

**NEW RECORD OF *ANCISTROPLAX CROCIDURAE* WATERSTON
(ANOPLURA : HOPLOPLEURIDAE) FROM INDIA WITH
REDESCRIPTION OF THE TAXA.**

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INTRODUCTION

Ancistropalax crocidurae was first reported by Waterston (1929) from horsfield from *Crocidura horsfield* Sri Lanka. This paper describes quite a few female specimens from single host, *Suncus etnaseus* from Arunachal Pradesh, India, which is recorded for the first time from India.

Earlier description of both genus and species was inadequate. As such, the species is redescribed following the terminologies after Mishra (1981).

The voucher materials are in National Zoological Collection at Zoological Survey of India, Calcutta.

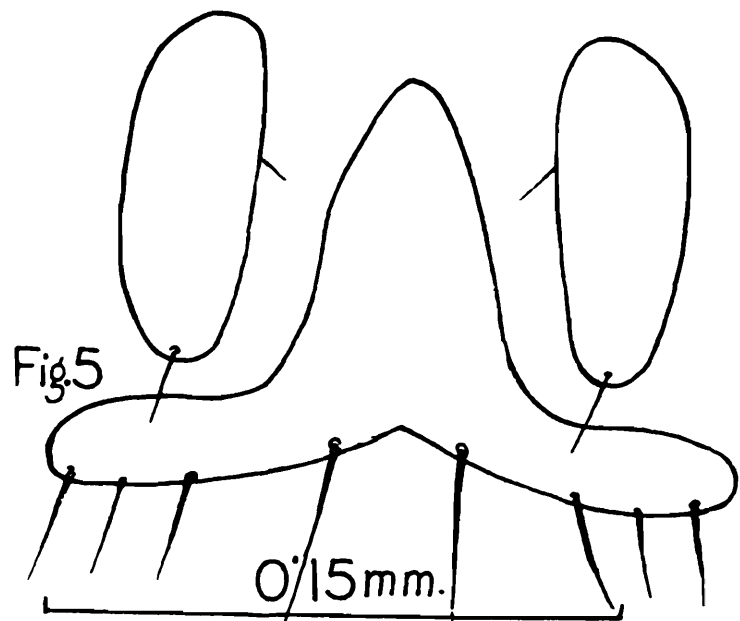
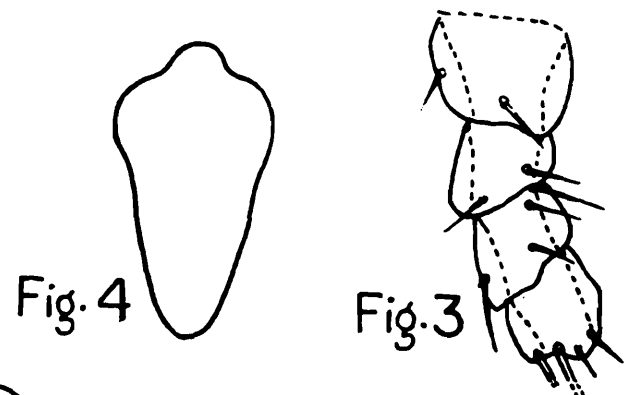
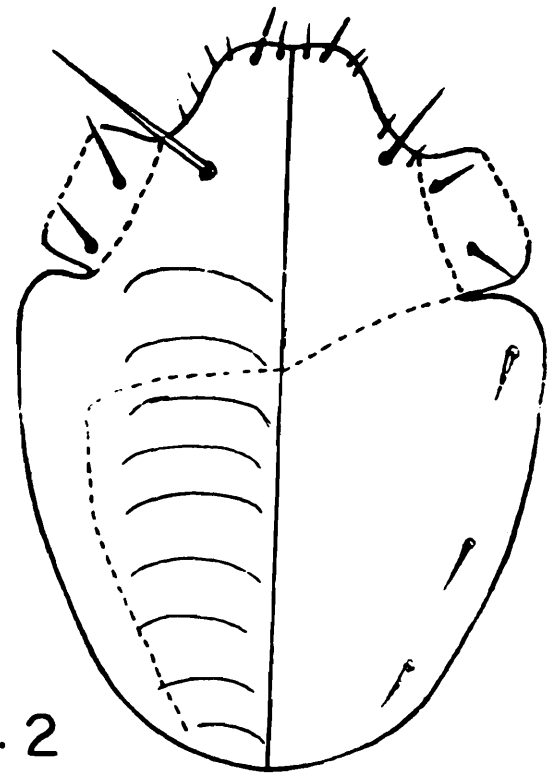
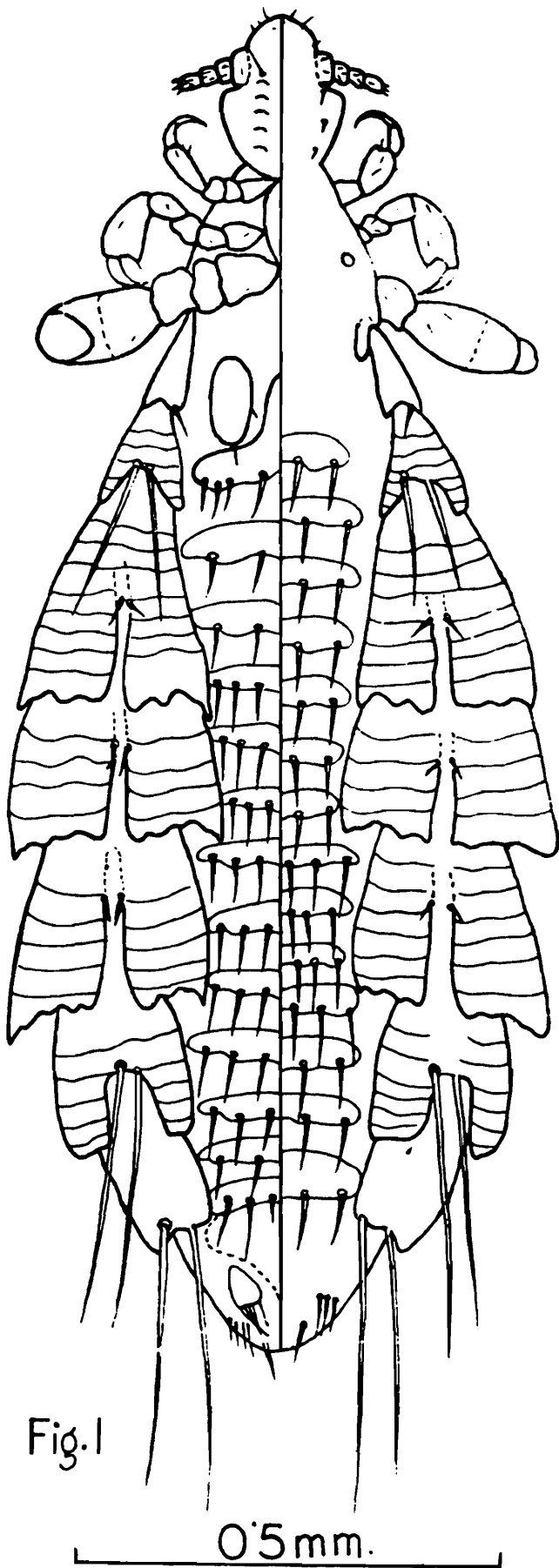
***Ancistropalax* Waterston 1929**

1929. *Ancistropalax* Waterston, *Parasitology*, 21 : 161.
1951. *Ancistropalax*, Ferris, *The sucking lice*, p.119.
1964. *Ancistropalax*, Johnson, Misc. Publ. Ent. Soc. America, 4 : 76.
1981. *Ancistropalax*, Mishra, *Rec. zool. Surv. India, Occ. paper*. 21 : 20.
Type species : *Ancistropalax crocidurae* Waterston.

Anoplura without eye; Antennae four segmented, first segment broad, remaining segments more or less same, terminal segment with a large sensoria. First pair of legs small and weak, with a slender claw; middle legs slightly larger; posterior pair highly modified with all the parts large and stout. Thoracic sternal plates well developed. abdominal tergites and sternites well developed and chitinized; sternites of segment II divided into two parts. Three tergites and three sternites present on each segment of III to VI. Paratergites present in segment II to VIII, of which those of segment III to VII large, appear as being longitudinally divided into two parts by a medianline of weak sclerotization. Spiracles present on III to VIII segments.

***Ancistropalax crocidurae* Waterston 1929**

1929. *Ancistropalax crocidurae* Waterston *Parasitology*, 21 : 161.
1932. *Ancistropalax crocidurae*, Ferris, *Contributions toward a monograph of the sucking lice*. pt. 5 : 308, figs. 188, 189.
1951. *Ancistropalax crocidurae*, Ferris, *The sucking lice*, p. 120, figs. 53, 54.



Figs. 1-5. *Ancistroplax crocidurae* Waterston. 1. Full body; 2. Head; 3. Antenna; 4. Sternal plate of thorax; 5. Sternite and setae of abdomen.

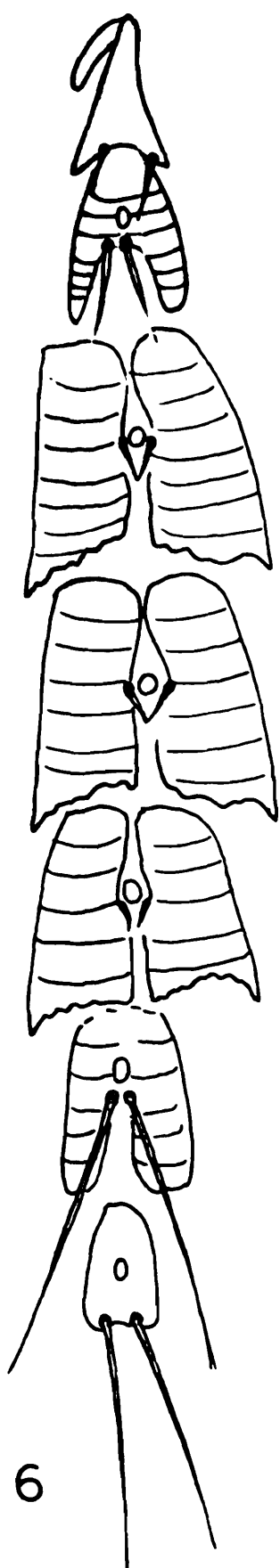


Fig. 6

0.4mm.

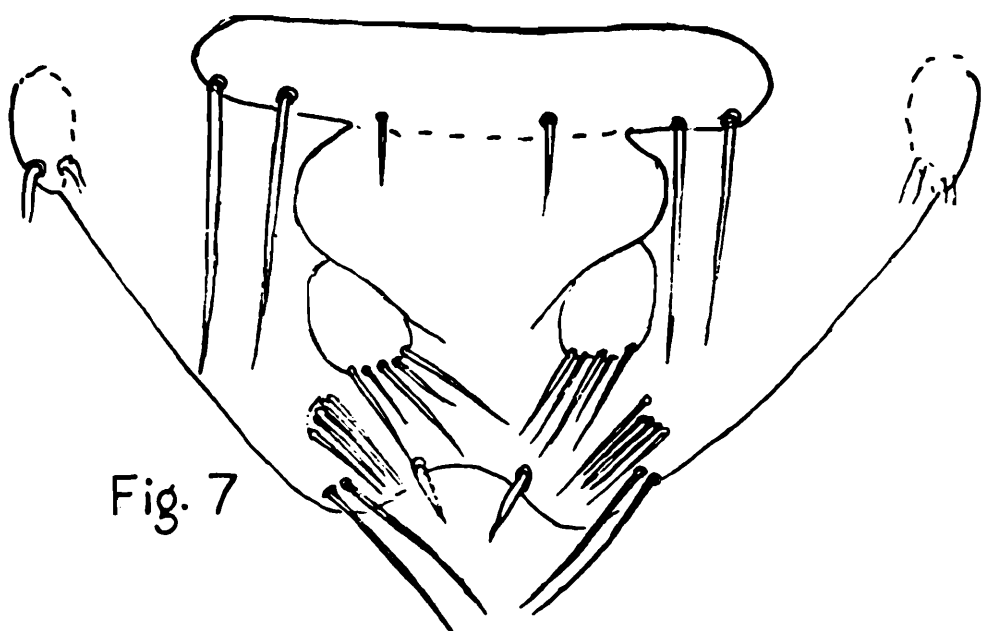


Fig. 7

0.15mm.

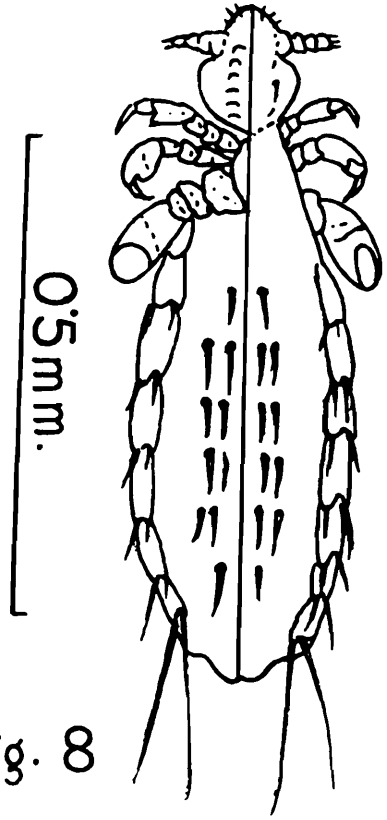


Fig. 8

0.5mm.

Figs. 6-8. *Ancistroplax crocidurae* Waterston. 6. Paratergites; 7. Genitalia; 8. Nymph.

Female : (Fig. 1) Total body length 1.54 mm. **Head** : (Fig. 2) slightly longer than broad, weakly pigmented with distinct, sclerotic ventral plate bearing a number of crescentic markings : post antennal angle present, occipital angle rounded. Chaetotaxy of the head : clypeal setae (CS) 2-3 pairs, small; ventral oral setae (VOS) 2-4 pairs, Ventral Pre-antennal setae (VPas) long; oral setae (OS) 2-4 pairs; Pre antennal setae (Pas) slightly long; Post-antennal setae (POS) 2 pairs; Marginal setae (MS) 2 pairs; Principal dorsal head setae (PDHS) absent. **Antennae** : (Fig. 3) Four segmented, first segment broad; remaining more or less same size, terminal segment with large sensorium. **Thorax** : small, shorter than head, thoracic sternal plate wedge-shaped (Fig. 4), with small rounded process anteriorly and long posterior process rounded at the tip. **Legs** : Anterior legs small, weak with slender claw, middle legs comparatively longer than anterior, but of same type; posterior legs with all parts enlarged and flattened, whole structure being very stout. **Abdomen** : Elongate and slender; **Dorsal** segment I and II without tergites. Segment III with single tergite; two rows of setae, anterior row with two minute setae, posterior row with 2 pairs of thin elongate setae; segment IV and VII each with 3 tergites, having 4-6 setae each; segment VIII and terminal segment each with single tergite having 4 or 5 setae. Setae off plates between tergites and paratergites (DAAS) absent. **Ventral** : segment I apparently without sternites. Sternites of segment II divided longitudinally into two oval plates seemingly articulating with corresponding paratergites; each oval plate with two minute setae, one in ventral other in lateral side of plate; ventral setae slightly longer than lateral (Fig. 5). Segment III with single sternite, cap shaped, prolonged medially between plates of segment II and provided with 8 setae, segments IV and VII each with 3 sternites having 4-6 setae each. Setae off plates between sternites and paratergites (VAAS) absent. **Lateral** : Paratergites (Fig. 6), II typical, like *Hoplopleura* sp. dorsal and ventral setae small, almost equal in size, III dorsal posterior process long and tapering, both setae long, ventral process broad, both process marked with transverse line. IV to VII each with posterior process lobe like, broad and serrated, posterior outer angles somewhat pointed, setae small sized except paratergite VII in which dorsal and ventral setae long, all with marked transverse line. Paratergite VIII without lobe and transverse line, both setae long. Spiracle small, present on III to VIII segments.

Genitalia : (Fig. 7) Genetal plate triangular, gonopod paired each with 3 long and 2 small setae, genital seta enlarged and spiniform.

Male : Unknown.

Nymph : 1, 2. Unknown.

Nymph : 3 (Fig. 8) Total body length 0.71 mm. **Head** : slightly longer than broad. Sclerotic ventral plate bearing a number of crescentic margins; post antennal angle and occipital angle slightly rounded. All typical head setae present. Principal dorsal head setae absent. **Antennae** 4 segmented, terminal segment bears sensorium. **Thorax** : Small; thoracic sternal plate present, wedge shaped, with small rounded tip. **Legs** :

anterior legs small, weak, with slender claw; middle legs slightly longer but same type of anterior pair; posterior pair flattened, with all parts enlarged. *Abdomen* : tergites and sternites absent; only few rows of setae in abdominal region. Paratergites poorly developed on segments II to III. Setae of paratergites smaller than plates except VIII which has 2 long setae.

Material examined : 3 females, 1 nymphs, India : Kanning dist. Jamiri, 18.10.85 Arunachal Pradesh, Coll. C. C. Adhikary.

Host : *Suncus etruscus* (Savi).

Remarks : The present specimens correspond with those described by Waterston (1929), and Ferris (1932) from Sri Lanka but with following differences: Clypeal setae 2-3 pairs, ventral preantennal setae long, post antennal setae slightly long; marginal setae 2 pairs. Tergites of segment III with two rows of setae; IV and VII with 4-6 setae each, segment VIII and terminal segment with 4 or 5 setae respectively, each oval plate of segment II having two minute setae; sternites of segment III with eight setae and IV to VII having 4-6 setae each; dorsal posterior process of paratergites III long and tapering, ventral process broad; IV to VII each with posterior process lobe-like; broad and serrated, posterior outer angle somewhat pointed. Each gonopod usually with three long and two small setae.

SUMMARY

Ancistroplax crocidurae Waterston known earlier from Sri Lanka is recorded from *Suncus etneseus* in India. Description of the genus and species is revised with inclusion of some new features of taxonomic importance.

ACKNOWLEDGEMENTS

The authors are thankful to the Director, Zoological Survey of India, for laboratory facilities, to Dr. V. C. Agarwal, ZSI, for identification of mammals and to Dr. P. K. Chaudhuri, Head Deptt. of Zoology, Burdwan University for other courtesies.

REFERENCES

- Ferris, G. F. 1932. Contributions towards a monograph of the sucking lice. *Stanford Univ. Publ. Univ. Ser. Biol. Sci.*, V.2, pt. V. P. 308, Figs. 188, 189.
- Ferris, G. F. 1951. The sucking lice. *Mem. Pacif. Cst ent. Soc.*, 1 : 1-320.
- Johnson, P. T. 1964. The hoplopleurid lice of the Indo-Malayan Subregion. *Mus. Publs. ent. Soc. America*, 4 : 68-86.
- Mishra, A. C. 1981. The Hoplopleurid lice of the Indian subcontinent. *Rec. zool. Surv. India Mis. Publ., Occ. paper 21* : 1-128.
- Waterson, J. 1929. On a new louse from a Ceylonase shrew. *Parasitology* 21 : 161-163.

**A NEW SPECIES OF OEDIPODINE GRASSHOPPER,
SPHINGONOTUS ORISSAENSIS, FROM EASTERN INDIA
(ORTHOPTERA : ACRIDIDAE)**

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INTRODUCTION

Material for this study was collected by one of us (Dr. H.K. Bhowmik). Little recent revisionary work has been done on the genus *Sphingonotus* Fieber. We depend largely on the monograph by Mistshenko (1936) and an examination of the collections in the British Museum (Natural History), London to determine this group. Fortunately there is no other *Sphingonotus* with such bright blue basal areas of the hind-wings, so diagnosis was comparatively easy. The nearest relative of the present material seems to be *Sph. kashmirensis* Uvarov and it is with this insect that the differential diagnosis given below compares this insect.

The key to species and subspecies in Mistshenko (1936) indicates a close affinity for this species with the *coerulans* group of species, but until a proper study is made using the sound produced and male phallic morphology throughout the genus, this cannot be certain.

Sphingonotus orissaensis sp. n

Differential diagnosis. Male. Vertex more declivate than in *kashmirensis* (Figs. 3 and 10) with median carinula more pronounced. Frontal ridge narrowed upwards above antennal bases (in *kashmirensis* almost parallel-sided).

Pronotal shield smooth on dorsal mid-line between transverse sulci 2 and 4, transverse sulci 3 bent backwards to touch sulcus 4 (in *kashmirensis* interzone between sulci 2 and 4 with deep median transverse crease dorally (Fig. 3), bordered anteriorly by raised callosity). Pronotal metazone more acutely pointed in *orissaensis* than in *kashmirensis*.

Tagmina with dark brown maculation and ill-defined transverse dark band on level with distal third of medial area (Fig 8), almost confluent with dark basal maculation of tegmen (in *kashmirensis* tegmen broader and maculation lighter, with transverse band (Fig 2) on level with tip of medial area narrow and clearly removed from basal dark

brown area). Hindwings in both species (Figs. 1 and 7) blue proximal to arcuate brown band, but blue in *orissaensis* bright and intense, in *kashmirensis* very light. Arcuate band in *orissaensis* angulate at vannal vein 3A, more smoothly curved in *kashmirensis*, in both species not touching hind margin of wing.

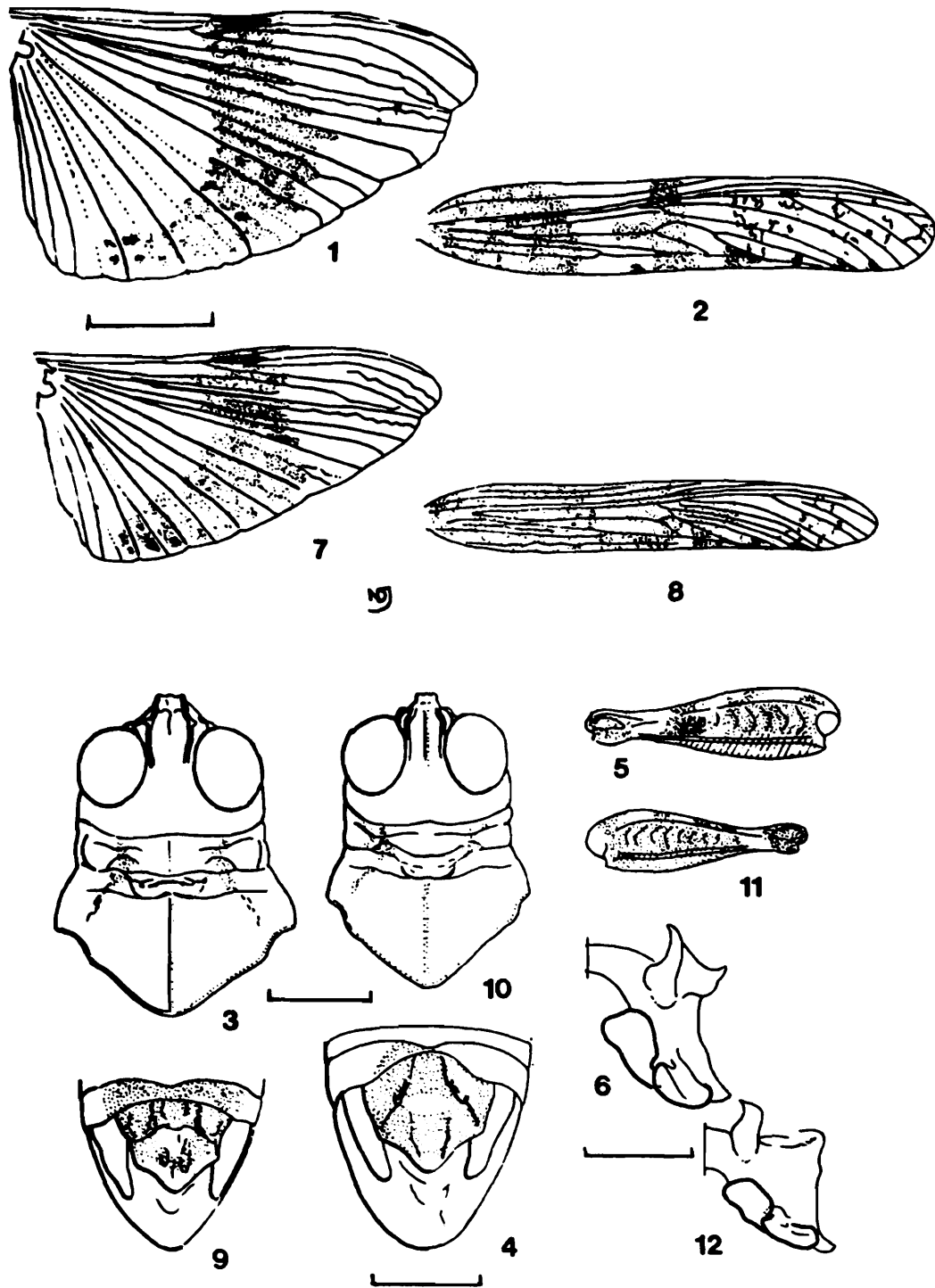
Hind femora in *orissaensis* (Fig 11) mainly black on inner side with traces of blue proximally and distally as shown. In *kashmirensis* inner area of hind femur black distally shading to brown basally with shaded area (Fig 5) slatey dull blue. Knee completely black in *orissaensis*, dark brown to black laterally, mottled above in *kashmirensis*. Hind tibia black proximally with a narrow cream band, distal four-fifths blue in both species but lighter in *kashmirensis*. In latter, additionally, extreme distal tip cream in colour. Outer side of hind femur almost entirely cream in *kashmirensis* with median and distal light vertical markings on dorso-outer area extending ventrally, but not reaching lower outer carina (in *orissaensis* outer area nearly grey and distal marking reaching lower outer carina broadly. Hairs at base of femur ventrally in *orissaensis*, absent in *kashmirensis*).

Thorax and abdomen in *orissaensis* bright blue below and on tergites dorsally, tergites 2-7 having conspicuous paired yellow spots dorsally (in *kashmirensis* abdomen cream throughout). Supra-anal plate in *orissaensis* heavily sculptured (Fig. 9) with pair of pre-apical teeth and coloured bright blue in shaded area shown in *kashmirensis* (Fig 4) supra-anal plate without pre-apical teeth; latero-basal ridges more oblique with weaker more decumbent marginal teeth than in *orissaensis*. Areas shown shaded, bright blue in *orissaensis* (Fig.9) and dull slate-blue in *kashmirensis* (Fig 4).

Epiphallus of *orissaensis* with ancorae (Fig 12) closer on mid-line and bridge stouter in *kashmirensis* (Fig. 6) ancorae widely separated, bridge slender and lophi (double lobes) bigger, but not overlapping).

Female. Generally similar to males, but in *kashmirensis* with weak arcuate wing band only strongly developed in vein 5A and broken between 1A and 2A (band similar to male and complete in *orissaensis*).

Measurements	♂		♀	
	n = 7		n = 2	
	unless otherwise stated			
Head width	2.94 – 3.20,	3.07;	3.7,	3.29
Pronotal length	2.67 – 3.29,	2.96;	3.86,	3.47
Tegminal length	15.01 – 17.67,	16.24;	20.79,	18.72
Femur length (n = 6)	7.87 – 8.82,	8.34;	10.36,	9.65
Femur depth (n = 6)	2.21 – 2.44,	2.31,	2.69,	2.65
Length frons to tips folded tegmina	19.59 – 22.66,	20.72;	26.48,	24.48



Figs. 1-12. *S. kashmirensis* 1. Right hindwing; 2. Right tegmen; 3. Head and pronotum from above; 4. Abdominal apex from above; 5. Left hind femur; inner aspect-stipple represents grey-brown to black pigment, diagonal shading slate blue; 6. Right half of epiphallic plate. *S. orissaensis* 7. Right hindwing; 8. Right Tegmen; 9. Abdominal apex from above; 10. Head and pronotum from above; 11. Right hind femur, inner aspect - stipple represents black pigment, diagonal shading light blue; 12. Right half of epiphallic plate.

Scale under Fig. 1 represents 5 mm and applies also to Figs. 2, 5, 7, 8 and 11; that under Fig. 3 represents 2mm and applies also to 10; that under Fig. 4. represents 1mm and applies also to 9; that under Fig. 6 represents 0.5mm and applies also to 12.

Material examined : 1♂ (holotype) INDIA, Orissa State, Dhenkekote, Keonjhar, W of Balasore, 28. ix. 1985 (Bhowmik); 6 ♂♂, 2 ♀♀ (paratypes), same locality, (27-28) ix. 85 (Bhowmik). A series of specimens, of both sexes, were also collected by one of us (Dr. Bhowmik) from Chunabati in Bihar in an identical habitat (in direct sunlight on the exposed portion of a hillock).

Discussion : The material was compared with a female paratype of *Sphingonotus kashmirensis* Uvarov, 19 from Kashmir, 8000 ft, 10.ix.1913 (Hingston) and a matching male from Kashmir, Gumari, Darel R, 2000 m, 22.vii.1985 (Piffli) both in the British Museum. Both these specimens are labelled as examined for this study and larger individuals than any specimens of *orissaensis*. 1 ♂ and 1 ♀, paratypes are deposited at the British Museum Natural History, London; the holotype and other paratypes will be deposited in the Zoological Survey of India, Calcutta.

SUMMARY

A new species *Sphingonotus orissaensis* sp.n. is described and compared diagnostically with *Sphingonotus kashmirensis* Uvarov.

REFERENCE

Mistshenko, L., 1936 Revision of the Palaearctic species of the genus *Sphingonotus* Fieber. *Eos, Madrid*, 12 : 65-282, 87 figs.

RECORDS OF ANOPHELINE MOSQUITOES COLLECTED FROM MANIPUR WITH ECOLOGICAL NOTES

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INTRODUCTION

The state of Manipur has remained poorly known for its mosquito-fauna and species description due to its inadequate accessibility. In spite of more attention of being paid for Anophelines due to their involvement in malaria transmission, thirteen Anopheles species were known during first half of this century (Covell 1927, 1931; Christophers, 1933; Puri, 1936, and Mortimer, 1946). In a recent survey, Malhotra et al. (1983) added Anopheles subpictus to the list of Anophelines.

In view of the above the state was surveyed for the mosquito-fauna during the period 1983 to 1985. The present communication presents the distribution record with ecological notes for the Anophelines.

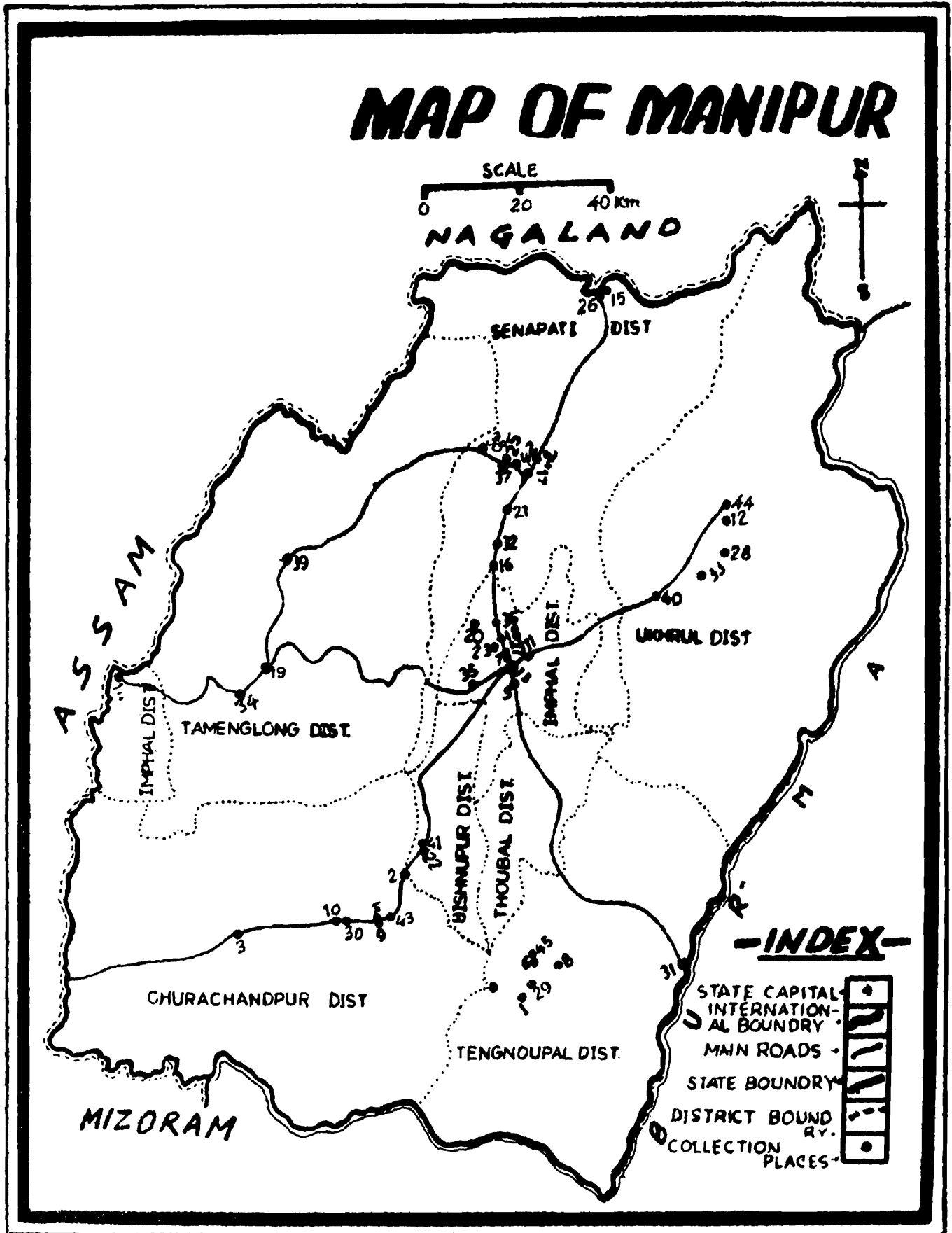
TOPOGRAPHY AND CLIMATE

The state of Manipur lies in the northeast corner of the country and extends from 23.83° to 25.68° N latitude and from 93.05° to 94.78°E longitude. The state have an area of about 22,327 sq. kilometres. The state have a centrally situated valley bounded with north to south running hill range at both the sides. A total of about 20,736 sq. kms area of the state is covered by the hills and they are covered with the mixed-type of vegetation. The state is drained by several small to large rivers, muddy and rocky nalas, streams, lakes and ponds.

The state enjoys the salubrious climate with well marked winter, and overlapping summer and rainy season. The winter season commences in November and continues up to February, and the summer commences in April and continues up to September. The summer season is the season of rain also. With the altitude variation, the state also admits the climatic variation in different parts. The temperature and relative humidity in the state usually varies from 0°C to 38.5°C and 20° to 100° respectively. The hilly region of the state receives more precipitation than the valley. The detailed ecogeographic features have been described by Ansari (1973).

The collections were made from 45 localities (vide Map) situated in different physiographic divisions of the state.

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MATERIALS AND METHODS

The adult mosquitoes were collected from different resting habitats viz., abandoned houses, cattle-sheds, banana groves, discarded motor-tyres, dried leaves, vegetation, human dwellings, nullah margin-grooves, pit-shelters, and trees holes etc. with the help of flash light and aspirator-tube. Fortnightly collections from human and bovine-baits were made during the dusk-hours in the valley. For recording day biting species regular collections were made with self-bait technique (WHO, 1975; and Rajput and Sinha, 1986). During night, the adults landing over electric light was also collected. In addition to these the immatures were also collected from different breeding places viz., ponds, pools, drains, nala margins, paddy fields, tree holes, bamboo-stumps, rock holes, discarded domestic containers, ant-wells, discarded motor tyres, and tanks etc. They were reared in the laboratory up to adult stage.

The field collected or reared mosquitoes were identified with the help of Christophers (1933); Harrison (1980); Harrison and Scanlon (1975); Puri (1955); Rao (1984); and Wattal & Kalra (1967). Besides, some recent papers were also consulted for the purpose. Identification was mainly done on adult characters. Genital characters of males and characters of immatures were also taken into consideration whenever these forms were available. Classification and nomenclature used here is based on *The Catalog of the Mosquitoes of the World* (Knight and Stone, 1977).

SYSTEMATIC ACCOUNTS

Tribe ANOPHELINI

1. *Anopheles barbirostris* van der Wulp

1884. *Anopheles barbirostris* van der Wulp, *Notes from the Leyden Museum*, 6 : 248.

Distribution : Throughout oriental region. In India recorded from almost all zones except high altitudes of Kashmir.

Present records : Bungmul (850 m.) - 1 ♀ (27 No.'84) from herb vegetation. Chingmeirono (785m.) - 17 ♀♀, 14 ♂♂ between 2 Oct.'83 and 14 Oct.'84 from shrubby vegetation, 5 ♀♀ between 30 Oct.'83 and 14 Oct.'84 from human bait during day, 1 ♂ (27 Jul.'84) from herb vegetation. Geljang (850m.) - 1 ♀ (27 Nov.'84) from shrubby vegetation of *Lithocarpus dealbata*. Imphal (785m.) - 2 ♀♀ (1 Nov.'84) from cattle-shed. Khongampat (785m.) 1 ♂, 5 ♀♀ between 27 No.'83 and 16 Dec.'84 from herb vegetation. Mantripukhari (785m.) - 8 ♀♀ between 11 Oct.'83 and 21 Oct.'84 from electric light, 7 ♂♂ between 23 Oct.'83 and 14 Oct.'84 from human bait, 23 ♀♀ between 26 Nov.'83 and 29 Oct.'84 from bovine bait, 3 ♀♀ between 26 Jul.'84 and 15 Oct.'84 from cattle-shed. Moltan-hill (820m.) - 1 ♂, 1 ♀ (1 Nov.'84) larvae reared from medows-pool. The species was found to associately breeding with *Anopheles nigerrimus* and *Culex pseudovishnui*.

2. *Anopheles crowfordi* Reid

1953. *Anopheles crowfordi* Reid : 41.

Distributed in some southeast Asian countries viz., Kampuchea, Malaysia, Sumatra and Vietnam. In India, the species have been recorded from Assam and Manipur only.

Present records : Mao (1,850m.) - 1 ♀ (8 Sept.'85) from human-bait.

3. *Anopheles gigas* Giles

1901. *Anopheles gigas* Giles, *Entom.Month.Mag.Ser. 2* : 196.

The species is restricted to oriental region only. In India, it have been recorded from high altitudes of Manipur, Meghalaya, Mizoram, Nagaland and Tamil Nadu.

Present records : Ukhrul (2,000m.) - 2 ♂♂, 2 ♀♀ (8 Jul.'84) reared from larval collection from discarded motor-tyres. The species associately breeds with *Aedes shortti*, *Culex theleri* and *Cx. vorax*.

4. *Anopheles lindesayi* Giles

1900. *Anopheles lindesayi* Giles, *Handb.ed. 1* : 116.

This montane species has been recorded from India, Pakistan, Nepal, U.S.S.R. and Burma. Recorded all along the Himalayas upto an altitude of about 3,000 meters.

Present records : Toribari (1,000m.) - 3 ♂♂, 2 ♀♀ (7 Dec.'83) larvae were reared from a stream-bed.

5. *Anopheles nigerrimus* Giles

1900. *Anopheles nigerrimus* Giles, *Handb. of Gnats or Mosq. ed. 1* : 161.

The species is endemic to oriental region and distributed throughout Indian region.

Present records : Canchipur (785m.) - 1 ♀ (20 Oct.'84) larva reared from paddy field. Chingmeirong (785m.) - 51 ♂♂, 36 ♀♀ between 11 Sep.'83 and 14 Oct.'84 from herbaceous growth below *Quercus acutissima* plants, 78 ♂♂, 53 ♀♀ between 12 Feb. '84 and 4 Dec.'84 larvae were reared from pond margin. Churachandpur (850m.) - 2 ♂♂ (8 Oct.'83), larvae reared from road side pool, 1 ♂, 2 ♀♀ (1 No.'84) larvae reared from pond margin. Geljang (850m.) - 3 ♂♂, 4 ♀♀ (27 Nov.'84) reared from a muddy-pit. Gwaltabi (785m.) - 5 ♂♂ (19 Nov.'84) collected from dried leaves of *Quercus acutissima*. Jiribam (150m.) - 1 ♂, 2 ♀♀ (7 Oct.'84) from herb vegetation and 4 ♀♀ (7 Oct.'84) from bovine-bait. Khongampat (785m.) - 6 ♂♂, 7 ♂♂ (27 No.'83), 3 ♂♂, 4 ♀♀ (29 Jan.'84), 3 ♂♂, 2 ♀♀ (12 Aug.'84), 1 ♂ (16 Dec.'84), from herb vegetation. Khurkhul (830m.) - 2 ♀♀ (29 Jan.'84), from herb vegetation. Koubruleikha (1,040m.) - 1 ♂ (12 Aug.'84) from shrubby vegetation. Langol-hill (785m.) - 1 ♂ (19 Feb.'84) larvae reared from road side pool, 1 ♂ (26 Jan.'84), larvae reared from pond margin, 1 ♂, 3 ♀♀ (26 Jan.'84) larvae reared from weedy pool. Mantripukhri (785m.) - 22 ♀♀ between 12 Sept.'83 and 15 Oct.'84 from cattle-sheds, 34 ♀♀, 2

♂♂ between 11 Oct.'83 and 21 Oct.'84 from electric light, 1 ♂ (23 Oct.'83), 1 ♀ (26 Sept.'84) from human-bait, 405 ♀♀ between 14 Nov.'83 and 29 Oct.'84 from bovine-baits, 1 ♀ (15 Nov.'83), 1 ♀ (14 Oct.'84) from human dwellings, 1 ♂, 1 ♀ (12 Jan.'84), 12 ♂♂, 14 ♀♀ (25 Mar.'84) larvae reared from pond margin. *Moltam-hill* (820m.) - 2 ♂♂, 3 ♀♀ (1 Nov.'84) larvae reared from meadows-pool. *New-heaven* (1,600m.) - 1 ♂, 2 ♀♀ (19 Nov.'84), larvae reared from a pit in the paddy field. *Nungba* (750m.) - 1 ♂ (8 Oct.'84), from bovine-bait. *Sumphejung* (1,280m.) - 2 ♂♂, 1 ♀ (7 Dec.'83), larvae reared from a harvested paddy field. *Tongou-Lonkoy* (820m.) - 1 ♀ (9 Jul.'84), from herbs in forest. *Toranglobi* (765m.) - 2 ♂♂, 3 ♀♀ (1 Nov.'84), larvae reared from road side pool. *Zaphou* (1,000m.) - 1 ♀ (21 Oct.'85), 1 ♂ (22 Oct.'85), from human-bait.

Associate-breeders were *Anopheles annularis*, *Anopheles barbirostris*, *An. peditaeniatus*, *Culex bitaeniorhynchus*, *Cx. fuscocephala*, *Cx. mimulus*, *Cx. malayi*, *Cx. pseudovishnui*, *Cx. tritaeniorhynchus*, *Cx. vishnui* and *Mimomyia chamberlaini*.

6. *Anopheles nitidus* harrison, Scanlon and Reid

1973. *Anopheles nitidus* Harrison, Scanlon and Reid, *Mosq.Syst.* 5 : 266.

The species is distributed in Indonesia, Kampuchea, Malaysia and Thailand. It has been recorded from Assam and Manipur in India.

Present records : *Chingmeirong* (785m.) - 1 ♂ (14 Aug.'84), larva was reared from pond margin. The species associately breeds with *Anopheles nigerrimus*.

7. *Anopheles peditaeniatus* (Leicester)

1908. *Anopheles peditaeniatus* (Leicester), 31.

The species is widely distributed in Oriental region and south Palaearctic region. Recorded from Assam, Bihar, Karnataka, Madhya Pradesh, Punjab, Tamil Nadu and West Bengal in India.

Present records : *Chingmeirong* (785m.) - 3 ♀♀, 2 ♂♂ between 11 Sept.'83 and 30 Oct.'83 from herbs below *Quercus acutissima* plantation, 3 ♀♀ between 30 Oct.'83 and 14 Jul.'84, larvae reared from pond margin. *Khongampat* (785m.) - 2 ♀♀ (27 Nov.'83) from herb vegetation. *Kwakta* (760m.) - 1 ♀ (8 Oct.'83), from herbs below mulberry plantation. *Mantripukhri* (785m.) - 6 ♀♀ between 21 Oct.'83 and 26 Jul.'84 from cattle-shed, 16 ♀♀ between 11 Oct.'83 and 21 Oct.'84 from electric light, 1 ♀ (30 Oct.'83) from human-bait. *Zaphou* (1,000m.) - 1 ♀ (22 Oct.'85) from human-bait.

Associated breeder was *Anopheles nigerrimus*.

8. *Anopheles sinensis* Wiedmann

1828. *Anopheles sinensis* Wiedmann, *Auss zweifl. Inst.* : 547.

Widely distributed in Oriental and south Palaearctic region. The species in India were reported to be endemic in Manipur.

Present records : Chingmeirong (785m.) - 1 ♀, 1 ♀ (12 Feb.'84), 1 ♀, 1 ♂ (26 Feb.'84), larvae reared from pond-margin, 1 ♀ (13 Feb.'84) adults collected from herb-vegetation. Gwaltabi (785m.) 1 ♀ (19 Nov.'84) from dried leaves. Hundung (2,000m.) - 1 ♂, 1 ♀ (19 Sept.'84), 3 ♂ ♂ (1 Feb.'85) larvae reared from pit in the harvested paddy-field. Kwakta (760m.) - 1 ♀ (8 Oct.'83) from herb vegetation. Langol-hill (785m.) - 4 ♀♀ (19 Feb.'84) larvae reared from an algal-pool. Mantripukhri (785m.) - 3 ♀♀ (23 Oct.'83), from human-bait, 1 ♀ (25 Feb.'84), from bovine-bait, 1 ♀ (25 Feb.'84) from cattle-shed, 1 ♀ (21 Oct.'84) from bulb-light. Mao (1,850m.) - 1 ♀ (8 Sept.'85) from cattle-shed. Zaphou (1,000m.) - 3 ♀♀ (22 Oct.'85) from human-bait. The species breeds in association with *Anopheles nigerrimus*.

9. *Anopheles annularis* Van der Wulp

1884. *Anopheles annularis* Van der Wulp, *Notes from the Leyden Museum*. 6 : 249.

The species has wide range of distribution in oriental region. Recorded from all over India.

Present records : Bullian (775m.) - 1 ♀ (8 Oct.'83) from cattle-shed. Chingmeirong (785m.) 5 ♀♀ (11 Sept.'83), 1 ♂ (18 Sept.'83) from shrubby vegetation, 24 ♀♀, 16 ♂ ♂ between 21 Nov.'83 and 25 Aug.'84 larvae were reared from pond margin. Gwaltabi (785m.) - 1 ♂ (19 Nov.'84) from dry leaves of *Quercus acutissima*. Mantripukhri (785m.) - 148 ♀♀ between 12 Sept.'83 and 15 Oct.'84 from cattle-shed, 1 ♀ (30 Oct.'83), 1 ♀ (14 Oct.'84) from human bait, 45 ♀♀ between 24 Mar.'84 and 29 Oct.'84 from bovine bait, 1 ♀ (23 Jan.'84) from wooden logs, 2 ♂ ♂ (13 Mar.'84) attracted to light, 16 ♂ ♂, 13 ♀♀ (25 Mar.'85) larvae reared from pond.

Associated breeders were *Anopheles nigerrimus*, *Culex bitaeniorhynchus*, *Cx. mimulus*, *Cx. malayi* and *Cx. pseudovishnui*.

10. *Anopheles jeyporiensis* var. *candidiensis* Koidzume

1924. *Anopheles jeyporiensis* var. *candidiensis* Koidzumi, *Trans. 5th Cong. F.E.A.T.M.*:98.

It has wide range of distribution in Oriental and south Palaeartic region. In India, it has been recorded from Andhra Pradesh, Assam, Manipur, Maharashtra, Madhya Pradesh, Uttar Pradesh and West Bengal.

Present records : Zaphou (1,000m.) - 11 ♀♀ (21 Oct.'85), 7 ♂ ♂ (22 Oct.'85) from human-bait.

11. *Anopheles kochi* Doenitz

1901. *Anopheles kochi* Doenitz, *Insektenborsa* 18 : 36.

The species is distributed in Oriental and south Palaeartic region. Recorded from Arunachal Pradesh, Assam, Manipur, Maghalaya, Mizoram, Nagaland, Sikkim and Tripura, in India.

Present records : Kongampat (785m.) - 6 ♂♂, 6 ♀♀ (27 Nov.'83) from herb vegetation. Moreh (150m.) - 1 ♀ (18 Aug.'84) from nala side groove in forest, 4 ♂♂, 3 ♀♀ (18 Aug.'84) larvae from rainy-pool, having turbid water.

Associated breeders were *Anopheles nigerrimus*, *Aedes caecus*, and *Culex fuscocephala*.

12. *Anopheles maculatus* Theobald

1901. *Anopheles maculatus* Theobald, *Monogr.Cul.* 1 : 171.

Distributed in Oriental region. Recorded from almost all parts of India.

Present records : Gwaltabi (785m.) - 1 ♂ (19 Nov.'84) from dry leaves of *Quercus acutissima*. Kanglatongbi (1,000m.) - 2 ♂♂, 2 ♀♀ (12 Aug.'84) from herb vegetation. Koubru-leikha (1,040m.) - 1 ♀ (7 Dec.'84) larvae reared from a pit at nala margin. Mantripukhri (785m.) - 1 ♀ (23 Oct.'83) from human-bait. New-heaven (1,600m.) - 1 ♀ (19 Nov.'84) larvae reared from road side drain. Nungba (750m.) - 2 ♀♀ (8 Oct.'84) from bovine-bait, 2 ♀♀ (8 Oct.'84) larvae reared from road side rainy pit. Nungdalal (1,100 m.) - 1 ♀ (7 Sept.'84) larvae reared from roadside rainy-pit. Tamenglong (1,200m.) - 1 ♀ (8 Nov.'84) from indoor cattle-shed, 2 ♀♀ (8 Nov.'84) from shrubby vegetation, 1 ♀ (8 Sept.'84) from indoor human dwellings. Zaphou (1,000m.) - 1 ♀ (21 Oct.'85) from human-bait.

The species associately breeds with *Anopheles maculatus* var. *willmorei*, *Culex bitaeniorhynchus*, *Cx. mimulus*, and *Cx. quinquefasciatus*.

13. *Anopheles maculatus* var. *willmorei* (James)

1903. *Anopheles maculatus* var. *willmorei* (James) in Theobald *Monogr.Cul.* 3 : 100.

The distribution of var. *willmorei* is restricted to Burma, Nepal, India and Pakistan. In India, it has been recorded from Himalayan and eastern part.

Present records : Mao (1,850m.) - 1 ♀ (8 Sept.'85) from human-bait. New-heaven (1,600m.) - 2 ♀♀ (19 Nov.'84) larvae reared from a road-side drain in forested area. Nungba (750m.) - 8 ♀♀ (8 Oct.'84) from bovine-bait, 3 ♂♂ (8 Oct.'84) larvae reared from road side rainy-pit. Nungdalal (1,100m.) - 3 ♂♂, 14 ♀♀ (7 Sept.'84) larvae reared from a road side rainy-pool. Tamenglong (1,200m.) - 2 ♂♂ (8 Sept.'84) larvae reared from a cement tank.

Associated breeders were *Anopheles maculatus*, *Culex mimulus* and *Cx. quinquefasciatus*.

14. *Anopheles minimus* Theobald

1901. *Anopheles minimus* Theobald, *Monogr.Cul.* 1 : 186.

The species has a wide distribution in Oriental and southern Palaearctic region. It is prevalent in Orient in Assam and eastern India including Manipur; northern and last central India with scattered distribution in Andhra Pradesh, Kerala, Karnataka and Tamil

Nadu.

Present records : Moreh (150m.) - 1 ♂ (18 Aug.'84) from human-bait, 21 ♂♂, 14 ♀♀ (18 Aug.'84) larvae reared from road side rainly-poll, 1 ♀ (19 Aug.'84) from nala margin groove in dense forest.

Associated breeder was *Culex quinquefasciatus*.

15. *Anopheles philippinensis* Ludlow

1902. *Anopheles philippinensis* Ludlow, *Journ.Amer.Med. Assoc.* : 426.

Mainly Oriental and Palaearctic in distribution. In India, it has been recorded from Andamans Island, Andhra Pradesh, Assam, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Uttar Pradesh and West Bengal.

Present records : Chingmeirong (785m.) - 2 ♂♂ (6 No.'83) larvae reared from pond margin.

16. *Anopheles splendidus* Koidzumi

1920. *Anopheles splendidus* Koidzumi, *Daiwan Kenkyujo Hokoku* 8 : 23, 32, 55.

The species is known to be distributed in oriental region, southern Palaearctic region and Afghanistan. It has been recorded from most of the states in India.

Present records : Mantripukhri (785m.) - 1 ♀ (14 Oct.'84) from human-bait. Langol-hill (785m.) - 1 ♀ (26 Jan.'84) from dried leaves below *Quercus acutissima* plantation.

17. *Anopheles subpictus* Grassi

1899. *Anopheles subpictus* Grassi, *R. C. Accad. Lincer.* 8 : 101.

The species has a wide geographic range including entire oriental region, Afghanistan, Iran, southern China and New Guinea. The species has been recorded from all over India.

Present records : Mantripukhri (785m.) - 35 ♀♀ between 4 Apr.'84 and 23 Jun.'84 from bovine-baits, 1 ♂, 12 ♀♀ between 9 and 23 Jun.'84 from cattle-sheds, 6 ♂♂ (15 Apr.'84) larvae reared from a muddy-pit in a dried pond with turbid water. Tongou-Lonkoy (820m.) - 1 ♀ (9 Jul.'84) from herb vegetation in forest.

Associated breeders were *Anopheles vagus* and *Culex pseudovishnui*.

18. *Anopheles tessellatus* Theobald *Mono.Cul.* 1 : 175.

1901. *Anopheles tessellatus* Theobald, *Mono. Cul.* 1 : 75;

The species distribution is restricted to oriental and southern Palaearctic region. In India, it is widely distributed and includes Andaman and Lakshadweep, but scarce in north western part.

Present records : Manipur : Mantripukhri (785m.) - 1 ♂ (19 Nov.'83) collected from bulb-light.

19. *Anopheles vagus* Donitz

1902. *Anopheles vagus* Donitz, *Zeit.f.Hyg.* : 80.

The species has a wide distribution in Oriental region, Kampuchea, Mariana Island, Moluccas and New Guinea. Records from all over India including Andamans.

Present records : Bungmul (850m.) - 1 ♀ (27 Nov.'84) from herb vegetation. Chingmeirong (785m.) - 1 ♂, (11 Sept.'83), 2 ♂ ♂, 1 ♀ (28 Jul.'84) from shrubby vegetation of *Quercus acutissima*, 1 ♀ (27 Jul.'84) from herb vegetation, 1 ♂, 3 ♀ ♀ (23 Oct.'83) larvae reared from cart-tract. Gwaltabi (785m.) - 1 ♀ (19 Nov.'84) from dry leaves of *Q. acutissima*. Imphal (785m.) - 1 ♀ (1 Nov.'84) from cattle-shed. Jiribam (150m.) - 1 ♂ from herb vegetation and 47 ♀ ♀ from bovine-bait (7 Oct.'84). Kanglatonqbi (785m.) - 1 ♂, 2 ♀ ♀ (12 Aug.'84) from herb vegetation. Khongampat (785m.) - 11 ♂ ♂, 12 ♀ ♀ (12 Aug.'84) from herb vegetation. Khongsong (650m.) - 1 ♂, 7 ♀ ♀ (9 Sept.'84) from road side rainy-pool. Mantripukhri (785m.) - 81 ♀ ♀, 8 ♂ ♂ between 12 Sept.'83 and 15 Oct.'84 from cattle-shed, 4 ♀ ♀ between 23 Oct.'83 and 11 Aug.'84 from human-bait, 855 ♀ ♀ between 14 Nov.'83 and 29 Oct.'84 from bovine-bait, 1 ♀ (13 Mar.'84), 1 ♀ (23 Aug.'84) attracted to electric light; 1 ♂ (9 Apr.'84), 1 ♂ (23 Aug.'84) from human dwellings, 5 ♂ ♂, 9 ♀ ♀ (15 Apr.'84) larvae reared from muddy-pit in a dried pond. Nungba (750m.) - 8 ♀ ♀ (8 Oct.'84) from bovine-bait, 2 ♀ ♀ (9 Oct.'84) from cattle-shed. Tamenglong (1,200m.) - 4 ♀ ♀ (8 Sept.'84) from bovine-bait. Ukhrul (1,200m.) - 1 ♂, 1 ♀ (8 Jul.'84) larvae reared from a rainy-pool.

Associated breeders were *Anopheles subpictus*, *Culex fuscocephala*, *Cx. pseudovishnui* and *Cx. quinquefasciatus*.

SUMMARY

The mosquito-survey of the state during 1983 to 1986 shows the presence of 19 species viz., *Anopheles barbirostris*, *An. crowfordi*, *An. gigas*, *An. lindesayi*, *An. nigerrimus*, *An. nitidus*, *An. peditaeniatus*, *An. sinensis*, *An. annularis*, *An. jeyporiensis* var. *candidensis*, *An. kochi*, *An. maculatus*, *An. maculatus* var. *willmorei*, *An. minimus*, *An. philippinensis*, *An. splendidus*, *An. subpictus*, *An. tessellatus* and *An. vagus* from the state. This communication includes the distribution records and ecological notes for the recorded species. The record of the *An. minimus* is noteworthy due to its vectorial role in the transmission of malaria in the northeast region.

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REFERENCES

- Ansari, S. A. 1973. Economic geography of Manipur. Ph.D. Thesis, G. V., Trio Book Store, Imphal.
- Christophers, S. R. 1933. *The Fauna of British India*, Diptera, Vol.IV, Family Culicidae, Tribe Anophelini, iv + pp.1-371, Taylor and Francis, London.
- Covell, G. 1927. A critical review of the data recorded regarding the transmission of malaria by the different species of Anopheline mosquitoes : With notes on their distribution, habits and breeding. *Ind. Med. Res. Mem.* 7.
- Covell, G. 1931. The present state of our knowledge regarding the transmission of malaria by the different species of anopheline mosquitoes. *Rec. Malar. Surv. Ind.* 2 : 1-48.
- Harrison, B. A. 1980. Medical Entomology Studies - XIII. The *Myzomyia* series of *Anopheles (Cellia)* in Thailand, with emphasis on intra-interspecific variations (Diptera : Culicidae). *Contrib. Am. Entomol. Inst.* 17(4) : 1-195.
- Harrison, B. A. & Scanlon, J. E. 1975. The subgenus *Anopheles* in Thailand (Diptera : Culicidae). *Contrib. Am. entomol. Inst.* 12(1) : 1-307.
- Knight, K. L. & Stone, A. 1977. *A catalog of the Mosquitoes of the World (Diptera : Culicidae)* Ed.II, Vol.VI, pp.1-611, The Thomas Say Foundation, Maryland.
- Malhotra, P. R., Chakraborty, B. C., Das, N. G. & Sarkar, P. K. 1983. Collection of mosquitoes in Manipur. *J. Assam Sci. Soc.* 25(2):80-83.
- Mortimer, D. A. 1946. Notes on the Anopheline fauna of Manipur area, Eastern Assam. *J. Malar. Inst. India* 6 : 269-271.
- Puri, I. M. 1936. The distribution of anopheline mosquitoes in India : additional records. *Rec.Malar.SurvInd.* 2 : 1-48.
- Puri, I. M. 1955. Synoptic table for the identification of the Anopheline mosquitoes of India. *Health Bulletin* No. 10 (Fourth Edition). Manager of Publications, Delhi.
- Rajput, K. B. & Singh, T. K. 1986. Day-biting mosquitoes (Diptera : Culicidae) of Manipur. *Entomon.* 12(1) : 21-25.
- Rao, T. R., 1984. *The Anophelines of India*. pp. 1-518< amalaria Research Centre, New Delhi.
- Wattal, B. L. & Kalra, N. L. 1967. Regionwise pictorial keys to the female Indian *Anopheles*. Indian Society for malaria and other communicable diseases; Delhi.
- WORLD HEALTH ORGANISATION 1975. *Manual on practical entomology in malaria vector bionomics and organisation of anti-malaria activities*. Part I and II Offset Publication.

BIOMETRY OF THE MAHSEER *TOR TOR* (HAMILTON)

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INTRODUCTION

Though some work has been done on the biology of *Tor tor* from other parts of India (Jhingran, 1975; Chaturvedi, 1976; Desai, 1970) there is practically no information on this aspect of *Tor tor* from the North-Eastern India. Hence a work on the biology of *Tor tor* was under taken and this paper deals with the biometry of this species of mahseer from Garo Hills, Meghalaya.

This kind of study is very much essential for solving the race problem of the species. Regarding the race problem Zupanovic (1968) stated, "As it is essential to be able to distinguish between different species, so it is essential to distinguish between the self perpetuating sub-groups within th species. These sub-groups may be equivalent to what taxonomists call sub-species, but they are presumably more generally of lesser rank. In the fishery literature, they are often called races or populations" *

MATERIALS AND METHODS

The material for the present study pertains to the specimens of *Tor tor* (Ham.) collected from River Simsang, situated in the East Garo Hills, Meghalaya (25°30'N, 90°40'E and altitude 1138 feet above sea level) during the period August 1978 through July 1980. Specimens were collected every month with the help of a cast net having a mesh size of 0.5 cm. Immediately after collection specimens were fixed in 10% formalin and brought to the laboratory for detailed measurements, weights and counts. The study is based on the examination of 256 specimens in the size range of 85.0 to 355.0 mm. A total of 31 morphometric and meristic characters have been taken up for study according to the methods described by Lowe-Mc Connel (1971). Divider and measuring boards, having graduations in millimeter have been used for various measurements. All linear measurements were made to the nearest mm.

The number of times each morphometric character went into the reference length of the fish was considered as the Biometric Index (Tobor, 1974). For each character, a mean biometric index for each 50.0 mm length group has been calculated.

The regression of various morphometric characters on standard length was obtained by least square method with the formula :

$$Y = a + bx$$

Where 'Y' is the variable character such as total length, head length etc., 'a' is the

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constant value to the determined, 'b' is the regression coefficient and 'X' the standard length. The correlation coefficient 'r' of these regressions was computed.

RESULTS AND DISCUSSION

The morphometric characters showed a proportional positive increase with increase in length of the fish. The mean and range of these values have been presented in Table I. Among the meristic characters (Table II) the number of pectoral fins rays and lateral line scales showed variations without any relation to length of the fish. The number of other meristic characters were constant.

TABLE - I
Morphometric analysis of *T. tor*

<i>Parameters</i>	<i>Species</i>		<i>Sexes</i>	
	<i>% Standard length</i> <i>Mean</i>	<i>Range</i>	<i>% Standard length</i> <i>Male</i>	<i>Female</i>
Total length	131.51	128.37 – 133.29	159.83	132.57
Fork length	112.39	110.72 – 114.02	113.66	111.79
Predorsal length	53.72	53.12 – 54.32	54.46	58.06
Head length	27.72	26.58 – 29.21	29.32	26.86
Head depth	19.61	17.72 – 20.56	21.31	19.50
Body depth	30.33	28.68 – 31.35	30.78	30.19
Least Height	12.37	11.43 – 13.08	13.75	12.26
Length of caudal peduncle	16.45	15.74 – 18.22	15.48	16.76
Dorsal fin length	14.64	13.50 – 15.61	15.75	14.91
Length of free margin of dorsal fin	18.22	16.03 – 19.22	20.40	16.97
Dorsal fin height	26.05	24.05 – 28.58	28.32	25.27
Pectoral fin height	21.51	21.09 – 22.46	22.31	20.72
Ventral fin height	19.53	18.98 – 20.88	20.03	18.98
Anal fin height	21.69	21.04 – 22.36	21.58	21.15
Anal fin base	7.68	7.17 – 7.88	7.92	7.19
Girth	74.31	70.75 – 76.89	66.48	66.63
Snout length	39.78	37.18 – 40.86	36.64	39.96
Eye diameter	21.31	19.04 – 26.35	24.80	20.37
Post-orbital length	44.17	41.17 – 45.97	42.85	45.47
Inter-orbital length	47.17	45.84 – 46.03	45.96	47.63
Length of upper jaw	26.37	25.49 – 27.49	24.80	26.77
Gape	37.80	35.81 – 37.90	35.71	38.77
Rostal barbel length	31.20	31.04 – 33.74	30.12	30.90
Maxillary barbel length	34.06	31.74 – 35.40	34.47	24.25

TABLE - II
Meristic characters of *T. tor*

<i>Parameters</i>	<i>T tor Mean</i>	<i>Range</i>
No. of dorsal fin rays	4/8	4/8 (Const.)
No. of pectoral fin rays	17.07	17 - 18
No. of pelvic fin rays	9	9 (Const.)
No. of anal fin rays	3/5	3/5 (Const.)
No. of caudal fins rays	19	19 (Const.)
No. of lateral line scales	25.8	25 - 27
No. of lateral line transverse scales	4/2	4/2 (Const.)

The regression coefficient 'b' (Table III) of different variable characters (Y) on standard length (X) indicates that the rate of growth in respect to standard length is highest in case of total length (b = 1.3283) and lowest in case of eye diameter (b = 0.0335) High values of correlation coefficient 'r' (Table III) obtained indicates a high degree of positive correlation of the different morphometric parameters with the reference length (standard length).

TABLE - III
Regression equations of morphometric parameters of *T. tor*

<i>Parameters</i>	<i>Regression equation</i>	<i>Correlation coefficient</i>
Total length (Y) on standard length (X)	$Y = - 1.7729 + 1.3283 X$	0.9996
Fork length (Y) on standard length (X)	$Y = 9.5745 + 1.0578 X$	0.9983
Predorsal length (Y) on standard length (X)	$Y = 1.1029 + 0.5299 X$	0.9997
Head length (Y) on standard length (X)	$Y = 4.0956 + 0.2502 X$	0.9997
Snout length (Y) on standard length (X)	$Y = - 0.1675 + 0.1103 X$	0.9998
Eye diameter (Y) on standard length (X)	$Y = 4.1495 + 0.0335 X$	0.9990
Inter-orbital distance (Y) on standard length (X)	$Y = 1.4395 + 0.1205 X$	0.9923
Gape (Y) on standard length (X)	$Y = 1.9590 + 0.0922 X$	0.9800
Rostal barbel length (Y) on standard length (X)	$Y = 0.9323 + 0.0803 X$	0.9932
Head depth (Y) on standard length (X)	$Y = 9.6250 + 0.1297 X$	0.9900
Body depth (Y) or standard length (X)	$Y = - 2.0831 + 0.3165 X$	0.9972
Length of caudal peduncle (Y) on standard length (X)	$Y = - 1.0792 + 0.1727 X$	0.9836
Dorsal fin length (Y) on standard length (X)	$Y = 3.3634 + 0.1241 X$	0.9941
Dorsal fin height (Y) on standard length (X)	$Y = 5.8411 + 0.2215 X$	0.9941
Pectoral fin height (Y) on standard length (X)	$Y = 1.3756 + 0.2058 X$	0.9992
Anal fin height (Y) on standard length (X)	$Y = - 0.8480 + 0.2220 X$	0.9965
Anal fin base (Y) on standard length (X)	$Y = 1.3195 + 0.0681 X$	0.9867
Girth (Y) on standard length (X)	$Y = 0.1177 + 0.7422 X$	0.9962

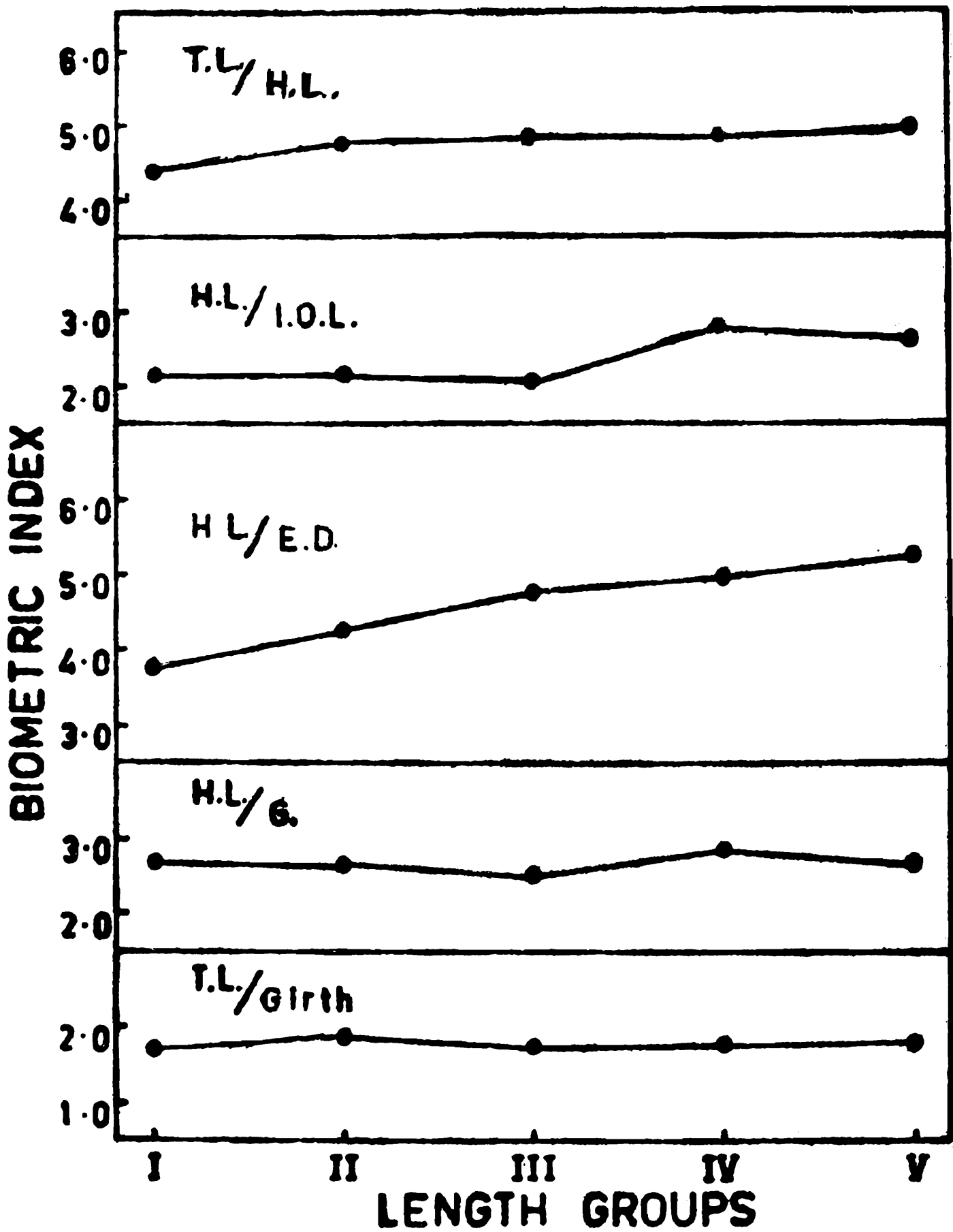


Fig. 1. Biometric indices of *T. tor* at different length-groups.

Biometric Index of *T tor* (Fig. 1) indicates that the eye diameter becomes progressively smaller in relation to head length. A similar case has been reported by Tobor (1974) in case of *Lates niloticus*. The growth of head length and girth in relation to total length and gape in relation to head length was almost constant. According to Bayagbona (1963) a constant index in any of the biometric characters in relation to its reference length is isometric. The growth of inter-orbital distance in relation to head length was found to be allometric and showed wide variations.

The morphometric ratios and meristic counts in *T tor* observed in the present study, were found to be quite similar to that observed by earlier workers (McClelland, 1839; Hora, 1940 a, c; Hamilton, 1822).

Considerable difference in the morphometric characters has been observed between males and females (Table I). The males were found to have greater height of dorsal, pectoral and pelvic fins than the females. On the other hand the females had greater height of anal fin, greater length of free margin of dorsal fin, greater eye diameter and maxillary barbel length and also the predorsal length, snout length and gape were greater.

Nikolsky (1963) stated that males and females often differ in the length and shape of the fins. According to him, in the males of many Cyprinoids, both the paired and the unpaired fins are slightly larger than the females. He cited examples of some species where males were found to differ in shape of the fins. For example in the males of certain lake baikal Sculpins, *Cotio comephorus*, the thoracic fins were found to be significantly larger. He further stated that in *Xiphophorus* (Fam. Poeciliidae) there is a long outgrowth on the caudal fin, whereas in the males of many pleuronectids of the family Bothidae, the rays of the dorsal fin are elongated, and so on. In majority of cases the difference between the structure of the fins in males and females is connected with the peculiarities of reproduction, as for example, the dorsal fin which is larger in male than in the female of the grayling, *Thymallus*, and increases still further towards the time of spawning, creates a turbulence close to the spawning fish during the spawning process, and delays the dispersal of the sperm by fast currents (Brown, 1938). The larger size of the pelvic fins of the male Tinch facilitates a more successful fertilization of the eggs and their attachment to plant stalks (Nikolsky, 1963). Hence such a difference in the morphometric characters of males and females may be represented as sexually dimorphic characters.

According to Gould (1966) ratios between morphological characters of fish will not necessarily be constant for the organisms of the same species due to variation resulting from differences in sex, race and nutrition and/or other environmental factors.

Various authors have shown that morphometric characters of fish can vary under the influence of environment and in particular the thermal factor during the period of incubation and the beginning of larval life (Schmidt, 1921; Barlow, 1961). According to Hubbs (1922) and Taning (1944) variation occurs in the number of rays in the unpaired

fins in several species which is also related to an adaptation to movement of water of various density.

Variations in the body proportions in the same species according to hydrographic conditions have also been recorded by various authors (Hubbs, 1922; Barlow, 1961). They associated these variations with the effect of the duration of periods of growth and of the relating differentiations which determine the number of vertebrae and of segments.

Many authors (Schmidt, 1921; Vladykov, 1934; Taning, 1944; Lindsay, 1954; Barlow, 1961) have reported that meristic characters, exhibit plasticity under the influence of environmental factors.

SUMMARY

Morphometric and meristic characters of *T. tor* (Hamilton) have been analysed. The morphometric characters of the species showed a proportional positive growth with the increasing length of the fish and a high degree of positive correlation with the reference length. Some of the meristic characters were found to be constant while some varied without showing any relation to the length of the fish. The biometric index indicated that the growth of head length, girth and gape is isometric while the growth of interorbital distance is allometric. The eye diameter becomes progressively smaller in relation to head length. Some difference has been observed between male and female of the species.

ACKNOWLEDGEMENTS

The author is grateful to Dr. S. A. K. Nasar, Department of Zoology, North-Eastern Hill University, Shillong for guidance. Thanks are also due to Professors R. G. Michael and M. K. Khare of the same department and to Professor H. L. Sarkar, Ex-Director, Jawaharlal Nehru University, New Delhi for help and encouragement. Financial assistance for this work was extended by the Indian Council of Agricultural Research, Hindustan Lever Research Foundation and Council of Scientific and Industrial Research.

REFERENCES

- Barlow, G. W. 1961. Causes and significance of morphological variation in fishes. *Syst. Zool.* 10 : 105-117.
- Bayagbona, E. O. 1963. Biometric study of two species of *Pseudotalithus* from the Lagos trawling ground. *Bulletin de Ifan*, T. XXV Ser. A.I.
- Brown, C. 1938. Observations on the life history and breeding habits of the Montana grayling, *Copeia* No. 3.
- Chaturvedi, S. K. 1976. Spawning biology of tor mahseer, *Tor tor* (Ham.) *J. Bombay nat. Hist. Soc.* 73 (1) : 336-344.

- Desai, V. R.** 1970. Studies on the fishery and biology of *Tor putitora* (Ham.). *J. zool. Soc. India.* 24(1) : 47-51.
- Gould, S. J.** 1966. Allometry and size in ontogeny and phylogeny. *Biol. Rev. Cambridge Philos. Soc.* 41 : 587-640.
- Hamilton, B.** 1822. An account of the fishes found in the River Ganges and its Branches. Edinburgh, 405 pp.
- Hora, S. L.** 1940a. The game fishes of India IX. The mahseers or the large-scaled barbels of India. 2. The tor mahseer *Barbus (Tor) tor* (Hamilton). *J. Bombay Nat. Hist. Soc.* 41 : 518-525.
- Hora, S. L.** 1940c. The game fishes of India XI. The masheers or the large-scaled barbels of India IV. The bokar of the Assamese and Katli of the Nepalese, *Barbus (Lissocheilus) hexagonolepis* McClelland. *Ibid.* 42 : 78-88.
- Hubbs, C.** 1922. Variation in the number of vertebrae and other meristic character of fishes correlated with the temperature of the water during development. *Amer. Nat.* 56.
- Jhingran, V. G.** 1975. *Fish and fisheries of India.* Hindustan Publishing Corporation, New Delhi, India, 954 p.
- Le Cren, E. D.** 1951. The length weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *J. Anim. Ecol.* 20 : 201-219.
- Lindsay, C. C.** 1954. Temperature controlled meristic variation in the Paradise Fish *Macropodus opercularis* (L.) *Can. J. Zool.* 32 : 87-98.
- Lowe-McConnel, R. H.** 1971. Identification of freshwater fishes. In : Methods for Assessment of Fish production in Freshwaters.. Ed. W. E. Ricker. Blackwell Scientific Publications Oxford and Edinburgh : 45-81..
- McClelland, J.** 1839. Indian Cyprinidae. In : Asiatic Researches. 19(2) : 217-465.
- Nikolsky, G. V.** 1963. *The Ecology of Fishes.* Academic Press. London and New York.
- Schmidt, J.** 1921. Racial investigation. VII. Annual fluctuations of racial characters in *Zoarcis viviparas* L. C. R. Lab. Carlesberg. 14 : 1-20.
- Taning, A. V.** 1944. Experiments on meristic and other characters in fishes. 1. On the influence of temperature on some meristic characters in sea trout and the fixation period of these characters. *Medd. Dan. Fisk., Havenders.* 11(3) : 1-66.
- Tobor, J. G.** 1974. A contribution to the study of *Lates niloticus* Nile perch, in Lake Chad. Federal Ministry of Information Printing Division, Lagos. Occasional paper No. 17 : 1-23.

Vladykov, V D. 1934. Environmental and taxonomic character of fishes. *Trans. R. Can. Inst.* 20 : 99-140.

Zupanovic, S. 1968. An introduction to Marine Fishery (Lecture notes), Marine Fisheries Department, Karachi (Mimiographed).

**IMPACT OF IDUKKI HYDRO-ELECTRIC PROJECT ON THE
POPULATION OF *VILLORITA CYPRINOIDES* VAR. *COCHINENSIS*
(HANLEY) INHABITING THE ESTUARIAN WATERS OF
MUVATTUPUZHA RIVER IN KERALA**

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INTRODUCTION

Idukki project in Kerala is one of the major hydro-electric projects in India. Apart from naturally affecting the ecosystem of the forest lands inundated by its reservoir, covering an area of 60 sq. kms, the project has led to the diversion of the water of one river (Periyar) to another (Muvattupuzha). This has affected the biotic and abiotic factors of both the rivers. Very little is known from the world over, and practically nothing from India, of the impacts of such changes. An attempt, therefore, has been made to assess the changes brought about by this project on the salinity contents in the lower reaches of one of the rivers and the impacts of changes in the salinity on the population of *Villorita cyprinoides* var. *cochinensis* (Hanley), a mussel inhabiting the estuarian waters of that river.

AREA OF STUDY

Idukki reservoir is one of the biggest artificially created freshwater bodies. It is formed by the construction of three dams across Periyar and its tributary Cheruthoni rivers. The coming up of the reservoir has led to the stoppage of the flow of water below the dams along a long stretch of Periyar river. The tailrace waters that leave the Idukki Project power generators at Moolamattom enter the Muvattupuzha river. This river divides into Murinjapuzha and Ithipuzha branches before joining the Vembanad Lake which is a brackish water body that joins the Arabian sea. The points of entry of these branches into the lake are separated by a distance of over 12 kms. The area of the lake between these points of entry, called Chempu part of the lake, is practically an enclosed area as there is a continuous stretch of landmass in the lake over four kms from the mainland. This landmass separates this waterbody, but for two outlets, from the main body of the lake (Fig. 1).

MATERIAL AND METHODS

Data on salinity content of the waters of Chempu area of Vembanad lake and from one point each 2 kms upstream from the estuaries of Murinjapuzha and Ithipuzha were collected once in each month during the summer season (January - June) between 1980 and 1983. Mohr's method was followed for determining salinity. Silvernitrate was

titrated against the sample by using potassiumchromate as indicator solution. Besides, data were collected from Kerala State Electricity Board (KSEB) on the quantum of tailrace waters discharged into the Muvattupuzha river daily for the period from 1980 to 1983 and the average discharge was calculated on the basis of such data. Information on the nature of the flow in Muvattupuzha river before the commissioning of the project in 1976 was gathered by questioning twenty long time inhabitants residing on the banks of the river along a stretch of 80 kms, as no other data for the flow of this period, are available.

Data on the availability of *Villorita cyprinoides* var. *cochinensis* (Hanley) found in the waters of Chempu part of the lake and in the lower reaches of the river for the pre-project period were collected by questioning forty long time inhabitants and fishermen of Chempu and surrounding areas as no such data were regularly collected and maintained by any scientific agency. Information on the population of the clams in the study area from 1980 to 1983 was gathered by examining and quantifying, once in two months, the catches made by the fishermen.

RESULTS AND DISCUSSION

a. *Replenishment in the flow of Muvattupuzha river*

As mentioned earlier, on the basis of data maintained by KSEB, on an average 200 M. cft. of water enter the river as tailrace. It was as high as 249 M. cft. on a day in June, 1982 and on certain days in previous years it was even higher. This replenishment in the flow allows the river to maintain a good flow all the year round whereas before the commissioning of the project the flow during summer months was restricted, especially along a stretch of many kms below Moolamattom, to a small channel running almost through the middle of the river.

b. *Impact of the entry of tailrace waters on the salinity content of the estuarian waters of Muvattupuzha river*

During the summer months (January - June) before the commissioning of the project in 1976 salinity in Muvattupuzha river used to be felt upto Kakkad, near Piravom i.e. along a stretch of over 12 kms from the estuary upstream, if the experiences and reports of inhabitants along this stretch are to be believed for no scientific data for the period are available. According to local fishermen many freshwater species of fishes that were seen in the lower reaches of the river before 1976 only during summer months are found in these water all the year round. These include *Channa striatus*, *Channa orientalis*, *Nandus marmoratus*, *Mastacembulus guentheri*, *Glossogobius giuris* and *Puntius filamentosus* which I could collect from these waters during the summer season also. According to the fishermen the quantity of freshwater fishes being caught from these waters has doubled and in the case of certain species trebled since 1976. This change in the piscian fauna is indicative of the decline in salinity.

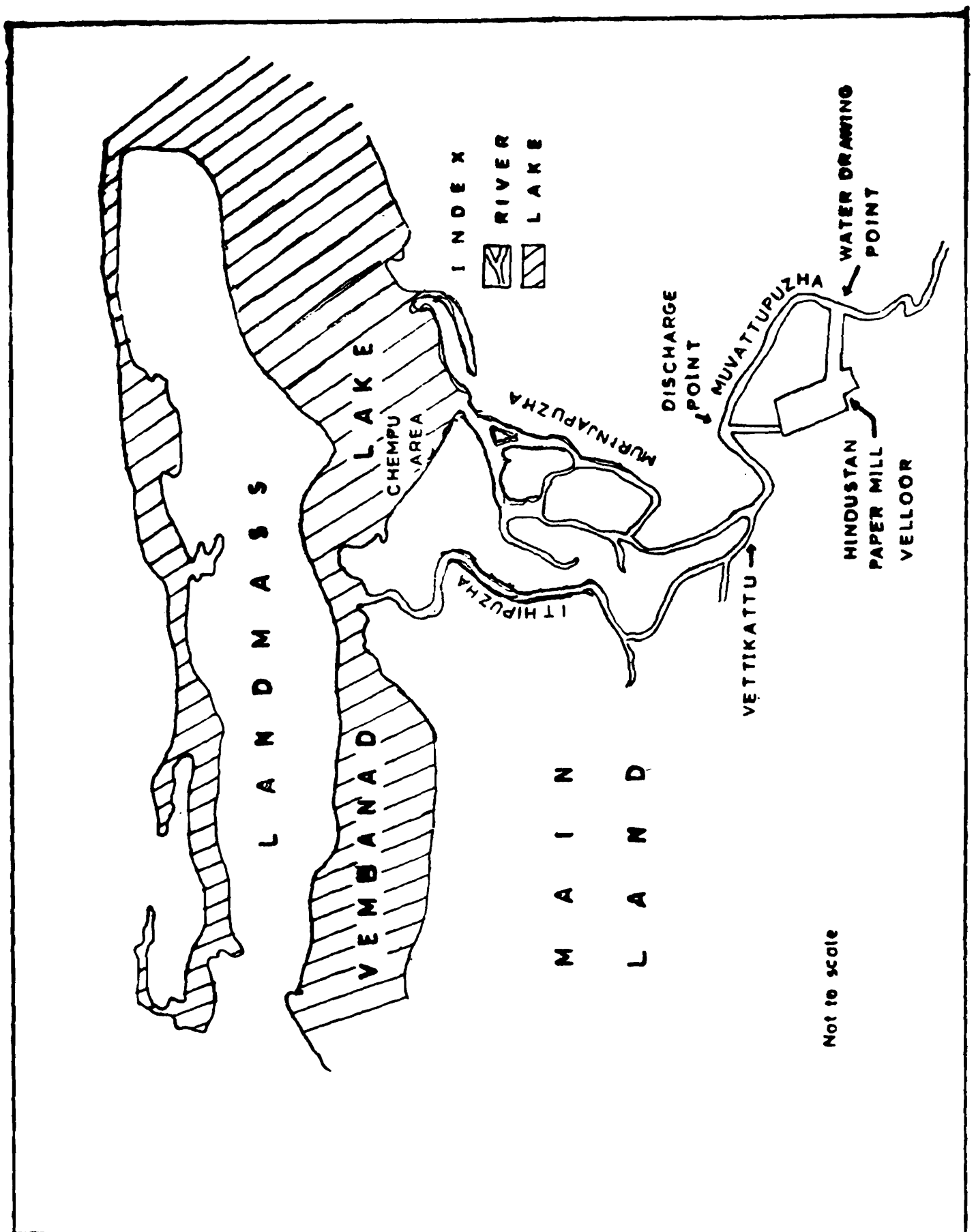


Fig. 1. Study area showing the Muvattupuzha River and its branches, Vembanad Lake, site of Hindustan Paper Mill etc.

TABLE - I

Showing salinity (‰) at 3 stations namely Chempu area of Vembanad Lake and at a point 2 kms. upstream from the estuaries of Murinjapuzha and Ithipuzha in summer (January - June) during the years 1980 to 1983.

<i>Year</i>	<i>Month</i>	<i>Chempu</i>	<i>Murinjapuzha</i>	<i>Ithipuzha</i>
1980	January	17.2	9.0	8.0
	February	30.0	12.0	8.0
	March	26.0	8.5	8.1
	April	26.0	8.0	7.5
	May	20.0	7.5	7.0
	June	18.0	6.5	6.0
1981	January	17.0	2.0	1.2
	February	24.0	6.7	6.3
	March	24.0	8.4	8.0
	April	23.0	7.6	7.1
	May	22.0	7.2	6.9
	June	18.6	6.5	6.2
1982	January	18.5	6.0	5.5
	February	26.0	7.5	7.0
	March	25.3	6.9	6.3
	April	24.4	7.2	7.0
	May	22.0	6.4	6.1
	June	18.0	6.0	5.2
1983	January	20.6	7.0	6.0
	February	25.6	12.0	8.0
	March	30.0	7.2	6.5
	April	24.0	8.5	8.2
	May	20.0	5.3	5.0
	June	17.4	4.4	4.0
Average salinity in summer months (January - June) during the years from 1980 to 1983		22.4‰	6.8‰	6.5‰

TABLE - II

Showing the landings of Clams from 4 boats, selected at random, at Chempu once in two months during July 1980 to May 1983

Year	Month	Boat 1		Boat 2		Boat 3		Boat 4	
		Quantity (Kg.)	size range (mm)	Quantity (Kg.)	size range (mm)	Quantity (Kg.)	size range (mm)	Quantity (Kg.)	size range (mm)
1980	July	30	17-40	31	15-36	30	20-41	32	17-41
	September	27	13-39	34	20-43	31	17-39	34	18-43
	November	35	18-46	27	19-52	37	15-47	26	16-42
1981	January	32	12-35	30	11-37	31	9-37	24	14-36
	March	18	13-27	20	14-32	22	15-31	20	16-33
	May	17	12-30	16	15-34	18	16-38	19	15-35
	July	26	16-41	28	20-37	27	18-40	26	19-39
	September	35	22-44	34	21-47	35	23-51	36	20-41
	November	41	24-45	40	20-48	41	12-39	44	21-48
1982	January	34	9-36	32	12-37	29	10-35	30	12-38
	March	22	8-28	21	9-30	20	13-32	21	9-30
	May	19	13-32	18	10-32	17	12-36	19	11-34
	July	29	17-37	27	16-34	28	15-35	27	14-37
	September	36	23-44	38	21-40	36	20-43	38	19-40
	November	46	14-48	43	10-50	47	9-47	48	11-47
1983	January	36	13-37	34	15-45	33	16-42	33	15-43
	March	23	10-34	25	14-29	24	14-28	25	14-29
	May	22	13-35	23	15-31	23	15-34	27	10-28

On the basis of data collected once in each month during the summer seasons from 1980 and 1983 salinity and chloride content beyond Vettikattu, i.e. beyond a stretch of 8 kms from the estuary upstream, is nil. During this period salinity content in the Chempu part of the lake was much less than that of the main body of the lake. It never went beyond 30.0‰ (February 1980 and March 1983) and was as low as 17.0‰ in January 1981 with an average of 22.40‰ for the entire summer periods since 1980.

In July 1983, after the onset of monsoon, it was as low as 1.40‰ in the area where the river enters the lake with the salinity going upto 18.1‰ as one reaches the centre of the Chempu part of the lake which covers approximately an area of 50 sq. kms.

At a point 2 kms upstream from the estuaries in Murinjapuzha salinity during this

period was in the range of 12.0‰ (February 1980 and April 1983) and 2.0‰ (January 1981) and in Ithipuzha in the range of 8.20‰ (April 1983) and 1.2‰ (January 1981).

c. *Impact of reduction in the salinity content on the population of Villorita cyprinoides var. cochinensis* (Hanley)

Villorita cyprinoides var. cochinensis (Hanley), popularly known as the black clam, occurs abundantly in the major estuaries, backwaters and lagoons of Kerala. The shell of the clam is used for the manufacture of cement and lime and the flesh provides a cheap source of protein food for a large section of people inhabiting the coastal areas of the state. This species grows to a size of 50 mm or even beyond.

Studies by Blum (1922) on *Teredo navalis* Hill and Kofoid (1927) on *Limnoria* sp. and Nagabhushanam (1955) on *Martesia demissus* revealed that around 6.0‰ is the lower lethal salinity limit of most of these bivalves. But *cochinensis* is capable of tolerating wide fluctuations in salinity. Studies on the salinity tolerance of *cochinensis* by Nair and Shynamma (1975) showed that larger clams (size : 40 - 50 mm) can tolerate salinity in the range of 4.73‰ and 27.11‰. In the smaller clams (size : 15-20 mm) the tolerance range is between 0.87‰ and 29.85‰. Some of the smaller ones survived even upto 5 days in sea water (salinity : 33.01‰) and upto 5 days in freshwater (salinity : 0‰).

The reduction in the salinity content of Chempu and surrounding areas of vembanad lake, which keeps the range within the tolerance limits of *cochinensis*, enables the specimens to thrive in the estuarine waters even in summer months and flourish later when the conditions become favourable after the onset of monsoon. In the past probably they could not survive in the Chempu part of the lake during summer months as salinity in this stretch also went up beyond their tolerance limits. Questioning many fishermen and long time inhabitants of the area revealed that no commercial collection of these mussels was prevalent in this area before 1976 as according to them the specimens used to die out in summer, their population was never high and hence their collection not economically viable. Since 1976 their population has been steadily going up. Present studies showed that now a days, on an average, about 200 country boats, each employing 2 to 3 persons, are engaged daily in collecting the specimens from this area of the lake. On an average each boat collects specimens worth (commercial value of the empty shells and edible flesh of the mussels) Rs. 150 (Table II). On a rough estimate, in recent times specimens of mussels worth nearly 10 million rupees are collected from the waters of this area annually.

ADDITIONAL OBSERVATIONS

Influence of the anticipated changes on the future population of Villorita cyprinoides var. cochinensis.

The completion of the third stage of the Idukki project, leading to the supplementation of the tailrace waters, is expected to further enhance conditions favourable for the growth of these mussels in the estuarian waters of Muvattupuzha river. But the Malankara hydel project, expected to be commissioned in 1988, is scheduled to divert much water from the Muvattupuzha river to the extent that the flow in the river is expected to be reduced by 60%.

The Hindustan Paper Mills at Vellore, which was partially commissioned in 1983, has started discharging effluents into the Muvattupuzha river at a point about 20 kms from the estuary. The diversion of water through the commissioning of the Malankara project and the initiation of full production, with the resultant discharge of more effluents, in the paper mill may lead to a situation when it will not be possible to dilute the toxic effluents in the river to the desirable limits. The cumulative impacts of all these changes anticipated on the population of mussels in the estuarian waters is yet to be seen. Apart from negating the present favourable impacts the changes expected in the near future may even adversely affect their population.

SUMMARY

Studies on the ecological impacts of Idukki hydro-electric project on the population of *Villorita cyprinoides* var. *cochinensis* (Hanley) inhabiting the estuarian waters of Muvattupuzha river is discussed. The reduction in the salinity content of the river is found to favourably affect its population.

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I am grateful to the Department of Environment, Government of India, and especially to its former Director the late Dr. N. L. Ramnathan for making available the funds for carrying out the studies.

REFERENCES

- Blum, H. F. 1922. On the effect of low salinity on *T. navalis*. *Univ. Calif. Publs. Zool.*, 22 : 349 - 368.
- Hill, C. L. & Kofoid, C. A. 1927. Marine borers and their relation to marine construction on Pacific coast. *Final Rep. San. Fran. Bay Piling Commt.*, pp. 1- 357.

- Nagabhushanam, R. 1955. Tolerance of marine wood borer *Martesia striata* (Linn.) to water of low salinity. *J. zool. Soc. India*, 7 : 83 - 86.
- Nair, G. S. & Shynamma, C. S. 1975. Studies on the salinity tolerance of *Villorita cyprinoides* var. *cochinensis* (Hanley). *Bull. Dept. Mar. Sci. Univ. Cochin*, 7(3) : 537 - 542.

**ABNORMAL SEGMENTATION IN THE ANTENNA OF AN
APTEROUS MALE LAC INSECT, *KERRIA LACCA* (KERR)
(HOMOPTERA : TACHARDIIDAE)**

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INTRODUCTION

Unlike female, the male insect of the Indian lac coccid, *Kerria lacca* (Kerr), is a typical insect in structure and shape. No morphological abnormality has so far been reported in it, except in one individual which was devoid of the penial stylus (Chauhan, 1970). In the present paper, a case of abnormal segmentation in an antenna is reported in an apterous male lac insect.

The male lac insect has a pair of slender, pale-yellow, plumose type antennae, composed of 9-10 segments. According to Green (1922) the antennae are normally ten jointed, but he stated that Dr. Imms observed in the apterous form that the number is frequently reduced to nine. In the normal 10-jointed antenna, the terminal joint tapers to a point and bears one or more knobbed hairs at its apex. Misra (1931), who carried out detailed morphological studies on all stages of the Indian lac insect, has described the antennae in male composed of 9 or 10 segments; the basal one stout, almost globular and nearly as long as broad; the second more globular than the first, while the third narrower than the second but much more slender; and the terminal one somewhat tapering. Each component segment is irregularly indented and these indentations mark the attachment of the setae. The author, during his studies on the systematics of lac insects (Varshney, 1977), has examined a large number of specimens both male and female. In one case, an apterous male insect was found to have one antenna of 8-segments only. This being a rare and gross abnormality, is recorded here.

MATERIAL

The material examined consisted of one slide, on which 7 apterous male lac insects (entire or teased) under one cover-slip, and two aedeagus under another cover-slip, were permanently mounted. Among these 7 specimens, only one had an abnormal antenna. The label data reads, "Apterous males (7); Ber Lac Kartiki crop; Pennis (2); 5.12.27. P. S. Negi" The slide was examined at the Indian Lac Research Institute, Namkum, Ranchi.

OBSERVATIONS

The right side antenna of the male insect under report, is abnormally segmented (Fig. 1). This is slightly smaller than the left antenna, which is normal in length and

segmentation (*vide* Table I). The abnormality has occurred due to the unusual length of the 6th segment of right antenna, with the result of a loss of one segment in it. This 6th segment is comparatively broader at its distal end and is bigger in length than any other individual segment of both antennae. On the other hand, this 6th segment of right antenna is smaller than the total length of 6th and 7th segments of left antenna, to which it is supposed to symmetrically balance. The other segments of the abnormal right antenna including the terminal one, however, do not show any other marked difference from their left counterpart. The antenna of the left side in this specimen is normal in structure, with usual 9 segments as commonly met with in the apterous forms.

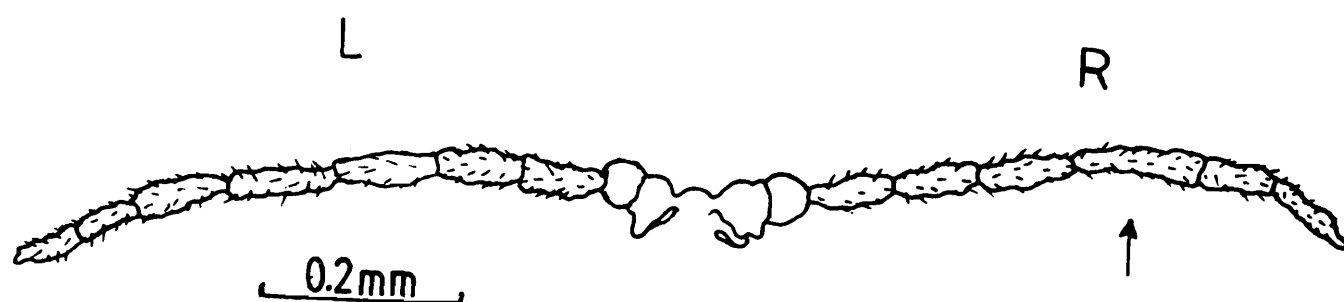


Fig. 1. Both antennae of an apterous male lac insect, drawn at table level with camera lucida, X 100.

L = left antenna; R = right antenna; arrow showing the abnormal 6th segment.

The measurements of both antennae are given in Table I.

TABLE - I

Measurements of the abnormal (right) and normal (left) antennae of an apterous male lac insect, *Kerria lacca* (Kerr)

1	Total length of left antenna	—	0.6 mm
2.	Total length of right antenna	—	0.54 mm
3.	Length of 6th segment of right antenna	—	0.13 mm
4.	Length of 6th segment of left antenna	—	0.1 mm
5.	Total length of 6th and 7th segments of left antenna	—	0.2 mm

DISCUSSION

Teratological observations, like the one made here, are interesting and reported frequently in insects. From India, the reports of antennal abnormality, however, are a few only. Ananthakrishnan (1948) reported abnormality in the antennae of *Rhipiphorothrips cruentatus* (Order Thysanoptera). Puttarudriah & Channabasavanna

(1952) found variations in the number of joints (segments) of antennae in individuals of *Bracon* spp. (Order Hymenoptera). Menon & Sarup (1958) recorded a freak in the antenna of a *Trogoderma granarium* (Order Coleoptera). Joshi (1961) has noted the asymmetrical position of pale segments in the antennae of *Paralabis dohrni* and *Euborellia annulipes* (Order Dermaptera). The present report of antennal abnormality in a male lac insect seems to be the first one in Order Homoptera from India.

Antennal abnormalities, although interesting, have little value to the taxonomists. Despite the suggestion of Hollinger (1917) for use of the antennal segmentation as a character in the coccid taxonomy, we find that the present day taxonomy of the coccids, to which the lac insect belongs, is largely based and practiced on the female morphology alone, which have either none or vestigial antennae only. Hence, the observation of a 8-segmented antenna in an apterous male lac insect, *K. lacca*, will have no effect on the taxonomy of the group as understood at present.

The frequency of this abnormality also appears to be extremely low in nature. It may have been caused due to some physiological disturbance or tissue deformation in the metamorphosis. The fact that the number of segments in antennae of male lac insect are 9-10 remains valid. The range of segmentation need not be extended to 8-10 because of the unique record of an 8-segmented antenna reported here, since it is an exceptional case.

SUMMARY

The male lac insect has a pair of 10-segmented antennae, which are reduced to 9-segments frequently in the apterous forms. The present paper reports a case of an apterous male insect of which the right antenna had 8-segments only, alongwith 9-segments in the left antenna. Its measurements and illustration are given. Antennal abnormalities in other insects are discussed.

ACKNOWLEDGEMENTS

The author is grateful to the Director, Indian Lac Research Institute, Namkum, Ranchi, for the study of material. He also thanks the Director, Zoological Survey of India, Calcutta, for encouragement.

REFERENCES

- Ananthkrishnan, T. N. 1948. An anomalous antenna in *Rhipiphorothrips cruentatus* Hood from Tambaram, South India. *J. Bombay nat. Hist. Soc.*, 47(2) : 393.
- Chauhan, N. S. 1970. Occurrence of an abnormal male in the lac insect, *Kerria lacca* (Kerr). *Indian J. Ent.*, 32(1) : 103.
- Green, E. E. 1922. Subfamily Tachardiinae. In : '*The Coccidae of Ceylon*' Part 5. Dulau & Co., London : 405-406, 410.

- Hollinger, A. H. 1917. Taxonomic value of antennal segments of certain Coccidae. *Ann. ent. Soc. Am.*, **10** : 264-271.
- Joshi, P. V. 1961. Asymmetrical position of pale antennal segments of *Paralabis dohrni* (Kirby) (Labiduridae, Dermaptera). *J. Bombay nat. Hist. Soc.*, **58** : 821-823.
- Menon, M. G. R. & Sarup, P. 1958. A unique instance of an antennal freak in *Trogoderma granarium* Everts (Coleoptera : Dermestidae). *Indian J. Ent.*, **20** : 67-68.
- Misra, A. B. 1931. On the internal anatomy of male lac insect, *Laccifer lacca* Kerr (Homoptera, Coccidae). *Proc. Zool. Soc. Lond.*, 1931 : 1361.
- Puttarudriah, M. & Channabasavanna, G. P. 1952. Variation in the number of joints of the two antennae in individuals of *Bracon* spp. (Braconidae, Hymenoptera). *Nature*, **169** : 378.
- Varshney, R. K. 1977. Taxonomic studies on lac insects of India (Homoptera : Tachardiidae). *Oriental Ins. Suppl.*, **5** : 1-97.

**STUDIES IN SEPTATE GREGARINES (APICOMPLEXA :
SPOROZOEAE) FROM ORTHOPTERAN INSECTS OF WEST
BENGAL: SEVEN NEW SPECIES OF *DIDYMOPHYES*,
HIRMOCYSTIS AND *QUADRUSPINOSPORA***

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INTRODUCTION

The orthopteran insects in association with other arthropods cause immense damage to the field crops. Frequently these orthopterans are parasitized by eugregarines in their hepatic caeca and midgut. Occasionally the protozoans produce heavy destruction to the host gut epithelium and, as such, much attention is being paid on these parasites as possible agents for biocontrol of harmful insects (Lipa, 1967; Haldar and Chakraborty, 1975; Ghose, Sengupta and Haldar, 1986).

The present communication deals with the structure and life history of seven new species of septate gregarines (Apicomplexa : Sporozoea) infecting orthopteran insects. The information might help future investigators in using these protozoans for the biological control of insect pests.

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

MATERIAL AND METHODS

The different insect hosts were collected from various places in West Bengal and were brought alive to the laboratory for microscopic examination of protozoan parasites. The insects were decapitated, their guts and hepatic caeca were dissected out and gently pressed for the parasites to come out from their lumen. Thin smear preparations were made on glass slides and fixed in Schaudinn's fluid and subsequently stained with Heidenhain's haematoxylin. For observing the developmental stages of parasites, some heavily infected hosts' gut were fixed in Bouin's fluid, 5.0 μm thick sections were cut and stained as above. For sporulation, the cysts were cultured in moist chambers (Sprague, 1941).

OBSERVATIONS

The hosts examined and found parasitized by the eugregarines along with the information on the place of collection, number of hosts examined, number of hosts parasitized and percentage of infection are given in TABLE I.

Genus *Didymophyes* Stein, 1848

Pointed papilla-like epimerite; spherical cyst; dehiscence by simple rupture; ellipsoidal spores and satellite without septum.

TABLE - I

Showing names of the hosts, names of the parasites, places of collection, number of hosts examined, number of hosts parasitized and percentage of infection of seven new species of gregarines from orthopteran insects

Sl. Nos.	Name of hosts	Name of the parasites	Place of collection	No. of hosts examined	No. of hosts parasitized	% of infection
1	<i>Tridactylus</i> sp.	<i>Didymophyes tridactyli</i> n.sp.	Kalyani, W.B. India	80	35	44.0
2.	<i>Gesonula punctiformis</i>	<i>Hirmocystis murtii</i> n.sp.	Kalyani, w.B. India	150	60	40.0
3.	<i>Phleoba antennata</i>	<i>Hirmocystis antennatae</i> n. sp.	Kalyani, W.B. India	122	36	30.0
4.	<i>Oxya hyla</i>	<i>Quadruspinospora platyepimerita</i> n.sp.	Naihati, W.B. India	70	45	64.2
5.	<i>Phleoba antennata</i>	<i>Quadruspinospora adigitalis</i> n.sp.	Kalyani, W.B. India	65	16	24.6
6.	<i>Gesonula punctiformis</i>	<i>Quadruspinospora gesonulae</i> n.sp.	Kalyani, W.B. India	50	35	70.0
7	<i>Oxya</i> sp.	<i>Quadruspinospora jalpaiguriensis</i> n.sp.	Jalpaiguri, W.B., India	73	48	65.7

Didymophyes tridactyli n.sp.
(Figs. 1 - 6)

Development : Extracellular.

Trophozoite : Vase-shaped body with small semilunar epimerite. Protomerite somewhat rectangular, always broader than long. Deutomerite is more or less spherical in shape containing a spherical or ovoidal nucleus which may be situated at any place. Nucleus possesses a distinct nuclear membrane and a large endosome. Cytoplasm of deutomerite is more granulated than other parts of the body.

Sporadin and association : Sporadin is cylindro-conical with hemispherical protomerite. A straight septum divides the protomerite from the deutomerite that is rectangular in shape and always broader than long. The spherical nucleus is situated at the posterior portion of the deutomerite. Association is caudo-frontal. The deutomerite

of the primite has a broad posterior extremity. The satellite characteristically lacks a protomerite and its deutomerite has an ovoidal shape. A thick band of cytoplasm connects the primite with satellite.

Gametocyst and spore : Freshly collected gametocyst is opaque white in colour with prominent ectocyst. The ectocyst measures 33.3 μm in diameter. The gametocytes are equal in size. The cysts are more or less spherical in shape and measure 116.6 μm to 233.2 μm x 133.3 μm to 283.2 μm . The partition between the gametocytes disappear after 24 hours of development. The cyst dehisces by simple rupture after 48 hours. The spores are released in a mass through a pore that appears to one corner of the cyst.

Double walled, ovoidal spores are covered by a rectangular hyaline coat. The spores measure 5.0 μm x 3.3 μm and the thickness of the hyaline coat is 1.7 μm . Formation of eight sporozoites is completed after 24 hours of cyst rupture.

Measurements (in microns) :

Trophozoite

TL = 42.5 - 46.8 (44.7);

LE = 4.3 - 12.8 (8.6); WE = 12.8 - 14.9 (13.9);

LP = 6.4 - 17.0 (11.7); WP = 17.0 - 25.5 (21.3);

LD = 17.0 - 31.9 (24.5); WD = 19.1 - 29.8 (24.5);

Sporadin

TL = 34.0 - 157.0 (81.7);

LP = 8.5 - 85.0 (24.2); WP = 8.5 - 106.3 (35.9);

LD = 23.4 - 125.4 (57.5); WD = 17.0 - 114.8 (50.1);

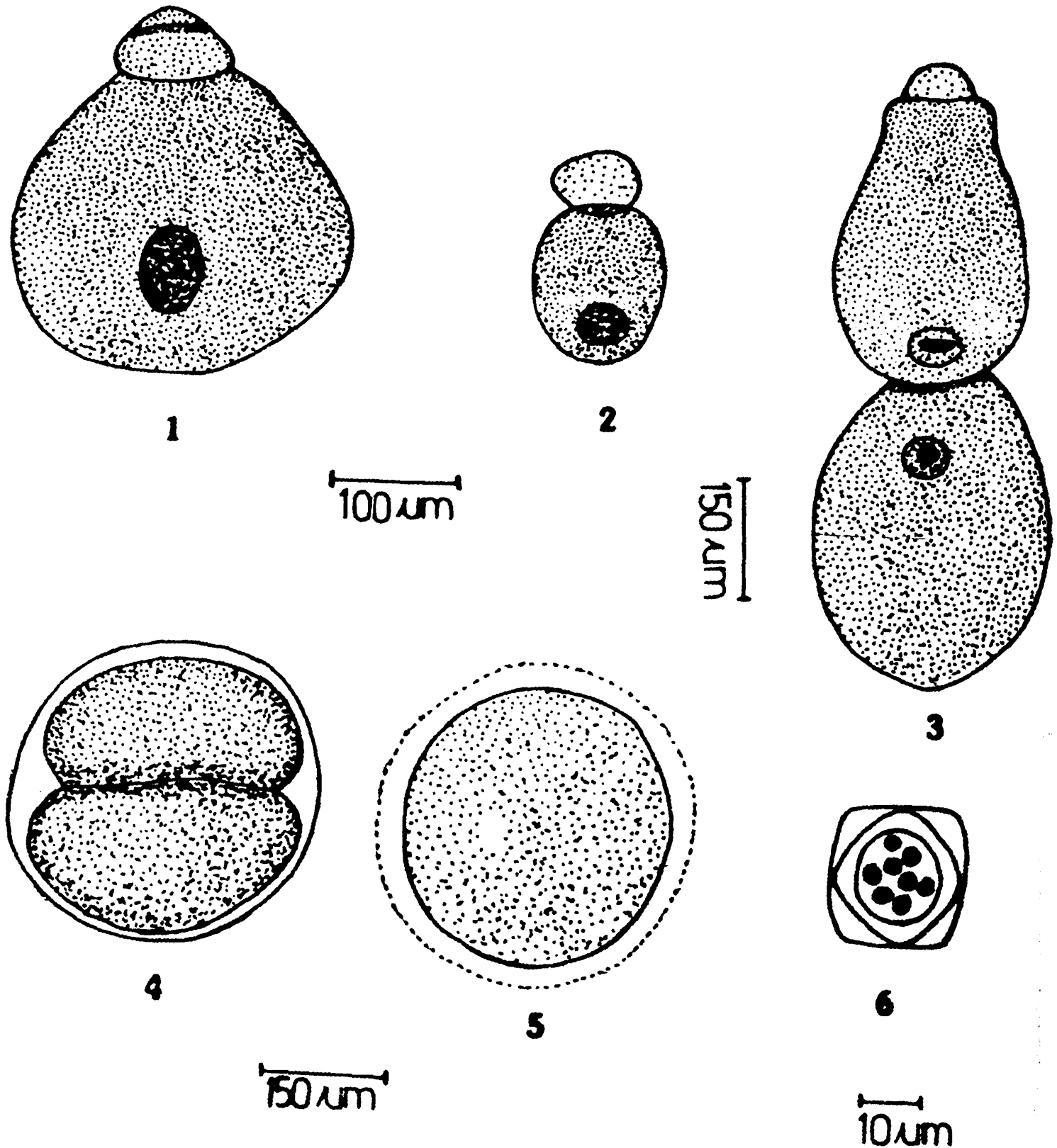
LN = 4.3 - 46.8 (14.2); WN = 4.3 - 46.8 (14.2);

LP : TL = 1 : 1.6 - 15.7 (5.8);

WP : WD = 1 : 0.5 - 2.8 (1.7).

Material : Holotype; Coll. No. X 15/4 S. C. Datta Coll. dated 8.9.1979. Type locality; Bidhan Chandra Krishi Viswa Vidyalaya, W B. Paratype; Coll. No. X 15/1 and others.

Affinities : In having sporadins in association and satellite without septum, the gregarine is at once placed in the genus *Didymophyes* Stein, 1848 under the family Didymophyidae Leger, 1892. It resembles *D. paradoxa* Stein, 1848 in ratios of LP : TL but differs from the latter in the ratios of WP and WD. It has an affinity with *D. leuckarti* Marshall, 1893 in ratios of WP and WD but their other features are different. The parasite under investigation has the following peculiarities of its own vase-shaped trophozoite and ovoidal spore surrounded by hyaline rectangular coat. In view of the above-mentioned features the present gregarine is given a new specific status and the name *Didymophyes tridactyli* n.sp. is given.



Figs. 1-6. Camera lucida drawings of different stages of life cycle of *Didymophyes tridactyli* n.sp. 1. Fully grown trophozoite. 2. Sporadin. 3. Syzygy. 4. Gametocyst. 5. Gametocyst prior to dehiscence. 6. Spore with rectangular coat.

Genus *Hirmocystis* Labbé, 1899

Sporadins in association of 2 to 12; epimerite conical or cylindrical knob, cysts spherical and ovoidal spores.

Hirmocystis murtii n. sp.
(Figs. 7 - 13)

Development : Intracellular.

Trophozoite : Elongated; knob-like epimerite, conical protomerite and cylindroconical deutomerite with rounded posterior extremity. An ovoidal nucleus is present at the centre of the deutomerite.

Sporadin and association : Elongated with dome-shaped protomerite and cylindrical deutomerite. The pellicle is thick in the anterior free margin of the protomerite. The nucleus is rounded. Cytoplasm is densely granulated in protomerite while in the deutomerite dense granules are scattered irregularly. Section through the nuclear region shows prominent dumbbell-shaped chromatin bodies.

Syzygy caudo-frontal showing larger satellite than primate. Epicyteal striations are pronounced and the cytoplasm is densely granulated. The pellicle is thick in both primate and satellite.

Gametocyst and spore : Orange-coloured with thick cyst wall. Spherical in shape measuring $340.0 \mu\text{m} \times 360.0 \mu\text{m}$ with transparent ectocyst. The ectocyst measures $16.0 \mu\text{m}$ in thickness. The gametocysts dehisce by simple rupture after 96 hours of development.

Spores are ovoidal, double-walled measuring $5.8 \mu\text{m} \times 4.2 \mu\text{m}$. On the fifth day of development eight sporozoites are formed in each spore and arranged linearly.

Measurements (in microns) :

Trophozoite

TL = 114.8;

IE = 10.6; WE = 8.5;

LP = 29.8; WP = 38.3;

LD = 74.4; WD = 55.3;

LN = 12.8; WN = 12.8;

Sporadin

TL = 93.5 - 383.2 (202.7);

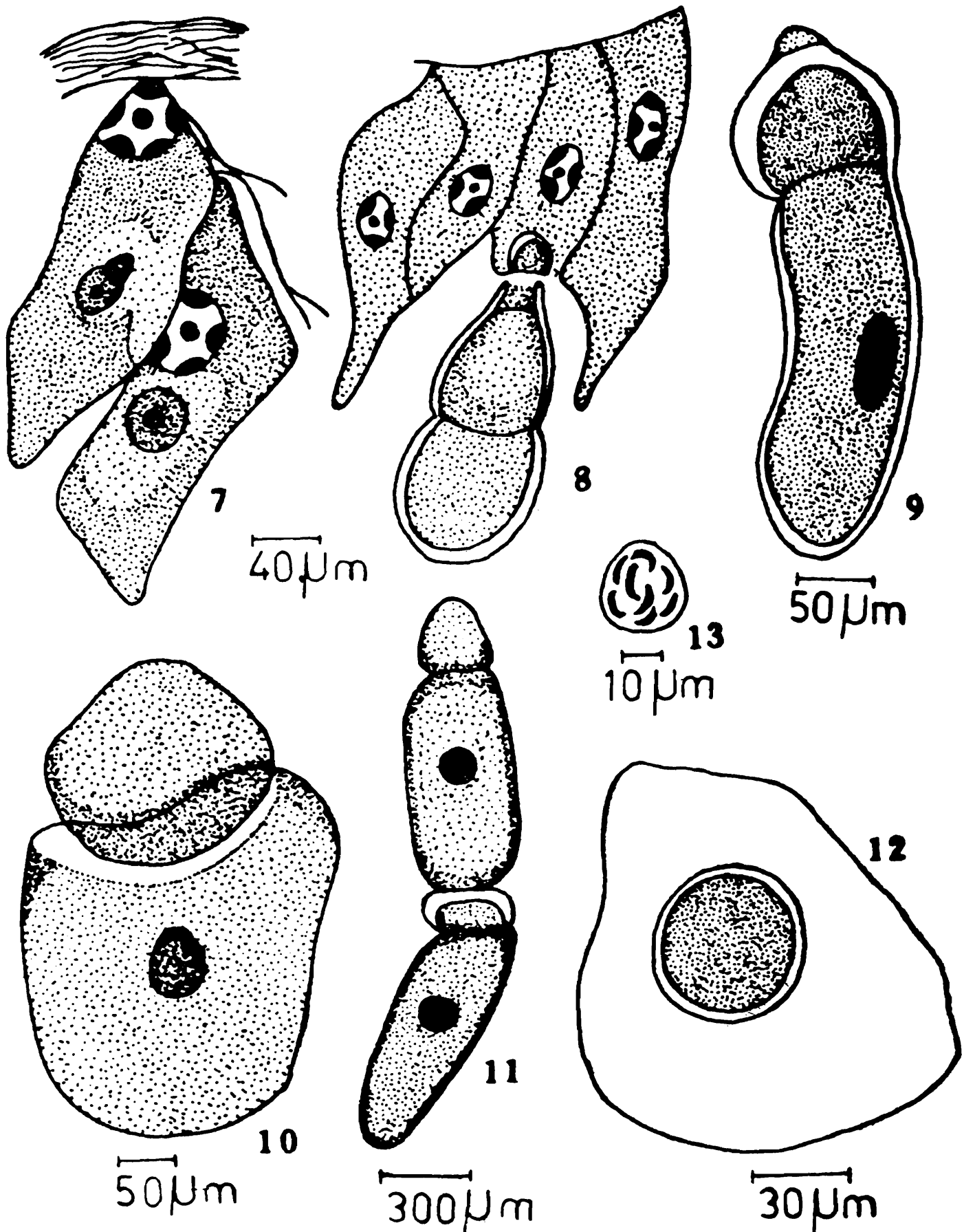
LP = 16.7 - 83.3 (46.9); WP = 33.3 - 116.6 (69.4);

LD = 63.8 - 299.9 (155.8); WD = 34.0 - 166.6 (109.4);

LN = 8.3 - 33.3 (19.7); WN = 8.5 - 33.3 (19.0);

LP : TL = 1 : 3.1 - 10.5 (4.9);

WP : WD = 1 : 1.0 - 1.5 (1.7).



Figs. 7-13. Camera lucida drawings of different stages of life cycle of *Hirmocystis murtii* n.sp. 7. Intracellular stages of development of the parasite. 8. Trophozoite attached to the gut wall. 9. Trophozoite. 10. Sporadin. 11. Sporadin in association. 12. Gametocyst with ectocyst. 13. Ovoidal spore with eight sporozoites.

Material : Holotype; Coll. No. B14/5 S. C. Datta Coll. dated 2.9.1979. Type locality; paddy fields of Bidhan Chandra Krishi Viswavidhalaya, Kalyani, W. B. Paratype; Coll. No. B10 and others.

Affinities : The parasite possesses close resemblances with *H. gryllotalpae* Labbé, 1899 in the shape of the cyst and spore but the two differ widely in other characters. The present form also shows similarities with *H. venticossa* Wellmer, 1911 and *H. pitcharis* Haldar and Chakraborty, 1979 in WP : WD value but the shape of the epimerite, general structure of the body, LP : TL and the presence of ectocyst in the gregarine separate in markedly from the other described and related species of *Hirmocystis* Labbé. The features justify the erection of a new species for the parasites for which the name *Hirmocystis murtii* n.sp. is proposed after the eminent gregarinologist, Prof. C. C. N. Murti.

***Hirmocystis antennatae* n. sp.**
(Figs. 14 - 19)

Development : Intracellular.

Trophozoite : Elongated with tongue-shaped epimerite, subspherical protomerite and elongated deutomerite. The protomerite is always broader than long. The pellicle covering the protomerite and deutomerite is thick (4.3 μm). Epicyteal striations are not clearly observable. The endoplasm is orange-coloured in living condition.

Sporadin and association : Cylindrical with oval protomerite and dome-shaped deutomerite. The pellicle is thick in both proto and deutomerite. Nucleus is oval in shape and the cytoplasm is finely granulated.

Association is caudo-frontal; protomerite of the primite is hemispherical whereas in the satellite it is flat. The primite is always smaller than the satellite.

Gametocyst and spore : Orange-coloured, spherical cyst measuring 420 μm to 500 μm x 460 μm to 500 μm . An ectocyst of 340 μm x 620 μm is present surrounding the gametocyst. After 56 hours of development the cyst dehisces by simple rupture. At the time of dehiscence the spores are liberate by simple rupture at one point of the cyst wall and come out with great force in a mass giving the appearance of a long duct.

Ovoidal spores measure 5.8 μm x 4.2 μm . Eight sporozoites are arranged irregularly within each spore. Formation of sporozoites is completed at 72 hours inside the moist chamber.

Measurements (in microns) :

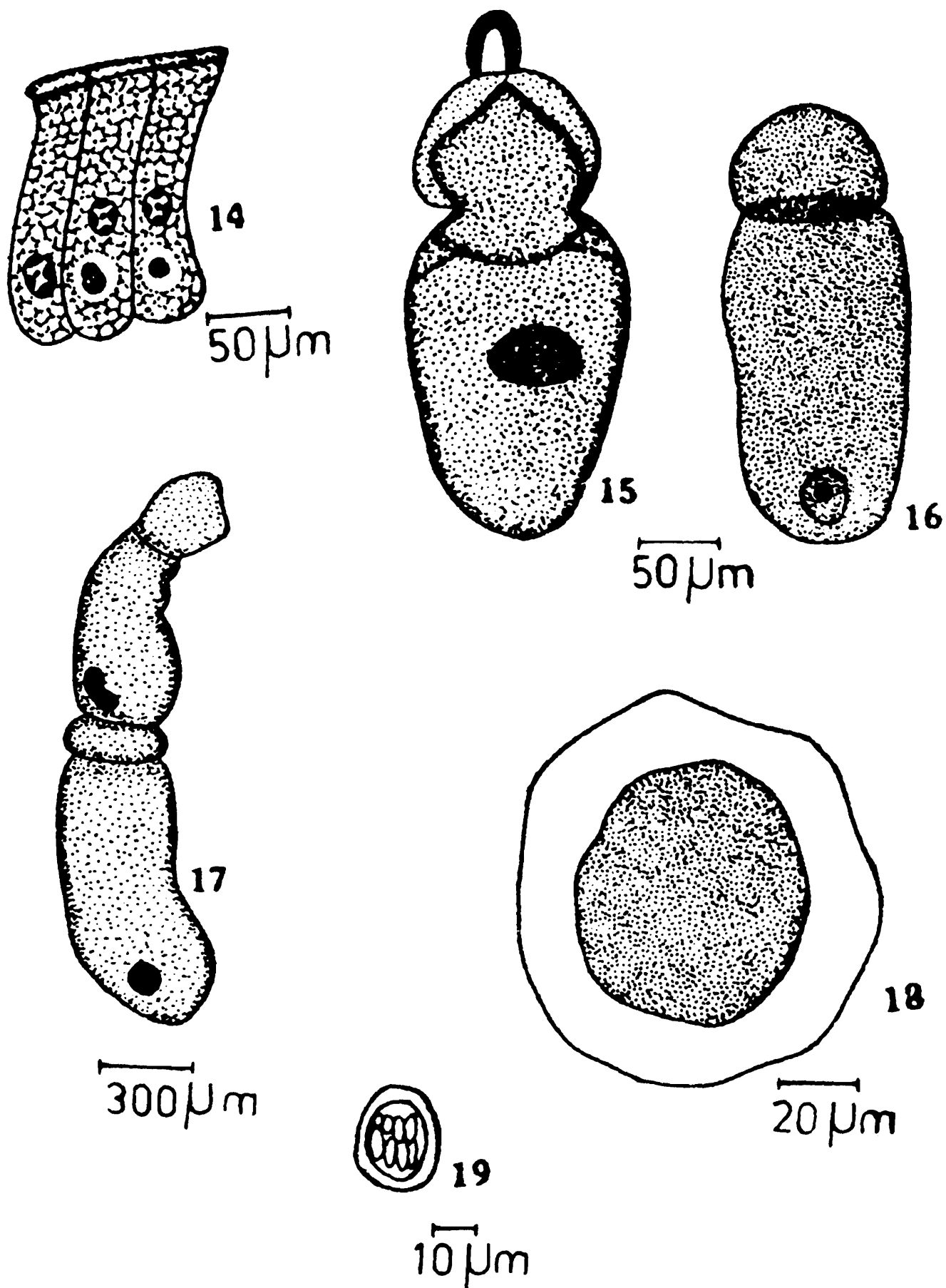
Trophozoite

TL = 166.6

LE = 8.3; WE = 16.7

LP = 33.3; WP = 50.0;

LD = 125.0; WD = 41.7;



Figs. 14-19. Camera lucida drawings of different stages of life cycle of *Hirmocystis antennatae* n.sp. 14. Section through hepatic caeca of the host showing intracellular stages of development. 15. Trophozoite. 16. Sporadin. 17. Syzygy. 18. Gametocyst. 19. Ovoidal spore with eight sporozoites.

Sporadin

TL = 150.0 - 516.5 (317.0);

LP = 33.3 - 100.0 (60.3); WP = 33.3 - 183.3 (100.4);

LD = 100.0 - 466.5 (256.3); WD = 33.2 - 216.6 (106.7);

LN = 16.7 - 41.7 (21.1); WN = 16.7 - 33.3 (20.3);

LP : TL = 1 : 2.2 - 10.3 (6.07);

WP : WD = 1 : 0.6 - 1.4 (1.26).

Material : Holotype; Coll. No. Ph/1 S. C. Datta Coll. dated 1.7.1979. Type locality; Kalyani University Campus, W. B. Paratype; Coll. No. Ph/2 and others.

Affinities : The gregarine under report has exceedingly thick pellicle and during association its satellite is always larger than primitive. Early gametocysts are covered by an ectocyst, which later disappear. The dehiscence of the cyst in the present form is very characteristic as elaborated earlier. Its early development is intracellular. The ratios between length of protomerite and total length (1 : 6.07) as well as width of protomerite and width of deutomerite (1 : 1.26) are also specific in this particular gregarine. The combination of such characters are sufficient for the erection of a new species for this hirmocystid for which the name *Hirmocystis antennatae* n.sp. is proposed.

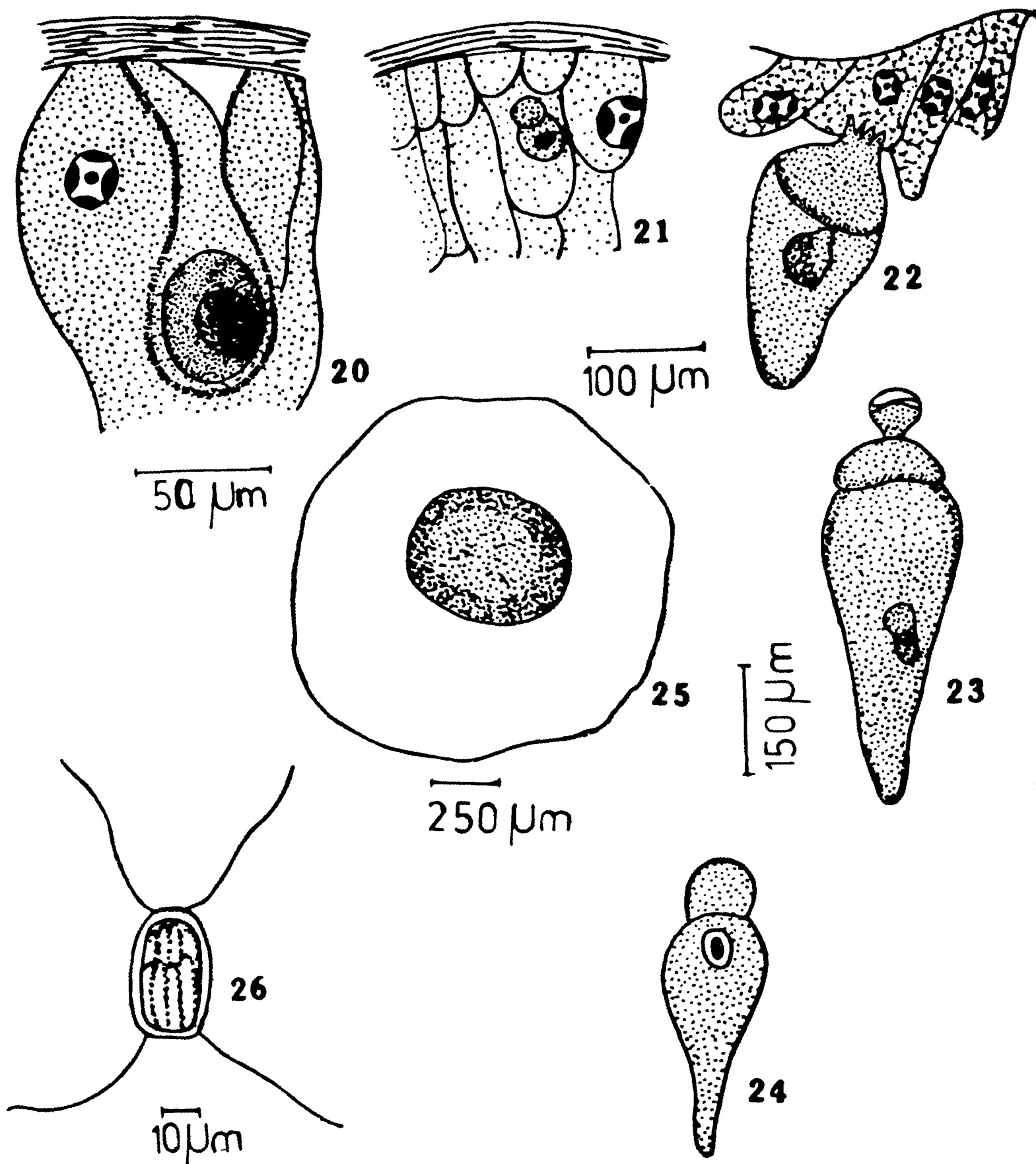
Genus *Quadruspinospora* Sarkar and Chakravarty, 1969,
emend. Haldar and Chakraborty, 1975.

Solitary, elongated trophozoite with subspherical epimerite having a variable number of stumpy digitiform processes, hemispherical protomerite and granular deutomerite, spherical gametocysts dehiscing by simple rupture, oval spores with a pair of long spines, development intracellular.

Quadruspinospora platyepimerita n.sp.
(Figs. 20 - 26)

Development : Intracellular.

Trophozoite : Elongated with the usual three segments. In the attached trophozoite epimerite possesses numerous short, stumpy digitiform processes. In the lumen-dwelling form epimerite is subspherical or knob like, broad at the free end and narrow at the base of attachment with the protomerite. The free end is devoid of any digitiform processes, their place being taken up by a characteristic flat disc-like structure. The protomerite is hemispherical in outline and is always broader than long. Elongated and cylindroconical deutomerite contains fine dense granules. The nucleus is oval in shape with clear nuclear membrane. The nuclear material is concentrated at the centre of the nucleoplasm.



Figs. 20-26. Camera lucida drawings of different stages of life cycle of *Quadruspinospora platyepimerita* n.sp. 20, 21. Intracellular development of the parasite. 22. A fully grown trophozoite attached with the epithelium of the hepatic caeca. 23. Trophozoite. 24. Sporadin. 25. A gametocyst with ectocyst. 26. Spore with spines and eight sporozoites.

Sporadin : Characteristically solitary with hemispherical protomerite. The deutomerite is conical in shape and broadest immediately behind the protomerite deutomerite septum. The mature sporadins associate sidewise in pairs, move together and ultimately become enclosed within a cyst wall.

Gametocyst and spore : Opaque white in color, almost spherical measuring 420.0 μm x 400.0 μm . Each is enclosed by a prominent ectocyst, measuring 240.0 μm x 320.0 μm . The gametocyst dehisces by simple rupture at about 96 hours.

The spores are oval bodies measuring 8.3 μm x 5.0 μm . The length of the spines varies from 24.9 μm to 33.2 μm . Formation of sporozoites is completed at 24 hours of dehiscence. The eight sporozoites are arranged in a linear fashion inside the spore.

Measurements (in microns) :

Trophozoite

TL = 441.5;

LE = 33.3; WE = 58.3;

LP = 50.0; WP = 116.6;

LD = 358.2; WD = 116.6

Sporadin

TL = 83.3 - 699.7 (243.3);

LP = 16.7 - 116.6 (52.6); WP = 33.3 - 166.6 (85.5);

LD = 66.6 - 583.1 (190.7); WD = 33.3 - 249.9 (90.8);

LN = 25.0 - 50.0 (35.4); WN = 16.7 - 50.0 (25.0);

LP : TL = 1 : 2.0 - 10.0 (7.9);

WP : WD = 1 : 0.4 - 2.0 (1.06).

Material : Holotype; Coll. No. B6/1 S. C. Datta Coll. dated 5.9.1979. Type locality; Naihati, W. B. Paratype; Coll. No. B5/2 and others.

Affinities : Sarkar and Chakravarty (1969) first established the genus *Quadruspinospora*. Later, Haldar and Chakraborty (1975a) emended the generic characters of this genus. However, presence of four spines in the spore is sufficient for placement of the parasite under the genus *Quadruspinospora* Sarkar and Chakravarty, 1969, emend. Haldar and Chakraborty, 1975. The structure of the epimerite as well as the measurements and ratios of different body parts in the present form are not in agreement with previously described species of *Quadruspinospora* and for this reason it is described here as *Quadruspinospora platyepimerita* n.sp. The specific trivial name implies the presence of flat disc-like structure in the epimerite of the fully grown trophozoite.

***Quadruspinospora adigitalis* n. sp.**
(Figs. 27 - 32)

Development : Intracellular.

Trophozoite : Elongated conical and possesses a sub-spherical epimerite, hemispherical protomerite and cylindroconical deutomerite. The septum separating the protomerite from deutomerite is inwardly curved. Younger trophozoites attach with host gut epithelial cells with distinct digitiform processes.

Sporadin : solitary with hemispherical protomerite and elongated deutomerite having a pointed extremity. An oval nucleus with a distinct nuclear membrane is present anteriorly in the deutomerite.

Gametocyst and spore : Freshly collected gametocysts enclosing two unequal gametocytes are milky white in color. These are spherical measuring 320.0 μm to 660.0 μm in diameter. A prominent ectocyst, 180.0 μm to 270.0 μm \times 180.0 μm to 200.0 μm , is present outside the gametocyst. After 48 hours of development the partition wall between the two gametocytes disappears. After 96 hours, the ectocyst disappears and one portion of the gametocyst bulges out. At about 112 hours the spores are liberated by simple rupture through this bulged point.

The spores are oval in shape with four spines. Each spore measures 8.3 μm \times 5.0 μm and each spine is 13.3 μm long. Elongated sporozoites are arranged at two poles of the spore.

Measurements (in microns) :

Trophozoite

TL = 799.7;

LE = 133.3; WE = 116.6;

LP = 183.3; WP = 250.0;

LD = 483.1; WD = 283.2;

LN = 30.6; WN = 21.4;

Sporadin

TL = 100.0 – 949.6 (277.1);

LP = 16.7 – 299.9 (63.6); WP = 41.7 – 199.9 (82.4);

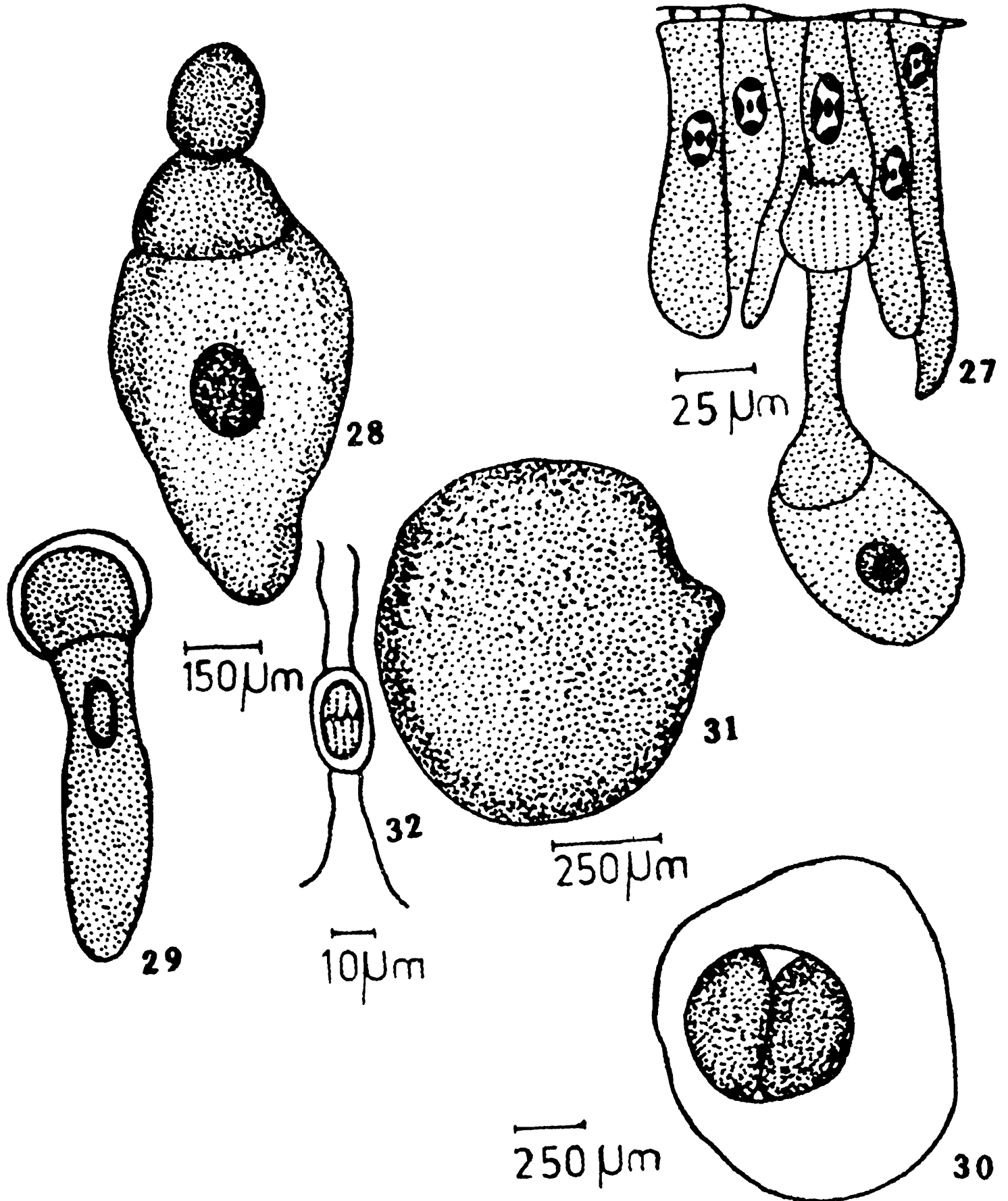
LD = 83.3 – 649.7 (216.1); WD = 33.3 – 249.9 (91.4);

LN = 16.7 – 50.0 (31.5); WN = 16.7 – 33.3 (24.1);

LP : TL = 1 : 2.2 – 21.5 (7.1);

WP : WD = 1 : 0.7 – 2.3 (1.2).

Material : Holotype; Coll. No. Ph/Q/1 S. C. Datta Coll. dated 4.1079. Type locality; Bidhan Chandra Krishi Viswa Vidyalaya, W B. Paratype; Coll. No. Ph/Q/3 and others.



Figs. 27-32. Camera lucida drawings of different stages of life cycle of *Quadruspinospora adigitalis* n.sp. 27. Showing attachment of trophozoite with its digitiform processes of epimerite. 28. Trophozoite. 29. sporadin. 30. Early gametocyst. 31. Mature gametocyst showing a bulge at one side. 32. Spore with spines at each pole and eight sporozoites.

Affinities : Presence of epimerite with stumpy, digitiform processes, solitary sporadins, dehiscence of cyst by simple rupture and ovoidal spores with spines confirm inclusion of the gregarine under the genus *Quadruspinospora*. Its LP : TL values closely resemble with *Q. megaspinosa* Haldar and Chakraborty, 1976 but all other characters like measurement of spore, spines and body structures are altogether different. The present form also shows similarities with *Q. platyepimerita* in the size and shape of the spore but differs in all other respects. In view of these differences, the present form undoubtedly warrants erection of a new species for which the name *Quadruspinospora adigitalis* n.sp. for the absence of any digitiform process in the epimerite.

***Quadruspinospora gesonulae* n.sp.**
(Figs. 33 - 38)

Development : Intracellular.

Trophozoite : Elongated, conical, the epimerite is subspherical, knob-like with fine thread like digitiform processes at the free surface. The protomerite is conical, broader than long while the deutomerite is elongated, tapering posteriorly. The pellicle is thin and epicyteal striations are not observable. Spherical nucleus with distinct nuclear membrane and an endosome is discernable. The nucleoplasm is filled with fine chromatin granules. The cytoplasm is densely granulated throughout the body.

Sporadin : Solitary. The protomerite is hemispherical while the deutomerite is elongated with gradually tapering posterior end. The septum separating the protomerite from deutomerite is thick.

Gametocyst and spore : Opaque white in color, ovoidal in shape and containing two equal gametocytes. The gametocyst measures 340.0 μm to 560.0 μm x 370.0 μm to 570.0 μm . A gelatinous transparent ectocyst encloses the cyst. After 24 hours of development the partition wall disappears and at 72 hours the cyst dehisces by simple rupture.

Oval spores measure 10.0 μm \times 5.0 μm . The length of each spine is 24.9 μm . Sporozoites are arranged along the longitudinal axis of the spore.

Measurements (in microns):

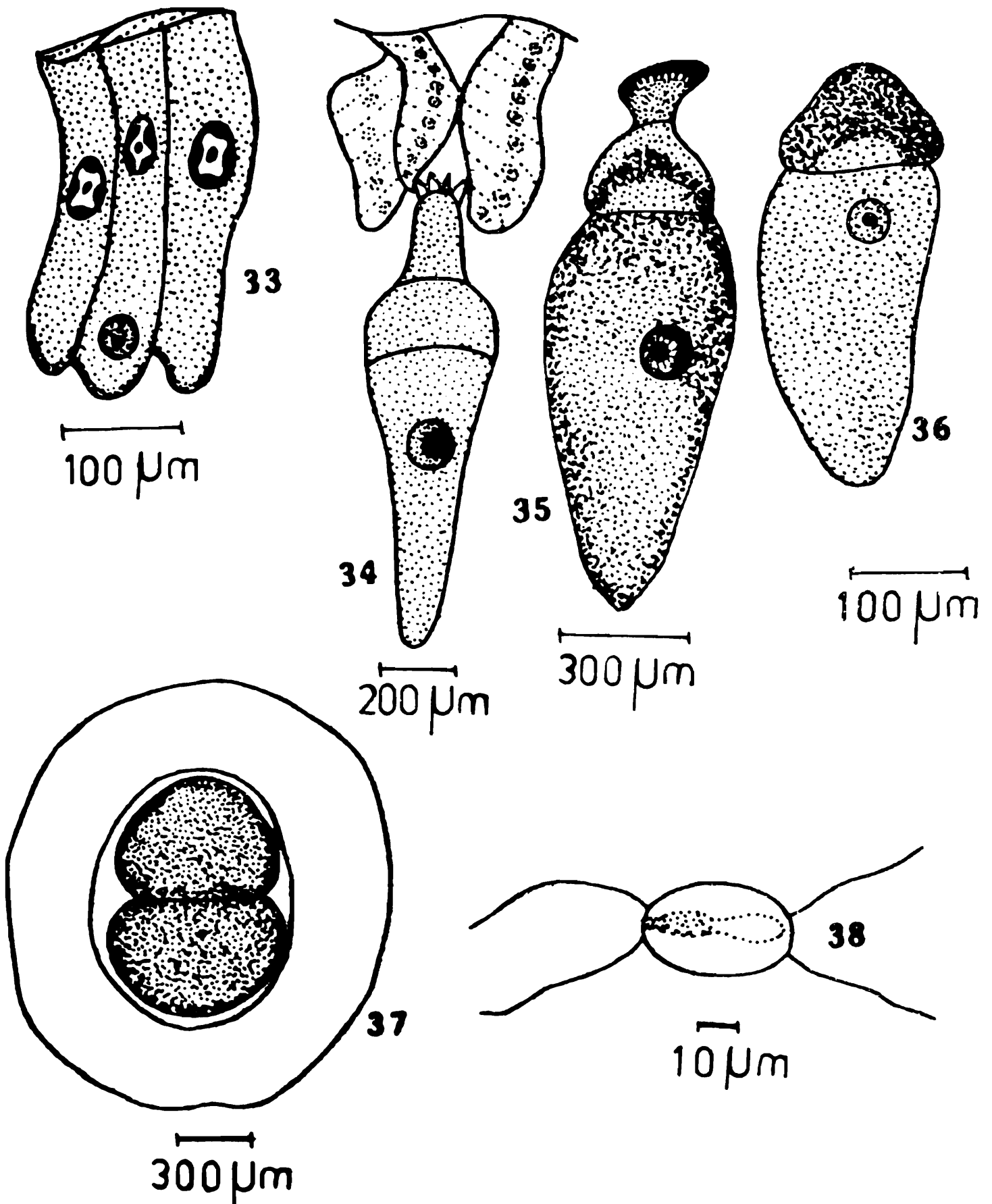
Trophozoite

TL = 316.5 - 649.7 (432.2);

LE = 16.7 - 50.0 (32.4); WE = 33.3 - 50.0 (44.4);

LP = 50.0 - 83.3 (66.6); WP = 83.3 - 183.3 (124.0);

LD = 249.9 - 533.1 (325.8); WD = 100.0 - 266.6 (167.5);



Figs. 33-38. Camera lucida drawings of different stages of life cycle of *Quadruspinospora gesnulae* n.sp. 33. Intracellular stages of development. 34. Showing trophozoite with characteristic epimerite attached with the epithelium of the hepatic caeca. 35. Trophozoite. 36. Sporadin. 37. A gametocyst with ectocyst. 38. Spore with spines.

Sporadin

TL = 299.9 - 733.0 (427.1);

LP = 50.0 - 100.0 (78.0); WP = 83.3 - 166.6 (123.4);

LD = 233.2 - 649.7 (349.1); WD = 83.3 - 183.3 (128.0);

LN = 25.0 - 33.3 (29.7); WN = 16.7 - 33.3 (26.2);

LP : TL = 1 : 4.0 - 10.0 (6.0);

WP : WD = 1 : 0.8 - 1.5 (1.2).

Material : Holotype; Coll. No. B/14/Q/1 S. C. Datta Coll. dated 4.10.1979. Type locality; Bidhan Chandra Krishi Viswa Vidyalaya. Paratype; Coll. No. B/14/Q/3 and others.

Affinities : The gregarine has a close similarity with *Q. chakravartyei* Chakraborty and Haldar, 1974 and *Q. indoaiolopii* Haldar and Chakraborty, 1976 in the ratios of LP : TL but differs from these two and the other described species of the genus in total length, length of the spines in the spore and number of digitiform processes. It is, therefore, considered to be a new species for which the name *Quadruspinospora gesonulae* n.sp. after the generic name of its host.

***Quadruspinospora jalpaiguriensis* n. sp.**
(Figs. 39 - 42)

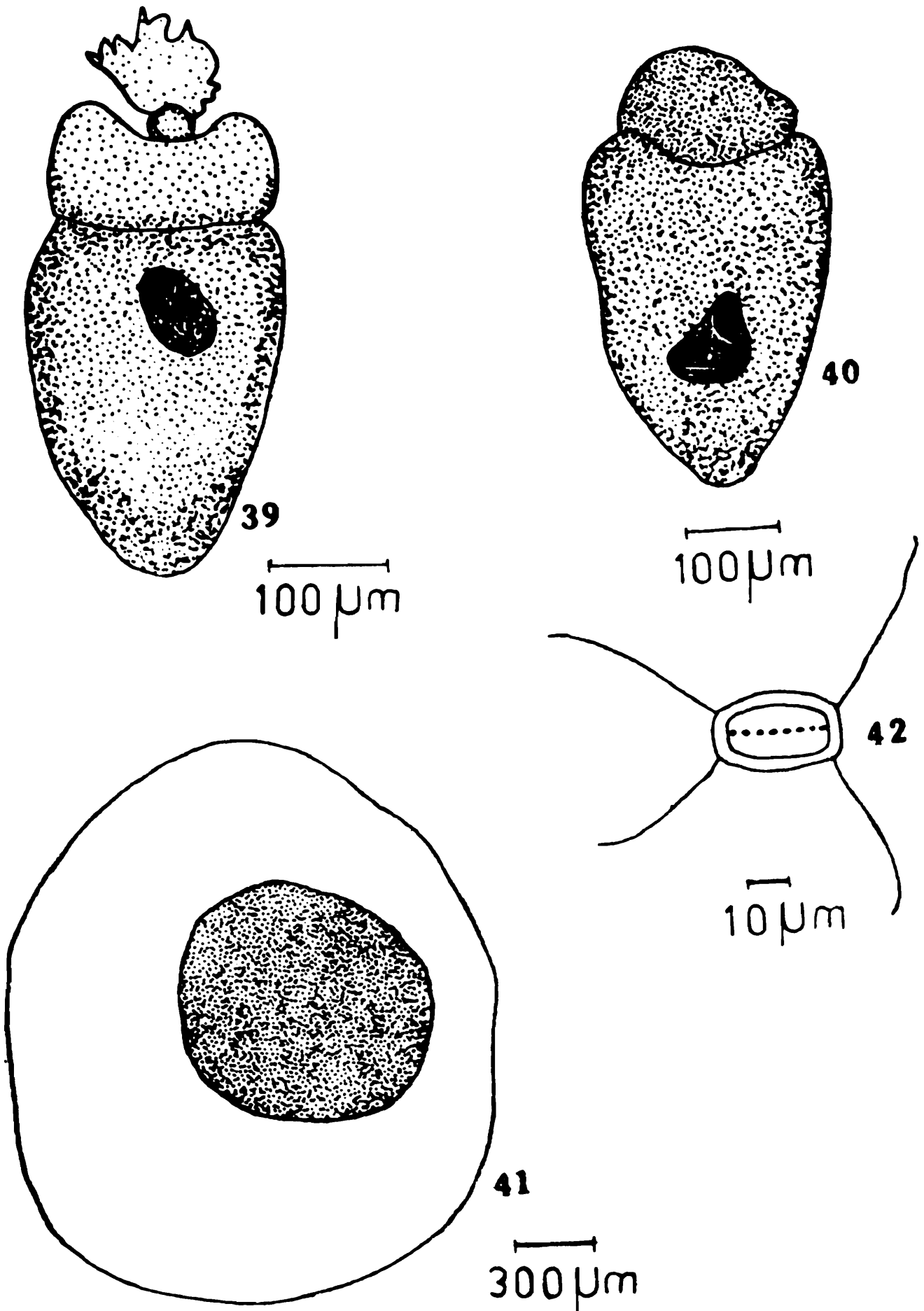
Development : Intracellular.

Trophozoite : Elongated, possesses a sub-spherical or knob-like epimerite with nine digitiform processes. The protomerite is hemispherical and broader than long. The deutomerite is elongated, conical and is separated from the protomerite by a thick septum. The nucleus is ovoidal with distinct nuclear membrane and several chromatin granules.

Sporadin : Solitary sporadins are found in the lumen of the hepatic caeca and midgut contents of the host. The protomerite is hemispherical and the deutomerite is conical in shape. The cytoplasm is uniformly granulated and epicyteal striations are lacking.

Gametocyst and spore : Spherical in shape, bright white in color with prominent ectocyst. The cysts measure 383.2 μm to 497.0 μm x 263.2 μm to 299.9 μm . The ectocyst disappears after 48 hours of development. After 96 hours the cyst dehisces by simple rupture liberating spores.

The spores are oval in shape measuring 6.6 μm x 5.0 μm . The spine measures 18.3 μm to 28.2 μm in length. 48 hours after the release of spores, sporozoites are formed which are arranged longitudinally.



Figs. 39-42. Camera lucida drawings of *Quadruspinospora jalpaiguriensis* n.sp. 39. Trophozoite. 40. Sporadin. 41. A gametocyst with prominent ectocyst. 42. Spore.

TABLE

Showing comparative characters of ten species of West Bengal to show the distinctiveness

Characters	<i>Q. aelopii</i> Sarkar and Chakravarty, 1969	<i>Q. chakra-</i> <i>vartyei</i> Chakraborty and Haldar, 1976	<i>Q. indoai-</i> <i>lopii</i> Haldar and Chakraborty, 1976	<i>Q. acridii</i> Haldar and Chakraborty, 1976	<i>Q. megas-</i> <i>pinosa</i> Haldar and Chakraborty, 1976
Total length	92.5 µm 290.0 µm	52.5 µm - 457.5 µm	140.0 µm 600.0 µm	70.0 µm - 720.0 µm	90.0 µm - 630.0 µm
Epimerite	With 8-12 digitiform processes	With 20-24 digitiform processes	10 23 digitiform processes	10 - 13 digitiform processes	13 - 16 digitiform processes
Protomerite	Hemispherical	Dome-shaped	Rhomboidal	Hemispherical	Hemispherical
Nucleus	Spherical	Spherical to elliptical	Spherical, subspherical	Oval or elliptical	Spherical or slightly oval
Gametocyst	530.0 µm 590.0 µm; equal or unequal gametocytes	350.0 µm - 420.0 µm; unequal gametocytes	250 µm 440.0 µm; equal gametocytes	240.0 µm - 280.0 µm equal gametocytes	290.0 µm - 300.0 µm; equal gametocytes
Spore	8.0 µm x 4.0 µm; four spine measuring 36.0 µm	9.0 µm x 5.0 µm; length of each spine 30.0 µm	10.0 µm x 5.0 µm; length of each spine 40.0 µm	9.0 µm x 5.0 µm; length of each spine 30.0 µm	9.0 µm x 5.0 µm; length of each spine 43.0 µm
LP : TL	1 : 5.3	1 : 6.1	1 : 6.3	1 : 5.8	1 : 5.5
WP : WD	1 : 1.1	1 : 1.2	1 : 1.4	1 : 1.8	1 : 1.1
Host	<i>Aeolopus</i> sp.	<i>Spathos-</i> <i>ternum</i> sp.	<i>Aiolopus</i> sp., <i>Aiolopus</i> <i>thalassimus</i> <i>tatmulus</i> (Fabr.)	<i>Acrida</i> <i>exaltata</i> (Walk.)	<i>Trilophidia</i> <i>annulata</i> Thumb.
Locality	Howrah	Kalyani	Kalyani, Naihati	Kalyani, Naihati	Kalyani, Naihati

- II

of *Quadruspinospora* described from grasshoopers
of presently described four new species.

<i>Q. attracto- morphii</i> Halder and Chakraborty, 1976	<i>Q. platyepi- merita</i> n. sp.	<i>Q. adigitalis</i> n. sp.	<i>Q. gesonulae</i> n. sp.	<i>Q. jalpaiguri- ensis</i> n. sp.
110.0 µm - 1020.0 µm	441.5 µm	799.7 µm	316.5 µm 649.7 µm	106.3 µm 533.1 µm
12 - 18 digitiform processes	Numerous short, stumpy brush-like digitiform processes	No distinct digiti- form processes in adult trophozoite	Subspherical knob-like with fine thread-like digitiform processes	Knob-like with nine digitiform processes
Rhomboidal	Hemispherical	Hemispherical	Conical	Hemispherical
Oval	Oval	Oval	Spherical	Ovoidal
300.0 µm - 440.0 µm; equal gametocytes	Spherical, 420 µm, equal or unequal gametocytes	320.0 µm 660.0 µm x 320.0 µm 660.0 µm; unequal gametocytes	340.0 µm 560.0 µm x 370.0 µm 570.0 µm; equal gametocytes	383.2 µm 497.0 µm x 263.2 µm 297.9 µm; equal or unequal gametocytes
10.0 µm x 5.0 µm; length of the spine 33.0 µm	Oval; 8.3 µm x 5.0 µm; length of the spine 24.9 µm to 33.2 µm	Oval; 8.3 µm x 5.0 µm; spine measures 13.3 µm in length	Oval; 10.0 µm x 5.0 µm; spine measures 24.9 µm in length	Oval; 6.6 µm x 5.0 µm; length of the spines 18.3 µm to 28.2 µm
1 : 7.09	1 : 2.0 10.0 (.7.9)	2.2 21.5 (7.1)	1 : 4.0 10.0 (6.0)	1 : 2.7 9.3 (5.8)
1 : 1.17	1 : 0.4-2.0 (1.06)	0.7 2.3 (1.2)	1 : 0.8 1.5 (1.2)	1 : 0.8 1.4 (1.2)
<i>Attracto- morpha</i> <i>crenulata</i> Fabr.	<i>Oxya hyla</i> Serville	<i>Phleoba</i> <i>antennata</i>	<i>Gesonula</i> <i>punctiformes</i> (Stal.)	<i>Oxya</i> sp.
Kalyani, Naihati	Naihati	Kalyani	Kalyani	Jalpaiguri

The comparative characters of the different species of *Quadruspinospora* are compiled in Table II.

Measurements (in microns) :

Trophozoite

TL = 106.3 - 533.1 (284.2);

LE = 12.8 - 33.3 (20.6); WE = 17.0 - 66.6 (36.9);

LP = 17.0 - 83.3 (46.4); WP = 46.8 - 133.3 (98.2);

LD = 72.3 - 416.5 (217.3); WD = 53.1 - 144.5 (106.7);

LN = 17.0 - 34.0 (25.4); WN = 12.8 - 34.0 (24.9);

Sporadin

TL = 85.0 - 766.4 (372.1);

LP = 21.3 - 133.3 (65.5); WP = 38.3 - 233.2 (133.2);

LD = 63.0 - 683.2 (307.9); WD = 42.5 - 249.9 (158.3);

LN = 12.8 - 41.7 (28.6); WN = 12.8 - 50.0 (27.9);

LP : TL = 1 : 2.7 - 9.3 (5.8);

WP : WD = 1 : 0.8 - 1.4 (1.2).

Material : Holotype; Coll. No. B1/1 S. C. Datta Coll., dated 3.3.1979. Type locality; Alipurduar, Jalpaiguri, W. B. India. Paratype; Coll. No. B1/3 and others.

Affinities : The gregarine possesses close similarities with *Q. acridii* Haldar and Chakraborty, 1976 and *Q. megaspinosa* Haldar and Chakraborty, 1976 in having hemispherical protomerite and the values of LP : TL and WP : WD, however, differs in all other respects. The combination of characters like epimerite with 9 digitiform processes and size of the gametocyst and spore are altogether new and for this reason the present form is described as a new species and the name *Quadruspinospora jalpaiguriensis* n.sp. is given for it, as this is the first report of a gregarine species from this locality in West Bengal.

SUMMARY

The present paper deals with seven new species of cephaline gregarines (Apicomplexa : Sporozoea) from Orthopteran insects.

REFERENCES

- Chakraborty, N. & Haldar, D. P. 1974. Morphology and life-history of a new cephaline gregarines from grasshopper. Proc. 61st Sci. Cong. Pt. III (Abst.), 51.
- Ghose, S., Sengupta, T. & Haldar, D. P. 1986. Two new septate gregarines (Apicomplexa : Sporozoea), *Gregarina basiconstrictonea* n.sp. and *Hirmocystis oxeata* n.sp. from *Tribolium castaneum*. Acta Protozool., 25 (1) : 93-108.

- Haldar, D. P. & Chakraborty, N. 1975. The genus. *Quadruspinospora* (Protozoa : Sporozoa). A new definition. *Curr. Sci.*, 44(15) : 558.
- Haldar, D. P. & Chakraborty, N. 1976. Observations on the morphology and life history of three new species of cephaline gregarines (Protozoa : Sporozoa) from grasshoppers in Kalyani, *Proc. Zool. Soc.*, 29(1) : 73-81.
- Haldar, D. P. & Chakraborty, N. 1979. Observations on three new species of cephaline gregarines (Protozoa : Sporozoa) of the genus *Hirmocystis* Labbé from coleopteran insects. *Z. Parasitenkd.*, 59 : 121-130.
- Labbé, A. 1899. Sporozoa. In "Das Tierreich", Friedlander. Berlin Leipzig, 5(20) : 1-180.
- Lipa, J. J. 1967. Studies on gregarines (Gregarinomorpha) of arthropods in Poland. *Acta Protozool.*, 5(8) : 97-179.
- Marshall, W. S. 1890. Beitrage Zur Kenntuis der Gregarinen. *Arch. Naturg.*, 59 : 25-44.
- Sarkar, A. & Chakravarty, M. 1969. Gregarines (Protozoa : Sporozoa) from insects. I. New cephaline gregarines of the family Actinocephalidae. *Proc. Zool. Soc.*, 22 : 17-29.
- Sprague, V 1941. Studies on *Gregarin. blattarum* with particular reference to the chromosome cycle. *Univ. Ill.*, 18(2) : 7-57.
- Stein, F. 1848. Uber die Nature der Gregarinen. *Arch. Anat. Physiol.*, 182-223.
- Wellmer, L. 1911. Sporozoon Ostprussischer Arthropoden. *Sch. Physik. Okonom. Ges. Konigsb.*, 52 : 102-164.

ON A SMALL COLLECTION OF FISH FROM THEKKADY WILDLIFE RESERVE, WESTERN GHATS

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INTRODUCTION

Thekkady Wildlife Reserve, a part of Western Ghats was surveyed by Dr. R.S. Pillai and party during 1975 & 1981 and subsequently by Dr. Koshy Mathew and party during 1986. The following areas viz. Molayar River, Vazhathopu, Valliyathuruthy, Manakavala, Nellikamparai, Dam site, Anguruli, Cheriya kaniyam, East of Boat landing, East and West Edapalayam, Periyar house and Periyar River lower camp were surveyed and 600 fish specimens were collected.

The specimens comprised 19 species belonging to 8 families. A systematic list of the species including length range, date and locality are given.

Day (1875 — 1878), Misra (1962), Jayaram (1981), Jayaram *et al.* (1982) were followed for the identification of species. Other revisionary works of importance viz. Menon (1964, 1987), Misra (1976), and Jayaram (1977, 1980) were referred to for the recent classification of the freshwater fishes. The present collection is an addition to our knowledge on the fish fauna of this part of Western Ghats. This is significant in that several important hill stream fishes like *Garra*, and *Noemacheilus* are encountered and commercially important *Puntius* spp. viz *P. Curmuca*, *P. dubius*, *P. lithopidos*, *Ompok*, *Heteropneustes* and *Channa* are recorded. Subsequent to Hora and Law (1941) the occurrence of *P. lithopidos* in the lower reaches of Western Ghats is of Ichthyological significance.

LIST OF FISHES OF THEKKADY

Order CYPRINIFORMES
Family CYPRINIDAE
Subfamily RASBORINAE

1. *Barilius gatensis* (Val.) 2 exs.
2. *Danio (D.) aequipinnatus* (Mc Clelland) 7 exs.
3. *Esomus barbatus* (Jerdon) 2 exs.
4. *Rasbora daniconius* (Ham.) 230 exs.

Subfamily CYPRININAE

5. *Puntius curmuca* (Ham.) 1 ex.
 6. *Puntius dubius* (Day)..... 1 ex.
 7. *Puntius lithopidos* (Day).....4 exs.
 8. *Puntius m. melanompyx* (Day)126 exs.
 9. *Tor khudree* (Skyles) 1 ex.

Subfamily GARRINAE

10. *Garra mullya* (Skyles).....3 exs.

Family HOMALOPTERIDAE

Subfamily NOEMACHEILINAE

11. *Noemacheilus denisoni denisoni* Day 1 ex.
 12. *N. triangularis triangularis* Day4 exs.

Family COBITIDAE

Subfamily COBITINAE

13. *Lepidocephalus thermalis* (Val.).....42 exc.

Order SILURIFORMES

Family SILURIDAE

14. *Ompok bimaculatus* (Bloch) 1 ex.

Family HETEROPNEUSTIDAE

15. *Heteropneustes fossilis* (Bloch)..... 1 ex.

Order ATHERINIFORMES

Family CYPRINODONTIDAE

16. *Aplocheilus lineatus* (Val.).....148 exs.

Order CHANNIFORMES

Family CHANNIDAE

17. *Channa orientalis* (Schneider)..... 31 exs.

18. *Channa striatus* (Bloch).....9 exs.

Order PERCIFORMES

Family CICHLIDAE

19. *Oreochromis mossambica* (Peters).....8 exs.

1. *Barilius gatensis* (Valenciennes)

1842. *Leuciscus gatensis* Valenciennes, *Hist. Nat. Poiss.*, 17, p.309, Pl.503 (Type locality : Western Ghats of India).

Material : 2 exs., 37.0—42.0 mm. S.L., Periyar River lower camp, Alt. 540 m., 10.11.1986.

Remarks : Day (1886-87) recorded 15 vertical bars and Jayaram (1982) 13-14 in the specimens they had studied. But in the two specimens studied by us they numbered 10 and 12 and 11 and 12 on the right and left sides of the fish respectively.

Distribution : Freshwaters of Peninsular India.

2. *Danio (Danio) aequipinnatus* (Mc Clelland)

1839. *Perilampus aequipinnatus* Mc Clelland, *Asiat. Res.*, 19, p.393, Pl. 16, Fig. 1 (Type locality : Assam).

Material : 7 exs., 34 - 63 mm. SL., Periyar River lower camp, Alt. 540 m., 10.11.1986.

Distribution India : Eastern Himalaya, Meghalaya, Deccan; Nepal; Bangladesh; Burma; Thailand and Sri Lanka.

3. *Esomus barbatus* (Jerdon)

1849. *Leuciscus barbatus* Jerdon, *Madras J. Lit. Sci.*, 15, p.322 (Type locality : Rivers and tanks all over Mysore and Carnatic).

Material : 2 exs. 47.0 mm. SL., Periyar River lower camp., Alt. 540 m. 10.11.1986.

Distribution : India : Tamil Nadu, Karnataka.

4. *Rasbora daniconius* (Hamilton)

1822. *Cyprinus daniconius* Hamilton, *Fish Ganges*, p. 327, 391, pl. 15, Fig. 89 (Type locality : the rivers of Southern Bengal).

Material : (230 exs.; 14.0—90.0 mm. S.L., Alt. 820-980 m.) 26 exs., 14.10.75; Vazhathopu; 20 exs., 23.10.75, Manakavala : 11 exs., 11.2.81, Nellikkamparai, 870 m; 3 exs., 12.2.81, Dam, 870 m; 22 exs., 15.2.81, Cheriyaaniyam, 870 m; 13 exs., 16.1.81, East of boat landing, 860 m.; 12 exs. 17.2.81, Cheriyaaniyam, 870 m.; 1 ex. 19.2.81, East Edapalayam, 860 m.; 3 exs., 21.2.81, East of boat landing, 860 m.; 7 exs., 23.2.81, Molayar, 980.; 2 exs., 24.2.81, Periyar house, 860 m.; 64 exs., 27.2.81, East to Edapalayam T.B., 870 m.; 16 exs., 28.2.81, 2 Kms. East of Edapalayam, 880 m.; 10 exs., 1.3.81 3 Kms. West of Edapalayam, 840 m.; 7 exs. 6.3.81. 1 Km. South of Manakavala T.B., 820 m.; 8.3.81, Valiyathuruthy, 840 m.

Distribution : Throughout India, Pakistan, Bangladesh, Sri Lanka, Burma, Malaya.

5. *Puntius curmuca* (Hamilton)

1807 *Cyrinus curmuca* Hamilton, *Journey Mysore*, 3, p. 344, pl. 30 (Type locality : Western Ghats of India).

Material : 1 ex., 152.0 mm. SL., 14.2.1981, Anguruli, 880 m.

Distribution : Rivers of Western Ghats.

6. *Puntius dubius* (Day)

(Fig. 1)

1867. *Puntius (Barbodes) dubius* Day, *Proc. zool. Soc. Lond.* p.291. (Type locality : Bhanwani river at base of Nilgiri Hills).

Material : 1 ex., 155.0 mm. SL., 23.10.1975, Manakkavala.

Distribution : Cauvery river system in Southern India and Periyar in Thekkady, Kerala.

7. *Puntius lithopidos* (Day)

(Fig. 2)

1873. *Barbus (Barbodes) lithopidos* Day, *Proc. zool. Soc. Lond.*, p. 708 (Type locality : South Kanara).

Material : 4 exs., 155.0—170.0 mm. SL., 23.10.75, Manakkavala.

Distribution : Coorg. S. Kanara, Deccan, Travancore and Madhya Pradesh.

Remarks : Hora and Law (1941) extended the range of this species further down the Western Ghats, upto Travancore. The occurrence of this species in Thekkady is an additional knowledge to its distribution in the higher ranges of Kerala.

8. *Puntius melanampyx melanampyx* (Day)

1865. *Labeo melanampyx* Day, *Proc. zool. Soc. Lond.*, p 298. (Type locality : Wynaad).

Material : (126 exs., 13.0 mm.—56.0 mm. SL., 840 m.—880 m.) 35 exs., 22.10.75 & 23.10.75, Manakkavala; 14 exs., 11.2.81, Nellikamparai, 870 m; 17 exs., 12.2.81, Dam, 870 m.; 2 exs., 13.2.81, Anguruli, 880 m.; 28 exs., 15.2.81, 17.2.81 & 18.2.81, Cheriyaaniyam, 870 m., 3 exs. 21.2.81, East of boat landing, 860 m.; 7 exs. 27.2.81, 1.5 kms. of Edapalyam, 880 m.; 9 exs., 1.3.81, 3 kms., West of Edapajayam, 840 m.; 1 ex., 7.3.81, 2 kms. West of Manakavala, 840 m.; 10 exs., 8.3.81.; Valliathuruthy, 840 m.

Distribution : India : Wynaad, Nilgiris, Travancore range of Hills, Cauvery River.

Remarks : Colour pattern varied from three bright bands to completely dark specimens in which the bands were very faint.

FIG 1

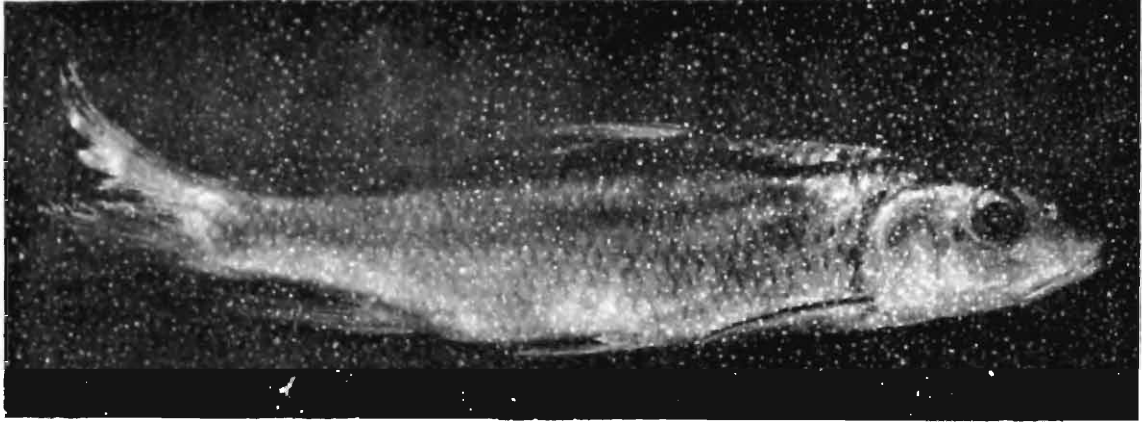


FIG. 2

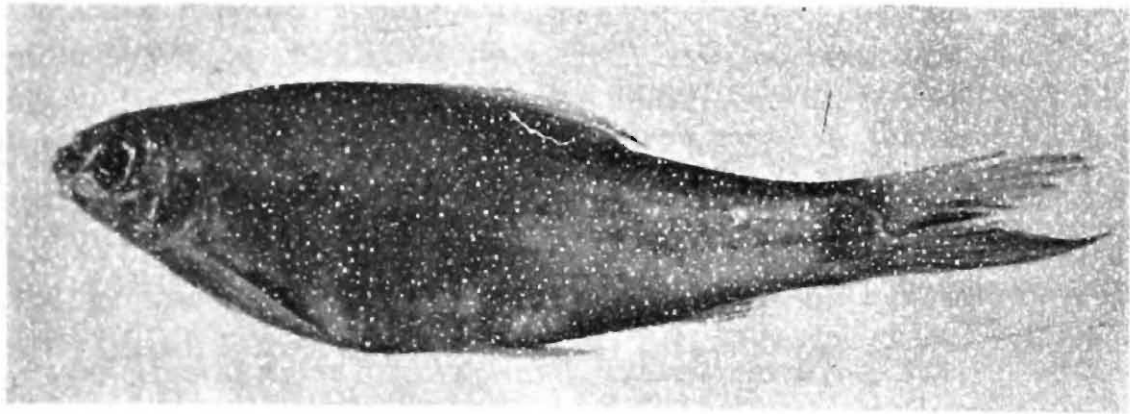


FIG.3

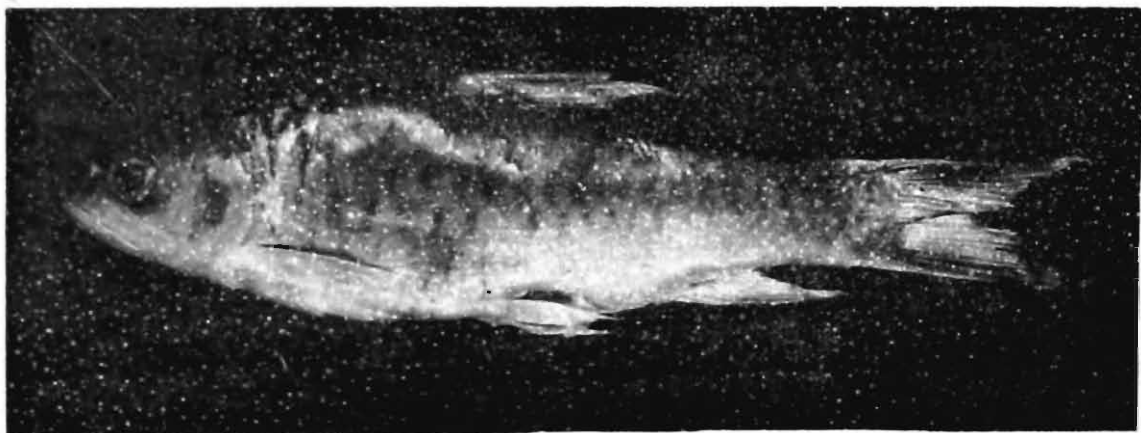


Fig. 1 *Puntius dubius* Day (Lateral view)

Fig. 2. *Puntius lithopidos* Day (Lateral view)

Fig. 3. *Tor khudree* (Sykes)

9. *Tor khudree* (Skyles)
(Fig. 3)

1841 *Barbus khudree* Sykes, *Trans. zool. Soc. Lond.*, p. 35 (Type locality : Mutha mula river, Poona).

Material : 1 ex., 145.0 mm. SL., 23.10.1975, Manakkavala.

Distribution : Rivers of Western Ghats.

10. *Garra mullya* (Sykes)

1841 *Chondrostoma mullya* Sykes, *Trans. zool. Soc. Lond.*, 2, p. 359, pl. 62, Fig. 3 (Type locality : Poona water ways).

Material : (3 exs., 30.0—86.0 mm. SL., 540 m. - 880 m.) 1 ex., 27.2.81, West of Edapalayam T.B., 880 m.; 1 ex., 7.3.81, 2 Kms. West of Manakkavala T.B., 840 m.; 1 ex., 10.11.86., Periyar River lower camp, 540 m.

Distribution : Throughout India, except Assam and the Himalaya.

11. *Noemacheilus denisoni denisoni* Day

1867. *Nemachilus denisoni* Day, *Proc. zool. Soc. Lond.*, p. 287 (Type locality : Bhawani River, base of Nilgiris).

1987. *Noemacheilus denisoni denisoni* Menon, *The Fauna of India and Adjacent Countries*, Pisces IV, Part I, Homalopteridae : 93-99, figs. 3 & 4. pl. 10.

Material : 1 ex., 30.0 mm., SL., 10.11.86., Periyar River lower camp., 540 m.

Distribution : India : Nilgiris, Coorg Hills, Kerala and Karnataka.

12. *Noemacheilus triangularis triangularis* Day

1865. *Nemachilus triangularis* Day, *Proc. zool. Soc. Lond.*, p. 295 (Type locality : Mundikyum, Travancore).

1987 *Noemacheilus triangularis triangularis*, Menon, Pisces IV, Part I. Homalopteridae, p. 168-171, pl. 11, Fig. 4, 5 & 8.

Material : (4 exs., 36-40 mm. SL., 860 m—880 m.) 1 ex., 14.2.81, Anguruli, 880 m.; 3 exs., 17.2.81, Cheriyananiyam, 860 m.

Distribution : Peninsular India : Western Ghats, Kallar, Pamba, Periyar and Bharathapuzha drainages in Kerala.

13. *Lepidocephalus thermalis* (Valenciennes)

1846. *Cobitis thermalis* Valenciennes, *Hist. nat. Poiss.*, 17, p. 78 (Type locality : Ceylon).

Material : (42 exs., 22-40 mm. S.L., 540m-980 m.) 6 exs., 14.10.75, Vazhathopu; 16 exs., 22.10.75 & 23.10.75, Manakkavala; 4 exs., 15.2.81, and 17.2.81, Cheriyananiyam, 870 m; 1 ex., 16.2.81, East of boat landing, 860 m.; 9 exs., 23.2.81, Molayar, 980 m; 3 exs., 24.2.81, Periyar House, 860 m.; 3 exs., 10.11.86, Periyar river camp, 540 m.

Distribution : Southern India : South of Krishna river, Karnataka, Kerala, Sri Lanka.

14. *Ompok bimaculatus* (Bloch)

1797. *Silurus bimaculatus* Bloch, *Syst. Ichth.*, 11, p. 17, pl. 369 (Type locality : Malabar).

Material : 1 ex., 285.0 mm., SL., 14.2.81, Anguruli, 880 m.

Distribution : Throughout India, Pakistan, Nepal, Bangladesh, Sri Lanka, Thailand, Malaya, Viet-Nam, East Indies, Yunnan.

15. *Heteropneustes fossilis* (Bloch)

1794. *Silurus fossilis* Bloch, *Naturg. Ausland. Fische.*, 8, p. 46, pl. 370, Fig. 2 (Type locality : Tranquebar).

Material : 1 ex., 64.0 mm. SL., 15.2.81, Cheriyaikkanam, 870 m.

Distribution : India, Pakistan, Nepal, Sri Lanka, Bangladesh, Thailand, Laos.

16. *Aplocheilus lineatus* (Valenciennes)

1846. *Panchax lineatum* Valenciennes, *Hist. nat. Poiss.*, 18, p. 381 (Type locality : Bombay).

Material : (148 exs., 14.0 mm - 48.0 mm. SL., 820-880 m.) 4 exs., 14.10.74, Vazhathopu; 5 exs., 22.10.75 & 23.10.75, Manakkavala; 6 ex., 11.2.81, Nellikkamparai, 870 m.; 31 exs., 12.2.81, Dam, 870 m.; 9 exs., 13.2.81 and 14.2.81 Anguruli, 880 m.; 60 exs., 15.2.81 and 17.2.81, Cheriya kaniyam, 870 m.; 6 exs., 16.2.81, East of boat landing, 860 m; 11 exs., 19.2.81, East of Edapalayam, 860 m.; 6 exs., 24.2.81, Periyar House, 860 m.; 8 exs., 27.2.81., 1.5 kms., West of Edapalayam, 880 m.; 6.3.81, 1 km. South of Manakavala T.B. 820 m.

Distribution : India : Coorg, Wynaad, Nilgiri, Sri Lanka.

17. *Channa orinetalis* (Schneider)

1810. *Channa orientalis* Schneider, *Syst. Ichth.*, p. 496, pl. 90, fig. 2. (Type - locality : Not given).

Material : (31 exs., 32-95 mm. SL., 860 m.—880 m.) 4 exs., 11.2.81., Nellikkamparai, 870 m.; 8 exs., 12.2.81, Dam, 870 m.; 3 exs., 14.2.81, Anguruli, 880 m.; 10 exs., 15.2.81 and 17.2.81, Cheriya kaniyam, 870 m.; 1 ex., 16.2.81, East of boat landing, 860 m.; 4 exs., 19.2.81, East of Edapalayam, 860 m.; 1 ex., 27.2.81, 1.5 kms. West of Edapalayam, 880 m.

Distribution : Throughout India, Nepal, Sri Lanka, Bangladesh, Burma, Pakistan.

18. *Channa striatus* (Bloch)

1793. *Ophiocephalus striatus* Bloch, *Naturg. Ausland, Fische.*, 2, p. 141, pl. 359 (Type locality : Malabar).

Material : (9 exs., 41-53 mm. SL.) 2 exs., 14.10.75, Vazhathopu; 3 exs., 23.10.75, Manakavala; 4 exs., 12.2.81, Dam, 870 m.

Distribution : Throughout India, Sri Lanka, Bangladesh, Pakistan, Burma, China, Philippines, Malaya, Malay Archipelago, Thailand.

19. *Oreochromis mossambica* (Peters)

1852. *Chromis mossambica* Peters, *Monatsb. Akad. Wiss.*, Berlin, p. 681 (Type locality : Zambesi river, S. Africa).

Material : (4 exs., 42-47 mm. SL.) 2 exs., 15.10.75, Vazhathopu; 2 exs., 15.2.81, Cheriayakanam, 870 m.

Distribution : East Africa to Natal. Widely introduced in India, Pakistan.

SUMMARY

The Ichthyofauna of Thekkady Wildlife Reserve is reported upon. The study has yielded 19 species belonging to 8 families.

ACKNOWLEDGEMENT

We wish to express our sincere thanks to Dr R.S. Pillai Officer-in-Charge, S.R.S., for providing the necessary facilities. Our sincere thanks are due to Dr K.C. Jayaram for going through the manuscript and to Shri S. Vijayraghavan, Photographer, S.R.S., for help in photography.

REFERENCES

- Day, F. 1875-1878. *The Fishes of India; being a natural history of the fishes known to inhabit the seas and freshwaters of India, Burma and Ceylon*, Text and Atlas in 4 parts. London, xx + 778 pp., 195 pls.
- Hora, S.L. and Law, N.C. 1941. The freshwater fish of Travancore. *Rec. Indian Mus.*, 43(2) pp. 233-256, 1 pl.
- Jayaram, K.C. 1977. Aid to the identification of Siluroids, 2 Siluridae, Schilbeidae, Pangasiidae, Amblycipitidae, Akysidae. *Rec. zool. Surv. India, Occ. Paper*, No. 10, 32 pp.
- Jayaram, K.C. 1980. Aid to the identification of the Suluroid fishes of India, Burma, Sri Lanka, Pakistan and Bangladesh. 4. Clariidae, Heteropneustidae, Chacidae, and Olyridae. *Rec. zool. Surv. India, Occ. paper*, No. 23, 23 pp.
- Jayaram, K.C. 1981. The Freshwater fishes of India, Pakistan, Bangladesh, Burma and Sri Lanka — A Handbook. xxii + 475 pp., xiii plates.

- Jayaram, K.C., Venkateswarlu, T. and Raghunathan, M.B. 1982. A survey of the Cauvery river system with a major account of its Fish Fauna. *zool. Surv. India, Occ. paper*. No. 36, 115 pp. Table I, xii plates.
- Menon, A.G.K. 1964. Monograph of the Cyprinid fishes of the genus *Garra* Hamilton, *Mem. Indian Mus.*, 14(4), pp. 173-260, 13 pls.
- Menon, A.G.K. 1987. *The Fauna of India and adjacent countries*, Pisces, IV, Teleostei-Cobitoideä, Part 1, Homalopteridae, x + 259 pp. xvi pls.
- Misra, 1962. An aid to the identification of the common commercial fishes of India and Pakistan. *Rec. Indian Mus.*, 57(1-4), pp. 1-320.
- Misra, 1976. *The Fauna of India and adjacent countries*. Pisces, 3. Teleostomi : Cypriniformes, Siluri. xxi + 367, pp, 15 pls.

**DESCRIPTION OF AN UNKNOWN FEMALE ALONG WITH TWO NEW
LOCALITY RECORDS OF THE FAMILY MYRMELEONTIDAE
(NEUROPTERA) FROM LAKSHADWEEP ISLANDS, INDIA**

S. K. GHOSH

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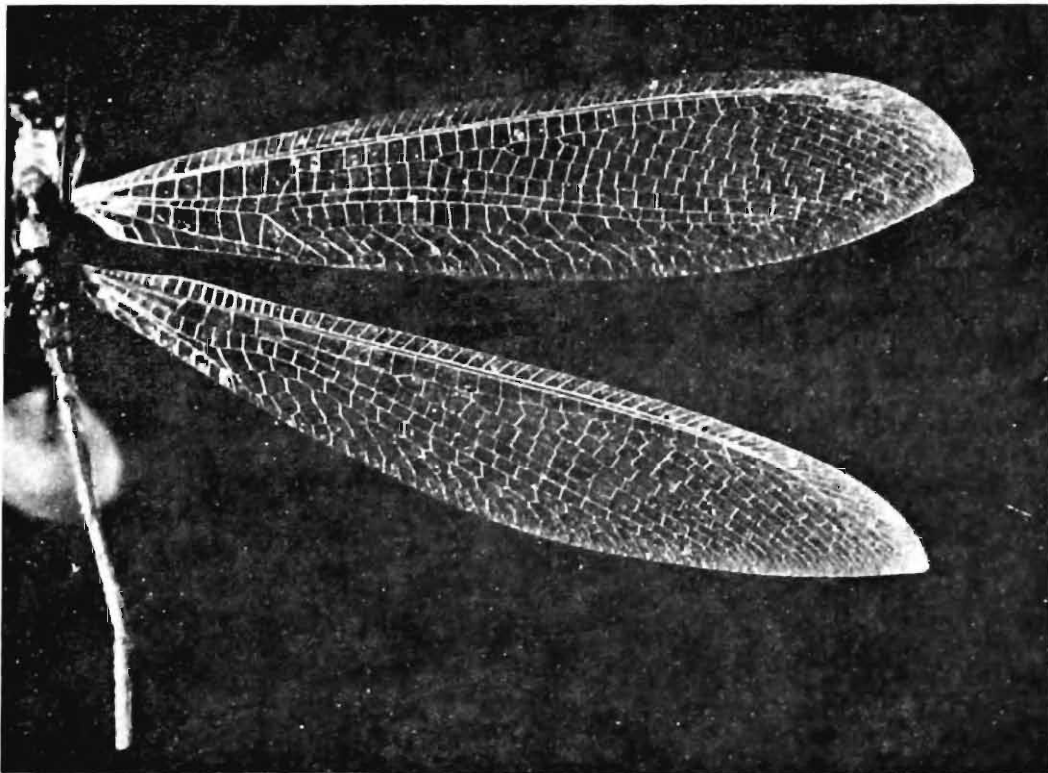
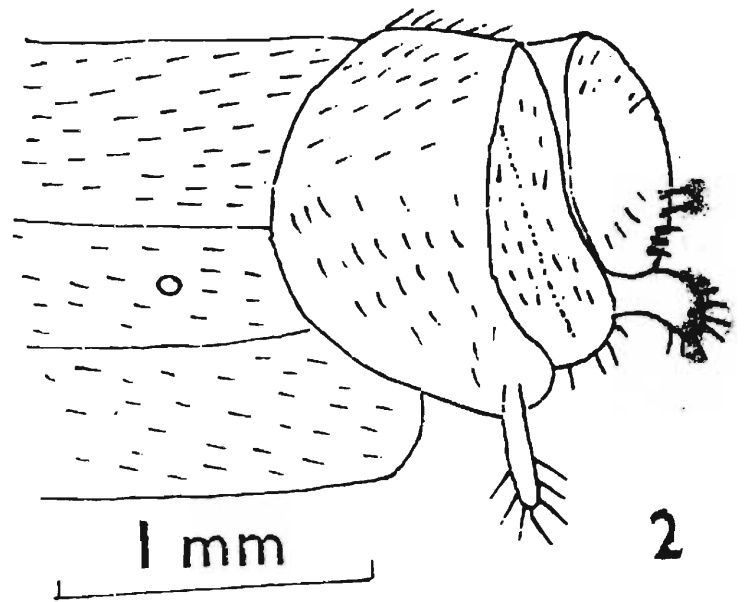
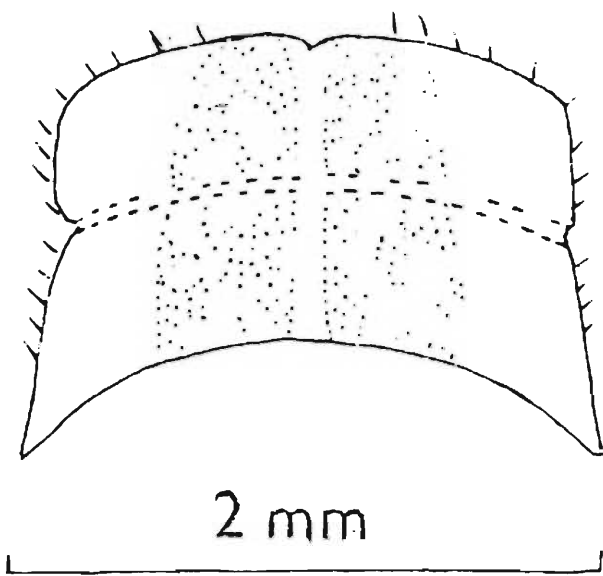
INTRODUCTION

The neuropteran fauna of Lakshadweep is not wellknown inspite of the great economic importance of the group as predators of various pests of crops. Prior to this report, the present author recorded (*vide* Ghosh, 1981) two species, viz., *Ankylopteryx octopunctata* (Fabricius) [Family Chrysopidae] and *Centroclisis eustalacta* (Gerstaecker) [Family Myrmeleontidae] from this Island. Recently, while examining a small collection collected during Lakshadweep Survey, 1984, the author has encountered two species, namely, *Myrmeleon assamensis* Ghosh (in press) and *Creoleon griseus* (Klug) belonging to the family Myrmeleontidae. Both the species have been recorded for the first time from the afore-said Island which is located in the Arabian sea within the jurisdiction of India. The unknown female of *M. assamensis* Ghosh has been described along with necessary illustrations. Geographical distribution of the species and the suitable references have been given.

Myrmeleon assamensis Ghosh

Female : Clypeus & labrum : pale brown; frons : shiny black; maxillary and labial palpi : brownish; vertex & antenna : black; pronotum (fig.1) : yellow with moderately long pale hairs and with two median longitudinal brownish stripes; lateral margins broadly and posterior margin narrowly yellow; meso - and metanotum : black but scutellum yellowish; wings : hyaline, without spot; pterostigma white; forewing (fig.3): venation yellow: Sc with brown bands at the junction of costal veinlets; 8 cross veins before Rs which is with 10 branches; hind wing (fig.3) : Venation yellow; Sc and R brown at the basal half; 4 cross veins before Rs; marginal fringes short and black, very dense; pillula present, yellowish with dense golden hair brush; leg: brown; tip of tarsal segments black; spurs of hind tibia about as long as first tarsal segment; claws red; hairs black; abdomen (fig.2) : black with rather dense, short and yellow hairs; tergite 8 broad in the upper part and tapering downwards; tergite 9 long and narrow with uniform thickness; ectoproct slightly broader than tergite 9, with slightly projecting upper part, rounded lower angle and digging hairs in addition to small hairs; gonapophysis lateralis small, rounded and with black hairs.

Measurements : 2 ♀♀ : Length of fore wing, 30 mm; hind wing 28 mm.



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Figs. 1-3. *Myrmeleon assamensis* Ghosh (female) : 1. Pronotum, 2. tip of female abdomen, 3. fore - and hind wings.

Material examined : 2 ♀♀ : India : Lakshadweep Islands, vegetable gardens, 3 kms. east of tourist hut, Kavaratti, 28. iii. 1984; southern end of Agatti, 6. iv. 1984 (*D. K. Mandal* and party coll).

Distribution : India : Assam and Lakshadweep Islands.

Remarks : The male of the species has been described new to science by Ghosh (the paper is in press) from Assam. Hitherto unknown female has been described in this paper. A single male specimen collected during Lakshadweep Survey, 1984 (in and around Dak Bungalow, Kadmat, 10. IV 1984, *D. K. Mondal* and party - Coll.) differs from female in having 9 cross veins before Rs which is with 12 - branches.

Creoleon griseus (Klug)

1834. *Myrmeleon griseus* Klug, *Symb. Phys.*, IV. Tafel 36, fig. 8.

1972. *Creoleon griseus*, Holzel, *Beitr. naturk. Forsch Sudw-Dtl.*, 1 : 61.

Measurement : Male : Length of fore wing, 30 mm; hind wing, 28 mm.

Material examined : One male : Indian : Lakshadweep Islands: Kadmat, in the compound of Dak Bungalow, 12. iv. 1984 (*D. K. Mondal* and party coll.)

Distribution : India (West Bengal, Bihar, Orissa, Uttar Pradesh, Maharashtra, Tamil Nadu, Lakshadweep Is.); Iran; Israel; Sudan; Egypt.

Remarks : The species is for the first time recorded from Lakshadweep Islands.

SUMMARY

Description of an unknown female and the new locality records of two species belonging to the family Myrmeleontidae collected during Lakshadweep Survey, 1984, have been provided in this paper.

ACKNOWLEDGEMENT

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REFERENCES

- Ghosh, S. K. 1981. New records of Neuroptera : Planipennia from the Lakshadweep Island, India, coupled with a short note on the taxonomic variation of *Centroclisis eustalsacta* (Gerst.). *Bull. Zool. Surv. India*, 3 (3) : 269-270.
- Ghosh, S. K. Contribution to the taxonomical studies of Neuroptera (Suborder Planipennia) from eastern India. I. Family Myrmeleontidae. *Rec. zool. Surv. India, Occ. pap.* (in press).

