. *Rana keralensis* Dubois; 9. *Rana limnocharis* Boie

Genus (4) *Tomopterna* Dum. & Bibr.

10. *Tomopterna breviceps* Schn.

Family Rhacophoridae

Genus (5) *Rhacophorus* Kuhl

11. *Rhacophorus leucomystax* (Kuhl)

Family Microhylidae

Genus (6) *Microhyla* Tschudi

12. *Microhyla ornata* (Dum. & Bibr.); 13. *Microhyla rubra* (Jerdon)

1. *Ansonia kamblei* sp. nov.

Material : A single specimen collected from Jeur, 29 Km north of Tembhorni, Karnala.

Diagnosis : A small toad with tympanum indistinct, cranial ridges and parotoid glands absent, skin beset with small tubercles. Hindlimbs slender, short, tibiotarsal articulation not reaching tympanum toes half webbed.

Description : **Head** : About as long as broad, without cranial ridges, snout truncated at tip, projecting beyond lower-jaw, canthus rostralis fairly distinct, loreal region concave, nostrils lateral, much nearer to tip of snout than to eye, internarial distance less than length of snout or diameter of eye. Eyes with pupil circular, its diameter about equal to inter-orbital distance. Upper eyelids flat, its width less than the inter orbital distance. Tympanum indistinct, vertically oval, its larger diameter half that of eye. An elevated oval patch fills the inter-orbital space and extends behind the level of eyes on the median aspect. Upper jaw toothless, vomerines absent, tongue small, pyriform. Parotoid glands absent.

Forelimbs: Slender, short, about half the body length from snout to vent. Fingers free, tips blunt, first, second and fourth of about same length, a single fleshy pad on palm.

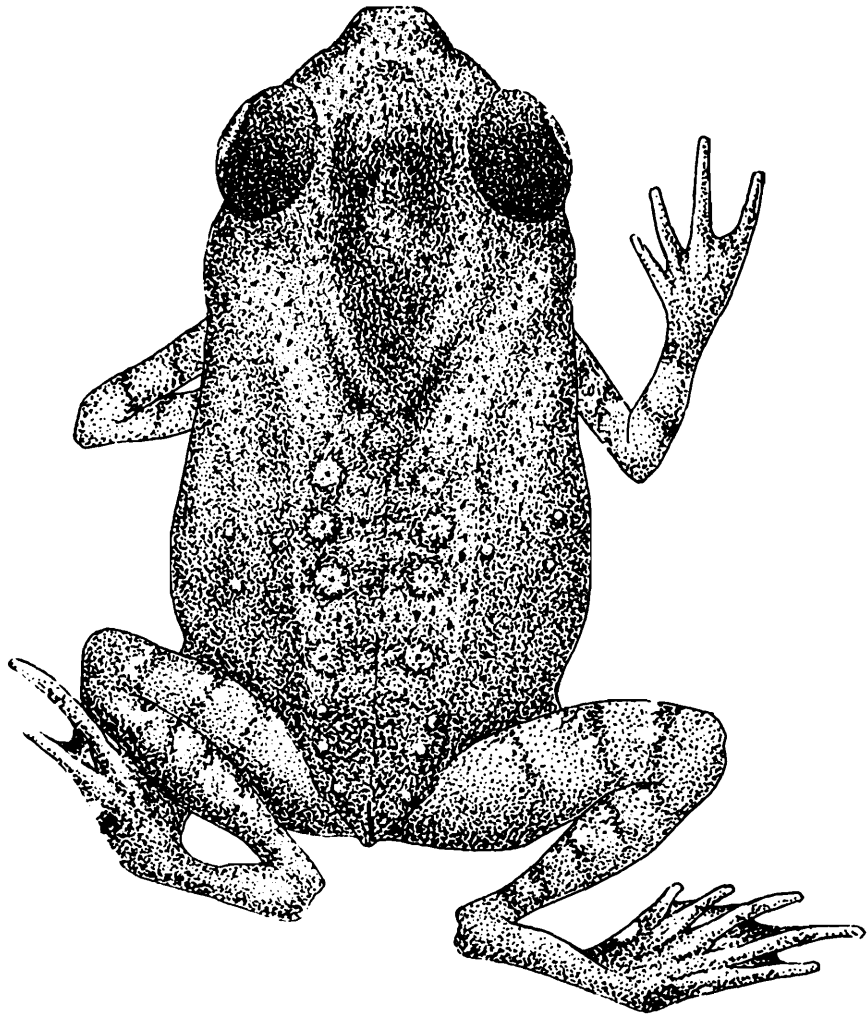


Fig. 1. *Ansonia kamblei* sp. nov.

Hindlimbs : Slender, short, tibiotarsal articulation not reaching tympanum when adpressed. Tibia one-third body length, $3 \frac{1}{2}$ times as long as broad, heels not meeting when limbs are folded at right angles to the body. Toes with blunt tips, about half webbed. Subarticular tubercles feebly developed, a large inner metatarsal tubercle and a small outer one present.

Skin : Dorsal surface covered with small blackish tubercles, a few larger ones on either side of the median line from the shoulder level to the hind end of the diapophyses of the sacral vertebrae, the latter projecting as a small hump above the vent. Ventrally the skin is rough without pronounced tubercles.

Colour : Dorsum and sides dark grey, dotted with small black tubercles. The elevated oval patch between the eyes reddish brown. Limbs faintly cross-banded. Light yellowish ventrally, throat speckled with a median reddish brown area. Breast and anterior belly mottled with brown.

Measurement in mm :

Total length (from tip of snout to vent)	14.6
Length of head (from tip of snout to angle of jaws)	5.2
Width of head (at angle of jaws)	5.2
Length of snout (from tip of snout to anterior corner of eye)	2.0

Diameter of eye	2.0
Width of upper eyelid	1.6
Minimum interorbital distance	1.9
Length of forelimb	8.5
Length of hindlimb	12.5
Length of tibia	5.0

Holotype : A toad of 14.6 mm from tip of snout to vent, loc. Jeur, 29Km North of Tembhurni, Karnala, Dist: Sholapur, Maharashtra State, Field Station No. 6, Reg. No.V/98, Coll. A.S. Mahabal, 25 April, 1983.

Affinities : A persusal of the characters enumerated above, particularly absence of cranial ridges, and parotoid glands, presence of tuberculated skin and webbed feet indicate that we are dealing with *Ansonia* under the family Bufonidae.

Bufonidae, in India, comprises four genera viz. *Ansonia*, *Bufo*, *Pedostibes* (= *Nectophryne*) and *Bufoides*. Parotoid glands are present in all except *Ansonia* and *Bufoides*. The present example differs from the single species known under *Bufoides*, viz. *B. meghalayana* described from Cherrapunji by Pillai and Yazdani (1973) in the absence of cranial ridges, warts and profuse tubercles on skin and a fully webbed feet.

Two species of *Ansonia* are hitherto known from India, *Ansonia ornata* from Brahmagiri Hills, Mysore (Gunther, 1875) and *A. rubigina* from Silent Valley, Kerala (Pillai and Pattabiraman, 1981). The present example is specifically distinct from *A. ornata* in the nature of tympanum, fingers, webbing on the feet, length of the hindlimbs, tuberculation of the dorsum and colour pattern. It differs from *A. rubigina* in the proportions of the head, pads on palm, webbing on feet, texture of the skin, tuberculation and colouration.

2. *Bufo beddomii* Gunther

1875. *Bufo beddomii* Gunther, *Proc. Zool. Soc. London*: 569.

Material : 11 exs. 15.5 mm Wasumbe tank, Vita, Sangli, Coll. A.S. Mahabal 16 ix. 79. (2) 1 ex. 20 mm Kand village, Shirala, Sangli, Coll. A.S. Mahabal, 25. ix. 79.

Both the palms and partly the toes are damaged in the smaller example while the toes are broken in the larger one. However the characters are sufficiently clear for a positive identification except for the fact that the toes do not appear to be entirely webbed.

Uniform dark above with whitish tips on tubercles. Pale or tan below with irregular marbling of brown.

Remarks : Inger's (1984) collection from Ponmudi constitutes the second series of the species after the original description of the species by Gunther (1875) from Malabar.

The present record from Maharashtra has extended its distribution considerably northwards which was previously restricted to Kerala.

Distribution : Western India.

3. *Bufo stomaticus* Lutken

1957. *Bufo stomaticus*, Kirtisinghe, *The Amphibia of Ceylon* : 17.

Material : 1 ex., 42.5 mm Namajicha mal, Tasgaon, Coll. A.S. Mahabal, 11.ix.79

This single example of toad agrees well with descriptions of the species by Kirtisinghe (1959) and Daniel (1963).

Dark brownish dorsum without markings, undersurface whitish with no marbling, tips of toes and fingers blackish.

Distribution : India, West Pakistan, Nepal and Srilanka.

4. *Bufo melanostictus* Schneider

1890. *Bufo melanostictus*, Boulenger, *Fauna Brit. India*: 505.

1963. *Bufo melanostictus*, Daniel, *J. Bombay nat. Hist. Soc.* 435.

Material : (1) 2 exs. Sakegaon Waghur river, Coll. R.H. Kamble, 23.i.1979. (2) 1 ex. Raber, Coll. R.H. Kamble, 26.i.1979. (3) 1 ex. Palsukhi river, coll. R.H. Kamble, 31.i.1979.(4) 1 ex. Sahastralingpal, Coll. R.H. Kamble, 31.i.1979.(5) 1 ex. Garkheda Kusmbi Nalla, Pal. Coll. R.H. Kamble, 2.ii.1979. (6) 8 exs. Jaman Nall Pal, Coll. R.H. Kamble. 2.ii.1979. (7) 1 ex. Tasgaon R.H., Coll, A.S. Mahabal, 12.ix.1979. (8) 1 ex. Maptemala, Atpadi Taluka, Coll. A.S. Mahabal, 13.ix.1979. (9) 1 ex. Jat R.H. Jat Taluka, Coll. A.S. Mahabal, 21.ix.1979. (10) 1 ex. Takari R.H. Coll. A.S. Mahabal. 22.ix.1979. (11) 1 ex. Retre Dam, Coll. A.S. Mahabal, 24.ix.1979 (12) 2 exs. Kand village, Shirala, Sangli, Coll. A.S. Mahabal, 25.ix.1979. (13) 1 ex. Miraj R.H. Sangli (D.T.). Coll. A.S. Mahabal, 29.ix.1979.

The largest example in the collection measures 88 mm from tip of snout to vent.

Distribution : Oriental Region and Malaysia.

5. *Rana hexadactyla* Lesson

1920. *Rana hexadactyla*, Boulenger, *Rec. Ind. Mus.* 10.

Material : (1) 3 exs. Namajicha, Mal. Tasgaon, Coll. A.S. Mahabal, 11.ix.1979. (2) 2 exs. Bhilwadi, Tasgaon, Coll. A.S. Mahabal. (3) 1 ex. Nall near vita, Coll. A.S. Mahabal, 15.ix.1979. (4) 1 ex. Retre Dam. Shirala, Coll. A.S. Mahabal, 24.ix.1979.

7 exs. are available. Dorsally dark grey and ventrally white.

Distribution : It is a Peninsular form, extending on the eastern coast as far as Calcutta.

6. *Rana cyanophlyctis* Schneider

1920. *Rana cyanophlyctis*. Boulenger. *Rec. Indian Mus.* : 12.

Material : (1) 4 exs. Mehram Tank, Jalgaon, Coll. R.H. Kamble, 19.i.1979. (2) 1 ex. Wakad Waghur river, Coll. R.H. Kamble, 21.i.1979. (3) 2 exs. Sakegaon Waghur river, Coll. R.H. Kamble.23.i.1979. (4) 2 exs. Raber, Coll. R.H. Kamble, 26.i.1979. (5) 7 exs. Ambhora Bhakao river, Coll.R.H. Kamble, 28.i.1979.(6) 5 exs. Palsukhi river, Coll. R.H. Kamble, 31.i.1979.(7) 1 ex. Sukhi river, Coll. R.H. Kamble, 1.ii.1979. (8) 2 exs. Kund Purna river, E. bad, Coll. R.H. Kamble, 6.ii.1979.(9) 1 ex. Lalkhamba Talou, Bodhawad, Coll. R.H. Kamble, 8.ii.1979.(10) 8 exs. Bodhawad tank, Bodhawad, Coll. R.H. Kamble, 8.ii.1979. (11) 1 ex. Jamner (Kong river), Coll. R.H. Kamble, 12.ii.1979. (12) 1 ex. Bandrud titur River, Coll. R.H. Kamble, 14.ii.1979. (13) 2 exs. Arav indrogad river, Panchara, Coll. R.H. Kamble, 16.ii.1979. (14) 1 ex. Anusewadi. Atpadi, Taluka, Coll A.S. Mahabal, 14.ix.1979. (15) 1 ex. Retre Dam. Shirala, Coll A.S. Mahabal. 24.ix.1979. (16) 4 exs. Near Kawalapur, Miraj Taluka, Coll. A.S. Mahabal, 26.ix.1979 (17) 1 ex. Sakradaman, Chinchani Road, Kasa, Coll. M. S. Pradhan, 6.iii.1984. (18) 2 exs. Pinjal Valley, Suryamal, Coll. M.S. Pradhan, 11.iii.1984. (19) 5 exs. Gar River, Coll. M.S. Pradhan, 12.iii.1984. (20) 3 exs. Val River on Mokhada Nasik road, Coll. M.S. Pradhan, 14.iii.1984. (21) 1ex. Bhasta River, Sapgaoon, Murbad, Coll. M.S. Pradhan, 16.iii.1984. (22) 3 exs. Saltan River, Ambadi, Coll. M.S. Pradhan, 19.iii.1984. (23) 1 ex. Bharangi River, Shahpur, Coll. M.S. Pradhan, 22.iii.1984.

59 examples, agreeing well with published descriptions. The largest example is-51 mm in total length, collected from Bhasta River. Dorsally greyish with more or less circular, darker patches. Ventrally white, spotted with black.

Distribution : Throughout India.

7. *Rana tigerina* (Daud.)

1920. *Rana tigrina*, Boulenger, *Rec. Indian Mus.* : 17.

Material : (1) 1 ex. Panchoo Bandar, Bassian, Coll. G.M. Yazdani, 27.x.1972. (2) 1ex. Talav Waki River, coll. R.H. Kamble, 13.ii.1979. (3) 1 ex. Atpadi near Kautholi village, Atpadi Taluka, 15.ix.1979.

The largest specimen measures about 149 mm collected from Atpadi near Kautholi village.

Brownish grey above with dark markings.

Distribution : Throughout India, Sri Lanka, Burma to Indo-China; South China and Formosa.

8. *Rana keralensis* Dubois

1920. *Rana verrucosa*, Boulenger, *Rec. Indian Mus.* : 26.

Material : (1) 9 exs. Wakad Waghur river, Coll. R.H. Kamble, 21.i.1979. (2) 3

exs. Velhala Talav, Coll. R.H. Kamble, 25.i.1979. (3) 2 exs. Ambhora, Bhakao river, Coll. R.H. Kamble, 28.i.1979. (4) 5 exs. Sahastra ling pal, Coll. R.H. Kamble, 31.i.1979. (5) 1 ex. Garkheda kusumbi nalla Pal, Coll. R.H. Kamble, 1.ii.1979. (6) 12 exs. Lahasar Nalla, Jamner, Coll. R.H. Kamble, 1.ii.1979. (7) 2 exs. Tinsha Mohali nall Pal, coll. R.H. Kamble, 2.ii.1979. (8) 7 exs. Jaman Nall Pal, Coll. r.H. Kamble, 2.ii.1979. (9) 6 exs. Pazar talov, Pimpri Panchan, E.bad Coll. R.H. Kamble, 4.ii.1979. (10) 8 exs. Hortale tank, South of E.bad, Coll. R.H. Kamble, 5.ii.1979. (11) 20 exs. Laskhamba Talov, Bodhawad, Coll. R.H. Kamble, 8.ii.1979. (12) 5 exs. Wadi Sar river, coll. R.H. Kamble, 9.ii.1979. (13) 4 exs. Yengaon Deo river, Bodhawad, Coll. R.H. Kamble, 10.ii.1979. (14) 2 exs. Jamnaer (Kong river), Coll. R.H. Kamble, 12.ii.1979. (15) 14 exs. Chinchkhed Waghar river, Coll. R.H. Kamble, 14.ii.1979.

The largest specimen measures 35 mm from snout to vent.

Dark grey above with markings. A light vertebral streak present in some. Head and back profusely warty.

Distribution : This species has hitherto been recorded only from the hill forests of Kerala and Tamilnadu. The present record extends its range considerably northwards.

9. *Rana limnocharis* Boie

1920. *Rana limnocharis*, Boulenger, *Rec. Indian Mus.* : 28.

Material : (1) 1 ex. Pal Sukhi River, Coll. R.H. Kamble, 31.i.1979. (2) 1 ex. Wasumbe tank, Vita, Sangli, coll. A.S. Mahabal, 16.ix.1979.

Brownish grey above with irregular darker markings. A median thin, white vertebral line present. Larger example from Wasumbe tank measures 23 mm from tip of snout to vent.

Distribution : Eastern Asia from Pakistan to Japan.

10. *Tomopterna breviceps* Schneider.

1920. *Rana breviceps*, Boulenger, *Rec. Indian Mus.* : 103.

Material : (1) 1 ex. Sahastra lingpal, Coll. R.H. Kamble, 31.i.1979. (2) 2 exs. Chinchni, Tasgaon, Coll. A.S. Mahabal, 13.ix.1979. (3) 1 ex. Atpadi pazar Talav, Atpadi taluka, Coll. A.S. Mahabal, 15.ix.1979. (4) 1 ex. Yerala river, Ambegaon Vita Coll. A.S. Mahabal, 17.ix.1979. (5) 1 ex. Eslampar Road, Takari, Coll. A.S. Mahabal, 19.ix.1979. (6) 1 ex. Retre Budruk, Takari, Coll. A.S. Mahabal, 21.ix.1979. (7) 3 exs. Machundi Jat Taluka, Coll. A.S. Mahabal, 19.ix.1979. (8) 1 ex. olal Nalla, Jat Tikota Road, Jat Taluka, Coll. A.S. Mahabal, 22.ix.1979. (9) 4 exs. Khalati village, Jat Taluka, coll. A.S. Mahabal, 23.ix.1979. (10) 1 ex. Retre Dam, Shirala, coll. A.S. Mahabal, 24.ix.1979. (11) 1 ex. Kand Village, Shirala, Coll. A.S. Mahabal, 25.ix.1979. (12) 2 exs. Giriling Miraj Taluka, Coll. A.S. Mahabal, 29.ix.1979.

Totally 19 specimens examined the largest measuring 33 mm in head and body. The smallest is 13 mm in size.

Distribution : Throughout India, Sri Lanka and Burma.

11. *Rhacophorus leucomystax* (Kuhl)

1882. *Rhacophorus maculatus*, Boulenger, *Cat. Batr. Sal. Brit. Mus.* : 83.

Material : 2 examples are available collected from Kasa R.H. and Tansa River on 5.3.84 measuring 55 mm and 39 mm respectively from tip of the snout to vent.

Distribution : Southeast Asia. Known from Darjeeling, Nilgiris, Salem, Malabar, Bombay and Madras.

12. *Microhyla ornata* (Dum. & Bibr.)

1934. *Microhyla ornata*, Parker, Monograph Microhylidae : 139.

Material : (1) 1 ex. Namajicha Mal. Tasgaon, Coll. A.S. Mahabal, 11.ix.1979. (2) 1 ex. Chinchni, Tasgaon, Coll. A.S. Mahabal, 12.ix.1979. (3) 1 ex. Nall near Vita, Coll. A.S. Mahabal, 15.ix.1979. (4) 1 ex Kand village, Shirala, Coll. A.S. Mahabal, 25.ix.1979.

Totally 4 specimens ranging from 19 mm to 21 mm form snout to vent.

Distribution : India, Sri Lanka, Southeast Asia, South China and Formosa.

13. *Microhyla rubra* (Jerdon)

1957. *Microhyla rubra*, Kirtishinghe, The Amphibia of Ceylon : 92.

Material : 1 ex. Wasumbe tank, vita, Coll. A.S. Mahabal, 16.ix.1979.

The example measures 16.5 mm in head and body. The better webbing on the toes and the well developed semicircular metatarsal tubercles separate this species from *Mornata*.

Colour conforms to the typical pattern of the species.

Distribution : Southern India, Assam, Sri Lanka and Malay Archipelago.

Remarks : This species has not been recorded north of Malabar in Western India and Bangalore in the Peninsula (Daniel, 1963a). Hence the present record is of interest.

CONCLUSION

An assessment of the total faunistic wealth of Amphibia of Maharashtra should await a detailed study on the basis of more intensivse surveys. However, on the basis of the present study and the two lists provided by Daniel (1974) and Yazdani and Mahabal (1976), the total numbetr of species of Amphibia expected to be occurring in Maharashtra may be put at 29, the additional species (not recorded in this paper) being the following :

1. *Indotyphlus battersbyi* Taylor; 2. *Ichthyophis subterrestris* Taylor; 3. *Bufo parietalis* Boulenger; 4. *Bufo microtypanum* Boulenger; 5. *Uperodon globulosum*

(Gunther); 6. *Ramanella variegata* (Stoliczka); 7. *Ramanella montana* (Jerdon); 8. *Rana malabarica* (Bibr.); 9. *Rana leithii* Boulenger; 10. *Rana temporalis* (Gunther); 11. *Rana beddomii* (Gunther); 12. *Tomopterna breviceps* (Schneider); 13. *Tomopterna rufescens* (Jerdon); 14. *Nyctibatrachus humayuni* Bhaduri & Kripalani; 15. *Philautus bombayensis* (Annandale); 16. *Philautus glandulosus* (Jerdon).

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ON A NEW SPECIES OF COPEPOD,
NOTHOBOMOLOCHUS PULICATENSIS SP. NOV.,
PARASITIC ON *HEMIRHAMPHUS GAIMARDI* VALENCIENNES
FROM THE PULICAT LAKE, EAST COAST OF INDIA

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INTRODUCTION

On the parasitic copepoda of Indian Marine fishes lot of work had been done (Pillai, 1967). The bomolochids of Kerala coast have been studied by Pillai (1965 and 1973) and Pillai & Natarajan (1977). But estuarine and brackishwater lake fishes have not received as much attention. Babu (1975) studied all the endo- and ecto-parasites of the fishes of the Pulicat Lake. His general survey, obviously far from complete, yielded some very interesting parasites and indicated the vast potential of the field. During the course of a detailed study on the biology of some fishes of the Pulicat lake, number of piscicolous copepods were observed (Kaliyamurthy, 1982). One of the bomolochid copepods is described here as new.

DESCRIPTION OF THE SPECIES

Family BOMOLOCHIDAE

Genus *Nothobomolochus* Vervoort.

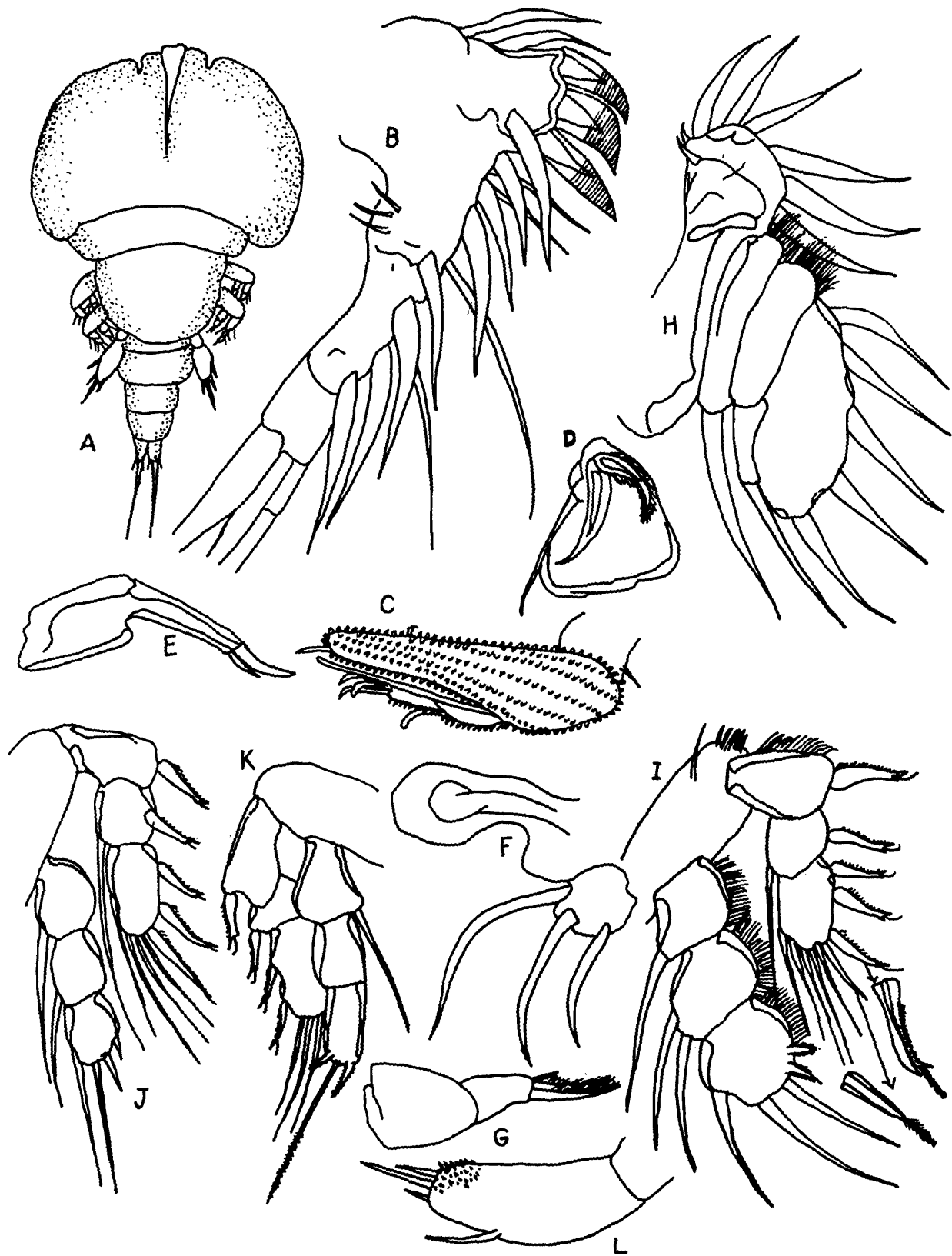
Nothobomolochus pulicatensis sp. nov.

Figs. A-L.

Material examined: : Five adult females from the inner surface of the opercles of *Hemirhampus gaimardi* Valenciennes.

Female : The carapace is nearly semicircular and the second thoracic segment is slightly narrower than carapace. The third segment is roughly semicircular and it overlaps the fourth segment. The fifth segment is much broader than long. The genital segment is slightly narrower than fifth segment. The abdomen is very short and three segmented. The caudal rami are short and their apical inner setae are stout and very long (Fig. A). The antennule is short with stumpy spines and setae (Fig. B); of the three processes, the first two are slightly shorter than the third and are bent towards the third.

All these spines are transversely wrinkled. Third segment of the antenna (Fig. C) is covered with blunt spines arranged into longitudinal rows. At the distal part there is a spine-fringed process, five hooks and a seta.



Figs. A-L. *Nothobomolochus pulicatensis*. A, female, dorsal view; B, antennule; C, antenna; D, maxilliped; E, mandible; F, maxillule; G, maxilla; H, leg-1; I, leg-2; J, leg-3; K, leg-4; L, leg-5.

The mandibles have upwardly curved blades with smooth edges (Fig. E). Maxillule has two large and one slightly smaller setae (Fig. F). The pragnath is rounded and smooth. Maxilla has two barbed blades and a small spine (Fig. G). Maxilliped is very characteristic and is triangular with a broad base (Fig. D). The claw is slender and slightly curved. The outer apical seta is chitinised, curved and spine like.

The segmentation of the endopod of first leg is not clear (Fig. H). The exopod carries two short spines and six setae. The outer margin of the first and second segments of endopod is hairy, and they have an inner seta each. The third segment carries five setae.

The outer margin of the first segment of exopod of second leg (Fig. I) is hairy with a single spine minutely barbed on the outer side. The second segment carries one outer spine and an inner seta. The last segment has four spines and five setae. The outer margins of the endopodal segments are hairy. The first segment has one seta, the second two and third three setae and two spines.

The first exopod segment of the third leg (Fig. J) has an outer spine. The second segment has one outer spine and an inner seta, and the third segment bears three spines and four setae. The endopodal segments one and two carry one inner seta each. The last segment has two setae and two small spines.

The first segment of the exopod of fourth leg (Fig. K) carries one spine, the outer side of which is serrated. The second segment carries one outer spine and an inner seta, while the third segment has three spines and five setae. The first segment of endopod has an inner seta, the second one is naked and the third carries three spines, the middle one being the longest.

The fifth leg (Fig. L) is narrow with a tapering end and has three spines and one seta. At its distal end a patch of spinules is seen.

Total length : 1.5 mm.

DISCUSSION

N. pulicatensis sp. nov. has a very characteristically short and broad body. There is a general reduction in the number of setae on the appendages. Second segment of endopod of fourth leg is completely devoid of setae. The shape of the maxilliped is triangular with a broad base and its apical outer seta is chitinised into a curved spine-seta, which is very peculiar to this species. All these characters clearly distinguish *N. pulicatensis* from the known species of *Nothobomolochus*. The wrinkled appearance of the three spines arming the antennule gives a remote resemblance to *N. denticulatus*.

SUMMARY

Nothobomolochus pulicatensis sp. nov. parasitic on *Hemirhamphus gaimardi* in the

Pulicat Lake, East coast of India is described in detail. It differs from the known species of *Nothobomolocus* in the general body shape, less number of setae on the appendages and in the modification of the apical outer seta on the maxilliped into a spineseta.

ACKNOWLEDGEMENTS

The author is grateful to Dr. A.V. Natarajan, Director for his kind interest and constant encouragement. His thanks are due to Dr. R.F. Cressey, Curator, Smithsonian Institution, Washington, U.S.A. and Dr. N. Krishna Pillai, Professor (Emeritus), Department of Aquatic Biology and Fisheries, University of Kerala, Trivandrum, for kindly examining the specimens and offering valuable suggestions in the identification of the parasite.

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SHORT COMMUNICATIONS

A NOTE ON THE ANIMAL REMAINS FROM NEOLITHIC LALJAL CAVE, DEBPAHAR, BINPUR, MIDNAPORE, WEST BENGAL.

MANOMAY GHOSH

Zoological Survey of India, Calcutta

It was my privilege to identify a small collection of animal remains, collected by a team of explorers of the State Archaeology Department, Govt. of West Bengal from a cave at Laljal (c 22° 44"50'N 86°41"20'E), Debpahar, 50 km N.W. of P.S. Binpur, District Midnapur, West Bengal (see Map). The remains though meagre, are significant from the archaeozoological point of view, as they are found contemporary with the Neolithic phase in the area and are associated with plundered burial, iron spear head, potsherds, ringstones, few microliths and charcoal.

According to Shri Sudhin Dey, the leader and exploration assistant, the material is estimated to be as old as 1000 to 1200 B.C. Therefore, it is reasonable to believe that the people in this part of settlement very likely reached the post Neolithic phase as evidenced by similar but little improved artifacts unearthed from pre-morayan phase of neighbouring Tomluk (Banerjee, in press) in the same district.

The material is composed of remains of fresh water river turtles (plastron pieces); tail quill of Indian porcupine, teeth of wolf-like animal; broken molar tooth of pig (young one) and a number of teeth of domestic cattle. These remains were collected on 17.10.81, from a depth between 80 cm to 1.07 meter. The material was closely associated with some Neolithic artifacts and human bone fragments. A list of the fauna collected during the excavation is given below :

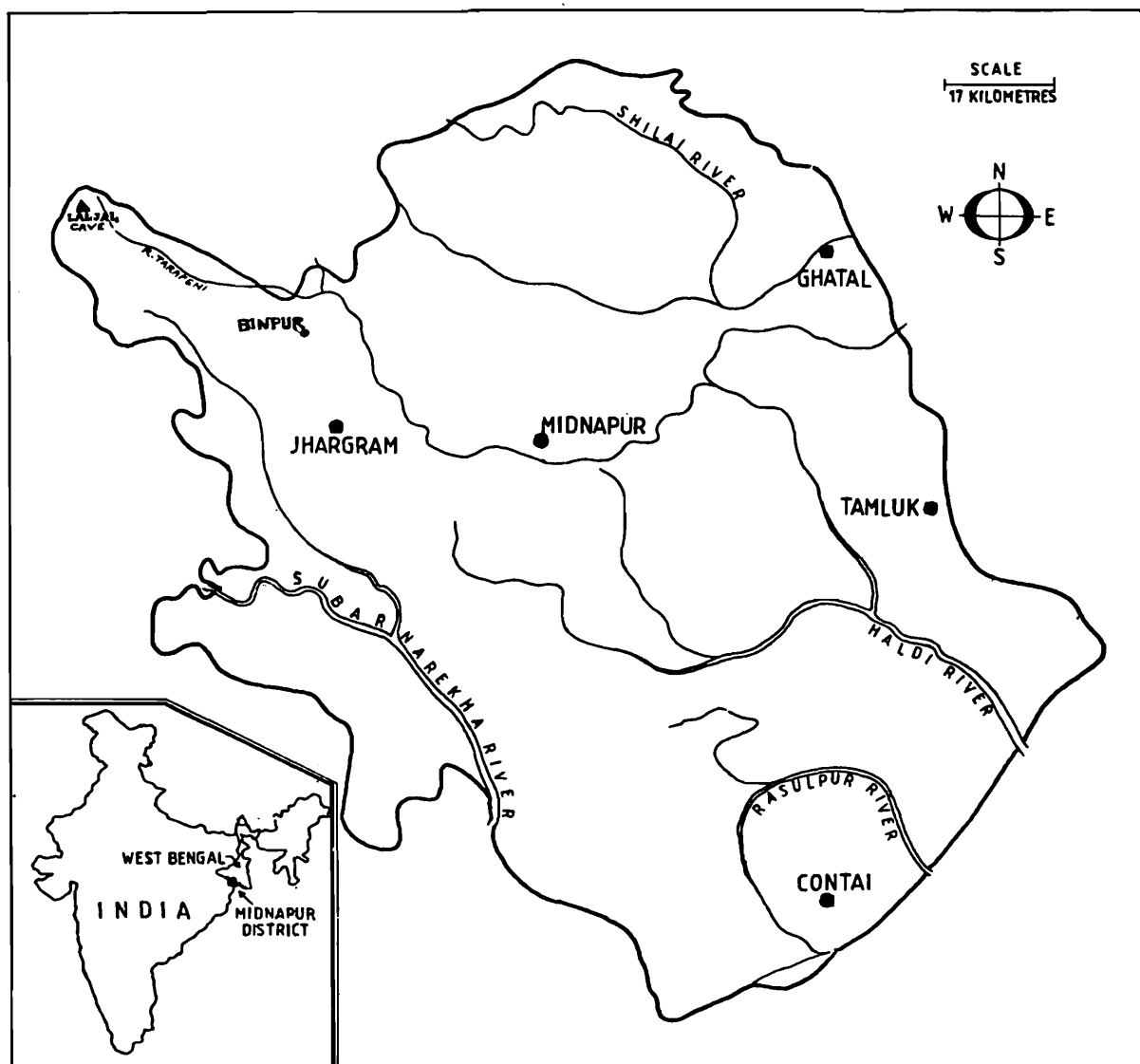
Class REPTILIA
Order TESTUDINES
Family TRIONYCHIDAE (fresh Water turtle)

Trionyx gangeticus Cuvier four pieces of plastron.

Class MAMMALIA
Order RODENTIA
Family HYSTRICIDAE (Indian porcupine)

Hystrix indica Kerr a piece of tailquill

Order CARNIVORA
Family CANIDAE (Some canid specimen)



Map showing the location of Neolittue Laljal Cave

Canis sp. indet Lower right 3rd incisor; upper right canine; upper right 2nd premolar; lower left 4th premolar (carnassial); upper right 1st molar (carnassial); upper left canine

Order ARTIODACTYLA

Family SUIDAE (Indian pig)

Susscrofa cristatus Wagner damaged upper 2nd molar of a young one.

Family BOVIDAE (cattle)

Bos indicus Linnaeus lower left premolar; upper left molar; upper left premolar.

The remains as a whole are very few, but it is beyond doubt that the identified animal species were all local and indigenous. The turtles and pig, perhaps were used as a dietary supplementation to these Neolithic men in the area, whose used up artifacts or implements were recovered from the same spot. The canid teeth (Figs. 2a, b, c) assumed to be of some wolf-like animal, indicate the presence of such carnivores within the vicinity of human pursuit and presumably were attracted by the carcasses or refused food stuff. Among other remains, the tail quill of a porcupine (Fig. 5 and 5a) containing a needle hole, is very interesting, specially for its occurrence among the potsherds, ringstones and microlithic flakes. It is presumed that this object was probably used as a needle by the people. It may be mentioned that the tail-quill, in contrast to the body-quill, is always hollowed, so that an aperture on its wall (Fig. 6) would permit a string for stitching. The cattle remains (Figs. 1a, b, c) are represented by some premolar and molar teeth. These teeth belong to fully adult specimens, representing domesticated stock.

Though it is not possible to comment on the local fauna as a whole or on the then prevailing animal husbandry practices based on such scanty material, yet from close association of these material with the iron spear head (hunting), charcoal (use of fire) burial (cremation of dead) it is reasonable to infer that the area in and around the cave, was inhabited by some well established Neolithic people, already in possession of the domesticated cattle. Food animals like the river turtle (Fig.3) or pig (Fig. 4) were of uncommon at the site and might have been used as food. The finding of tail quill of Indian porcupine with a needle hole is interesting and has few parallels in the archaeological sites in India.



1a



1b



1c



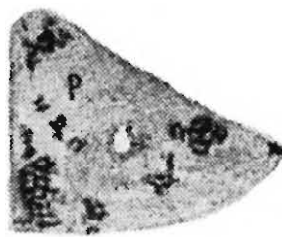
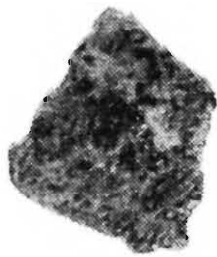
2a



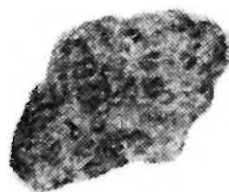
2b



2c



3



4



5

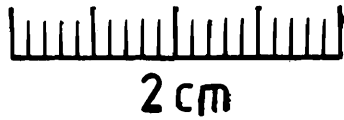
1a, 1b & 1c.- Molars and premolar teeth of cattle, *Boa* sp.

2a, 2b & 2c.- Molar, carnassial and canine teeth of some canid, *Canis* sp. indet.

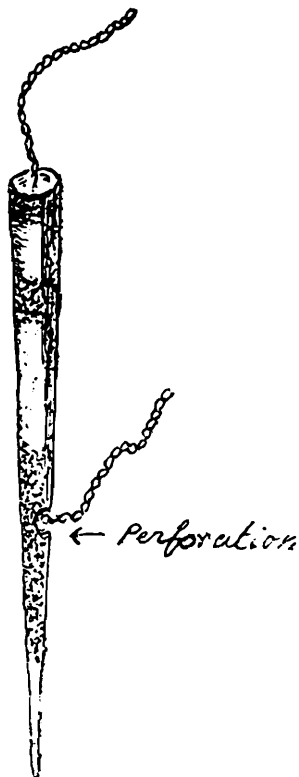
3.- Four pieces pf plastron of fresh water river turtle, *Trionyx gangeticus*.

4.- Damaged molar tooth of young pig, *Sus scrofa*.

5.- Tail quill of Indian porcupine, *Hystrix indica*.



5a



6

5a.- Tail quill of Indian porcupine, *Hystrix indica* slightly enlarged to show the perforation.

6.- Tail quill of Indian porcupine, usage as a needle ?