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RECORDS OF NEMATODES FROM COLDWATER
FISHES OF GARHWAL, HIMALAYA

By

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INTRODUCTION

An extensive survey and study of the helminth parasites of fishes from different regions of India has been made. But, the Garhwal Himalaya, being isolated, has not been explored so far for the type of helminth infection. In the present study a number of helminth parasites were collected from different coldwater fishes of Garhwal Himalaya. Of the nematodes, two species are found to be new and other species reported here, are being reported for the first time from this region. All the measurements are recorded in mm.

Family—Rhabdochonidae (Travassos, Artigas and Pereira, 1928) Skrjabin, 1946

Genus—*Rhabdochona* Railliet, 1916

Rhabdochona (Rhabdochona) hellichi (Sramek, 1901)
Chitwood, 1933

Description (Based on 30 specimens) : These nema'odes are medium sized with smooth cuticle. The mouth is convex in dorsal view. The prostome is funnel-shaped. Fourteen number of fairly long anterior teeth are present. The basal teeth are present in males. The vestibule is long and becomes contracted in older specimens forming S-shaped

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structure. The oesophagus is quite long. The tail is conical with a terminal spike.

Male : Body 5.92-10.94 long, 0.06-0.17 wide ; Prostome 0.022-0.03 long, 0.02-0.022 wide ; Vestibule 0.10-0.14 long, 0.01-0.012 wide ; Muscular oesophagus 0.35-0.53 long, 0.03-0.04 wide ; Glandular oesophagus 1.64-3.45 long, 0.045-0.07 wide ; Cervical papillae at 0.045-0.092 ; Nerve ring at 0.15-0.26 ; Excretory pore at 0.25-0.39 from anterior end ; Sixteen pairs of anal papillae of which ten pairs subvental preanal and six pairs postanal ; Spicules unequal and dissimilar ; Long spicule 0.41-0.59 with a bifurcate distal tip, small spicule 0.16-0.165 long with a Distinct dorsal barb at distal tip ; Tail conical, 0.27-0.43 long with a cuticular terminal spike.

Female : Body 6.81-10.76 long, 0.15-0.20 wide ; Prostome 0.022-0.028 long, 0.02-0.023 wide ; Vestibule 0.10-0.13 long, 0.018-0.02 wide ; Muscular oesophagus 0.38-0.49 long, 0.03-0.04 wide ; Glandular oesophagus 1.99-4.17 long, 0.08-0.12 wide ; Cervical papillae at 0.045-0.092 ; Nerve ring at 0.16-0.24, Excretory pore at 0.248-0.39 from anterior end ; Vulva post equatorial, 2.67-2.96 from anterior end ; Eggs not visible ; Tail 0.32-0.45 long.

Hosts : *Schizothorax richardsonii*, *S. plagiosomus* and *Crossocheilus latius*.

Habitat : Small intestine.

Locality : Srinagar-Garhwal (Altitude 560 m).

Remarks : This is the first report of the species from Garhwal Himalaya.

***Rhabdochona (Globochone) sarana* Karve and Naik, 1951**

Description (Based on 10 female specimens) : These nematodes are small sized. The pharynx is barrel-shaped. Eight anterior and four about basal teeth are present. The oesophagus is fairly long. The uterine branches are opposed and vagina is short. The tail bears a crown of three conical processes.

Female : Body 4.69-6.50 long, 0.12-0.14 wide ; Prostome 0.02-0.023 long, 0.013-0.015 wide ; Vestibule 0.08-0.082 long, 0.009-0.01 wide ; Muscular oesophagus 0.19-0.22 long, 0.06-0.08 wide ; Glandular oesophagus 3.045-4.126 long, 0.09-0.11 wide ; Cervical papillae at 0.12-0.13 ; Nerve ring 0.11-0.12 from anterior end ; Vulva 3.265-4.116 from anterior end ; Vagina muscular with well developed vaginal lips ; Tail with a crown of conical processes 0.14-0.16 long.

Host : *Tor putitora*

Habitat : Small intestine

Locality : Srinagar-Garhwal (Altitude 560 m)

Remarks : The present parasite differs from the original form described by Karve and Naik (1951) in body size and generic host only. This is the first report of this nematode from this locality and the host.

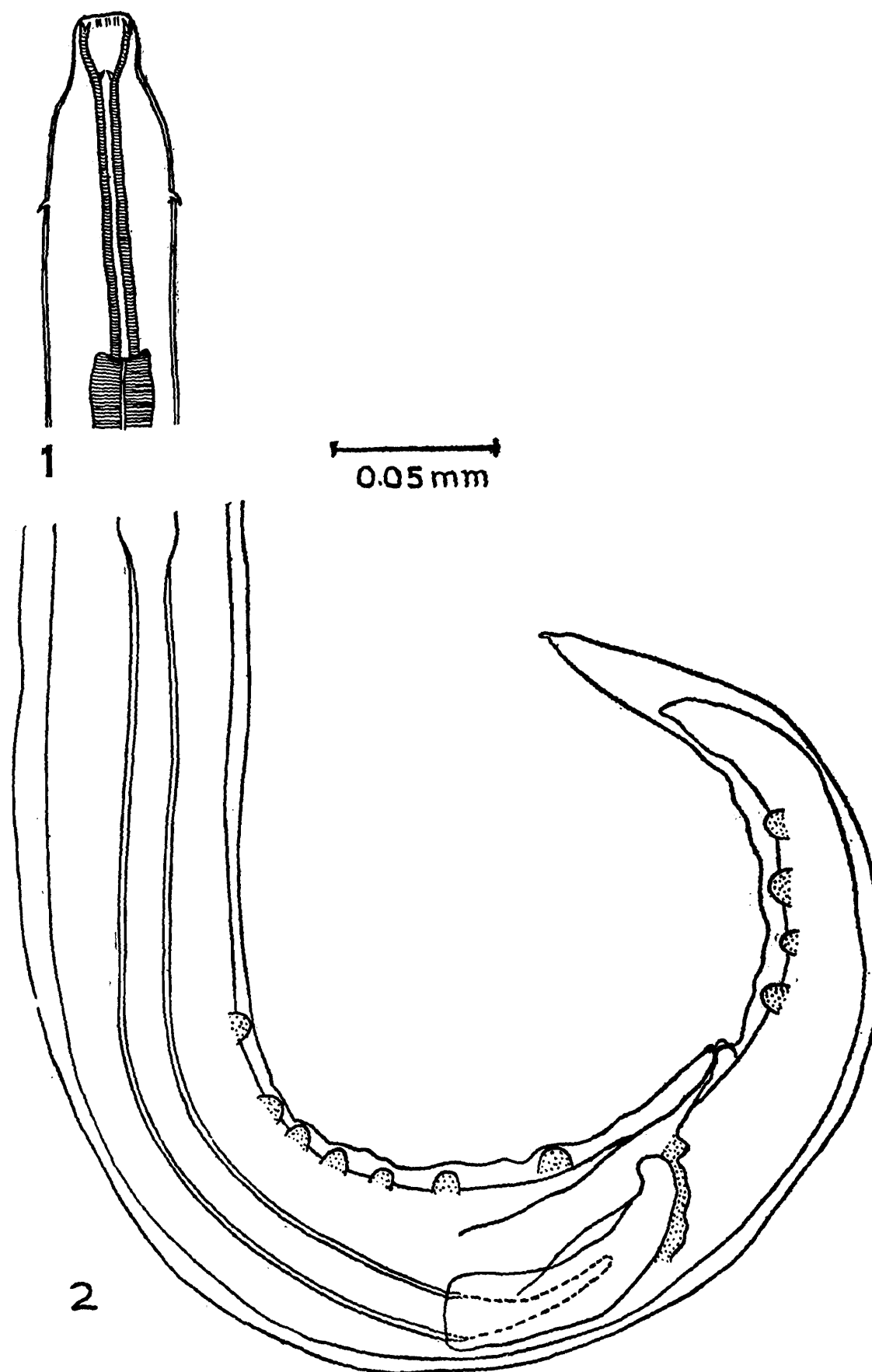
***Rhabdochona noemeeheili* sp. n.**

(Figs. 1 & 2)

Description (Based on six specimens) : These nematodes are small sized with smooth cuticle. The cervical papillae are medium sized and situated near the middle of the vestibule. The lateral teeth are arranged in couples, two pairs on each side. The vestibule is short. The spicules are unequal and dissimilar. The tail is bluntly conical.

Male : Body 3.40-3.98 long, 0.12-0.13 wide Prostome 0.015-0.017 long, 0.019-0.021 wide ; Vestibule 0.099-0.12 long, 0.01 wide ; Muscular oesophagus 0.21-0.23 long ; Glandular oesophagus 1.43-1.50 long ; Cervical papillae at 0.16-0.17 from anterior end ; Twelve pairs of caudal papillae of which seven pairs preanal, five pairs postanal ; Spicules unequal and dissimilar ; Smaller spicule, boat-shaped and relatively wide with rounded end, 0.096-0.099 long ; Longer spicule 0.36-0.37 with bluntly pointed distal tip ; Tail bluntly pointed, 0.164-0.169 long.

Host : *Noemacheilus montanus*



Figs. 1-2. *Rhabdochona noemacheili* sp. n. ; Fig. 1. male (anterior end, lateral view). Fig. 2. male (posterior end, lateral view).

Habitat : Small intestine

Locality : Srinagar-Garhwal (Altitude 560 m)

Remarks : Hitherto two species viz. *Rhabdochona* (*Rhabdochona*) *sellichi* (Sramek 1901) Chitwood, 1933 (cited Moravec 1975) and *Rhabdochona* (*Globochona*) *minima* Moravec and Daniel, 1976 are known under the genus from the same generic host. The new species comes close to *R. (Rhabdochona) hellichi* in the number of caudal papillae but differs from it in the size of the body and shape of both spicules. It also differs from *R. (Globochona) minima* in the number of caudal papillae and shape of the spicules. It however comes very close to *Rhabdochona (Rhabdochona) glyptothoracis* Karve and Naik, 1951, in the shape of spicules but differs in body size and in the number and arrangement of caudal papillae. The species has been named after the name of the fish *Noemacheilus montanus*.

Family Cucullanidae Cobbold, 1164.

Genus **Cucullanus** Muller, 1777

Cucullanus thrai sp.n.

(Figs. 3 & 4)

Description : (Based on 10 specimens) : The head bears to prominent lateral lips, each provided with three papillae and bounding a slit-like mouth. The oesophagus is muscular throughout, dilated anteriorly forming false buccal capsule and is also enlarged posteriorly. The intestine is simple. The vulva is situated in the posterior half of the body. The lower lip of the anus is prominent. The tail is bluntly conical with a terminal spike.

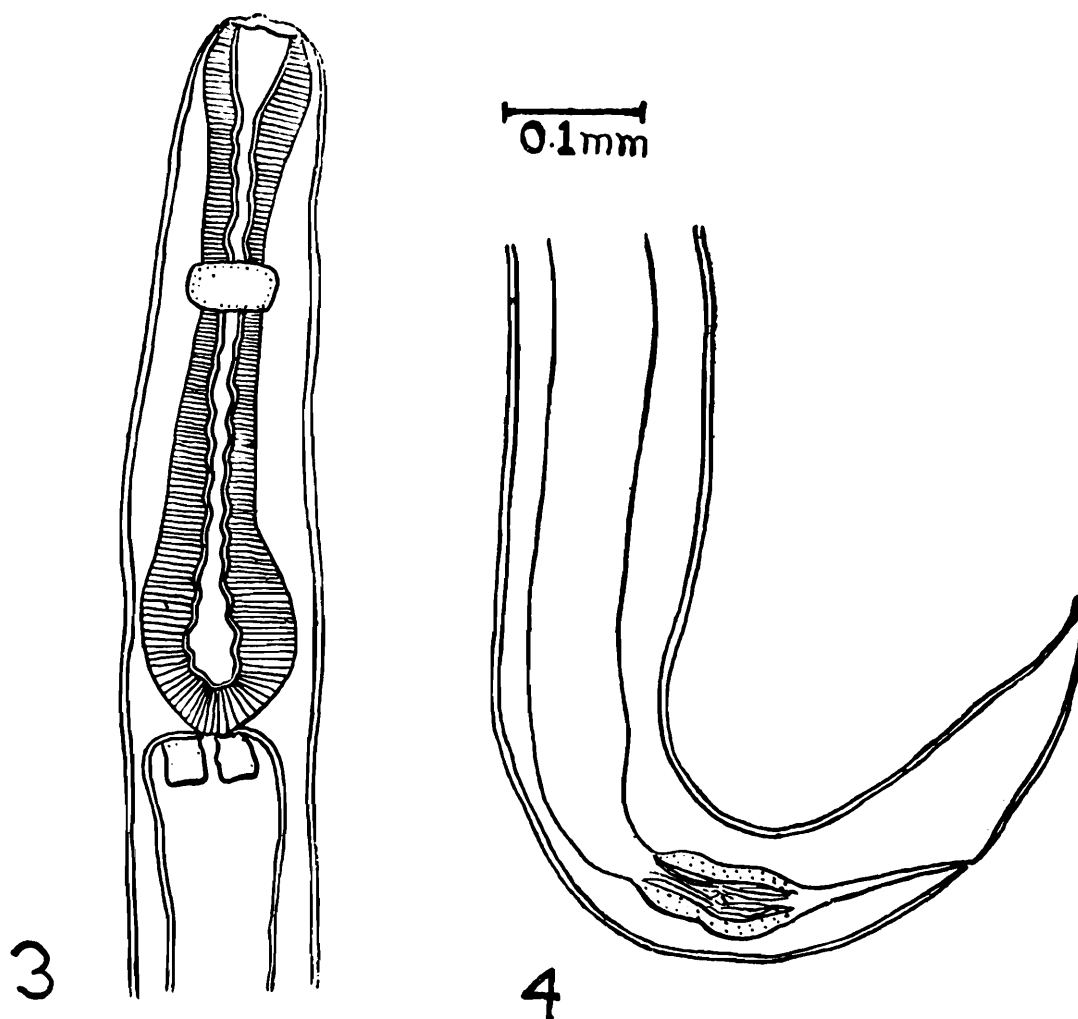
Female : Body 3.75-4.02 long, 0.15-0.16 wide ; Buccal capsule 0.075-0.076 long, 0.07-0.071 wide ; Oesophagus 0.43-0.45 long ; Nerve ring at 0.18 and vulva at 2.37-2.56 from anterior extremity ; Tail 0.21-0.23 long.

Host : *Tor pntitora*.

Habitat : Small intestine.

Locality : Srinagar-Garhwal (Altitude 560 m).

Remarks : Hitherto four species, viz. *C. jaiswali* (Ali, 1957) Petter, 1974, *C. jalnaensis* (Kalyankar, 1971) Petter, 1974, *C. lucknowi*, Campana-Rouget, 1961 and *C. pseudcutropi*, Agrawal, 1967 of the genus *Cucullanus* are known from Indian



Figs. 3-4. *Cucullanus torai* sp. n. ; Fig. 3. female (anterior end, laterla view), Fig. 4. female (tail end, lateral view).

freshwater fishes. The present spencies differs from the above species in the body size and shape of the tail. This is the first generic from this host and from the locality, Garhwal Himalaya. It has been named after the name of the fish *Tor putitora*.

Family ANISRKIDAE (Ralillet and Henry, 1912)

Skriabin and Karokhin, 1945

Genus *Goezia* Zeder, 1800

Goezia sp.

Description (Based on 20 specimens); The body is medium sized. The cuticle has a series of rings provided with backwardly directed spines. The lips are flattened and expanded outwards, separated from the body by a constriction. The oesophagus is slightly swollen into a bulb giving off posteriorly a long ventricular appendage. The intettinal caecum is present. The vulva is situated in the middle of the body. The tail is abruptly tapering to a blunt process.

Female : Body 5.55-6.36 long, 0.25-0.27 wide ; Oesophagus 0.64-0.73 long, 0.05-0.055 wide ; Intestiny1 caecum forwardly directed 0.36-0.40 long ; Oesophageal or ventricular appendage backwardly directed, 0.74-0.78 long ; Vulva 3.02-3-25 from anterior end ; Tail 0.11-0.13 long.

Hosts : *Garra gotyla*, *Crosocheilus latius* and *Schizothorax* spp.

Habitat : Small intestine.

Locality : Srinagar-Garhwal (Altitude 560 m).

Remarks : Identification upto the species level could not be done. This is the first generic record from these hosts and from the locality of Garhwal Himalaya.

SUMMARY

The study deals with an account of five species of nematodes from coldwater fishes Garhwal Himalaya. Two nematodes, *Rhabdochona noemacheili* from *Noemacheilus montanus* and *Cucullanus torai* from *Tor putitoro* were new to science. *Rhabdochona* (*Rhabdochona*) *hellichi* (Sramek, 1901) Cnitwood, 1933 from *Schizothorax richardsonii*, *S. plagiostomus* and *Crossocheilus latius* ; *Rhabdochona* (*Globochona*) *sarana* Karve *latius* and *Schizothorax* ssp. have been reported for the first time from this area.

ACKNOWLEDGEMENTS

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CONTRIBUTION TO THE TAXONOMICAL STUDIES
OF NEUROPTERA (SUBORDER PLANIPENNIA)
FROM EASTERN INDIA

II. FAMILY ASCALAPHIDAE

By

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INTRODUCTION

The Ascalaphids are beautiful insects and superficially resemble Odonata by the colour and form of the wings and, Rhopalocera of the order Lepidoptera by long and clubbed antennae. The present study has been undertaken to provide an account of the collections made by different survey parties of Zoological Survey of India from the eastern part of the subcontinent, viz., Sikkim, Arunachal Pradesh, Assam, Meghalaya, West Bengal and Orissa. It incorporates a brief review on earlier investigation, external morphological characters, classification and provides the taxonomical account of the concerned species along with the geographical distribution. Altogether fifteen species have so far been reported from eastern region, of which all but one have been included in the taxonomic account while the remaining one has been reviewed from literature. From the examined material, redescription of two species, description of a subspecies, additional characters and morphovariations of the known species have been incorporated and the new locality records have also been indicated. Besides, running keys to all the taxa examined, suitable illustrations and references have been provided.

EARLIER INVESTIGATION

Ascalaphids are known from India on the basis of account rendered by various workers including Westwood (1848), Walker (1853), MacLachlan (1873), van der Weele (1908), Needham (1909), Banks (1911, 1914, 1933), Fraser (1922), Navas (1924), Alexandrov Martynov (1926), Kimmins (1949), Ghosh (1977, 1985) and Ghosh & Sen 1977). Amongst a total of thirtythree species reported by these workers from India, only fifteen are so far known to occur in the eastern Peninsular and Himalayan sectors.

EXTERNAL MORPHOLOGICAL CHARACTERS

The author in his first report on the Family Myrmeleontidae from Eastern India which has been published (*vide occ. Pap. Rec. Zool. Surv. India, 52*), has given in detail the terminology of different morphological features. As this family closely resembles myrmeleontids, so author feels it unnecessary to provide the morphological details in this family. However, the diagnostic characters along with the male and female genitalic features (*vide Tjeder, 1977*) are briefed hereunder :

Antenna : long, slender and strongly clavate at apex ; eye : simple, entire or divided by a groove ; thorax : stout ; wings : with long or short excision at the extreme base of posterior margin ; axillary angle generally prominent ; hypostigmatic cell not differentiated ; pterostigma large or small ; 2-4 rows of apical cells beyond pterostigma ; Cu_2 strong and free but running parallel and very close to $1A$; radial cuneate area always present (Comstock, 1918) ; leg : spur on hind tibia as long as first or equal to two or three basal tarsal segments taken together ; abdomen : laterally compressed ; shorter or longer than wings ; male genitalia : with ectoproct in the form of a pair of convex plates or forceps or projections and without trichobothria ; gonarcus hood-like and arch-like ; parameres either connected to gonarcus or immovably fixed to it apically ; pelta, a vertical plate, situated between the parameres ; pulvinus, a

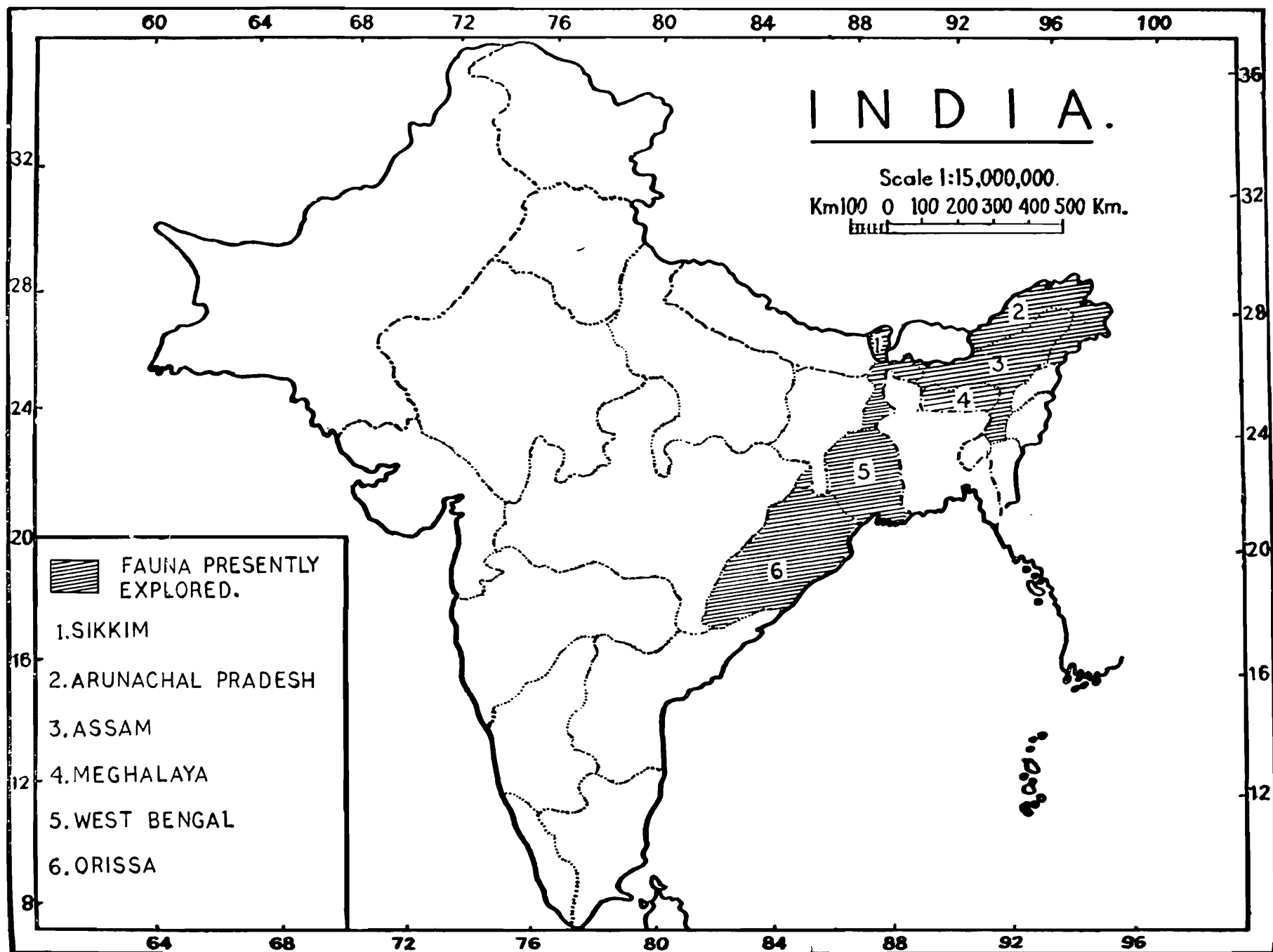
bag-like, thumb-like or finger-like eversion of the gonosaccus which is situated on either side of gonarcus and clothed with gonosetae ; hypandrium internum stem-like, very small, weakly sclerotised and unpigmented ; female genitalia : with ectoproct usually like a pair of convex plates ; ventrovalvae, a pair of hairy plates situated below the 8th tergite ; interdens, a plate with a downwardly directed tooth situated centrally or apically between the ventrovalve ; linguella, a tongue-like, usually unpaired structure situated under the lateral hind margin of 8th sternite ; distivalvae, a pair of hairy valvae situated distally of the linguella and ventrally of the 9th tergite ; spermatheca small, usually sclerotised and unpigmented.

BRIEF REVIEW ON CLASSIFICATION

Burmeister (1839), Lefebvre (1842), Rambur (1842), Walker (1853) and others grouped the earlier described species under the generic divisions or sections. MacLachlan (1873) attempted to arrange about 103 species in 27 new generic groups. Van der Weele (1908) classified the family into three subfamilies, viz., Protascalaphinae, Haplogleniinae and Ascalaphinae. The first two subfamilies have further been subdivided into several tribes to accommodate different genera while the tribal classification for the last one has been omitted by him (*loc. cit.*). The author has, however, principally adopted the classification given by van der Weele (*Loc. cit.*) without considering the tribes.

GEOGRAPHICAL DISTRIBUTION

The pattern of distribution of the fauna under study highlights certain important aspects. Out of a total of fifteen species known from Eastern India, *Idricerus decrepitus* (Walker) and *Ascalaphus dicax* (Walker) are represented from the Palaearctic region, the latter extending to the Papuan area. Of the remaining species from the Oriental region, eight are endemic in India. The material from Eastern India, constitute about 50% of the entire Indian fauna. The majority of these occur in the north-eastern Himalayas, particularly



Sikkim, Assam, Meghalaya and Darjeeling of West Bengal. It is interesting to note that five species constitute new locality records for the different states of India.

SYSTEMATIC ACCOUNT

Key to the subfamilies of the family ASCALAPHIDAE

Eyes entire	...	<i>Haplogleniinae</i>
Eyes equally or unequally divided into two parts	...	<i>Ascalaphinae</i>

Subfamily *HAPLOGLENIINAE*

Key to the genera of the subfamily Haplogleniinae

Apical field of both wings with 3 cell rows ; without dark-coat ; antennae dark coloured but not ringed with light colour	...	<i>Protidrecerus</i> Van der Weele
Apical field of both wings with 2 cell rows ; crossveins more or less with dark-coat ; ante- nnae pale or somewhat darker but always ringed with light colour	...	<i>Idricerus</i> MacLachlan

Genus *Protidrecerus* van der Weele

Protidrecerus van der Weele, 1908, *Cat. coll. Selys*, 8 : 61.

Characters : Antenna : naked, unicoloured and much shorter than forewing ; wings : membrane hyaline ; fore and hind border parallel ; tip blunt and rounded ; forewing : with semicircular excision at the base of inner margin ; apical filled with 3-rows of cells ; veins unicoloured and without any band ; axillary angle almost even ; hindwing : considerably shorter and narrower than forewing ; legs : spur of hindtibia as long as two basal tarsal segments taken together ; abdomen : unicoloured and shorter than hindwing in male.

Type species ; *Idricerus exilis* MacLachlan.

Distribution : India, China and Japan.

Remarks : The genus is represented by only one species from India which is dealt with here.

Protidricerus elwesi (MacLachlan)

Idricerus elwesi MacLachlan, 1891, *Trans. ent. Soc. Lond.*, p. 512.

Protidricerus elwesi, van der Weele, 1908, *Cat. coll. Selys*, 8 : 63.

Material examined : 1 ♀ : India : Arunachal Pradesh, Tirap dist., Namdapha, Gibbon land, 2.v.1981, Coll. *S Biswas and party*.

Remarks : The details of the species have been provided in earlier paper (*vide* Ghosh : 1985).

Genus Idricerus MacLachlan

1871. *Idricerus* MacLachlan, 1871, *J. Linn. Soc.*, 11 : 200.

1908. *Idricerus*, van der Weele, 1908, *Cat. coll. Selys*, 8 : 65.

Characters : Antenna shorter than wings, straight ; club very large, broadly and shortly pyriform ; a dense tuft of hairs on face and between antennae ; eye : entire ; thorax : very villose ; wing : elongate, rather narrow, slightly dilated at middle ; apex subacute ; forewing : with a semicircular excision at the very base of inner margin followed by a small obtusely angular dilatation ; not appendiculate, with network moderately open ; leg : moderately stout ; spur of hind tibia hardly as long as 1st two tarsal joints taken together ; abdomen : shorter than wing.

Type species : *Ascalaphus decrepitus* Walker

Distribution : Central and South-East Asia.

Indicerus decrepitus (Walker)

Ascalaphus decrepitus Walker, 1859, *Trans. R. ent. Soc. Lond.*, (2) 5 : 197.

Idricerus decrepitus, MacLachlan, 1871, *J. Linn. Soc.*, 11 : 240.

Idricerus decrepitus, Weele, 1908 *Cat. Coll. Selys*, 8 : 66.

Idricerus decrepitus, Needham, 1909, *Rec. Indian Mus.*, 3 : 197.

Measurement : 1 ♀ : length of antenna, 24 mm ; forewing, 35 mm ; hindwing, 30 mm.

Material examined : India : Meghalaya ; Risa colony Shillong, 19.vii.1973, Coll. *M. Rynth*.

Distribution : INDIA : Meghalaya, Kashmir ; Turkestan.

Remarks : The specimen (Fig. 1) agrees well with the description given by Weele (1908).

Subfamily *ASCALAPHINAE**Key to the genera of the subfamily Ascalaphinae*

- | | |
|--|-------------------------------|
| 1. Ectoproct in both sexes short. ... | 2 |
| — Ectoproct in both sexes especially in male long ... | 5 |
| 2. Forewing or both wings pterostigma short, as long as high ; apical field broad | 3 |
| — Pterostigma long, not less than twice as long as high ; apical field narrow ... | 4 |
| 3. Body long and densely hairy ; wing tip obtuse and angular ; hindwing distinctly broadened at hind margin, antenna long reaching pterostigma of forewing in length ... | <i>Agrionosoma</i> Weele |
| — Body short and sparsely hairy, wing tip rounded ; hindwing not broadened at hind margin ; antenna short, not reaching pterostigma of forewing in length ... | <i>Suhalacsa</i> Hagen |
| 4. Abdomen of male as long as or longer than hindwing ; antenna straight ; legs slender ... | <i>Suphalomitus</i> Weele |
| — Abdomen of male distinctly shorter than hindwing ; antenna in either sex specially in male distinctly bent ; legs stout ... | 6 |
| 5. Wing tip angular ; abdomen longer than wings in males ; antenna denticulate internally at base ... | <i>Acheron</i> Lefebvre |
| — Wing tip rounded ; abdomen much shorter than wings ; antenna without teeth at base ... | <i>Hybris</i> Lefebvre |
| 6. Wings appendiculate ; spur of hind tibia as long as first two tarsal segments taken together ... | <i>Glyptobasis</i> MacLachlan |
| — Wings not appendiculate ; spur of hind tibia as long as or shorter than 1st tarsal segment ... | <i>Ascalaphus</i> Fabricius |

Genus *Agrionosoma* Weele

Agrionosoma Weele, 1908, *Cat. Coll. Selys*, 8 : 169.

Characters : Body : Single coloured, dark, long and densely hairy ; head : small with long dense hairs ; antenna :

reaching up to pterostigma of forewing ; club elongate, spindle-shaped with apex rounded ; eye : lower and upper halves almost equal ; thorax : elongate and densely hairy ; wing : pterostigma short, as long as high ; apical field broad ; apex rounded ; hindwing : anal margin distinctly broadened ; leg : slender, dark and less hairy ; spur of hind tibia longer than 1st tarsal segment ; abdomen : bare, long, slender and longer than the hind wing.

Type-species : *Agrionosoma swinhoei* Weele

Distribution : India and Thailand.

***Agrionosoma dohrni* Weele**

Agrionosoma dohrni Weele, 1908, *Cat. Coll. Selys*, 8 : 171.

Redescription : Labrum, clypeus and frons : dark brown with concolorous hairs ; antenna : light brown but club dark and conspicuously ringed with yellow, reaching up to pterostigma of forewing ; vertex : with dark brown and grey hairs ; thorax : greyish brown and clothed with greyish brown long and soft hairs ; wing (Fig. 2) : hyaline ; apex obtuse and angular ; pterostigma yellow, almost as long as high ; venation brown ; pterostigma with 4 crossveins ; about 8 crossveins before Rs : apical field with 3 rows of cells ; hindwing : shorter and narrower than forewing ; 5 crossveins before Rs ; leg : black with black hairs, femur yellow with whitish and black hairs ; spur of hind tibia almost equal to first two tarsal segments taken together ; claw brown ; tibia and tarsus with black bristles ; abdomen : longer than hindwing but shorter than forewing ; dark brown with apex of each segment bordered black ; 1st segment with long black hairs at middle ; other segments with short black hairs:

Measurements : 1 ♂ : length of forewing, 33 mm ; hindwing, 27 mm ; abdomen, 29 mm.

Material examined : 1 ♂ : India : West Bengal : 1 km. S. W. of Reyana forest rest house on the way to Rambhi Hill range, 400 m., Darjeeling, 31.iii.1973, Coll. *H. S. Sharma*.

Distribution : INDIA : Sikkim and West Bengal.

Remarks : Weele (1908) described this species from Sikkim from a male specimen. It is recorded for the first time from West Bengal.

Genus **Suhpalacsa** Lefebvre

Suhpalacsa Lefebvre, 1842, *Guer. Mag. Zool.*, 4 : 92.

Suphalasca Hagen, 1866, *Stettin. ent. Ztg.*, 27 : 273.

Suphalasca (Part), Brauer, 1868, *Verh. Zool. bot. Ges. Wien.*, 18 : 397.

Suphalasca, MacLachlan, 1871, *J. Linn. Soc.*, 11 : 253.

Suphalasca, Weele, 1908, *Cat. Coll. Selys*, 8 : 157.

Characters : Body : with scanty hairs ; antenna : straight approximately reaching about three fourth of the length of the forewing, but not reaching pterostigma ; club rounded and almost straight ; thorax : smaller than head and scarcely villose ; elongate and small, considerably reticulated ; anterior and posterior margins almost parallel ; forewing : broad, rounded and excised at base ; axillary angle not prominently excised ; pterostigma short and quadrilateral ; apical field with 3 rows (seldom 2) of cells ; hindwing : constricted at anal margin ; spur of hindtibia as long as 1st joint of tarsus ; straight, without appendices and half or three fourths of the length of hindwing.

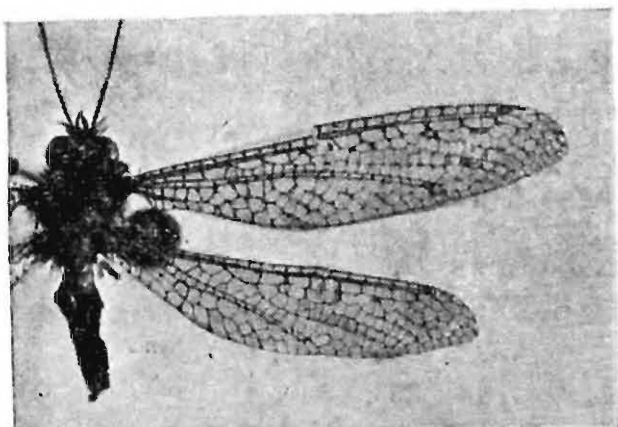
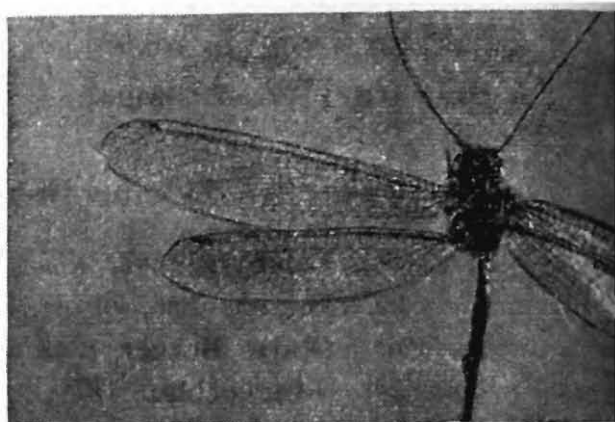
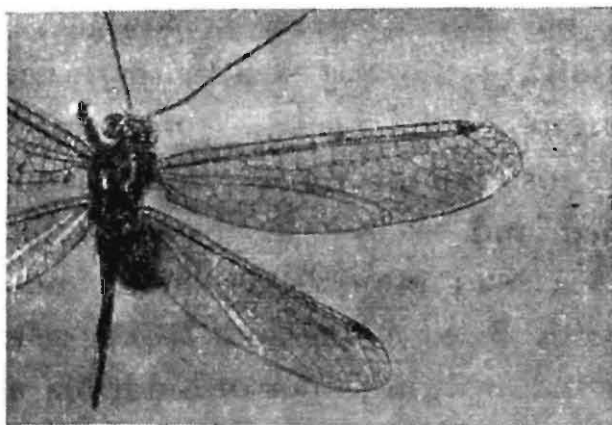
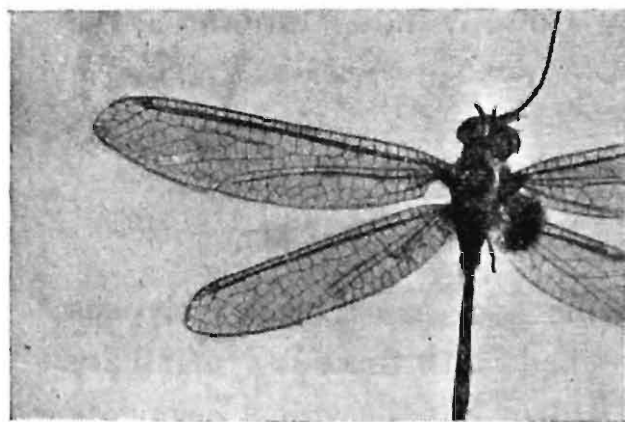
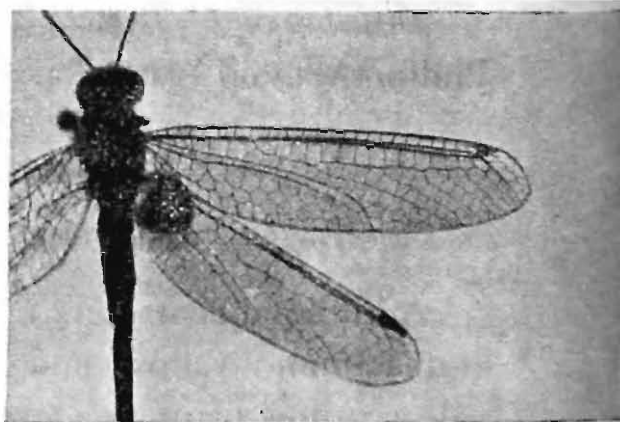
Type-species : *Ascalaphus flavipes* Leach

Distribution : Africa, Israel, Taiwan, India, Indonesia, the Philippines and Australia.

Suhpalacsa orsedice Banks

Suphalasca orsedice Banks, 1914, *Proc. Acad. nat. Sci.*, 66 : 617.

Additional characters : Frons and gena : black ; clypeus and labrum : yellow and blotched with fuscous ; maxillary palp : yellow ; antenna : pale brown but the apical segments and the club more darker ; pronotum : pale yellow ; with anterior and posterior margins bordered black ; mesoscutum : yellow with dark brown shades laterally ; metascutellum : pale yellow ; upper half of supraepisternum black ; wing (Fig. 3) : hyaline with yellowish suffusion at the extreme

**1****2****3****4****5**

Figs. 1-5. 1. *Idricerus decrepitus* (Walker), fore- and hindwing, 2. *Agrionosoma dohrni* Weele, fore- and hindwing, 3. *Suhpalacsa orsedice* Banks, fore- and hindwing, 4. *Suphalomitus verbosus* (Walker), fore- and hindwing, 5. *Suphalomitus brevis* Kimmins, fore- and hindwing.

base ; apex rounded ; all veins and crossveins brown ; forewing ; pterostigma brown ; axillary angle obtuse ; leg : coxa, tibia and tarsus black ; femur brownish yellow ; claw dark brown ; spur of hind tibia almost equal to 1st tarsal segment ; abdomen : blackish.

Measurement : 1 ♀, 1 ex. (without abd.) : length of antenna, 20 mm ; forewing, 29-30 mm ; hindwing, 25-25.5 mm.

Material examined : 1 ♀, 1 (without abd.) : INDIA : West Bengal : Rongpo rest house, Darjeeling, 31.v.1974, Coll. *Jo athan and party*.

Distribution : INDIA : West Bengal.

Remarks : Banks (1914), while describing the species, did not mention exact locality. But the present species is recorded here from West Bengal.

Genus *Suphalomitus* Weele

Suphalomitus Weele, 1909, *Cat. Coll. Selys*, 8 : 181.

Characters : Body : dark grey or brown and sparsely hairy ; antenna : straight ; hindwing : distinctly shorter than forewing ; pterostigma elongate, at least twice as long as maximum width ; apex of wing angular and tongue-shaped ; leg : slender and dark ; abdomen : as long as or longer than hindwing in male ; cylindrical ; 1st abdominal tergite without elevation.

Type-species : *Suphalomitus verbosus* (Walker)

Distribution : Africa, Malagasy, India, Sri Lanka, the Phillippines, Australia.

Key to species of the genus Suphalomitus

2nd abdominal tergite without tuft of black bristles at base ; pterostigma elongate ; labrum and clypeus yellowish ; greyish hairs between bases of antennae	...	<i>verbosus</i> (Walker)
2nd abdominal segment with tuft of black bristles ; labrum and clypeus brownish ; dense blackish brown hairs between bases of antennae	...	<i>brevis</i> Kimmins

Suphalomitus verbosus (Walker)

Ascalaphus verbosus Walker, 1853, *Cat. Brit. Mus. Neur.*, p. 426.

Ascalaphus profanus Walker, 1853, *Ibid.*, p. 428.

Helicomitus verbosus, MacLachlan, 1871, *J. Linn. Soc.*, 11 : 262.

Helicomitus profanus MacLachlan, 1871, *Ibid.*, p. 262.

Suphalomitus verbosus, Weele, 1908, *Cat. Coll. Selys*, 8 : 183.

Suphalomitus verbosus, Fraser, 1922, *Rec. Indian Mus.*, 24 : 514.

Suphalomitus verbosus, Kimmins, 1949, *Ann. Mag. nat. Hist.* (12) 2 : 4.

Material examined : 1 ♂ ; India : Motinagar, Shillong, Meghalaya, Coll. Jyrwa, 5.v.1973 ; 1 ♂ : Singlam, Sikkim, 300 m. 7.vii.1979, M. Prasad and party, Coll.

Measurements : 2 ♂ ♂ : length of forewing, 28-29 mm ; hindwing, 22 mm.

Distribution : INDIA : Karnataka, West Bengal, Meghalaya ; Sri Lanka.

Remarks : The specimens (Fig. 4) differ from each other in colouration of wing and also of pterostigma. In the specimen from Sikkim the wings are tinted with light brown all throughout and the pterostigma is dark brown in colour while the wings are clear and hyaline and the pterostigma is yellowish in specimen from Meghalaya. The species is for the first time recorded from Meghalaya.

Suphalomitus brevis Kimmins

Suphalomitus brevis Kimmins, 1949, *Ann. Mag. nat. Hist.*, (12) 2 : 15.

Measurement : 1 ♂ (?) ; length of forewing, 30 mm ; hindwing, 24 mm.

Material examined : 1 ♂ : INDIA ; West Bengal : Gayabari, Stn. No. 1, alt. 1236 m., Darjeeling, 24.iv.1971, Coll. A.R. Bhawmick and party.

Distribution : INDIA : Karnataka, Kerala, Tamil Nadu and West Bengal.

Remarks : The tip of abdomen is lost. So, the sex has been doubtfully determined by the measurement of the wings (Fig. 5) and also by the presence of a tuft of black bristles in the 2nd tergite of the abdomen.

Genus *Acheron* Lefebvre

Acheron Lefebvre, 1842, *Guer. Mag. Zool.*, 92 : 6.

Hybris (part) Hagen, 1866, *Stettin. ent. Ztg.*, 27 : 273.

Acheron, MacLachlan, 1871, *J. Linn. Soc.*, 11 : 265.

Acheron, Weele, 1908, *Cat. coll. Selys*, 8 : 227.

Characters : Antenna : shorter than forewing ; denticulate internally at base ; club broadly pyriform ; eye : with upper division slightly larger than lower one ; thorax : elongate, dilated at middle, especially in females ; tip angular ; extreme base of fore-wing obliquely excised and followed by a slight dilatation ; rather densely reticulated ; Cu₂ confluent with 1A in both wings ; pterostigma large with apical portion obliquely extended ; costal area in hindwings of female somewhat dilated at base ; leg : spur of the hind tibia hardly longer than the first tarsal joint ; abdomen : very long in male, much longer than the wings but in female shorter ; slender and laterally compressed in both sexes ; appendices absent ; gonopod short in males.

Type-species : *Ascalaphus trux* Walker.

Distribution : China, India, Bangladesh, Bhutan, Burma, Malay.

Acheron trux (Walker)

Ascalaphus trux Walker, 1853, *Cat. Brit. Mus. Neur.*, p. 432.

Ascalaphus loquax Walker, 1853, *Ibid.*, p. 434.

Ascalaphus anticus Walker, 1853, *Ibid.*, p. 434.

Ascalaphus longus, Walker, 1853, *Ibid.*, p. 453.

Acheron longus, MacLachlan, 1871, *J. Linn. Soc.*, 11 : 265.

Helicomitus ctenocerus Gerst., *Mitt. Naturw. ver. Neu Vorpomm. U. Rugen*, 15 : 101.

Acheron trux, Weele, 1908, *Cat. Coll. Selys*, 8 : 228.

Acheron trux, Fraser, 1922, *Rec. Indian Mus.*, 24 : 516.

Distribution : INDIA : Assam, Meghalaya, Sikkim, West Bengal ; Bhutan and Burma.

Remarks : Walker (1853) recorded four species of *Acheron* viz., *A. trux*, *A. loquax*, *A. longus* and *A. anticus*. Weele (1908) synonymized the last three species with the first and redescribed it. He (*loc. cit.*) illustrated the female of that species

and also of *loquax* which was considered to be a subspecies. He, however, did not specifically mention the nomino-typical subspecies. On careful examination of a series of specimens available for study, the author came to the conclusion that one more subspecies, *A. trux trux* (Walker) may also be added from North-east India. Both the sexes of each subspecies differ from each other by the colouration of wings. These are dealt with here.

Key to subspecies of Acheron trux (Walker)

Wings sub-hyaline or pale brown in ♂ ;
hindwing in female bright tawny except at
tip ; subcostal region with dark brown tinge
in both sexes ... *A. trux loquax* (Walker)

Wings hyaline in ♂ ; hindwing in female
without tawny colouration ; subcostal region
pale brown in both sexes ... *A. trux trux* (Walker)

Acheron trux loquax (Walker)

Ascalaphus loquax Walker, 1853, *Cat. Brit. Mus. Neur.*, p. 432.

Acheron trux loquax, Weele, 1908, *Cat. Coll. Selys*, 8 : 228.

Description : Male : Frons : brownish yellow with tawny hairs ; clypeus, labrum and vertex : dark brown with black hairs ; antenna : shorter than wings ; scape and pedicel blackish brown with greyish hairs intermingled with white ; flagellar segments brown, dentate at base but the dentation gradually diminishing in size towards apex ; pronotum : brown, darker anteroposteriorly ; mesonotum : brown with yellow markings and blackish hairs ; metanotum : brown with black hairs ; wings (Fig. 6) : tip angular ; membrane brown ; extreme base darkbrown ; costal and subcostal areas darker than other regions ; each costal blackish brown, broadly margined with brown clouds in forewing ; pterostigma darkbrown with 6 cross veins ; all other veins and cross veins blackish brown ; apical field with 4-rows of cells ; hairs on veins and marginal fringes short and black ; abdomen : longer than wings, dark brown ; 1st tergite laterally with a few, long, black, soft hairs and black bristles ; 3rd

tergite laterally with black bristles at base ; 4th tergite naked ; 5th to 8th tergite thickly clothed with short black hairs ; sternite dark brown with an yellowish brown spot at base of each segment from 4th to 8th ; ectoproct short with short black hairs except at tip which is with long and black hairs.

Measurement : 3 ♂ ♂ : length of forewing, 37-38 mm ; hindwing, 31-33 mm.

Female : Differs from ♂ by the following characters : forewing (Fig. 7) ; foreborder tinged with darkbrown along costal and subcostal areas before pterostigma ; crossveins before Rs and all but few between R and 1st branch of Rs clouded with brown ; hindwing : bright tawny except at tip ; abdomen : shorter than wings ; tergites orange-yellow ; 1st and 2nd tergites with long black hairs ; all other segments with short black hairs ; sternite black.

Measurement : 14 ♀ ♀ : Length of forewing, 41-43 mm ; hindwing, 37-39 mm.

Material examined : 1 ♂, 1 ♀ : India, Goalpara, date & Coll. nil ; 1 ♀ : Jamduar, 4.vi.1973, Coll. S. S. Saha ; 1 ♀, 1 ♂, upper Assam, date & Coll. nil ; 8 ♀ ♀ : Sibsagar, date & Coll. nil ; 1 ♂ : without locality data ; 1 ♀ : Meghalaya, Risa colony, 4.ix.1974, Coll. R. Mathur ; 1 ♀ : Assam, Kamrup, Mothorguri, Manas Sanctuary, 19.iii.1975, Coll. S. S. Saha ; 1 ♀ : Assam, Sibsagar, date & Coll. nil.

Distribution : INDIA : Assam, Meghalaya and Bengal

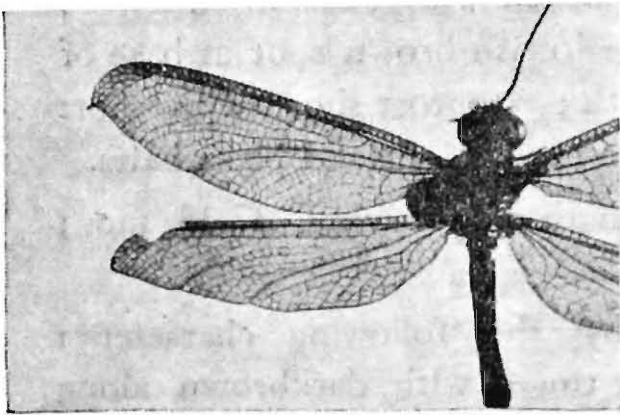
Remarks : The subspecies is for the first time recorded from Assam and Meghalaya.

***Acheron trux trux* (Walker)**

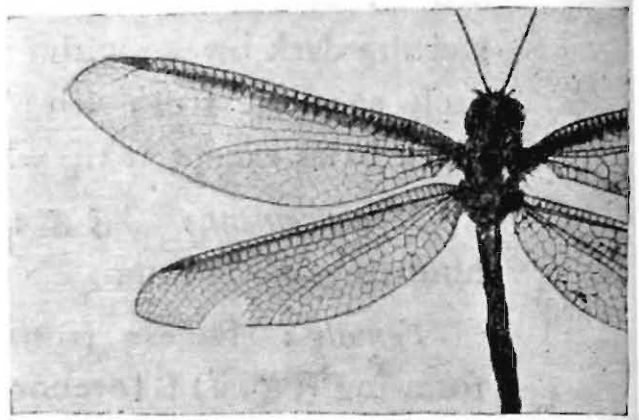
Ascalaphus trux Walker, 1853, *Cat. Brit. Mus. Neur.*, p. 432.

Acheron trux, Weele, 1908, *Cat. Coll. Selys*, 8 : 228-230.

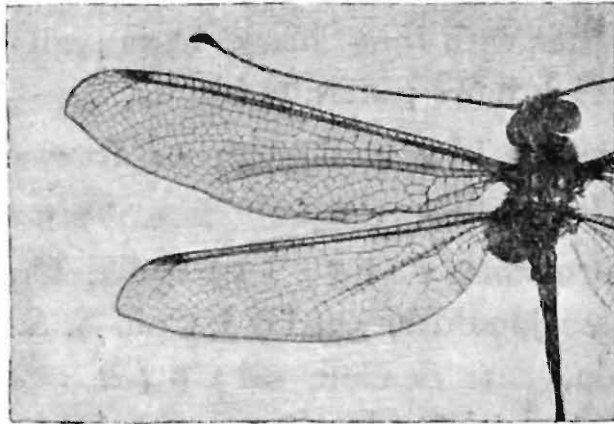
Characters : Labrum : with a row of black hairs at margin ; frons and vertex : with tawny hairs ; meso- and metapleura : yellow ; wings (Fig. 8) : pterostigma with 6 crossveins ; legs ; deep red ; spurs of hindtibia equal to two tarsal segments taken together ; abdomen : 1st, 2nd and



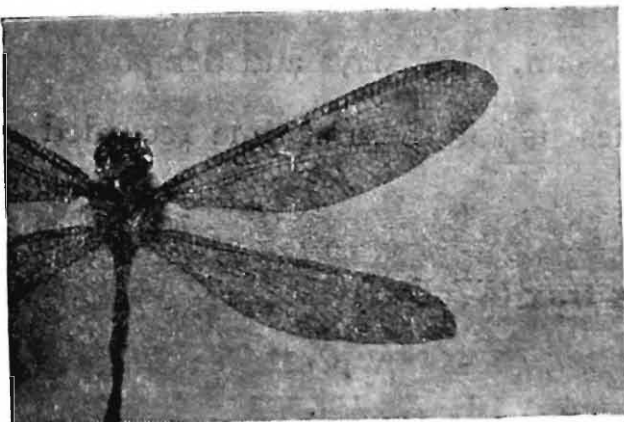
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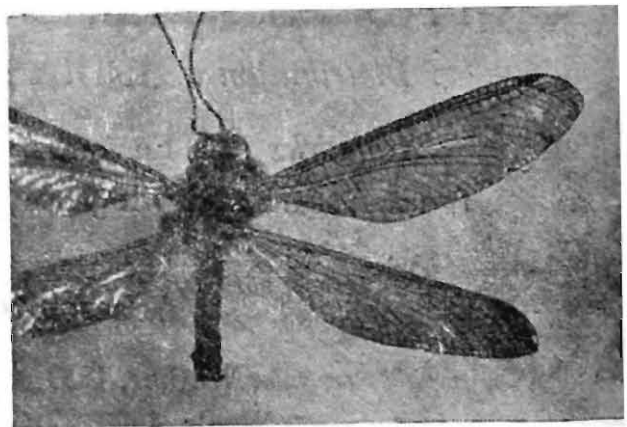
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Fig.s 6-10. 6. *Acheron trux loquax* (Walker), fore- and hindwing, male, 7. *Acheron trux loquax* (Walker), fore- and hindwing, female, 8. *Acheron trux trux* (Walker), fore- and hindwing, 9. *Hybris angulata* (Westwood), fore- and hindwing, 10. *Glyptobasis cornuta* Kimmins, fore- and hindwing.

3rd segments yellow with brown margin ; all other segments brown ; 1st and 2nd tergites with tawny wooly hairs and short, black bristles ; sternites with an yellow spot at base of each segment and also with black hairs ; 1st, 2nd and 3rd sternites with a longitudinal yellow stripe interrupted at middle with a narrow dark brown line.

Measurement : 4 ♂♂ : length of forewing, 37.40 mm., hindwing, 33-35 mm., 1 ♀ : length of forewing, 42 mm ; hindwing, 39 mm.

Material examined : 1 ♂ : India, Darjeeling, Rongpo, Andherikhola, 18.v.1979, Coll. *P. Haldar and party* ; 1 ♂, Assam, Mothorguri, Manas sanctuary, 13.v.1175, Coll. *S. S. Saha* ; 1 ♀ : Sibsagar, date—Nil, Coll. *S. E. P.* ; 1 ♂ : Meghalaya, Dawki, 10.v.1972, Coll. *S. Biswas* ; 1 ♂ : Shillong, Mawpa, 31.viii.1967, Coll. *R. K. Varshney*.

Distribution : INDIA : Sikkim, Assam, Maghalaya, West Bengal.

Remarks : In Assam specimens the pterostigmal colour is pale brown while in Darjeeling specimens the colour is dark brown. However, the subspecies constitutes a new locality record for Meghalaya.

Genus *Hybris* Lefebvre

Hybris Lefebvre, 1842, *Guer Mag. Zool.*, 92 : 6.

Hybris, Hagen, 1866, *Stett. Ent. Ztg.*, 27 : 293.

Hybris, Brauer, 1868, *Verh. Zool. bot. Ges. Wien.*, 18 : 397.

Hybris, MacLachlan, 1873, *J. Linn. Soc.*, 11 : 266.

Characters : Antenna : as long as wing ; in males basal portion bent outwardly and without teeth or hair ; in female straight ; club shortly but broadly pyriform, almost truncate ; eye : upper half larger than the lower one ; wing : elongate, considerably dilated at middle ; forewing : with an excision near base ; axillary angle somewhat prominent ; leg : spur of hind tibia almost as long as 1st tarsal joint ; abdomen : shorter than forewing and laterally compressed in both sexes ; male with appendices somewhat long, cylindrical and forcipate, sometimes shorter and somewhat spoon-shaped.

Type-species : *Ascalaphus javanus* Burmeister

Distribution : China, India, Indonesia, Insulinde and Japan.

***Hybris angulata* (Westwood)**

Ascalaphus (Ogcogaster) angulatus Westwood, 1848, *Cabinet Orient.*, p. 69.

Hybris angulata, MacLachlan, 1873, *J. Linn. Soc.*, 11 : 267.

Redescription : Labrum, clypeus and frons : black brown with blackish hairs ; antenna : longer than hindwing and strongly curved at base, scape and pedicel concolorous to frons and with black long hairs intermingled with white hairs ; deep excavation between frons and antennal bases ; vertex : yellow with black hairs ; thorax : pronotum black at middle with anterior and posterior margin yellow ; a broad black stripe originating on either side of the pronotum extending obliquely to the middle of yellow meso-scutellum and a narrow, black median longitudinal line on prescutum of mesothorax joining on either side with aforesaid lateral black stripe ; mesothoracic pleura dark brown with one yellow stripe ; metathorax yellow ; wings (Fig. 9) : membrane with brownish tinge specially in apical half ; costal and subcostal areas more darkbrown at extreme base than any other part ; costal, Sc and R dark brown and all other longitudinal veins black brown ; pterostigma dark brown with 5 crossveins ; apical field with 4 rows of cells ; hairs on veins and margin short and black ; fringes on hind margin at extreme base long and greyish ; hindwing : shorter and narrower than forewing ; leg : blackish brown with long and short black hairs ; foretibia with comb-like hairs at inner margin ; fore femur yellow ventrally ; spur of hind-tibia equal to two tarsal segments taken together ; claws black and large ; abdomen : tergites 1-8 yellow with a black ring at the end of each segment ; ectoproct darkbrown, forcipate with an yellow spot at base, also with long black hairs at base and short black bristles at rounded tip ; 9th sternite large, black and with two lateral protruberance ; apex of 9th sternite elongate, angulated and placed below the ectoproct.

Measurements : 2 ♂♂ : Length of forewing, 34-36 mm., hindwing, 31-32 mm., abdomen (with ectoproct) 22-25 mm., 1 ♀ : length of forewing, 35 mm., hindwing, 30 mm.

Material examined : India : 1 ♂ : Meghalaya, Cachar, Loharband, 3.x.1975, Coll. N. Muraleedharan and party ; 1 ♂ : West Bengal, Nadia, Haringhata farm, 28.vii.1975, Coll. S. K. Ghosh and 1 ♀ : Calcutta, date & Coll. Nil.

Distribution : INDIA : Assam, Meghalaya and West Bengal ; Bangladesh ; Burma.

Remarks : The specimens from West Bengal differs from Meghalaya specimen by the clear hyaline wings except brownish tinge at the extreme base and apical field specially of the hindwing. However, the species is a new record for West Bengal and Meghalaya.

Genus *Glyptobasis* MacLachlan

Glyptobasis MacLachlan, 1971, *J. Linn. Soc.*, **11** : 268.

Glyptobasis, Weele, 1908, *Cat. Coll. Selys*, **8** : 240.

Characters : Antenna : shorter than wings ; slightly bent proximally in males ; the bent portion being provided with a small sharp tooth or spine on each segment ; club in the form of a short truncate cone ; thorax : slightly villose ; wing : elongate, much dilated at middle ; densely reticulated ; Cu₂ confluent with 1A in both wings ; fore-wing : appendiculate at base ; leg : spur of hindtibia almost equal to two first tarsal joints taken together ; abdomen : rather shorter than wings, variably coloured with bright markings ; slender in males with a pair of claw-like corneous appendices ; appendix superiores not forming forceps.

Type species : *Ascalaphus dentifera* Westwood

Distribution : India, Burma and Sri Lanka.

Key to species of the genus *Glyptobasis*

- Antenna angled near base ; 10th sternite with a pair of curved horns, each with a small and strong branch at the inner margin towards the base ... *cornuta* Kimmins
- Antenna without angle ; 10th sternite with a pair of curved claws, each strongly swollen at middle but without any branch at the inner margin towards base ... *dentifera* (Westwood)

***Glyptobasis cornuta* Kimmins**

Glyptobasis cornuta Kimmins, 1949, *Ann. Mag. nat. Hist.*, (12) 2 : 25.

Measurement : ♂ ♂ : length of body, 23-27 mm ; antenna 22-24 mm ; forewing, 31-32 mm ; hindwing, 27-30 mm.

Material examined : INDIA : 4 ♂ ♂ : Orissa : Nāndan-kanan, 27.vii.1974, coll. N. Acharya.

Distribution : INDIA : Orissa.

Remarks : Kimmins (1949) doubtfully recorded this species (Fig. 10) from India but this study shows the existence of the species in Orissa. The description of ♂ agrees well with the description given by Kimmins.

***Glyptobasis dentifera* (Westwood)**

Ascalaphus (*Ogcogaster* ?) *dentifer* Westwood, 1848, *Cab. Orient. Ent.*, p. 69.

Ascalaphus dentifer Walker, 1853, *Cat. Brit. Mus. Neur.*, p. 421.

Glyptobasis dentifera, MacLachlan, 1871, *J. Linn. Soc.*, 11 : 278.

Glyptobasis dentifera, Weele, 1908, *Cat. Coll. Selys*, 8 : 241.

Glyptobasis dentifera, Needham, 1909, *Rec. Indian Mus.*, 3 : 198.

Glyptobasis dentifera, Fraser, 1922, *Ibid.*, 24 : 516.

Glyptobasis dentifera, Kimmins, 1949, *Ann. Mag. nat. Hist.*, 12(2) : 19.

Measurement : ♀ ♀ : length of body, 25-26 mm ; antenna, 26-30 mm ; forewing, 33-36 mm ; hindwing, 30-32 mm. ♂ : length of body, 28 mm ; forewing, 33 mm ; of hind wing, 30 mm.

Material examined : 1 ♀ : INDIA : Orissa : Jhanpara, Angul, 30.ix.1972, Coll. K. Rai and party ; 2 ♀ ♀ : Orissa :

Inspection bungalow, Dhenkanal, 5-7.x.1972, Coll. *K. Rai and party* ; 1 ♂ : Orissa : Godianali, Dhenkanal, 8.x.1972, Coll. *K. Rai and party*.

Distribution : INDIA : Goa, Maharashtra, Punjab, Uttar Pradesh, South India, Orissa and West Bengal.

Remarks : The species (Fig. 11) agrees well with the descriptions given by Weele (1908) and Kimmins (1949).

Genus *Ascalaphus* Fabricius

Ascalaphus Fabricius, 1775, *Syst. Ent.*, p. 313.

Helicomitus MacLachlan, 1871, *J. Linn. Soc.*, 11 : 261.

Ascalaphus, Tjeder, 1972, *Ent. scand.*, 3 : 153.

Characters : Antenna : shorter than wings ; often irregularly sinuous in basal half in male ; club short ; eyes : lower division shorter than upper one ; thorax : villose ; wings : appendiculate ; tip rounded ; apical field narrow and generally with two rows of cells ; pterostigma elongate ; inner margin of forewing hardly excised near base ; leg : spur of hindtibia as long as or shorter than first tarsal segment ; abdomen : shorter than hindwing ; ectoproct in both sexes short.

Type-species : *Myrmeleon barbarus* Linnaeus

Distribution : Africa (except the south-western and central parts of Sahara), Malagassy, Israel, India, Sri Lanka, Malay states, Sumatra, Java, the Philippines, Japan.

Key to the species of genus Ascalaphus

1. Posterior lobe of prothorax in male large with two rounded processes ; mesoscutum in male with a small triangular process on either side ... *prothoracicus* (Kimmins)
- Posterior lobe of prothorax in male normal in size without any process ; mesoscutum in male without any process ... 2

2. 4th tergite of abdomen in male very much swollen ... *abdominalis* (Kimmins)
- 4th tergite of abdomen in male generally not swollen or very slightly swollen ... 3
3. 4th and 5th tergite of abdomen in male without long, black setae ; angle of anal lobe of forewing very much obtuse ... *dicax* (Walker)
- 4th and 5th tergite of abdomen in male with long, black setae ; angle of anal lobe of forewing less obtuse ... *sinister* (Walker)

***Ascalaphus prothoracicus* (Kimmins)**

Helicomitus prothoracicus Kimmins, 1949, *Ann. Mag. nat. Hist.*, (12) 2 : 6.

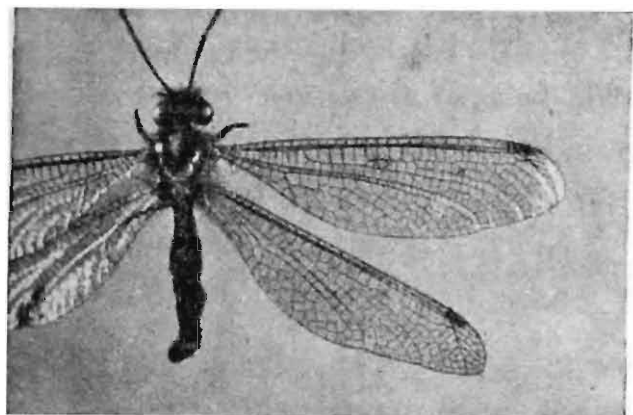
Characters : Antenna : shorter than hindwing ; pronotum : posterior lobe with long yellowish hairs intermingled with brown hairs in addition to tuft of backwardly directed black hairs on the rounded process ; wings (Fig. 12) : clear, hyaline or tinged with brownish ; venation darkbrown ; pterostigma brown with 5-6 cross veins ; two rows of apical cells beyond pterostigm ; abdomena : brown.

Measurement : ♂ : length of antenna, 16-19 mm ; forewing, 26-29 mm ; hindwing, 22-25 mm ; ♀ : length of antenna, 19-20 mm ; forewing, 30-31 mm ; hindwing, 25-26 mm.

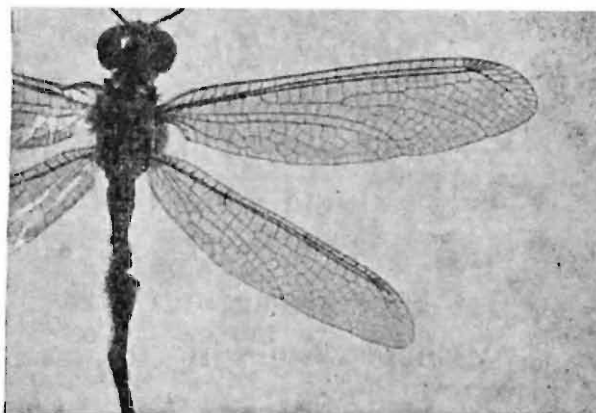
Material examined : 1 ♂ : India : Assam : Jamduar, 30.vi.1973, Coll. S. S. Saha and party. 1 ♂ : Calcutta, Maulali, 16.v.1975, Coll. S. S. Saha ; 1 ♂ : Sikkim, Rongpo, River bed, 28.v.1979, Coll. M. S. Shishodia & party ; 2 ♀ ♀ , 3 ♂ ♂ , Howrah, Botanical Garden, grass field near, 1982, Coll. A. K. Hazra & party.

Distribution : INDIA : Assam.

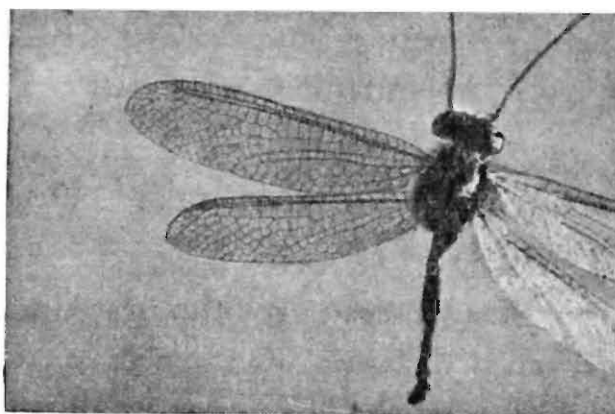
Remarks : Kimmins (1949), while recording the species, did not mention the exact locality. However, at present the species is reported from Assam, Sikkim and West Bengal.



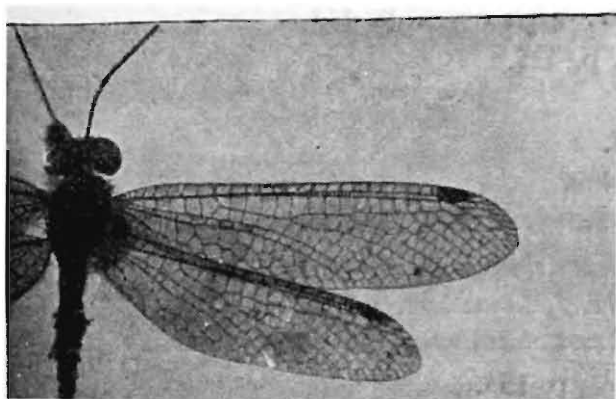
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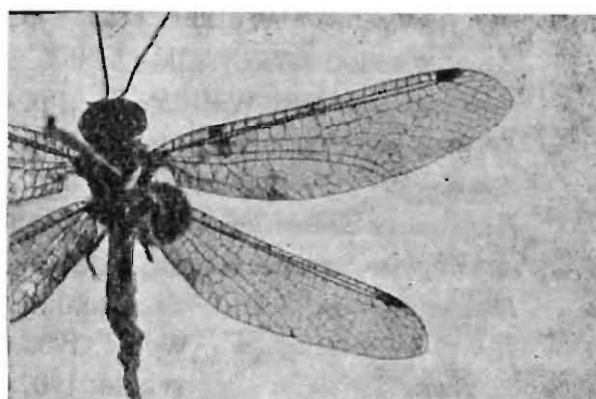
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Figs. 11-15. 11. *Glyptobasis dentifera* (Westwood), fore- and hindwing, 12. *Ascalaphus prothoracicus* Kimmins, fore- and hindwing, 13. *Ascalaphus abdominalis* Kimmins, fore- and hind wing, 14. *Ascalaphus dlcax* (Walker), fore- and hindwing, 15. *Ascalaphus sinister* (Walker), fore- and hindwing.

Ascalaphus abdominalis (Kimmings)

Helicomitus abdominalis Kimmings, 1949, *Ann. Mag. nat. Hist.*, (12) 2 : 4-6.

Morphovariation : Face : yellowish with yellowish white hairs ; yellow hairs encircling the base of antenna ; vertex : elevated with black hairs intermingled with white ; pleura : pale yellow ; wings (Fig. 13) : pterostigma of wings brownish yellow with 6 cross veins and 2 rows of apical cells beyond it ; lateral margin of the 4th abdominal tergite without V-shaped excision.

Measurement : ♂ ♂ : length of antenna, 16-17 mm ; forewing, 24-26 mm ; hindwing, 20-22 mm.

Material examined : 1 ♂ : India : West Bengal : Malda College camp, Malda, 11.x.1975, Coll. B. C. Nandi ; 1 ♂ : Orissa : Angul, Inspection bungalow, 3.x.1972, Coll. K. Rai & party ; 1 ♂ : Nandankanan, -vii.1974, Coll. L. M. Acharya.

Distribution : INDIA : Karnataka, Orissa and West Bengal.

Remarks : The species is for the first time recorded from West Bengal and Orissa. The species varies from the original description by the characters as shown above.

Ascalaphus dicax (Walker)

Ascalaphus dicax Walker, 1853, *Cat. Brit. Mus. Neur.*, p. 423.

Ascalaphus immotus Walker, 1853, *Ibid.*, p. 425.

Ascalaphus procax Walker, *Ibid.*, p. 425.

Ascalaphus odiosus Walker, *Ibid.*, p. 426.

Ascalaphus insimulans Walker, *Ibid.*, p. 429.

Ascalaphus insimulans Westwood, 1888, *Trans. R. Ent. Soc. Lond.*, p. 1.

Ascalaphus cervinus Hagen, 1858, *Verh. Zool.-bot. Ges. Wien*, p. 481.

Helicomitus insimulans MacLachlan, 1871, *J. Linn. Soc.*, 11 : 262.

Helicomitus insimulans, Weele, 1905, *Notes Leyden Mus.*, 26 : 200.

Helicomitus insimulans, Weele, 1907, *Ibid.*, p. 153.

Suphalasca cervinus Gerstaecker, 1885, *Mitt. naturw. ver. Neu. vorpomm. u. Rugen*, 16 : 88.

Suphalasca placida Weele, 1906, *Notes Leyden Mus.*, 26 : 228.

Suphalasca placida, Weele, 1907, *Ibid.*, 28 : 156.

Helicomitus dicax, Weele, 1908, *Cat. coll. Selys*, 8 : 178.

Helicomitus dicax, Fraser, 1922, *Rec. Indian Mus.*, 24 : 514.

Helicomitus dicax, Kimmings 1949, *Ann. Mag. nat. Hist.*, (12) 2 : 2.

Additional characters : Vertex, gena, frons, clypeus and maxillary palp : yellow ; clypeus separated from frons by a deep excavation and vertex with long hairs ; antenna : basal segments with long yellowish hairs intermingled with brown ; reaching pterostigma of hindwing ; pro-meso-and metanotum : with long black hairs on lateral margin ; mesoscutellum yellow ; supra-episternum with long, black hairs on upper half and yellowish white on lower half ; forewing (Fig. 14) : pterostigma yellow with 3-4 crossveins ; 2 rows of apical cells beyond pterostigma ; leg : slender and yellow ; abdomen : smaller than antenna ; brown, but laterally black ; 1st segment with long, black hairs laterally but all other segments shortly ciliated.

Measurement : ♀ ♀ : length of body, 20-23 mm ; antenna, 18-20 mm ; forewing, 30-32 mm ; hindwing, 25-26 mm.

Material examined : 1 ♀ : India ; Orissa : Gadianali, Dhenkanal, 8.x.1972, Coll. *K. Rai and party* ; 1 ♀ : Assam : Jamduar, 30.vi.1973, Coll. *S. S. Saha and party* ; 1 ♀ : Calcutta, vi.1973, Coll. *R. Rahaman* ; 1 ♀ : Calcutta, 17.v.-1975, Coll. *D. K. Thakur* ; 2 ♀ ♀ , West Bengal, Bethuaduari Reserve Forest, 6.vii.1979, Coll. *A. K. Hazra & party* ; 1 ♀ : Orissa, Baligaon, Puri, 18.iii.1974, Coll. *S. K. Ghosh*.

Distribution : Arabia ; China ; India (Assam, West Bengal, Orissa) ; Sri Lanka ; Indonesia ; the Philippines ; New Guinea ; Japan.

***Ascalaphus sinister* (Walker)**

Ascalaphus sinister Walker, 1853, *Cat. Brit. Mus. Neur.*, p. 424.

Helicomitus sinister Kimmins, 1949, *Ann. Mag. nat. Hist.*, (12) 2 : 3.

Additional characters : Vertex : brown ; clypeus, labrum and frons : yellow ; frons with white hairs and vertex with blackish brown hairs intermingled with white ; maxillary palp : yellow to fuscous ; antenna : yellow, reaching almost the pterostigma of hindwing ; pronotum : with long black hairs on hind margin ; meso-and metascutellum : with white hairs on hind margin ; supra-episternum with dense, short,

black hairs on upper half and also with a few, long and white hairs on the lower half ; forewing (Fig. 15) : pterostigma brown with 6 crossveins and two rows of apical cells beyond it ; hindwing : pterostigma with 5 crossveins ; abdomen : orange yellow.

Measurement : ♀ ; Length of antenna, 18 mm ; forewing, 29 mm ; hindwing, 25 mm ; abdomen, 14 mm.

Material examined : 1 ♀ : India : Orissa : Amlapara, Dhenkanal, 5.x.1972, Coll. K. Rai and party.

Distribution : INDIA : Bombay, Orissa, West Bengal ; Sri Lanka.

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

SPECIES REVIEWED FROM LITERATURE

Genus *Ogcogaster* Westwood

Ogcogaster Westwood, 1848, *Cab. Orient. Ent.*, p. 69.

Ogcogaster, Hagen, 1866, *Stettin. ent. Ztg.*, 27 : 374.

Ogcogaster, Brauer, 1868, *Verh. Zool.-bot. Ges. Wien.*, 18 : 397.

Ogcogaster, MacLachlan, 1873, *J. Linn. Soc.*, 11 : 264.

Ogcogaster, Weele, 1908, *Cat. Coll. Selys*, 8 : 253.

Type species : *Ascalaphus* (*Ogcogaster*) *tesselatus* Westwood.

Remarks : Westwood (1848) while describing *tesselatus* under *Ascalaphus* Fabricius placed it in the subgenus *Ogcogaster*. Subsequent workers gave generic status to this subgenus and the species *tesselatus* Westwood (= *tesselata*) was included under the genus *Ogcogaster* which is so far known from India and Pakistan. Amongst a total of four species, viz., *O. kempi* Fraser, *O. kirbyi* Weele, *O. segmentator* (Westwood) and *O. tessellata* (Westwood), only the last one is so far reported from eastern India which is dealt with here.

Ogcogaster tessellata (Westwood)

Ascalaphus (*Ogcogaster*) *tessellatus* Westwood, 1848, *Cab. Orient. Ent.*, p. 69.

Ogcogaster tessellatus, MacLachlan, 1873, *J. Linn. Soc.*, 11 : 265.

Ogcogaster tessellata, Fraser, 1922, *Rec. Indian Mus.*, 24 : 518.

Distribution : INDIA : Western Himalayas including Himachal Pradesh, Gujarat, Bihar ; Pakistan ; Rawalpindi.

Remarks : The description, as given by Westwood (1848) and Weele (1908) along with the illustration, provides ample scope to consider *O. tessellata* as a good species.

SUMMARY

The paper incorporates the taxonomic account along with earlier investigation, salient morphological characters, brief review on classification and geographical distribution of the family Ascalaphidae under the suborder Planipennia of the order Neuroptera from Eastern India. Out of a total of fourteen species examined, male of *Acheron trux loquax* (Walker) has been described, two species, viz., *Hybris angulata* (Westwood) and *Agrionosoma dohrni* Weele redescribed, five species and two subspecies established as new locality records for the area under consideration. Running keys to all the taxa, their morpho-variations, relevant illustrations and references have been provided. Besides, the literature review of one more species has also been dealt with. Thus, an account of a total of fifteen species distributed over ten genera under two subfamilies of Ascalaphidae from Eastern India has been furnished in the paper.

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APHIS GOSSYPHII GLOVER (INSECTA : HOMOPTERA :
APHIDIDAE), A NEW PEST OF BETEL VINE IN
WEST BENGAL, INDIA

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INTRODUCTION

Aphis gossypii Glover (Homoptera), known as cotton aphid, is the commonest aphid in India. The species is remarkable for its colour variation and extreme polyphagism depending upon the seasonal fluctuation in population and also physiological condition of host plants.

A perusal of literature reveals that *A. gossypii* Glover infests about 459 species of plants belonging to 85 families in India. Besides, it has also been recorded on undetermined plants belonging to 20 plant families. *A. gossypii* shows the highest degree of polyphagism among Aphididae in India.

During the course of survey for the aphid fauna in and around Calcutta, the authors came across *A. gossypii* infesting the under surfaces of leaves of the betel vine plant (*Piper betle* : Family : *Piperaceae*), one of the important crops in the village areas and the major source of income for some people.

Although aphid fauna is thoroughly explored, no species was found attacking this, important crop until Joshi and Mathur (1967) reported *Aphis gossypii* Glover infesting it from Western India (Rajasthan).

The present finding is, therefore, of interest since it constitutes a new host record from West Bengal in North-East India. Its occurrence on *Piper betle* in other parts of the country is yet to be ascertained.

Material examined : Many apterous and alate viviparous females and numerous apterous and alatoid nymphs from *Piper betle*, India : West Bengal, Biraballavpara, 24 Parganas, 25.iii.1985, Coll. L. K. Ghosh.

Biological notes : The aphids are found to infest heavily the under surface of the leaves. As a result, the leaves gradually fade out and finally dry up. The ants *Solenopsis geminata* (Fabr.) and *Sima rufonigra* Mays were found in association with the aphids.

Measurements (in mm) of apterous viviparous female : Length of body 1.4-1.6 ; width of body 0.80-1.0 ; antenna 1.0-1.32 ; antennal segment III 0.20-0.25, IV 0.17-0.19, V 0.14-0.16. VI (0.10+0.22-0.28) ; ultimate rostral segment 0.12 ; second joint of hind tarsus 0.10 ; siphunculus 0.30-0.33 ; cauda 0.14-0.16.

Measurements (in mm) of alate viviparous female : Length of body 1.1-1.5 ; width of body 0.80-0.90 ; antenna 0.80-0.90 ; antennal segment III 0.14-0.15, IV 0.13-0.14, V 0.14-0.15, VI (0.10+0.20-0.25) ; ultimate rostral segment 0.10 ; second joint of hind tarsus 0.10 ; siphunculus 0.18-0.20 cauda ; 0.17-0.19.

Distribution : INDIA : Through plains and hills.

ELSEWHERE : Cosmopolitan.

SUMMARY

Aphis gossypii Glover infests 459 species in 275 genera of plants belonging to 85 families in India. It proves to be the highest polyphagous species of Aphididae in India. The occurrence of the aphid on the plant *Piper betle* (Family : Piperaceae) is hitherto not recorded from Northeast India. Biological notes on infestation and measurements are provided.

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A CONTRIBUTION ON THE ESTUARINE ODONATA
OF EAST INDIA

By

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Thirty five species of Odonata from the estuarine areas of East India (West Bengal and Orissa) are recorded by FRASER AND DOVER (1922), MITRA *et al.* (1976), PRASAD AND GHOSH (1982) and RAM *et al.* (1982). In the present communication 30 species under 21 genera are reported from these areas, of which 10 spp., *Lestes viridula* Rambur, *Copera annulata* (Selys), *Pseudagrion rubriceps* Selys, *Pseudagrion australasiae* Selys, *Pseudagrion spencei* Fraser, *Aciagrion pallidum* Selys, *Ischnura aurora* (Brauer), *Agriocnemis lactiola* Selys, *Potamarcha obscura* (Rambur) and *Tholymis illarga* (Fabricius), are reported for the first time. Out of these, seven are new records for the estuarine areas of West Bengal and three for the estuarine are of Orissa. The study raises total number of species known from East India to 42. In this paper a check-list, brief field notes and keys for species are given.

LIST OF COLLECTION LOCALITIES

WEST BENGAL :

A. *District Midnapore* : Balisai, Contai, Digha, Fatehpur (Nandakumar), Junput, Mahishadal, Nimalakhya, Nandakumar and New Digha.

B. *District 24 Parganas* : Bakkhali, Canning, Diamond Harbour, Fraserganj, Ghutiari Sharif, Kakdwip, Kulpi, Namkhana and Piali.

ORISSA :

A. *District Ganjam* : Barkul and Gopalpur.

B. *District Puri* : Khandagiri, Nandakanan and Puri.

C. *Chilka* : Barkunda Island.

SYSTEMATIC ACCOUNT

Order : ODONATA
 Suborder : ZYGOPTERA
 Superfamily : LESTINOIDEA
 Family : LESTIDAE

1. *Lestes viridula* Rambur

1842. *Lestes viridula* Rambur, *Ins. Neurop.*, : 252-253.

1933. *Lestes viridula*, Fraser, *Fauna Brit. India*, 1 : 45-46.

Material : 1 ♂, Digba, 7.2.1985. coll. M. Prasad.

Remarks : Agrees fairly well with the published description of the species, but it differs by having 10-11 postnodal nervures in forewings and 11 in hindwings. Specimen was observed very active and flying within the dry long grasses present at the side of the pond. The pond is situated very nearer to the sea shore. It is recorded for the first time from the estuarine area of West Bengal.

Distribution : Kangra, Bilaspur, Dehra Dun, Nainital, Pauri Garhwal, Bihar, Deccan, Western India, South Coorg and Bombay.

2. *Lestes elata* Hagen

1858. *Lestes elata* Hagen, *Verh. zool. -bot., Ges. Wien*, 8 : 478.

1933. *Lestes elata*, Fraser, *Fauna Brit. India*, 1 : 37-40.

Distribution : Confined to Peninsular India, Orissa and Sri Lanka.

Family : PLATYCNEMIDIDAE

3. *Copera annulata* (Selys)

1863. *Psilocnemis annulata* Selys, *Bull. Acad. Belg.*, (2) 16 : 172.

1933. *Copera annulata*, Fraser, *Fauna Brit. India*, 1 : 203-206.

Material : 1 ♂, Mahishadal, 5.7.1984, coll. G. K. Srivastava.

Distribution : Assam, Himachal Pradesh, Manipur, South India, West Bengal and extended upto Malayasia.

Remarks : 12 postnodal nervures in forewings and 11 in hind wings. Specimens were seen fluttering above the pond water under the shadow of small bushes and aquatic vegetation present beneath the tree at the side of pond. Pairs were also observed in tandem flying above the surface of water. It is recorded for the first time from the estuarine area of West Bengal.

Family : COENAGRIONIDAE

4. *Ceriagrion coromandelianum* (Fabricius)

1798. *Agrion coromandelianum* Fabricius, *Ent. Syst. Suppl.* : 287.

1933. *Ceriagrion coromandelianum*, Fraser, *Fauna Brit. India*, 1 : 315-316.

Material : 1 ♂, Contai, 27.5.1984, coll. G. K. Srivastava ; 1 ♂, Kakdwip 20.10.1984, coll. M. Prasad ; 1 ♀, Bakkhali, 18.3.1985, coll. G. K. Srivastava ; 1 ♂, Barkul, 14.3.1985 ; 1 ♂, Gopalpur, 13.3.1985 and 1 ♂, Nanda Kanan, 6.3.1915, coll. R. K. Varshney.

Distribution : Throughout India, Sri Lanka, Burma, Malaysia, Indochina and South China.

Remarks : A very common species and recorded almost throughout the year nearby the estuarine areas of east India. Both males and females were observed in tandem and in copulation wheel position. Oviposition behaviour was also recorded during the course of collections.

5. *Ceriagrion cerinorubellum* (Brauer)

1865. *Pyrhosoma cerinorubellum* Brauer, *Verh. zool.- Bot. Ges. Wien.*, 15 : 511.

1933. *Ceriagrion cerinorubellum*, Fraser, *Fauna Brit. India*, 1 : 326-328.

Material : 2 ♂ ♂, Contai, 27.5.1984 and 1 ♂, 2 ♀ ♀, Mahishadal, 5.7.1984, coll. G. K. Srivastava.

Distribution : Assam, Himachal Pradesh, Coorg, Uttar Pradesh, West Bengal, Borneo, Burma, Sri Lanka, Malaysia and Sumatra.

Remarks : Adults were seen at the temporary and permanent water bodies near the sea shore. During the collection period males and females were seen commonly in tandem position.

6. *Pseudagrion microcephalum* (Rambur)

1842. *Agrion microcephalum* Rambur, *Ins. Neurop.*, : 259.

1933. *Pseudagrion microcephalum*, Fraser, *Fauna Brit. India*, 1 : 278-280.

Material : 1 ♂, Diamond Harbour, 22.10.1984, coll. M. Prasad.

Distribution : Throughout the plains of India, Burma, Sri Lanka and extending to Australia.

Remarks : Postnodal nervures are 10 in forewings and 8 in hindwings.

7. *Pseudagrion australasiae* Selys

1916. *Pseudagrion australasiae* Laidlaw, *Rec. Indian Mus.*, 12 : 21-23.

1954. *Pseudagrion australasiae*, Lieftinck, *Treubia*, 22 : 1-202.

Material : 1 ♂, Diamond Harbour, 22.10.1984, coll. M. Prasad and 1 ♂ Canning, 28.11.1984, coll. G. K. Srivastava.

Distribution : Assam West Bengal, Burma and extending into Malaysia.

Remarks : Agrees well with the published description except for having 10 postnodal nervures in forewings and 8 in hindwings. It is first time recorded from the estuarine area of West Bengal.

8. *Pseudagrion decorum* (Rambur)

1842. *Agrion decorum* Rambur, *Ins. Neurop.*, : 258.

1933. *Pseudagrion decorum*, Fraser, *Fauna Brit. India*, 1 : 286-289.

Material : 1 ♂, Kulpi, 21.10.1984 ; 1 ♂, 1 ♂, Diamond Harbour, 22.10. 1984 ; 2 ♂ ♂, Digha, 7.2.1985 and 1 ♂, Contai, 8.2.1985, coll. M. Prasad.

Distribution : Coorg, Himachal Pradesh, Nilgiris, Uttar Pradesh, West Bengal, Burma and Sri Lanka.

Remarks : 10 postnodal nervures present in forewing and 8 in hindwing. It is one of the most common species of the genus *Pseudagrion* and found near temporary and permanent water bodies. Sometimes adults were observed performing tandem, wheel and oviposition behaviour at the ponds.

9. *Pseudagrion spencei* Fraser

1922. *Pseudagrion spencei* Fraser, *Mem. Dep. Agric. India ent. Ser.*, 7 (7) : 47-84.

1933. *Pseudagrion spencei*, Fraser, *Fauna Brit. India*, 1 : 292-294.

Material : 2 ♂♂, Barkunda Islands, Chilka, 14.3.1985 and 1 ♂, Barkul, 14.3.1985 coll. R. K. Varshney.

Distribution : Bihar, Madhya Pradesh, West Bengal and Pakistan.

Remarks : It is recorded for the first time from the estuarine areas of Orissa.

10. *Pseudagrion rubriceps* Selys

1876. *Pseudagrion rubriceps* Selys, *Bull. Acad. Belg.* (2) 42 : 510.

1933. *Pseudagrion rubriceps*, Fraser, *Fauna Brit. India*, 1 : 296-299.

Material : 1 ♂ Diamond Harbour, 22.10.1984, coll. M. Prasad ; 1 ♂, Ghutiari Sharif, 29.11.1984 and 1 ♂, Piali, 30.11.1984, coll. G. K. Srivastava.

Distribution : Widely distributed in the plains and sub-montane area of continental India except desert tract and Burma.

Remarks : 9-10 postnodal nervures in forewing and 8 postnodals in hindwings. It is also one of the most common species of the genus *Pseudagrion*. It is first time recorded from the estuarine area of West Bengal.

11. *Pseudagrion andamanicum* Fraser

1924. *Pseudagrion andamanicum* Fraser, *Rec. Indian Mus.*, 26 : 411-412.

1933. *Pseudagrion andamanicum*, Fraser, *Fauna Brit. India*, 1 : 281-282.

Distribution : Andaman and Orissa (Fraser, 1933 & Prasad et. al. in press).

12. *Aciagrion pallidum* Selys

1891. *Aciagrion pallidum* Selys, *Ann. Mus. Civ. Genova*, (2) 10 : 512-513.
 1933. *Aciagrion pallidum*, Fraser, *Fauna Brit. India*, 1 : 344-345.

Material : 1 ♀, Gopalpur, 13.3.1985, coll. R. K. Varshney.

Distribution : Deccan, Dry zones of Assam, Poona, Satara and Burma.

Remarks : It is recorded for the first time from the estuarine area of Orissa.

13. *Ischnura senegalensis* (Rambur)

1842. *Agrion senegalensis* Rambur, *Ins. Neurop.*, : 276.
 1933. *Ischuura senegalensis*, Fraser, *Fauna Brit. India*, 1 : 348-351.

Material : 1 ♂, 1 ♀, Junput, 29.7.1984, coll. G. K. Srivastava, 1 ♀, Fatehpur (Nandakumar), 29.8.1984 ; 1 ♂, Kakdwip, 20.10.1984. coll. M. Prasad ; 1 ♂, Canning, 28.11.-1984 coll. G. K. Srivastava, 2 ♂ ♂, Puri, 10.3.1985 and 1 ♂, Barkul, 14.3.1985, coll. R. K. Varshney.

Distribution : Himachal Pradesh, Manipur, Maharashtra, Rajasthan, Uttar Pradesh, West Bengal, Burma, Sri Lanka and extends eastwards upto Malaysia.

14. *Ischnura aurora* (Brauer)

1858. *Agrion delicatum* Hagen., *Verh. zool.-bot. Ges. Wien.*, 8 : 479.
 1965. *Agrion aurora*, Brauer, *Verh. zool.-bot. Ges. Wien.*, 15 : 510.
 1915. *Ischnura aurora*, Ris, *Nova caledonia Zool.*, 2 : 4, 67.

Material : 1 ♂, Kulpi, 21.10.1984, coll. M. Prasad.

Distribution : Himachal Pradesh, Punjab, South India, Uttar Pradesh, Australia, Borneo, Burma, Sri Lanka, Malaysia, New Gunia, Philippines, Samoa and Sondaic Achipelago.

Remarks : It is recorded for the first time from the estuarine area of West Bengal.

15. *Rhodischnura nursei* (Morton)

1907. *Ischnura nursei* Morton, *Trans. Ent. Soc. Lond.*, : 306-307.
 1933. *Rhodischnura nursei*, Fraser, *Fauna Brit. India*, 1 : 367-371.

Distribution : Dry zones of North West India, Madhya Pradesh, parts of West Bengal and Orissa.

16. *Enallagma insulae* Fraser

1920. *Enallagma insulae* Fraser, *Rec. Indian Mus.*, 19 : 32-33.

1933. *Enallagma insulae*, Fraser, *Fauna Brit. India*, 1 : 378-379.

Distribution : Orissa.

17. *Agriocnemis lacteola* Selys

1877. *Agriocnemis lacteola*, Selys, *Bull. Acad. Belg.*, (2) 43 : 144.

1933. *Agriocnemis lacteola*, Fraser, *Fauna Brit. India*, 1 : 381-383.

Material : 1 ♂, Fatehpur (Nandakumar), 29.8.1988, coll. M. Prasad and 1 ♂, Nandakanan 6.3.1985, coll. R. K. Varshney.

Distribution : Assam, Bihar, Sikkim and West Bengal.

Remarks : It is recorded for the first time from the estuarine area of Orissa.

18. *Agriocnemis pygmaea* (Rambur)

1842. *Agrion pygmaea*, Rambur, *Ins. Neurop.*, : 278.

1933. *Agriocnemis pygmaea*, Fraser, *Fauna Brit. India*, 1 : 398-401.

Material : 1 ♂, New Digha, 26.5.1984 ; 1 ♂, Junput 29.7.1984, coll. G. K. Srivastava, 1 ♂, Kakdwip, 20.10.1984 ; 1 ♂ Canning, 28.11.1984, coll. G. K. Srivastava and 1 ♀, Nandakanan, 6.3.1985, coll. R. K. Varshney.

Distribution : Assam, Himachal Pradesh, Madras, Malabar, Manipur, Nicobar, Punjab, Rajasthan, Uttar Pradesh, West Bengal, Australia, Burma, Sri Lanka, China, Formosa, Java, Malaysia, Manila, North Guina, Philippines, Signapore and Seychelles.

Remarks : It is most commonly found near the water body. Sometime adults were observed even at very small ditches with dry or green vegetations. Tandem and wheel position invariably observed at the waterbody.

19. *Onychargia atrocyana* Selys1865. *Onychargia atrocyana* Selys, *Bull. Acad. Belg.* (2) 20 : 416.1933. *Onychargia atrocyana*, Fraser, *Fauna Brit. India*, 1 : 417-418.

Distribution : Assam, North Coorg, Malabar, Anaimalai Hills and West Bengal.

Suborder : ANISOPTERA

Superfamily : AESHNOIDEA

Family : GOMPHIDAE

20. *Ictinogomphus rapax* (Ramour)1842. *Diastatomma rapax* Rambur, *Ins. Neurop.*, : 169.1934. *Ictinus rapax*, Fraser, *Fauna Brit. India*, 2 : 373-376.

Material : 1 ♂, Nimalakhy, 31.8.1984, coll. M. Prasad.

Distribution : Throughout India, Burma, Sri Lanka and Malaysia, except in desert area.

Remarks : Differs from the published descriptions in having the nodal index $\frac{10-9}{11-14} : \frac{20-11}{15-12}$.

Family : AESHNIDAE

21. *Anax guttatus* (Burmeister)1839. *Aeshna guttata* Burmeister, *Handb. Ent.*, 2 : 840.1936. *Anax guttattus*, Fraser, *Fauna Brit. India*, 3 : 140-142.

Distribution : Assam, Annaimalai Hills, Coorg, Nilgiris, Madras Waltair, West Bengal and extends from Seychalles to Samoa in the Pacific.

Superfamily : LIBELLULOIDEA

Family : MACRODIPLACTIDAE

22. *Macrodiplax cora* (Brauer)1867. *Diplax cora* Brauer, *Ver. zool. -bot. Ges. Wien*, 17 : 20, 289.1936. *Macrodiplax cora*, Fraser, *Fauna Brit. India*, 3 : 448-450.

Distribution : Coimbatore, Plateau, Western Ghat, West Bengal, East coast of Africa, Oceania, Australia and throughout southern Asia.

23. *Aethriamanta brevipennis brevipennis* (Rambur)

1842. *Libellula brevipennis* Rambur, *Ins. Neurop.*, : 114.

1936. *Aethriamanta brevipennis brevipennis*, Fraser, *Fauna Brit. India*, 3 : 445-447.

Material : 1 ♂, 1 ♀, Mahishadal, 5.7.1984 and 1 ♂, Contai, 30.7.1986, coll. G. K. Srivastava.

Distribution : Assam, South India, West Bengal, Sri Lanka and Burma.

24. *Urothemis signata signata* (Rambur)

1842. *Libellula signata* Rambur, *Ins. Neurop.*, : 117.

1936. *Urothemis signata signata*, Fraser, *Fauna Brit. India*, 3 : 442-444.

Material : 1 ♀, Contai, 27.5.1984, coll. G. K. Srivastava ; 1 ♀, Kulpi 21.10.1984 ; 1 ♂, Balisai, 9.2.1985, coll. M. Prasad and 1 ♂, Frasergang, 19.3.1985, coll. G. K. Srivastava.

Distribution : Eastern Uttar Pradesh, Peninsular India, West Bengal, Burma and Sri Lanka.

Remarks : Occurs commonly along the sea shore during May to November. Sometimes found flying in the sky along with *Pantala flavescens* (Fabr.) within the bed of seashore.

Family : LIBELLULIDAE

25. *Lathrecista asiatica asiatica* (Fabricius)

1798. *Libellula asiatica* Fabricius, *Ent. Syst. Suppl.*, : 283.

1936. *Lathrecista asiatica asiatica*, Fraser, *Fauna Brit. India*, 3 : 281-284.

Distribution : Borneo, New Guinea, Malabar, Philippines, West Bengal, Somoa and Sondaic Archipelago.

26. *Potamarcha obscura* (Rambur)

1942. *Libellula obscura* Rambur, *Ins. Neurop.*, : 64.

1936. *Potamarcha obscura*, Fraser, *Fauna Brit. India*, 3 : 289-291.

Material : 1 ♀, Digha, 28.5.1984 ; 1 ♂, Bakkhali, 18.3.1985, coll. G. K. Srivastava ; 1 ♂, Khandagiri, 7.3.1985 and 1 ♀, Gopalpur, 13.3.1985, coll. R. K. Varshney.

Distribution : Himachal Pradesh, Madhya Pradesh, Uttar

Pradesh, West Bengal, from Sri Lanka to Tibet and from West coast of India to Philippines and Formosa.

Remarks : It is commonly found away from the seashore nearby residential area or near water bodies resting on the bushes or twigs. It is recorded for the first time from the estuarine area of West Bengal.

27. *Orthetrum sabina* (Drury)

1770. *Libellula sabina* Drury, III. *Exot. Ins.*, 1 : 114-115.

1936. *Orthetrum sabina*, Fraser, *Fauna Brit. India*, 3 : 300-302.

Material : 1 ♂, New Digha, 26.5.1984, coll. G. K. Srivastava.

Distribution : Assam, Bihar, Himachal Pradesh, Manipur, Punjab, Uttar Pradesh, West Bengal, North East Africa, Eastward across to Australia, Nepal and Pacific Islands.

28. *Orthetrum pruinosum neglectum* (Rambur)

1842. *Libellula neglecta* Rambur, *Ins. Neurop.*, : 86.

1936. *Orthetrum pruinosum neglectum*, Fraser, *Fauna Brit. India*, 3 : 311-313.

Distribution : Throughout India, Burma, Hong Kong, Nepal, Indochina, Malaya, Thailand and Tibet.

29. *Brachydiplax sobrina* (Rambur)

1942. *Libellula sobrina* Rambur, *Ins. Neurop.*, : 114.

1936. *Brachydiplax sobrina*, Fraser, *Fauna Brit. India*, 3 : 325-327.

Material : 2 ♂ ♂ 1 ♀, Balisai, 23.7.1984, coll. G. K. Srivastava.

Distribution : Assam, Himachal Pradesh, Maharashtra, Punjab, Uttar Pradesh, Travencore, Western coast of India, West Bengal, Burma and Sri Lanka.

Remarks : During the course of collection of specimens it was seen that it is very common all along the sides of a pond. Specimens were resting on twigs. These are very small in size and length in comparison to the other common

specimens of this species. Following are the measurements of male and female.

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	17.50 mm	23.00 mm	22.00 mm
Female :	16.00 mm	24.00 mm	22.00 mm

30. *Brachydiplax chalybea* Brauer

1968. *Brachydiplax chalybea* Brauer, *Verh. zool.-bot. Ges. Wien.*, 18 : 173.

1936. *Brachydiplax chalybea*, Fraser, *Fauna Brit. India*, 3 : 328-329.

Distribution : Assam, West Bengal, Burma, Java, Malaysia Siam and Sumatra.

31. *Acisoma panorpoides panorpoides* Rambur

1842. *Acisoma panorpoides* Rambur, *Ins. Neurop.*, : 28.

1936. *Acisoma panorpoides panorpoides*, Fraser, *Fauna Brit. India*, 3 : 330-331.

Material : 1 ♀, Contai, 27.5.1984 and 1 ♀, Mahishadal, 5.7.1985, coll, G. K. Srivastava.

Distribution : Assam, Himachal Pradesh, Madhya Pradesh, Manipur, Punjab, Uttar Pradesh, Western India, West Bengal, Sri Lanka Celebes, China, Japan, Moluccan islands, Sumatra and Tiwan.

32. *Diplacodes trivialis* (Rambur)

1842. *Libellula trivialis* Rambur, *Ins. Neurop.*, : 115.

1936 *Diplacodes trivialis*, Fraser, *Fauna Brit. India*, 3 : 336-338.

Material : 1 ♂, New Digha, 26.5.1984, coll. G. K. Srivastava and 1 ♀, Nandankanan, 6.3.1985, coll. R. K. Varshney.

Distribution : Himachal Pradesh, Madhya Pradesh, Madras, Punjab, Manipur, Uttar Pradesh, West Bengal, Australia, Burma, Sri Lanka, Nepal and Seychelles.

Remarks : It is one of the most common species in the area. specimens were also observed either flying or resting on the sand of the seashore. Female were performing oviposition behaviour in the tidal water.

33. *Diplacodes nebulosa* (Fabricius)

1793. *Libellula nebulosa* Fabricius, *Ent. Syst.*, 2 : 379.

1933. *Diplacodes nebulosa*, Fraser, *Fauna, Brit. India*, 3 : 335-336.

Material : 1 ♂, Mahishadal, 30.8.1984, coll. *M. Prasad*.

Distribution : Himachal Pradesh, Madhya Pradesh, Madras, Uttar Pradesh, West Bengal, extended from Western India, and from Sri Lanka to Australia and Southwards to Java.

34. *Brachythemis contaminata* (Fabricius)

1793. *Libellula contaminata* Fabricius, *Ent. Syst.*, 2 : 382.

1936. *Brachythemis contaminata*, Fraser, *Fauna Brit. India*, 3 : 365-366.

Material : 1 ♀, Contai, 27.5.1984 ; 1 ♂, Mahishadal, 5.7.1984. coll. *G. K. Srivastava* and 1 ♀, Contai, 8.2.1985, coll. *M. Prasad*.

Distribution : Assam, Bihar, Himachal Pradesh, Madhya Pradesh, Punjab, Rajasthan, Uttar Pradesh, West Bengal, Burma, Sri Lanka and extending east of China, Java, Formosa, Philippines and Sumatra.

Remarks : It is very common species and occurring through out the year in the estuarine areas, It was observed ovipositing or in Tendem position within the seashore or in the ditches in which tidal water entered. Some times adults were recorded flying over the sea water in the sea.

35. *Crocothemis servilia servilia* (Drury)

1770. *Libellula servilia* Drury, *III. Ex. Ins.*, 1 : 112-113.

1936. *Crocothemis servilia servilia* Fraser, *Fauna Brit. India*, 3 : 345-347.

Material : 1 ♀, Contai, 27.5.1984 ; 1 ♀, Fraserganj, 19.3.1985 and 1 ♀, Namkhana, 20.3.1985, coll. *G. K. Srivastava*.

Distribution : Bihar, Himachal Pradesh, Madhya Pradesh, Manipur, Punjab, Rajasthan, Uttar Pradesh, West Bengal, Australia, Nepal, Philippines and Sondaic Archipelago.

Remarks : Most common species in estuarine areas of Eastern India.

36. *Neurothemis tullia tullia* (Drury)

1773. *Libellula tullia* Drury, *III Exot. Ins.*, 2 : 85.

1936. *Neurothemis tullia tullia*, Fraser, *Fauna Brit. India*, 3 : 360-362.

Material : 1 ♂, Mahishadal, 5.7.1984, coll. G. K. Srivastava ; 1 ♂, Kulpi, 21.10.1984, coll. M. Prasad and 1 ♂, Canning, 24.11.1984, coll. G. K. Srivastav.

Distribution : Bihar, Bombay, Himachal Pradesh, Madhya Pradesh, Penisular India, Punjab, Uttar Pradesh, West Coast of India, West Bengal, Burma, Sri Lanka, Hongkong, Indo-China and Malacca.

37. *Trithemis pallidinervis* (Kirby)

1889. *Sympetrum pallidinervis* Kirby, *Trans. zool. Soc. India.*, 12 : 327.

1936. *Trithemis pallidinervis*, Fraser, *Fauna Brit. India*, 3 : 389-391.

Material : 1 ♂, Contai, 27.5.1984, coll. G. K. Srivastava.

Distribution : Assam, Bihar, Himachal Pradesh, Punjab, Uttar Pradesh, West Bengal, Burma, Sri Lanka, Formosa and and Philippines.

Remarks : A common species around stagnant water, some times observed near seashore either on wing or resting on twigs.

38. *Rhyothemis variegata variegata* (Linn.)

1763. *Libellula variegata* Linnaeus, *Amoenitates. Acad.*, 6 : 412.

1936. *Rhyothemis variegata variegata*, Fraser, *Fauna Brit. India*, 3 : 423-424.

Material : 1 ♀, Mahishadal, 26.5.1984, coll. G. K. Srivastava ; 1 ♀, Nandankanan, 6.3.1985 and 1 ♀, Barkunda islands, 14.3.1985, coll. R. K. Varshney.

Distribution : Assam, Bihar, Himachal Pradesh, West Bengal, Burma, Sri Lanka, Malaysia and Philippines.

39. *Zyxomma petiolatum* Rambur

1842. *Zyxomma petiolatum* Rambur, *Ins. Neurop.*, : 30.

1936. *Zyxomma petiolatum*, *Fauna Brit. India*, 3 : 409-410.

Distribution : Throughout India, Burma, and Sri Lanka.

40. *Tholymis tillarga* (Fabricius)

1798. *Libellula tillarga* Fabricius, *Ent. Syst. Suppl.*, : 285.

1936. *Tholymis tillarga*, Fraser, *Fauna Brit. India*, 3 : 411-413.

Material : 1 ♀, Nimalakhya, 31.8.1984, coll. *M. Prasad*.

Distribution : Himachal Pradesh, Madhya Pradesh, Punjab, Uttar Pradesh, West Bengal, Australia, Burma, Sri Lanka, Madagascar and tropical africa.

Remarks : It is recorded for the first time from the estuarine arears of West Bengal.

41. *Pantala flavescens* (Fabricius)

1798. *Libellula flavescens* Fabricius, *Ent. Syst. Suppl.* : 285.

1936. *Pantala flavescens*, Fraser, *Fauna Brit. India*, 3 : 414-416.

Material : 1 ♂, 1 ♀, Contai, 8.2.1985, coll. *M. Prasad*.

Distribution : Circumtropical and subtropical in distribution.

Remarks : A most common species in the estuarine area of east India. Swarms of this species were mostly seen either at seashore or sometimes they were flying above the sea water and moves upto 10 to 20 metres in side the sea. Specimens of *Tamea basilaris burmeisteri* Kirby were also seen in its swarm.

42. *Tamea basilaris burmeisteri* Kirby

1889. *Tamea burmeisteri* Kirby, *Trans. zool. Soc. Lond.*, 12 : 316.

1936. *Tamea basilaris burmeisteri*, Fraser, *Fauna Brit. India*, 3 : 432-434.

Distribution : Himachal Pradesh, Punjab, Rajasthan, Uttar Pradesh, West Bengal, Burma, Sri Lanka and Malaysia.

Key to the Odonata of Estuarine area of East India

A key to the 42 species of Odonata under 30 genera and 7 families known to occur in Estuarine areas of East India is given below. Fraser (1933, 1934, 1936 and 1957) has been adopted with some modifications.

1. Eye well separated ; fore and hind-wings approximately similar in shape and breadth

...

- | | | |
|--|-----|-----------------------------------|
| Eye not well separated ; fore and hindwings variable in shape and breadth | ... | 20 |
| 2. Veins IRiii and Riv arising nearer to the arc than the nodes | ... | 3 |
| Veins IRiii and Riv arising nearer to the arc | ... | 4 |
| 3. Thorax with a uniform narrow ante humeral stripe on each side ; sides of the thorax khaki brown and black points absent | ... | <i>L. viridula</i> Rambur |
| Thorax with narrow ante humeral stripes expended outwardly at the upper ends, sides of the thorax pale brown with a few black points | ... | <i>L. elata</i> Hagen |
| 4. Discoidal cell elongate, anterior and posterior sides subequal, legs very long | ... | <i>Copera annulata</i> Selys |
| Discoidal cell short, anterior, side considerably shorter than the posterior legs not very long | ... | 5 |
| 5. Arc situated distal to the level of distal antenodal nervure, the junction of the ab and 1A markedly angulated | ... | 6 |
| Arc situated at the level of distal antenodal nervure | ... | 7 |
| 6. Labrum metallic blue ; abdominal segment (1-6) pale greenish yellow | ... | <i>Agriocnemis pygmaea</i> Rambur |
| Labrum non-metallic, abdomen whitish in colour | ... | <i>Agriocnemis lactiola</i> Selys |
| 7. ab arising from the hind border of the wing at the point where ac meets it | ... | 8 |
| ab arising from the hind border of the wing, more or less proximal to the point where ac meets it | ... | 16 |
| 8. A proximal ridge on the frons ; postocular coloured spots absent | ... | 9 |
| Ridge absent on the frons | ... | 10 |

- | | | | | |
|-----|---|-----|--|----|
| 9. | Abdomen bright red at base | ... | <i>Ceriagrion cerinorubellum</i>
(Brauer) | |
| | Abdomen citron yellow | ... | <i>Ceriagrion coromandelianum</i>
(Fabr.) | |
| 10. | Pterostigma in forewing longer than
that in the hind wing | ... | <i>Aciagrion pallidum</i> Selys | |
| | Pterostigma in fore and hindwing of
the same size | ... | | 11 |
| 11. | Face and vertex reddish orange | ... | <i>Pseudagrion rubriceps</i> (Selys) | |
| | Face and vertex not reddish orange | ... | | 12 |
| 12. | Thorax pale blue | ... | <i>Pseudagrion decorum</i>
(Rambur) | |
| | Thorax sky blue or green | ... | | 13 |
| 13. | 10th abdominal segment bigger than
superior anal appendages | ... | <i>Pseudagrion australasiae</i>
Selys | |
| | 10th abdominal segment and superior
anal appendages equal in size | ... | | 14 |
| 14. | Hind wing 14-16 mm in length | ... | <i>Pseudagrion spencei</i> Fraser | |
| | Hind wing more than 17 mm in
length | ... | | 15 |
| 15. | Second abdominal segment on dorsal
side with black goblet shape making | ... | <i>Pseudagrion microcephalum</i>
(Ramb.) | |
| | Second abdominal segment on dorsal
side with black rectangular marking | ... | <i>Pseudagrion andamanicum</i>
Fraser | |
| 16. | Postocular coloured spots always
present in adult stage | ... | | 17 |
| | Postocular coloured spots absent in
the adult stage | ... | <i>Rhodischnura nursei</i>
(Morton) | |
| 17. | Dorsal apical tubercles on 10th
abdominal segment of male present | ... | | 18 |
| | Dorsal apical tubercles on 10th
abdominal segment of male absent | ... | | 19 |
| 18. | Abdominal segments 3 to 6 citron on
dorsum | ... | <i>Ischnura aurora</i> (Brauer) | |
| | Abdominal segments 3 to 6 black on
dorsum | ... | <i>Ischnura senegalensis</i>
(Rambur) | |

19. Dorsum of 1st abdominal segment
with a broad quadrate black spot
confluent with an apical ring ... *Enallagma insulae* Fraser
- Dorsum of 1st abdominal segment
totally black ... *Onyahargia atrocyana* Selys
20. Eye meeting at point or broadly
confluent ; 8th abdominal segment
with a yellow ring ... *Ictinogomphus rapax*
(Ramb.)
- Eye confluent above ... 21
21. Discoinal cells closely similar in fore
and hind wings and traversed ... *Anax guttatus* (Burmeister)
- Discoidal cells differing in fore and
hindwings, not traversed ... 22
22. Sectors of arc separated from origin,
feebly developed primary antenodal
present ... 23
- Sectors of arc fused at their origin,
primary antenodal absent ... 25
23. Subtrigone in forewing entire ... *Aethriamanta b. brevipennis*
(Rambur)
- Subtrigone in forewing 3 celled ... 24
24. Abdomen blood red ... *Urothemis s. signata*
(Rambur)
- Abdomen bright pale yellow ... *Macrodiplex cora* (Brauer)
25. Apex of loop in the wing open ... 26
- Apex of loop in the wing closed ... 27
26. An opalescent white spot in the
hind wings present ... *Tholymis tillarga* (Fabr.)
- An opalescent white spot in the
middle of the hind wing absent ... *Zyxomma petiolatum*
(Rambur)
27. Distal antenodal nervure in fore-
wing complete ... 28
- Distal antenodal nervure in fore-
wing incomplete ... 32
28. Frons metallic above ... 29
- Frons non-metallic above ... 30

29. Bases of both fore and hindwings
dark-brown ... *Brachydiplax chalybea*
Brauer
- Bases of both fore and hindwings
uncoloured hyaline ... *Brachydiplax sobrina*
(Rambur)
30. Small sized species ; only 6 antenodal
nervures in forewings ... *Acisoma panorpoides*
panorpoides Rambur
- Medium sized species ; not less than
12 antenodal nervures in forewings ... 32
31. Males violaceous-red due to a thin
overlying pruinescens, abdomen not
enormously swollen at the base ... *Orthetrum pruinatum*
neglectum (Ramb.)
- Males not violaceous-red, abdomen
enormously swollen at base ... *Orthetrum sabina* (Drury)
32. Lobes of prothorax with long hairs ... 33
- Lobes of prothorax without long
hairs ... 34
33. Apices of fore and hindwing tipped
with black ... *Diplacodes nebulosa* (Fabr.)
- Apices of fore hindwing not tipped
with black, anal appendages yellow ... *Diplacodes trivialis*
(Rambur)
34. Sectors of arc in forewing separated
and divergent at the origin ; black
and golden yellow markings present
on the wings ... *Rhythemis v. variegata*
(Linn.)
- Sectors of arc in forewing arising
from common long stalk ... 35
35. Discoidal field converging at wing
border ... 36
- Discoidal field parallel or divergent
at the wing border ... 37
36. Nervure IRii present in between Rii
and Riii ... *Pantala flavescent* (Fabr.)
- Nervure IRii absent in between Rii
and Riii, Leg very long and spidery,
ptrostigma bicolourous ... *Trithemis pallidinervis*
(Kirby)

37. Pterostigma unequal in fore and hindwings, two large black spots surrounded by golden yellow markings present at the base of wings ... *Tramea basilaris burmeisteri* Kirby
- Pterostigma equal in size in fore and hind wings ... 38
38. Only one cubital nervure present in all the wings ... 39
- More than one cubital nervure present in all the wings, an opalescent white band in the wings present ... *Neurothemis tullia tullia* (Drury)
39. Red or pale yellow species, basal or medial yellow marking present on wings ... 40
- Variable coloured species, base of wings rarely marked with red or pale yellow ... 41
40. Broad reddish yellow medial marking present on the wings ... *Brachythemis contaminata* (Fabr.)
- Small basal yellow marking present at the base of wings ... *Crocothemis s. servilia* (Drury)
41. Only one row of cells present in between IRii and RSpl ... *Lathrecista a asiatica* (Fabr.)
- Two rows of cells present inbetween IRii and RSpl ... *Potamarcha obscura* (Rambur)

SUMMARY

Altogether 42 species of Odonata are recorded from the estuarine area of East India. Out of these 7 are new records for the estuarine area of West Bengal and 3 for the estuarine area of Orissa.

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SOME NEW RECORDS OF HYPERMASTIGIDS (Protozoa)
FROM EASTERN UTTAR PRADESH, INDIA

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INTRODUCTION

A survey on termite flagellates from Eastern Uttar Pradesh comprising the district Azamgarh, Ballia, Gorakhpur, Deoria and Basti were conducted. Previously no such survey was taken up from this part of India. Out of two hundred examples of termite examined from twenty localities almost all the termites belonging to *Coptotermes heimi* (Wasm.) harbour six species namely, *Holomastigotoies ogivalis*, *H. bengalensis*, *H. sphaeroidalis*, *Spirotrichonympha froilanoi*, *Pseudotriconympha indica* and *P. cardiformis*. De Mello (1937) from Daman, Karandikar and Vittal (1954) from Dhawar, Chakravarty and Banerjee (1956) and Das (1976) from West Bengal reported these species. Termites were collected from the various cultivated trees, timber depots, wood and log, plywood and cemented brick built wall. Most of the collections were made from mango tree (*Mangifera indica*), banyan tree (*Ficus bengalensis*), pipal (*Ficus religiosa*) jackfruit and drum-stick (*Moringa* sp.) which were infested by these termites. The gut of the termites was desected and smears of the gut contents were prepared. The live flagellates were studied in fresh smears of the guts contents diluted with 0.5% saline. The specimens were fixed in Schaudins fluid and stained with Heidenhain's iron haematoxylin. All the measurement were taken with the aid of ocular micrometer and photomicrograph were also taken.

Order : HYPERMASTIGIDA

Family : HOLOMASTIGOTIDAE

Holomastigotoides ogivalis De Mello, 1937

(Fig. A)

Description : The body resembles the form of an inverted cup with a blunt finger like elevation, measuring 60.5-90 μm in length (average 80.75 μm), and 40.5-56.25 μm (average 48.37 μm) in breadth. The body is covered by two types of flagella. The shorter flagella occupy the whole of the body in dextrotropic rows leaving the posterior extremity which is thickly set with longer flagella. The nucleus is oval and measures 11.62 x 9 μm , Prenuclear zone well developed and clearly visible in permanent preparation.

Host : *Coptotermes* sp., Daman, India, *C. heimi* (Wasm.) Dharwar, Karnataka ; *C. heimi* (Wasm.), Haldia (Midnapore Dist.) and Falta (24-Parganas Dist.), West Bengal ; *C. heimi*, Kasumi, Nichlaul, (Gorakhpur Dist.) Uttar Pradesh.

Remarks : De Mello (1937) described this species from *Coptotermes* sp., Karandikar and vittal (1954) and Das (1976) recorded it from *C. heind*. In the present study the species recorded it from *C. heimi* from Eastern Uttar Pradesh is identical with type and other recorded species. But it is smaller in size and finger like elevation is very distinct and well developed.

Holomastigotoides bengalensis Chakravarty and
Banerjee, 1956

(Fig. B)

Description : The body is more or less oval but sometime elliptical with the anterior part of the body gradually tapering and terminating in a blunt cone while posterior end is round. The body measures 67.50-76.72 μm (average 70.86 μm) in length and with 41.25-48 μm (average 43.12 μm) in breadth. Flagella are of two types. The shorter ones cover the whole body whereas the longer ones occupy the posterior portion of the body. Axostyle is well developed extending upto

the posterior extremity of the body. The nucleus lies anterior. It is oval in shape and $11 \times 9.5 \mu\text{m}$ in size. The conical prenuclear zone is densely granulated around the anterior part of the nucleus.

Host : *Heterotermes* sp., Calcutta (type host) ; *Heterotermis indicola* (Wasm.), Indian Museum campus Calcutta ; *Coptotermes heimi* (Wasm.), Padrauna, Gauribazar (Deoria Dist.) ; Bilthra Road, Nagra (Ballia Dist.) Uttar Pradesh.

Remarks : Chakravarty and Banerjee (1956) described *H. bengalensis* from an undetermined species of *Heterotermes* and Das (1976) recorded this species from the host *Heterotermes indicola* (Wasm.) in West Bengal. *Coptotermes heimi* (Wasm.) is therefore, a new host record for *H. bengalensis* from Eastern Uttar Pradesh. The present species is identical with the type in all respects except that this is slightly smaller in dimension and the exostyle is extending upto the posterior extremity of the body wall.

Holomastigotoides sphaeroidalis De Mello, 1937

(Fig. C)

Description : Body shape is spherical as indicated by its specific name, measuring $14.4-32 \mu\text{m}$ in diameter (average $21.8 \mu\text{m}$). Flagella are of one type covering the body dextrotropically. Nucleus is circular in shape and situated very near to a point at the anterior end from which the flagellar bands seems to diverge out. It measures $13 \times 6 \mu\text{m}$ in diameter. Axostyle is not well developed and prenuclear zone is distinct.

Hosts : *Coptotermes* sp., Daman, *Heterotermes malabaricus* Snyder, Dharwar, Karnataka ; *Heterotermes indicola* (Wasm.), Indian Museum campus Calcutta, West Bengal ; *Coptotermes heimi* (Wasm.), Dharwar ; *Coptotermes heimi* Maldah (Ballia Dist.) ; Maryadpur, Lalganj (Azamgarh Dist.) Uttar Pradesh.

Remarks : De Mello (1937) described this species from

Coptotermes sp., Karandikar and Vittal (1954) recorded this species from *Coptotermes heimi* and *Heterotermes malabaricus* and Das (1976) recorded it from *Heterotermis indicola* and they described it as perfectly spherical. The present species recorded from *Coptotermes heimi* (Wasm.) is a new record of this area and having the same shape as recorded by previous workers but the axostyle is not clearly visible and even it is lacking in some specimens.

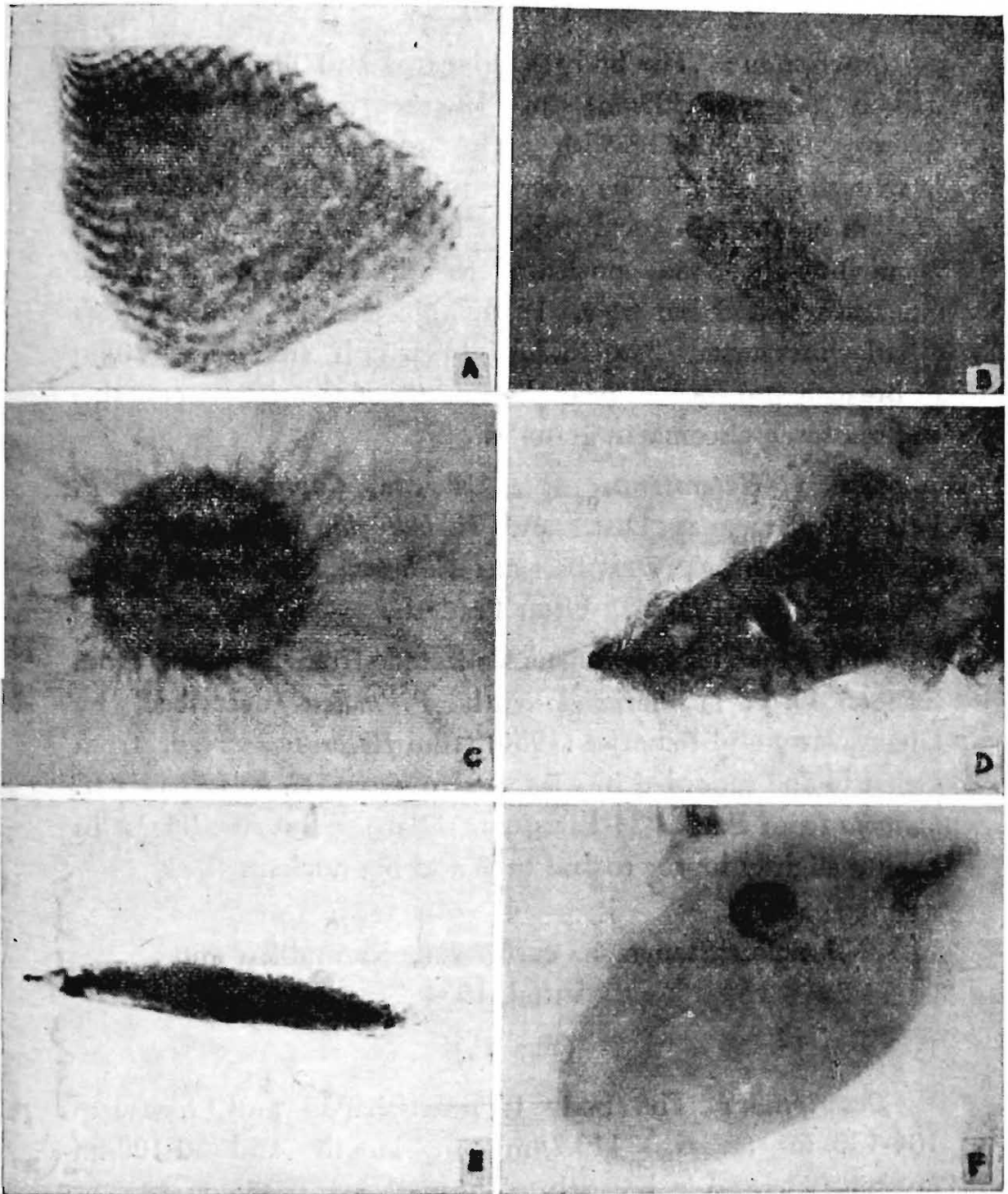
***Spirotrichonympha froilanoi* Karandikar and Vittal, 1954**

(Fig. D)

Description : The body is cone-shaped with anterior portion narrowed to a blunt end and posterior portion is the broadest. The body measures $19.2-51.2\mu\text{m}$ (average $32.5\mu\text{m}$) in length and $14.4-33.6\mu\text{m}$ (average $21.1\mu\text{m}$) in breadth. Nucleus more or less round, located anteriorly and measures $4.8-6\mu\text{m}$ in diameter. The body is covered with flagella of two types which can be distinguish by their length and location. The posterior portion carry a bunch of very long flagella. The axostyle does not extend beyond the posterior extremity of the body.

Hosts : *Coptotermes heimi*, Dharwar ; *Heterotermes malabaricus*, Dharwar, Karnataka ; *C. heimi*, Falta (24-Paraganas), West Bengal *C. heimi*, Kusumi, Farenda (Gorakhpur Dist.) Uttar Pradesh.

Remarks : Karandikar and Vittal (1954) described this species from gut of *Coptotermes heimi* and *Heterotermes malabaricus* from Karnataka and Das (1976) recorded it from *C. heimi* from West Bengal. Karandikar and Vittal and Das stressed on the character namely presence of long flagella spreading out from the posterior surface in a brush like manner and the axostyle protrude out side to a short distance respectively as for specific diagnosis. The present material collected from *C. heimi* is identical with type except that its axostyle is not protruding out side the body.



Figs. A—F. A. *Holomastigotoides ogivalis* De Melo x 680, B. *Holomastigotoides bengalensis* Chakravarty and Banerjee x 425, C. *Holomastigotoides spaeroidalis* De Mello x 1380, D. *Spirotrichonympha froilanoi* Karandikar and Vittal x 1220, E. *Pseudotrichonympha indica* Chakravarty and Banerjee x 185, F. *Pseudotrichonympha cardiformis* Karandikar and Vittal x 525.

Family : TRICHONYMPHIDAE

Pseudotrichonympha indica Chakravarty and
Banerjee, 1956

(Fig. E)

Description : The body is elongated and measures 274.7-328 μ m (average 300 μ m) in length and 53.7-102.5 μ m (average 68.3 μ m) in breadth. The broadest part of the body is near the middle. The rostral tube measures 10.25 μ m to 12.3 μ m having an apical cap. Flagella are of three types occupying the same position as described in *P. indica* Chakravarty and Banerjee, 1956. Nucleus is more or less circular measuring 24.0-28.7 μ m in length and 20.5-24.0 μ m in breadth and located near the middle of the body containing scattered chromatin granules.

Hosts : *Heterotermes* sp., Calcutta, *Coptotermes heimi*, Falta (24-Paraganas Dist.) and *H. indicola*, Indian Museum Campus Calcutta ; West Bengal ; *C. heimi*, Khalilabad, Basti, Mehdawal (Basti Dist). Uttar Pradesh.

Remarks : The specimens collected from *C. heimi* from Eastern U. P. is identical with *P. indica* described by Chakravarty and Banerjee (1956) from *Heterotermes* sp. from Calcutta and recorded by Das (1976) from *C. heimi* and *H. indicola* from Falta (24-Paraganas Dist.). But it differs in having slightly bigger rostral tube and big nucleus.

Pseudotrichonympha cardiformis Karandikar and
Vittal, 1954

(Fig. F.)

Description : The body is heart-shaped and measures 104-130 μ m (average 113.2 μ m) in length and 80-100 μ m (average 90.4 μ m) in breadth. The anterior part consists of a bell like campanula with a rostral tube which measure 15 μ m in length. The campanular surface is covered by three types of flagella which are distinguishable from one another in regards to their length and location. The first type of flagella is the shortest and immobile and are strictly confined

to the rostral tube. Second type of flaggella is the longest and arranged below the first one. The third type is arranged in longitudinal rows in a leiotropic manner. They cover the companula and rest of the body. Nucleus is spherical and situated in the middle of the body and measures 10-15 μ m in diameter.

Hosts : *Heterotermes malabaricus* and *C. heimi*, Dharwar, Karnataka (Type host) ; *C. heimi*, Falta (24-Paraganas Dist.), and Haldia (Midnapore Dist.), West Beugal ; *C. heimi* ; Sonavali, (Gorakhpur Dist.), Sukhpura (Ballia Dist.), Uttar Pradesh.

Remarks : Karandikar and Vittal (1954) described this species from *H. malabricus* and *C. heimi* from Dharwar and Das (1976) recorded it from *C. heimi* from Falta (24-Paraganas Dist.) and Haldia (Midnapore Dist.). The specimen recorded from Eastern Uttar Pradesh is exactly identical with the type in all characters except that it is smaller in size and nuclear length.

SUMMARY

A systematic account of the species of hypermastigids recorded from the Eastern Uttar Pradesh consisting of six species namely *Holomastigotoiaes ogivalis*, *H. bengalensis*, *H. Sphaeroidalis*, *Spirotrichonympha*, *froilanoi*, *Pseudotrichonympha indica* and *P. Cardiformis* from the gut of a termite, *Coptotermes heimi* (Wasm.) has been dealt with in this paper. This includes some morphological variations recorded in the species. These flagellates will be new record from this area.

ACKNOWLEDGEMENTS

Sincere thanks are due to the Director, Zoological Survey of India for facilities provided for the work. Thanks are also due to Dr. A. K. Mandal, Scientist-'SE' Zoological Survey of India, Calcutta for going through the manuscript and valuable suggestions.

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SOME ORIBATID MITES (ACARINA :
CRYPTOSTIGMATA) FROM MEGHALAYA
WITH DESCRIPTION OF THREE NEW SPECIES

By

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Zoological Survey of India, Calcutta

INTRODUCTION

The oribatid mite fauna of the eastern Himalaya was little known through the report of only a few oribatid species from Darjeeling, West Bengal. The present paper is based on a small collection from Shillong, Meghalaya. Altogether 7 species belonging to 7 genera under 6 families are reported, of which 3 are new to science while the rest are new to the state. The genera *Mesotritia* and *Euphthiracarus* are reported here for the first time from India. All measurements are in microns. The types are deposited in the National Collection of the Zoological Survey of India, Calcutta.

***Mesotritia indica* sp. n.**

(Figs. 1-3)

Colour light brown ; length of the body 552, width 425 ; length of the aspis 310, width 195.

Dorsum of the aspis finely granulated, a single lateral carina on each side of aspis, rostral setae (34) inserted well behind the lamellar setae, fine, smooth, a little shorter than lamellar setae ; lamellar setae (40) fine, smooth ; inter-lamellar setae (34) fine, smooth ; sensillus short about the same length as the lamellar setae, slightly thickened with blunt head ; a pronounced scale below bothridium.

Notogaster minutely granulated with fine lines of striation ; fourteen pairs of fine, short setae on notogaster, length of notogastral setae ranges between 34-40.

Genital plate completely separated from the aggenital plate by a distinct suture, six pairs of minute genital setae ;

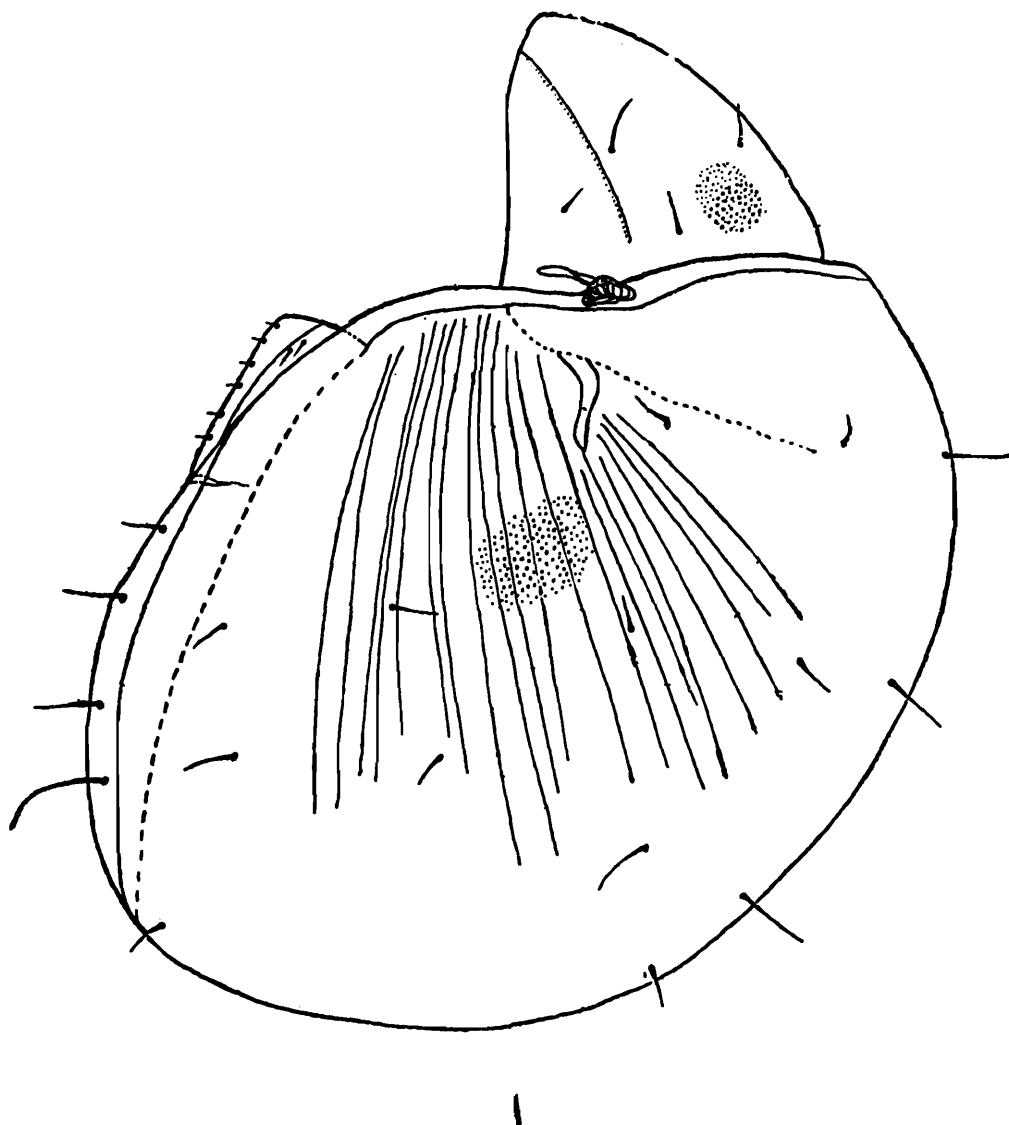


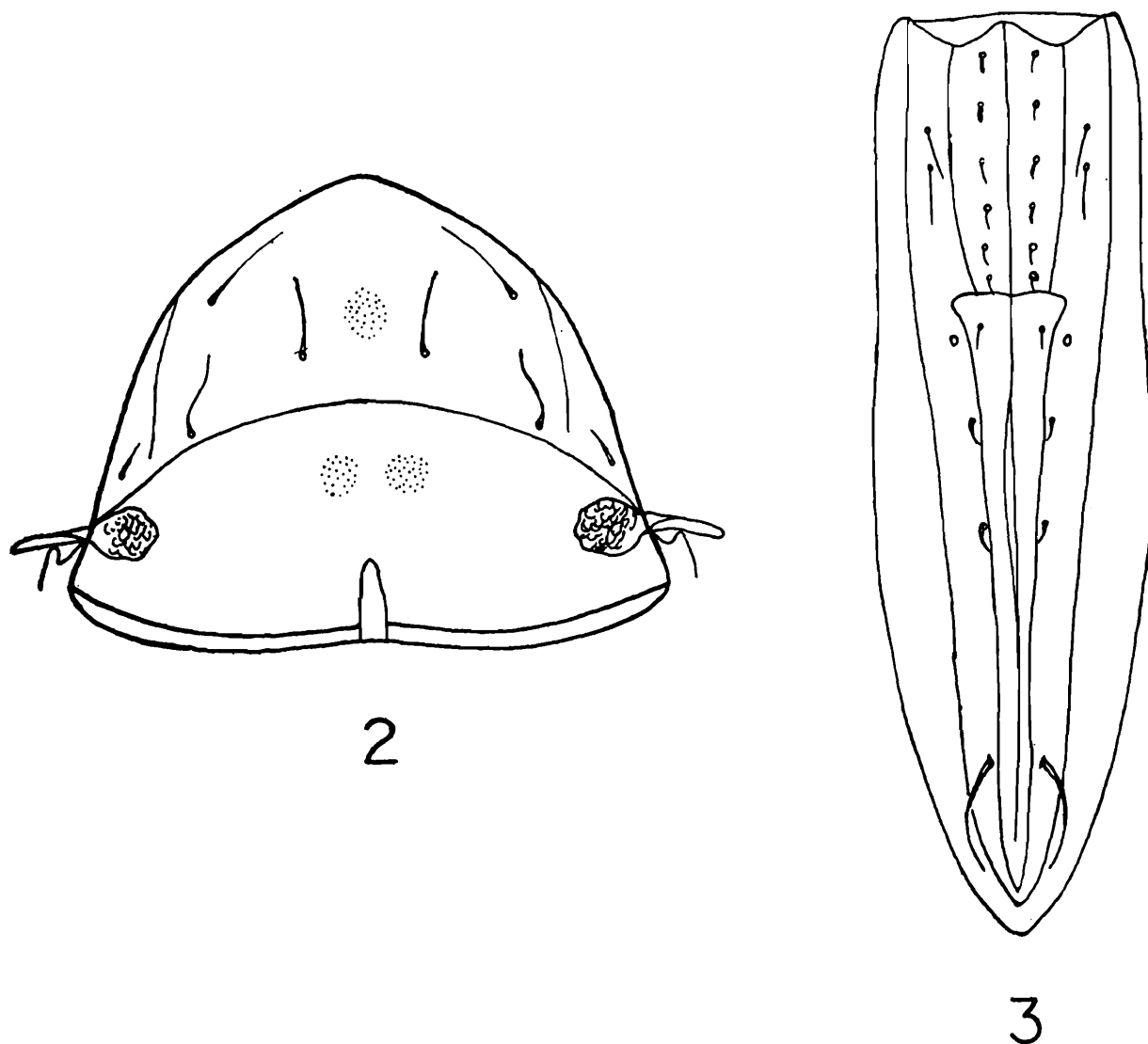
Fig. 1. *Mesotritia indica* sp. n. : Lateral

two pairs of fine aggenital setae occupy the middle portion of the aggenital plate, about half the length of ad_3 ; oblique fissure between aggenital and adanal plates absent, anal plate with single pair of minute setae, adanal plate with 3 pairs of setae, ad_1 and ad_2 minute, ad_3 much longer than the remainders ; a pair of distinct adanal fissure (iad) situated near the anal setae.

All the tarsi triheterodactyl.

Holotype : Adult ♀, India : Meghalaya : Shillong : Laitkor protected forest, altitude 1929 m, from pine forest litter and soil, 15.vii.1981, coll. V. T. Darlong.

Remarks : The new species is closely related to *Mesotritia* (*Mesotritia*) *testacea* Forsslund, 1963 and *Mesotritia maerkeli*



Figs. 2 & 3. 2. *Mesotritia indica* sp. n. : Aspis, 3. *Mesotritia indica* sp. n. : Genito-anal region

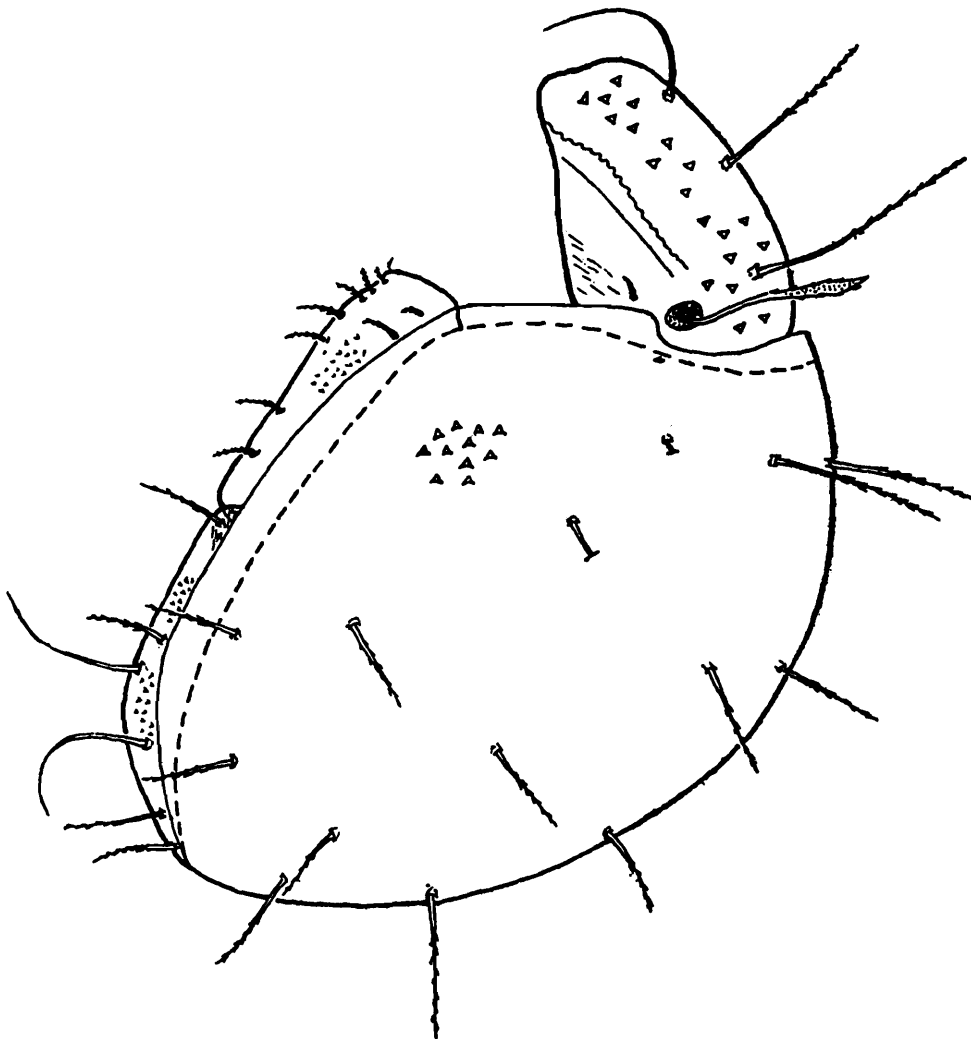
Sheals, 1965 in the character of body size and prodorsal and notogastral setae, but it is easily distinguishable from the *testacea* and *maerkeli* by the finely granulated body with fine striations, small rostral setae, shape of sensilla and position of aggenital setae. The genus *Mesotritia* is reported here for the first time from India.

***Euphthiracarus meghalayensis* sp. n.**

(Figs. 4-6)

Colour light brown ; length of the body 586, width 460 ; length of aspis 264.

Aspis with two lateral carinae on each side, the upper one slightly irregular and strong, the lower one weak; surface of aspis between the upper carinae sculptured with papillae, the remaining portion of aspis smooth; rostral setae long (126-138), smooth, directed outward and bent downward; lamellar setae long (103-115), finely barbed,



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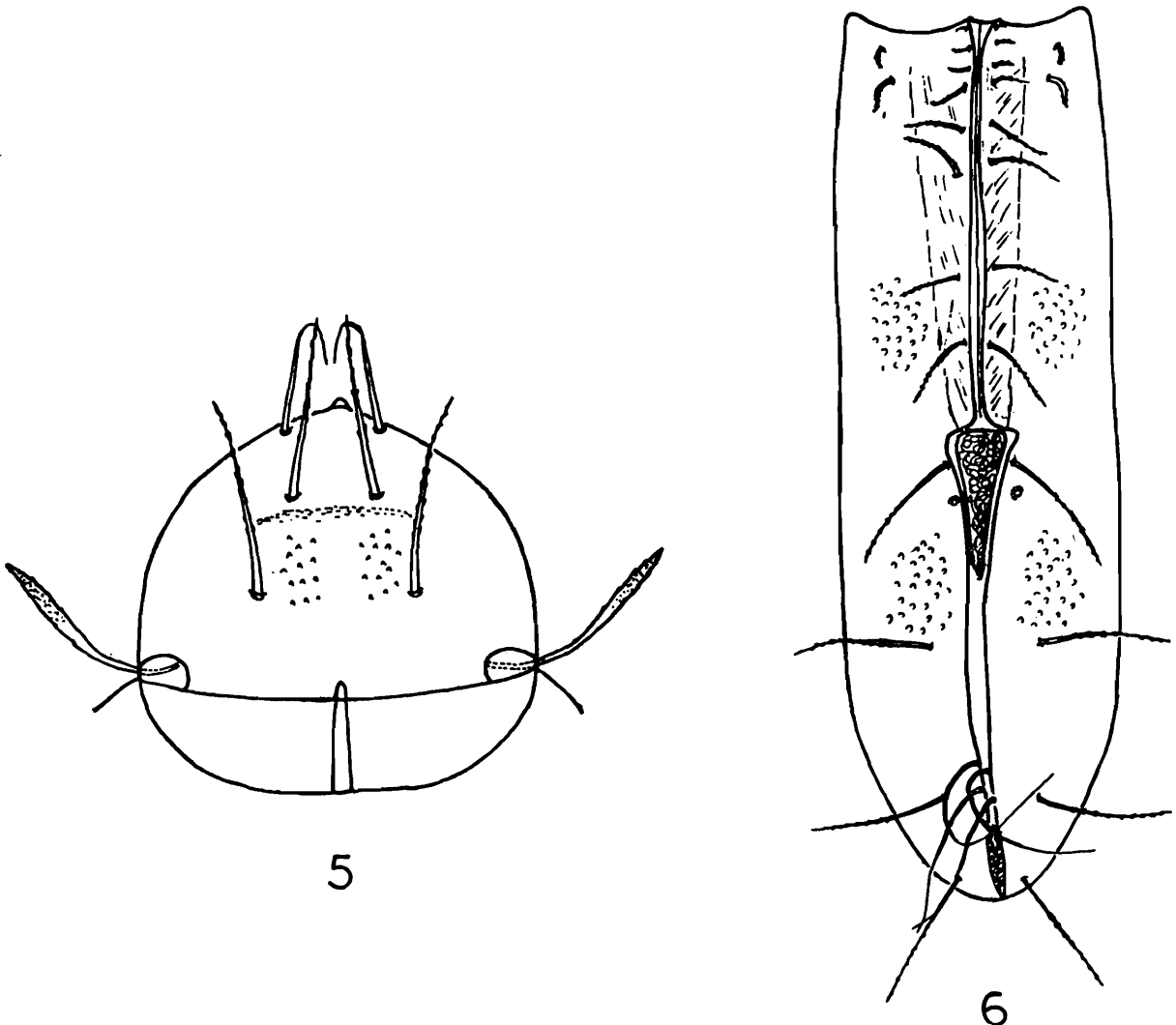
Fig. 4. *Euphthiracarus meghalayensis* sp. n. : Lateral

interlamellar setae long (138-155), stout, finely barbed; sensillus (92-115) with apical portion weakly thickened and minutely serrated; very pronounced scale below the bothridium; exobothridial seta short and fine.

The whole surface of notogaster distinctly sculptured with papillae; fourteen pairs of notogastral setae, long (69-115), erect, minutely barbed.

Genito-aggenital region with distinct papillae; 8 pairs

of genital setae on each side, minutely barbed, unequal in length; ano-adanal region sculptured with minute papillae,



Figs. 5 & 6. 5. *Euphthiracarus meghalayensis* sp. n. : Aspis, 6. *Euphthiracarus meghalayensis* sp. n. : Genito-anal region.

papillae not so large and clear as on notogaster, adanal setae ad_1 - ad_3 and anal seta an_3 strong, weakly barbed, an_1 and an_2 glabrous, long and whip like, the tip of an_1 strongly curved backward.

All the tarsi triheterodactyl.

Holotype : Adult ♀, India : Meghalaya : Shillong : Laitkor protected forest, altitude 1929 m, from pine forest litter and soil, 15.vii.1981, coll. V. T. Darlong. **Paratypes** : 2 ♀♀, data same as above.

Remarks : The new species differs from all other species of *Euphthiracarus* by the presence of distinct papillae on the

body surface, smooth *ro*, number of genital setae and size of aggenital setae. The genus *Euphthiracarus* is reported here for the first time from India.

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

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

Material examined : 1 ♀, India : Meghalaya : Shillong : Laitkor protected forest, altitude 1929 m, from pine forest litter and soil, 15.vii.1981, coll. V. T. Darlong.

Distribution : India : West Bengal, Meghalaya (new record) ; Tahiti.

Remarks : The material from Meghalaya agrees with the drawings and descriptions of *Rhysotritia ardua* (Koch) var. *otaheitensis* except in the length of the body which is slightly larger in the present specimen.

***Eremobelba shillongensis* sp. n.**

(Figs. 7-8)

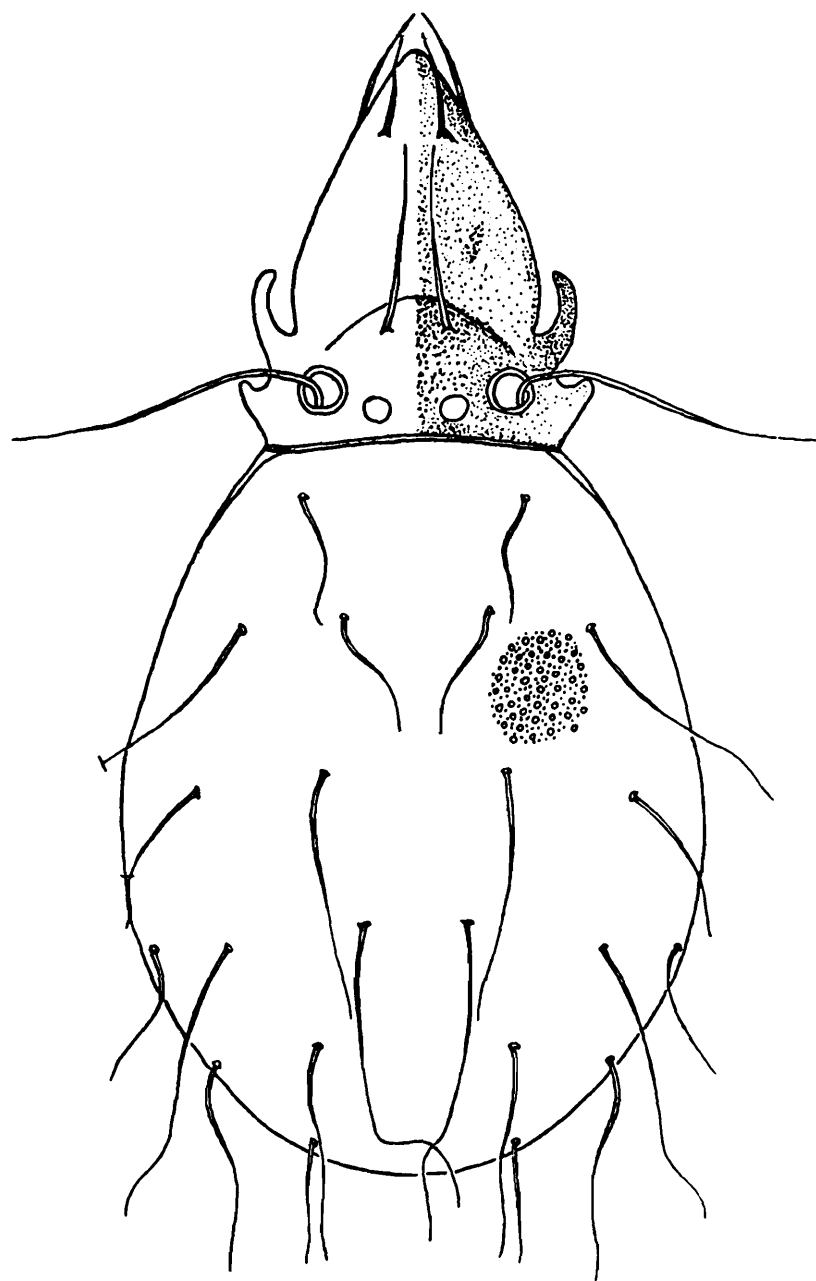
Colour light brown ; length of the body 563, width 333.

The surface of prodorsum unevenly granulated, the granules at the posterior region of prodorsum, near bothridium, dense and form an arched elevation, middle portion of prodorsum with fine punctations ; rostral setae (57) slightly longer than lamellar setae, smooth, fine, directed outward and curved inward, tips nearly meeting each other ; lamellar setae (34) smooth, fine, straight ; interlamellar setae long (103), smooth, fine, straight, extended beyond the middle of prodorsum ; sensillus long (161), flagellate, smooth ; a pair of circles in between bothridia.

Notogaster with cerotegument, broad, posteriorly rounded, anterior margin straight, foveolated, small granules on the notogaster throughout, eleven pairs of notogastral setae, long (max. 142), flagellate, smooth.

Ventral region finely granulated ; infracapitulum with

two pairs of small smooth hairs ; epimeral setal formula 3-1-3-3, setae 1C, 3C and 4C with six branches, others



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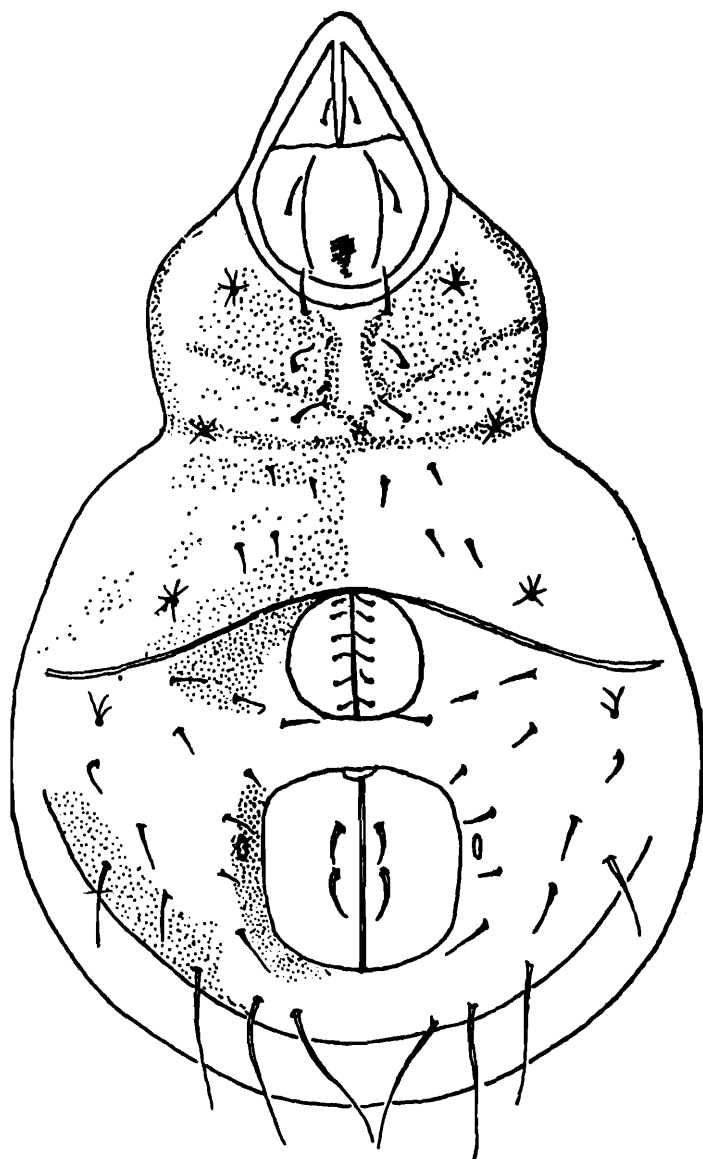
Fig. 7. *Eremobelba himalayensis* sp. n. : Dorsal

smooth ; 16 pairs of setae on the ventral plate, one pair of setae with three branches, others smooth, three posterior pairs of setae long and flagelliform ; genital setae 6 pairs, minute, smooth ; anal setae 2 pairs, smooth.

Legs monodactyl.

Holotype : Adult ♀, India : Meghalaya : Sillong : Laitkor protected forest, altitude 1929 m, from pine forest

litter and soil, 15.vii.1981, coll. V. T. Darlong. Paratype :
1 ♀, data same as above.



8

Fig. 8. *Eremobelba himalayensis* sp. n. : Ventral

Remarks : The new species is related to *Eremobelba japonica* Aoki, 1959, *E. nagaroerica* Haq, 1978 and *E. himalayensis* Mondal & Kundu, 1984. However, it is distinguishable from *E. japonica* by granulations of the body and long interlamellar setae and from *E. nagaroerica* and *E. himalayensis* by the presence of smooth interlamellar setae and sensillus, absence of notogastral elevation, smooth setae on infracapitulum, number of branched setae on epimeral and ventral plates.

***Dolicheremaeus coronarius* Chakrabarti, Bhaduri and Kundu**

Dolicheremaeus coronarius Chakrabarti, Bhaduri and Kundu, 1981, *Mitt. Zool. Mus. Berlin*, 57(1) : 15.

Material examined : 3 ♀ ♀, India : Meghalaya : Shillong : Laitkor protected forest, altitude 1959 m, from pine forest litter and soil, 15.vii.1981, coll. V. T. Darlong.

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

Remarks : The present species shows distinct resemblance with *D. coronarius* Chakrabarti, Bhaduri and Kundu from Darjeeling Himalaya, West Bengal, India except in having weakly developed *co. pm.* and *co. nm.* The species is represented here for the second time from Indian sub-continent.

***Suctobelba quadricarina* Hammer**

Suctobelba quadricarina Hammer, 1958. *Biol. Skr. Dan. Vid. Selsk.*, 10(1) : 43.

Material examined : 1 ♀, India : Meghalaya : Shillong : Laitkor protected forest, altitude 1929 m., from pine forest litter and soil, 15.vii.1981, coll. V. T. Darlong.

Distribution : India : West Bengal, Meghalaya (new record) ; Argentina.

Remarks : The present species is well in accord with the original description and figures of *S. quadricarina* from Argentina. The species is recorded here for the second time from India.

***Galumna crenata* Deb and Raychaudhuri**

Galumna crenata Deb and Raychaudhuri, 1975. *Annot. Zool. Japan*, 48(3) : 167.

Material examined : 4 ♀ ♀, India : Meghalaya : Shillong : Laitkor protected forest, altitude 1929 m, from pine forest litter and soil, 15.vii.1981, coll. V. T. Darlong.

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

Remarks : The present species is well in accord with the original description and figures of *G. crenata* Deb and Raychaudhuri from West Bengal, India. The species is reported here for the second time from Indian sub-continent.

SUMMARY

Seven oribatid mite species belonging to seven genera under six families from Meghalaya, India are treated in this paper. Of these, 3 species viz., *Mesotritia indica* sp. n., *Euphthiracarus meghalayensis* sp. n. and *Eremobelba shillongensis* sp. n. are new to science. The first two genera mentioned above are reported here for the first time from India. Four other species are new record for the state.

ACKNOWLEDGEMENT

The author is grateful to the Director, Zoological Survey of India, for providing necessary laboratory facilities. Sincere thanks are also due to Dr. V. T. Darlong, Zoological Survey of India, Itanagar, Arunachal Pradesh.

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TWO NEW SPECIES OF THE GENUS
SCHELORIBATES (ACARINA : ORIBATEI)
FROM BHUTAN

By

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INTRODUCTION

The soil oribatid fauna of Bhutan was unexplored till the work of Chakraborti and Wilson (1981). They reported 11 genera distributed over 14 species including 4 species of the genus *Scheloribates*. During a short trip to Bhutan the author collected few oribatid mites and the present paper is based on that collection. Incidentally all the specimens examined in the present study belong to the genus *Scheloribates* and include three species, of which, *S. rostopilosus* and *S. bhutanensis* are considered here as new to science and the other one *S. laticlava* Hammer, 1961, is recorded here for the first time from Bhutan. Thus the total number of oribatid species and genera so far known from Bhutan stands to 11 and 17 respectively. All measurements are in microns. Types of the new taxa have been deposited in the National Collection of Zoological Survey of India, Calcutta.

***Scheloribates rostopilosus* sp. n.**

(Figs. 1-2)

Colour light brown ; length of the body 390, width 288 ; integument smooth without any microsculpture ; prodorsum broad at the base, short ; rostrum rounded with hyaline lip, rostral hairs thick, strongly feathered, about five times as long as their mutual distance ; lamellae dark, broad, stout, extend beyond the middle portion of prodorsum ;

lamellar heads connected by thin translamellar line ; lamellar hairs finely barbed, stout, about one and half times as long as their mutual distance, extend beyond the tip of the rostrum ; interlamellar hairs slightly shorter than

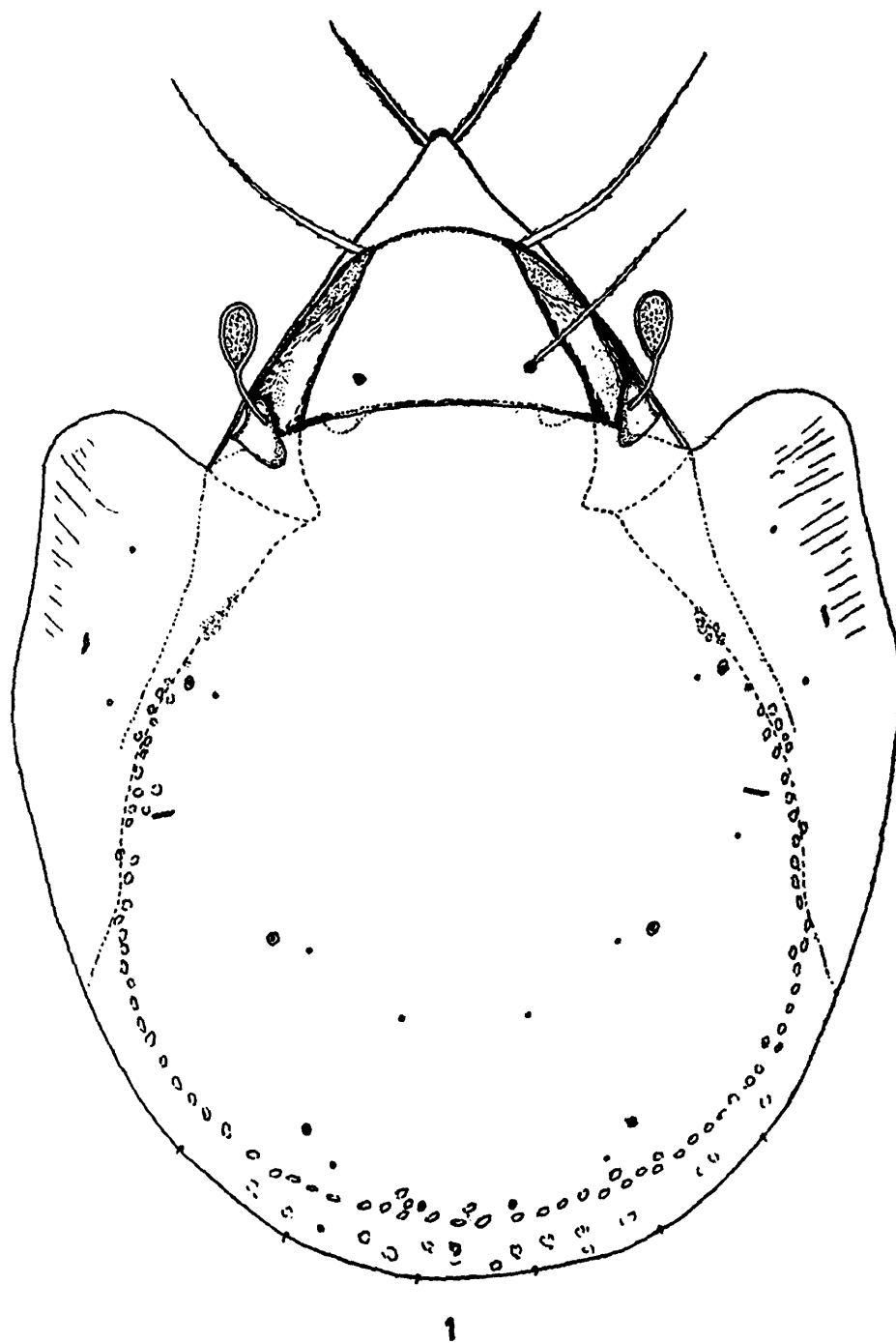


Fig. 1. *Scheloribates rostopilosus* sp. n. : Dorsum

lamellar hairs, minutely barbed, stout, base covered with thick chitinous scale ; sensillus with short stalk, head club shaped, broadest distally, flat, covered with minute scales, directed outwards and forwards, does not reach the lateral border of the broad pteromorph.

Notogaster longer than broad, posterior part rounded ; dorsosejugal suture arched ; pteromorph broad, shoulder rounded, faint striations ; notogastral hairs ten pairs, except

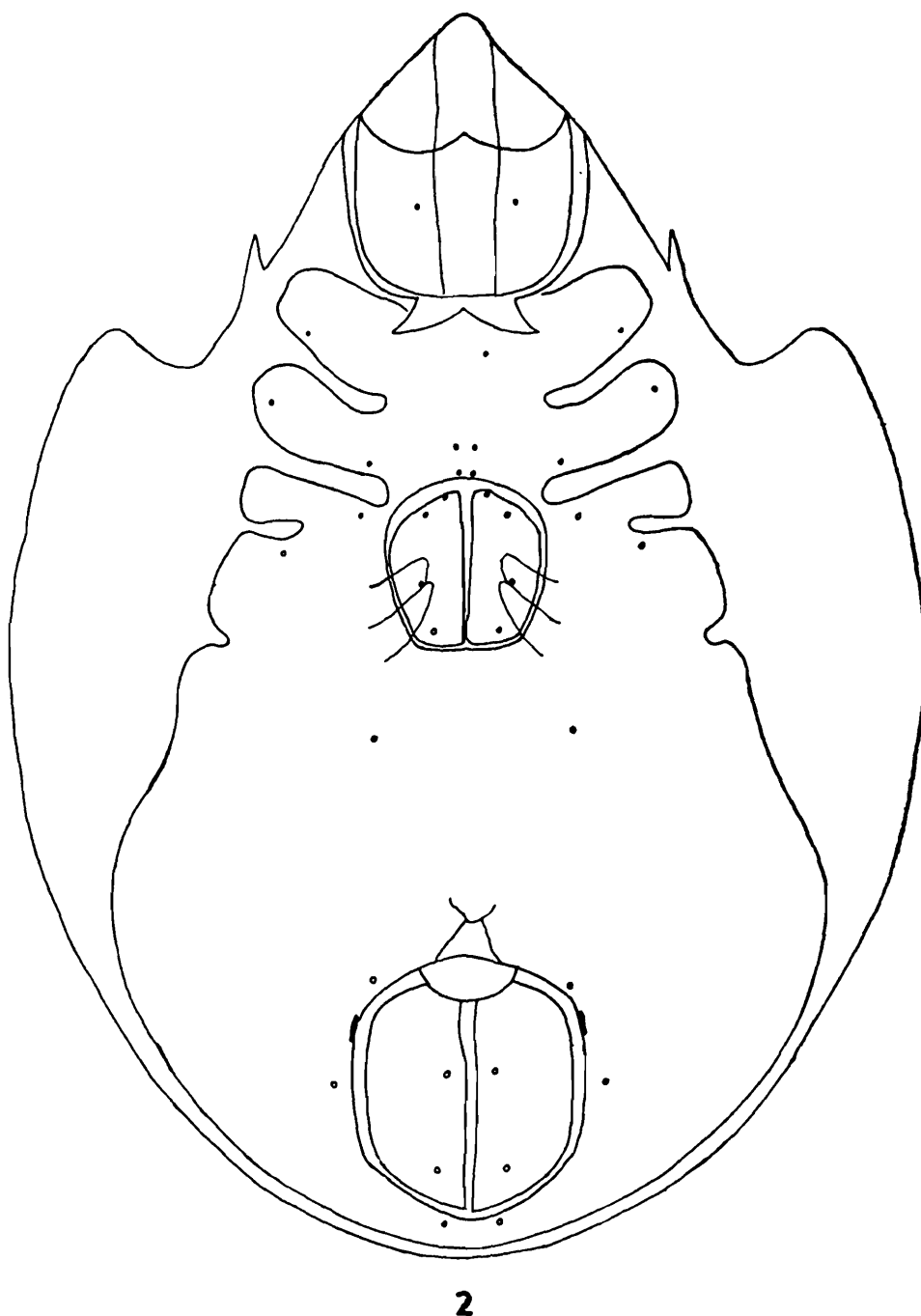


Fig. 2. *Scheloribates rostopilosus* sp. n. Venter

short and fine P_1 - P_3 represented by their alveoli ; some scattered light spots of glandular tissue present along the lateral margin ; fissures *ia*, *im* and *ip* found on dorsal side.

Genital plates as long as broad, four pairs of genital hairs ; anal plate about one and half times longer than genital plates, equal in length and width, two pairs of anal hairs ; three pairs of adanal hairs and one pair of adanal fissures ; apodemata III nearly touching the anterolateral border of genital plates ; legs with one strong claw.

Holotype : Adult female, Bhutan : Phuntsholing ; 4 kms away from Jaigaon towards Gumpa, from forest soil and litter, 24.XI.1983, coll. A. K. Sanyal.

Remarks : The new species differs from all other species of *Scheloribates* by the presence of very characteristic rostral hairs.

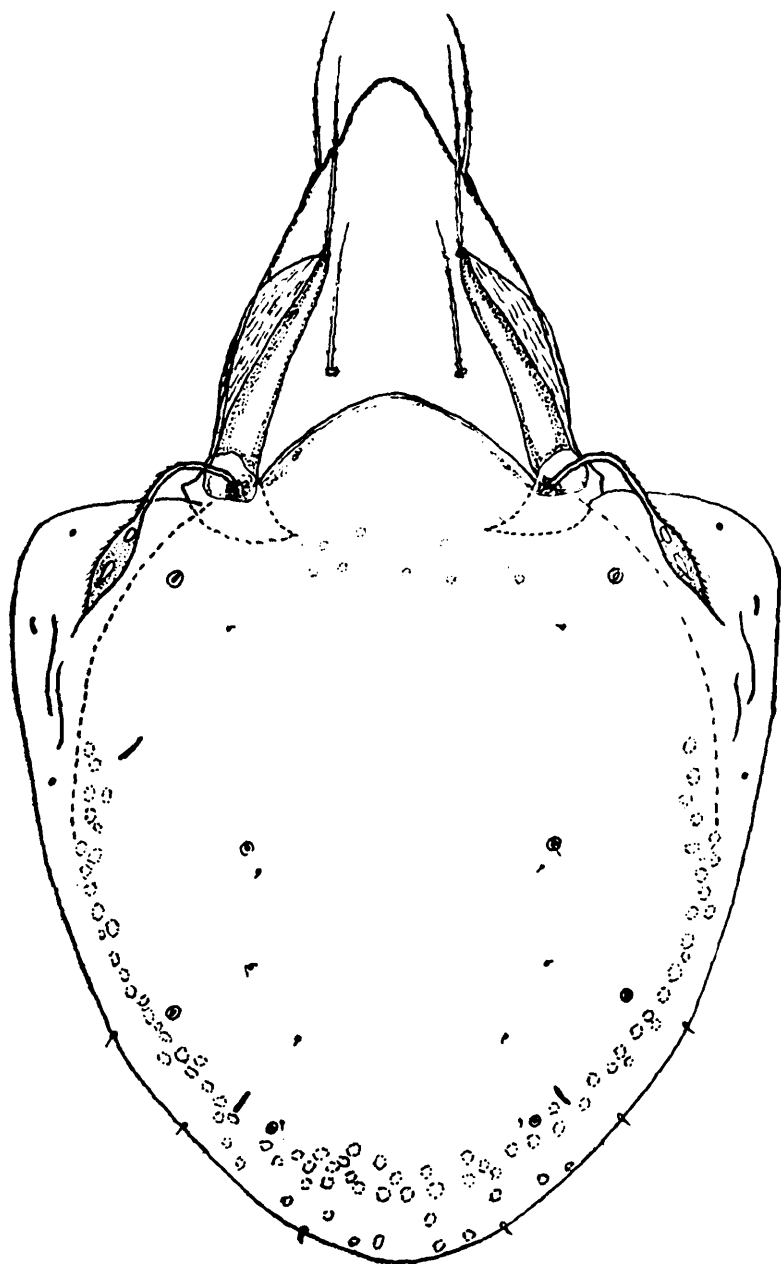
***Scheloribates bhutanensis* sp. n.**

(Figs. 3-4)

Colour light brown ; length of the body 309 ; width 200 ; microsculpture of the integument absent ; prodorsum broad at the base, long ; rostrum rounded, rostral hairs inserted laterally on distinct apophyses, long, thin, minutely barbed, as long as their mutual distance ; lamellae stout and extend upto middle portion of prodorsum ; lamellar hairs slightly longer than the mutual distance between their bases, finely barbed and extend beyond the tip of the rostrum ; inter-lamellar hairs as long as rostral hairs, finely barbed ; bothridium cup-shaped ; sensillus with long stalk, lanceolate head with two light spots and fine bristles, terminates in a thin thread, directed outwards and backwards, reaches beyond the lateral margin of pteromorph.

Notogaster longer than broad, posterior border rounded ; dorsosejugal suture deeply curved ; pteromorph rounded distally and laterally ; notogastral hairs ten pairs, minute ; light spots of glandular tissue present along the lateral border of notogaster , four pairs of small sacculi present on notogaster ; fissure *ia*, *im* and *ip* visible on dorsal view.

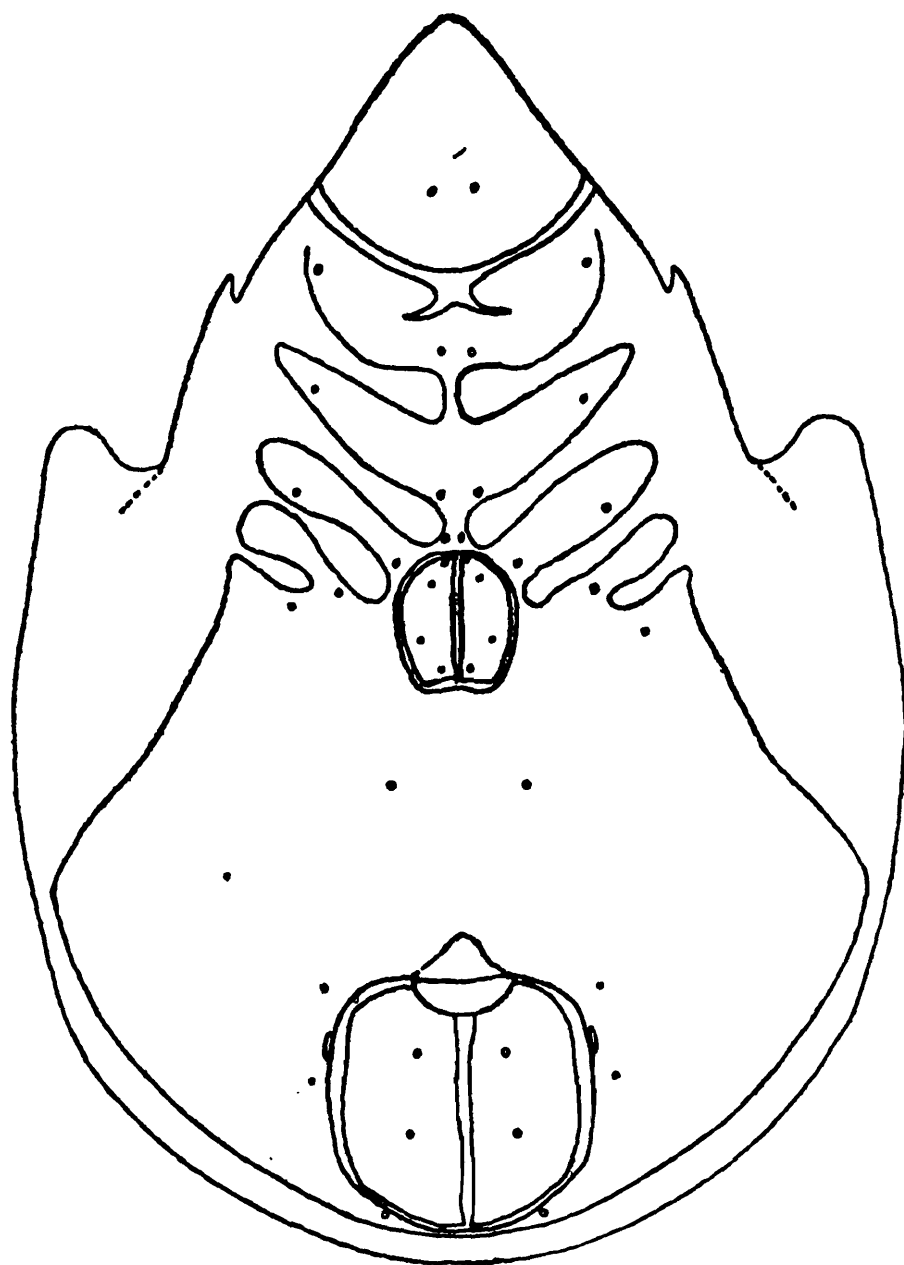
Genital plates more or less equal in length and breadth ;
two anteriorad and two posteriorad pairs of genital hairs ;



3

Fig. 3. *Scheloribates bhutanensis* sp. n. Dorsum

anal plates longer than the genital plates, two pairs of hairs placed medially ; three pairs of adanal hairs ; one pair of adanal fissures placed antero-laterally of each anal plate ; apodemata II and III nearly meeting in front of the genital field ; all tarsi have two claws.



4

Fig. 4. *Scheloribates bhutanensis* sp. n. Venter

Holotype : Adult female, Bhutan : Phuntsholing : 4 kms away from Jaigaon towards Gumpa, from forest soil and litter, 24.XI.1983, coll. A. K. Sanyal.

Remarks : The new species resembles *Scheloribates bidactylus* Hammer, 1961 in general body shape, in having long, barbed rostral, lamellar and interlamellar hairs and in bidactylous tarsi but can easily be separated from the peruvian species in having smaller body size, in length of *la*, long

sensills having thin thread at the tip of the head which extends beyond the lateral outline of pteromorpha, no incurvation in the middle of the lateral border of pteromorpha.

***Scheloribates laticlava* Hammer, 1961**

Material examined : 6 adult females, phuntsholing, 4 kms away from Jaigaon towards Gumphu, from forest soil and litter, 24.XI.1983.

SUMMARY

Three species belonging to the genus *Scheloribates* are reported from Bhutan which include two new species and one new record for the country.

ACKNOWLEDGEMENTS

The author is grateful to the Director, Zoological Survey of India, Calcutta for providing laboratory facilities. Thanks are also due to Sri R. K. Kulin, Acarology Section, Zoological Survey of India for assistance.

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THE CRANIOLOGY AND DENTITION IN THE
PIGMY HOG, WITH A NOTE ON THE
GENERIC STATUS OF *PORCULA*
HODGSON, 1847.

By

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INTRODUCTION

The shy, rare and apparently inaccessible Pigmy Hog, with its restricted distribution in the thatch lands under the tropical hill forests of the eastern sub-Himalayas, created great interest among naturalists and taxonomists from time to time. Unlike the common European and Asiatic boars (*Sus* spp.), this animal was never domesticated and is struggling for its existence in the limited habitation concealed from sight.

Though much importance has been laid recently to save this threatened species of suid (Mukherjee 1963 ; Oliver 1978 ; Tikader 1983), yet it is very unfortunate that the taxonomic importance of this species has been always overlooked.

Pigs and their allies, African Wart Hogs (*Phacochoerus* spp.), American Peccaries (*Tayassu* spp.), etc., comprising six recognised genera and their nine to twelve living species, belong to the mammalian suborder Suiformes (Bunodontia). The other member in the suborder is the Hippopotamus. Characteristically these animals do not possess horns or antlers and unlike the ruminants, the other members of the even-toed Artiodactyla, their teeth are bunodont, i., e., cusps are cone-shaped tubercles. Members of the family Suidae are characterised by the following morphological features : (i) temporal canal absent ; (ii) supraorbital process short

and not connected with the zygomatic arch ; (iii) pterygoid fossa present and opening posteriorly ; (iv) infra-orbital foramina (some times double) large and situated above the third and forth premolars ; (v) canines with persistent pulp and growing ceaselessly ; (vi) a prenasal bone present and snout provided with a disc-like cartilage at tip ; (vii) third and fourth metapodials are always separate ; (viii) stomach simple and a caecum present in the alimentary system. The Pigmy Hog belongs to this group.

Among the living members of Suidae, two species (one polytypic and another occur at present in India : the Indian Boar, *Sus scrofa cristatus* Wagner 1839, the Andnman Pig, *Sus scrofa andamanensis* Blyth 1858 and the Pigmy Hog, *Sus (Porcula) salvanus* Hodgson 1847. The Indian Boars and the Andaman Pigs, in general morphology and behaviour show close affinities with the European Boar *Sus scrofa scrofa* Linnaeus. The differences are slight, for example, the Andaman Pigs show poor development of the crest and mane, their last molars (M^3) are a bit reduced in size and either shorter or nearly equal to the combined length of the preceeding two molars M^1 & M^2 taken together. Besides, these pigs are of moderate stature. But the Pigmy Hog is very distinct from *Sus* Linnaeus, 1758 proper, by several broad morphological and ethological features (list No. 3), for which it deserves a separate and distinct taxonomic status. However, since its discovery and first description, subsequent systematists always underestimated and failed to assess properly the taxonomy of this animal.

HISTORICAL RESUME

It was Hodgson (1847 & 1848) who first ventured to study the morphology and anatomy of this unique species of Pig, based on a sub-adult male specimen and described it as a new genus and species of Suid *Porcula salvania*. The generic characters which he attributed were meagre and incorrect. For example the dentition was found to be erroneous by subsequent workers who studied adult speci-

mens of the same species that were kept mainly in the possession of the then Society's garden (now London Zoo) and British Museum. Hodgson, considering his only specimen nearly as full grown claimed the dental formula of this animal as $\frac{6}{8} \frac{1}{1} : \frac{1}{1} \frac{6}{8} : \frac{6}{8} = 40$ and comparing the straight milk canines, he correlated it with that of peccaries. Besides the dentition, "unusually diminished size of the inner back digits" impressed upon him to hold such view. In fact the peccaries are morphologically quite different from the Pigmy Hogs and belong to a separate family Dicotylidae. The dental formula is $I\frac{2}{8} C\frac{1}{1} P\frac{3}{8} M\frac{3}{8} = 38$. The Peccaries lack in the peculiar prenasal bone ; the third and fourth metapodials in them are fused to form a single bone ; the canines are almost straight like the carnivores ; the stomach is differentiated in three sections and so many other peculiarities by which they are distinct from the Suids.

However, almost within a decade of its first description Gray (1863), while accessing Hodgson's collection in the British Museum, renamed the Pigmy Hog by confusion as a dwarf species of *Sus* i. e. *Sus lilliputensis*. Garson (1883) and others studying the internal morphology of Pigmy Hog, observed great anatomical similarity with that of *Sus scrofa* Linnaeus and concluded that the Pigmy Hog was undoubtedly a species of *Sus* proper with negligible differences. It should be mentioned that the internal organs are found often quite similar, both structurally and functionally even in animals belonging to two separate families. However, Garson's proposition was not refuted and consequently the Pigmy Hog was considered as a species of *Sus* Linnaeus, 1758.

There after, since late 19th century, no further authentic occurrence of this tiny hog was reported and eventually no further taxonomic or biological investigation was made. But those few, who attempted to study the scanty and mingled up material in the custody of museum, were rather confused. Their contention was wrong and as such it was not very astonishing when Tate (1947) mistook the animal

as a subadult pig (*Sus scrofa*), or a pig with stunted growth. Actually the rarity of the animal, its rather remote and inaccessible habitat, were the reasons of such incorrect conception, especially under the circumstances of Hodgson's self-defeating statement. Only on the basis of very small size, three pairs of teats and very short tail, the species has obtained recently a separate subgeneric status (Ellerman & Morrison Scott 1966). Thus *Porcula salvania* Hodgson became *Sus salvanius* (Hodgson) for some period and was subsequently revived as *Sus* (*Porcula*) *salvanius* Hodgson. Yet, in a recent monograph, Groves (1981), opined that *Sus salvanius* is a true *Sus* and is closely related to *Sus scrofa*.

Scope : Under these circumstances, it was felt necessary to study and review different aspects of the Pigmy Hog and its taxonomic distinctiveness to justify the validity of its nomenclature.

Fortunately, after a long absence, the animal which was thought to be extinct by zoologists reappeared dramatically in March, 1971. A twenty four hour long wood fire in north western Assam drove out a number of its kind along with the closely associated Hispid Hares from their covers. It created great impetus among interested zoologists (Mallinson, 1971, 1977 ; and Oliver, 1978, 1980). They ventured to study the breeding and population biology of this animal. Though their works were mainly concentrated on captive animals, yet the results have great role to play in determining the status of this, the tiniest pig in the world.

Now, by supplementation of the recent biological observations to the former recorded inferences (List No. 2), it becomes apparent that the taxonomic assignment originally made by Hodgson for this unique animal was worthwhile. The craniology and dentition of this hog (Table nos. 3 & 4) justify the eligibility of *Porcula* as a valid genus and is the present topic of this article.

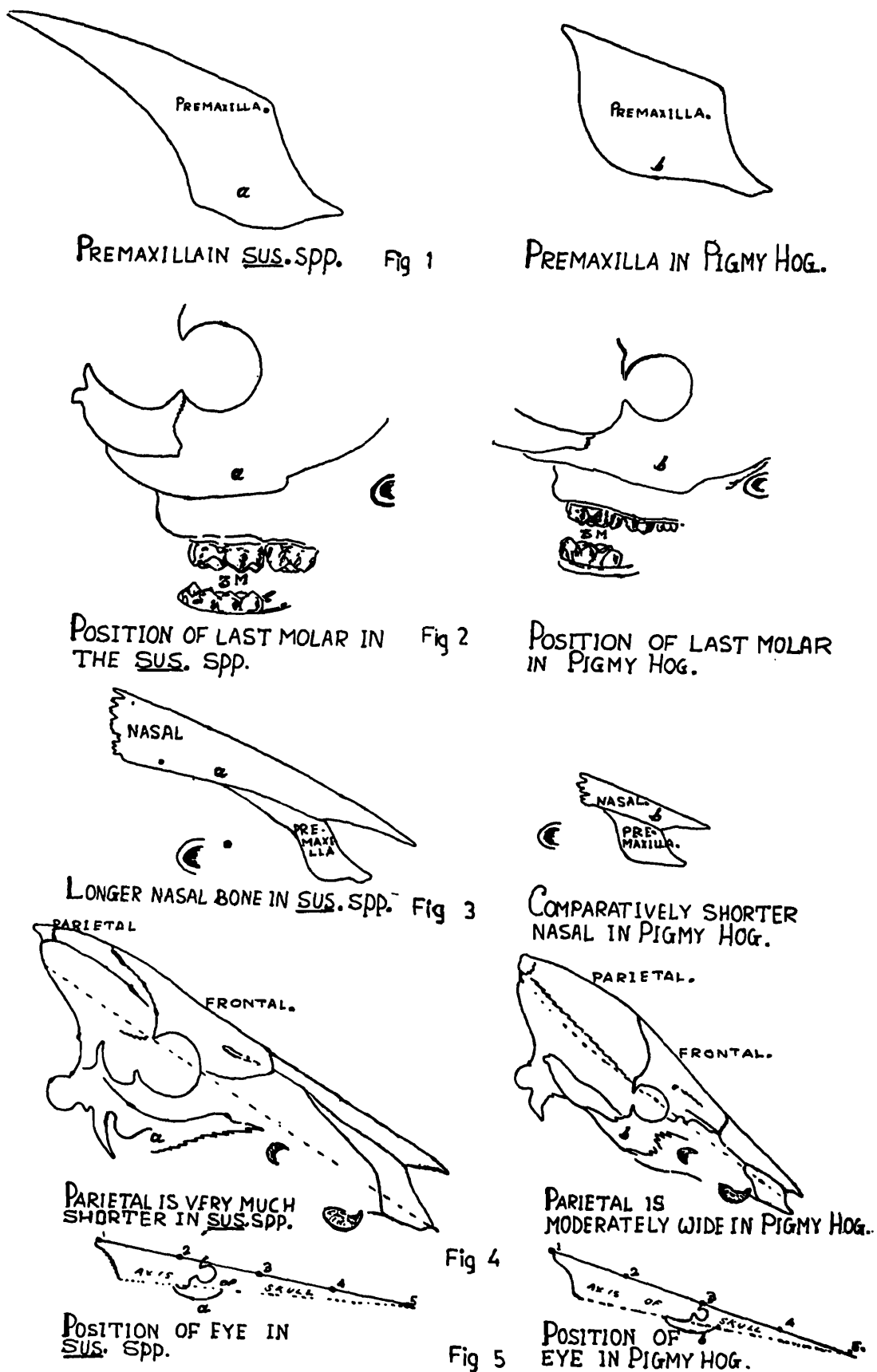
Material for present study :

- (A). Three specimens of skulls with jaws of *Sus scrofa cristatus* Wagner :

- (i) Adult male skull with jaws of wild boar, Z. S. I. Reg. No. 18056, Loc. Cuttack, Orissa, Collector-T-Shaw.
 - (ii) Adult female skull with jaws of wild sow, Z. S. I. Reg. No. 17999, Loc. Arakan, Burma, Collector-A. Phayre.
 - (iii) Adult castrated pig's skull with jaws from Calcutta.
- (B) Two specimens of skulls with jaws of *Sus scrofa andamanensis* Blyth :
- (i) Adult male skull with jaws of wild specimen, Z. S. I. Reg. No. 17994, Loc. Port Blair, South Andaman, Collector-Major Ford, (1867).
 - (ii) Adult female skull with jaws of wild specimen, Z. S. I. Reg. No. 10952, Loc. South Andaman Collector-R. Hodgart.
- (C) Two specimens of skulls with jaws of Pigmy Hog, *Porcula salvania* Hodgson :
- (i) Adult male skull with jaws, Reg. No. 4334, I. M.
 - (ii) Sub-adult female skull with jaws, Reg. No. 19312.
- (D) One complete skull with jaws of adult collared Peccary, *Tayassu tajacu* (Linnaeus) Reg. No. 19311, Loc. Arizona.
- (E) Pre-historic remains of maxillary and mandibular specimens of Pigs, *Sus* spp. recovered from thirty two Archaeological sites in India.

Observations : Superficially the peccary shows some similarities to the Pigmy Hog (convergence), by the possession of very reduced number of mammae (four pairs) ; a very short, sparsely haired tail ; roundish ear , and a short head (skull) with smaller orbits. Besides, the Peccary also breeds once in a year and raises a very small litter size, generally not exceeding two. But like the disimilarities in the anatomy and in limb bones, the craniology and dentition of the Peccary (Table 1 & 2, fig. f, k, q) are also very different and

eliminate any close phylogenic relation between the two. Whereas the craniology and dentition in *Porcula* and *Sus* are



Figs. 1-5 : The shapes and position of different bones in the skull and the position of the orbit in the Pigmy Hog and in the Indian Boar.

to some extent very similar (Table 3 & 4, Plate I-II). In this regard *Porcula* is nearer to the polytypic genus *Sus* with the following major differences (figs 1-5) : The nasal bone is comparatively shorter and broader in the Pigmy Hog. This bone is always longer in *Sus* species. The premaxilla tends to be rectangular in the Pigmy Hog, but in the species of *Sus* this is rather triangular and tapering behind. The orbit is situated above the M^2 in the Pigmy Hog, but in *Sus* spp. this is found above the edge of M^3 . The zygomatic arch is very much concavely arched in the species of *Sus*, but in the Pigmy Hog, it is less so. The parietal bone is narrower and longer in the Pigmy Hog, but it is shorter and broader in *Sus* sp. The facial and frontal profile are rather arched in the Pigmy Hog, but they are almost in a plain in the Indian Boars and Andaman Pigs. The maxillae are laterally much more notched in the Pigmy Hog. The orbit is nearly complete because of the extended processes.

Out of the above mentioned differences, the shape of the premaxilla, the position of the orbit, the length of the nasal and parietal bones are of high taxonomic weight.

Discussion ; The general morphological characters of Suids as mentioned before are found in the Pigmy Hog, hence its place as a member of the family Suidae is unquestionable, but that it is not congeneric with *Sus* is obvious from the following points.

The Pigmy Hog (fig. 6 b) possesses essentially a small rudimentary tail (aprox. 3 cm), containing less than ten coccygeal vertebrae in contrast to the comparatively long tail of *Sus* spp. (*S. scrofa*, *S. barbatus*, *S. verrucosus*) which is composed of more than twenty coccygeal vertebrae. The teats in such species are always six pairs and placed equidistantly, whereas in the Pigmy hog the teats are three pairs and the gaps are uneven. The skull and jaws in Pigmy Hog are comparatively shorter than any species of *Sus*.

The Crest in Pigmy Hog is not high. The mane is absent in this animal. The ear in this hog is rather oval and like the tail is almost devoid of hairs. Now from the reports

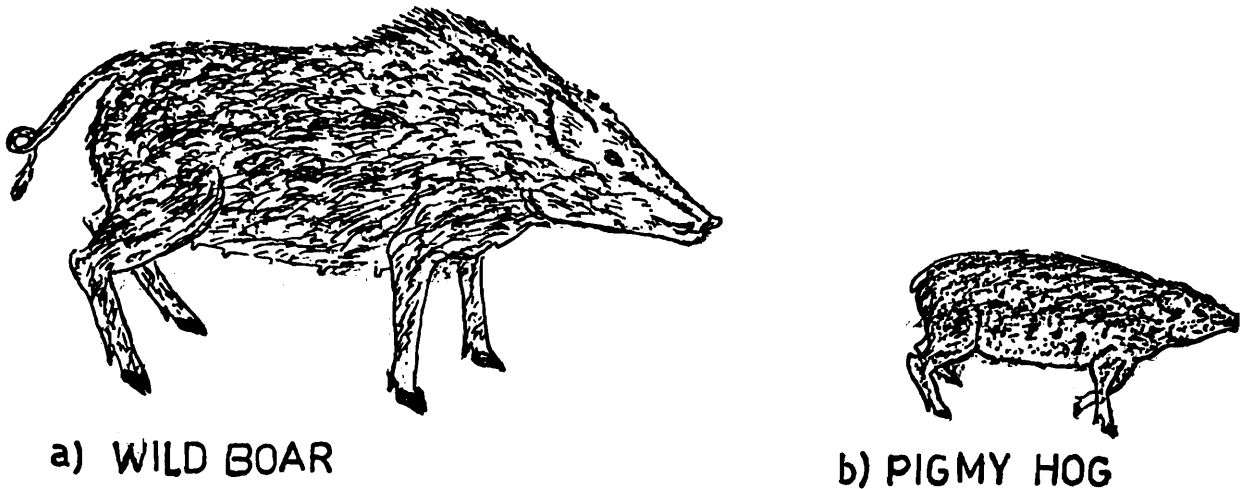
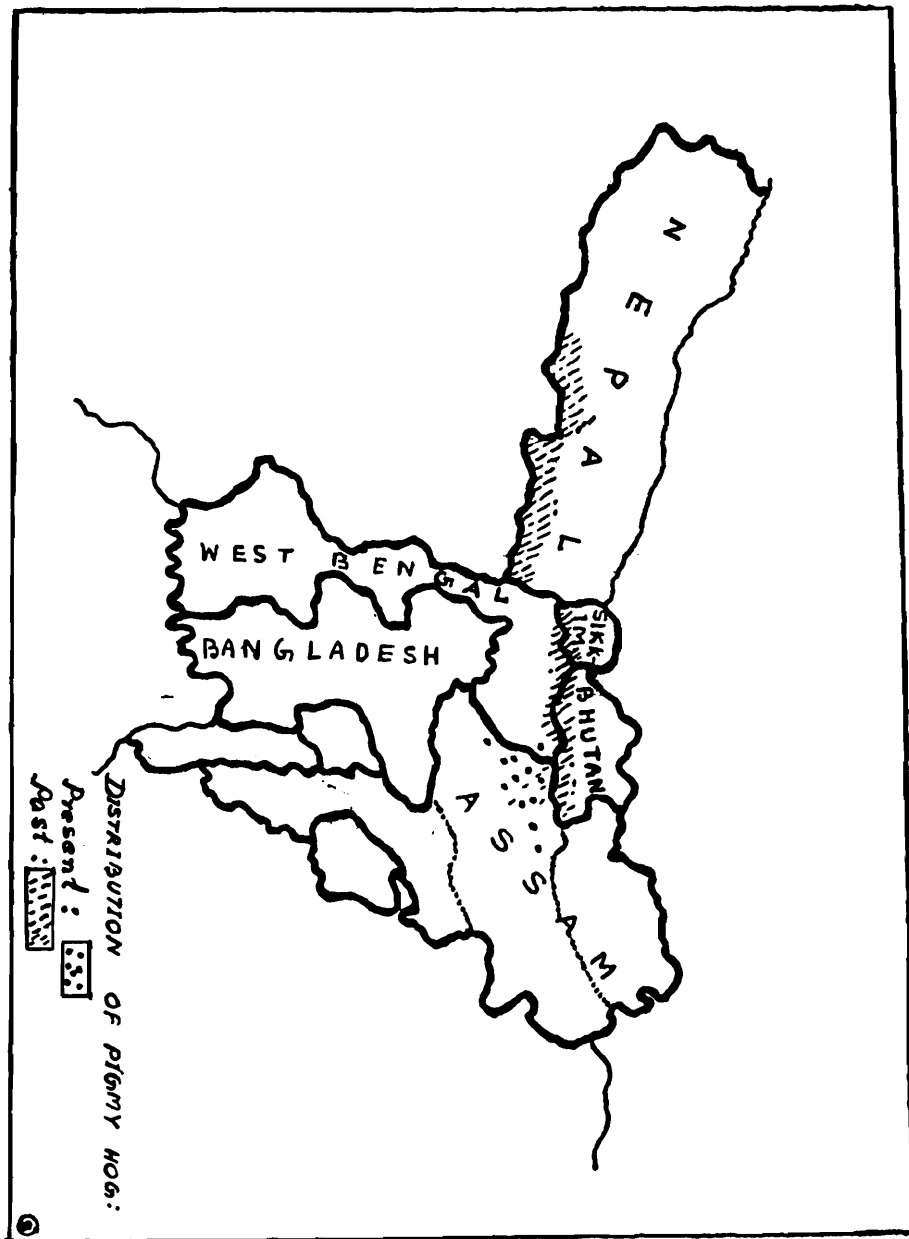


Fig. 6. The Indian Boar and the Pigmy Hog, their comparative size and shape.

of Mallinson and Oliver (List No. 2) it is learnt that the animal breeds only once in a year. After a gestation period of approximately 110 days, 3-4 young are born in April/May. It may be mentioned that the number of teats are proportionate to this litter size, but the litter size, which should have been inversely proportional to the body size, according to the general principle in mammals (Storer & Usinger, 1965) and should have comprised a few more offspring than those of *Sus* spp., shows astonishingly poor number in a year. It is very significant and indicates strongly a separate phylogeny of this hog. Oliver also observed that the pectoral half in the Pigmy Hog is comparatively weaker than the pelvic part, which is just reverse in the *Sus* spp. This certainly influences the gait in this animal. The more inward position of the cheek teeth inside the buccal cavity and the reduction of size in M^3 , are quite significant. Certainly it affects the chewing movements (ectal-ental) in this hog. The restricted and limited habitat of this hog, including its former distribution (Map-1), is also very striking. The zone is not bridged by any intermediate species around, to suggest a phylogenetic splitting from *Sus*. It ranges within the tropical hill forests of the Eastern sub-Himalayas (av. alt. 600 & 700 meters) composed of tall grass jungles or thatch lands and with a different biota. In this closed eco-system its occurrence is also interestingly found in association with another important species of mammal, the Hispid Hare.

(Oliver, 1980). In such a niche, where perennial waterholes are not frequent, the highlander (hog) seems to be not in the habit of wallowing like *Sus scrofa*.



Now, supplementing the craniology and dentition (List No. 1) it is observed that the Pigmy Hog is generically different from *Sus* proper i. e. it is separated from such a taxon by a 'decided gap'. It is noteworthy that the pigs or species of *Suidae* are animals which have succeeded in maintaining their unaltered and primitive characters, so far as their osteology, dentition, feeding and breeding habits are concerned. This has also been observed and reported by

Zeuner (1963) in his work on domesticated animals, and has been testified by the present author while accessing over the prehistoric animal remains of pigs, collected from different Archoeological sites in India. None of this ancient remains showed any affinity with those of the Pigmy Hogs. The new Anoplura species, recently found to be an ectoparasite in the Pigmy Hog, is also evolved distinctly and is hostspecific (Mishra & Singh, 1978).

Therefore, this tiniest hog in the world is believed to be

PHYLOGENETIC POSITION OF PORCULA, HODGSON, 1847

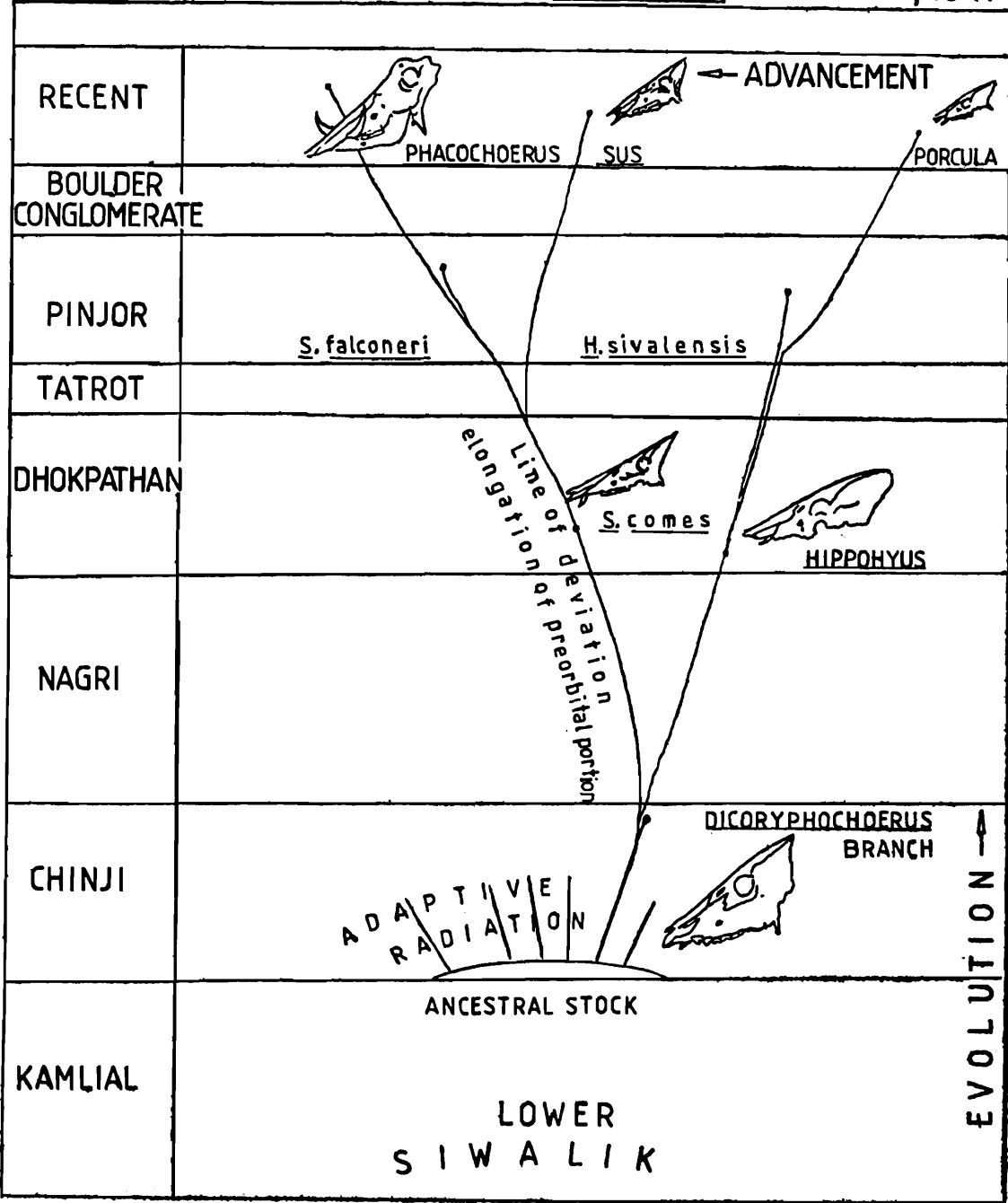


Fig. 7. The phylogenetic position of *Porcula* Hodgson.

confined within its peculiar ecological niche for the last thousands of years, without making any contribution toward domestication. If it was congeneric with *Sus*, it should have had many features in common with the type species *Sus scrofa* Linnaeus. On the contrary, the short preorbital portion and the more centrally placed orbit rather suggest its phylogenetic affinity with the extinct *Hyppohyus* stock (fig. 7).

Conclusion : Considering all the salient features and characters (morphology and ethology) in the Pigmy Hog, it becomes apparent that this species is quite distinct from *Sus* proper by possessing a number of characters with high taxonomic weights. The Pigmy Hog retains a more primitive character than the advanced *Sus* or *Phacochoerus* groups. The differences are greater than among the wolf, the jackal, the coyote, the dog as species of *Canis*, or the zebra, the horse, the onager, the ass as species of *Equus*. Actually the differences between *Sus* and *Porcula* (fam. Suidae) are as profound as between *Loxodonta* and *Elephas* (fam. Elephantidae) or between *Capra* and *Ovis* (fam. Bovidae). Naturally *Porcula* Hodgson, 1847 should be retained with immediate attention as a valid genus for the Pigmy Hog, especially in the period of its declining population and at the moment when it is listed in the Red Data Book of IUCN. The genus is appeared to have a lineage to the extinct Genus *Hippohyus*. In the later the facial portion was rather short and the orbit was almost centrally placed (Colbert, 1935).

SUMMARY

The Pigmy Hog (ARTIODACTYLA : SUIFORMES : SUIDAE) is generically different from *Sus* Linnaeus (1758) and deserves a separate generic status, as originally proposed by Hodgson (1847). But that it had close affinity with the New World Peccary (SUIFORMES : TYASSUIDAE), as he claimed, is wrong. Subsequent workers' efforts were mainly concentrated to nullify such a view of Hodgson and to

establish evidences of its close similarity with the Old World Pig, *Sus scrofa*. The present paper highlights the special features in Pigmy Hog and its craniology.

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Abbreviations used in the articles :

I-incisor ; C-canine ; P-premolar ; M. Molar ; min-minimum ; max-maximum, W-width ; B-breadth ; H-height ; mm-millimeter : cm-centimeter ; C-centigrade.

N. B. The measurements in the tables are taken to be as mean readings.

Present Inferences : Points in favour (*List No. 1*)

The salient features in the skull and mandibles as observed in the Pigmy Hog. (Plates I-III & Figs 1-5) :—

Facial bones : Parietal is longer *cf.* It is proportionately shorter in *Sus* spp.

Frontal is shorter, than those of *Sus* spp. and nearly equal to that of the parietal.

The parieto-forntal ratios are 1 : 1.50 in the *Porcula* and 1 : 2.20 in *Sus*.

Nasal is shorter, never exceeds the line of the infra-orbital foramen. *cf.* It is always longer and exceeds the line of infra-orbital foramen in *Sus* spp. The cranio-nasal ratios are 1 : 3.1 in *Porcula* and 1 : 1.85 in *Sus*.

Maxillary bones : Premaxilla is more rectangular in Pigmy Hog. *cf.* it tends to be narrow and prismatic in *Sus* spp. due to posteriorly extended angular cone. The cross diagonal ratios are 1 : 2.5 in *Porcula* and 1 : 3.5 in *Sus*.

Infraorbital foramen is comparatively smaller and more towards the orbit in the Pigmy Hog *cf.* It is either in the middle of the maxilla or towards the premaxilla in *Sus*.

Orbit is smaller in Pigmy Hog and it is almost in the middle of the lateral axis of the skull, *cf.* It is more towards the crania for the extended facial bones in *Sus* spp. and at least 1.60 times furthest from that of the orbital position in *Porcula*.

Mandibles : The horizontal ramus is shorter in comparison to that of the *Sus* sp. No deviation in height is marked near M² or M³ as observed in adult *Sus* spp.

Dentition : The dental formula and number of teeth in Pigmy Hog are of course similar to those of *Sus* i.e. $I_{\frac{3}{3}}C_{\frac{1}{1}}P_{\frac{4}{4}}M_{\frac{3}{3}} = 44$. But the dentition differs strikingly in the following points.

The position of the cheek teeth is a little interior of the buccal in the pigmy Hog, because the facial and the mandibular bones are comparatively less elongated. The combined length of M^1 and M^2 exceeds greatly the length of adjacent M^3 both in upper and lower series in the Pigmy Hog (Table No. 5). These are always shorter (less) than the M^3 in *Sus* proper. Ofcourse the M^3 in the Andaman Pig is nearly equal or some what shorter than the combined length of M^1 and M^2 taken together. The interalveolar space between the lower canine and first premolar is much reduced in the Pigmy Hog.

Previous Inferences :—
(List No. 2.)

OBSERVER	PIGMY HOG				REMARKS
		Snout to vent	Height	Weight	Tail
Hodgson (1847 & 1848)		18"to 20" (male) 26"	8"-10"	7-10, nearly 12lb.	Shorter jaws ; eyes placed midway between the snout and ear ; tail very short, nude but distinct (1847). Face greatly contracted ; three pairs of teats ; no mane ; the molar teeth are carried much more back ward (1848).

OBSERVER PIGMY HOG			REMARKS	
	<i>Length</i>	<i>Tail</i>		
Garson (1883)	58 cm	3.2 cm	Tail is hairless ; three pairs of mammae ; ear nearly ovoid in form ; adult dentition $I\frac{3}{8}$ $C\frac{1}{1}$ $P\frac{4}{4}$ $M\frac{3}{8}=44$; the right central lobe of liver is comparatively larger than left, while in the pig, they are of almost equal size ; absence of the transverse fold between the gastric cavity.	
	<i>Length</i>	<i>Height</i>		
Mallinson (1971)	(male) 66-71 cm	22.9-30.5 cm	Breeding once in a year ; gestation 110-120 days ; litter size 3-4 ; births between April-May, exception May June (in London Zoo) ; conception in Dec-Jan ; temp :— 7.C°-11.C° (min) & 30.C°-37.C° (max).	
	(female) 55.2-62.2 cm	(male) 20.3-21.6 cm (female)		
	<i>Height</i>	<i>Tail</i>	<i>Weight</i>	
Oliver (1980)	11"	±3 cm	8kg	The close association of the two species-Hispid Hare and Pigmy Hog ; similar distribution and habitat preference ; present and past distribution ; the fore quarters proportionately less massive than the hind quarters ; tail sparsely haired ; never domesticated.

Sum up Inferences : Points in favour (list no. 3) :—

The distinctive characters in Pigmy Hog in comparison to those of *Sus* spp. are tabulated below :—

Pigmy Hog (<i>Procula salvania</i>)	MANE : Absent.
SKULL : Parietal comparatively long ; Nasal short, within the line of Infraorbital foramen ; Orbit smaller and in the middle of the skull ; Premaxilla broad and almost rectangular.	PELVIC PORTION : Superiorly developed. BREEDING : Once in a year, mainly in April /May, with a litter size of 3 to 4. HABITAT : Dweller of the tropical hill forest with an average altitude of 600-700 meters, where tall grasses are the main cover.
MANDIBLE : Ramus shorter, just double the vertical height.	Common Boar (<i>Sus scrofa cristatus</i>)
DENTITION : Third molar of medium size, less than the combined length of M ¹ and M ² ; situation of molars beyond the orbital plane.	SKULL : Parietal very short ; Nasal quite long, exceeds the line of infraorbital foramen ; Orbit large and more posteriorly situated ; Premaxilla narrow and tends to be triangular.
TAIL : Very short, not more than 3cm. and almost naked.	MANDIBLE : Ramus longer, more than twice the vertical height.
EAR : Medium size, roundish, scantily haired.	
MAMMAE : Always three pairs.	
NUCHAL CREST : Incipient.	

DENTITION : Third molar robust, longer than M^1 and M^2 taken together ; situated within orbital plane.

TAIL : Quite long, more than 15cm. with a tassel, reaches the calcaneum.

EAR : Bigger, pointed, coarsely haired.

MAMMAE : Five to six pairs.

NUCHAL CREST :

Prominent.

MANE : Present.

PELVIC PORTION :

Inferiorly built.

BREEDING : Twice in a year with a litter size of 6 to 8, any time in the year.

HABITAT : Dweller of riverine plains mainly, where hot and humid environment prevails.

TABLE 1 : Measurement of the skull bones and mandibles (in mm) of *Tayassu tajacu* (Linnaeus).

SKULL	LENGTH	WIDTH	REMARKS
Nasal	Medial 94	Maximum 40	The nasal is moderately short.
Frontal	Medial 71	Anterior 37 Posterior 77	
Parietal	Medial 45 Lateral 83	Anterior 78 Minimum 6 Posterior 38	The parietal is very narrow and constricted behind (plate II, fig. k).
Occipital	62.50-80.00	37.50-39.00	
Maxilla	Maximum 87	65	Indicates the distance.
Premaxilla	Maximum 60	14	
Infraorbital foramen	From orbit 38 From apex 61		
Overall length of the skull=235 mm			
			REMARK
MANDIBLE :	Length of the horizontal ramus	... 155	The diastema is quite long like the ruminants
	Vertical height	... 75	
	Gap between the lower canine and 1P (diastema)	... 28	

The dentition in *Porcula* is similar to those of *Sus*, *Potamochoerus* and *Hylochoerus*, so far as the dental formula is concerned : $1\frac{3}{1}C\frac{1}{1}P\frac{4}{4}M\frac{3}{3}=44$. This primitive formula and dentition, except the mole (Talpidae, Insectivora) is not seen in any other recent mammals. Whereas the dentition in

peccaries (Dicotylidae) is different and possesses a reduced dental formula : $I\frac{2}{3}C\frac{1}{1}P\frac{3}{3}M\frac{3}{3}=38$.

TABLE 2 : Measurement of different teeth in *Tyassu tajacu* (in mm).

Teeth	Upper			Teeth	Lower			Remarks
	L	B	H		L	B	H	
1 I	9.2 ;	7.0 ;	13.0 ;	1 I				The upper jaw lacks one incisor.
2 I	8.0 ;	5.1 ;	13.0 ;	2 I				
C	17.0 ;	10.0 ;	32.0 ;	3 I				
1 P	8.5 ;	7.5 ;	7.4 ;	C	12.7 ;	11.0 ;	43.0 ;	Both the upper & lower canines are straight like the carnivores.
2 P	10.0 ;	9.8 ;	9.0 ;	1 P	7.8 ;	4.5 ;	8.8 ;	
3 P	10.5 ;	10.0 ;	8.5 ;	2 P	9.0 ;	6.0 ;	8.8 ;	
1 M	11.0 ;	10.7 ;	7.8 ;	3 P	11.0 ;	6.0 ;	9.0 ;	All the molars are almost equal in size (plate III, fig. q.).
2 M	12.0 ;	11.5 ;	9.0 ;	1 M	11.9 ;	9.2 ;	7.5 ;	
3 M	12.5 ;	11.0 ;	8.0 ;	2 M	13.4 ;	10.0 ;	7.5 ;	
				3 M	14.5 ;	10.3 ;	9.0 ;	

The inter alveolar space between C & P, in upper and lower jaws in Peccary is very high in comparison to *Sus* and *Porcula*.

	<i>Tayassu tajacu</i>	<i>Sus scrnfa</i>	<i>Porcula salvanius</i>
C—P			
upper	22.0mm	7.0mm	.50mm
C—P			
lower	29.0mm	10.0mm	3. 0mm

On the contrary, the space between P¹ & P² is very negligible or nil in Peccary, whereas in *Sus* and *Porcula*, this is reasonably high in the lower jaws.

	<i>Tayassu tajacu</i>	<i>Sus scrofa</i>	<i>Porcula salvanius</i>
1P—2P			
lower	.80mm	14.5mm	3.8mm

Table 3 : Measurement of the skull and individual bones in them (in mm) as observed in the Pigmy Hog, Indian Boar and Andaman Pig.

SKULL :—

Item	Topography	<i>Sus (Porcula)</i> <i>salvanius</i>	<i>Sus anda-</i> <i>manensis</i>	<i>Sus</i> <i>scrofa</i>	Remarks
Nasal	Length	58	112	177	The nasal is short in Pigmy Hog (plate II, fig. 1)
	Width	28	26	52	
Frontal	Length	60	90	108	The parietal is longer in Pigmy Hog.
	Width	40	65	91	
Parietal	Length	40	35	45	
	Width	20	29	35	
Occipital	Length	39	85	117	The diagonal length is shorter in Pigmy Hog.
	Width	34	58	69	
Maxilla	Length	58	97	140	
	Width	41	50	70	
Premaxilla	Length (diagonal)	45	97	140	
	Width	16	27	37	
Infraorbital foramen	From orbit	22	60	80	
	From apex of maxilla	34	52	74	
Overall length of skull		160±5	255±10	375±15	The skull is nearly three times longer than the nasal in Pigmy Hog.

MANIBDLE (measurement in mm) :—

Item	Topography	<i>Sus (Porcula)</i> <i>salvanius</i>	<i>Sus anda-</i> <i>manensis</i>	<i>Sus</i> <i>scrofa</i>	Remarks
Ramus	Horizontal Length	125	170	250	The ramus is shorter in Pigmy Hog
	Vertical Height	62	75	117	
		37	50	75	
Body	Length				
	Width	29	35	58	
Condyle	Breadth	14	19	27	

Table 4 : Measurement of different teeth in the maxilla and mandible as observed in the Pigmy Hog, Indian Boar and Andaman Pig (in mm).

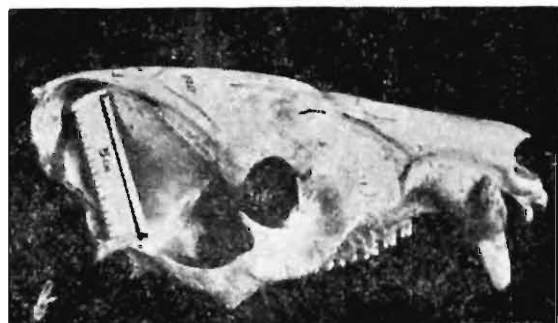
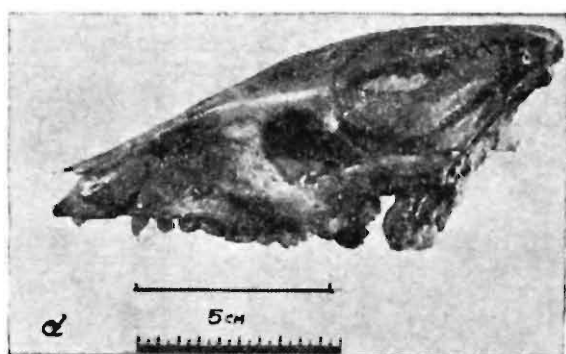
TEETH		<i>Sus (Porcula) salvanus</i>			<i>Sus andamanensis</i>			<i>Sus scrofa</i>			Remarks
		W.	B.	H.	W.	B.	H.	W.	B.	H.	
1I	Upper	12	4	10	13	7	15	15	7	17	
	Lower	4	5	11	6	8	22	8	9	27	
2I	Upper	7	3	5	12	6		15	5	11	
	Lower	5	4	14	6	8	23	10	10	26	
3I	Upper	5	3	5	7	3	8	8	4	10	
	Lower	3	2.5	6.5	.	.		7	5	16	
C	Upper	9	8	20	9	8	12	29	24	70	
	Lower	6	7	30	7	9	20	16	17	65	
1P	Upper	6	3	4	.	.	.	8	4	7	
	Lower	5	2.5	4	8	6	8	7	3	8	
2P	Upper	8	4	6	11	7	12	15	7	12	
	Lower	5	3	4.5	10	6.5	9	13	5	10	
3P	Upper	8	6	7	12	9	10	16	11	11.5	
	Lower	7.5	4	7	11	7	9	15	8	13	
4P	Upper	7	8	6.5	11.5	11	10	15	16	11	
	Lower	8.55	5	7	11.5	8	10	17	10	13	
1M	Upper	9	9	7	14	12	11	17	15	9	
	Lower	9.5	6.5	4	13	10	10	17	12	8.5	
2M	Upper	14	10.5	8	18	14	12	24	19	11	
	Lower	13	8.5	7	17	12	8	24.5	16	9	
3M	Upper	15	11	9	22.5	15	14	42	21	16	
	Lower	15	9	8.5	23.5	18	9	46	17.5	14	

Table 5 : Linear length of combination tooth ($M^1 + M^2$) in comparison with that of M^3 in the natural species.

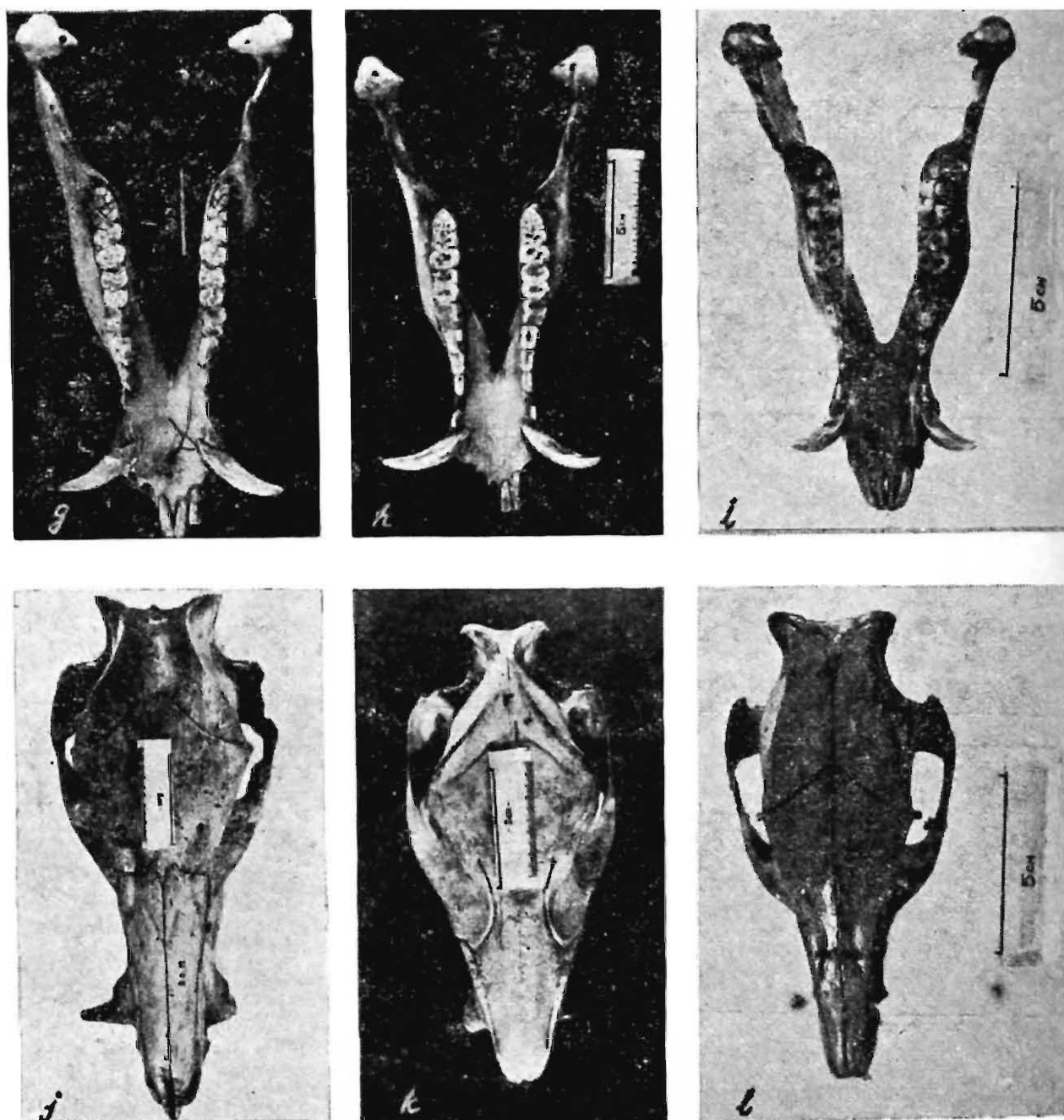
	<i>Sus (Porcula) salvanus</i>	<i>Sus anda-manensis</i>	<i>Sus scrofa</i>
Upper $M^1 + M^2$	22.70 cf. 15.00	32.00 cf. 22.50	40.00 cf. 42.00
cf. 3M	i.e.)	i.e.)	i.e.)
Lower $M^1 + M^2$	22.40 cf. 15.00	29.00 cf. 24.00	30.20 cf. 46.00
cf. 3M	i.e.)	i.e.)	i.e.)

In *Tayassu tajacu* the molars are almost equal in size (see table no. 2).

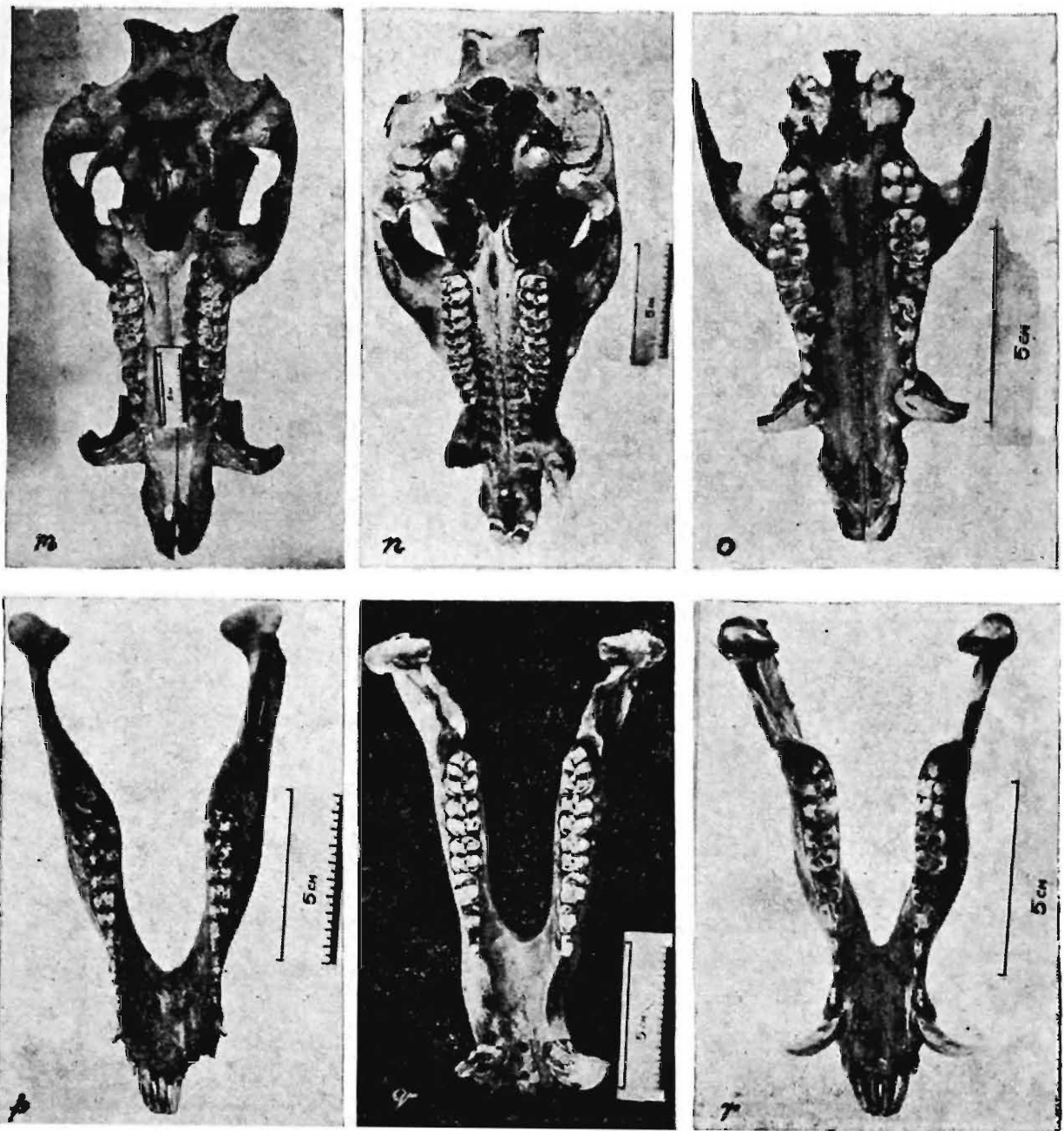
In *Sus scrofa cristatus* M^3 is always robust and greater than $M^1 + M^2$.



Figs. a-f. a. Lateral view of the skull of the Indian boar, *Sus scrofa cristatus*
b. —do— —do— Andamanese pig, *Sus scrofa andamanensis*
c. —do— —do— broken skull of adult male Pigmy hog, *Sus*
(Porcule) *salvanus*
d. —do— —do— of the skull of a female —do— —do— —do—
e. —do— —do— of the Indian boar, *Sus scrofa cristatus*
f. —do— —do— of the collared peccary, *Tayassu tajacu*



Figs. g-l. g. Mandible with teeth of the Indian boar *Sus scrofa cristatus*
 h. —do— —do— Andamanese pig, *Sus scrofa andamanensis*
 i. —do— —do— Pigmy hog, *Porcula salvania*
 j. Dorsal view of the skull of Indian boar, *Sus scrofa cristatus*
 k. —do— —do— collared peccary, *Tayassu tajacu*
 l. —do— —do— Pigmy hog, *Porcula salvania*



Figs. m-r. m. Maxilla with upper dentition in the Indian boar, *Sus scrofa*
n. —do— —do— collared peccary, *Tayassu tajacu*
o. —do— —do— Pigmy hog, *Porcula salvania*
p. mandible with dentition of a juvenile Indian boar, *Sus scrofa cristatus*
q. —do— —do— the collared peccary *Tayassu tajacu*
r. —do— —do— the Pigmy hog, *Porcula salvania*

REPORT OF MELANISM ON THE NORWAY RAT,
RATTUS NORVEGICUS (BERKENHOUT)
[RODENTIA : MURIDAE] IN INDIA

By

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While progressing with the identification and cataloging of the fluid-preserved specimens of rodents present in the National Zoological Collections of the Zoological Survey of India, Calcutta, the author came across with four examples of complete melanistic form of rat and after careful identification they turned out to be the examples of the Norway Rat, *Rattus norvegicus* (Berkenhout). The specimens mentioned above were collected by W. C. Hossack from Calcutta in the year 1906.

Colour variation of rodents, specially in rats, is a well-known fact. But extreme colour variations, commonly known as albinism and melanism are rare in rats in India. The later has been reported on the House Rat, *Rattus rattus* (Linnaeus) in India by Bhattacharyya (1973). There is no report of melanism on *Rattus norvegicus* in India. Hence, the present material reported here constitutes the first authentic record of melanism on the *Rattus norvegicus* within Indian limits. However, melanism on this species is already known from some western countries.

Here, in these four specimens, the colour of the body and tail is completely jet black, with no line of demarcation between the dorsal and ventral aspects.

All measurements are taken after Ellerman (1963) and are in millimetre.

Material : 1 ♂, 2 ♀, adult ; 1 ♂ subadult ; Zoological Survey of India Registration Number 8367, 8371, 8372,

8373 ; in alcohol ; collected in the year 1906 ; Calcutta ; W. C. Hossack collector.

Measurement : External : 1 ♂, 2 ♀, adult : Head and body 280.0, 247.0, 223.0 ; tail 228.0, 192.0, 170.0 ; hindfoot 43.0, 40.5, 39.3 ; ear 20.0, 19.5, 18.0.

Cranial : 1 ♂, 2 ♀, adult : Occipitonasal 52.2, 48.7, 45.5 ; condylobasal 51.8, 47.8, 45.0 ; nasal 21.2, 18.8, 17.8 ; palate 29.7, 27.0, 26.0 ; molar tooth row 7.3, 7.1, 7.2 ; bulla 7.9, 7.5, 7.3 ; anterior palatal foramina 9.2, 8.3, 7.9 ; diastema 16.6, 14.5, 13.5.

Different views have been put forward as to the causes and occurrence of melanism in rats. Watson (1944) noted that 21 of 1,266 *Rattus norvegicus* trapped from several localities in the British Isles were melanistic and surmised that an incidence as high as 1.66% could not be accounted for the mutation and recombination factors alone but to the extent that it had been established in the rat population of those areas. After getting 19.1% melanistic form in a population of *Rattus norvegicus* in southwestern Georgia, Smith (1958) remarked that such a high prevalence of melanism appears to substantiate the findings of Keeler and King (1941) who noted that this black coat colour is a simple Mendelian recessive character. Rohe (1961) found a melanistic population of this rat confined to underground sewers. The fact that the population was completely isolated and that the litters were all melanistic led him to believe that it was a true breeding melanistic colony. Lloyd (1909) obtained thirteen examples of melanistic *Bandicota bengalensis* from two localities at Rangoon in Burma and remarked that they had arisen quite independently of one another and it seems much more likely that they had been bred there. Bhattacharyya (1973) reported melanism in five examples of the House Rat, *Rattus rattus* (Linnaeus) collected from Calcutta by W. C. Hossack in the year 1906 but he declined to give any remark depending on dead specimens. But here the four examples of *Rattus norvegicus* collected in the year 1906 from Calcutta and subsequently not finding any melanin

form of this rat in and around Calcutta led the author to believe that this melanin coat character is not established in *Rattus norvegicus* population of Calcutta or its surroundings.

Pattern of coat colour inheritance and mutation have been studied on *Mus musculus*, *Rattus rattus* and *Rattus norvegicus* (Deol, 1963 ; Searle, 1967). Based on the above studies, it is sufficient to say that these melanistic forms may be due to a mutation from agouti to non-agouti (*Rattus norvegicus*), but are not necessarily so, as mutation at the extension locus, for instance, can produce the same sort of change (*Mus musculus*, *Rattus rattus*). There are several other possibilities too.

SUMMARY

The author has described melanism in the Norway Rat, *Rattus norvegicus* (Berkenhout) from Calcutta which is the first record of its occurrence in India. He has also discussed the causes and occurrence of melanism in rats.

ACKNOWLEDGEMENTS

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STUDIES ON THE HAEMATOZOA OF
CATFISHES FROM INDIA

By

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INTRODUCTION

Considerable attention has been paid to the haematozoa of man and domestic animals due to their medical and veterinary importance. But little work has been done on the blood parasites of cold blooded animals.

The catfishes are the scale-less fishes which come under the order siluriformes, comprising of 30 families with about 2000 species distributed from South America, Africa, Europe, Asia to Japan (Jayaram, 1977). Of which, 13 families comprising of 46 genera are found in Indian subcontinent. Of these representatives of 10 families, Ariidae, Plotosidae, Siluridae, Clariidae, Heteropneustidae, Amblycipidae, Sisoridae, Bagridae, Schilbeidae and Pangasiidae have been examined for the protozoan parasites and the rest Olyridae, Chacidae and Akysidae have not been studied due to nonavailability of material.

Valentin (1841) was the first who detected a haemoflagellate from a fish-European brown trout. Since then, a number of workers have contributed much in this field and the following are considered as pioneers from abroad :

Minchin (1909), Henry (1910, 13), Hoare (1930), Laird (1951, 52), Saunders (1958, 60, 66), Noble (1968) Becker (1970, 77) and Lom (1979).

In India, Lingard (1904) was the first who recorded a trypanosome from fish and subsequently, de Mello and Valles (1936), Qadri (1955, 62), Hassan and Qasim (1962),

Misra, Haldar and Chakravarty (1969, 72), Haldar, Misra and Chakravarty (1971), Ray Chaudhury and Misra (1973), Misra, Chandra and Chaudhury (1973), Tandon and Joshi (1973), Tandon (1977), Tandon and Chandra (1977 ab), Mandal (1975, 78a b), Saratchandra and Narsimhmurti (1978), Mukherjee and Halder (1979) and Gupta and Jairajpuri (1981) did some work on the haematozoa of fishes.

A consolidated account of the haematozoa of particular groups of fishes is still lacking except that of Mandal (1979) who dealt with the blood inhabiting forms of the fishes belonging to the genus *Mystus* Scopoli. The present communication gives a detailed account of the haematozoa of Indian catfishes, mainly based on the author's own observations or as described by the other workers.

Six genera, *Trypanosoma*, *Cryptobia* (= *Trypanoplasma*) *Haemogregarina*, *Dactylosoma*, *Babesiosoma*, *Mesnilium* and *Haematractidium* have been recorded from different groups of fishes. However, the genera *Trypanosoma*, *Cryptobia* (= *Trypanoplasma*), *Dactylosoma* and *Haematractidium* only have been recorded from Indian Cat fishes.

The material for the present study is mainly brought from different parts of India particularly from West Bengal, Orissa, Assam, Uttar Pradesh, Bihar and Goa, and the potential sources were the markets of different places visited by the author or to contact the fishermen at the time of catch. The usual methods for preparing blood smears are followed after puncturing the branchial blood vessels of the fishes. Stains like Wright, Leishman or Giemsa were used for routine staining. Organ imprints were made only when the host was positive for haematozoa. The other procedures are vividly enumerated by Mandal (1979) and followed.

While describing a parasite, for the sake of convenience, the host family was given first followed by the specific name. The number of individuals examined and the number infected is shown in parenthesis. In addition, a table has been appended showing the number of hosts examined, number infected together with the name of the parasite.

The type materials will be deposited to the collection of Zoological Survey of India, Calcutta.

Family ARIIDAE

Five genera of fishes, *Arius*, *Osteogobius*, *Batrachoccephalus*, *Ketengus* and *Hemipimelodus* have been examined. Although *Arius* is represented by 20 species only *A. sona* (Ham.) and *A. dussumieri* Valenciennes have been examined. *Batrachoccephalus* represented by single species, *B. meno* has been examined. *Ketengus* is having single species *K. trypis*. *Hemipimelodus* is also represented monotypically in India and both are not examined due to the nonavailability of material.

Host : *Arius sona* (Ham.) (20 : 5)

Loc. Kakdwip, 24 Parganas, West Bengal

Parasite : **Haematractidium** sp.

The smaller ring form measured 2.25 μm in diameter and had a centrally placed nucleus. The elongated form had two nuclei and measured 6.0 X 2.5 μm (vide Mandal *et al.*, in Press).

Host : *A. dussumieri* (Valenciennes) 20 : 0

Loc. Kakdwip, 24 Parganas, West Bengal

Host : *B. meno* (Ham.). 15 : 0

Loc. Calcutta market

Family PLOTOSIDAE

Of the two species *P. canius* Ham. and *P. anguilaris* Ham only one, *P. canius* has been examined.

Host : *Plotosus canius* Ham. (40 : 1)

Loc. Canning, 24 Parganas, West Bengal

An undetermined parasite was encountered intraerythro-citically on one occasion and the infection was very light. The length of the parasite was 6 μm . The nucleus was divided into two lobes and showed inter connecting bridge.

The identification is only possible subject to the availability of more material.

Family SILURIDAE

Three genera *Silurus*, *Ompok*, and *Wallago*, are included in the family. Of which, *Ompok pabda* (Ham.). *O. pabo* (Ham.) and *Wallago attu* (Schneider) have been examined.

Host : *Ompok pabda* (Hamilton (30 :))

Loc. Calcutta market

Host : *Ompok pabo* (Hamilton (10 : 0)

Loc. Calcutta market

Host : *Wallago attu* (Schneider (30 : 2)

Loc. : Champahati, 24 Parganas, West Bengal

Parasite : **Trypanosoma tandoni** Mandal, 1980

(Fig. 1)

Description : The trypanosomes are monomorphic, elongated and attenuated at both ends. Generally "S" shaped. Length of the cell body 23.5 μm (range 20 μm -27.5 μm), length of the free flagellum 14.5 μm (range 11.5-18.5 μm), distance from anterior end of the body to the anterior end of nucleus 10.0 μm (range 9.00-11.00 μm), length of the nucleus 2.5 μm (range 2.25-3.00 μm) width of the nucleus, 0.75 μm (range 0.5-1.30 μm) distance from posterior end of the nucleus to the Kinetoplast 7.00 μm (range 6.00-8.5 μm) ; length of the Kinetoplast 7.00 μm (range 1.00-1.75 μm), width of the Kinetoplast 0.85 μm (range 0.5 μm -1.00 μm) ; distance from Kinetoplast to the posterior tip 1.5 μm (range 0.5-2.00 μm), width of the undulating membrane 0.6 μm (range 0.3-0.95 μm), maximum width of the cell body 1.5 μm (range 1.3-1.8 μm). No polymorphism was noted and no division stages were found in the blood or any other organ smear preparations.

Cytoplasm : The cytoplasm stain faint blue with Giemsa. Numerous granules are localized in the cytoplasm, concentrated at the border opposite the undulating membrane in a linear fashion. Sometimes a few small vacuoles (2-5) in number were found on the cytoplasm anterior to the nucleus.

Nucleus : Sausage shaped, placed almost at the middle of the body. Sometimes shifted a little towards the post-

terior end. It stains deep blue but does not occupy the entire width of the body. The Chromatin material is uniformly distributed. No karyosome was observed.

Kinetoplast : Almost naviculoid in shape, sometimes oval form has also been encountered in the preparations. It stains very deep with any stain used and does not exceed the width of the cytoplasmic mass where it is situated.

Flagellum and undulating membrane : Appears from the base of the Kinetoplast and trails anteriorly bordering the undulating membrane. It extends beyond the body as a distinct long free flagellum and perform a clear lashing movement when the organism is observed in citrate preparation. The undulating membrane stains very faint, having 5-9 folds and can easily be separated from the body cytoplasm by its light colour bordered by thick flagellum.

Family CLARIIDAE

Single genus *Clarius*, monotypically represented *C. batrachus* (Linnaeus).

Host : *Clarius batrachus* (Linnaeus) 45 : 15/45 : 3

Loc. Calcutta market

Parasite (i) *Trypanosoma batrachi* Qadri, 1973

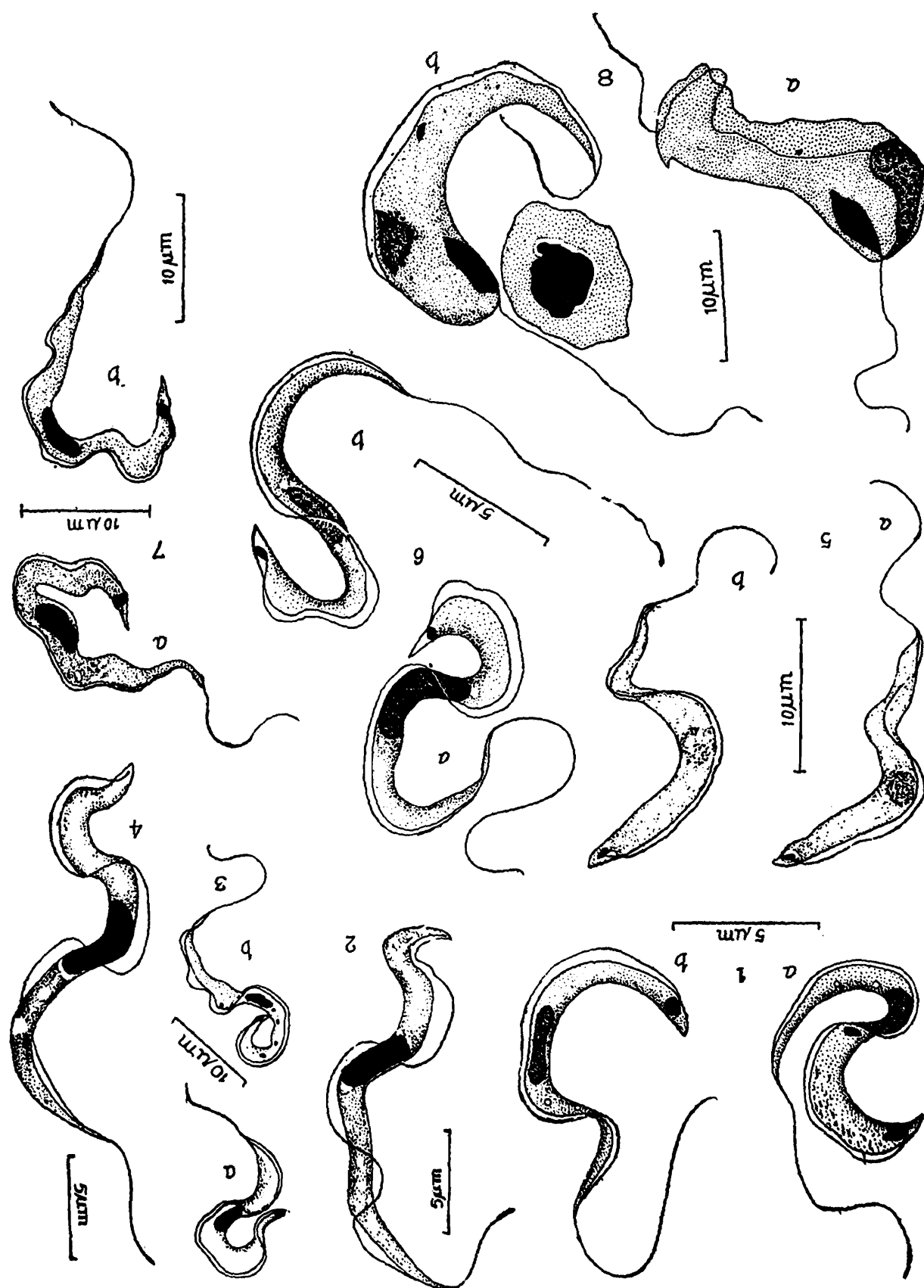
(ii) *Trypanosoma maguri* Tandon and Joshi, 1973

***Trypanosoma batrachi* Qadri, 1962**

(Fig. 2)

Description : The trypanosome is monomorphic. Length of the cell body 25.5 μm (range 22.00-29.00 μm) ; breadth of the cell body 2.00 μm (range 1.5-3.5 μm) ; length of the free flagellum 12.00 μm (range 9.00-14.00 μm), length of the nucleus 2.5 μm (range 2.00-3.00 μm), breadth of the nucleus 1.35 μm (1.00-1.5 μm), length of the Kinetoplast 1.00 μm (range 1.00-1.50 μm).

Cytoplasm : Granular with many vacuoles of different sizes, sometimes the volution granules form a compact mass and appear very deep in the stained preparation.



Figs. 1a—8b : 1a, b. *Trypanosoma tandoni* Mandal, 1980, 2. *T. batrachi* Qadri, 1962, 3a, b. *T. maguri* Tandon & Joshi, 1973, 4. *T. danilewskyi saccobranchi* Qadri, 1962, 5a, b. *T. mukundi* Roychaudhury and Misra, 1973, 6a, b. *T. bengalensis* Mandal, 1979, 7a, b. *T. vittati* Tandon & Joshi, 1973, 8a, b. *Trypanoplasma indica* (Mandal, 1979).

Nucleus : Situated a little towards posterior half of the body elongated and uniformly compact and occupies almost the whole breadth of the body where it is situated. The ends of the nucleus are surrounded by a clear halo.

Kinetoplast : Oval, or round or bean-shaped, compact, situated, posteriorly sometimes the length exceeded the width where it is situated.

Flagellum and undulating membrane : The organism has got a long flagellum and trails along body margin after forming the undulating membrane which can be differentiated from the body cytoplasm. It extends beyond the body as free end and performs a lashing movement in citrate preparation. The undulating membrane stains very deep and showed 3-6 folds.

Remarks : Stumpy forms as observed by the author, were not observed.

Trypanosoma maguri Tandon and Joshi, 1973
(Fig. 3)

Description : The trypanosome is polymorphic, attenuated at both ends. The large and small forms have been encountered in the preparation. Large forms : Length of the cell body $25.5\ \mu$ (range $18.00-35.5\ \mu$), length of the free flagellum $15\ \mu$ (range $9.00-21.5\ \mu$), breadth of the cell body $2.00\ \mu$ (range $1.5-3.00\ \mu$) breadth of the nucleus $1.25\ \mu$ (range $0.7-1.5\ \mu$) ; length of the Kinetoplast $0.75\ \mu$ (range $0.5-1.5\ \mu$), width of the Kinetoplast $0.5\ \mu$ (range $0.3-1.5\ \mu$).

Small form : Length of the cell body $5.00\ \mu$ (range $3.00-6.5\ \mu$), breadth of the cell body $1.2\ \mu$ (range $1.00-2.2\ \mu$) ; length of nucleus $1.5\ \mu$ (range $1.00-2.00\ \mu$) ; width of the nucleus $1.00\ \mu$ (range $0.5-1.5\ \mu$) ; length of the Kinetoplast $0.5\ \mu$ (range $0.8-1.00\ \mu$) width of the Kinetoplast $0.3\ \mu$.

Cytoplasm : Granular and the granules are distributed throughout the body. Stray small vacuoles are also found. The granular disposition is well marked at the border opposite the undulating membrane.

Nucleus : Oval or reniform, almost placed at the middle of the body or slightly behind the middle. The chromatin granules are densely concentrated and do not form any Karyosomal mass.

Kinetoplast : Ovoidal or reniform appears reddish purple with Leishman stain. Sometimes a hole was found around the Kinetoplast.

Flagellum and undulating membrane : The flagellum is thick and conspicuous but the undulating membrane is difficult to differentiate from the body.

Remarks : de Mello and Valles described a trypanosome from *Clarias batrachus* as *Trypanosoma clariae* Montel (1905) var. *batrachi* var. nov. in 1936.

Subsequently two more species, *I. batrachi* Qadri, 1962 and *I. maguri* Tandon and Joshi, 1973 have been described after obtaining the specimens from the same host material of this subcontinent. While describing these two, the authors have not mentioned the work of de Mello and Valles.

A detailed examination of the material by the author and a perusal of the literature showed that *T. batrachi* and *T. maguri* are different from *Trypanosoma clariae batrachi* (= *Trypanosoma clariae* var. *batrachi*, de Mello and Valles, 1936).

However, from the description of de Mello and Valles it appears that this is monomorphic. But *T. clariae* Montel, 1905 as redescribed by Mathis and Leger, 1911 from Tonkin (vide Wenyon, C. M. 1926. *Protozoology* Vol. II p. 1400) after obtaining the host *Clarias macrocephalus*, is dimorphic viz. 'var *parva*' and 'var *magna*' measuring the length of the cell body 39 μm and 64 μm and length of the free flagellum 9 μm and 11 μm respectively.

de Mello and Valles gave the measurements of this specimen as follows : Length of cell body varies from 12.5 μm -30.00 μm and the flageller length varies from 9 μm -32 μm . Though the authors described a subspecies '*batrachi*' as monomorphic while species was dimorphic. But it is premature at this stage to comment further as the present author is not having any material of this particular subspecies.

Thus *Clarius batrachus* has one subspecies, *T. clariae butrachi* de Mello and Valles 1936 and two species, viz. *T. batrachi* Qadri, 1962 and *T. maguri* Tandon and Joshi, 1973.

Family HETEROPNEUSTIDAE

Single genus *Heteropneustus*, monotypically represented viz., *H. fossilis* (Bl.).

Host : *Heteropneustus fossilis* (Bl.) (30 : 10/30 : 12/30)

Loc. : Calcutta Market.

Parasites (i) *Trypanosoma danilewskyi saccobranchi* Qadri, 1962.

(ii) *Trypanosoma mukundi* Raychaudhury and Misra, 1973.

***Trypanosoma danilewskyi saccobranchi* Qadri, 1962.**

(Fig. 4)

Description : The trypanosome is monomorphic more pointed at the anterior end. Length of the cell body $29.5\ \mu\text{m}$ (range $27.30\text{--}33.5\ \mu\text{m}$) ; breadth of the cell body $1.2\ \mu\text{m}$ (range $1.00\text{--}1.5\ \mu\text{m}$), length of the free flagellum $13.5\ \mu\text{m}$ (range $11.00\text{--}15.5\ \mu\text{m}$), length of the nucleus $3.00\ \mu\text{m}$ (range $2.00\text{--}3.5\ \mu\text{m}$) ; breadth of the nucleus $0.5\ \mu\text{m}$ (range $0.7\text{--}1.00\ \mu\text{m}$) ; length of the Kinetoplast $0.5\ \mu\text{m}$ (range $0.75\text{--}1.5\ \mu\text{m}$) :

Cytoplasm : Granular with large vacuoles situated mostly at the anterior region of the body. The granules are uniform but in some species it is found to concentrate more towards the side opposite to undulating membrane.

Nucleus : Compact, elongated situated at the posterior half of the body not always occupying the entire width of the body. The vacuoles are always situated at both ends of the nucleus.

Kinetoplast : Very densely stained either elongated, round or bar like, sometimes occupies the entire width of the body.

Flagellum and undulating membrane : Flagellum very thick and prominent trails along the margin of the body and forms a narrow undulating membrane. It extends as free flagellum for about half the length of the body. The undulating membrane showed 6-9 folds.

Remarks : Roychaudhury and Misra (1973) described the species viz. *T. mukundi* from *Heteropneustus fossilis* after obtaining the parasite in 3 examples of fish out of 10 examined.

Trypanosoma mukundi Roychaudhury and Misra, 1973

(Fig. 5)

Description : This blood parasite was found to occur in two forms, a 'slender' form with a free flagellum and a 'stumpy' form with a relatively short flagellum.

Slender form : The slender trypomastigote form is fusiform in shape with a long free flagellum. The posterior end is abruptly pointed while the anterior tip is narrowly pointed. The nucleus is elongate to elongate-oval in shape and placed more or less centrally, slightly towards the posterior half. The nucleus stains deep purple with Giemsa. It is not a homogenous mass but was granulated and had a distinct nuclear membrane. A halo around the nucleus is absent. The nucleus usually adheres to the cell wall of the parasite. No distinct karyosome was observed.

Cytoplasm stains light blue with Giemsa and is granulated. In some forms a few small vacuoles were observed in the posterior half of the cell body. Volutin granules within the cytoplasm were not seen. The narrow cell body is widest at its middle part where the nucleus is situated. The Kinetoplast is small and round, usually with a halo and stains deep purple. It is not located at the posterior tip but slightly subterminal. A distinct flagellum arises from the side of the Kinetoplast and forms the undulating membrane with 4-6 attachments with the cell body and leaves the body as a free flagellum at the anterior tip. The undulating membrane stains light pink with Giemsa.

Stumpy form : This form resembles the slender form in structural morphology but differs in shape, size, number of attachments of undulating membrane and in the length of the free flagellum as stated by the authors. The posterior tip of the parasite is narrowly pointed.

The nucleus is round to ovoid and the Kinetoplast is nearer to the nucleus than in the slender form. The undulating membrane touches the cell body at 6-9 points indicating that this form is more active than the others, as was observed under the phase contrast microscope in the live condition. The free flagellum is distinct but short.

No intermediate forms were seen.

Measurements :

	<i>Slender form</i>	<i>Stumpy form</i>
Total length of the parasite including (free flagellum)	32.5-43.5 μm	22.0-28.5 μm
Length of the cell body	24.0-28.5 μm	18.0-23.5 μm
Breadth of the cell body	2.0-2.5 μm	1.9-2.5 μm
Length of the free flagellum	9.0-15.5 μm	4.0-6.5 μm
Length of the nucleus	2.25-3.75 μm	2.25-3.75 μm
Breadth of the nucleus	1.75-2.25 μm	1.75-2.25 μm
Diameter of the Kinetoplast	0.75 μm	0.75 μm

Family AMBLICEPIDAE

Single genus *Amblyceps* and monotypically represented, *A. mangois* (Hamilton) in India.

Host : *Amblyceps mangois* (Hamilton) 5 : 0.

Loc. : Calcutta market.

Family SISORIDAE

Having 12 genera *Bagarius*, *Batasio*, *Conta*, *Erethistoides*, *Euchislogelanis*, *Exostoma*, *Gagala*, *Glypothorax*, *Hora*, *Myersglanis*, *Pseudocheneis* and *Sisor*. Only *Bagarius bagarius* (Ham.) has been examined.

Host : *Bagarius bagarius* (Ham.) 20 : 0

Loc. : Kakdwip, 24-Parganas, West Bengal

Genus **Batasio** Blyth

Three species, *Batasio batasio* (Hamilton), *B. tengara* (Hamilton) and *B. trayancoria* Hora and Law. Only *B. batasio* has been examined.

Host : *Batasio batasio* (Hamilton) 5 : 0

Loc. : Calcutta market.

Family BAGRIDAE

Comprises 5 genera *Rita*, *Chandramara*, *Horabagrus*, *Mustus* and *Aorichthys*.

Genus **Rita** Bleeker

Having 4 species *R. chrysea* Day, *R. gogra* (Sykes), *R. kuternee* (Sykes) and *R. rita* (Hamilton), only 3 species *R. chrysea*, *R. kuternee* and *R. rita* have been examined.

Host : *Rita chrysea* Day 15 : 0

Loc. : Balugaon, Orissa

Host : *R. kuturnee* (Sykes) 10 : 0

Loc. : Parlakhemindi, Orissa

Host : *R. rita* (Hamilton) 20 : 0

Loc. : Calcutta market

Genus **Mystus** Scopoli

Having 38 species and 13 are found in India, of which, 6 species, *M. bleekeri*, *M. cavasius* (Hamilton), *M. gulio* (Hamilton), *M. vittatus* (Bloch), *M. tengara* (Hamilton) and *M. menoda* (Hamilton) have been examined.

Host : *Mystus bleekeri* (Day) 30. 4

Loc. : Canning, W. Bengal

Parasite : **Trypanosoma bengalensis** Mandal, 1979

Trypanosoma bengalensis Mandal, 1979

(Fig. 6)

Description : Monomorphic, elongated and attenuated at both ends. Length of the cell body $15.5\ \mu\text{m}$ (range $14.00\text{-}17.5\ \mu\text{m}$), length of the free flagellum $10.5\ \mu\text{m}$ (range $8.5\text{-}12.5\ \mu\text{m}$), distance from anterior end of the body to the anterior end of the nucleus $7.5\ \mu\text{m}$ (range $5.5\text{-}8.5\ \mu\text{m}$) length of the nucleus $2.5\ \mu\text{m}$ (range $2.00\text{-}3.00\ \mu\text{m}$), width of the nucleus $0.5\ \mu\text{m}$, distance from posterior end of the nucleus to the Kinetoplast $5.00\ \mu\text{m}$ (range $4.5\text{-}5.5\ \mu\text{m}$), diameter of the Kinetoplast $0.75\ \mu\text{m}$ (range $0.5\ \mu\text{m}\text{-}1.00\ \mu\text{m}$), distance from Kinetoplast to the post. tip $1.00\ \mu\text{m}$ ($1.00\text{-}1.5\ \mu\text{m}$), width of the undulating membrane $0.5\ \mu\text{m}$, maximum width of the cell body 1.75 (range $1.5\text{-}2.00\ \mu\text{m}$).

Cytoplasm : Granular, granules are arranged along the border opposite the undulating membrane. Two large vacuoles are found at both the extremities of the nucleus.

Nucleus : Bean-shaped, centrally placed, in some specimens it is shifted a little towards the posterior end. It never exceeds the width of the body.

Kinetoplast : Round, stains very deep and does not exceed the width of the body where it is situated.

Flagellum and undulating membrane : The flagellum arises from the Kinetoplast and trails along the border forming on undulating membrane and extends beyond the body as free flagellum. The undulating membrane stains light blue having 3-7 folds. The flagellum is very slender.

Host : *M. vittatus* (Bloch) (40 : 4/40 : 3/40 : 1/40).

Loc. : Taldi, West Bengal, for *T. vittati* and *Cryptobia india* and *Dactylosoma* sp. Champahati, 24-Parganas, W. Bengal.

Parasites : (i) **Trypanosoma vittati** Tandon and Joshi, 1973

(ii) **Cryptobia indica** Mandal, 1979

(iii) **Dactylosoma** sp.

Trypanosoma vittati Tandon and Joshi, 1973

(Fig. 7)

Description : Monomorphic, configuration varies from C to S. Length of the cell body 25.5 μm (range 20.00-35.5 μm), length of the free flagellum 12.5 μm (range 8.5-14.00 μm), distance from anterior end of the body to the anterior end of the nucleus 10.5 μm (range 9.5-12.5 μm), length of the nucleus 3.00 μm (range 2.00-4.5 μm), width of the nucleus 1.2 μm (range 0.7-1.4 μm ; distance from posterior end of nucleus to the Kinetoplast 9.00 (8.5-11.5 μm), length or width of the Kinetoplast 1.5 μm , distance from Kinetoplast to the posterior tip 2.25 μm (range 2.00-3.00 μm) ; width of the undulating membrane 0.5-1.5 μm .

Cytoplasm : Uniformly granular, a little dense towards the portion anterior to the nucleus. Sometimes a few stray small vacuoles are seen throughout the body.

Nucleus : Bean-shaped, almost situated at the middle, compact with chromatin material, occasionally a clear area is visible at both extremities of the nucleus. The nucleus does not exceed the width of the body.

Kinetoplast : Almost round, deep with any stain used. It sometimes exceeds the width of the body where it is situated.

Flagellum and undulating membrane : Undulating membrane distinct clearly out lined, can be differentiated easily from the body cytoplasm and bordered by the thick flagellum throughout the length of the body. The flagellum extends as free portion, very distinct and can be stained with any Romonowsky type of stain.

Remarks : Mandal (1979) has discussed the validity of *T. vittati* Tandon and Joshi as well as about its pleomorphic nature. Tandon and Joshi, 1973 described this species after obtaining the host materials from Gomati River, Lucknow, U. P. with the parasite obtained from fish out of 12 examined.

Cryptobia indica Mandal, 1979 [= **Trypanoplasma indica**
(Mandal, 1979)]
(Fig. 8)

Description : Monomorphic, broad, sickle-shaped, measuring 28.5 μm (range 25.00-30.00 μm) in length and 8.5 μm (range 6.00-10.0 μm) in width. The nucleus measures 7.5 μm (range 5.00-8.5 μm) in length and 3.00 μm (range 2.5-3.5 μm) in width. Kinetoplast measures 5.5 (range 5.00-6.00 μm) in length and 1.5 μm (range 0.75-2.00 μm) in width. Length of the anterior flagellum 25.00 μm (range 21.00-30.00 μm), width of the undulating membrane 0.25 μm ; length of the trailing flagellum 10.5 μm (range 9.00-12.00 μm).

Cytoplasm : Stains faint blue having fine granules all over the body, less so at the posterior region.

Nucleus : Situated anteriorly, reniform or ovoidal in shape and loosely packed with large irregular chromatin masses.

Kinetoplast : Large, oblong or reniform in shape situated close to the ventral surface towards the anterior end and stained deep pink with any Romonoswky type of stain. Most cases it lies opposite to nucleus.

Flagellum and undulating membrane : Anterior flagellum long and moves freely when alive. Posterior flagellum trails along the margin of the body forms an undulating membrane and extends as free portion.

Dactylosoma sp.

Description : An organism with granular cytoplasm and a clear nucleus was encountered intraerythrocytically and placed under the genus *Dactylosoma* Labbe, 1894. The merozoites are 5 in number and arranged in the form of fan. Further specimens are needed for specific determination (Vide Mandal, 1979) of the parasite.

Remarks : While describing *C. indica* from *M. vittatus* after obtaining the specimens from blood, a search was made to trace the organism from the gut but could not be detected.

Lom (1979) was of opinion that the individual occurring in the bloodstream should be considered as the genus *Trypanoplasma* Laveran and Mesnil and the form found in the gut would come under the genus *Cryptobia* Leidy. Therefore *Cryptobia indica* Mandal, 1979 should be considered as *Trypanoplasma indica* (Mandal).

Host : *M. cavasius* (Hamilton) 30 : 0

Loc. : Calcutta, market.

Host : *M. gulio* (Hamilton) 60 : 0

Loc. : Calcutta market

Host : *M. tangara* (Hamilton) 10 : 0

Loc. : Calcutta market

Host : *M. menoda* (Hamilton) 5 : 0

Loc. : Calcutta market

Genus *Aorichthys* Wa

Having 2 species, *A. aor* (Hamilton) and *A. seenghala* (Sykes) and both the species have been examined.

Host : *Aorichthys aor* (Hamilton) 15 : 1

Loc. : Calcutta market

Parasite : *Trypanosoma* sp.

Description : Monomorphic, configuration mostly like 'S'. Length of the cell body 32.5 μm (range 30.00-38.5 μm), length of the free flagellum 14.00 μm (range 12.00-18.00 μm), length of the nucleus 2.5 μm (range 12.00-3.5 μm).

Cytoplasm : Granular, deeply stained with Romanowsky type of stains. The granules are uniformly distributed throughout the length of the body.

Kinetoplast : Oval, deeply stained and appears as dark pink and does not exceed the entire width of the body.

Flagellum and undulating membrane : Flagellum arises from the kinetoplast and trails along the border forming an undulating membrane and extends beyond the body as free flagellum. The undulating membrane has 4-9 folds.

Host : *A. seenghala* (Sykes) 16 : 0

Loc. : Calcutta market

Joshi (1976) described *T. seenghala* after obtaining the specimens from *M. seenghala* (= *A. seenghala*). Whereas Tandon and Chandra (1977 a, b) detected *Trypanosoma* sp., from *M. seenghala* (= *A. seenghala*) in 40 examples out of 1158 fishes examined at Lucknow, U. P. Out of 16 examples examined from Calcutta market, the author could not detect any parasite. However, the description given below for *T. seenghali* is based upon Joshi (1976).

***Trypanosoma seenghali* Joshi, 1976**

Description : Shape : The body is elongated and slender, tapering at both ends, posterior extremity generally ends sharply.

Cytoplasm : It is finely granulated, the distribution of granules is not even, as few forms have less granules in the posterior part of the body. Granules take dark azurophilic stain. Vacuoles are not present in these forms.

Nucleus : Oval or round, occupies most of the body width. It stain pinkish purple. The nuclear chromatin is not very dense. Karyosome absent. Nucleus is generally situated in the anterior half, but may be present in the posterior half of the body.

Kinetoplast : Small, round or oval and stains purple-blue and placed a little away from the posterior end.

Blepharoplast : Not distinct in any form.

Flagellum : It directly arises from the Kinetoplast and runs along the border of the undulating membrane, before becoming free. It may be long or short. A marked variation in the free flagellar length of few forms is noted.

Undulating membrane : Very distinct. No granules or myonemes are present.

Dimensions : The dimensions of both the smallest and the largest forms of *T. seenghali* are given in the next page.

Particulars	Smallest form (μm)	Largest form (μm)	Mean & range (μm)
Length of free flagellum	9.7	10.0	8.50 (4.5-12.0)
Length of body	17.8	28.0	24.50 (17.8-28.0)
Total length	27.5	38.0	33.0 (27.5-38.0)
Width of body at the centre	1.5	2.2	1.71 (1.2-2.5)
Width of the undulating membrane	1.3	1.8	1.40 (0.9-2.1)
Long axis of nucleus	2.2	3.0	2.76 (1.5-3.5)
Short axis of nucleus	1.7	2.0	1.0 (1.2-2.3)
Distance of nucleus from flagellar end	11.6	12.6	11.43 (8.5-15.0)
Length of kinetoplast	0.9	1.0	0.95 (0.3-1.2)
Width of kinetoplast	0.6	0.8	0.56 (0.3-1.0)
Distance of kinetoplast from and flagellar end	0.8	1.8	1.20 (0.4-2.0)
Nuclear index	1.7	0.7	0.88 (0.7-1.8)

Remarks : While describing the species the author has not mentioned about the Trypanosome (unnamed) described by Lingard, 1904 from the same host.

Family SCHILBEIDAE

Seven genera *Ailia*, *Silonia*, *Proeutrosiichthys*, *Eutropiichthys*, *Neotropius*, *Clupisoma* and *Pseudeutropius* are included. Among them *Ailia coila*, *Clupisoma garua*, and *Eutropiichthys vacha* (Ham.) have been examined.

1. *Host :* *Ailia coila* (Hamilton) 20 : 0
Loc. : Calcutta market.
2. *Host :* *Clupisoma garua* (Hamilton) 3 : 0
Loc. : Chaibasa, Bihar.
3. *Host :* *Eutropiichthys vacha* (Hamilton) 25 : 0
Loc. : Calcutta market.

Family PANGASIIDAE

Includes one genus *Pangasius* and monotypically represented by *P. pangasius* (Ham.) which was examined.

Host : *Pangasius pangasius* (Ham.) 30 : 0

Host specificity, prevalence and pathogenicity.

The genera *Trypanosoma*, *Trypanoplasma*, *Dactylosoma* and *Haematractidium* have so far been reported from Indian catfishes. From the information available so far, as well as from the present study it is clear that these parasites are not restricted to any particular host. The work on this aspect along with the prevalence and incidence of infection have not been taken up so far on a large scale. However, some studies on the effects of *Trypanosoma* and *Trypanoplasma* on the hosts have recently been carried out. Lom (1973) while discussing the host specificity of Trypanosomes in fishes stated that no strain appeared to be specific for a particular host from which it was recorded. Khan (1976) conducted some experiments after taking a few morphologically similar Trypanosomes of fish from seven species of marine Teleosts and found that no marine fish species tested was insusceptible to Trypanosomes isolated from different hosts. Becker (1977) has opined that the host parasite relationship of haematozoa particularly the Trypanosome is eurihospitalic. Mandal (1979) while dealing with the haematozoan parasites of fishes belonging to the genus *Mystus* Scopoli found that the host species like *M. vittatus* and *M. bleekeri* have parasites whereas the *M. cavasius* and *M. gulio* did not have them though they were collected from the same ecological niche. Of course, the role played by the vector like leeches was also taken into account.

Lom (1979) wrote a chapter on the biology of trypanosomes and trypanoplasma of fish in 'The Biology of Kinetoplastida' where he discussed in detail the different aspects of trypanosomal and trypanoplasmal infection in fishes. He has also agreed that most of the blood inhabiting forms are generally transmitted by the vectors like the leeches. Further the author remarks that the prevalence and transmission depends on the bottom, pelagic or littoral forms. The fish living near bottom or littoral vegetation are more exposed to leeches than the pelagic one. The incidence of infection also depends upon temperature, season or the age of the fish.

Becker (1977) stated that slow moving stream bordered by aquatic vegetation provides a favourable habitat for production of many fishes along with the leech species. The fishes examined from such areas will surely reveal a high incidence of infection. Mandal (1978c) found that the percentage of trypanosomal infection varies with the herbivorous, omnivorous or carnivorous habit of fish. The lowest percentage of infection was noticed in the carnivorous fishes and the highest in the herbivorous fish. The same author further noted that the factors like the bottom dwelling habit with limited mobility, the surface feeding habit and the mucus on the body of some fishes are equally important while considering the variations in percentage of infection. The bottom dwelling habit with limited mobility in fishes may increase the incidence of infection as the vector gets more opportunities to take blood meal. While on the other hand, the surface feeding habit and the mucus on the body prevent the vector in taking blood from the fish which leads to decline the incidence of haematozoan infection.

Regarding the pathogenicity of haematozoans of fishes a little work has been done so far. Some of them are found to be non-pathogenic and Lom (1979) stated that in most cases the fishes pass without any sign of infection. However, the trypanosome causes a disease commonly known as piscine trypanosomiasis which incurs heavy annual loss of fish, a potential source of animal protein for consumption.

So far little attention has been paid, to study the pathogenesis of this disease. Recently Kipp (1968), Smirnova (1970) outside India have worked on these aspects. In our country, Tandon and Joshi (1973) did some work after obtaining the trypanosome from *Clarius batrachus* (46.6%) and *Mystus vittatus* (8.3%). The percentage of infection is mentioned in the parenthesis. They observed some pathological symptoms specially in the blood of the infected fish. The percentage of haemoglobin was reduced along with a decrease in the number of erythrocytes and leucocytes. They have also noted some abnormal cells and macrophages in the circulation of the infected fishes.

Tandon and Chandra (1977 a, b) studied the serum cholesterol and serum alkaline phosphatase levels in some naturally infected fishes. It was found that the reduction of serum cholesterol level was the highest (42.3%) in the spiny eel, *Mastacembelas armatus* and the lowest in the carp *Cirrhina mrigala* (4.46%). Catfishes like *Heteropneustes fossilis* showed a loss of 9.83% while *Clarius batrachus* showed 12.46%, *Mystus seenghala* 11.65% and *Wallago attu* 12.05%.

The trypanosomes are known to consume large quantities of sugar from blood resulting on complete consumption of carbohydrate reserve, thereby causing strain on the liver—a chief centre of cholesterol metabolism. The trypanosomal infection disturbed the cholesterol metabolism—leads to hypocholesterolemia in the infected fishes. The same author stated that the alkaline phosphates level of *Cirrhina mrigala* reduced to 69.91% and in *M. armatus* it was found as 10.94% whereas in *Clarius batrachus* it goes down to 40.68% and in *M. seenghala* was 8.82%. The minimal level was observed in *W. attu* which was about 3.91%.

They further observed that the metabolic activity is reduced due to trypanosome infection in fishes. The alkaline phosphatase of active fish, *Clarius batrachus* reduced to 40.68% the herbivorous carp, *Cirrhina mrigala* showed a loss 69.91% and the hardy fish, *Wallago attu* suffered a minimal loss of 3.91% due to trypanosomal infection in the blood stream.

As regards the Trypanoplasmosis due to *Trypanoplasma* infection Walis and Wolf (1955) Makeyeva (1956) Britchuk (1969) Migala (1967, 71) did some work while Nowichi (1940) questioned about the pathogenic potency of *Trypanoplasma*. However, the same was not accepted by the others. On the other hand Lom (1979) was of the opinion that the pathogenic changes of trypanoplasmosis is still not available. In the present investigation no difference was noticed between the infected and uninfected fishes in blood cell count where as in the infections with *Dactylosoma* and *Haematractidium*

it was found that in both cases there was dislocation of the erythrocyte nuclei along with some hypertrophy of the infected cells.

Table I. Showing the number of fishes examined and number parasitised along with the name of the parasite.

Name of fish	No. examined	No. infected	Name of the parasite
1. <i>Arius sagar</i> (Ham.)	20	5	<i>Haematractidium</i> sp. Mandal <i>et al.</i>
2. <i>Plotosus canius</i> (Ham.)	40	1	Undermined
3. <i>Ompok pabda</i> (Hamilton)	30	0	
4. <i>Ompok pabo</i> (Hamilton)	10	0	
5. <i>Wallago attu</i> (Schneider)	32	2	<i>Trypanosoma</i> <i>tandoni</i> Mandal 1980
6. <i>Clarius batrachus</i>	45	15	<i>Trypanosoma</i> <i>batrachi</i> Qadri, 1962
7. <i>Clarius batrachus</i>	45	3	<i>Trypanosoma</i> <i>maguri</i> Tandon & Joshi, 1973
8. <i>Heteropneustes fossilis</i>	30	10	<i>Trypanosoma</i> <i>danilewski</i> <i>saccobranchi</i> Qadri, 1962
9. <i>Heteropneustes fossilis</i>	30	12	<i>Trypanosoma</i> <i>mukundi</i> Raychaudhury & Misra, 1973
10. <i>Amblyceps mangois</i>	5	0	
11. <i>Rita chricia</i> (Day)	15	0	
12. <i>Rita kuturnee</i> (Sykes)	10	0	
13. <i>Rita rita</i> (Hamilton)	20	0	
14. <i>Batasio batasio</i> (Hamilton)	5	0	
15. <i>Mystus bleekeri</i> (Day)	34	0	<i>Trypanosoma</i> <i>bengalensis</i> Mandal, 1979 (b)
16. <i>Mystus vittatus</i> (Bloch)	40	4	<i>Trypanosoma</i> <i>vittati</i> Tandon & Joshi, 1973

Cont.

Name of fish	No. examined	No. infected	Name of the parasite
17. <i>Mystus vittatus</i> (Bloch)	40	3	<i>Cryptobia indica</i> Mandal, 1979= <i>Trypanoplasma</i> <i>indica</i> Mandal, 1979
18. <i>Mystus vittatus</i> (Bloch)	40	1	<i>Dactylosoma</i> sp. Mandal
19. <i>Mystus clavasi</i>	30	0	
20. <i>Mystus qulio</i> (Hamilton)	60	0	
21. <i>Mystus tanger</i> (Ham.)	10	0	
22. <i>Mystus menoda</i> (Ham.)	5	0	
23. <i>Aorichthys aor.</i> (Ham.)	15	1	<i>Trypanosoma</i> sp.
24. <i>Aorichthys seenghala</i> (Sykes)	6	0	<i>Trypanosoma</i> <i>seenghali</i> Joshi, 1976 from Lucknow, U.P.
25. <i>Alilia coila</i> (Hamilton)	20	0	
26. <i>Clupisoma garua</i>	3	0	
27. <i>Eutropiichthys vacha</i> (Hamilton)	35	0	
28. <i>Pungasius pungasius</i> (Ham.)	30	0	

SUMMARY

Of the 13 families of catfishes occurring in Indian subregion, 10 families, Ariidae, Plotosidae, Siluridae, Clariidae, Heteropneustidae, Amblycipidae, Sisoridae, Bagridae, Schilbeidae and Pangasiidae have been studied for haematozoan parasites so far. Three genera, *Trypanosoma*, *Cryptobia* (= *Trypanoplasma*) and *Dactylosoma* have been recorded. A total 8 species of trypanosomes with one *Trypanosoma* sp., have been described from these catfishes. An undetermined parasite has also been recorded from the estuarine catfish, *Plotosus canius*.

A comment on the pathogenicity of these parasites has been added. The possible mode of transmission of these parasites and the role of vector have been discussed.

ACKNOWLEDGEMENT

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OBSERVATIONS ON THE FIELD BIOLOGY AND
ECOLOGY OF SOME GRASSHOPPERS
(ORTHOPTERA : ACRIDOIDEA)
NEAR CALCUTTA

By

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INTRODUCTION

Grasshoppers and locusts are the oldest and most serious enemies of agriculture, probably from the time when cultivation was first practiced about 10,000 years ago in the middle east. For any meaningful control measures it is essential to have a base line data on the ecology and biology of target species. Ecological and biological studies on Indian grasshoppers mainly limited to the works of Coleman (1911), Coleman and Kannan (1911), Pruthi and Nigam (1939), Roonwal (1945, 1976), Agarwal (1955), Katiyar (1955, 1956, 1961), Banu and Kushwaha (1974), Hazra *et. al* (1981), Julka *et al* (1982). The present study was initiated in a predominantly paddy growing area near calcutta in gangetic West Bengal in order to determine the incidence, seasonal activity, and habitat preference of some grasshoppers in relation to paddy and other cultivated grasses which act as alternate host-plants. The efforts have also been made to study the migration of grasshoppers from uncultivated zones to cultivated zones and vice versa. The habitat described for each species is that in which adults and nymphs were found. The classification used was that of Dirsh (1961).

MATERIAL AND METHODS

The samples of grasshoppers were collected from August 1976 to July 1977 from following selected habitats :—a

cultivated field, uncultivated area, comprising open grass land (inhabited by long and short grasses) and short bushy vegetation. The collections were made once a week between 08.00 hrs to 10.00 hrs, using an insect net of conventional design of 30 cm. diameter. In order to standardise the sampling technique the collections were made by sweeping each site for half an hour on every occasion, grasshoppers were collected by sweeping the nets following the catch count method. Although the method might not have given a precise numerical estimates of absolute abundance, it was considered adequate for the present study. The temperature and relative humidity data were collected from the experimental site while the rainfall data was collected from the Meteorological office, Calcutta.

DESCRIPTION OF HABITATS

Cultivated field : The field was 100×75 meters in area, located in south of Calcutta. The paddy crop was sown towards the end of August and harvested in late December. From January to May, the vegetation consisted of dried stubbles of harvest paddy and patches of short brown grass which turns green with the onset of premonsoons or local showers.

Uncultivated field :

(a) *Open grassland* : The selected plot was about 25×75 meters by the side of the cultivated field and bushy area. It was covered with green grass with the onset of premonsoon showers, which grew to a maximum height of about 35 to 40 cm. towards the end of October. The grasses start turning dry from mid November and by the end of May the field is covered with short, dry brown grasses.

(b) *Bushy area* : This area is located by the side of uncultivated zone near a pond. The study area was roughly 100 m.×20 m. and major vegetation in the area was as follows : *Reaclinthus tithymaloides*, *Xanthium strumarium*, *Antigonon* sp., *Andropogon* sp. and *Lippia* sp. etc. There was

an under growth of grasses also. The grasses remained green from middle of May to middle of November and became dry and pale during December to May and part of June.

CLIMATE

The climate of experimental site in Garia (about 20 Km. from Calcutta) is same as that of Calcutta city (West Bengal); and can be divided into four distinct seasons : spring (February-March), summer (April-June), rainy (July-middle to September), autumn (middle of September-November), winter (December-January). Most rainfall was received during the monsoons from late June to middle of September. Due to north-west wind some rain also occurred in April and May, often accompanied by high speed winds. Temperature increased gradually from February and reached the maximum of 36.75°C during the month of May (Fig. 1). It then steadily

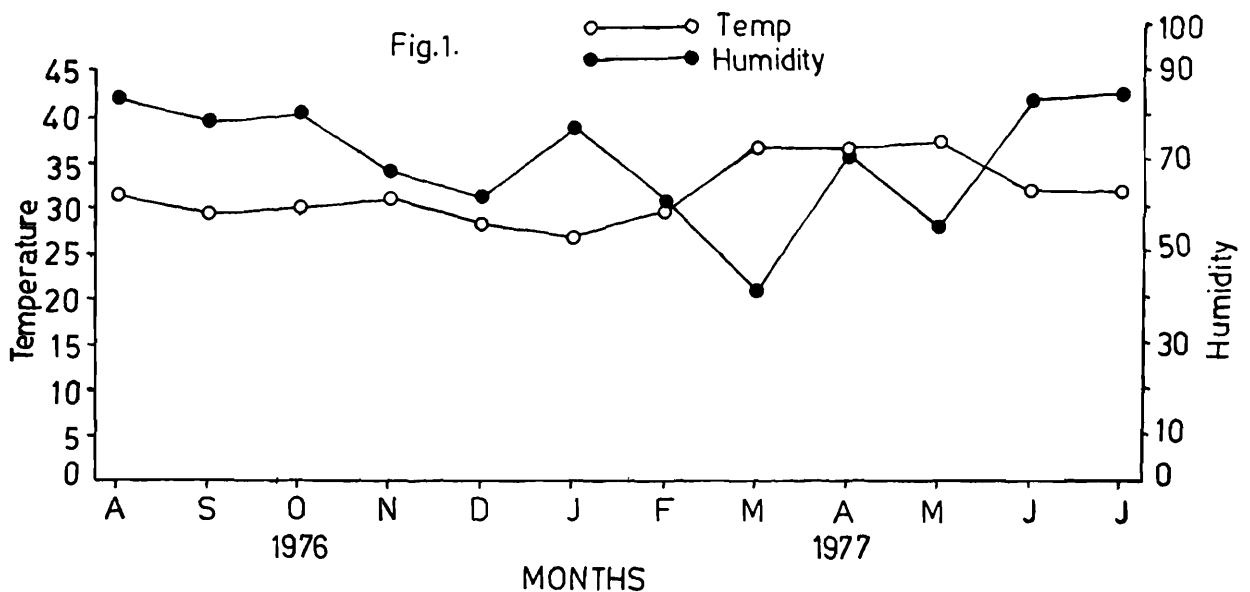


Fig. 1. Monthly Changes in climatic factors.

decreases with the onset of rains. The coldest part of the year was from middle of December to end of January with minimum temperature of 11.3°C in the month of January. The average relative humidity ranged from 35% in the month of March to 92% in the month of July-September.

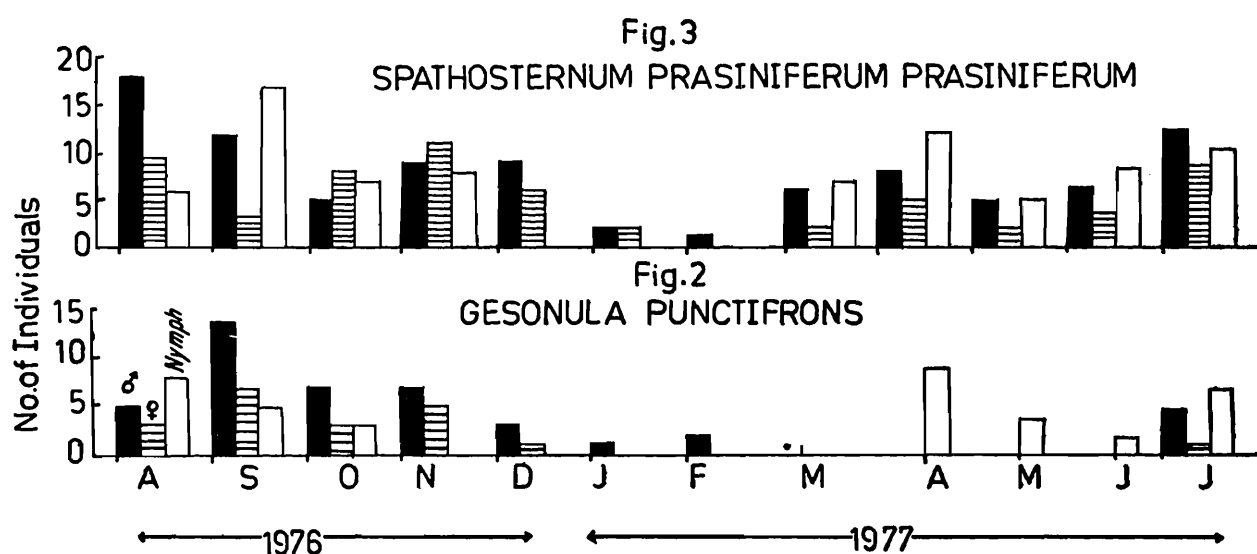
OBSERVATION

FAMILY ACRIDIDAE

Subfamily : HEMIACRIDINAE

***Gesonula punctifrons* (Stal)**

This species was found consistently amongst water hyacinth and adjoining grasses and bushes, but also occurred in low numbers in the paddy fields adjoining to water hyacinth. No adults were found in paddy fields away from water hyacinth



Figs. 2-3. Seasonal fluctuations in abundance of *Gesonula punctifrons* and *Spathosternum prasiniferum prasiniferum*.

zones. The adults start appearing from July and the population increases rapidly and reaches its peak in the month of September (Fig. 2). This level was somewhat maintained till November and then gradually declines to a very low level from January to February and no adults were encountered from March to June. Nymphs of all stages occur in the same habitat as adults and start appearing from the end of April and are encountered till late October with zero Nymphal population from November to March.

***Spathosternum prasiniferum prasiniferum* (Walker)**

This species was one of the most common acridid and occurs throughout the year on grasses, paddy, pulses and in bushes adjoining to cultivated fields. The population builds up towards the end of June and reaches its peak by August

(Fig. 3). The peak level attained during this period was maintained till December with slight low level in October end. Thereafter the number decreases suddenly and reaches the lowest level in February. From March onwards the population again built up but did not reach the previous level. Nymphs were found almost throughout the year except from December to February. The trend of population pattern suggests more than one generation in a year. This species showed seasonal changes in colouration in which most individuals were lush green in colour in the rainy season. During drier parts of the year a large portion of the population was brown. It has been observed that during monsoons major part of the population starts migrating from bushes and grasses towards newly growing lush green paddy fields and feeds voraciously on emerging paddy plants causing extensive damage. During this period the adults were found copulating in the fields. With the maturation of paddy in November/December the population starts moving near the green grasses along the sides of ponds and irrigation canals.

Hieroglyphus banian (Fabricius)

Uncommon and was found only once in September and in November, however few nymphs were found in August. Both adults and nymphs were found in paddy fields. This species is a major pest of paddy in India especially in southern, western and north-eastern part of the country but in the present study, surprisingly, we have not come across this pest in the experimental area.

Subfamily OXYINAE

Oxya fuscovittata (Marschall)

Found almost throughout the year and is associated with grasses and paddy. Adults recorded from August to December are generally confined to paddy whereas in the rest of the month they were consequently collected from grasses and bushy zones adjoining water ponds.

Beginning in early July, the population on paddy gradually builds up towards the end of the month. (Fig. 4). In early August the number rise steadily and reaches its peak in early September, coinciding with growth of paddy plants. The population slightly decreases but the general infestation pattern is maintained till early December which decreases to near zero level in January and February when only aged females were found in the collection. Towards late march the population again increases and reaches its peak in May with a sharp decline in June. The trend of population suggests more than two generations per annum.

Nymphs in all stages of development were found in the same habitat as that of adults, almost throughout the year except in January-February when very small nymphs, probably first instar was seen.

This species causes considerable damage to paddy plants by eating voraciously on stem of young plants and on leaves at latter stages.

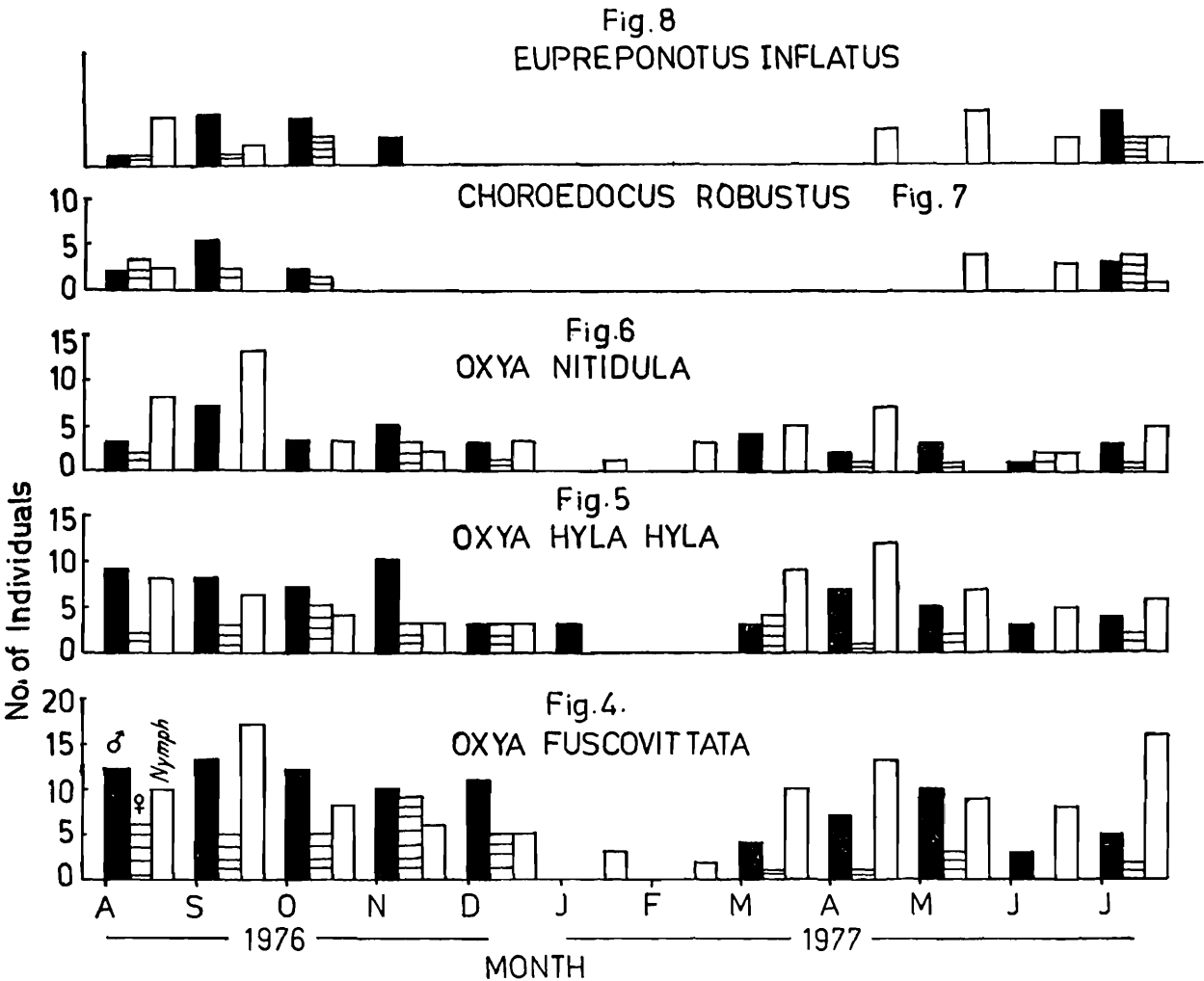
***Oxya hyla hyla* Serville**

Wide spread and locally common and occurs in the same habitat as that of *Oxya fuscovittata*. Beginning in July the population gradually increased to a maximum in early November then gradually decreases to lowest level by end of January. From early March the population increased again and reaches its maximum in April but did not reach the previous level and low level is maintained till May. Nymphs in all stages of development were found in the same habitat throughout the year except January and February (Fig. 5). This species also causes damage to paddy by eating on stem of young plants and on leaves at the latter stages.

***Oxya nitidula* (Walker)**

Locally common and occurs in low numbers in the same habitat as that of preceeding two species of *Oxya*. Adults recorded throughout the year except January and February and follows the same seasonal pattern as of *O. fuscovittata*

and *O. hyla hyla* (Fig. 6). This species also causes damage to growing paddy plants.



Figs. 4-8. Seasonal fluctuations in abundance of *Oxya fuscovittata*, *Oxya hyla hyla*, *Oxya nitidula* *Choroedocus robustus*, *Eupreponotus inflatus*.

Subfamily EYPREPOCNEMIDINAE

Choroedocus robustus (Serville)

This species was encountered in low number in bushy areas with mixed vegetation. The nymphs appear towards the end of May and the adults start appearing only in July. The population reaches its peak in September and disappears by October (Fig. 7). No adults and nymphs were found till next May. This is a large grasshopper and prefers mixed vegetation zone and moves to paddy fields once it starts growing towards maturity.

Eupreponotus inflatus Uvarov

Nymphs and adults occur amongst long coarse grass with bushes ; sometime on edges of paths and migrate to paddy fields once it starts maturing. Nymphs start appearing from April and the adults were encountered only from July (Fig. 8). This species is also found in low number till November and then it suddenly disappears till next April.

Heteracris pulcher (Bolivar)

It was one of the rarest species. A single female was captured in September from the bush during the entire study period.

Subfamily CYRTACANTHACRIDINAE

Cyrtacanthacris tatarica (Linnaeus)

Not common, or at least not often seen during the entire sampling period. Two females were caught in September from bushes in the study area.

Subfamily ACRIDINAE

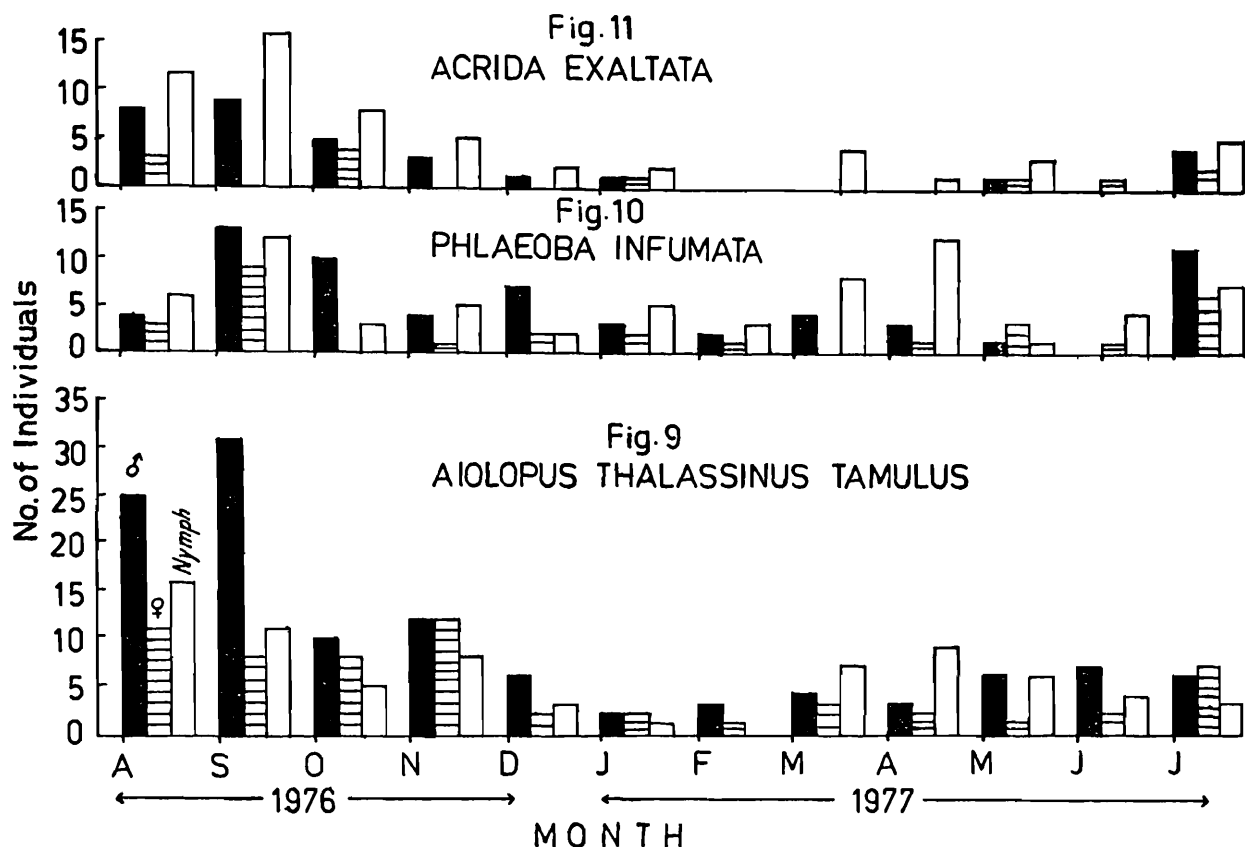
Aiolopus thalassinus tamulus (Fabricius)

This acridid was the most abundant species and was found in cultivated as well as natural grass field and bushes. Adults and nymphs are found throughout the year with highest peak in the month of August and September (Fig. 9). This species also migrates from its natural habitat i.e. wild grasses and bushes to cultivated fields of paddy once the paddy is replanted. It also occurs in two colour forms, the greenish-brown during rainy season and the dull brown when the vegetation starts drying up. This species breeds throughout the year.

Phlaeoba infumata (Brunner)

This species also breeds throughout the year and reaches its peak in the month of September. Maximum population

was during rainy season while minimum in dry months of May and June (Fig. 10).



Figs. 9-11. Seasonal fluctuations in abundance of *Aiolopus thalassinus tamulus*, *Phlaeoba infumata*, *Acrida exaltata*.

P. infumata is associated with crops of paddy and bushes and natural grasses. The adults prefer long and hard grasses while nymphs were found in swampy areas.

***Trilophidia annulata* (Thunberg)**

This species was mainly found on bare ground by the side of pond or Kacha road along with green grasses. It breeds continuously throughout the year but occurs in low numbers. The highest average population was in the month of August and minimum in February (Fig. 12).

***Acrida exaltata* (Walker)**

This species was very common and occurs wherever there were suitable patches of grasses, rarely occurring in the bushy zone. Nymph and adults were found throughout the year except late January to middle of March. The population

starts building towards end of June, gradually reaches its peak in September and then gradually declines and disappears by middle of January. Nymphs were far more abundant during the rainy season and breeding was at its peak during this period (Fig. 11).

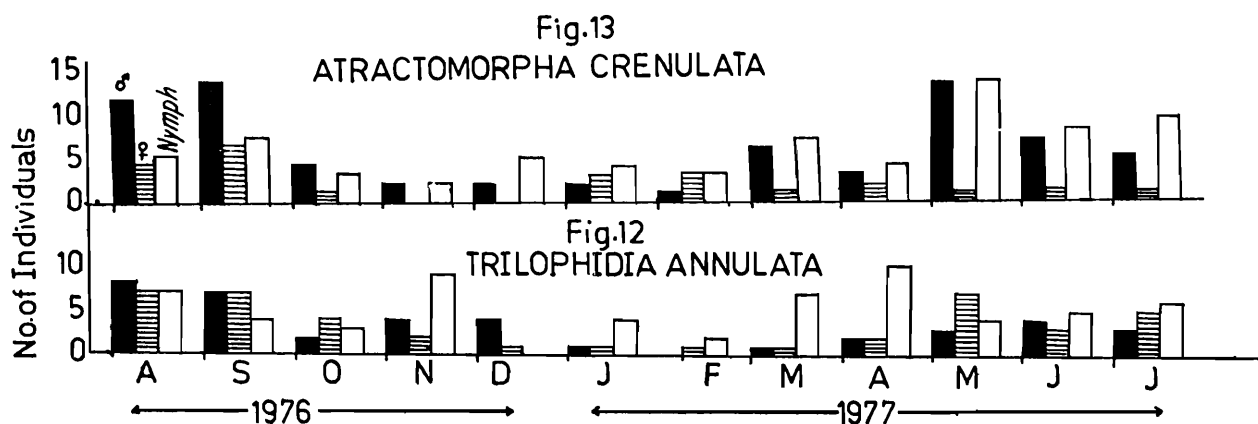
Acrida exaltata was found in lush green colour during rainy season while in other parts of the year, the green forms are found in association with green vegetation while brown form with drier vegetables, matured paddy fields and dry grasses. The adults of the species migrates from grasses to lush green paddy fields in September and October cause considerable damage to growing plants.

Family : PYRGOMORPHIDAE

Subfamily : PYRGOMORPHINAE

***Atractomorpha crenulata* (Fabricius)**

Adults and nymphs of this species were found throughout the year. The population pattern suggests that it has an active period from May to September then there is a gradual decline and the level is maintained till the end of May. Peak of nymphal activity was in the month of May and minimum during November. (Fig. 13).



Figs 12-13 Seasonal fluctuations in abundance of *Trilophidia annulata* and *Atractomorpha crenulata*.

Adults recorded from August to November are generally confined to paddy where as during rest of the months they were consequently collected from grasses and bushy zones.

DISCUSSION

The results presented in this study were based on collections of grasshoppers in a field near Calcutta. Grasshoppers collected in this study belonged to thirteen genera of the families Acrididae and Pyrgomorphidae. It is clear from the present investigation that during the period of low incidence of grasshoppers (December to February) these species took shelter on different herbs. Maximum migration of these grasshoppers from wild vegetation to the adjoining paddy fields were noticed when the latter is at flowering stage (October to November).

The study of data on population (Figs. 2-13) of different species reveals that *Aiolopus th. tamulus* was the most dominant species and represents 14.36% of total population followed by *Oxya fuscovittata* (13.55%), *Spathosternum pr. prasiniferum* (13.44%), *Atractomorpha crenulata* (9.42%), *Phlaeoba infumata* (9.24%), and *Oxya hyla hyla* (8.55%), population of other species such as *Trilophidia annulata* (8.24%), *Acrida exaltata* (6.95%), *Oxya nitidula* (5.67%), *Gesonula punctifrons* (5.61%), *Eupreponotus inflatus* (2.69%), *Choroedocus robustus* (2.16%), were numerically low but occurred throughout the year and the species like *Hieroglyphus banian* (0.82%), *Cyrtacanthacris tatarica* (0.29%), and *Heteracris pulcher* (0.05%), occurred very rarely during the period of observation.

An attempt has been made to find out the relationship between the population of grasshoppers and the environmental factors and also between some other parameters considered in this study. For this correlation coefficient and regression analysis were made. From table 1, it is seen that the relative humidity shows a positive correlation (column 3 of table 1) with the grasshoppers population but showed significant relationship only with the population of total number of male, total number of *Trilophidia annulata*, total number of *Eupreponotus inflatus* and total number of *Choroedocus robustus*. Temperature shows negative correlation with the total number of male, female, *Oxya fuscovittata*

phlaeoba infumata, *Aiolopus th. tamulus*, *Acrida exaltata* and *Gesonula punctifrons*, and with other population it shows a positive but not significant correlations (Table 1).

* Significant at 5% level.

TABLE 1

Showing relationship between grasshoppers species and environmental factors.

Parameters	Mean $\pm$ S.D.	'r' value	Y=a+bx
Y : No. of <i>phlaeoba infumata</i>			
	13.25 $\pm$ 8.37		
Relative humidity	70.46 $\pm$ 13.50	0.37	Y= - 2.86+0.23X
Temperature	31.68 $\pm$ 3.22	-0.16	Y= 25.98-0.40X
Y : No. of <i>Aiolopus th. tamulus</i>			
	19.75 $\pm$ 14.41		
Relative humidity	70.46 $\pm$ 13.50	0.38	Y= - 8.94+0.41X
Temperature	31.68 $\pm$ 3.21	-0.04	Y= 24.92-0.04X
Y : No. of <i>Acrida exaltata</i>			
	8.58 $\pm$ 8.60		
Relative humidity	70.46 $\pm$ 13.50	0.50*	Y= -14.26+0.32X
Temperature	31.68 $\pm$ 3.22	-0.21	Y= 26.32-0.56X
Y : No. of <i>Trilophidia annulata</i>			
	11.75 $\pm$ 5.56		
Relative humidity	70.46 $\pm$ 13.50	0.41	Y= - 0.22+0.17X
Temperature	31.68 $\pm$ 3.22	-0.32	Y= 6.03-0.56X
Y : No. of <i>Gesonula punctifrons</i>			
	8.50 $\pm$ 7.80		
Relative humidity	70.46 $\pm$ 13.50	0.55*	Y= -13.98+0.32X
Temperature	31.68 $\pm$ 3.22	-0.14	Y= 19.37-0.34X
Y : No. of <i>Eupreponotus inflatus</i>			
	3.83 $\pm$ 3.66		
Relative humidity	70.46 $\pm$ 13.50	0.55*	Y= - 6.79+0.15X
Temperature	31.68 $\pm$ 3.22	0.23	Y= - 4.46+0.26X
Y : No. of <i>Choroedocus robustus</i>			
	2.83 $\pm$ 3.13		
Relative humidity	70.46 $\pm$ 13.50	0.69*	Y= - 9.33+0.17X
Temperature	31.68 $\pm$ 3.22	0.01	Y= 3.25+0.01X
Y : No. of total Grasshopper			
	142.75 $\pm$ 79.14		
Relative humidity	70.46 $\pm$ 13.50	0.43	Y= -36.93+2.55X
Temperature	31.68 $\pm$ 3.22	0.11	Y= 55.82+2.74X

Parameters	Mean $\pm$ S.D.	'r' value	Y=a+bx
Y : No. of Male			
Grasshopper	55.50 $\pm$ 37.40		
Relative humidity	70.46 $\pm$ 13.50	0.43	Y= -29.28+1.20X
Temperature	31.68 $\pm$ 3.22	+0.08	Y= 85.43-0.94X
Y : No. of ♀			
Grasshopper	27.92 $\pm$ 18.01		
Relative humidity	70.46 $\pm$ 13.50	0.52*	Y= -20.77+0.69X
Temperature	31.68 $\pm$ 3.22	-0.11	Y= 48.29-0.64X
Y : No of Nymph	58.33 $\pm$ 32.23		
Relative humidity	70.46 $\pm$ 13.50	0.27	Y= 12.91+0.64X
Temperature	31.68 $\pm$ 3.22	0.47	Y= -90.88+4.71Y
Y : of <i>Atractomorpha</i>			
<i>crenulata</i>	13.50 $\pm$ 7.60		
Relative humidity	70.46 $\pm$ 13.50	0.08	Y= 10.54+0.04Y
Temperature	31.68 $\pm$ 3.22	0.32	Y= -10.12+0.75X
Y : No. of <i>Oxya</i>			
<i>fuscovittata</i>	17.67 $\pm$ 11.18		
Relative humidity	70.46 $\pm$ 13.50	0.23	Y= 4.06+0.19X
Temperature	31.68 $\pm$ 3.22	-0.04	Y= 22.24-0.4 X
Y : No. of <i>Oxya hyla hyla</i>	12.25 $\pm$ 6.76		
Relative humidity	70.46 $\pm$ 13.50	0.02	Y= 11.38+0.01X
Temperature	31.68 $\pm$ 3.32	0.57*	Y= 25.59+1.10X
Y : No. of <i>Oxya nitidula</i>	8.08 $\pm$ 5.07		
Relative humidity	70.46 $\pm$ 13.50	0.18	Y= 3.28+0.07X
Temperature	31.68 $\pm$ 3.22	0.13	Y= 1.79+0.20X
Y : No. of <i>Spathosternum</i> sp.	19.33 $\pm$ 10.60		
Relative humidity	70.46 $\pm$ 13.50	0.47	Y= - 6.90+0.37H
Temperature	31.68 $\pm$ 3.22	0.18	Y= 0.26+0.60X

From figure 14 it is evident that the population of total grasshoppers attained its peak period of activity in September and lowest activity in February. The nymphal population were highest (42.17%) in comparison to total male and total female followed by male population (37.27%). The nymphal population of four species viz. *Atractomorpha crenulata*, *Oxya nitidula*, *Oxya fuscovittata* and *Phlaeoba*

infumata were found in every month throughout the sampling period in the field, which indicate that these species were multivoltine, i.e., more than one generation a year. This may be due to the influences of factors like moisture, temperature,

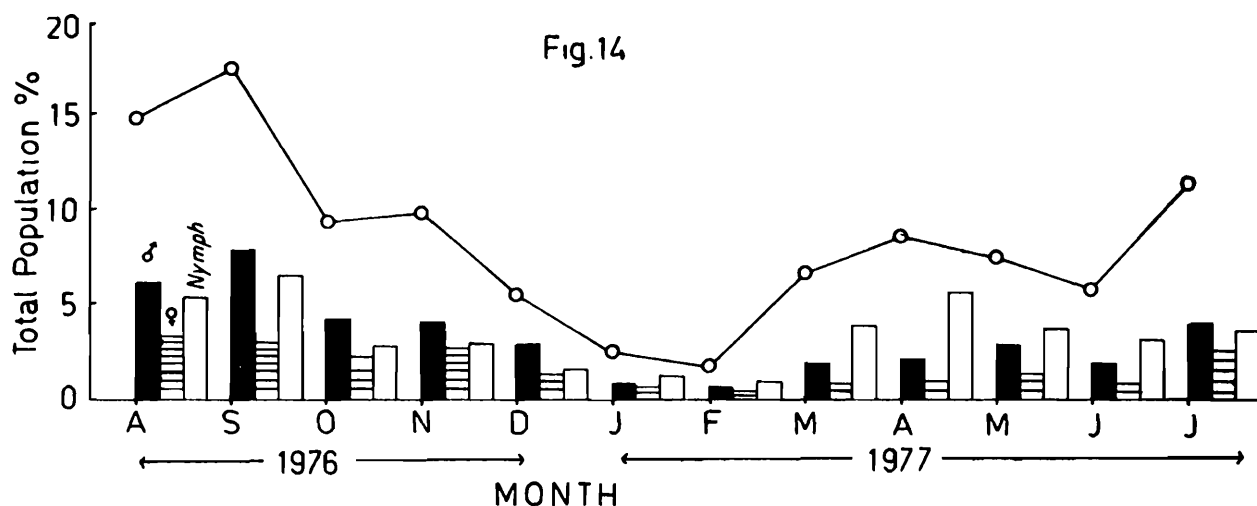


Fig. 14. Total population of acridids in the study area.

soil conditions and food on these species in the study field. It agrees well with the observations of Isely (1937) and Uvarov (1977). The absence of nymphal population from the field of some predominant species have been summarised in table 2. It can be concluded from the present study that the physical factors like temperature, relative humidity and the biotic factors like vegetations are mainly responsible for the population fluctuations and distribution of the major grasshoppers in this study as evident from the statistical analysis (Table 1).

TABLE 2.

Showing months when Nymphs of Predominant grasshopper species not occurred in the field.

Nymph not found

Species	Months
1. <i>Spathosternum pr. prasiniferum</i>	Dec., Jan., Feb.
2. <i>Oxya hyla hyla</i>	Jan., Feb.
3. <i>Acrida exaltata</i>	Feb., Jun.
4. <i>Eupreponotus inflatus</i>	Oct., Nov., Dec., Jan., Feb. and Mar.

<i>Species</i>	<i>Months</i>
5. <i>Trilophidia annulata</i>	Dec.
6. <i>Gesonula punctifrons</i>	Nov., Dec., Jan., Feb., and March.
7. <i>Choroedocus robustus</i>	Sept., Nov., Dec., Jan., Feb. Mar. and Apr.
8. <i>Aiolopus th. tamulus</i>	Feb.

SUMMARY

Certain seasonal fluctuations in the population of short-horned grasshoppers from three distinct vegetational sites, namely cultivation, grass-land and bushy zone at Garia near Calcutta, West Bengal have been reported. Grasshopper were collected at weekly interval using an insect net of conventional design of 30 cm. diameter.

The study of data on population fluctuations of different species reveals that *Aiolopus thalassinus tamulus* was the most dominant species and represents 14.36% of total population followed by *Oxya fuscovittata* 13.55% *Spathosternum prasinerum* Pr. (13.44%), *Atractomorpha crenulata* (9.12%), *Phlaeoba infumata* (9.24%) and *Oxya hyla hyla* (8.55%). Population of other species such as *Trilophidia annulata* (8.24%), *Acrida exaltata* (6.95%), *Oxya nitidula* (5.61%), *Gesonula punctifrons* (5.61%) were numerically low but occurs throughout the year and species like *Eupreponotus inflatus* (2.69%), *Choroedocus robustus* (2.16%), *Heiroglyphus banian* (0.82%), *Cyrtacanthacris tatarica* (0.29%) and *Heteracris pulcher* (0.05%) occurred very rarely during the period of study.

Monthwise analysis of male, female and nymph population shows maximum during monsoon and minimum during winter months. The regression and co-relations study was done between different environmental factors and grasshoppers population and their interrelationship are discussed.

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ETHNOZOOLOGY IN THE TRIBAL WELFARE OF
MADHYA PRADESH AND ORISSA

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INTRODUCTION

In a developing country like India it is extremely difficult for an ordinary citizen to afford medicine, especially in prolonged diseases. Even if with difficulty we can extend the medical facilities, how many have the capacity for the post-care after the discharge from hospitals. All of us know that there are a number of indigenous medicines which if readily made available can be utilized with advantage. The ordinary citizens can afford these medicines ; besides they are time-proven and practically without any side effects. The ethnozoological survey of Madhya Pradesh and Orissa has shown vast potential in developing indigenous medicines from animals. When these medicines are to be produced on a large scale, it will automatically generate employment. There is not much to gain by simply saying that we have to uplift the tribals. On the contrary we should find ways and means to achieve our goal. Large scale production of tribal medicines is one of such ways. And the ideal place to start such factories is the tribal areas. It is because the raw material required is animals that can easily be reared or cultured in their areas rather than in cities. Most of these animals used for medicines can also be used for food, which contain precious animal protein. Intelligent exploitation of these animals can provide the much needed protein food for

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the tribals as well as for others. The flesh of many of these animals has a ready market and some of them are delicacies. Besides, their hides can be utilised in leather industry and skeleton in bone meal industry. So what I want to stress is that side by side with the development of these areas we also stand to gain much benefit, or rather there is an all round development of the country. In other words mutual help is more beneficial than one-way traffic.

MATERIAL AND METHODS

A detailed data sheet on ethnozoology was prepared to ascertain the utility of animal parts as medicine, food, fertilizers, fuel and dye ; their role in witchcraft, astrology or forecasting, mechanical uses, ornamental uses, decorative purposes and industrial uses ; their application in omen, folklore, myths and totems and taboos ; and their role as harmful animals, pests, vectors, baits and pets. I gave field training to a team of four scientists from 4th to 27th November 1982 for systematically collecting field data. For the survey the 'Tribal Map of India' (based on 1961 census) showing the distribution of tribes compiled by the Anthropological Survey of India, Calcutta and the 'Annexure to the Tribal Map of India' by Gohain (1971) were found extremely useful. Data were collected from different villages of the same district and from different tribes living in the same village. Mostly the data were collected from the tribals living in the mid of forest and they were compared with the data collected from the same communities living near urban areas. It has shown the impact of urban culture on tribals.

Madhya Pradesh was selected for the first survey because it has the largest tribal population in India. According to 1981 census, it has 52.18 million people, of which 11.99 million are tribals. It means that 22.97% of the population is tribals. This state was surveyed from 4th November 1982 to 4th April 1983. Of the forty-five districts, forty-one were surveyed, the details of which are given below in the order of dates of survey :

Table 1. Details of Madhya Pradesh Survey

Districts surveyed	Localities surveyed	Name of tribes	Date
1	2	3	4
Rewa	Barhara, Behradaba, Chirah, Damodargarh, Dhumai, Gopla, Hanumana, Harrah, Jarkur, Kanaihaya, Kunrar	Badigar, Baiga, Gond, Kol	9-12.xi.1982
Sidhi	Bindul, Chamdarsa, Dudhmania, Juiry, Kusmi, Rauhal, Sarai	Agaria, Baiga, Biar, Gond, Khairwar, Kol, Panika	14-17.xi.1982
Satna	Kumhari, Naugawa, Obra, Ruhania, Paharigaon, Pateri, Pipria, Shivsagar, Turrah	Bhand, Bhumiya, Gond, Kol, Mawasi, Nat, Pao	19-23.xi.1982
Panna	Agra Basti, Baragaon, Madala, Mandla, Muthnur, Ranigunj. Selha	Bhumiya, Gond, Khairwar, Kol, Nat, Sonr	24-26.xi.1982
Chatarpur	Kurrah, Pinotha	Bhumiya, Gond, Khairwar, Saur	28-29.xi.1982
Tikamgarh	Chomo, Prathbipur	Gond, Saur	1.xii.1982
Datia	Khodan, Senpura, Tilejha	Seharia	4.xii.1982
Gwalior	Bhartari, Damanka, Moraigaon	Sebaria	5-6.xii.1982
Bhind	Gohad, Mehgaon	Gond, Korku	7.xii.1982
Shivpuri	Jakhlon, Karaigaon, Majra, Mayagaon, Survara	Seharia	9-10.xii.1982
Morena	Chakgaon, Gaswanigaon, Gopalpurgaon, Kapoora, Paligaon	Patillah, Seharia	12-13.xii.1982
Guna	Agaragaon, Bhaintagaon, Bhula, Chandanbhergaon, Godar	Bhilalas, Seharia	15-18.xii.1982
Vidisha	Goria, Madiakhurd, Manupura, Raisnagar	Gond, Meena, Seharia	20-24.xii.1982
Rajgarh	Harjipura, Junapani, Vijaygarh	Bhilalas, Seharia	26-27.xii.1982
Shajapur	Mayapur, Tukrana	Bhilalas	28.xii.1982
Sehore	Beerapura, Nadan, Shampura, Shekpura	Bhilalas, Gond, Korku	29-30.xii.1982 & 29.i.1983
Ujjain	Khacharod, Rasoolabad	Bhilalas	31 xii.1982
Mansaur	Kachnar, Lughmara	Bhil	1.i.1983

(Contd. Table 1)

Districts surveyed	Localities surveyed	Name of tribes	Date
1	2	3	4
Ratlam	Chawrakheri, Kotada, Rowati, Tamalias	Bhil	2-3.i.1983
Jhabua	Ambakhra, Bari, Burdoo, Gandela, Kayrawat, Kund	Bhil, Bhilalas	5-8.i.1983
Dhar	Fulgawri, Gaurpur	Bhil, Bhilalas	9-10.i.1983
Indore	Budhipura	Bhil	11.i.1983
W. Nimar (Khargaon)	Ahilyapura	Bhil	13.i.1983
E. Nimar (Khandawa)	Baisawa, Chaigaon, Dadwara, Dhakochi, Jogibera	Bhil, Bhilalas, Gond, Korku	14-16.i.1983
Betul	Baretha, Bundala, Dehargaoon, Kheri, Shahpur	Gond, Korku	18-19.i.1983
Hoshangabad	Chakar, Gogharpura, Ochapura, Timdukhera	Gond, Korku, Mawasi	22-23.i.1983
Dewas	Kuapanigaon, Parchiayagaon, Pujapura, Ratatalai	Bhilalas, Korku	27 i.1983
Raisen	Bhutpalasigaon, Gautampura Colony, Kiratnagar, Leemdhana, Mayus Khurd, Nayapura	Gond, Keer, Korku	1-4.ii.1983
Narasimhapur	Baretha, Karakbel, Mugwani, Nooriagaon, Rosra, Sutegaon	Gond, Kol, Mudia, Pardhan	7-9.ii.1983
Chindwara	Burrah, Chattiborena-gaon, Gulchigaon, Karaboh, Mehgaon Khurd, Puwagaon	Gond, Mawasi, Pardhan	10-13.ii.1983
Seoni	Chapara, Kurai, Mohgaon, Sukhtara	Gond, Pardhan	16-17.ii.1983
Jabalpur	Barella, Richai, Kohilas, Sakra, Umariagaon	Bhumiya, Gond, Kol, Pardhan	19-24.ii.1983
Mandla	Barikheri, Kamta, Kurameli, Rata	Gond, Kol	26-28.ii.1983
Shahdol	Amkantak, Beharia, Bikrampur, Choradih, Bartarh, Kishwahi	Baiga, Gond, Kavar, Kol, Panika, Pao	3-5.iii.1983
Balaghat	Halba Tola, Hirapurgaon, Kanhatola, Kirnapur	Baiga, Gond, Halba	7-8.iii.1983
Durg	Limora, Sakragaon	Gond, Halba	10.iii.1983
Bastar	Aderagaon, Deogaon, Kakalgurgaon, Kanhapurigaon, Nelbargaon, Rodegaon	Bhattra, Dhurwa, Gond, Halba, Madia, Muria, Pardhi	13-18.iii.1983

Contd. 1

Districts surveyed	Localities surveyed	Name of tribes	Date
1	2	3	4
Raipur	Barari, Gullu, Mudpur, Padaritalgaon, Sakarwara	Dewar, Gond, Kamar, Pardhi	20-23.iii. 1983
Bilaspur	Banbagha, Makhanpur	Dhanwar, Gond, Khairwar, Oraon, Saur	25.iii.1983
Raigarh	Ganeshpurgaon, Jhalla	Binjhwar, Kondh, Korwa, Oraon	27-28.iii. 1983
Surguja	Dhanwargaon, Jigdi, Sitapur	Baiga, Gond, Kavar, Nagesia, Oraon	30.iii. to 2.iv.1983

Bhopal, Damoh, Sagar and Rajnandan districts were not surveyed as the tribals are sparsely distributed there. According to Ali (1973) there are 58 classified tribes in Madhya Pradesh, of which we have come across only 39tribes.

For the second survey Orissa was selected. According to 1981 census, its population is 26.37 'million, of which 5.92 million are tribals. It means that 22.43% of the population is tribals. It was surveyed from 5th August to 25th September 1983 and the details are given below in the order of dates of survey as in the case of Madhya Pradesh :

Table 2. Details of Orissa Survey

Districts surveyed	Localities surveyed	Name of tribes	Date
1	2	3	4
Mayurbhanj	Balidia, Besarpani, Kenduva, Khadia, Thmadihi	Bathudi, Bhuiya, Bhumij, Kharia, Lodha, Mankirdia, Santal	8-9.viii.1983
Keonjhar	Ausanpat, Baniasahi, Dawrg, Gondbarai, Guptaganga, Lakhminarayanapur, Pukarapani, Ranki, Srirampur	Bathudi, Bhuiya, Bhumij, Gond, Juang, Kolha, Mankirdia, Munda, Santal, Sounti	11-13.viii. 1983

Cont. 2

1	2	3	4
Sundargarh	Baregad, Belsora, Maheshdihi, Pandiripani, Sagbahai, Timadihi	Bhuiya, Gond, Kawar, Kharia, Kisan, Korwa, Munda, Oraon	16-19.viii. 1983
Sambalpur	Kishipali, Lahamani	Bhuiya, Gond, Mirdhas, Munda, Oraon	22-24.viii. 1983
Dhenkanal	Deogaon, Nimidha, Pandarbharania	Gond, Matya	26-28.viii. 1983
Baudhkhond- mals (Phulwani)	Dalpad, Gailbed, Landibandh, Ranipathra	Gond, Khond	30-31.viii. 1983
Bolangir	Bhejipadar, Deogaon, Kharsalbanji, Kulia Bahal, Lankari, Photanuda, Pandel	Gond, Khond, Mirdhas, Saora	2-4.ix.1983
Kalahandi	Kamthana, Korlakot, Uditnarainpur	Gond, Khond, Saber	6-7.ix.1983
Koraput	Charagaon, Didayi, Durkagutha, Gadipur, Malimoda, Marla, Mudligora	Bhuiya, Didayi, Gadaba, Kondh, Matya, Paroja	9-11.ix.1983
Puri	Khurd, Muragarh	Gond	18-22.xi.1983
Balasore	Bairamgari, Chandipur, Hidiagaon, Talwari	Bhumij, Kolha, Santal	24.ix.1983

Of the thirteen districts of Orissa, in Cuttack and Ganjam the tribals are sparsely distributed and the party could not collect worthwhile data. In the constitution of India 62 Scheduled Tribes have been recognised from the state, of which we have come across only 25 tribes.

DATA

The ethnozoological survey has revealed that there are 894 applications of drugs derived from various animals in Madhya Pradesh and 234 applications in Orissa. Of these, those that have wider applications are given below in tabular form ;

TABLE 3.—Uses of animal products as medicine in Madhya Pradesh tribal area.

<i>Name of animal</i>	<i>Disease (s) for which used</i>	<i>Mode of application</i>	<i>Name of tribe (s) which uses. District (s) to which they belong are given in bracket</i>
1	2	3	4
1. MAMMALS			
Barasinga <i>Cervus duvacei</i> Cuvier	Pains in general, especially ribs pain	Antler powdered and applied. Powdered antler dissolved in water, oil, milk or cowdung and applied as ointment.	Bhand (Satna) ; Bhil (Indore and Khandawa) ; Bhilalas (Sehore, Shajapur and Dhar) ; Bhumiya (Chatarpur, Panna and Satna) ; Gond (Betul, Bhind, Chatarpur, Hoshangabad, Khandawa, Panna, Sidhi and Vidisha) ; Khairwar (Chatarpur and Panna) ; Kol (Panna and Satna) ; Korku (Betul, Bhind, Hoshangabad and Raisen) ; Mawasi (Hoshangabad and Satna) ; Meena (Vidisha) ; Pahalwan (Satna) ; Saur (Chatarpur, Panna and Tikamgarh) ; Seharia (Guna, Morena, Gwalior, Rajgarh and Vidisha) ;
Goat <i>Capra</i> sp.	Night blindness	Liver consumed. Liver dried, powdered and dissolved in water, ghee, etc. to use as eye ointment. Liver juice applied as eye ointment.	Baiga (Shahdol) ; Bhil (Khandawa, Mansaur and Ratlam) ; Bhilalas (Guna, Jhabua, Khandawa, Rajgarh and Sehore) ; Bhumiya (Jabalpur) ; Binjhwar (Rajgarh) ; Gond (Khandawa, Panna, Raisen, Satna, Shahdol and Vidisha) ; Gond Muslims (Rewa) ; Kawar (Shahdol) ; Khairwar (Chatarpur) ; Keer (Raisen) ; Kol (Jabalpur and Mandla) ; Kondh (Rajgarh) ; Korku (Bhind, Hoshangabad and Raisen) ; Mawasi (Chindwara) ; Meena (Vidisha) ; Panika (Shahdol) ; Seharia (Guna, Gwalior and Vidisha)

1	2	3	4
„	Tuberculosis	Flesh or milk consumed. Urine orally administered. Droppings roasted on fire and fumes passed into a closed room where the patient is made to lie. Goat tied by the bed side of the patient (it is said that the smell of excreta is helpful in cure).	Bhil (Khandawa) ; Bhilalas (Dewas and Khandawa) ; Bhumiya (Jabalpur and Panna) ; Gond (Balaghat, Betul, Bilaspur, Durg, Jabalpur, Mandla, Raisen and Seoni) ; Halba (Balaghat, Bastar and Durg) ; Kol (Jabalpur, Mandla and Shahdol) ; Korku (Hoshangabad and Raisen) ; Korwa (Rajgarh) ; Oraon (Bilaspur and Surguja) ; Panika (Shahdol) ; Pardhan (Seoni)
„	Injury, sprain, pains including rheumatic pain, back ache, etc.	Droppings used in different ways : dried, burnt, dissolved in water and applied ; burnt and fumes passed over affected parts, etc.	Bhumiya (Jabalpur) ; Gond (Shahdol, Seoni, Betul, Hoshangabad, Balaghat, and Jabalpur) ; Halba (Balaghat) ; Mawasi (Chindwara) ; Nagesia (Surguja) ; Pao (Shahdol) ; Pardhan (Chindwara)
Porcupine <i>Hystrix indica</i> Kerr	Cough, cold & allied diseases	Intestine administered in different ways. Fat consumed, or massaged, or both simultaneously done.	Biar (Sidhi) ; Dhurwa (Bastar) ; Gond (Bhind, Chindwara, Mandla, Narasimhapur, Raisen, Tikamgarh and Vidisha) ; Keer (Raisen) ; Khairwar (Chatarpur and Sidhi) ; Kol (Narasimhapur) ; Kondh (Raigarh) ; Korku (Bhind and Raisen) ; Mawasi (Hoshangabad) ; Meena (Vidisha) ; Panika (Shahdol) ; Pao (Satna) ; Pardhan (Seoni) ; Saur (Tikamgarh) ; Seharla (Datia and Gwalior)

Contd. 3

1	2	3	4
Sambar <i>Cervus uni-</i> <i>color</i> Kerr	Pains in general : ribs pain, chest pain and headache	Antler powdered, dissol- ved in water, oil, hen's egg, honey or cow's urine, etc. and applied as ointment.	Baiga (Balaghat and Shahdol); Bhilalas (Dewas, Jhabua and Khandawa); Bhumiya (Chatarpur and Jabalpur); Binjhar (Rai- pur); Dewar (Raipur); Dhanwar (Bilaspur); Dhurwa (Bastar); Gond (Balaghat, Bastar, Bilaspur, Chindwara, Jabalpur, Mandla, Narasimhapur, Raisen, Sehore, Seoni, Shahdol and Tikamgarh); Halba (Balaghat and Durg); Kamar (Raipur); Kavar (Shahdol); Keer (Raisen); Khairwar (Bilaspur); Kol (Mandla and Narasimhapur); Kondh (Raigarh); Korku (Dewas, Raisen and Sehore); Mawasi (Chindwara and Hoshangabad); Mudia (Narasimhapur); Oraon (Raisen, Sehore and Surguja); Panika (Shahdol and Sidhi); Pao (Shahdol); Pardhan (Chindwara, Jabalpur and Nara- simhapur); Sehar (Sidhi)

1	2	3	4
		2. BIRDS	
Peacock <i>Pao cristatus</i> L.	Ear complaints	Feather roasted, powdered, dissolved in mustard oil or water and used as ear drops. Feather roasted, powdered, dissolved in honey and orally administered. Bone or lower part of foot powdered and dissolved in water, oil, breast milk, or lemon juice and used as ear drops. Bone of foot boiled in oil and used as ear drops (more commonly in mustard oil).	Baiga (Balaghat, Shahdol, Sidhi and Surguja) ; Bhand (Satna) ; Bhatta (Bastar and Indore) ; Bhil (Dhar, Jhabua and Ratlam) ; Bhilalas (Dewas, Dhar, Guna, Raigarh, Sehore and Ujjain) ; Bhumiya (Jabalpur, Panna and Satna) ; Binjhwar (Raigarh) ; Dewar (Raipur) ; Dhanwar (Bilaspur) ; Dhurwa (Bastar) ; Gond (Balaghat, Betul, Bhind, Bilaspur, Chatarpur, Chindwara, Durg, Hoshangabad, Jabalpur, Khandawa, Mandla, Narasimhapur, Panna, Raipur, Raisen, Satna, Sehore, Seoni, Shahdol, Sidhi, Surguja, Tikamgarh and Vidisha) ; Halba (Balaghat and Durg) ; Kamar (Raipur) ; Kavar (Shahdol and Surguja) ; Keer (Raisen) ; Khairwar (Chatarpur and Panna) ; Kol (Jabalpur, Mandla, Narasimhapur, Panna, Satna and Shahdol) ; Kondh (Raigarh) ; Korku (Betul, Bhind, Dewas, Hoshangabad, Raisen and Sehore) ; Korwa (Raigarh) ; Mawasi (Hoshangabad and Satna) ; Meena (Vidisha) ; Mudia (Narasimhapur) ; Nagesia (Surguja) ; Oraon (Raigarh and Surguja) ; Panika (Shahdol) ; Pahalwan or Nat (Panna and Satna) ; Pao (Satna) ; Pardhan (Chindwara, Jabalpur and Seoni) ; Pardhi (Raipur) ; Saur (Bilaspur and Tikamgarh) ; Seharla (Datia, Guna, Gwalior, Morena, Rajgarh, Shivpuri and Vidisha) ; Sonr (Panna)

1	2	3	4
„	Vomiting	Feather roasted, powdered, dissolved in water, milk, honey, ghee, etc., sometimes to which is added pepper, cardamum powder, or onion, etc. and taken.	Baiga (Shahdol) ; Bhumiya (Jabalpur) ; Binjhwar (Raigarh) ; Dewar (Raipur) ; Gond (Bilaspur, Chindwara, Durg, Jabalpur, Seoni and Shahdol) ; Halba (Bastar and Durg) ; Kamar (Raipur) ; Keer (Raisen) ; Khairwar (Bilaspur) ; Kondh (Raigarh) ; Korwa (Raigarh) ; Nagesia (Surguja) ; Oraon (Surguja) ; Panika (Shahdol) ; Pao (Shahdol) ; Pardhan (Chindwara and Seoni) ; Pardhi (Bastar)
Pigeon <i>Columba livia</i> Gmelin	Paralysis	Blood orally administered. Blood massaged on affected part. Blood massaged along with flesh consumed. Blood and flesh consumed. Juice from flesh extracted and consumed. Feather used to fan on affected part.	Baiga (Shahdol) ; Bhattra (Bastar) ; Bhil (Dhar, Indore, Jhabua, Khandawa, Ratlam and W. Nimar) ; Bhilalas (Dewas, Dhar, Khandawa, Raigarh, Sehore, Seoni, Shajapur and Ujjain) ; Bhumiya (Chatarpur) ; Binjhwar (Raigarh) ; Dhanwar (Bilaspur) ; Gond (Balaghat, Bastar, Betul, Bhind, Bilaspur, Chatarpur, Chindwara, Durg, Jabalpur, Khandawa, Mandla, Narasimhapur, Panna, Raipur, Raisen, Sehore, Seoni, Shahdol and Vidisha) ; Halba (Balaghat, Bastar and Durg) ; Kawar (Raipur and Shahdol) ; Keer (Raisen) ; Khairwar (Bilaspur, Chatarpur and Panna) ; Kol (Jabalpur, Mandla, Narasimhapur and Shahdol) ; Korku (Betul, Dewas, Hoshangabad, Khandawa, Raisen and Sehore) ; Korwa (Raigarh) ; Mawasi (Hoshangabad) ; Meena (Vidisha) ; Mudia (Narasimhapur) ; Nat (Panna) ; Oraon (Bilaspur and Raigarh) ; Panika (Shahdol) ; Pao (Shahdol) ; Pardhan (Chindwara, Narasimhapur and Seoni) ; Pardhi (Bastar and Raipur) ; Saur (Bilaspur and Chatarpur) ; Seharla (Gwalior, Satna, Shivpuri and Vidisha)

1	2	3	4
3. REPTILES			
Monitor Lizard <i>Varanus bengalensis</i> (Daudin)	Pain and rheumatic complaints	Fat massaged on affected part. Fat mixed with 'ajwan' (<i>Trachyspermum ammi</i>) and orally administered.	Bhand (Satna); Bhil (Ratlam); Bhilalas (Sehore); Bhumiya (Chatarpur, Panna and Satna); Binjhwar (Raigarh); Gond (Bilaspur, Betul, Chatarpur, Panna, Satna and Tikamgarh); Khairwar (Chatarpur and Panna); Kol (Panna); Korku (Raisen); Korwa (Raigarh); Nagesia (Surguja); Oraon (Bilaspur and Raigarh); Pao (Satna); Pardhan (Chindwara); Saur (Chatarpur and Tikamgarh); Seharla (Gwalior); Sonr (Panna)
„	Swelling of neck in bulls (Veterinary use)	Fat massaged on affected part. Fat mixed with common salt and applied on affected part. Skin roasted, mixed with its oil and applied on affected part.	Baiga (Surguja); Bhil (Dhar, Khandawa and W. Nimar); Bhilalas (Jhabua and Khandawa); Dewar (Raipur); Dhanwar (Bilaspur); Gond (Betul, Bhind, Bilaspur, Chindwara, Hoshangabad, Jabalpur, Khandawa, Mandla, Narasimhapur, Raipur, Raisen

Contd. 3

1	2	3	4
		Fat mixed with the fat of wild boar and massaged.	and Surguja) ; Kamar (Raipur) ; Kavar (Shahdol) ; Keer (Raisen) ; Khairwar (Bilaspur) ; Korku (Bhind, Dewas and Hoshangabad) ; Mawasi (Chindwara and Hoshangabad) ; Mudia (Narasimhapur) ; Nagesia (Surguja) ; Nat (Panna) ; Oraon (Bilaspur and Surguja) ; Pardhan (Chindwara and Seoni) ; Pardhi (Raipur)
Tortoise and turtle <i>Geochelone</i> sp. and <i>Chitra</i> sp.	Piles and allied complaints	Head kept in contact with rectum. Head ground in water and applied. Head dried, roasted and orally administered. Head crushed in castor oil and applied externally. Carapace kept in contact. Carapace ground in water and applied. Carapace roasted on bonfire and fumes passed on anal region. Neck dried, ground in water and applied	Binjhar (Raigarh) ; Dewar (Raipur) ; Dhanwar (Bilaspur) ; Gond (Bastar, Bilaspur, Mandla, Seoni and Raipur) ; Halba (Balaghat) ; Kamar (Raipur) ; Khairwar (Bilaspur) ; Kol (Jabalpur and Mandla) ; Kondh (Raigarh) ; Korwa (Raigarh) ; Mawasi (Hoshangabad) ; Nagesia (Surguja) ; Oraon (Bilaspur and Raigarh) ; Panika (Shahdol) ; Pardhi (Bastar) ; Pardhan (Seoni) ; Saur (Bilaspur)

Contd. 3

1	2	3	4
4. MOLLUSCS			
Cowrie (Not specific)	Ear complaints	Shell roasted, powdered and dropped into ear. Shell powder mixed with turmeric powder or vermillion and dropped into ear. Shell roasted, powdered, dissolved in lemon juice with turmeric powder or in any oil, milk, breast milk, etc., and used as ear drops. Shell powdered, dissolved in water, milk, breast milk or mustard oil and used as ear drops. Shell powder mixed with 'babul' flower and dissolved in lime juice and used as ear drops.	Bhil (Jhabua, Khandawa and Ratlam) ; Bhilalas (Dewas, Guna and Khandawa) ; Bhumiya (Chatarpur, Jabalpur, Panna and Satna) ; Biar (Sidhi) ; Binjhwar (Raigarh) ; Dewar (Raipur) ; Dhanwar (Bilaspur) ; Gond (Betul, Bilaspur, Bhind, Chatarpur, Chindwara, Durg, Jabalpur, Panna, Raipur, Satna, Seoni, Sidhi, Surguja, Tikamgarh and Vidisha) ; Halba (Balaghat and Durg) ; Kamar (Raipur) ; Kavar (Shahdol) ; Keer (Raisen) ; Khairwar (Bilaspur, Chatarpur, Panna and Sidhi) ; Kol (Jhabua, Mandla, Narasimhapur, Panna, Satna and Sidhi) ; Kondh (Raigarh) ; Korku (Betul, Bhind and Raisen) ; Korwa (Raigarh) ; Mawasi (Hoshangabad) ; Meena (Vidisha) ; Oraon (Bilaspur) ; Pardhan (Jabalpur and Narasimhapur) ; Pao (Satna) ; Pardhi (Raipur) ; Panika (Shahdol) ; Saur (Bilaspur, Chatarpur and Tikamgarh) ; Seharla (Guna and Gwalior)

1	2	3	4
5. CRUSTACEANS			
Crab <i>Paratelophusa</i> sp.	Diseases pertaining to liver, including jaundice	Flesh cooked and consumed. Flesh crushed in water and orally administered. Juice extracted by boiling flesh in water and taken. Juice from flesh extracted and orally administered.	Bhil (Khandawa); Bhilalas (Rajgarh and Shajapur); Bhumiya (Chatarpur and Jabal- pur); Dewar (Raipur); Gond (Bhind, Chatarpur, Khandawa and Tikamgarh); Khairwar (Chatarpur and Panna); Kondh (Raigarh); Korwa (Raigarh); Nat (Panna); Nagesia (Surguja); Oraon (Raigarh and Surguja); Panika (Shahdol); Pardhan (Jabal- pur); Saur (Tikamgarh); Seharla (Datia, Gwalior, Raigarh and Shivpuri)
„	Cough, cold, fever and breathing trouble	Flesh cooked and consumed. Flesh roasted, dissolved in honey and taken. Flesh roasted, powdered, dissolved in water and given in betel to children. Flesh crushed in water and applied and side by side consumed. Juice from flesh orally administered.	Bhil (Indore, Jhabua and Ratlam); Bhilalas (Dhar and Ujjain); Bhumiya (Jabalpur); Binjhar (Raigarh); Dhurwa (Bastar); Gond (Bastar, Bilaspur, Chatarpur, Durg, Hoshanga- bad, Jabalpur, Narasimhapur, Panna, Raipur, Tikamgarh and Surguja); Halba (Balaghat and Durg); Kamar (Raipur); Kavar (Shahdol); Keer (Raisen); Khairwar (Bilas- pur); Kol (Mandla and Panna); Mawasi (Chindwara); Muria (Bastar); Oraon (Bilaspur and Raigarh); Panika (Shahdol); Pardhan (Chindwara and Seoni); Pardhi (Bastar); Seharla (Guna)

1	2	3	4
6. ANNELIDS			
Earthworm <i>Pheretima</i> sp.	To increase lactation	Flesh as such or dried in the sun or roasted and orally administered. Flesh dried mixed with cane sugar or food and taken. Flesh mixed with broken wheat or milk and consumed. Flesh kept inside the mouth of fish and the roasted fish consumed. Flesh taken along with betel.	Baiga (Balaghat and Shahdol) ; Bhil (Khandawa) ; Bhilalas (Dewas, Dhar, Guna, Jhabua, Rajgarh and Sehore) ; Bhumiya (Chatarpur) ; Binjhwar (Raigarh) ; Dewar (Raipur) ; Dhanwar (Bilaspur) ; Dhurwa (Bastar) ; Gond (Balaghat, Bastar, Bilaspur, Betul, Chindwara, Durg, Hoshangabad, Khandawa, Mandla, Narasimhapur, Raipur, Raisen, Seoni and Vidisha) ; Halba (Balaghat and Durg) ; Kavar (Shahdol) ; Khairwar (Bilaspur and Panna) ; Kol (Narasimhapur and Shahdol) ; Kondh (Raigarh) ; Korku (Betul, Hoshangabad, Raisen and Sehore) ; Korwa (Raigarh) ; Meena (Vidisha) ; Mudia (Narasimhapur) ; Nagesia (Surguja) ; Nat (Panna) ; Oraon (Surguja) ; Panika (Shahdol) ; Pardhan (Seoni) ; Pardhi (Bastar) ; Seharla (Guna, Morena and Rajgarh)

TABLE 4. Summary of animal uses for medicine in Madhya Pradesh tribal area.

<i>Name of animal</i>	<i>Disease (s)</i>	<i>No. of Tribes</i>	<i>No. of Districts</i>
Barasinga	Pains in general , especially ribs pain	13	19
Goat	Night blindness	17	21
„	Tuberculosis	11	16
„	Injury, sprain, pains, including rheumatic pain, back ache, etc.	7	8
Porcupine	Cough, cold and allied diseases	16	17
Sambar	Pains in general, ribs pain, chest pain and head ache	23	22
Peacock	Ear complaints	33	39
„	Vomiting	17	11
Pigeon	Paralysis	26	33
Monitor	Pain and rheumatic complaints	17	12
Lizard			
„	Swelling of neck in bulls	18	20
Tortoise and turtle	Piles and allied complaints	17	12
Cowrie	Ear complaints	26	28
Crab	Diseases pertaining to liver including jaundice	15	15
„	Cough, cold, fever and breathing trouble	19	24
Earthworm	To increase lactation	25	26

Other medicinal uses

<i>Name of animal</i>	<i>Part used</i>	<i>Disease (s) for which it is used</i>
1	2	3
Barasinga	Antlers	Temperature, headache, tonsillitis, cough and cold, pneumonia, eye complaints
Goat	Liver	Liver enlargement, general weakness, whooping cough, spleen trouble, cough and cold
	Droppings	Swelling of stomach, body, etc., nasal bleeding, scorpion bite, wounds, fever
	Urine	Liver complaints, rickets, boils on head, hair fall, itching, skin diseases, cough and cold, pneumonia, breathing trouble, swellings, weeping, loss of appetite
Porcupine	Blood	Breathing trouble
	Flesh	Excess urination
	Undigested faecal matter	Stomach pain
	Intestine	Blood purification, malaria, ulcer, general weakness, body pain, cholera, safe and timely delivery, stomach pain, stomach bulging, measles
	Fat	Swellings and pain, night blindness, rheumatic pain
	Skin	Baldness
	Spine	Ribs pain, asthmatic complaints
Sambar	Fat	Piles, cracks on the foot, swelling on the neck of domestic animals

Contd. 4

1	2	3
	Antler	Ear complaints, cough and cold, pneumonia, breathing trouble, cyst in breast of ladies, dysentery, to remove pus from boil, ascariasis, as a general tonic for improvement of health
Peacock	Feather	Stomach pain, body ache, small pox, chicken pox, fever, neurotic complaints, scorpion bite, delirium, cough and cold, whooping cough, breathing trouble
	Lower part of foot	Ribs pain, rheumatic pain, schiatic pain, swellings
	Bone	Breathing trouble, cuts, wounds, muscular pain, eye trouble
	Fat	For joining broken bones
Pigeon	Blood	Asthma, tuberculosis, rheumatic and muscular pains, breathing trouble, to lower the rate of heart beat
	Flesh	Cough, breathing trouble, tuberculosis, rheumatic complaints
	Fat	Rheumatic complaints
	Excreta	Menstrual disorders, breathing trouble, asthma, rickets
Monitor Lizard	Fat	Cough, cold, swellings, boils, wounds, pneumonia, fever, rickets, general weakness, eye complaints, scorpion bite, eczema

Contd. 4

1	2	3
	Stomach and gut contents	Cold, fever, pneumonia
	Lungs	Cold and fever
Tortoise and Turtles	Fat	Boils, rheumatic complaints
	Head	Loose motion, rickets
	Carapace	Minor injuries and wounds, intestinal parasites, eye troubles, boils, swellings, rickets, enlargement of stomach, itching, blood in cough, nasal bleeding, as antiseptic, burns, neurotic complaints, pain in back bone, swelling in the neck of bull, paralysis and general weakness in cattle, for septic in bulls
	Skin	Itching
	Blood and flesh	Sexual weakness in male
	Flesh	Tuberculosis
Cowrie	Shell	Cyst, cough, cold and fever, wounds, cataract, red eyes
Crab	Flesh	Tuberculosis, measles, general weakness, swelling of body, ear complaints, pus formation in finger, for broken leg, lethargy, body ache, rheumatic pain, rickets, stomach pain
	Fat	Burns
	Flesh and eggs	To increase lactation
Earthworm	Flesh	To prevent unborn baby from diseases, general weakness, giddiness, cough and cold, rickets, parasitic infection, wounds, snake bite, loose motion, ear complaints, jaundice, worms trouble

TABLE 5. Uses of animal products as medicine in Orissa tribale area.

24	Name of animal	Disease(s) for which used	Mode of spplication	Name of tribe(s) which uses. District(s) to which they belong are given in brackets
	1	2	3	4
			1. MAMMALS	
	Bat	Asthma	Fat massaged on chest.	Bathudi (Keonjhar) ; Bhuiya (Keonjhar and Mayurbhanj) ; Bhumij (Keonjhar) ; Gond (Bolangir, Dhenkanal, Kalahandi, Keonjhar, Phulbani and Sundargarh) ; Juang (Keonjhar) , Kavar (Sundargarh) ; Khond (Phulbani) ; Kolha (Keonjhar) ; Kondh (Kalahandi) ; Matya (Dhenkanal) ; Mirdhas (Bolangir) ; Munda (Sambalpur and Sundargarh)
	Not specific		Fat orally administered.	
			Flesh fried in ghee and consumed.	
			Flesh mixed with pepper, cooked and consumed.	
	„	Rheumatic pain	Fat massaged.	Bhuiya (Sambalpur and Sundargarh) ; Bhumij (Balasore) ; Didayi (Koraput) ; Gadaba (Koraput) ; Gond (Bolangir, Dhenkanal, Phulbani, Puri, Sambalpur and Sundargarh) ; Kavar (Sundargarh) ; Kharia (Sundargarh) ; Khond (Bolangir) ; Kolha (Balasore) ; Kondh (Koraput) ; Korwa (Sundargarh) ; Matya (Koraput) ; Mirdhas (Bolangir and Sambalpur) ; Munda (Sambalpur and Sundargarh) ; Oraon (Sambalpur and Sundargarh) ; Paroja (Koraput) ; Sabar (Kalahandi) ; Santal (Balasore and Keonjhar) ; Saora (Bolangir) ; Saunti (Keonjhar)
			Flesh orally administered.	
			Liver juice orally administered.	

1	2	3	4
Goat <i>Capra</i> sp.	Tuberculosis	Milk taken in empty stomach. Urine and excreta smelled. Bile or blood orally administered. Liver consumed. Urine orally administered or along with its massage in some cases.	Bhuiya (Keonjhar, Mayurbhanj and Sambalpur) ; Didayi (Koraput) ; Gadaba (Koraput) ; Gond (Dhenkanal, Kalahandi, Puri, Sambalpur and Sundargarh) ; Kavar (Sundargarh) ; Khond (Phulbani) ; Kolha (Balasore and Keonjhar) ; Kondh (Koraput) ; Korwa (Sundargarh) ; Matya (Koraput) ; Mirdhas (Bolangir and Sambalpur) ; Munda (Sambalpur) ; Paroja (Koraput) ; Sabar (Kalahandi) ; Santal (Balasore) ; Saora (Bolangir).
Tiger <i>Panthera tigris</i> (L.)	Rheumatic pain	Fat or oil extracted from fat massaged. Tongue taken alongwith betel.	Bathudi (Keonjhar) ; Bhuiya (Keonjhar and Sambalpur) ; Bhumij (Balasore and Keonjhar) ; Didayi (Koraput) ; Gond (Bolangir, Dhenkanal, Kalahandi, Keonjhar, Phulbani and Sambalpur) ; Juang (Keonjhar) ; Khond (Bolangir, Kalahandi and Phulbani) ; Kolha (Balasore) ; Kondh (Koraput) ; Matya (Dhenkanal and Koraput) ; Mirdhas (Bolangir) ; Munda (Sambalpur) ; Paroja (Koraput) ; Sabar (Kalahandi) ; Santal (Balasore and Keonjhar) ; Saora (Bolangir) ; Saunti (Keonjhar)
Wild boar <i>Sus scrofa</i> L.	Rheumatic pain	Fat massage.	Bathudi (Mayurbhanj) ; Bhuiya (Sambalpur) ; Bhumij (Balasore and Mayurbhanj) ; Gadaba (Koraput) ; Gond (Puri, Sambalpur and Sundargarh) ; Kharia (Sundargarh) ; Kondh (Phulbani) ; Kolha (Balasore) ; Kondh (Koraput) ; Lodha (Mayurbhanj) ; Matya (Dhenkanal) ; Munda (Sambalpur) ; Oraon (Sambalpur) ; Paroja (Koraput) ; Santal (Balasore and Mayurbhanj) ; Saunti (Keonjhar)

Contd. 5

1	2	3	4
2. BIRDS			
Malabar Pied Hornbill <i>Anthracoceros coronatus</i> (Boddaert)	Rheumatic pain	Oil extracted from fat and massaged. Flesh cooked and taken.	Bathudi (Keonjhar and Mayurbhanj) ; Bhuiya (Mayurbhanj, Sambalpur and Sundargarh) ; Bhumij (Balasore and Keonjhar) ; Didayi (Koraput) ; Gadaba (Koraput) ; Gond (Bolangir, Kalahandi, Keonjhar ; Puri, Sambalpur and Sundargarh) ; Juang (Keonjhar) ; Kavar (Sundargarh) ; Kharia (Sundargarh) ; Khond (Bolangir and Phulbani) ; Kolha (Balasore, Bolangir and Keonjhar) ; Kondh (Koraput) ; Lodha (Mayurbhanj) ; Matya (Koraput) ; Mirdhas (Bolangir and Sambalpur) ; Munda (Sambalpur) ; Paroja (Koraput) ; Sabar (Kalahandi) ; Santal (Bolangir, Keonjhar and Mayurbhanj) ; Saora (Bolangir) ; Sounti (Keonjhar)
Peacock <i>Pao cristatus</i> L.	Ear complaints	Foot bone boiled in mustard oil or crushed in water and used as ear drops. Egg broken and contents used as ear drops.	Bathudi (Mayurbhanj) ; Bhuiya (Keonjhar) ; Gond (Kalahandi and Keonjhar) ; Kharia (Sundargarh) ; Khond (Bolangir) ; Lodha (Mayurbhanj) ; Matya (Dhenkanal) ; Mirdhas (Bolangir) ; Paroja (Koraput) ; Santal (Mayurbhanj)

1	2	3	4
3. REPTILES			
Spiny-tailed Lizard <i>Uromastix hardwicki</i> Grey	Rheumatic pain	Flesh orally taken. Juice from flesh extracted and orally administered. Oil extracted from fat massaged.	Bathudi (Keonjhar) ; Bhuiya (Sambalpur and Sundargarh) ; Bhumij (Balasore) ; Didayi (Koraput) ; Gadaba (Koraput) ; Gond (Puri, Sambalpur and Sundargarh) ; Kharia (Sundargarh) ; Kolha (Balasore and Keonjhar) ; Kondh (Koraput) ; Korwa (Sundargarh) ; Matya (Koraput) ; Mirdhas (Sambalpur) ; Munda (Sambalpur) ; Oraon (Sundargarh) ; Santal (Balasore) ; Sounti (Keonjhar)
4. ANNELIDS			
Earthworm <i>Pheretima</i> sp.	To increase lactation	Flesh fried in ghee and orally administered. Flesh crushed in water and taken.	Bathudi (Keonjhar and Mayurbhanj) ; Bhuiya (Keonjhar and Sambalpur) ; Bhumij (Balasore and Keonjhar) ; Didayi (Koraput) ; Gadaba (Koraput) ; Gond (Bolangir, Dhenkanal, Kalahandi, Keonjhar, Koraput and Puri) ; Kharia (Sundargarh) ; Khond (Bolangir) ; Kolha (Balasore) ; Kondh (Koraput) ; Matya (Dhenkanal and Koraput) ; Mirdhas (Bolangir) ; Oraon (Sundargarh) ; Paroja (Koraput) ; Santal (Balasore and Mayurbhanj) , Saora (Bolangir) ; Sounti (Keonjhar)

TABLE 6. Summary of animal uses for medicine in Orissa tribal area.

Name of animal	Disease(s)	No. of Tribes	No. of Districts
Bat	Asthma	12	9
„	Rheumatic pain	20	10
Goat	Tuberculosis	16	11
Tiger	Rheumatic pain	17	8
Wild boar	Rheumatic pain	16	9
Malabar Pied Hornbill	Rheumatic pain	21	10
Peacock	Ear complaints	10	7
Spiny-tailed Lizard	Rheumatic pain	16	6
Earthworm	To increase lactation	17	11

Other Medicinal Uses

Name of animal	Part used	Disease(s) for which it is used
1	2	3
Bat	Blood	Ear complaints
	Fat	Breathing trouble, rickets
	Flesh	Liver trouble, nasal bleeding, oral bleeding, rickets, tuberculosis
Goat	Ghee	Cough and cold
	Urine	Purification of blood, itching, cuts and wounds
	Bile	Fever, night blindness
	Fat	Burns
	Flesh	Anaemia
	Liver	Night blindness
	Skin	Blood dysentery
	Blood	Diarrhoea

Contd. 6

1	2	3
Tiger	Tongue	Appendicitis, asthma, to reduce enlargement of spleen
	Fat	Paralysis
	Milk	To increase lactation
Wild boar	Fat	Small pox, burns
	Teeth	Boils
	Flesh	General weakness
Malabar Pied Hornbill	Flesh	Paralysis
	Head	Nasal bleeding
Peacock	Feather	Vomiting, cough, tuberculosis, dysentery
	Bone of foot	Boils, burns
	Flesh	Vomiting
	Liver	Cough, cold and fever
Uromastix	Fat	Impotency in male, scorpion bite, burns, conjunctivitis, skin diseases
	Flesh	Head ache, muscular pain, joint pain, impotency of male, asthma
	Head	Swelling in the neck of bulls
Earthworm	Excreta	Scorpion bite
	Flesh	Indigestion, roundworm, spleen swelling

OTHER USES

Flesh of these animals are used as food by most of the tribals. Goat milk is drunk by all. Skins of barasinga, goat, tiger, monitor lizard, etc. are widely used for making sandals, vessels for fetching water, etc. A number of them like peacock, pigeon, sambar, barasinga, etc. are kept as pets. Among these animals goat is the most widely used one for sacrifice. For entertainment, goat fights and pigeon fights are often arranged.

INDUSTRIAL USES

It is only appropriate to point out the important industrial uses of these animals to show how the rearing of such animals will be beneficial to both tribals as well as others.

Food : Goat milk is commonly drunk ; the goat is called the poor man's cow. Meat of barasinga, bat, goat, porcupine, sambar, wild boar, peacock, pigeon, monitor lizard, tortoise, turtle and crab is eaten. Of these, the meat of sambar, turtle, wild boar and crab is known for its delicacy. Venison or deer meat is easily digested and is recommended for invalids. Though the nutritive value of crab meat is not as high as that of fish, it is considered to be of unique dietary and medicinal value. The lard of wild boar is used as cooking medium.

Leather : The skin of goat, sambar and monitor lizard is widely used in leather industry. Turtle flippers are also used to a limited extent. Sambar hide makes excellent suede leather for golfing and walking shoes. Barasinga skin can be readily used in leather industry. Tiger skins are regarded as coveted trophies.

Hairs and feathers : Different types of hairs are obtained from different goat breed. They are used in the manufacture of blankets, upholstery, pile fabrics, men's summer suiting, lining, rugs, braids, nets, shoe laces, hats, decorative trimmings, shoe wigs, curtains, bed spreads, etc. Peacock feathers are extensively used for decorative purposes ; fans, picture-frames, etc. are made from them in Agra, Varanasi, Jhansi, etc. There is a limited demand for peacock feathers from America for theatrical purposes. Wild boar bristles are used for making various types of brushes, ranging from shaving and toilet types to painting and distempering types. Porcupine quills are used in cottage industries for ornamental finish of articles of utility. Quill feathers of pigeon are utilised for making tooth picks.

Shells : Shells of cowrie and tortoise are used for decorative purposes. Cowrie shells are also used for ornamental purposes and for indoor games ; because of their beauty, form

and colour markings, they have been favourite objects for curio collectors. Broken cowries are used for lime manufacture. The shell of crabs are powdered after blanching and used as feed for poultry and swine.

Antlers : are used in making handles for cutlery, umbrellas and sticks and generally for fancy artistic ware. They retain their shape and finish under varying climatic conditions.

Manure : Excreta of most of these animals can be utilised as manure for enriching the soil. Bones can be utilised for bone meal, which forms valuable manure. Crab shells are also used as manure.

Hormonal preparations : Glands such as thyroid, pituitary and pancreas of wild boar can be used in the manufacture of hormonal preparations. Valuable pharmaceutical preparations like pepsin, thyroxine, pituitrin, insulin, liver extracts, testosterone, etc., can be prepared out of these glands.

SOME SUGGESTIONS FOR TRIBAL WELFARE

Hunger and unemployment are the major problems the tribals are facing throughout the country today. From the foregoing account it will be seen that there are 11 animals that have been in wide use for medicinal purposes in Madhya Pradesh and similarly 8 animals in Orissa. Most of them are also sources of food. At the same time they have considerable industrial potential also.

Only the efforts which are mutually beneficial will have long lasting success. The following proposals, if implemented, will bring tribals to the main stream ; they, therefore, are put forth for the upliftment of the tribals as well as for the benefit of the rest of the country.

1. It is proposed to start farms by the Government for rearing various animals in the tribal areas. Here as many tribals as possible should be employed and as and when they get sufficient experience the senior cadre should be gradually replaced by the tribals.

2. Monetary assistance should be given to the interested

and deserving individuals to start their own private farms to rear these animals. If encouraged, many tribals will come forward to take advantage of it. Collection centres may be established at important places to purchase their products to enable them to get right price for their products.

3. Industries based on these farm products can be started in the tribal areas to increase employment opportunities.

(a) After testing their efficacy, medicines can be produced on a large scale which can be utilised by the tribals as well as by others. When there is an all out attempt to achieve 'health for all by 2000 A.D.', as declared by the World Health Organisation at Alma Ata, tribal medicines can also play a significant role. More scientific approach should be made to develop the tribal medicine and training centres should be established to impart systematic training in this branch of medicine.

(b) Factories for canning the meat of various animals like barasingha, bat, goat, porcupine, sambar, wild boar, pigeon, monitor lizard, tortoise and turtle can be established. In some cases there is taboo in eating the flesh of certain animals, which is only a question of time to overcome.

(c) Leather industry can be established with the ready availability of animal skin.

(d) Bone meal can be manufactured from the bones of animals, which is much in demand in agriculture.

(e) Factories can be established for the manufacture of blankets, bed spreads, rugs, etc., from hairs that can be obtained from goats.

(f) Peacock feather can be utilised on a large scale for making decorative articles and their quills for floats for fishing. The quill feather of pigeon can be used for making excellent tooth picks.

(g) Factories for manufacture of hormones from the glands such as thyroid, pituitary and pancreas of wild boar can be established.

(h) Cottage industry can be established for preparation

of feed for poultry and swine from blood of wild boar and shells of crabs.

(i) Cottage industry may be established for making handles for cutlery, umbrellas, sticks and generally for fancy artistic ware from antlers.

(j) Shells of cowrie can be used for manufacture of lime.

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STUDIES ON THE GENUS *TETROCHETUS* LOOSS, 1912
(DIGENEA : HEMIUROIDEA : ACCACOELIIDAE)
OCCURRING IN INDIAN MARINE FISHES

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INTRODUCTION

Specimens of the genus *Tetrochetus* Looss, 1912 were collected from four species of fishes from the Bay of Bengal and the Arabian Sea. These fish hosts are : *Coryphaena hippurus* Linn., *Balistes capistratus* Shaw, *Exocoetus volitans* Lacepede and *Diodon hystrix* Linn. A careful study of these specimens reveals that the material from *Coryphaena hippurus* is *Tetrochetus coryphaenae* Yamaguti, 1934, that from *Balistes capistratus* and *Exocoetus volitans* is *T. aluterae* (Hanson, 1955) and that from *Diodon hystrix* is *T. macrorchis* Yamaguti, 1971.

The material has been processed according to the standard method. Diagrams have been drawn with the aid of a Camer lucida. Showing of all the details in them has been considered unnecessary as they are almost identical in each species in the genus under consideration. The more important purpose before the author is to expose those characters which may be helpful in separating them out. All measurements are in micrometers unless otherwise stated. The material is deposited with the National Collections of the Zoological Survey of India, Calcutta.

SYSTEMATIC ACCOUNT

Family : ACCACOELIIDAE ODHNER, 1911

Subfamily : ACCACOELIINAE Odhner, 1911

Genus *Tetrochetus* Looss, 1912

syn. *Paratetrochetus* Hanson, 1955

***Tetrochetus coryphaenae* Yamaguti, 1934**

(Fig. 1)

Host : *Coryphaena hippurus* Linn., Common dolphin-fish (Coryphaenidae).

Location : Intestine.

Locality : Tuticorin (Gulf of Mannar, Bay of Bengal).

Number of specimens : 57, on six slides ; collected on 16.11.75.

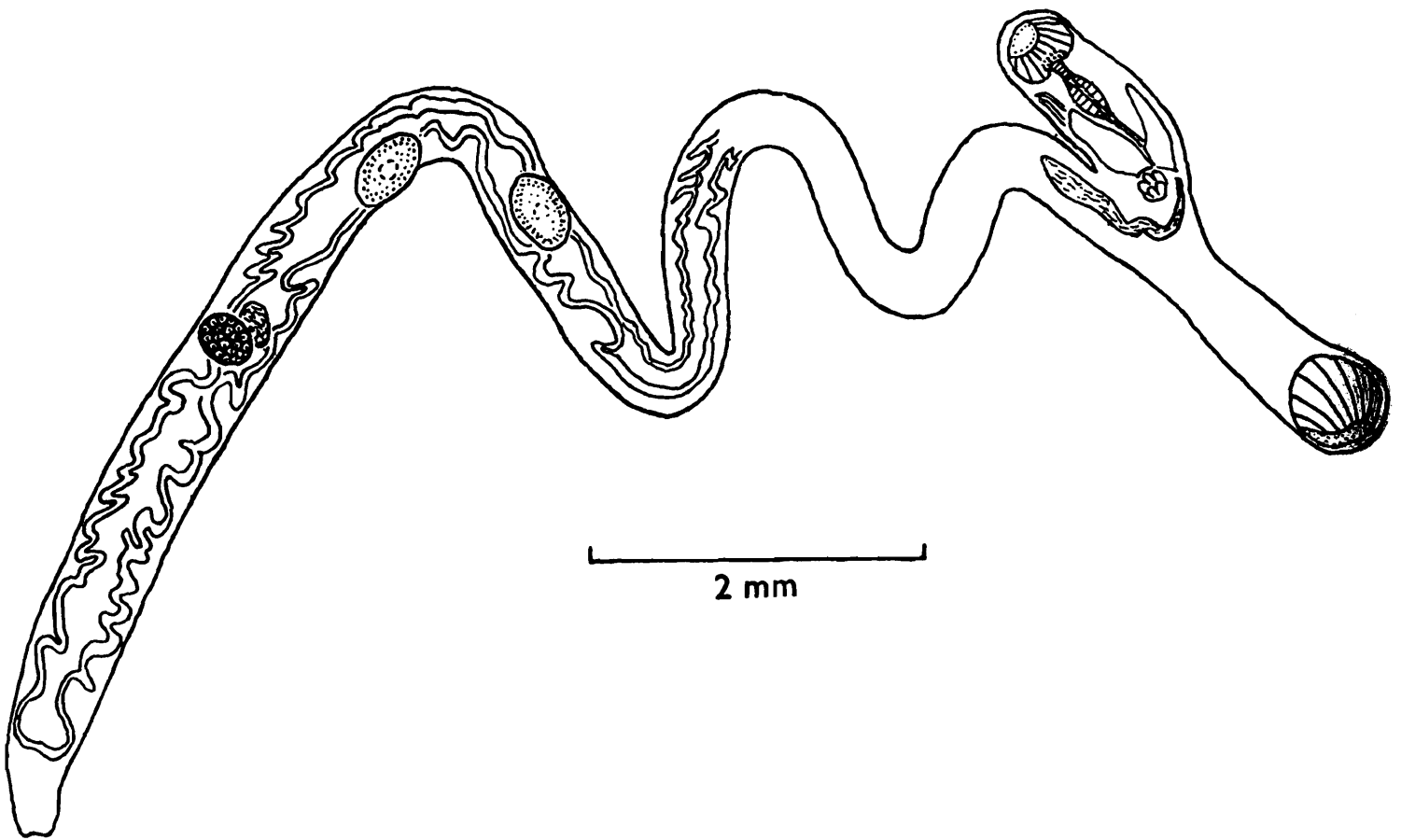


Fig. 1. *Tetrochetus coryphaenae* from *Coryphaena hippurus*.
Vitellarium not shown.

Specimens deposited : Z. S. I. Reg. Nos. W 7720/1 to W7725/1

This species is typically thin, slender, much elongated, with sides almost parallel and the size of the testes as compared to the body is small. The present material includes young adults to fully mature specimens of varying sizes. In some specimens the testes may form slight bulges in the wall. The specimens are more or less in agreement with the des-

criptions of Yamaguti (1934, 1970) and Gibson (1976). This is the most slender of all the known species of *Tetrochetus*. Tkachuk (1979) described *Tetrochetus lesnoyi* in fishes *Allocyttus verrucosus*, *Neocyttus rhomboidalis* and *Cyttosoma boops* (family Oreosomatidae) from Southeast Atlantic. He observed that, although it comes close to *T. coryphaenae* Yamaguti, 1934 in general morphology and anatomy, his species differs from Yamaguti's considerably in larger body ($6.786 - 16.2 \times 1.782 - 1.980$ mm), oral sucker ($0.702 - 0.900 \times 0.612 - 0.900$ mm), ventral sucker ($1.152 - 1.710 \times 0.810 - 1.296$ mm), testes ($0.594 - 0.900 \times 0.486 - 0.702$ mm and $0.612 - 0.756 \times 0.576 - 0.720$ mm), and much larger eggs ($0.056 - 0.064 \times 0.024 - 0.032$ mm). Keeping in view the accounts of *T. coryphaenae* by Yamaguti (1934, 1974) and Gibson (1976), and *T. lesnoyi* Tkachuk, 1979, the former is definitely slenderer with smaller eggs than the latter. Therefore, the present author concurs with Tkachuk (1979) that *T. lesnoyi* is distinguishable from *T. coryphaenae*.

***Tetrochetus aluterae* (Hanson, 1955) Yamaguti, 1958**
(Fig. 2)

Hosts and Localities : *Balistes capistratus* Shaw, Trigger fish (Balistidae) from Gopalpur and Paradip (Bay of Bengal) and Tuticorin (Gulf of Mannar, Bay of Bengal) ;
Exocoetus volitans Lacépède, Flying fish (Scomberesocidae) from Tuticorin (Gulf of Mannar, Bay of Bengal).

Location : Intestine.

Number of specimens : 10 from *B. capistratus*, on 10 slides, collected on 3.2.65, 18.5.72 and 29.5.72. 7 from *E. volitans*, on 3 slides, collected on 17.11.75.

Specimens deposited : Z. S. I. Reg. Nos. W7726/1 to W7738/1

These specimens are in various stages of maturity i.e. immature, young adults and fully mature. Of these, only three from *B. capistratus* and all from *E. volitans* are worth studying. They broadly conform to the description of *T. aluterae*, differing only slightly in various body measurements. This is medium-sized (max. length 3.64 mm), cylindrical to subcylindrical, attenuates from testicular region anteriorly, and definitely broader (max. width 0.76 mm) in

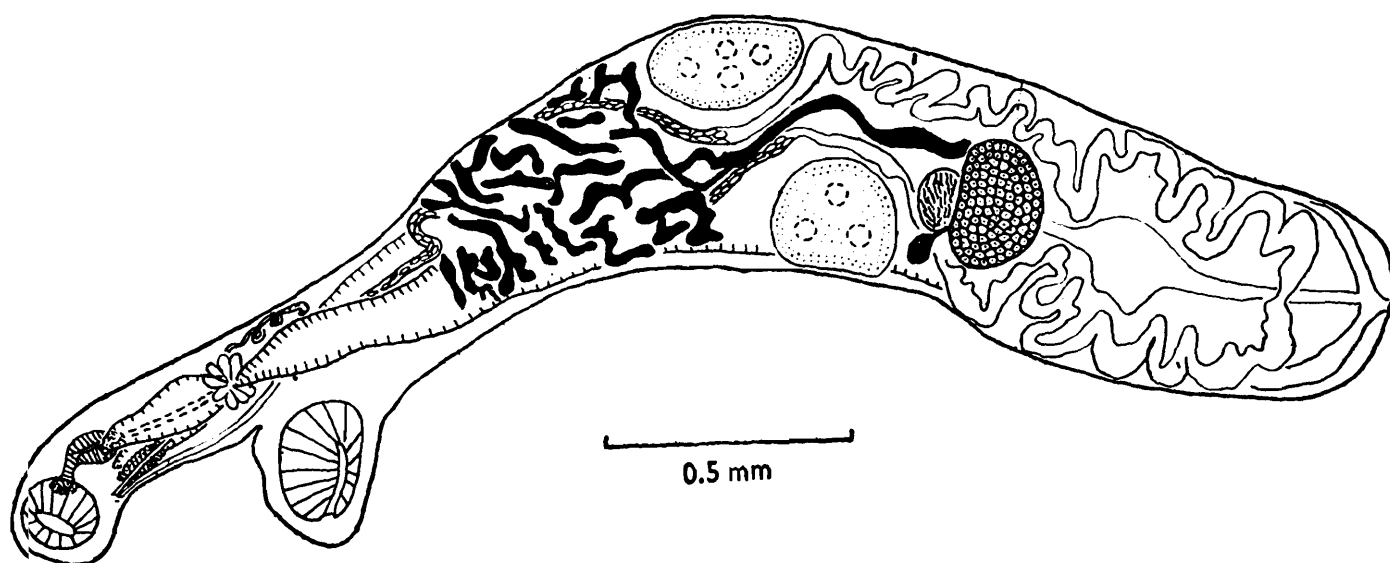


Fig. 2. *Tetrochetus aluterae* from *Balistis capistratus*.

comparison, to *T. coryphaenae*. In a somewhat contracted specimen the pregonadal attenuation is absent. Sucker length ration 1 : 1.29-1.48. Anterior testis 227-354 long, 140-291 in depth ; posterior testis 224-372 long, 140-300 in depth ; Ovary 105-242 long, 140-301 in width. Eggs $21-35 \times 14-16$.

Tetrochetus mitnevi Zubtschenko, 1978 in *Zeus faber* (Zeidae) and *Decapterus* sp. (Carangidae) from North Atlantic looks like that contracted specimen of *Tetrochetus aluterae* (Hanson, 1955) in the present material in which pregonadal attenuation of body has consequently disappeared although there is slight difference in the egg size (Holotype $0.030-0.034$ mm $\times$ $0.016-0.019$, Paratypes $0.020-0.035 \times 0.016-0.020$ mm in *T. mitnevi*). *Tetrochetus scomheresoxis* Nikolaeva, 1966, in *Scomberesox saurus* (Fam. Scomberesocidae) from the Mediterranean and other seas was not compared with *T. aluterae*

(Hanson, 1955). It is quite probable that on further investigations, these two species may not prove to be unidentical.

***Tetrochetus macrochis* Yamaguti, 1970.**

(Fig. 3)

Host : *Diodon hystrix* Linn., Porcupine puffer (Diodontidae).
Location : Intestine.
Locality : Trivandrum (Arabian Sea).
Number of specimens : 2, on one slide ; collected by Dr. T. D. Soota and party on 28.1.1976.

Specimens deposited : Z.S.I. Reg. No. W7739/1

Important measurements : Body 8.167-11.00 mm long, 1.677-1.980 mm wide. Acetabulum borne on a short peduncle, 605-688 long, 567-618 wide. Oral sucker 371-467 long,

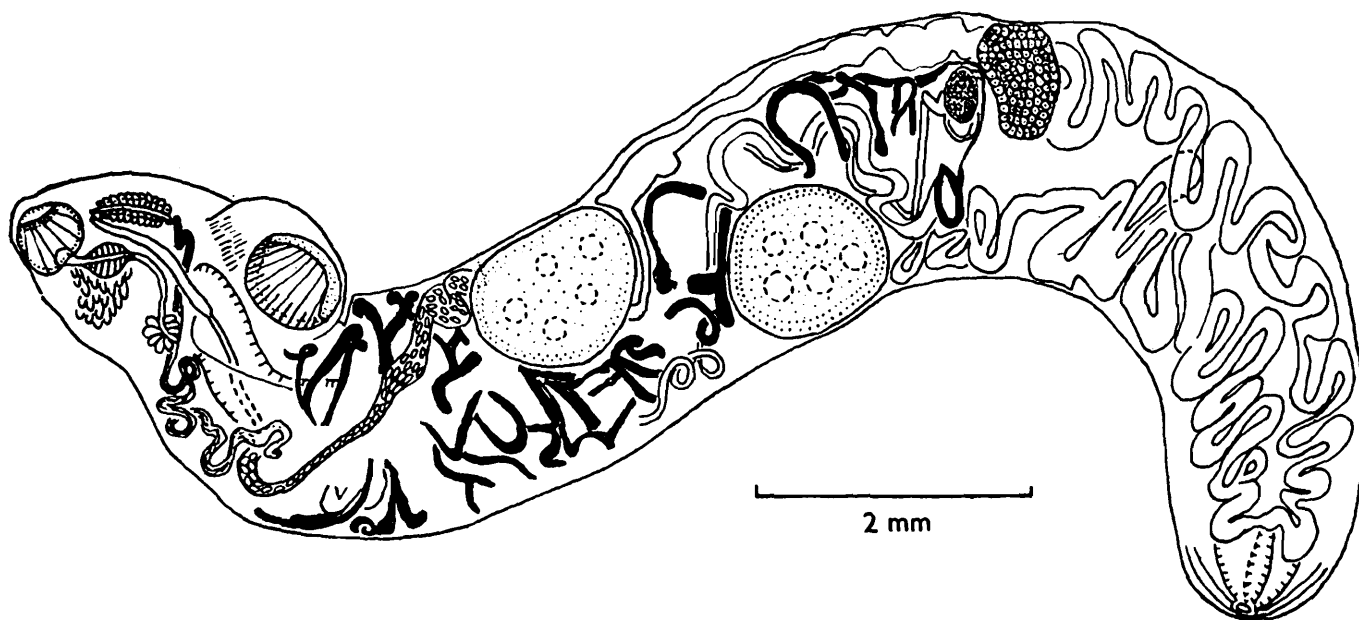


Fig. 3. *Tetrochetus macrochis* from *Diodon hystrix*.
First anterior limb of uterus not shown.

398-481 wide. Acetabulum distinctly larger than oral sucker. Prepharynx absent. Testes two, antero-dorsal and postero-ventral in position situated near body wall, diagonally disposed in middle region of hindbody, 825-1196 long, 618-948 wide. Ovary 495-756 long, 536-577 wide. Mehils'

gland anterior to ovary. Vitelline reservoir near ovary ; vitellarium tubular, branched, between ovary and base of acetabular peduncle. Proximal part of ascending uterus forms uterine seminal receptacle, it then descends to slightly short of posterior end of body, crosses transversely and then ascends again, distal part forming metraterm ventral to pars prostatica. Both the ducts open separately into small genital atrium. Eggs $21-31 \times 14-24$.

This species is robust, quite large and broadest of all the species described so far. The body is greatly elongated with almost parallel or subparallel sides. The testes are very large, sometimes forming slight bulges in the body wall. With these characters, this species can be distinguished from the previous two species in the collection.

It was originally described by Yamaguti (1970) from the Hawaiian fishes *Xanthichthys ringens* (type host), *Diodon* sp. (*hystrix*?) and *Sphaeroides cutaneous*. Radhakrishnan and Nair (1979) identified their specimens from *Diodon hystrix* from Trivandrum, Arabian Sea, as *Tetrochetus coryphaenae* Yamaguti 1934, but the measurements (particularly the large size of testes in relation to the body length and width) such as body length 6.1-7.2 mm, width 1.28-1.6 mm ; oral sucker $0.268 \times 0.32-0.352$ mm ; acetabulum 0.32-0.48 mm ; anterior testis $0.576-0.640 \times 0.480-0.496$ mm ; posterior testis $0.560 \times 0.627 \times 0.480-0.512$ mm ; ovary $0.352-0.4 \times 0.4.0.412$ mm ; eggs 0.028×0.02 mm ; given by them indicate their specimens could only be *T. macrorchis*.

Further, *T. macorchis* has great similarity to *T. hamadai* Fukui and Ogata, 1935 reported from the intestine of a different pufferish, *Sphaeroides spadiceus*, from Mamotori, Japan. It has body size 5.3-15.5 mm long, 1.2-3.21 mm wide, and the eggs are $21-27 \times 16-19$. It was twice further reported from Japan (Maisaka, Sizouka prefecture and Taizi, Wakayama Prefecture from the same species of host by Yamaguti 1938, 1951 respectively). The measurements of the specimens from Wakayama Prefecture are : body $5.3-10 \times 1.2-1.8$ mm ; oral sucker 0.3-0.52 mm long ; ventral sucker 0.95-1.1 mm

long, 0.8—1.0 mm deep ; testes 0.4—0.18 mm long, 0.6—0.88 mm deep ; eggs $24-27 \times 16-19$. Yamaguti (1970) distinguished *T. hamadai* from his own species, *T. macrochis*, both from different pufferfishes, in larger body and smaller eggs. To my mind, the two species further differ from one another in more characters. *T. hamadai* has much smaller ventral sucker than the oral sucker, testes are much smaller as compared to body length causing no bulges on the body wall, and the vitellarium extends posteriorly behind the ovary, whereas in *T. macrochis*, ventral sucker is not much larger than the oral sucker, the testes are much larger and may cause bulges on the body wall and the vitellarium does not extend posteriorly behind the ovary. It is likely that further information on *Tetrochetus* material from various pufferfishes (family Tetraodontidae) may prove *T. macrochis* to be identical with *T. hamadai*.

Tkachuk (1979) has compared his species, *T. lesnoyi*, with *T. hamadai* Fukui and Ogata, 1935 and found that the former is distinct from the latter on the basis of larger body, gonads and other structures including eggs. Moreover, *T. lesnoyi* has been reported from non-puffer fishes and *T. hamadai* has been reported from puffers.

Although, it is easier to distinguish between Indian species of *Tetrochetus* when their different populations are present before the investigator, but it may be rather difficult to identify *Tetrochetus* material when the investigator is confronted with a single population only. However, an attempt is made here to provide a key to separate the Indian species of *Tetrochetus* with the help of a combination of characters in fully mature specimens.

Key to species of *Tetrochetus* from Indian fishes.

1. Body narrow, slender, elongated ;
sides almost parallel ; testes small
as compared to body length and
width ; ventral sucker larger than
oral sucker ... *T. coryphaenae*

Body broader, not slender and narrow; testes medium-sized or large as compared to body length and width; ventral sucker tending to be equal to oral sucker of definitely larger than oral sucker ...

2

2. Body usually attenuated from pregonadal level to base of acetabular peduncle; testes medium-sized as compared to body length; ventral sucker almost equal to oral sucker ...

T. aluterae

Body robust, broader and usually large as compared to body length, sometimes pressing body wall so as to form bulges on surface; ventral sucker definitely larger than oral sucker ...

T. macrorchis

Thus, three distinct species of *Tetrochetus* occur in the fishes of the Bay of Bengal and the Arabian Sea.

Nahhas and Cable (1964) identified their specimens from *Diodon hystrix* as *Tetrochetus coryphaenae* from Jamaica, Caribbean Sea, but they neither furnished morphological and morphometric details nor provided an illustration of the specimens. They should be studied afresh in the light of Yamaguti's (1970) report on *Tetrochetus macrorchis* and the present communication.

DISCUSSION

Hanson (1955) proposed the genus *Paratetrochetus* to distinguish it from *Tetrochetus* in having a pharynx "with slender anterior extension projecting into lumen of conical elevation in base of oral cavity; small bulb-like muscular addition at posterior end of pharynx." Yamaguti (1958, 1871) and Bray and Gibson (1977) considered the former to be a synonym of the latter. Siddiqi and Cable (1960) held a similar view, and reported their specimens collected from Puerto Real, Mona Is. (Puerto Rico) from the fish hosts *Caryphaena hippurus* and *Acanthocybium solandri* as *T. aluterae* (Hanson, 1955). Accepting Hanson's genus as valid,

Purukhin (1964) described another species, *Paratetrochetus hansonii*, from the Gulf of Tonkin, North Viet-Nam. Skrjabin (1959) also accepted the validity of *Paratetrochetus*. He placed it nearer to *Rhynchopharynx* Odhner 1928 than to *Tetrochetus*, and categorised *Paratetrochetus* along with *Rhynchopharynx* under the subfamily Rhynchopharynginae Yamaguti, 1958, and preferred to keep *Tetrochetus* under a separate subfamily Tetrochetinae Looss, 1912 instead of keeping the latter genus in the subfamily Accacoeliinae Odhner, 1911 as did Yamaguti (1958, 1971). However, Yamaguti (1971) did not decide the fate of the subfamily Tetrochetinae Looss, 1912. Bray and Gibson (1971) considered all the existing accacoeliid genera under only one subfamily, Accacoeliinae (synonymising with it the subfamilies Tetrochetinae Looss, 1912, Accacladiinae Yamaguti, 1958, Orophocotylineae Yamaguti, 1958, Rhynchopharynginae Yamaguti, 1958, and Guschanskianinae Skrjabin, 1959), and erected a new genus *Paraccacladium* under a new Paraccaccladiinae. The new genus is based on the description of a new species *Paraccacladium jamiesoni*, the specimens of which were collected from the rectum of *Coryphaenoides rupestris* off the West coast of Great Britain. This system of classification of the family Accacoeliidae has been followed here. The synonymy of *Paratetrochetus* with *Tetrochetus* has been established beyond doubt as the anterior prolongation of the pharynx into the base of the oral sucker is a feature of all accacoeliids, and thus there is no prepharynx in the genus just as in other hemuroid genera.

Ten species have so far been described under the genus *Tetrochetus* Looss, 1912 :

- T. raynerii* (Nardo, 1833) Looss, 1912, emend. Bray and Gibson, 1977 ; the type species,
- T. hamadai* Fukui and Ogata, 1935,
- T. coryphaenae* Yamaguti, 1934,
- T. proctocolus* Manter, 1940,
- T. aluterae* (Hanson, 1955) Yamaguti, 1958 ; (Syn. : *Paratetrochetus aluterae* Hanson),

T. hansonii (Parukhin, 1964), (Syn. : *Partetrochetus hansonii* Parukhin),
T. scomberesoxis Nicolaeva, 1966,
T. macrororchis Yamaguti, 1970,
T. mitnevi Zubtschenko, 1978, and
T. lesnoyi Tkachuk, 1979.

Of these, *T. raynerii*, and *T. hansonii* have oral sucker distinctly larger than the acetabulum. They are excluded from consideration here. *T. hamadai*, *T. coryphaenae*, *T. proctocelus*, *T. scomberesoxis*, *T. macrororchis*, *T. mitnevi* and *T. lesnoyi* have oral sucker distinctly smaller than the acetabulum. In *T. aluterae* the suckers are almost equal with a tendency towards a slightly larger acetabulum. Bray and Gibson (1977) emended the species name *T. raynarianum*. While describing *T. macrororchis*, Yamaguti (1970 ; p. 91) stated "Pars prostatica narrow, sigmoid, uniting with the uterus just before opening at level of posterior end of oral sucker". It means that at least a very short hermaphroditic duct is formed. Contrary to this, Bray and Gidson (1977 : 86), while giving the salient features of *Tetrochetus* state, "Male and female ducts open together into shallow genital atrium", i.e. without uniting with each other. Further, while redescribing *T. raynerii* (Nardo, 1933), the type species, from the original material, they state "There is no sign of sinus organ, sinus sac or hermaphroditic duct", and the metraterm runs straight ventral to the pars prostatica, the two ducts open together but separately into the base of the shallow genital atrium. The present studies also show no evidence or trace of the male and female ducts uniting together before entering the genital atrium.

Skrjabin (1959) gave a key to the species of the genus *Tetrochetus* separating *T. coryphaenae* and *T. proctocelus* on the basis of the measurements of the suckers and body. Yamaguti (1970) also gave a key to the species of *Tetrochetus* from Hawaiian fishes separating *T. coryphaenae*, *T. aluterae* and *T. macrororchis*. The author used the characters such as the sizes of the suckers, shapes and sizes of body and sizes

of testes in relation to the lengths and widths of body. Siddiqi and Cable (1960) identified their specimens from the fish host *Coryphaena hippurus* and *Acanthocybium solandri* as *T. aluterae* except for a slight difference in egg size. The present study of the specimens of *Tetrochetus* from four different host fishes also reveals that species in the genus can be distinguished only on the basis of the nature and size of the body, size of the testes with respect to the body, and size of the suckers.

SUMMARY

Specimens of worms belonging to the genus *Tetrochetus* Looss, 1912 were collected from the marine fishes *Coryphaena hippurus*, *Balistes capistratus*, *Exocoetus volitans* (Bay of Bengal) and *Diodon hystrix* (Arabian Sea). They have been identified as *T. coryphaenae* Yamaguti, 1934 (from *Coryphaena hippurus*), *T. aluterae* (Hanson, 1955) Yamaguti, 1958 (from *Balistes capistratus* and *Exocoetus volitans*) and *T. macrorchis* Yamaguti, 1971 (from *Diodon hystrix*). Thus, three species of *Tetrochetus* belonging to the family Accacoeliidae Looss, 1912 are reported to occur so far in the marine fishes of the Bay of Bengal and the Arabian Sea. Although it is difficult to distinguish the species of the genus *Tetrochetus* thus far known, some combinations of characters are given with the help of which, at least, the present three species can be separated. Even by seeing the mounted specimens with the naked eye, these three species can be separated.

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ADDITION OF THE FAWN-COLOURED MOUSE,
MUS CERVICOLOR HODGSON, 1845 [RODENTIA :
MURIDAE] TO THE FAUNA OF SUNDERBANS IN
WEST BENGAL, INDIA

While examining a small collection of rodents obtained by Dr. A. K. Mondal, Superintending Zoologist, Zoological Survey of India, from Hemnagar in South Sunderbans, 24-Parganas District, West Bengal, three adult and seven juvenile grey-bellied mice with bicoloured tail were found. On closer examination they were found to be examples of the Fawn-coloured Mouse, *Mus cervicolor* Hodgson.

The southern half of 24-Parganas District of West Bengal is occupied by an 'active delta' system of saline soils, crisscrossed by enumerable tidal rivers, canals, and creeks at the mouth of the Ganga, forming a wilderness of swamps, morasses and forests, the Sunderbans. Its boundry is demarcated by the Raimangal and Hooghly rivers in the east and west respectively and the Bay of Bengal in the south. The northern limit of Sunderbans cannot be clearly defined due to progressive reclamation of the land over the last 150 years. The area lies approximately between 21°0'-21°21' N and 88°0'-89°0' E. It is a region of grassy savannahs and muddy islets covered with mangroves and dense evergreen forests. Its environmental condition is quite separate from the other parts of our country. To protect the biota of this region the Government of India recently has declared it as a National Park. Any addition to the fauna of this region is, therefore, require special mention.

According to authoritative literature this species occurs within the Indian limits in southern India, Maharashtra, Gujarat, Rajasthan, Madhya Pradesh, Meghalaya, Nagaland, Arunachal Pradesh (Ellerman, 1961 ; Ellerman and Morrison-

Scott, 1966), Assam (Blanford, 1891 ; Ellerman, 1961 ; Ellerman and Morrison-Scott, 1966 ; Marshall, 1977), Manipur (Ellerman, 1961 ; Marshall, 1977), and Jammu and Kashmir (Chakraborty, 1983). Outside Indian limits, it occurs in Pakistan (Taber *et al.*, 1967), Sri Lanka (Ellerman, 1961 ; Ellerman and Morrison-Scott, 1966), Nepal (Hodgson, 1845 ; Blanford, 1891 ; Ellerman, 1961 ; Ellerman and Morrison-Scott, 1966 ; Marshall, 1977), Burma, Thailand, Laos, Vietnam (Ellerman, 1961 ; Ellerman and Morrison-Scott, 1966 ; Marshall, 1977), Sumatra and Java in Indonesia (Marshall, 1977), and Ryukyu Islands in Japan (Ellerman, 1961 ; Ellerman and Morrison-Scott, 1966). The only report of this mouse West Bengal is at Singur in Hugly District (Mandal, 1976). However, it has not yet been reported from the Sunderbans in West Bengal. Hence the present material constitutes the first authentic record of its occurrence in the Sunderbans of West Bengal, India.

The details of the adult specimens are given below. The measurements were taken in the field by the collector. All measurements are taken after Ellerman (1961) and given in millimetres.

Material : 1 ♂, 2 ♀ ; Z.S.I. Registration Numbers 21258, 21259, 21260 ; in alcohol ; Hemnagar, South Sunderbans, 24-Parganas, West Bengal ; 28 December 1967 ; A. K. Mondal collector ; deposited in the National Zoological Collection of India, housed at the Zoological Survey of India, Calcutta.

Measurements :

External : Head and body 88, 82, 78 ; tail 79, 70, 59 ; hindfoot 17, 15, 16 ; ear 11, 11, 11.

Cranial : Occipitonasal 22.9, 21.8, 21.0 ; condylobasal 22.5, 21.3, 20.5 ; nasal 8.4, 8.2, 7.8 ; palate 12.1, 11.7, 11.4 ; bulla 3.2, 3.1, 3.0 ; molar tooth row 3.4, 3.3, 3.3 ; anterior palatal foramen 4.8, 4.7, 4.5 ; diastema 7.2, 6.6, 6.1.

The specimens were collected by the collector from fields.

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REVIEW

Butterflies of the Himalaya by Prof. M. S. Mani, (Oxford & IBH Publ. Co.), New Delhi, X+181 pp., 34 figs., 25 pls. b. & w., Col. Rs. 240.00.

This handy volume on Butterflies of the Himalaya is yet another in the series of High altitude Entomological and Ecological publications from the pen of Prof. Mani, an authority on High Altitude insect life.

The volume is divided into X chapters. General information on the characters of taxonomic importance, classification, the seasonal dimorphism and colour variation, succession, Ecotypes, migration, hostplant associations coupled with a brief description of the panorama of the Himalaya makes an interesting and useful reading to both the specialist and generalist. The genera and species have been discussed under their respective natural families. Keys to families, subfamilies, (and in some cases genera), and the species have been provided in a most comprehensive way. Even in those cases where generic keys were not given the author has provided a brief general description. The distribution maps are undoubtedly useful.

The biogeography of the extant Himalayan butterflies has been discussed specially in the light of the evolution of the Himalayan mountain system in the past. The discussion on the centres of evolution of the various genera and species may provide comparative guide line for the other Lepidopterists to checkup their observations on the origin, dispersal and evolution of their respective groups of Lepidoptera. The larval colour variations though not discussed except in a passing way, may form an interesting subject of study in relation to the altitude and host association-wise. Perhaps in some of the groups like Lycaenidae, one may find more species complexes than have been hitherto recorded and provide an interesting material for taxonomic study.

The volume is provided with 94 useful references. A good index to genera and species discussed is also provided in the end. The printing and get up are good except for few typographical errors.

Naturally one would expect a lot more colour in a book on butterflies, but then it would also push up the production cost of this already high priced volume.

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