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**ANIMAL REMAINS & BONE TOOLS FROM PANDU RAJAR DHIBI,
A PROTOHISTORIC SITE IN BURDWAN, WEST BENGAL.**

MANOMAY GHOSH and UTPAL SAHA

Zoological Survey of India, Calcutta - 700 053.

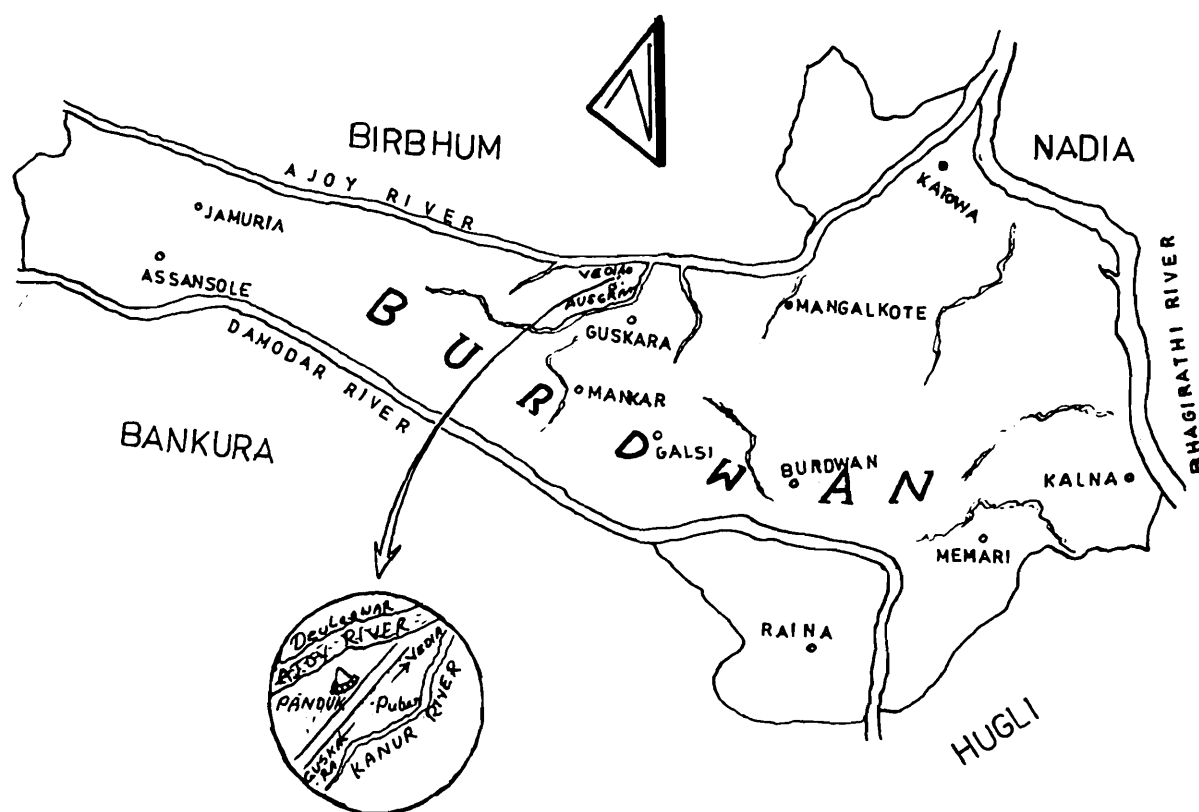
INTRODUCTION

We had the occasion to study the animal remains and bone tools unearthed in 1985, from Pandu Rajar Dhibi, the type site of Ajoy Valley Civilization in Burdwan. The site (see map) is situated about 10 km away from Bhedia on way to Bolepur from Calcutta. The place was originally known as 'Raja pontar danga' which meant the burial ground of the king. It was designated as Pandu Rajar Dhibi (the mound of King Pandu), by Late P. C. Dasgupta, ex-Director of State Archaeology Department, West Bengal in 1962. The colloquial Bengali terms 'danga' or 'dhibi' denote a mound or elevated land. The local people were accustomed to see this ancient mound from time immemorial. Late Dasgupta was the pioneer to explore and excavate the site about two decades ago. The excavation unveiled that a Protohistoric culture flourished in and around the Ajoy Valley several thousand years ago. The inhabitants of this site were Proto-Australoid or Veddaic race. They were characteristically long headed, broad-nosed and dark skinned race. Though this primitive society stuck to hunting, yet their economic life was based upon agriculture. It was learnt that cultivation of paddy was known to them.

The earlier excavations unearthed varied stone implements (microliths), potteries, copper implements and human burials. Analysis of all these relics revealed that from old stone age a protohistoric culture sprang up and flourished in and around the confluence of river Ajoy and its tributaries Kunoor and Kopai. This culture later on merged with the chalcolithic development dated 1012 ± 120 B.C., and achieved maritime contact with the Red Sea Coasts and Aegian World (Dasgupta 1965).

In a recent excavation in 1985, conducted by Shri Sudhin Dey, Superintendent under the direction of Dr. S. C. Mukherjee, Director of the State Archaeology Department, the present materials along with other important antiquities were collected. Comparatively, the bone tools and animal remains obtained earlier, were scanty, yet mention may be made to those of the arrow heads and awls and the remains tentatively identified as of Nilgai, Sambar, Pig and Cattle. Besides these, one copper fish hook, fish and Pea fowl figurines were discovered. In spite of the fragmentary nature of some samples, the present collection is quite rich and promising. The material belongs to two categories. The first or primary type are purely bony or skeletal remains derived from slaughtered food animals viz., Fish, turtle, fowl, pig, deer, goat etc. The second type are the fashioned out implements, comprising bone tools viz., points, scrapers, arrowheads etc.

Analysis of this Archaeo-zoological material reflects the food habit, level of industry achieved by those Protohistoric people and finally it throws light on the then environment and associated animal life.



Not to the scale

Map showing the location of Pandu Rajar Dhibi

I. THE SYSTEMATIC ACCOUNT OF THE REMAINS IDENTIFIED :

Phylum ARTHROPODA
Class CRUSTACEA
Order DACAPODA
Family PATAMONIDAE

The Freshwater Crab

30.3.85; PRDB; trench No. 'B'; layer (1,2) - calcified tibia.

Phylum CHORDATA
Class PISCES
Order CYPRINIFORMES
Family CYPRINIDAE

Catla catla (Hamilton)

10.3.85; PRDB; trench No. 'B'; layer (6); depth 1.09 meter - Opercular bone.

Undetermined carps

10.3.85; PRDB; trench No. 'B'; layer (7); depth 1.10 meter - A rib with broken distal end; 17.3.85; PRDB; trench No. 'B'; layer (7); depth 1.38 meter - Broken ribs; 21.3.85; PRDB; trench No. 'A'; layer (6) - Fish rib; 24.3.85; PRDB; trench No. 'B'; layer (7); locus B III + 0.57 X 1.37 - 1.95 meter - Broken ribs; 27.3.85; PRDB; trench No. 'A'; Ash pit; depth 1.60 - Pectoral bone & ribs of large carps; 27.3.85; PRDB; trench No. 'A'; Ash pits (4) depth 2.22 meter; - girdle bones and ribs; 28.3.85; PRDB; trench No. 'B'; layer (6); locus B III + 0.30 X 2.70 - 1.22 meter - Ribs.

Order SILUROIDEA
Family BAGRIDAE

24.3.85; PRDB; trench No. 'A'; layer (5); locus A II + 0.44 X 2.55 - 1.13; depth 1.13 - Proatlas of *Rita* sp. 28.3.85; PRDB; trench No. 'B'; layer (5); depth 1.25 meter - Condylar portion of the right pectoral spine of *Mystus* sp.

Class REPTILIA
Order TESTUDINES
Family TRIONYCHIDAE

***Lissemys punctata punctata* (Bonnaterre)**

8.3.85; PRDB; trench No. 'B'; layer (6); locus BI + 0.25 X 1.92 - 1.31; depth 1.31 meter - piece of plastron; 8.3.85; PRDB; trench No. 'B'; layer (6); locus B II + 0.41 X 1.03 - 0.82; depth 0.82 - Piece of plastron; 21.3.85; PRDB; trench No. 'B'; layer (10); depth 1.90 meter - Piece of plastron, likely used as a sharp tool; 27.3.85; PRDB; trench No. 'A'; Ash pit; 1.60 meter - piece of carapace.

Order CROCODILIA
Family GAVIALIDAE

***Gavialis gangeticus* (Gmelin)**

PRDB; trench No. 'B'; layer (1) - Dorsal scute.

Class AVES
Order GALLIFORMES
Family PHASIANIDAE

***Gallus gallus murghi* Robinson & Kloss**

5.3.85; PRDB; trench No. 'A'; layer Ash pit; depth 1.07 meter - Distal condylar bone (with cut marks) of left tibia; 19.3.85; PRDB; trench No. 'A'; layer (8); depth 1.90 meter - Charred and broken oblique process of sternal bone; 21.3.85; PRDB; trench No. 'A'; layer

(6) - Broken coronoid bone; 27.3.85; PRDB; trench No. 'A'; layer (10) - Broken shaft bone; 29.3.85; PRDB; trench No. 'B'; layer (7) - Broken right scapula.

Class MAMMALIA
Order CARNIVORA
Family CANIDAE

Canis aurius indicus (Hodgson)

9.2.85; PRDB; trench No. 'A'; locus AI + 0.45 X 3.90 - 0.48 layer (3) - 5th metatarsal of left pes; 17.3.85; PRDB; trench No. 'A'; Locus III + 0.25 X 0.60 X - 1.50; layer (8); depth 1.50 meter - Upper left canine; 27.3.85; PRDB; trench No. 'A'; Ash pit; depth 1.60 meter - Occipital portion of skull with condyles.

Order ARTIODACTYLA
Family SUIDAE

Sus scrofa cristatus Wagner

13.2.85; PRDB; trench No. 'B' layer (3) - Piece of mandibular bone of left side with 3rd premolar; 20.2.85; PRDB; trench No. 'B'; layer (2A); Burning place -; 0.20 cm - Damaged body of mandible with broken incisors; 12.3.85; PRDB; trench No. 'B'; layer (7) - Broken zygomatic arch of right side; 16.3.85; PRDB; trench No. 'A'; locus A O + .47 X 2.54 - 1.29; layer (7) - Broken piece of maxilla of right side with 3rd & 4th premolars; 23.3.85; PRDB; trench No. 'B'; layer (10); depth 2.40 meter - Broken piece of zygomatic bone; 27.3.85; trench No. 'A'; layer (10) - Upper right 1st molar; 27.3.85; PRDB; trench No. 'B'; layer (10); depth 2.15 meter - Fragment of frontal bone with supra orbital foramen; 28.3.85; PRDB; trench No. 'B'; locus B III + .30 X 2.70 - 1.22 meter; layer (6) - Broken lower 3rd premolar; 4.4.85; PRDB; trench No. 'C'; locus C + D - M X 1.40 X 2.55 meter; layer (9); depth 2.55 meter - 4th metatarsal of left pes.

Family CERVIDAE

Axis porcinus Zimmermann

12.3.85; PRDB; trench No. 'B'; layer (7); depth 1.23 meter - Disc of thoracic vertebra; 12.3.85; PRDB; trench No. 'B'; layer (8) - Glenoid portion of scapula (charred); 19.3.85; PRDB; trench No. 'B'; layer (8) - Glenoid portion of scapula of right side; 8.4.85; PRDB; trench No. 'A'; locus 4.12 mt; layer after (11); mother soil; Ash pit - Two fragments of rib; 9.4.85; PRDB; trench No. 'C'; layer - 1 pit; depth 2.97 meter - 2nd upper right molar with a portion of maxilla.

Cervus duvauceli Cuvier

3.3.85; PRDB; trench No. 'A'; locus I + 0.40 X 0.38 - 0.41; - Distal fragment of right tibia; 17.3.85; PRDB; trench No. 'A'; locus III + 0.25 X 0.60 - 1.50; layer (8) - Charred piece of the ramus of mandible; 31.3.85; PRDB; trench No. 'A'; Ash pit material - Charred rib.

Family BOVIDAE

Bubalus bubalis (Linnaeus)

5.3.85; PRDB; trench No. 'B'; layer (5); - Damaged upper 3rd molar; 10.3.85; PRDB; trench No. 'B'; layer (6); - Fragment of a rib; 17.3.85; PRDB; trench No. 'B'; layer (8); depth 1.27 meter - Piece of a thoracic rib, 19.3.85; PRDB; trench No. 'A'; locus A III + 0.00 X 2.20 - 1.40; layer (6); Broken scapula; 24.3.85; PRDB; trench No. 'B'; locus IV + 0.43 X 1.33 - 1.65 mt; layer (7); depth 1.65 meter - Upper 1st molar; 4.4.85; PRDB; trench No. 'C'; locus C 0 + DM X 1.40 mt X 2.55 mt; layer (9); depth 2.55 meter - Bone point, polished, made out of the horncore.

Bos indicus Linnaeus

5.3.85; PRDB; trench No. 'A'; locus I + 0.45 X 0.65 X - 1.15; layer (5); depth 1.15 meter - Broken 3rd thoracic rib; 6.3.85; PRDB; trench No. 'B'; locus III X 1.30 - 0.68; layer (6); depth 0.68 meter - Broken thoracic rib; 8.3.85; PRDB; trench No. 'B'; locus BI + 0.25 X 1.92 - 1.31; layer (6); depth 1.31 meter - Upper left 2nd molar; 9.3.85; PRDB; trench No. 'B'; Peg IV 0.78 X 1.47 X 1.02; layer (6); - Upper left 3rd molar; 9.3.85; PRDB; trench No. 'B'; layer (6); 1 meter from surface - Proximal fragment of thoracic rib; 18.3.85; PRDB; trench No. 'A'; locus A III + 0.88 X 1.19 0 - 1.10; layer (8); depth 1.10 meter - Right upper 3rd molar; 21.3.85; PRDB; trench No. 'C'; locus I + 0.28 X 1.53 X 0.50; layer (3) - Shaft bone of left metatarsal; 22.3.85; PRDB; trench 'A'; locus A II + 0.63 X 1.66 - 1.70 mt; layer (9); - Upper right 2nd molar of sub-adult beast; 23.3.85; PRDB; trench No. 'B'; layer (10); depth II; 2.00 mt - Broken piece of lower 3rd molar; 31.3.85; PRDB; trench No. 'A'; Ash pit - Condylar fragment of left humerus; 31.3.85; PRDB; trench No. 'B'; layer (14); depth 3.25 mt - Distal end of metatarsal.

Capra hircus aegagrus Erxleben

1.4.85; PRDB; trench No. 'B'; layer (14); - Broken olecranon process of right ulna; 1.4.85; PRDB; trench No. 'C'; layer (8); - Broken shaft of right humerus.

Order RODENTIA

Family MURIDAE

Rattus sp.

10.3.85; PRDB; trench No. 'A'; depth Peg II - 0.65 mt - Lower incisor.

II. FOLLOWING BONE TOOLS HAVE BEEN IDENTIFIED FROM THE SITE :

21.3.85; PRDB; trench No. 'A'; I - 1.06; layer (6); depth 1.06; - Scraper and point made

from shaft bone; 18.3.85; PRDB; trench No. 'A'; locus A III + 0.43 X 1.73; layer (8); depth - 1.73 mt - Bone point for incision on pottery; 14.2.85; trench No. 'B'; layer (1); depth B - 0.03; - Bone point made from the tine of antler of Hog Deer; 28.3.85; PRDB; trench No. 'A'; layer (8); depth 1.80 mt - Bone points, probably made from shaft end of cattle tibia; 29.3.85; PRDB; trench No. 'A'; depth 2.12 mt - Bone point; 15.3.85; PRDB; trench No. 'B'; locus 0 + .50 X 1.34 - 1.06 mt - Polished fine point, made from the antler of Hog Deer; 1.4.85; PRDB; trench No. 'C'; layer (8); - Bone spear head (tanged); 27.3.85; PRDB; trench No. 'A'; A III + 0.74 X 1.39 - 1.45; layer (7); depth 1.45 mt - Bone point; 16.2.85; PRDB; trench No. 'A'; locus I - 1.64 - 0.72; layer (3a) - Bone point, made from the phalanx of jackal; 27.3.85; PRDB; trench No. 'B'; locus III + 0.13 X 0.35 - 1.90; layer (9) - polished bone point, hacked from bovine fibula; 5.3.85; PRDB; trench No. 'B'; locus II - 0.85; layer (4); depth 0.85 meter - Polished bone (burnt), used for etching purpose; 12.3.85; PRDB; trench No. 'A'; locus A III X 1.14 - 1.08; layer (5) - Bone implement, bead hacked from phalangeal bone with perforation; 12.3.85; PRDB; trench No. 'A'; layer (4); depth 0.95 cm - Piece of rib bone, used as a cutter; 14.3.85; PRDB; trench No. 'A'; layer (6) - fragment of scapula, used as a scraper; 17.3.85; PRDB; locus A III + 0.55 X 1.65 - 1.65 mt; layer (8) - Scraper hacked from a compact bone; 17.3.85; PRDB; trench No. 'B'; layer (7); depth 1.15 mt. - Bone tool for digging purpose - two pieces of compact bone, derived from the femoral bone of cattle; 20.3.85; PRDB; trench No. 'B'; locus B II + 0.00 X 0.00 - 1.60; layer (8); depth 1.60 metre - Bone scraper from parietal bone of cattle; 22.3.85; PRDB; trench No. 'A'; locus A I + 00 + 1.79 - 1.80; layer (8); depth 1.80 mt. - Spear head, hacked from femoral shaft; 25.3.85; PRDB; trench No. 'B'; peg IV, 0.72 X 1.42 - 1.77 mt; layer (8); depth 1.77 metre Double sided blade or scraper; 25.3.85; PRDB; trench No. 'B'; peg IV, 0.72 X 1.42 - 1.72 mt; layer (8); depth 1.77 mt; - Barbed harpoon, hacked from the lower jaw of buffalo; 27.3.85; PRDB; trench No. 'B'; locus III - 0 + 0.98 - 2.09 mt; layer (10); depth 2.09 mt. - Bone bead made from small mammalian vertebra.

Besides the above mentioned animal remains and bone tools, following inorganic objects have been identified. 13.3.85; PRDB; trench No. 'B'; layer (3); - a fragment of black unpolished ware; 6.3.85; PRDB; trench No. 'A'; locus A II + 0.39 X 1.40 - 1.00; layer (6); depth 1.00; - A piece of bluish black polished flint; 27.3.85; PRDB; trench No. 'B'; peg III 0 + 0.98 - 2.09 mt; layer (10); depth 2.09 mt. - 'Pea Iron Ore' - It generally forms in low lying and marshy area, enveloping some organic substance.

DISCUSSION

The study of the bone tools and animal remains unveils that the area was once much fertile and teeming with vegetation. The rivers were affluent and the soil had the capacity to retain the moisture to a greater degree. The area around the rivers was immensely rich in wild animals and birds. The bone remains from ashpit and hearths testify that animals like Barasingha, Hog deer, pig and Jungle fowls in nearby jungles provided the inhabitants with rich animal protein. The overall analysis of the collection throws some light on the following aspects of past life :

Food habit and use of fire : The ancient veddaic inhabitants were not pure vegetarians.

That they had a special addiction to animal diet is evident from the huge fish remains in association with the remains of turtle and fowl, which plentifully occurred from the ashpit and hearths. Besides these, a number of skeleton of slaughtered Hog deer and Barasingha also have been found. This testifies that the people in general, or specially the legendary royal family of 'Pandu Raja', specially prized the delicacy of venison for which they used to hunt the animals regularly from nearby jungles.

Among the domesticated animals, pigs, goats, humped cattle and buffalo are noteworthy. It is assumed that these animals might have contributed to their diet, as many of their remains bear cut marks and show charred condition. Some of the bones show signs of maceration and breakage along the shaft bones. The latter probably resulted from the extraction of marrow. The charred condition of the bones, occurrence of flint and the presence of hearths or ashpit indicate the use of fire as well as the system of broiling of flesh. The flint is a compact crypto crystalline silica, used by prehistoric men for the production of fire and fabrication of weapons. It is noteworthy that in more advance stage, the flints were shaped perfectly from a pressure exerted by an antler bone, and here we encounter that sample too.

Some of the economically important animal fauna :

Fish : Fishes which occur in the collection were all edible and mainly large size carps (Cyprinidae). From early time the prehistoric men adopted the practice of fishing. Even the Neanderthal men about 1,50,000 years ago used to spear the fish for a substantial diet (Demdeek, 1966). Fishes are easier to capture and broil than other animals and is the reason why early settlers used to select their dwelling site near the rivers abounding with fish. The remains of the carps in question are mostly ribs. It is noteworthy that carps were the most ancient and popular edible fish in India and China. Fattened carps were considered in post Aryan culture as a symbol of fertility and good omen. Remains of edible fishes were recovered also from Harappa, Mohenjodaro, Hastinapur and a few other sites. The remains from those sites were mainly vertebrae.

Turtle : The specimens of the Indian Flap Shelled Turtle, identified in the collection are mainly represented as plastron and carapace. The species was distributed widely in the Ganges, Indus and their tributaries. At present it is becoming rare. The flesh is edible and people in the country used to capture this animal from very ancient time along with other aquatic animals. Remains of this species were also recorded from Mohenjodaro, Harappa, Nagda, Hastinapur and Jaugada (Nath, 1961).

Fowl : The jungle fowls are supposed to be the ancestor of the native old fashioned multicoloured cock of India which differs of course by a more slender body (Zeuner, 1963). The bird abounds the woods of northern India. Remains of fowl (*Gallus* sp.) were also unearthed from Harappa, Rupar, Lothal, Brahmagiri and Jaugada. The remains of fowl from Harappa are supposed to be of domesticated stock. Fowl as a table bird, became popular in the north western India prior to 500 B.C. It reached Mesopotamia (Iraq and Iran) and Egypt from India as early as 1500 B.C.

Humped cattle : The humped cattle which is considered by the Hindus as a sacred animal is basically a beast of milch cum 'burden'. Rutimeyer (1862) considered the animal as the sole type of domestic cattle of Asia and Africa since unknown past. Remains of humped cattle were also unearthed from many ancient sites like Harappa, Mahenjodaro, Maski, Rupar, Rangpur and many other sites. From the measurement, the sample from Pandu Rajar Dhibi are assumed to be of adult animals with medium stature (runt).

Buffalo : The buffaloes have been used in the plains of eastern India from a pretty long time in threshing corn, for milk and as draught animals. These animals were definitely domesticated in India from the endemic wild species during early Agricultural Phase. The wild progenitors are still extant in the hot and humid forest in India. Remains of domesticated buffaloes have been recovered from Harappa, Mohenjodaro, Hastinapur, Maski, Rangpur, Rupar and Taxilla.

Goat : It appears that the present day breeds of goat in India are derived from an admixture of three different progenitors, viz., The Markhor, the Bezoar and the Joura. Among these, it is assumed that the main stock descended from the bezoar, which inhabited the Sind, Punjab, Persia, Asia Minor and Greek Islands at large. The remains from Pandu Rajar Dhibi on comparative study, appears to be of adult beast but with stunted growth. Remains of domestic goats were also recovered from Harappa, Rupar, Rangpur, Nevasa, Maski, Nagda and Jaugada.

Pig : The remains of pig in the collection belong to sub-adult and young specimens. Probably these animals were selected from the captive stock for consumption. The domesticated pig in India is derived from its wild ancestor *Sus scrofa cristatus*, which inhabit the riverine forests and grass jungles in India. Remains of domestic pig were also recorded from Mahenjodaro, Harappa, Rupar, Lothal, Nasik, Nagda, Ujjain and Jaugada.

Hog deer : Remains of hog deer is being reported for the second time from a prehistoric site in India. So long, it was in the record only from Mohenjodaro. Of course other deer species, namely Chital, Swamp deer, Sambar and Hangul were reported to occur from a number of old sites. The remains of Hog deer in the present collection were compared with the modern specimen and were found resembling in size and shape. It is to be mentioned that most of the fine bone points in the collection were hacked out from antlers of this deer. This species of deer occurs in Sind, Punjab, Kumaon, Nepal, West Bengal, Bangladesh and Assam. Outside India it is also found in Burma, Sri Lanka and Malayan Peninsula.

Animal keeping : Among the animal remains, it is already mentioned that domesticated pig, goat, cattle and buffalo have been identified. Pigs and buffaloes are animals which prefer to live in damp ground with ample water reserver, whereas the goats and cattle prefer comparatively high and dry zones. Besides this, their food habit also differs. Therefore to raise these animals simultaneously, requires adequate knowledge in animal husbandry and it is assumed that the people had already achieved that much knowledge in animal domestication. The cattle and buffalo are basically milch animals. So, it is likely that they were kept for primarily for milk. But as the people were practising agriculture at the same time,

it is assumed that the animals were also deployed in ploughing or in allied jobs in agriculture.

Bone tools and sense of frugality : The sense of frugality in those people is reflected from the art of tool making (industry). Majority of the tools were hacked out from the waste bones or skeleton that were left after consuming the flesh. So, it is understood that the animals which served the people with milk, flesh or power, also provided the bone implements. The selection of particular bones, horn and antler for utilization in the manufacture of specified bone tools indicates the people's aptitude in bone tool industry and testifies their knowledge on osteology. That the calcareous tines of antlers or cornified horns are more resistant to wear and tear than ordinary bones were known to them and eventually these materials were selected for making finer points to be used in pottery work (engraving, designing and boring) which renders the tools liable to regular abrasion. A little inferior or coarse points were usually made from the compact bone walls in the shafts of long bones. The scrapers (blades) have been fashioned out from thin parietal, scapular and rib bones, though rarely, the strong and straight long bones were also hacked to scrapers. It appears that some of the tools were sharpened regularly and some were renewed for the second time on becoming blunt. In some cases the tools were sharpened by some metallic weapons that left very sharp cleavage on them. The dependence on the bones as a raw material for tools, suggests that metal were dearer to the people and from the point of durability the bones were convenient, easy to carve and easily available material.

Environ and Animal life : The identified animal remains were compared with the bones of recent specimens and were found to resemble them closely. The species are mainly from hot humid plains, teeming with vegetation. The occurrence of a few samples of 'Bog Iron Ore' testifies that some parts of the area were swampy or low-lying. Fishes belonging to the family Bagridae (Cat fishes) and Cyprinidae (Carps), along with the remains of Flap Shelled aquatic turtle testify by their huge remains that the area was inundated regularly by rains and the affluent rivers and contained large water bodies. The magnificent size of some of the carp remains, recalls that these fishes used to attain enormous growth (8-9 kg) under favourable water condition. The remains of jungle fowl, Hog deer, Swamp deer and jackal testify that scrub jungles and forested areas persisted along with grassy plains in the vicinity of the settlement. Majority of the animals disappeared from the site a long time ago with the shrinkage of the jungles. But the jackals and the jungle fowl survived in the zone till a few decades ago. The disinterred remains of jackals from the habitation area is interesting. Probably these animals on being lured by the captive animals or birds used to come close to the settlements and were entrapped and slaughtered. Capturing of jungle fowl for its flesh was a common practice among the tribals in the area till it was plentiful. It is assumed that the native domesticated fowl has descended from this stock of jungle fowl, through successive captive-breeding.

SUMMARY

It appears that prior to 3500 B.P. and before the advent of full-fledged metallurgy, the site in question at Ajoy Valley was inhabited by a group of protohistoric people, who led

a pastoral life based on agriculture. They knew the use of fire and used to roast and cook their food. For designing and carving the pottery, they depended largely on bone tools, which they fashioned from antlers and long bones. The people usually lived by hunting and fishing, besides nominal agriculture. There were jungles in outskirts which harboured a number of wild birds and mammals. The deer, fowls, large fishes and turtles provided the people with valuable protein diet.

ACKNOWLEDGEMENT

The authors owe to Dr. B. K. Tikader and Dr. S. C. Mukherjee, Directors of the Zoological Survey of India and State Archaeology, Government of West Bengal respectively, for necessary advice and facilities to carry out the work. They are also thankful to Dr. A. K. Dutta, Dr. C. B. Srivastava, Shri S. Banerjee and K. C. Basu for their co-operation. Lastly, the sincere efforts made by SarbaShri Sudhin Dey, Dilip Roy and Biswanath Samanta of the State Archaeology, in collecting the material and to make the work a co-ordinated success is gratefully acknowledged.

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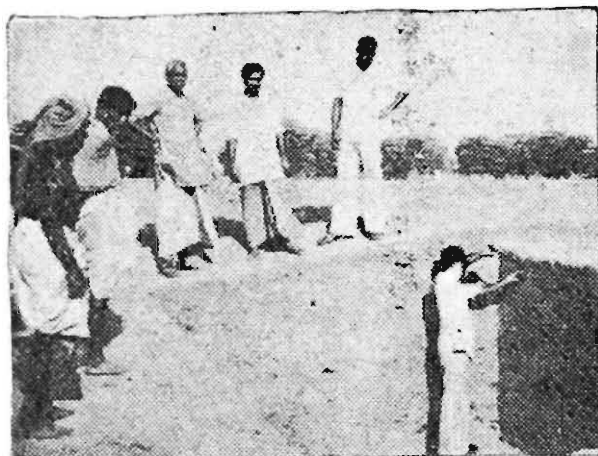
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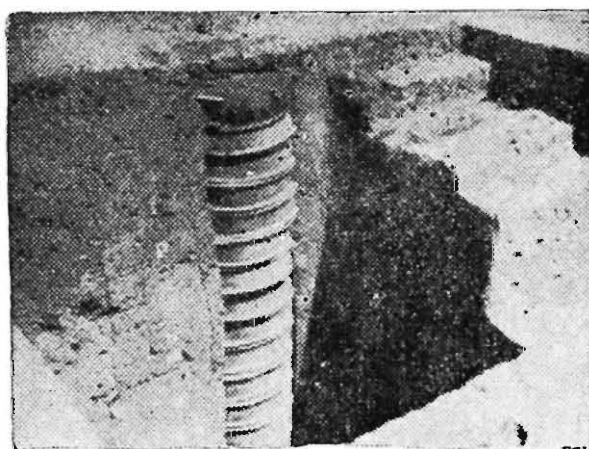
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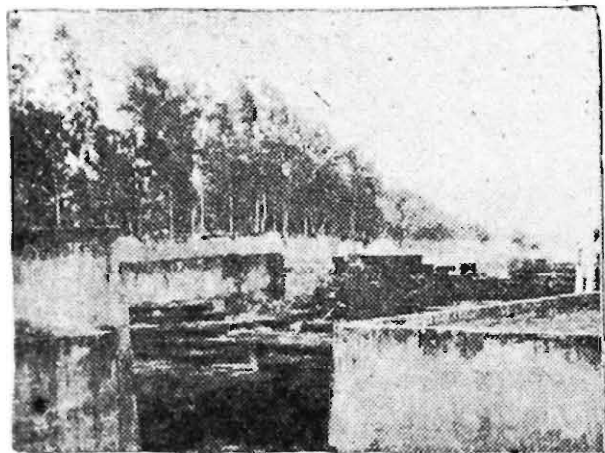
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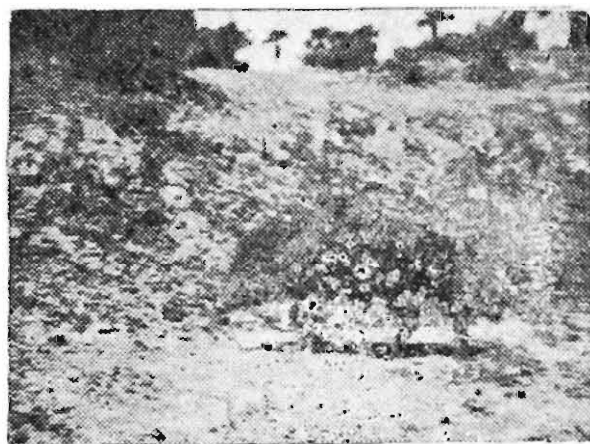
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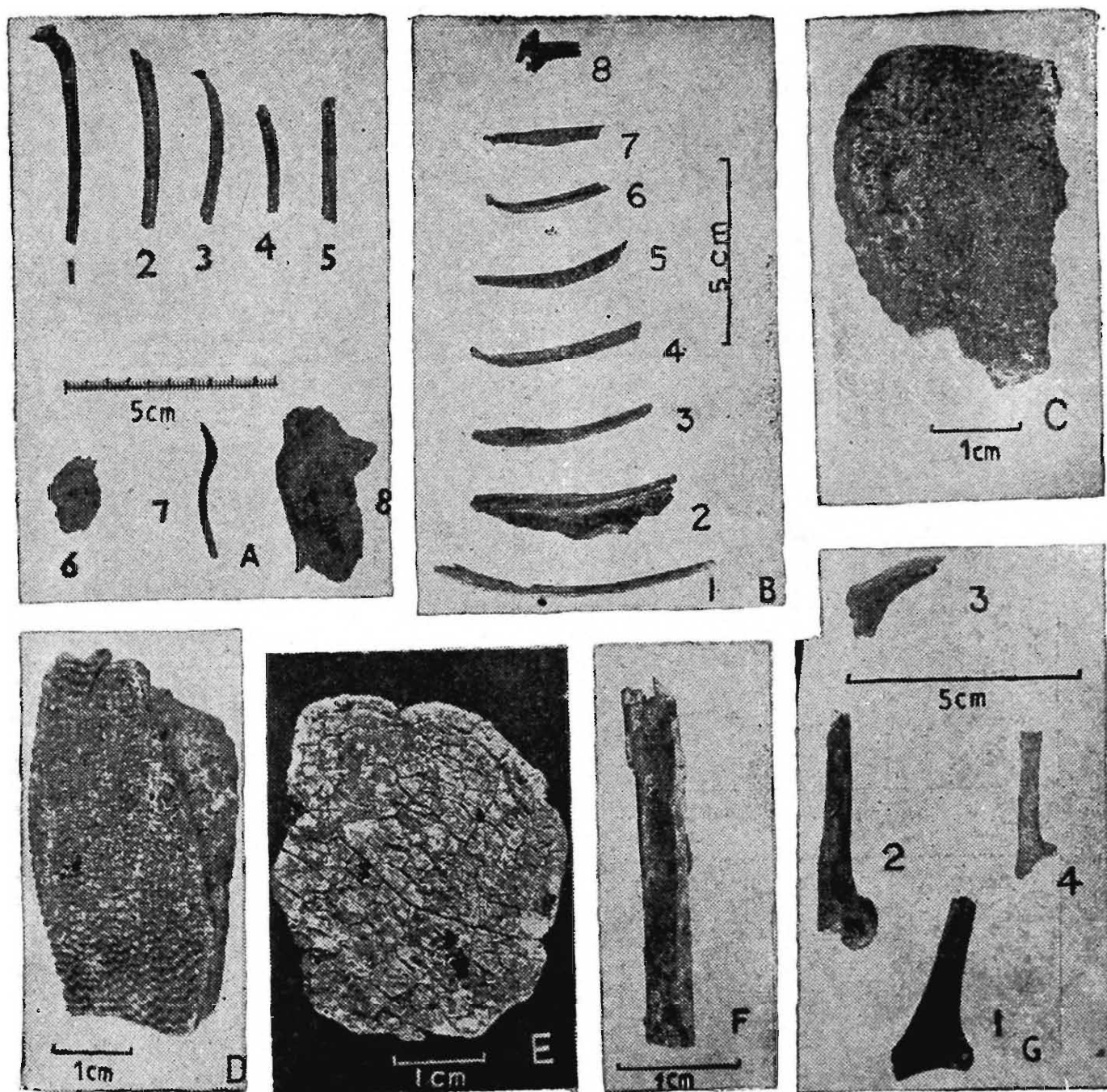


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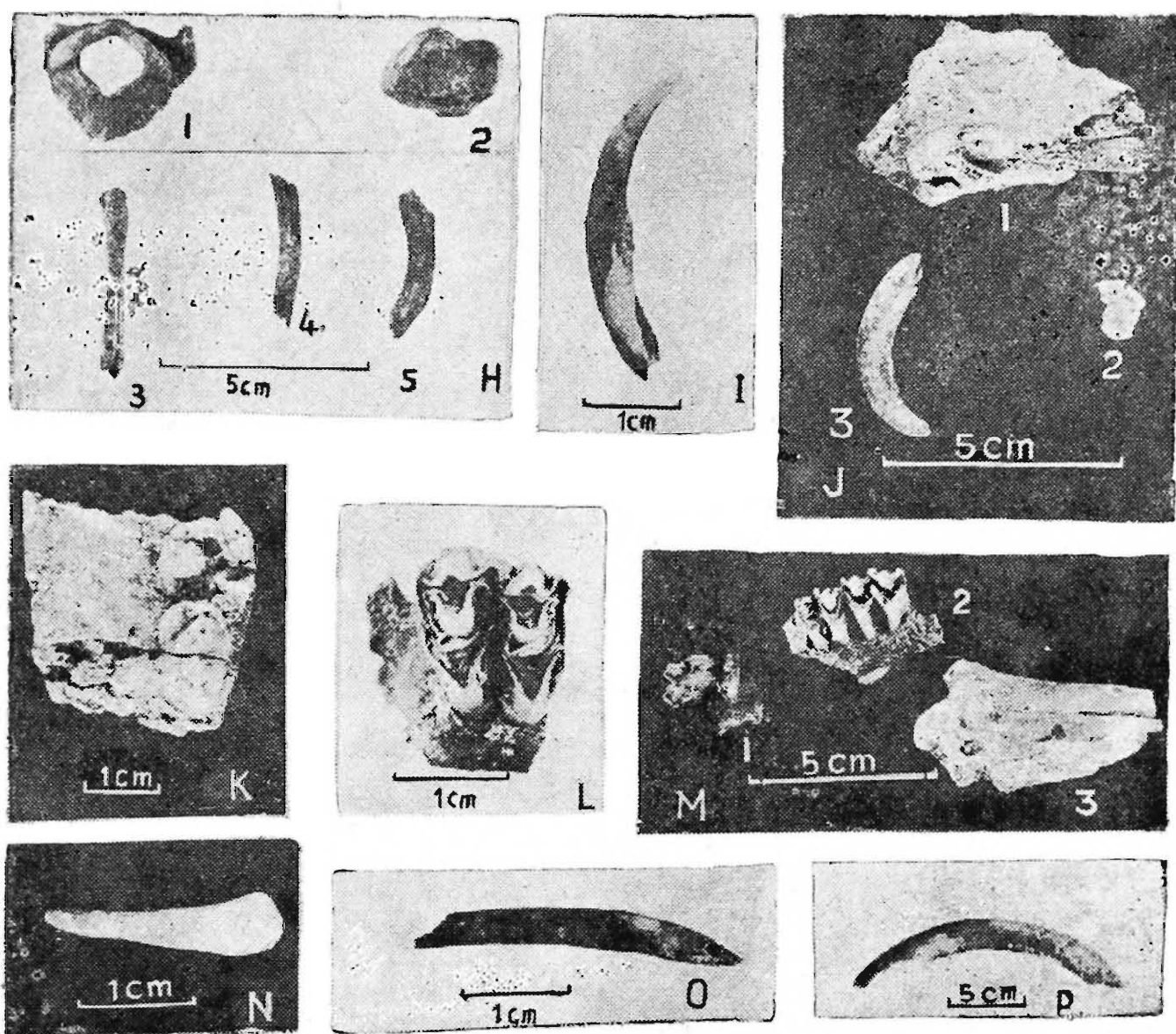


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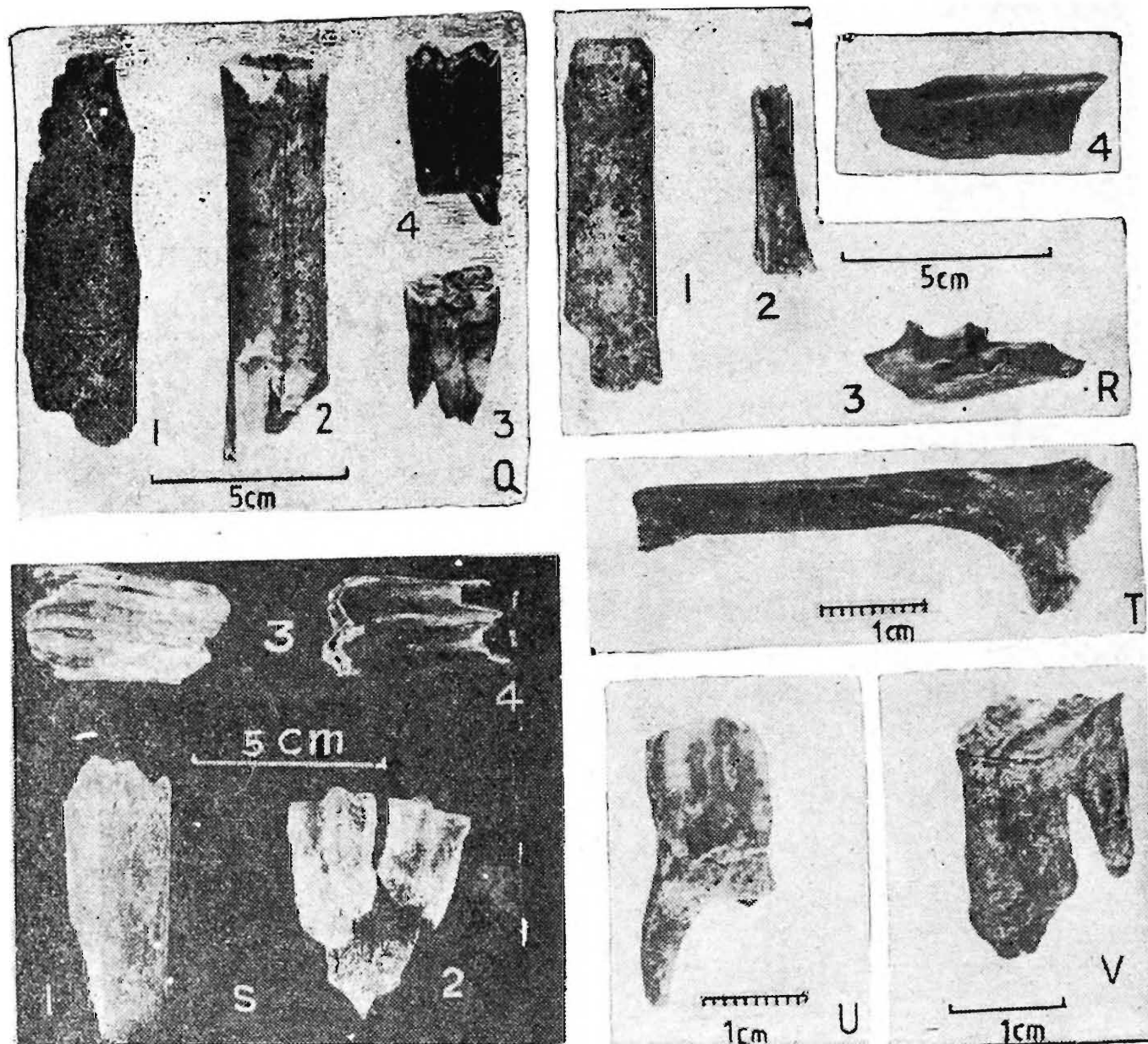
A. Dried up river bed of Kunoor. The shallow water accumulated in low areas is being pumped out for growing crops. B. 'Kop-palla Band' once an enormous lake, still at present continues to harbour hundreds of aquatic birds, which nest amidst the weeds. C. A trench on the mound of Pandu Rajar Dhibi, dug down by the State Archaeology department. One of the team members is seen to collect a few shells. D. The peering well, came to our sight as a result of excavation, testifies from its situation that not very late, the place was used for habitation. E. The protected archaic site of Barasat-danga. It is about 3 km south of Panduk village. The local guard of the Archaeological Survey of India, is seen to explain the layout of the old structure, supposed to be the ruins of a treasury house or a temple complex. F. A grunting domestic boar, is foraging through the meadow—a very common sight.



A. 1-5. Fish ribs mainly of *Catla catla* & *Labeo rohita*. 6. Proatlas of a bagrid fish? *Rita* sp; 7. Branchial arch of a cyprinid fish. 8. Opercular bone of *Catla catla*. B. 1-7. Ribs of varying sizes, mainly of cyprinids. 8. Condylar portion of the right pectoral spine of *Mystus* sp. C & D. Pieces of plastron and carapace of *Lissemys punctata punctata* (Bonnaterre). E. Damaged dorsal scute of gharial *Gavialis gangeticus* (Gmelin). F. Broken shaft bone of some bird. G. 1. Charred and broken oblique process of sternal bone; 2. Condylar bone of left tibia with cut marks; 3. Broken right scapula. 4. Broken coronoid bone—all of *Gallus gallus murghi* Robinson & Kloss.



H. 1. Occipital portion of skull with condyles of *Canis aurius indicus* (Hodgson). 2. Lunate bone. 3. 5th metatarsal of left pes of *Canis aurius indicus* (Hodgson). 4 & 5. Two fragments of ribs of *Axis porcinus* Zimmermann. I. Upper left canine of *Canis aurius indicus* (Hodgson). J. 1. Damaged body of mandible with broken incisor of *Sus scrofa cristatus* Wagner. 2. Broken lower 3rd premolar of *Sus scrofa cristatus* Wagner. 3. Canine tooth. K. Broken piece of maxilla of right side with 3rd and 4th premolar of *Sus scrofa cristatus* Wagner. L. 2nd Upper right molar with a portion of maxillary bone of *Axis porcinus* Zimmermann. M. 1. Molar with a portion of maxillary bone of *Axis porcinus* Zimmermann. 2. Two molar teeth with a portion of maxillary bone of *Axis porcinus* Zimmermann. 3. Distal end fragment of right tibia of *Cervus duvauceli* Cuvier. N. Incisor tooth. O. Canine of a big rodent/ Fig. P. Incisor teeth of a rodent? *Rattus* sp.



Q. 1. Charred rib piece of swamp deer, *Cervus duvauceli* Cuvier. 2. Shaft bone of left metatarsal bone of *Bos indicus* Linnaeus. 3. Molar tooth of *cervus duvauceli*. 4. Upper molar of *Bubalus bubalis* Linnaeus. R. 1. Broken rib of *Bubalus bubalis* Linnaeus. 2. Broken shaft of right humerus of *Capra hircus aegagrus* Erexleben. 3. Broken olecranon process of right ulna of *Capra hircus aegagrus* Erexleben. 4. Charred piece of broken ramus of mandible of *Cervus duvauceli* Cuvier. S. 1. Piece of thoracic rib of *Bubalus bubalis* (Linnaeus). 2. Distal end of metacarpal of *Bos indicus* Linnaeus. 3. Upper right 2nd molar of sub adult cattle *Bos indicus* Linnaeus. 4. Upper left 3rd molar of *Bos indicus* Linnaeus. T. Charred rib fragment. U. Premolar tooth. V. Upper 1st premolar tooth of *Bubalus bubalis* (Linnaeus).

**ON A RARE TOAD, *BUFO HOLOLIUS* GUNTHER FROM
NAGARJUNASAGAR, ANDHRA PRADESH**

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While examining the Amphibia collection at the Fresh Water Biological station, Zoological Survey of India, Hyderabad, the senior author came across a single example of interesting toad which on closer study turned out to be *Bufo hololius* Gunther.

The authors are thankful to Dr Babu Rao, the then Officer-in-Charge of the Station for kindly making the specimen available for study.

There does not appear to be any record of collection of *Bufo hololius* since its original description by Gunther from Malabar in 1875. The present collection of this rare toad from Nagarjunasagar, Andhra Pradesh, after a gap of 115 years thus constitutes an important record.

Amphibian taxonomy has undergone considerable changes during the last hundred years; more and more characters of taxonomic importance have been discovered to supplement the rather brief descriptions which were in vogue then. The purpose of this paper is to highlight the present record of this rare toad along with a full description. The type material of this species being deposited in the British Museum of Natural History, London, by Gunther, makes this the only specimen available in India.

MATERIAL EXAMINED

A single male specimen, 35.5mm from the tip of snout to vent, collected from Nagarjuna Sagar on 18.9.1980 by D.M.Mahato, Reg.No.A/F.B.S/Z.S.I./361.

DIAGNOSIS

Medium-sized robust toad without cranial ridges, parotoid glands large, tympanum about as large as eye, toes webbed at base, skin with large, flat glandular patches on the dorsum.

DESCRIPTION

(Figs. 1 & 2)

Head :- Depressed, 1.4 times broader than long. Snout a little produced forwards, truncated at tip and projecting well beyond lower jaw; its length from its tip to the anterior border of eye equal to length of upper eyelid. Nares laterally placed, its distance from the anterior border of eye a little longer than its distance from the tip of the snout. Canthal ridge clearly defined, slightly concave; loreal region vertical. Cranial ridges absent. Interorbital region slightly depressed, a little broader than width of the upper eyelid. Eye with circular pupil. Tympanic annulus distinct, circular, tympanum depressed, its diameter slightly less

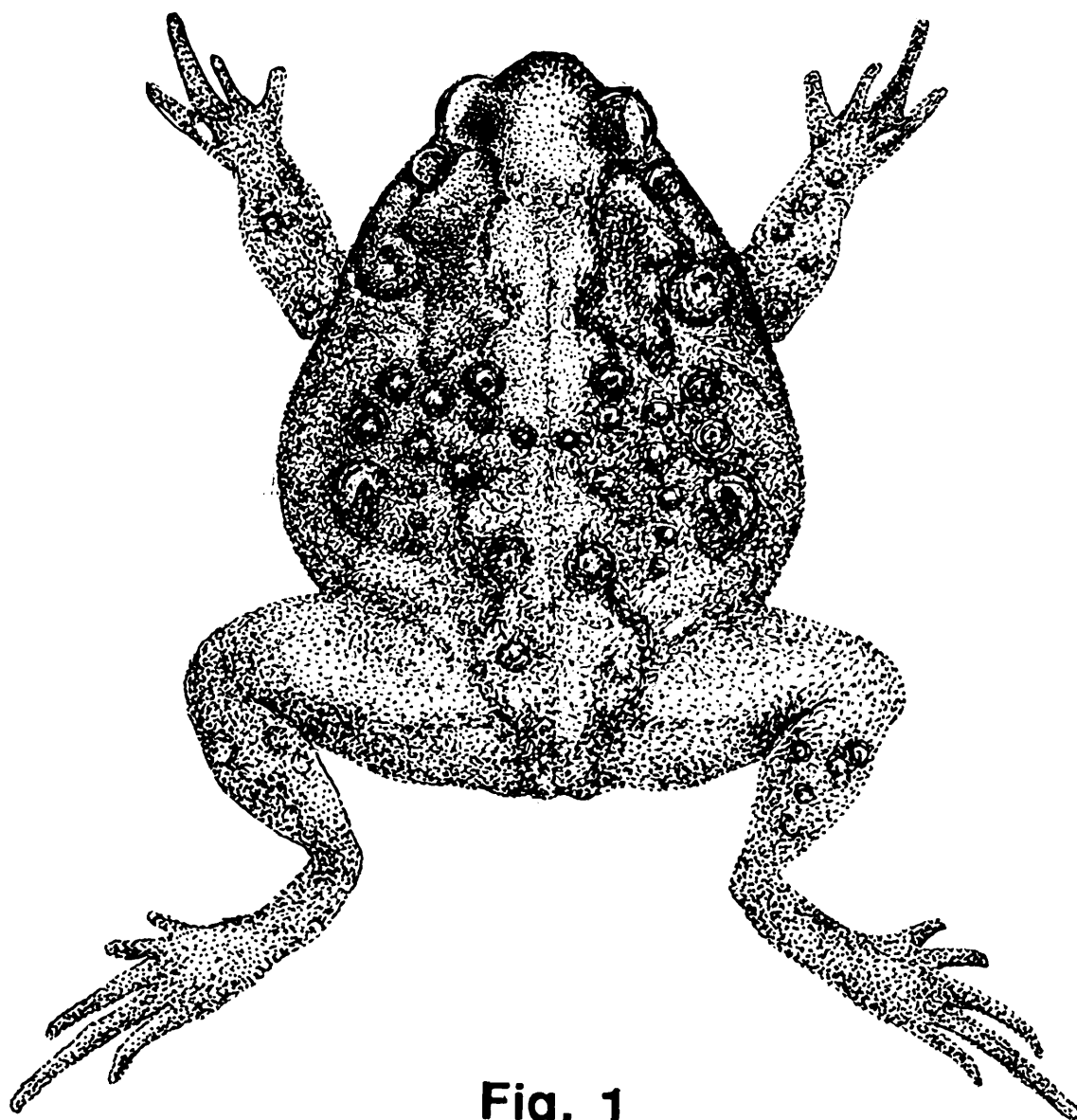


Fig. 1



Fig. 2

Fig. 1. Dorsal view of *Bufo hololius* . Fig. 2. Lateral view of the head of *Bufo hololius*.

than that of the eye. Upper eyelid flat, longer than broad, almost covering the eye from above. Parotoid glands, large, flat, irregular in shape with another smaller gland lateral to it, the peduncle of which joins the tympanum at its vertral margin. Jaws toothless; vomerines absent. Tongue entire, Pyriform, its tip narrower than base.

Forelimbs : Moderately short, fingers free. First finger longer than second, shorter than third. Subarticular tubercles indistinct, digits depressed, tips blunt, rounded.

Hindlimbs : Short, moderately stout, tibio-tarsal articulation of a depressed limb not reaching tympanum. Tibia one-third in length from tip of snout to vent and a little over 2.5 times as long as broad. Toes depressed, tips blunt, fourth toe much longer. Slightly webbed at base. Subarticular tubercles not very conspicuous. Two metatarsal tubercles, inner elongated, larger than the outer which is placed almost at the middle of the fleshy foot.

Skin : Dorsum beset with large, flat circular glandular patches. Snout, interorbital and inter - parotoid areas smooth. The glandular patches with nipple-like elevations, with or without tiny, black tips. The black-tipped spines are more abundant on the anterior parts viz snout, outer margin of upper eyelid, upper jaw, tympanic annulus and parotoid. Upper surface of limbs also with smaller tubercules. Ventral surface rough except for the throat which is smooth.

Colour : Olive brown (in the preserved state) marbled with lighter brown. Two lighter patches, one between the eyes and other between the parotoids. Glandular patches with orange tips. Lower parts buff-coloured.

<i>Measurements :</i>			<i>mm</i>
Total length (from tip of snout to vent)	..	..	35.5
Length of head (from tip of snout to angle of jaws)	..	..	10.0
Width of head (at angle of jaws)	..	..	14.0
Length of snout	..	..	3.5
Diameter of eye	..	..	4.0
Width of upper eyelid	..	..	4.0
Interorbital distance	..	..	4.0
Diameter of tympanum	..	..	3.0
Length of forelimb	..	..	15.0
Length of hindlimb	..	..	27.0
Length of tibia	..	..	12.0

Murthy (1968) has reported six species of Amphibia from Nagarjun Valley viz. *Rana cyanophlyctis*, *R. limnocharis*, *R. tigrina*, *Microhyla ornata*, *Bufo melanostictus*, and *Bufo andersoni*. The present record of *Bufo hololius* not only adds to the list but also extends range of its earlier distribution far eastwards to the Eastern Ghats. The single example described earlier by Gunther (1875) was from the Western Ghats region (Malabar).

The depressed body, protective eyelids and flat glands are all suggestive of a life in crevices among rocks. Nothing is known of its habits or larvae.

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ON A COLLECTION OF TETRANYCHID MITES FROM ARUNACHAL
PRADESH, INDIA WITH DESCRIPTIONS OF TWO NEW SPECIES

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INTRODUCTION

The information pertaining to mite fauna of Arunachal Pradesh is scanty (Prasad, 1974) and so far as tetranychid mites are concerned, practically nothing is known (Gupta, 1985). The present paper is based upon the collection made during 1981- 1983 from five districts viz. Upper Subansiri, Lower Subansiri, West Siang, Lohit and Tirap. Altogether 15 species under 6 genera are treated in this paper, of which two are described here as new to science. All are first reports from the state.

The measurements given in the text are in microns. The types are in the collection of the Zoological Survey of India, Calcutta. The collection pertaining to 1983 was made by both the authors, while that of 1981 was made by the junior author alone.

Family TETRANYCHIDAE

TETRANYCHIDAE Donnadieu, 1875, *Faculte des sciences de Lyon*, p-9.

Key to the genera and species of Tetranychidae

- 1. Tarsus I with single set or without closely associated duplex setae, empodial claw absent with one pair of paraanal setae *Aponychus bambusae* sp. nov.
- Tarsus I with 2 pairs of duplex setae, the proximal member of each pair shorter than distal member, empodium claw-like or splits distally 2
- 2. With 2 pairs of paraanal setae 3
- With 1 pair of paraanal setae 5
- 3. Empodium claw-like 4
- Empodium ending with tuft of hairs *Eotetranychus*, 6
- 4. Empodium a single claw - like structure with proximoventral hairs *Panonychus*, 11
- Empodium splits into 2 claw-like structures *Schizotetranychus masoni*

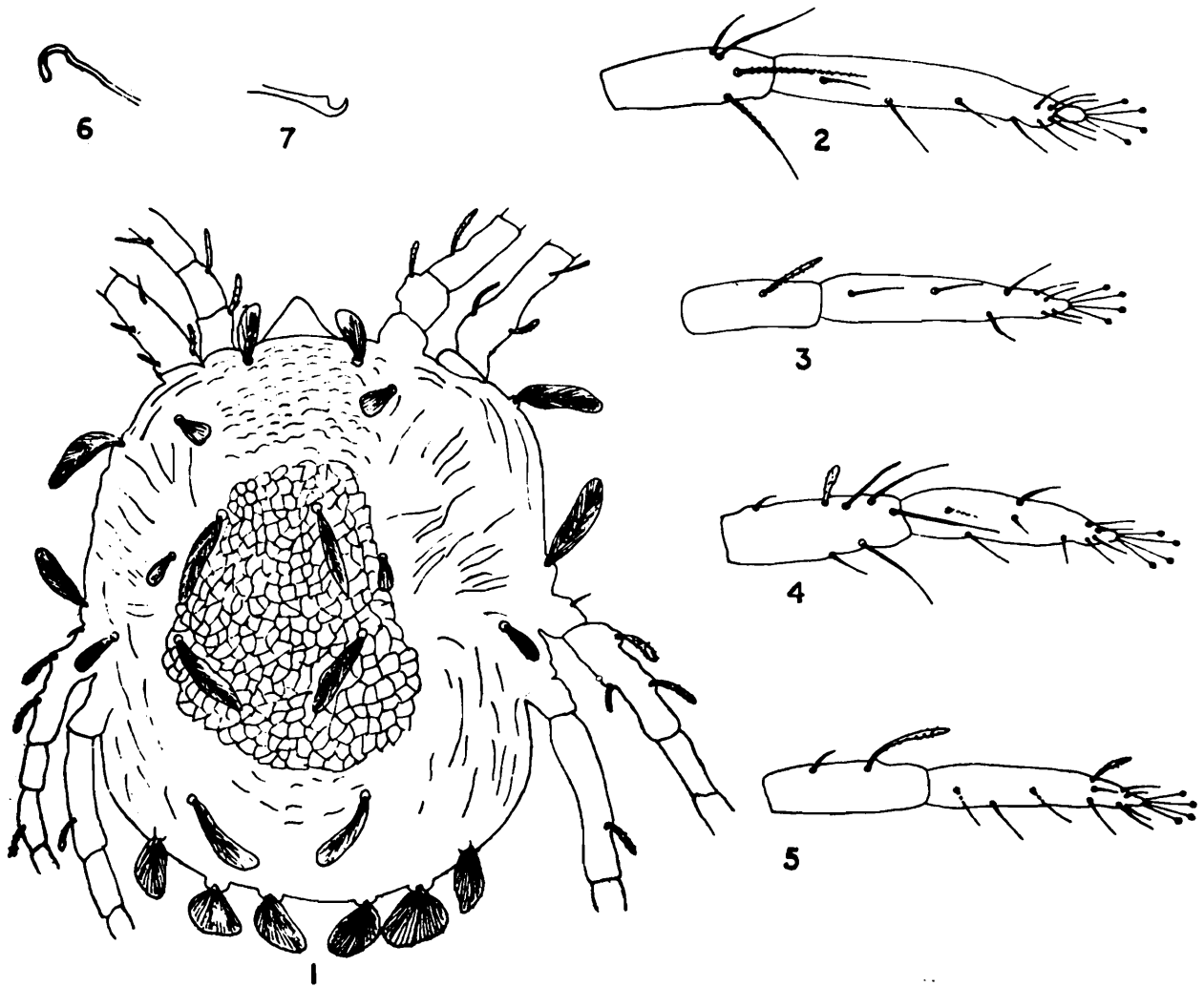
* Present address : Principal Scientist and Project Coordinator (Agri. Acarology), AICRP, Univ. of Agri Science, GKVK, Bangalore 56065.

5. Empodium claw-like with proximoventral hairs, duplex setae of tarsus I distal and approximate *Oligonychus*, 12
- Empodium splits distally, usually into 3 pairs of hairs, duplex setae of tarsus I well separated *Tetranychus*, 14
6. Dorsal idiosomal setae serrate 7
- Dorsal idiosomal setae not serrate 8
7. Aedeagus gradually tapering and forming a broad ventral bent *Eotetranychus kankitus*
- Aedeagus gradually narrows distally and curves dorsad and forming a distal knob *E. broodryki*
8. Distal portion of aedeagus sigmoid *E. frosti*
- Distal portion of aedeagus curved but not sigmoid 9
9. Genital flap with longitudinal striae *E. sexmaculatus*
- Genital flap with transverse striae 10
10. Peritreme at the distal end as a small bulb *E. pamelae*
- Peritreme at the distal end curved *E. indicus* sp. nov.
11. Fifth pair of dorsocentrals and 4th pairs of dorsolaterals equal in length *Panonychus citri*
- Fifth pair of dorsocentrals about 1/3 length of 4th pairs of dorsolaterals *P. ulmi*
12. Aedeagus bent ventrad, tarsus I with not more than single tactile seta on venter just distad of duplex setae *Oligonychus coffeae*
- Aedeagus bent dorsad, although the distal end may be directed ventrad, tarsus I with 2 tactile setae on venter just distad of duplex setae 13
13. Aedeagus with distal end strongly sigmoid *O. sacchari*
- Aedeagus with distal end not strongly sigmoid *O. oryzae*
14. Knob of aedeagus berry-like, rounded anterior projection more strongly developed than the posterior convexity *Tetranychus neocaledonicus*
- Knob of aedeagus not globular, the caudal projection angulate *T. cinnabarinus*

1. *Aponychus bambusae* sp. nov.

(Figs. 1 - 7)

Male : Body including rostrum 285 long, 159 wide, oblong. Peritreme at the distal end forming hook - like structure. Palpus with terminal sensillum slender. Idiosoma with dorsal integument wrinkled Idiosomal setae small, serrate and spatulate. Dorsal propodosomal, humerals, second dorsolateral, inner sacrals, clunal setae of same length. Outer sacral absent. I- III dorsocentral setae measure 18 -25, II propodosomal - 21, III propodosomal - 28, humeral - 28. Leg with spatulate setae. Tibia I with 1 sensory, 1 spatulate and 5 tactile setae; tarsus I with 1 sensory and 8 tactile setae. Tibia II with 1 sensory, 1 spatulate setae; tarsus II with 1 sensory, 1 spatulate and 9 tactile setae. Aedeagus more or less hook-like structure.



Figs. 1-7 : *Aponychus bambusae* sp. nov.

1. Dorsum of female; 2. Tibia & tarsus I of female; 3. Tibia & tarsus II of female; 4. Tibia & tarsus I of male; 5. Tibia & tarsus II of male; 6. Peritreme of female; 7. Aedeagus.

Female : Body including rostrum 393 long, 159 wide, oblong. Peritreme at the distal end hook - like. Palpus with terminal sensillum slender. Idiosomal setae spatulate. I - III dorsocentral setae measure 46 -64, II propodosomal - 28, III propodosomal - 43, humeral -46 and inner sacral and III dorsocentral setae short with fan - like appearance. Tibia I with 1 sensory, 2 spatulate and 1 tactile setae ; tarsus I with 10 tactile setae Tibia II with 1 spatulate seta; tarsus II with 8 tactile setae. Genital flap with transverse striae. Holotype Male, INDIA : Arunachal Pradesh, Tezu, Arun Bihar, 21.i.1983, on sugarcane , Reg. No. 3185 / 17. Paratypes 5 Females , data same as for holotype , Reg. No. 3186 / 17.

Remarks : This new species resembles *Aponychus makaoi* Ehara & Wongsiri (1975) in the absence of the outer sacral setae, but is easily distinguished from it by having the

dorsocentral setae being five times longer.

2 *Panonychus citri* (McGregor)

1916. *Tetranychus citri*, McGregor, *Ann ent. Soc. Am.*, 9 : 284.

1985. *Panonychus citri*, Gupta, *Handbook. Plant mites of India*. Zool. Surv. India, Calcutta, pp. 92-93.

Material examined : 1 Male, 10 Females, Arunachal Pradesh, Kimin, 2.xi.1981, ex an undet. plant; 1 (M), 5 (F), Yazuli, 30.x.1981, on pear; 15 (F), Loilang, 22.i.1983, ex vegetable plant; 1 (M), Bogapani, 6.i.1983, ex an undet. plant : 1 (M), 6 (F), Deban, area around Lama Basti, 15.i.1983, ex squash ; 2(M), 36(F) on way to Loilang, 7 .i. 1983 , ex banana; 1(M), 19(F), Deban, area around Lama Basti, 15. i. 1983, ex pear; 15(F), Tezu, 21.i.1983, ex pear.

Distribution : India : West Bengal, Assam, Meghalaya, Arunachal Pradesh, Punjab, Jammu & Kashmir . Outside India : China, Japan, Middle East, South Africa, New Zealand, Argentina, Bermuda, Cuba, Mexico, Florida, California.

3 *Panonychus ulmi* (Koch)

1836. *Tetranychus ulmi* Koch, *Deut. Crust. Myr. Arach.*, 1 : 11.

1985. *Panonychus ulmi*, Gupta, *Handbook. Plant mites of India*. Zool. Surv. India, Calcutta, pp. 93-94.

Material examined : Several (M), (F), India, Arunachal Pradesh, area around Tezu Circuit House, 22.i.1983, on an undet. plant.

Distribution: India : Himachal Pradesh, Uttar Pradesh, Jammu & Kashmir, Arunachal Pradesh. Elsewhere : Europe.

4. *Eotetranychus sexmaculatus* (Riley)

1985. *Tetranychus 6-maculatus* Riley, *Insect Life*, 2 : 225-226.

1985. *Eotetranychus sexmaculatus*, Gupta, *Handbook. Plant Mites of India*. Zool. Surv. India, Calcutta, pp. 77-78.

Material examined : 1 Male, 1 Female, Arunachal Pradesh, Hyauliang, 26.i.1983, on an undet. plant.

Distribution : India : Meghalaya, Arunachal Pradesh, Karnataka, Tamil Nadu. Elsewhere : Taiwan, Formosa, New Zealand, U.S.A.

5. *Eotetranychus frosti* (McGregor)

1952. *Tetranychus frosti* McGregor, *Proc. ent. Soc. Wash.*, 54 : 142.

1985. *Eotetranychus frosti* Gupta, *Handbook. Plant mites of India*. Zool. Surv. India, Calcutta, pp. 72-73.

Material examined : 1 Male, 8 Female, Arunachal Pradesh, Ringo, Maru, 25.x.1981, on citrus.

Distribution : India : Gujarat, Jammu & Kashmir, Arunachal Pradesh Elsewhere:

Arizona, California, Louisiana, Missouri, North Dakota, Ohio, New York.

6. *Eotetranychus pamelae* Manson

1963. *Eotetranychus pamelae* Manson, *Acarologia*, 5 : 353 - 35

1985. *Eotetranychus pamelae*, Gupta, *Handbook. Plant mites of India*. Zool. Surv. India, Calcutta, p.76.

Material examined : 1 Male, 4 Female, Arunachal Pradesh, Along Agril. Farm, 19.x.1981, ex citrus; 1(M), 3(F), Keying, 20.x.1981, ex mulberry.

Distribution : India : Assam, Arunachal Pradesh, Tamil Nadu.

7. *Eotetranychus kankitus* Ehara

1955. *Eotetranychus kankitus* Ehara, *Annotnes zool. Jap.*, 28: 178.

1985. *Eotetranychus kankitus*, Gupta, *Handbook. Plant mites of India*. Zool. Surv. India, Calcutta, p.75.

Material examined : 1 Male, 14 Females, Arunachal Pradesh, Hapoli, 20.x.1981, ex apple.

Distribution: India : Meghalaya, Arunachal Pradesh, Tamil Nadu.

8. *Eotetranychus broodryki* Meyer

1974. *Eotetranychus broodryki* Meyer, *Rep. South. Africa Dept. Agr. Tech. Ser. Ent. Mem.*, 36 : 201.

1985. *Eotetranychus broodryki*, Gupta, *Handbook. Plant mites of India*. Zool. Surv. India, Calcutta, pp. 71-72.

Material examined : 1 Male, 10 Females, Arunachal Pradesh, Area around Dhala tea estate, 19.i.1981, ex tea.

Distribution : India : Orissa, Arunachal Pradesh Elsewhere: Rhodesia.

9. *Eotetranychus indicus* sp. nov.

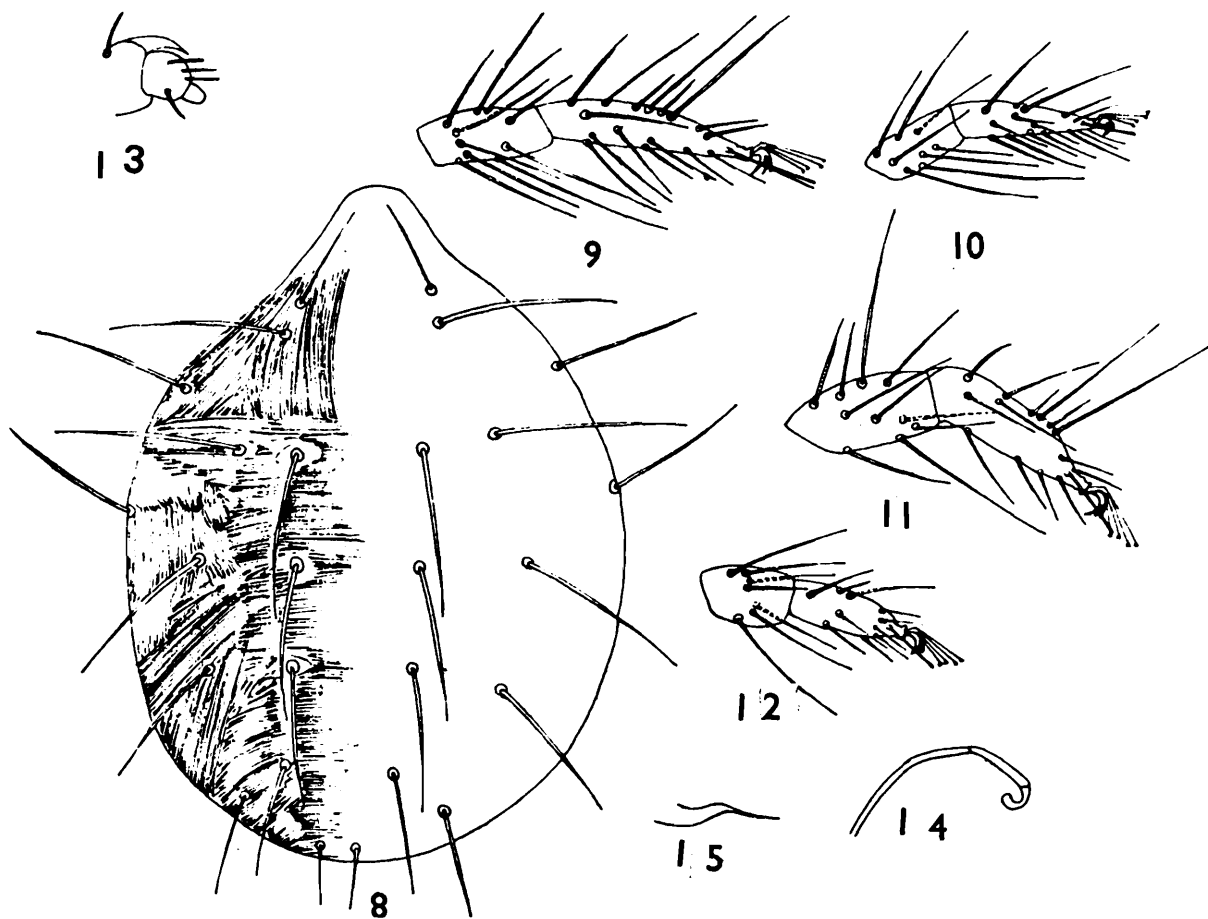
(Figs. 8-15)

Male : Body including rostrum 357 long , 177 wide. Palpus with terminal sensillum 2 times as long as wide; dorsal sensillum much longer, fusiform. Dorsal setae of idiosoma longer than interval between their longitudinal bases. Tibia I with 3 sensory and 7 tactile setae; tarsus I with 1 sensory and 3 tactile setae proximal to duplex setae. Tibia II with 1 sensory and 6 tactile setae; tarsus II with 1 sensory and 2 tactile setae proximal to duplex setae. Aedeagus with proximal portion of shaft curved abruptly and narrowed, distal portion very slender and much similar to that of *E. smithi* Pritchard & Baker.

Female : Body including rostrum 432 long, 213 wide. Palpus with terminal sensillum slightly longer than wide; dorsal sensillum much longer. Peritreme ends in hook-like structure. Dorsal idiosomal setae slightly longer than the interval between their longitudinal bases. Tibia I with 2 sensory and 8 tactile setae; tarsus I with 2 sensory and 4 tactile setae

proximal to duplex setae. Tibia II with 1 sensory and 7 tactile setae proximal to duplex setae. Outer and inner sacral of same length. Dorsal striations as figured. Genital flap with transverse striae. Medioventral setae moderate in size. Holotype Male, India : Arunachal Pradesh, Baskim village, 24.x.1981, ex apple. Reg. No. 2192/17. Paratypes 4 Females data same as for holotype. Reg. No. 2192/17.

Remarks : The aedeagus of this species resembles *Eotetranychus smithi* Pritchard & Baker (1955) but differs from it in relative number of tactile and sensory setae of tibia and tarsus of both the sexes.



Figs. 8-15. *Eotetranychus indicus* sp. nov.

8. Dorsum of female; 9. Tibia & tarsus I of female; 10. Tibia & tarsus II of female; 11. Tibia & tarsus I of male; 12. Tibia & tarsus II of male; 13. Distal segment of palpus of female; 14. Peritreme of female; 15. Aedeagus.

10. *Schizotetranychus masoni* Gupta

1980. *Schizotetranychus masoni* Gupta, *Rec. zool. Surv. India*, 77: 111-117.

Material examined : 3 Males, Arunachal Pradesh, Hapoli Horticultural garden, ex mother plant.

Distribution: India : Andaman Nicobar Is., Arunachal Pradesh.

11. *Oligonychus coffeae* (Nietner)

1861. *Acarus coffeae* Nietner, *Observ. Coffee Tree Ceylon*, p. 31.

1985. *Oligonychus coffeae*, Gupta, *Handbook. Plant mites of India*. Zool. Surv. India, Calcutta, pp. 83-84.

Material examined : 2 Males, 20 Females, Arunachal Pradesh, Dhala tea estate area, 19. i. 1983, ex tea.

Distribution : India : West Bengal, Assam, Arunachal Pradesh, Tamil Nadu. Elsewhere : U.S.A. , U. S. S. R. Africa, Australia, Japan, Indonesia, Taiwan, Sri Lanka.

12. *Oligonychus oryzae* (Hirst)

1926. *Paratetranychus oryzae* Hirst, *Proc. zool. Soc. Lond.*, p. 830.

1985. *Oligonychus oryzae*, Gupta, *Handbook. Plant mites of India*. Zool. Surv. India, Calcutta, pp. 88-89.

Material examined : 1 Male, 10 Females, Arunachal Pradesh, Yazuli, 30.x.1981, ex paddy.

Distribution : India : Orissa, Arunachal Pradesh, Andaman Nicobar Is., Tamil Nadu, Punjab.

13. *Oligonychus sacchari* (McGregor)

1942. *Paratetranychus sacchari* McGregor, *J. Univ. Puerto Rico*, 26 : 91

1985. *Oligonychus sacchari*, Gupta, *Handbook. Plant mites of India*. Zool. Surv. India, Calcutta, p.90.

Material examined : 2 Males, 9 Females, Arunachal Pradesh, Kimin, 31.x.1981, ex an undet. plant; several (M), (F), 24.x.1981, ex grass; 1(M),9(F)Kimin, 3.x.1981, ex citronella plant.

Distribution : India : West Bengal, Assam, Arunachal Pradesh. Elsewhere : Puerto Rico.

14. *Tetranychus cinnabarinus* (Boisd.)

1867. *Acarus cinnabarinus* Boisdual, *Ent. Hort.*, 88.

1985. *Tetranychus cinnabarinus*, Gupta, *Handbook. Plant mites of India*. Zool. Surv. India, Calcutta, pp. 106-108.

Material examined : 3 Males, 17 Females, Arunachal Pradesh, Lidabali, 14.x.1981, ex an undet. plant; 2(M), 28 (F), Loilang, 22.i.1983, ex papaya; 1(M), 8 (F), Deban, area around Forest Rest House, ex papaya.

Distribution : India : Orissa, Meghalaya, Arunachal Pradesh , Bihar, Rajasthan, Punjab,

Gujarat, Haryana, Tamil Nadu, Karnataka. World wide.

15. *Tetranychus neocaledonicus* Andre

1933. *Tetranychus neocaledonicus* Andre, *Bull. Mus. natn. Hist. nat. Paris*, (2) 5 : 302.

1985. *Tetranychus neocaledonicus*, Gupta, *Handbook. Plant mites of India*. Zool. Surv. India, Calcutta, pp 113-115.

Material examined : Several Males, Females, Arunachal Pradesh, Deban around Chakma Basti, 16.i.1983, on papaya.

Distribution : India: Assam, Arunachal Pradesh, Meghalaya, Orissa, Bihar, Punjab, Delhi, Haryana, Uttar Pradesh, Rajasthan, Maharashtra, Kerala, Karnataka. Elsewhere: Hawaii, Fiji, Bahamas, Venezuela, Puerto Rico, U.S.A., Africa.

SUMMARY

Fifteen species of tetranychid mites belonging to six genera are reported here from Arunachal Pradesh. This includes two new species, of *Aponychus* and *Eotetranychus*. All are new reports for the state.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. P.D. Gupta, Scientist-SE & Officer-in Charge, Central Regional Station, Z.S.I., Jabalpur, for laboratory facilities and to the authorities of the Government of Arunachal Pradesh, for extending various help while conducting survey.

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ON SEXUAL DIMORPHISM IN *BARILIUS BARNA* HAMILTON (PISCES : CYPRINIDAE)

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Zoological Survey of India, Dehra Dun

INTRODUCTION

Tilak and Jaffer (1982), reported secondary sexual differences in the pectoral girdle and fin of *B. bendelisis* Hamilton but no other species of the genus *Barilius* had so far been known to show such characteristics. Recently, sexually dimorphic characters were observed in the male and the female of *B. barna* in the pelvic region. Apart from this, other differences in the external morphology of the male and the female of this species also show differences. The well-developed pelvic fin should need strong pelvic muscles and hence, the pelvic bones should also show a similar development. Therefore, the external morphology and the pelvic girdle of the male and the female have been thoroughly examined here in a long series of specimens and the sexually dimorphic characters have been described and figured in this communication.

MATERIAL AND METHODS

The material for the present study has been collected from hill-streams along the base of Himalaya or shivalik ranges in Uttar Pradesh. The material under study was collected from a large number of localities. Altogether 120 male and 98 female specimens of different size range were examined, and of these 10 examples of male and 6 of female were dissected for study of osteology of the pelvic region. The pelvic fin along with the girdle was removed from the abdominal region with the help of a pair of scissors and treated with 4% Potassium hydroxide solution and stained in alizarin 'S' red in a usual manner. The muscles were carefully removed and the stained girdle and the fins were studied under a low power stereomicroscope. The extent of variation in the morphology of the girdle in different specimens was found to be insignificant. The morphological characters of the bony parts were normal and uniformly similar in the material studied here. The drawings of the bony parts have been prepared with the help of a camera lucida fitted over a low power stereomicroscope.

OBSERVATIONS

External morphology

The scales of the body of the male are tuberculated, there are four or more rows of tubercles on each scale. These tubercles are absent in the female. The snout is also tuberculated both in the male and the female but these tubercles are more prominent in the former.

The body of the male is deeper (being 3.96-4.45 times in total length) against 4.45-4.75 times in the total length of the female.

The shape and configuration of the pelvic fin of the male is significantly different from that of the female. Of the seven branched rays of pelvic fin of the male, the last two (sixth and seventh) are extremely thickened and tend to fuse along their basal part, making the inner end of the fin formidably strong. The other rays of this fin are also thickened. The whole fin has a wider expanse and opens out in the shape of a fan. The rays of the pelvic fin of female are of normal type. The pelvic fin is longer in the male, reaching the origin of the anal fin; its length is contained 1.26-1.33 times in head length, 5.93-6.45 times in total length and 1.00-1.06 times in the distance between the origin of the ventral and anal fins. In the female, the pelvic fin is weaker and smaller. The length of the pelvic fin in female is contained 1.40-1.56 times in head length, 7.37-7.60 in total length and 1.26-1.40 times in the distance between the origins of the ventral and anal fins. This clearly distinguishes the male and the female.

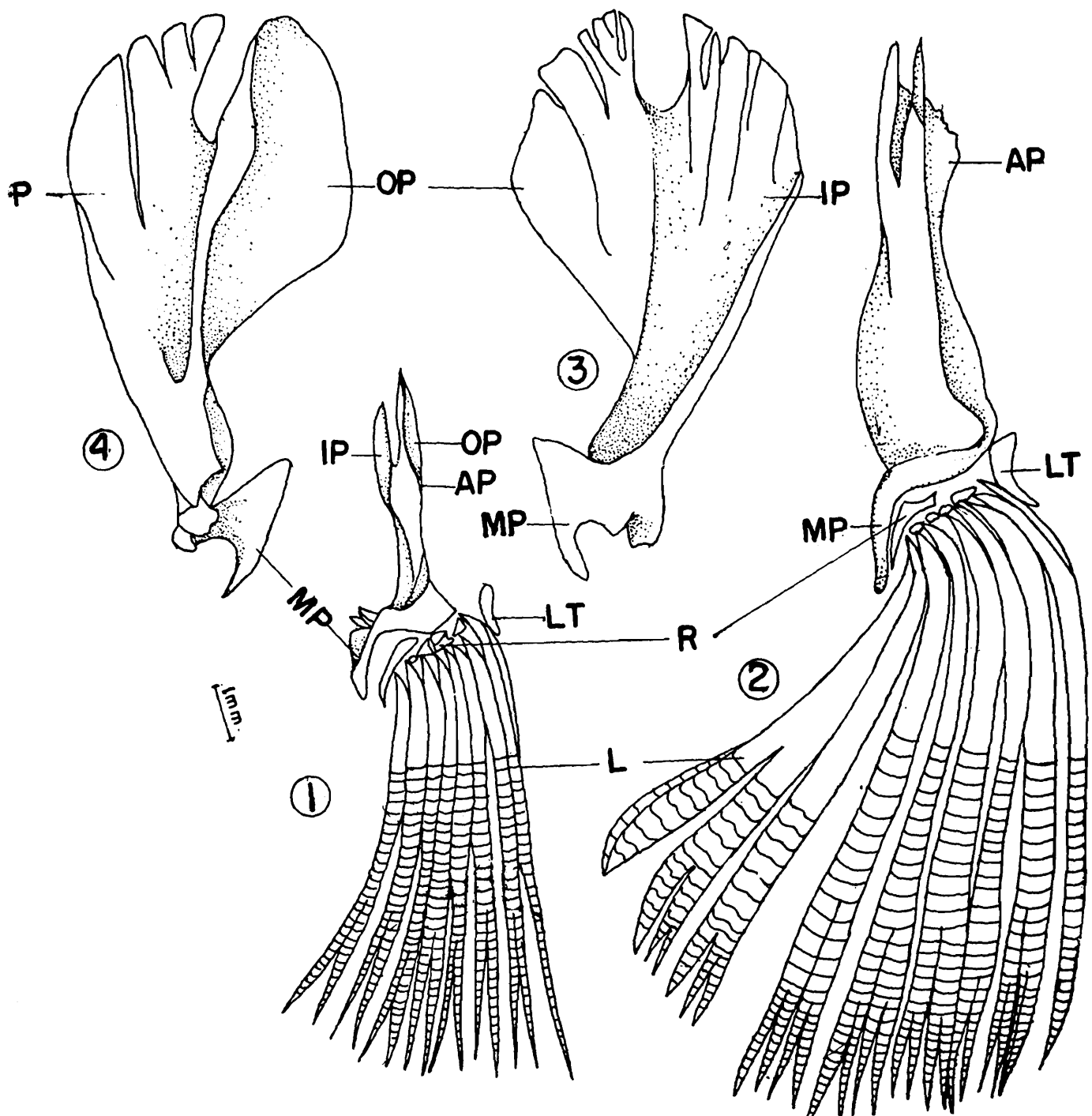
Pelvic girdle :

The pelvic girdle of *B. barna* is basically of a cyprinid type (Howes, 1978, 1980) but is highly modified in the case of male.

In female (fig. 1), the basipterygium is thin and weak with the anterior end (AP, fig.1) bifurcated into outer (OP, fig.1) and inner processes (IP, fig.1). The outer process (OP, fig.1) is slightly longer than the inner (IP, fig.1) and also bears a vertical ridge for attachment of pelvic muscles. The inner process (IP, fig.1) is twisted at the tip. The medial process (MP, fig.1) is prominent and helps in the union of basipterygium of the other side. The anterior process of the basipterygia of the two sides do not meet each other. Attached to the bifid ends of the lepidotrichia (L, fig.1) of the pelvic fin on the one side and the body of the basipterygium of the other, There are six radials (R, fig.1). Five of the radials are small nodular bodies while the sixth and the inner-most radial is bent rod-shaped bone which lies outer to the medial process, probably to afford additional strength to the pelvic symphysis. The laterotrichium (LT, fig. 1) is a small rod-shaped bone attached to the outer side of the base of the first unbranched ray to which is attached another reduced ray of much smaller length.

In the male (fig. 2,3,4), the basipterygium has a formidable growth and the anterior process (AP, fig. 2,3,4) has expanded into a wide plate-like structure. The outer (OP, fig. 2,3,4) and the inner (IP, fig. 2,3,4) processes of the anterior end of the basipterygium are separated by a wide notch.

In life, the anterior end of the basipterygia as well as the medial processes of the two sides remain closely applied to each other. In the dorso-lateral expanded position (fig.3,4), both on the outer as well as the inner surfaces of the basipterygium, there are strong ridges and deep grooves for the accommodation of formidable pelvic muscles. There are only five radials (R, fig. 2) and the laterotrichium (Lt, fig.2) are accordingly enlarged and thickened.



Abbreviations

A P , anterior process; I P , inner process; L , lepidotrichium; L T , laterotrichium; M P , medial process; O P , outer process; R , radial.

Fig. 1. Dorsal view of pelvic girdle of *Barilius barna* (Female). Fig. 2. Dorsal view of pelvic girdle of *Barilius barna* (male). Fig. 3. Medial view of pelvic girdle of *Barilius barna* (male) Fig. 4. Lateral view of pelvic girdle of *Barilius barna* (male).

DISCUSSION

The sexual dimorphism in the genus *Barilius* has earlier been reported in the pectoral girdle of *B. bendelisis* by Tilak and Jaffer (1982) and Tilak and Baloni (in press) and no other species of this genus has been reported to show any kind of sexual dimorphism. The discovery of a trenchant difference in the pelvic fins and the girdles of the male and female of *B. barna* is quite important because it differs from *B. bendelisis* in which a similar difference exists only in the pectoral region. The tubercles on the scales and the snout, the depth of body, the length of pelvic fins and development of the basipterygium and related structure are significantly different in the male and the female of *B. barna*. The formidable expansion of the anterior fan-shaped process of basipterygium of male with prominent ridges and grooves is a development for holding and attachment of strong muscles of the pelvic region. Such strong muscles are required for the movement of heavily built pelvic fin of the male. The thickened pelvic rays, a few of the last rays tending to fuse, forming a strong bony fin is probably used for digging in the sand and mud. It appears that the male digs a burrow during the breeding season for the accommodation of the spawn laid by the female. This heavy development of the pelvic fin is probably because of the special type of parental care assumed by the male. The pelvic fin and the girdle of the females is not so developed because such a demand is not made on this structure of this sex.

The extreme changes in the shape and size of pelvic girdle of the male and the female is brought about due to the secondary sexual characters assumed by the male and they help to distinguish the sexes without any difficulty. Such a change in the body of the male during breeding or near breeding periods of the year is irreversible.

It is a curious fact to record that the exhibition of sexually dimorphic characters is prominently exhibited in the pelvic region of *B. barna* and in the pectoral region of *B. bendelisis*. This shift in the function of the fins of the male of the two species is probably co-related with their mode of living.

Day (1878), while describing *B. barna*, recorded the characters of the young and the adult. The present study indicates that the young of Day (1878) is infact the female and the adult the male. Day (1878) did not record any kind of sexual dimorphism in this species. The taxonomic description of *B. barna*; therefore, needs a revision through a study of long series of both the male and female of this species. Such a study of this species is nearing completion and an updated description will be published elsewhere.

SUMMARY

There is a marked sexual dimorphism in the male and female of *Barilius barna* Hamilton in the pelvic region which is different from *B. bendelisis* which exhibits such a difference in pectoral region. The sexually dimorphic characters of the male are normally developed during the breeding season and there after the development so acquired becomes irreversible. The well developed pelvic fin with thickened and partly fused rays, the strong and fan shaped pelvic bone, tubercles on the scales of the body and on the snout, and deeper body in the male distinguish it clearly from the female. The pelvic fins and the girdles of both the female and male are described and figured to highlight the sexually dimorphic character.

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**ON A COLLECTION OF GROUSE - LOCUSTS (ORTHOPTERA :
TETRIGIDAE) FROM MAHARASHTRA, INDIA, WITH SOME NEW
DISTRIBUTIONAL RECORDS**

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INTRODUCTION

Walker (1871), Bolivar (1898, 1902 and 1917), Hancock (1912, 1913, 1915), Kirby (1914), Hebard (1929), Gunther (1938 and 1939) and Willemse (1938) have studied the Tetrigid fauna of India. However, none has dealt with the Tetrigid fauna of Maharashtra State exclusively.

The present study is based upon the material collected from the State by Dr. B. S. Lamba former Joint Director of the Zoological Survey of India, and Dr. S. Y. Paranjape and his colleagues of the Modern College, Pune. It reports a total of fifteen species of which eight are recorded here for the first time from Maharashtra State. The distributional records of all included species have been provided.

A list of eleven species recorded earlier by other authors from Maharashtra State is also appended at the end.

SYSTEMATIC ACCOUNT

Order	ORTHOPTERA
Superfamily	TETRIGOIDEA
Family	TETRIGIDAE
Subfamily	CLADONOTINAE

1. *Potua sabulosa* Hancock

1915. *Potua sabulosa* Hancock, *Rec. Indian Mus.*, 11 : 62 - 63.

Material examined : 1 Male, Satara District, Satara Road, Girivihar, 17.vii. 1983, S.Y. Paranjape & Party.

Distribution : India (Maharashtra - Satara District).

Remarks : Median carinula of vertex short, a little produced in front and extended up to the middle of eyes behind ; frontal costa arched between the antennae, narrowly forked

between the paired ocelli and widely forked in front ; paired ocelli placed below the middle of eyes ; antennae filiform and located below the level of eyes.

Pronotum extended upto the two-thirds of the posterior femora ; lateral carinae of pronotum distinct ; prozonal carinae prominent and run parallel ; lateral lobes of pronotum deflexed downwards and subtruncate at apex ; tegmina minute and elongate ; wings reduced to minute scales ; anterior femora little compressed, lower margin well serrated and tuberculated, upper margin finely serrated ; median femora compressed, bicarinate, upper margin undulated and lower margin denticulated - the nature of denticle laminate type ; posterior femora widened, upper margin curved and produced into a prominent spine at apex, lower margin subtuberculated ; posterior tibiae biannulate with yellow band ; first and third tarsal segments of posterior legs more or less equal in length ; first and second pulvilli a little shorter than the third.

This specimen differs from the description provided by Hancock (1915) for this species, in having the extension of pronotum up to two-thirds of the posterior femora and the presence of wings in the form of minute scales.

The present specimen was collected from the wet walls, covered with mosses and Bryophytes.

Subfamily SCELIMENINAE

2. *Euscelimena harpago* (Serville)

1839. *Tetrix harpago* Serville, *Ins. Orth.*, : 763.

1887. *Scelimena harpago*, Bolivar, *Annls soc. ent. Belg.*, 31 : 216.

1938. *Euscelimena harpago*, Gunther, *Mitt. zool. Mus. Berl.*, 23 : 364.

Material examined : 1 Male, Pune, Shivajinagar, Bank of river Mutha, 559 m, 25.v. 1983, Dr. S.Y. Paranjape & Party.

Distribution : India (Maharashtra, Tamilnadu, Madhya Pradesh, Uttar Pradesh and Bihar) ; and Sri Lanka.

Remarks : It is semi-aquatic in nature : found near the water line of perennial water bodies. Its coloration and swimming adaptations have been described by Roonwal (1981).

3. *Criotettix latifrons* Hebard

1929. *Criotettix latifrons* Hebard, *Revue suisse Zool.*, 36 : 578.

Material examined : 2 Females, Nasik, Panchwati, Bank of river Godawari, 5.iii.1983, Dr. S.Y. Paranjape and Party.

Distribution : South India.

Remarks : Collected by the side of perennial water bodies, especially rivers and streams. Recorded here for the first time from Maharashtra.

4. *Eucriotettix tricarinatus* (Bolivar)

1887. *Criotettix tricarinatus* Bolivar, *Annls Soc. ent. Belg.*, 31 : 223.

1929. *Eucriotettix tricarinatus*, Hebard, *Revue suisse Zool.*, 36 : 573.

Material examined : 1 Male, Ahmednagar , Bank of stream near Dongargan , 17. iii. 1983, Dr. S.Y Paranjape and Party.

Distribution : India (Tamilnadu and Kerala) ; and Sri Lanka.

Remarks : Collected from the marshy vegetation near the stream. Recorded here for the first time from Maharashtra.

5. *Eucriotettix flavopictus* (Bolivar)

1902. *Criotettix flavopictus* Bolivar, *Annals Soc. ent. Fr.*, 70 : 582.

1938. *Eucriotettix flavopictus*, Gunther, *Stettin. ent. ztg.*, 99 : 133, 170, 180, 187.

Material examined : 2 Females, Satara, Mahabaleshwar, Lingmala, 1372m., 20.vii. 1983, Dr. S.Y. Paranjape and Party.

Distribution : India (Tamilnadu, Kerala, Karnataka, Meghalaya-Cherrapunji) ; Burma-Dawna Hills.

Remarks : Spines of lateral lobes of pronotum are not much longer and pointed. This species is generally found in South India but once has been reported from Cherrapunji (Hancock, 1907). Present specimens were collected in the vicinity of torrential streams. Recorded here for the first time from Maharashtra.

6. *Eucriotettix* sp.

Material examined : 2 Males, Satara, Mahabaleshwar, Pratapgad, 10. x. 1982, Dr. S.Y Paranjape and Party.

Distribution : India ; Sri Lanka ; Burma ; Taiwan ; South China-Hainan, Indonesia-Borneo, Java and Bali ; Singapore ; Greater and Smaller Sunda Islands ; Tonkin ; and New Guinea.

Remarks : Specimens were collected in the vicinity of streams and water-falls. This species come very close to *Eucriotettix Pallidus* (Hancock) except that the posterior process of pronotum of it is not subnodulose.

7. *Thoradonta lativertex* Gunther

1983. *Thoradonta lativertex* Gunther, *Stettin. ent. ztg.*, 99 : 128.

Material examined : 1 Female, Jalgaon, 15. xi. 1982, Dr. S. Y. Paranjape and Party; 1(F), Jalgaon Bank of Sukhi Pal river, 5. i. 1983, Dr. S. Y. Paranjape and Party.

Distribution : India (Himachal Pradesh).

Remarks : Recorded here for the first time from Maharashtra. The specimens were collected near the perennial water bodies.

8. *Thoradonta pruthii* Gunther

1938. *Thoradonta pruthii* Gunther, *Stettin. ent. ztg.*, **99** : 129.

Material examined : 1 Male, Pune, Empress garden, 25. ii. 1983, Dr. S. Y. Paranjape and Party.

Distribution : India (Madhya Pradesh and Karnataka).

Remarks : Recorded here for the first time from Maharashtra. This material was collected in the vicinity of perennial water bodies, especially rivers and streams.

Subfamily TETRIGINAE

9. *Euparatettix personatus* (Bolivar)

1887. *Paratettix personatus* Bolivar, *Annls Soc. ent. Belg.*, **31** : 278.

1904. *Euparatettix personatus*, Hancock, *Spolia zeylan.*, **2** : 145.

Material examined : 1 Male, Ahmednagar, Shirdi, 11. xi. 1982, Dr. S. Y. Paranjape and Party.

Distribution : India (Throughout India); Burma; Sri Lanka; Indonesia - Java; Philippines; and Sulawesi.

Remarks : It was collected in the vicinity of marshy vegetation near lakes.

10. *Euparatettix histricus* (Stal)

1860. *Tetrix histrica* Stal, *Kong. Svens. Fregatten Eugenics Resa Omkring Jorden*, Stockholm, **3** : 347.

1887. *Paratettix histricus*, Bolivar, *Annals Soc. ent. Belg.*, **31** : 279.

1937. *Euparatettix histricus*, Gunther, *Revue suisse Zool.*, **44** : 133.

Material examined : 1 Male, Dhule, near Nekana Lake, 9. x. 1982, Dr. S. Y. Paranjape and Party; 1(M), Raigad, Khopoli, near Khandala Lake, 11. x. 1982, Dr. S. Y. Paranjape and Party; 1(M), Pune, near Pashan Lake, 20. xi. 1982, Dr. S. Y. Paranjape and Party; 1(M), Pune, Shivajinagar, bank of river Mula, Dr. S. Y. Paranjape and Party; 1 Female, Nasik, bank of river Godawari, 5. ii. 1983, Dr. S. Y. Paranjape and Party; 1(F), Ahmednagar, Sangammer, bank of river Pravara, 7. ii. 1983, Dr. S. Y. Paranjape and Party; 1(F), Pune, Shivajinagar, bank of river Mutha, 5.iii. 1983, Dr. S. Y. Paranjape and Party.

Distribution : India (Tamilnadu, Orissa, Bihar, West Bengal, and Meghalaya); Sri Lanka; Java; Borneo; Sumatra; Philippines-Mindanao; Malay Islands; N. Australia; and N. Caledonia.

Remarks : Colour variations are recorded as follows : whole pronotum dark brown or dirty yellow, except the middle of shoulders which is brown; median longitudinal stripe white, and the thin lateral line white which runs from the anterior to the posterior part of shoulders; head and anterior part of shoulders dark brown, and the rest part ashy with one oblique dark brown patch behind the shoulders; whole pronotum dark brown except the middle of shoulders which is brown; whole pronotum dirty yellow are recorded.

Specimens were collected from the marshy vegetation near lakes or rivers. Recorded here for the first time from Maharashtra.

11. *Hedotettix gracilis* (De Hann)

1842. *Acridium* (*Tetrix*) *gracile* De Hann, *Temminck, Verh- handel., Orth.*, : 167, 169.

1887. *Hedotettix gracilis*, Bolivar, *Annls Soc. ent. Belg.*, 31 : 188, 283.

1914. *Hedotettix gracilis*, Kirby, *Faun. Brit. India, Orth. Acrid.*, : 72.

Material examined : 12 Males, 4 Females, Pune, Bhorghat, 15. x. 1965, Dr. B.S. Lamba ; 1(M), Raigad, Khopoli, near Khandala Lake, ii. x. 1982, Dr. S. Y. Paranjape and Party; 1(F), Pune, Shivajinagar, bank of river Mula, 28. xi. 1982, Dr. S. Y. Paranjape and Party.

Distribution : India (Throughout) ; Burma ; Sri Lanka ; Pakistan ; Bangladesh ; Thailand ; Indonesia-Sumatra, Java ; Sulawesi ; Vietnam ; and Taiwan.

Remarks : Specimens were collected from the marshy vegetation.

12. *Hedotettix punctatus* Hancock

1909. *Hedotettix punctatus* Hancock, *Trans. R. ent. Soc. Lond.*, 1908: 422.

Material examined : 1 Male, 1 Female, Pune, Pashan Lake, 12. ii. 1983, Dr. S. Y. Paranjape and Party.

Distribution : India and Borneo.

Remarks : Gunther (1941) studied the material of this species from Madhya Pradesh (Basha Ghat), and Rajasthan. It was also studied by me from Karnataka (Bangalore). Present report from Maharashtra is a new record. The specimens were collected from the vicinity of marshy vegetation.

13. *Coptotettix conspersus* Hancock

1915. *Coptotettix conspersus* Hancock, *Rec. Indian Mus.*, 11 : 119.

Material examined : 162 Males, 165 Females, Pune, Bhorghat, 15. x. 1965, Dr. B. S. Lamba; 1(M), 1(F), Pune, Pashan Lake, 12. ii. 1983, Dr. S. Y. Paranjape and Party; 1(M), 1(F), Ahmednagar, bank of river Sina, 2. ii. 1983, Dr. S. Y. Paranjape and Party.

Distribution : India (West Bengal, Assam, and Uttar Pradesh) ; and Sri Lanka.

Remarks : Pronotum presents significant colour variations : it varies from brown to dark brown or rusty, creamy to whitish in general, but variegation or shades of different colours also marked. These shades of colour may be as follows : a broad transverse yellow or brown band on the shoulders, or a long linear white line in the middle of pronotum, which runs from head to the posterior end of tegmen or head and the anterior part of shoulders more darker than the posterior, or the colour of posterior angles of lateral lobes of pronotum may be different than that of pronotum. Posterior femora also show colour variations. It may resemble or completely differ in colour with the pronotum.

The undulations of median carina of pronotum also vary. These are either superficial, or clearly marked with intermediate stages as well. In males, the depth of these undulations are less pronounced than the females, but exceptions are also met with. The granules and rugulae on the pronotum may be feeble or prominent, and distributed sparsely.

Recorded here for the first time from Maharashtra.

14. *Ergatettix dorsifera* (Walker)

1871. *Tettix dorsifera* Walker, *Cat. Derm. Salt. Brit. Mus.*, 5 : 825.

1929. *Ergatettix dorsifera* , Hebard, *Revue suisse Zool.*, 36 : 588.

Material examined : 3 Males, 5 Females, Pune, Bhorphat, 15. x. 1965, Dr. B. S. Lamba.

Distribution : India (Uttar Pradesh, Bihar, Orissa, West Bengal, Madhya Pradesh, Assam, Kerala, Karnataka, and Maharashtra); Burma; Sri Lanka; Bangladesh; Nepal; and Sumatra.

Remarks : It is closely related to *Ergatettix guntheri* steinmann but differs in having less distinct undulation on median carina, and without dilated lobes on the lateral carinae of hind process of pronotum; and less developed tubercles on external surface in the middle of hind femora.

15. *Ergatettix guntheri* Steinmann

1912. *Euparatettix nodulosus* Hancock, *Mem. Dep. Agric. India ent. Ser.*, 4 : 155. (preoccupied).

1970. *Ergatettix guntheri* Steinmann, *Acta zool. hung.*, 16 (1-2) : 234.

Material examined : 1 Male, Ahmednagar, Shirdi, 11. xi. 1982, Dr. S. Y. Paranjape and Party, Dhule, near Nekana lake, 20. i. 1983, Dr. S. Y. Paranjape and party.

Distribution : India (West Bengal, Assam, Madhya Pradesh, Orissa, Bihar, Uttar Pradesh, and Maharashtra); Bangladesh; and Sri Lanka.

Remarks : The dorsum of pronotum with strongly developed rugulae and nodules, median carina of pronotum with clear undulations and distinctly developed tubercles on external surface of hind femora.

List of other species recorded by earlier authors from Maharashtra State.

Name	Locality
1. <i>Acanthalobus curticornis</i> Hancock	Satara District : Yenna Valley, Medha, 2200 Ft. (F. H. Gravely).
2. <i>Scelimena uncinata</i> (Serville)	Bombay.
3. <i>Thoradonta sinuata</i> Hancock	Satara District : Western of Yenna Valley, Moleshwar, 3200 Ft. (F.H. Gravely).
4. <i>Euparatettix corpulentus</i> Hancock	Western base of Western Ghats : Kasara.

5. <i>Tetrix lineifera</i> (Walker)	Bombay.
6. <i>Tetrix lineosua</i> (Walker)	Bombay.
7. <i>Tetrix nigricolle</i> (Walker)	Bombay.
8. <i>Tetrix obliquifera</i> (Walker)	Bombay.
9. <i>Tetrix umbrifera</i> (Walker)	Bombay.
10. <i>Coptotettix indicus</i> Hancock	Bombay : Kalayan; Satara District, Koyna Valley, Vela, 2,100 Ft. (F. H. Gravely).

SUMMARY

Fifteen species are reported from Maharashtra, out of which eight are new records for this State.

ACKNOWLEDGEMENTS

I am grateful to the Director, Zoological Survey of India, for providing the laboratory facilities, and to Dr. S. Y. Paranjpe, Modern College, Pune, for placing his valuable collection for study at my disposal. Thanks are also due to Dr. G. K. Srivastava, for going through the manuscript.

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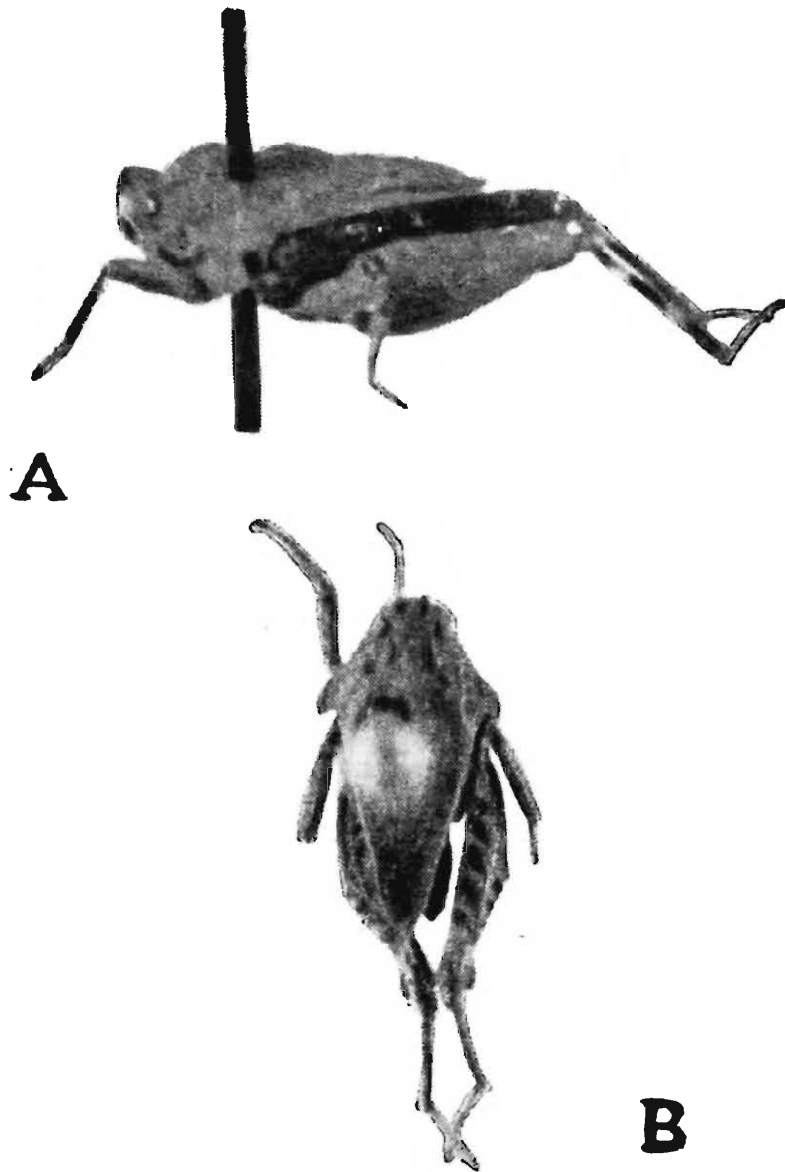
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* Original not seen

SHISHODIA

Plate 1



- A.** Lateral View of the Body of *Potua Sabulosa*
Hancock.
- B.** Dorsal View of the Body of *Potua Sabulosa*
Hancock.

ON THE TAXONOMICAL DESCRIPTION AND DISTRIBUTION OF COPPER MAHSEER, *ACROSSOCHEILUS HEXAGONOLEPIS* (McCLELLAND)

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INTRODUCTION

Being faced with the various technological constraints with respect to the composite fish culture in the hilly area, the extension of an alternate pisciculture practice in such regions is certainly obvious. Moreover, in hilly areas, due to diverse climatic conditions ranging from tropical climate of the foot-hills through temperate to Alpine conditions of the high hills and the varied topographical conditions, no single aquacultural practice can be suggested. In this regard, the practice of hill-stream fisheries and the conservation of the important hill stream fishes will be much valuable. Mahseers among the hill stream fishes form an important group which possesses some fishery potentialities.

The fish *Acrossocheilus hexagonolepis* known as copper mahseer is a commercially important rheophilic teleost of north-eastern India. It is locally known as Katli in Nepal, Bokar in Assamese and Ngara in Manipur. The fish is found to have a good growth rate attaining 134-145 mm. in the first year of its life and generally attains a maximum length of 72 cm. weighing 5.5 kg. It can be used for stocking purpose also.

The genus *Acrossocheilus* is known to be represented in the Indo-Malayan region by the following eight species:

1. *A. bantamensis* (Rendahl)
2. *A. deauratus* (Cuv. & Val.)
3. *A. hexagonolepis* (McClelland)
4. *A. malcomi* Smith
5. *A. manipurensis* Datta, Karmakar & Laishram
6. *A. schroederi* Smith
7. *A. sumatranus* (Weber & Beaufort)
8. *A. vittatus* Smith

In India, the genus is represented by two species viz. *A. hexagonolepis* and *A. manipurensis*. The relationship and their identifying characters has already given by Datta *et al.*, (1984).

Taxonomic position of A. hexagonolepis :

McClelland (1839) was the first to identify this species from the large rivers of Assam under the genus *Barbus*. Day (1878, 1889); Misra (1959); and Jayaram (1981) have already described the taxonomic position of this fish.

The genus *Acrossocheilus* was erected by Oshima in 1919 for a Formosan species (*formosanus*) and now is used for the group of fishes of South-eastern Asia formerly called *Lissocheilus* (Myers, 1941 and Smith, 1945). Thus, this species although discovered under the genus *Barbus*, was for sometimes included under the subgenus *Lissocheilus* and now under the genus *Acrossocheilus* as the name *Lissocheilus* is not available for use in ichthyology because it was first employed by Zittel (*Handbuch der Palaeontologie*, 1882) for a genus for fossil molluscs.

MATERIAL

125 specimens of the fish were collected from Taret hill stream, Tengnoupal District, Manipur. Morphometric measurements were made; the colouration in fresh condition was recorded and their habits were also observed.

SYNONYMY

1839. *Barbus hexagonolepis* McClelland, *Asiat. Res.* xix, pp. 270, 336 pl. xli, fig. 3 (type locality: large rivers of Upper Assam).
1940. *B. (Lissocheilus) hexagonolepis*, Hora, *J. Bom. nat. Hist. soc.*, xlii, p. 78, text-figs. 1-4, pl. (see for synonymy).
1945. *Acrossocheilus dukai*, Smith, *Bull. U.S. nat. Mus.*, No. 188, p. 205.

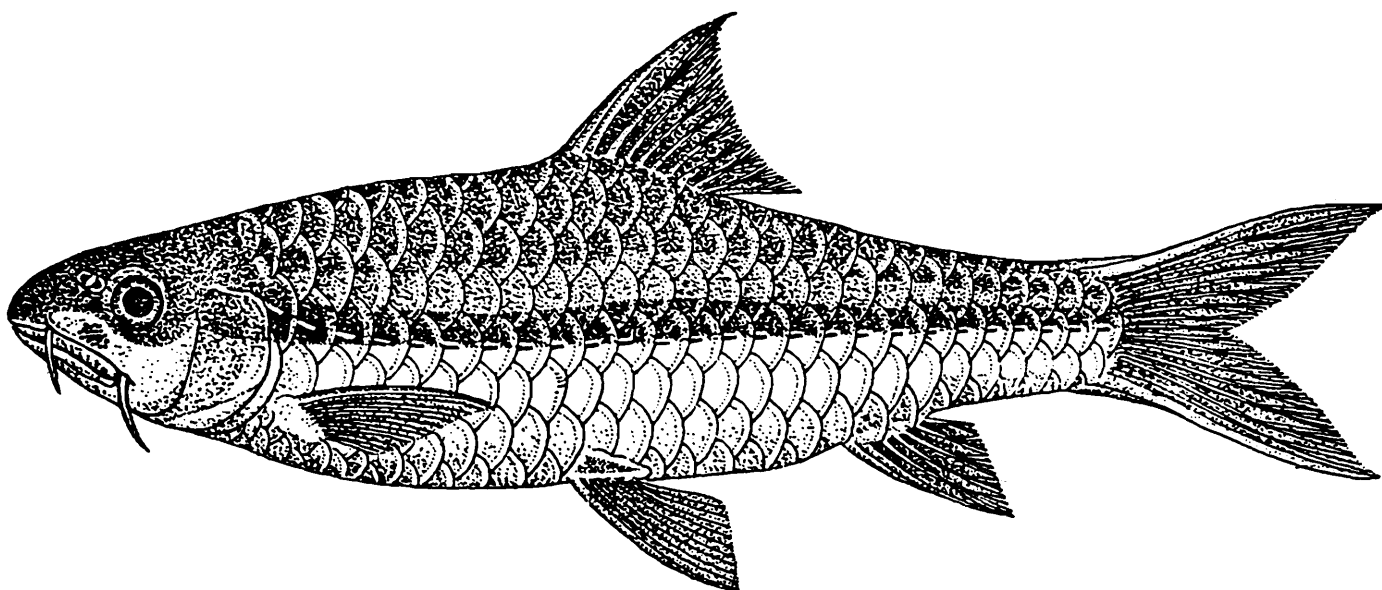


Fig 1. *Acrossocheilus hexagonolepis* (McClelland)

DESCRIPTION (Fig.1)

D.3/9; P.14; V.9; A.2/5; C .19; L.1. 26-28

Body elongated, not very deep and compressed. Dorsal and ventral profiles more or less equally arched. Head relatively shorter and bluntly rounded in front. Several rows of horny tubercles present on sides of the snout, in front and below eyes. Lips thick, continuous round the angle of mouth, but labial groove widely interrupted in the middle. Lower jaw covered by a sharp horny covering. Two pairs of barbels maxillary pair longer than rostral.

Length of head 4.9 - 5.1; of caudal 5.7 - 6.0; and depth of body 4.7 - 5.2 times in total length. Least height of caudal peduncle 2 times in its length. Diameter of eye 1.8 - 1.9 from the tip of snout; 1.75 - 2.4 times in inter-orbital space and 4.4 - 5.5 times in length of head.

Fins : Dorsal inserted opposite or slightly in advance of pelvics, its spine strong and entire. Pectoral fins low and pointed. Caudal deeply forked with pointed lobes.

Scales : Large and hexagonal, lateral line complete with 26-28 scales. Pre-dorsal scales 8; circumpeduncular scales 9; 5/2 scales between lateral line and base of pelvic fin and 9/2 scales between lateral line and base of dorsal fin.

Colour : Body beautifully coloured with olive green superiorly and silvery white below with a dark yellowish green lateral band above lateral line. Sides of head golden. In large sized individuals, back and head, base of fins and scales blackish grey; but opercular plates, fins and scales tipped with yellow.

Distribution , Habit and Habitat : Widely distributed in the fresh waters of Southern China, Thailand, Burma, Malay Peninsula and Archipelago.

In India, the fish is generally distributed in the hill streams of Eastern Himalayas, Assam, Garo Hills, Naga Hills, Khasi Hills and Manipur. The fish is purely an inhabitant of hill stream, where it takes freely worms and other baits. During the day time, they move in shoals in the area where current is not very fast but the fish is considered a fast swimmer. It has wide tolerance of water temperature 10° c to 31° c.

SUMMARY

A detailed study on taxonomic characters including synonymy of the copper mahseer, *Acrossocheilus hexagonolepis* (McClelland) from Taret hill stream, Tengnoupal District of Manipur has been made here with a view to add additional data to the existing description of the species. The colouration, habit and habitat with its distribution in India and extra-Indian regions are also given.

ACKNOWLEDGEMENT

The author is grateful to the Head, Department of Zoology, University of Calcutta for providing necessary facilities. Gratitude is expressed to Dr. N.C. Datta, Dept. of Zoology,

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**CONTRIBUTION TO THE AMPHIBIAN FAUNA OF ANDAMAN AND
NICOBAR WITH A NEW RECORD OF THE MANGROVE FROG,
RANA CANCRIVORA.**

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INTRODUCTION

The amphibian fauna of Andaman and Nicobar Islands is very poorly known. Barring the few records of Ranid frogs in his monograph by Boulenger (1920) , the papers on the Amphibia of Andaman and Nicobar are those of Cherchi (1954) , Pillai (1977) and Mansukhani and Sarkar (1980).

The present paper is based on a collection sent to the author by Dr A.K. Das from the Andaman and Nicobar Regional Station, Port Blair in 1980 and an earlier collection made by Shri S. Chakrapani in October, 1972. In all, 15 examples have been studied and these belong to two families and four species.

The discovery of *Rana cancrivora* inhabiting mangrove swamps and hitherto not known from either Indian mainland or Andaman and Nicobar deserves special mention. One example of *Rana keralensis*, presently considered to be restricted to Kerala and Tamilnadu has also been recorded from Andaman.

SYSTEMATIC ACCOUNT

Class AMPHIBIA
Order ANURA
Family RANIDAE

1. *Rana cancrivora* Gravenhorst

1920. *Rana cancrivora*, Boulenger, *Rec. Indian Mus.*, 20 : 23.

1923. *Rana cancrivora*, Van Kampen, *The Amphibia of the Indo-Australian Archipelago* : 170.

1954. *Rana cancrivora*, Inger, *Fieldiana Zoology*, 33 : 260.

Material examined : 1 ex., Carbyn's cove, Port Blair, 6.ii.1980, Coll. K.K.Tiwari; 1 ex., Krishnanagar, Havelock, 10. vi. 1980, Coll. M.K. Dev Roy. Both the specimens were from mangrove swamps.

Distribution : *R. cancrivora* is known from Malay Peninsula, Java, Sumatra, Borneo and Philippines. It has not previously been recorded from the Indian Mainland or Andamans.

Description : Head a little broader than long, inter-orbital space narrower than upper eyelid, tympanum distinct, its diameter half that of eye , tips of fingers and toes obtuse, first

finger extending beyond second, tibio-tarsal articulation reaches eye, toes three-fourths webbed, the webs strongly notched, two distal phalanges of fourth toe free, outer metatarsal separated nearly to the base and with a distinct dermal fringe along the outer side, an inner blunt metatarsal tubercle, no outer tubercle.

Upper surface with short elongated folds and tubercles in the example from Krishnagar (48 mm in total length) while, it is smooth in the example from Carbyn's Cove (34 mm). Smooth ventrally.

Brown above with a few dark spots. No vertebral line. A small white spot on forehead between the anterior corners of eyes. Ventrally white, faintly marbled with brown.

Remarks: Annandale (1920) remarks that this species is frequently found in brackish water and is able to survive in sea water for short periods. This has enabled the species to live in the mangrove swamps of Andaman. No other species of frog was collected from these areas. Inger (1954) notes that in the Philippines, they may be found in ditches, rice fields, ponds or swamps.

Rana cancrivora is the only amphibian recorded from mangrove areas of South East Asia (Macnae, 1968). Its tadpoles are common in pools within the swamp and eggs are laid in crab holes.

Rana cancrivora is not known from the Indian mainland. Although not previously recorded from Andaman and Nicobar group of islands, its occurrence is not unexpected judging from its known pattern of distribution.

2. *Rana keralensis* Dubois

1920. *Rana verrucosa*, Boulenger, *Rec. Indian Mus.*, 20 : 26.

Material examined : 1 ex., Mayabunder, Andaman, 13.x.1972, Coll. S. Chakrapani.

Distribution : Forested hills of Kerala and Tamilnadu.

Remarks : This small frog measuring 30 mm in head and body agrees well with the descriptions of Boulenger (1920) and Daniel (1975). This new record of the species from the Andaman Island constitutes a major extension outside its distribution viz. the southern tip Indian mainland.

3. *Rana limnocharis* (Boie) Wiegmann

1920. *Rana limnocharis*, *Rec. Indian Mus.*, 20 : 28.

1923. *Rana limnocharis*, Van Kampen, *The Amphibia of the Indo-Australian Archipelago* : 167.

Material examined : 1 ex., Havelock Island, 6.x.72, coll. S. Chakrapani, 2 exs., Havelock Island, 8.x.72, Coll. S. Chakrapani; 1 ex., South Port Blair, 18.x.72, Coll. S. Chakrapani; 1 ex., Kalighat, 18.x.72, Coll. S. Chakrapani; 1 ex., Dalthaman tank, Port Blair, 19.vii.78, Coll. M.K. Dev Roy; 1 ex., Delanipur, Port Blair, 1.x.1980, Coll. H.L. Das.

Distribution : India, Sri Lanka, South China and Japan to the Malay Peninsula and the Philippines.

Remarks: 7 examples ranging from 22 mm to 50 mm in body length are referable to this species notwithstanding a certain degree of variation exhibited by a few examples.

Boulenger (1920) recognises three separate sub-species including *andamanensis* from the Andaman group of islands. The present examples do not readily fall into the frame work of *andamanensis*. Owing to its wide distribution in diverse habitats and abundance, *R. limnocharis* exhibits considerable intraspecific variations which often renders recognition of subspecies difficult.

Family BUFONIDAE

4. *Bufo camortensis* Mansukhani and Sarkar.

1980 . *Bufo camortensis*, Mansukhani and Sarkar, *Bull. zool.Surv. India*, 3 (1 & 2) : 97.

Material examined: 1 ex., Arong, Car Nicobar, 26 . xii . 1979, Coll . M.K.Dev Roy; 1 ex., Chukchuka, Car Nicobar, 28 .xii .1979, Coll . M.K. Dev Roy; 1 ex., I. A. F. Car Nicobar, 29. xii. 1979, Coll. M.K.Dev Roy; 1 ex., Kynuka, Car Nicobar, 30. xii. 1979, Coll. M.K. Dev Roy; 1 ex., Kakana, Car Nicobar, 5. i. 1980, Coll. M.K. Dev Roy; 1 ex., Kimus, Car Nicobar, 5.i. 1980, Coll. M.K. Dev Roy.

Distribution: Known only from Andaman and Nicobar Islands, India.

Remarks: Six more specimens ranging in size from 32 mm to 86 mm are being recorded from the above localities in Car Nicobar since its discovery in 1980 from Camorta and Nancowry Islands.

Except for the two small examples measuring 32 and 35 mm from I.A.F. and Arong respectively, the presence of a parietal ridge, though faint, is unmistakable. Though not mentioned in the description, this ridge is clearly discernible in the figure given by the authors. The presence of a parietal ridge would certainly alter the interspecific affinities of this species. Contrary to the view held by Mansukhani and Sarkar, on the basis of the presence of a parietal ridge, *B. camortensis* is likely to be more related to *B. parietalis* Boul., *B. fergusoni* Boul. or *B. silentvalleyensis* Pillai (1981) known from the hills of southern India or with *B. biporcatus* Gravenhorst from Java, Borneo and Burma and not to *B. melanostictus*. The parietal ridge in *B.camortensis* is deflected to the median line making an angle with the supraorbital ridge as in *B. parietalis* or *B. silentvalleyensis*.

In all other characters the present specimens agree with the descriptions of Mansukhani and Sarkar.

SUMMARY

Four species of Amphibia falling under two families are being reported from Andaman and Nicobar. The discovery of the mangrove frog, *Rana cancrivora* is significant since it has not previously been recorded from either these islands or from the Indian mainland. *Rana keralensis* which was restricted to Kerala and Tamilnadu is also recorded from Andaman.

ACKNOWLEDGEMENT

The author is indebted to Dr A. K. Das for making the collections available.

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NOTES ON AMPHIBIANS COLLECTED FROM BASTAR DISTRICT, MADHYA PRADESH, INDIA

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INTRODUCTION

Amphibian fauna of the sparsely populated tribal district of Bastar is poorly known. The works of Annandale (1909), Boulenger (1882, 1890, and 1920) and Parker (1934) contain no information of the amphibians of Bastar. Keeping this in view, a survey of Bastar district was undertaken by the Herpetology Division of the Zoological Survey of India from 1979 to 1981. 1047 examples of amphibians were collected from different ecological habitats like muddy drains, tanks, lakes, bushes, trees, litter, and village huts.

DESCRIPTION OF BASTAR DISTRICT

Bastar district is situated between latitudes 17° 46' N. and 20° 34' N. and longitudes 80° 15' E. and 82° 1' E., and its area is about 39,060 Sq. km.

The land is undulating, rocky and infertile. For this reason cultivation is poor, and as a consequence, the standard of living is also very poor. The district can be divided into five main physiographic divisions, viz., Kotri-Mahanadi plain in the north ; Abujhmar Hills ; northeastern plateau (Indrawati Plain) ; southern plateau which include Bailadila Hills, Tikanpalli Hills and Dantewara Plain ; and Godavari-sabari lowland.

This district is very hot during summer (46.1° C in May) because of hot winds that blow all day and night. During winter the cold is severe (4.4° C in December). Monsoon prevails from the middle of June to middle of October. It is more (150-160 cm) in the southwestern and less (130-150 cm) in the northeastern and southern parts.

Bastar is a forest district. Here trees like Sal (*Shorea robusta*), Teak (*Tectona grandis*), Bija (*Pterocarpus marsupium*), Saja (*Terminalia tomentosa*), Dhanra (*Anogeissus latifolia*), Dhobin (*Dalberoa planiculata*), Munid (*Mitragyna parviflora*), Mohua (*Madhuca indica*), Mango (*Mangifera indica*), Gab (*Diospyros peregrine*), Amloki (*Emblica officinalis*), Haritaka (*Terminalia chebula*), Baher (*Terminalia abelera*), Jaiphal (*Myristica fragrans*), Tendu (*Diospyros melanoxylon*), etc. are found in good numbers. Sal forests are concentrated in the northeastern part while the teak in the southwestern corner of the district.

SYSTEMATIC ACCOUNT

Class AMPHIBIA

Order ANURA

Family RANIDAE

1. *Tomopterna breviceps* Schneider
(Indian Burrowing Frog)

1799. *Rana breviceps* Schneider, *Hist. Amph.* 1 : 40

1920. *Rana breviceps* Boulenger, *Rec. Indian Mus.*, 20 : 103-105

Material examined: 3 frogs. 1 ex., Kondagaon, 20.x.1981; 1 ex., Pharasgaon. 21.ix.1981; 1 ex., Kotapad, 16.ix.1981; Coll. D.P. Sanyal & party.

Measurements : Snout to vent length, 23-28 mm.

Distribution : Bastar : As above. *Elsewhere* : Gujarat, Maharashtra, Rajasthan, Himachal Pradesh, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal in India. Also Sri Lanka, Nepal and Upper Burma.

2. *Rana cyanophlyctis* Schneider (Skipper Frog)

1799. *Rana cyanophlyctis* Schneider, *Hist. Amph.* 1 : 137

1920. *Rana cyanophlyctis*, Boulenger, *Rec. Indian Mus.*, 20 : 12-15.

Material examined : (a) 187 frogs and (b) 7 tadpoles. (a) 4 ex., Dantwara, 27-28. ii. 1979 ; 6 ex., bank of Indravati river, near Jagdalpur, 17. ii. 1979; 8 ex., Konta, 24.ii.1979; 6 ex., Durnapal, 23.ii.1979 (All have been Collected by Dr. R. C. Sarma & D. P. Sanyal). 46 ex., Barsoor, 2. vi. 1980 ; Bailadila, 4. vi. 1980; 10 ex., Jagdalpur, 16. vi. 1980 ; 8 ex., Barsoor, 31. v. 1980 ; 5 ex., Pali, 1. vi. 1980 ; 8 ex., Geedam, 5. vi. 1980 ; 4 ex., Chitrakut, 13. ix. 1981 ; 3 ex., Chhotedonger, 25. ix. 1981 ; 2 ex., Jagdalpur, 12. ix. 1981 ; 28 ex., Kotapad, 16-17. ix. 1981 ; 20 ex., Narayanpur, 28. ix. 1981 ; 8 ex., Benoon, 17. ix. 1981. Coll. D. P. Sanyal & Party.

(b) 6 ex., Dantwara, 26.ii.1979; 1 ex., Bailadila, 4.vi.1980.Coll. R.C. Sharma & D.P Sanyal.

Measurements : Snout to vent length 22-65 mm.

Distribution : Bastar : As above. *Elsewhere*: It is common throughout India from the base of the Himalaya to the Southern part of the country. Also Nepal, Sri Lanka and Thailand.

3. *Rana Limnocharis* Boie (Paddy-field Frog)

1835. *Rana Limnocharis* (Boie) Wiegmann, *N. Acta. Ac. Leop. Carol*, 17 (i) : 255.

1920. *Rana Limnocharis*, Boulenger, *Rec. Indian Mus.*, 20 : 28-35.

Material examined : 802 frogs. 28 ex., Charama, 5.iii.1979; 8 ex., Kondagaon, 7.iii.1979; 7 ex., Dantwara, 27. ii. 1979; 21 ex., Jagdalpur, 17. ii. 1979; 11 ex., Sukma, 17.ii.1979; 1 ex., Konta, 27. ii. 1979; 39 ex., Durnapal, 23.ii.1979; 3 ex., Konta, 22. ii. 1979. (All have been Collected by Dr. R. C. Sharma & D. P. Sanyal). 3 ex., Barsoor, 2. vi. 1980 ; 38 ex., Chintapalli, 10. vi. 1980 ; 2 ex., Bailadila, 4. vi. 1980 ; 4 ex., Salkapara, 6. vi. 1980 ; 53 ex., Avapalli, 11. vi. 1980 ; 6 ex., Bijapur, 8. vi. 1980 ; 28 ex., Geedam, 5. vi. 1980 ; 24 ex., Jagdalpur, 12. ix. 1981 ; 31 ex., Chitrakut, 13. ix. 1981 ; 36 ex., Kotapad, 18. ix. 1981 ; 47 ex., Chhotedonger, 25. ix. 1981 ; 36 ex., Narayanpur, 25. ix. 1981 ; 27 ex., Kondagaon, 20. ix. 1981 ; 59 ex., Sancepur, 26. ix. 1981 ; 31 ex., Jagdalpur, 12. ix. 1981 ; 48 ex., Phasargaon, 21. ix. 1981 ; 26 ex., Kodtapad, 16. ix. 1981 ; 32 ex., Narayanpur, 28. ix. 1981 ; 96 ex., Kondagaon, 22.ix.1981; 52 ex., Narayanpur, 17. ix. 1981. Coll. D. P. Sanyal & Party.

Measurement : Snout to vent length 10 to 35 mm.

Distribution : Bastar : as above. *Elsewhere* : The species is widely distributed in India and found in almost all the biotopes of the country. Also Eastern Asia from Pakistan, Nepal, Sri Lanka and China to Japan.

4. *Rana tigerina* Daulin (Indian Bull Frog)

1803. *Rana tigerina* Daulin, *Hist. Rain. Gren. Crap.*, : 64.

1920. *Rana tigrina*, Boulenger, *Rec. Indian Mus.*, 20 : 17-23.

Material examined : 17 frogs. 3 ex., Konta, 24. ii. 1979 ; 1 ex., Durnapal, 23. ii. 1979; 8 ex., Konta, 24. ii. 1979. (All have collected by Dr. R. C. Sharma & D. P. Sanyal). 1 ex., Geedam, 5. vi. 1980 ; 3 ex., Chintapalli, 10. vi. 1980; 1 ex., Barsoor, 31. v. 1980. Coll. D. P. Sanyal & Party.

Measurments : Snout to vent length 16 to 161 mm.

Distribution : Bastar : As above. *Elsewhere* : it is common throughout India from the base of Himalaya to South India. Also Nepal, Sri Lanka, Burma, Thailand, South China and Taiwan.

Family RHACOPHORIDAE

5. *Polypadates maculatus* (Gray) (The Chunam Frog or Tree Frog)

1832. *Hyla maculata* Gray III. *Indian Zool.* 1, pl. 82. Fig. 1.

1931. *Rhacophorous maculatus*, Ahl, *Das Tierreich*, 55, Anura III : 133-134.

Material examined : 18 Frogs. 1 ex., Jagdalpur, 19. iv. 1979 ; 2 ex., Sukma, 19. iv. 1979. (All have been Collected by Dr. R. C. Sharma & D. P. Sanyal). 12 ex., Geedam, 5. vi. 1980 ; 1 ex., Pali, 1. vi. 1980 ; 1 ex., Bailadila, 4. vi. 1980., 1 ex., Jagdalpur, 12. ix. 1981. Coll. D. P. Sanyal & Party.

Measurments : Snout to vent length 43 to 68 mm.

Distribution : Bastar : As above. *Elsewhere* : South India and Plains of North India in general. Also Sri Lanka.

Family MICROHYLIDAE

6. *Microhyla ornata* (Dumeril & Bibron) (Ornate Microhylid Frog)

1841. *Engystoma ornatum* Dumeril & Bibron, *Erpet. Gen.*, 8 : 745

1934. *Microhyla ornata*, Parker, *Monogr. of the Microhylidae* : 139-141.

Material examined: 7 frogs. 4 ex., Banapur, 14. ix. 1980; 2 ex., Bodearpur, 15. vi. 1980; 1 ex., Jagdalpur, 12. ix. 1981. coll. D.P. Sanyal & Party.

Measurements : Snout to vent length 11 to 22 mm.

Distribution : Bastar : As above. **Elsewhere :** The species is widely distributed in India and found all over the plains of the country upto an altitude of 1524 metre. Also Srilanka, Burma, South China, South-east Asia and Taiwan.

Family BUFONIDAE

7. *Bufo melanostictus* Schneider (Common Indian Toad)

1799. *Bufo melanostictus* Schneider. *Hist. Amph.* 1 : 216.

1890. *Bufo melanostictus*, Boulenger, *Fauna Brit. India, Rept. & Batr.* : 505-507.

Material examined : 6 toads. 1 ex., Sukma; 1 ex., Geedam, 5.vi.1980; 1 ex., Suklapara, 6.vi.1980; 1 ex., Bijapur. 8.vi.1980; 1 ex., Geedam, 5.vi.1980; 1 ex., Jagdalpur, 12.ix.1981. Coll. D.P. Sanyal & Party.

Measurements: Snout to vent length 18 to 87 mm.

Distribution: Bastar: As above. **Elsewhere :** This is the commonest toad found all over the Indian plains. Also Sri Lanka and Burma. Its range extends to Southern China, Malay Peninsula and Archipelago.

SUMMARY

The paper deals with the Amphibia collected by various parties of the Zoological Survey of India from Bastar District, M.P. It consists of 1047 examples belonging to four families, four genera and seven species. All the species are recorded for the first time from Bastar District.

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ON AN ACCOUNT OF INDIAN LEPTOPHLEBIIDAE (EPHEMEROPTERA) WITH KEY TO THEIR IDENTIFICATION

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INTRODUCTION

Mayflies are amphibiotic insect and represent order Ephemeroptera which inhabit both lotic and lentic ecosystem of our waters. Leptophlebiidae is one of the family of these insects which in our country are represented by 10 species under 9 genera. It represents 1/9 of our mayfly species as there are another 80 mayflies recorded under 24 genera and 11 families (Table-I, Page 61). This family has maximum number of genera, though species wise Baetidae with 35 species occupies first position among our mayfly faunal component. All Indian Leptophlebiids are endemic to our limits except one which is endemic to Hong Kong. These represents 1/10 of our high altitude mayflies. A detailed taxonomic position, salient characteristics of family and genera with reference to Indian forms has been provided. A key has been formulated to distinguish Indian Leptophlebiids alongwith verification table providing parallel taxonomic characters at a glance.

SYSTEMATICS

Leptophlebiidae is one of the most distinctive family of mayflies represented almost all over the world by 377 species under 62 genera. In contrast to it our own Leptophlebiid mayflies are represented by 10 species under 9 genera (Table-II, Page 61). It thus represents only a very small fraction of world's fauna of this group and obviously indicates strong possibility of more representation, as is also true for the whole order, on further detailed investigation of our lotic and lentic ecosystem both at high altitude and plains.

Our knowledge of Indian Leptophlebiids is due to Gillies (1951), Demoulin (1955), Peters and Edmunds (1970), Dubey (1971), Peters (1975). Srivastava (1979, 1982) has discussed our high altitude mayflies representation and our endemic component. In the Indian subregion (India, Sri Lanka, Pakistan, Nepal, Sikkim, Bhutan, Bangladesh, Burma) Leptophlebiids are represented by 20 species under 12 genera (Hubbard and Peters, 1978). Among these a few genera like *Hagenulus* Eaton, *Kimminsula* Peters and Edmunds, *Megalena* Peters and Edmunds are not represented in India while genera like *Gilliesia* Peters and Edmunds, *Indialis* Peters and Edmunds, *Nathanella* Demoulin, *Notophlebia* Peters and Edmunds, *Thraulodes* Ulmer and *Thraululus* Eaton have no representatives in neighbouring countries. Peters and Edmunds (1970) have considered overall oriental Leptophlebiidae alongwith Ethiopian and Palearctic region in study of this group from Eastern Hemisphere.

Salient features of Leptophlebiidae :

Eaton 1884 (1883-84) first recognized this family as "section 5 of Leptophebio", though Banks (1900) established the family name as Leptophlebini. Initially Jacobson and Bianchi (1905) gave it status of subfamily Leptophlebiinae and (Traver *et al.* 1935) placed it under Baetidae along with Caeninae, Baetinae, Ephemerellinae etc. most of which were assigned family status subsequently. Demoulin (1958) placed this family under Superfamily Heptagenioida along with two other families Ametropodidae and Heptageniidae.

Members of this family are distinguished by following salient points, specially considering our own Leptophlebiid representatives.

These are small to medium sized mayflies. Smallest is *Choroterpes (Euthraulus) parvula* with body 4 mm. and largest is *Atalophlebia chialhnia*. Eyes of male divisible into upper larger and lower smaller part mounted on long or short stalk. Both eyes may be closely placed but not meeting on dorsum as in *Choroterpes (Euthraulus) parvulus*, *Indialis rossi*, *Isca (Isca) purpurea*, *Nathanella indica*, *Thraulodes semicastaneus* or they meet on dorsum as in *Gilliesia hindustanica*, *Indialis badia*, *Notophlebia hyalina*. Eyes in female not divided, remain well separated in all members by distinct gap.

Both fore and hind wing may be present as in *Indialis*, *Thraulodes*, *Choroterpes*, *Gilliesia*, *Atalophlebia*, *Thraulodes* or hind wing absent as in *Isca*, *Nathanella* and *Notophlebia*. Fore wing almost of same size as body, may be hyaline or translucent. Its vein MA_1 and MA_2 attached at base and 1 intercalary vein between them at wing margin. MP_1 and MP_2 independent as in *Gilliesia* or attached at wing base and 1 intercalary vein between them. Attachment may be by a cross vein as in *Nathanella*, *Notophlebia* or directly to form a fork as in *Isca (Isca) purpurea*. No intercalary vein between MP_2 and CuA but there are 2-8 between CuA and CuP. Anal veins 2-3 strongly arched. Cross veins are many or few, in former they may be well spread as in *Atalophlebia*, *Gilliesia*, *Thraulodes* but in latter restricted to apical half as in *Nathanella indica* or absent from tip and periphery as in *Isca (Isca) purpurea* cross vein surrounded by yellowish brown pigments. Rs and M_p forked at varying distance from base to margin. It may be at 1/4-1/7 in case of Rs and normally 1/2 in case of M_p . Fork may be symmetrical or asymmetrical.

Hind wing when present are minute about 1/4 to 1/5 of fore wing, elongated, oval or spherical. *Choroterpes (Euthraulus) parvula*, *Gilliesia hindustanica*, *Thraulodes marhies* have void or spherical hind wing but *Indialis badia* I. *rossi* have elongated oval hind wing. Hind wing may have costal projection which may be well developed and acute as in *Gilliesia hindustanica*, *Indialis badia*, *Thraulodes semicastaneus* or well developed but obtusely rounded as in *Indialis rossi*. In *Thraulodes marhies* costal projection though present but not well developed, only slightly bulging outwards. In *Atalophlebia chialhnia* costal projection is absent but costa is outwardly arched. Longitudinal veins are costa, Subcosta, Radial sector which may be branched once or twice. Anal veins are present but not well developed; There may be free intercalary vein between the fork of Rs in *I. rossi*, *Gilliesia hindustanica*, *Thraulodes semicastaneus*, *Choroterpes (Euthraulus) parvula*. *Atalophlebia chialhnia* has also one intercalary vein but is not free as in previous cases. *Indialis badia* has two free intercalary veins. Cross veins are only a few 3-4 as in *Thraulodes semicastaneus*, *Indialis rossi*, *Choroterpes (Euthraulus) parvula*. *Indialis badia* and *Gilliesia hindustanica* has

10-11 cross vein, while *Atalophlebia chialhina* has 25-30 cross veins well spread throughout wing expanse between all longitudinal veins.

Fore leg longest, in some cases it may be even longer than body as in *Isca* (*Isca*) *purpurea*, *Nathanella indica*. Tarsus of fore leg of male 5 segmented, the basal one is very short, middle and hind tarsus of fore leg and tarsus of all the three legs in female four segmented. Claws may be similar in shape in all the three legs as in *Atalophlebia*, *Nathanella*, or may be dissimilar fore claw apically hooked and other 2 obtuse pad like as in *Choroterpes*, *Gilliesia*, *Indialis*, *Isca*, *Notophlebia*, *Thraulodes*.

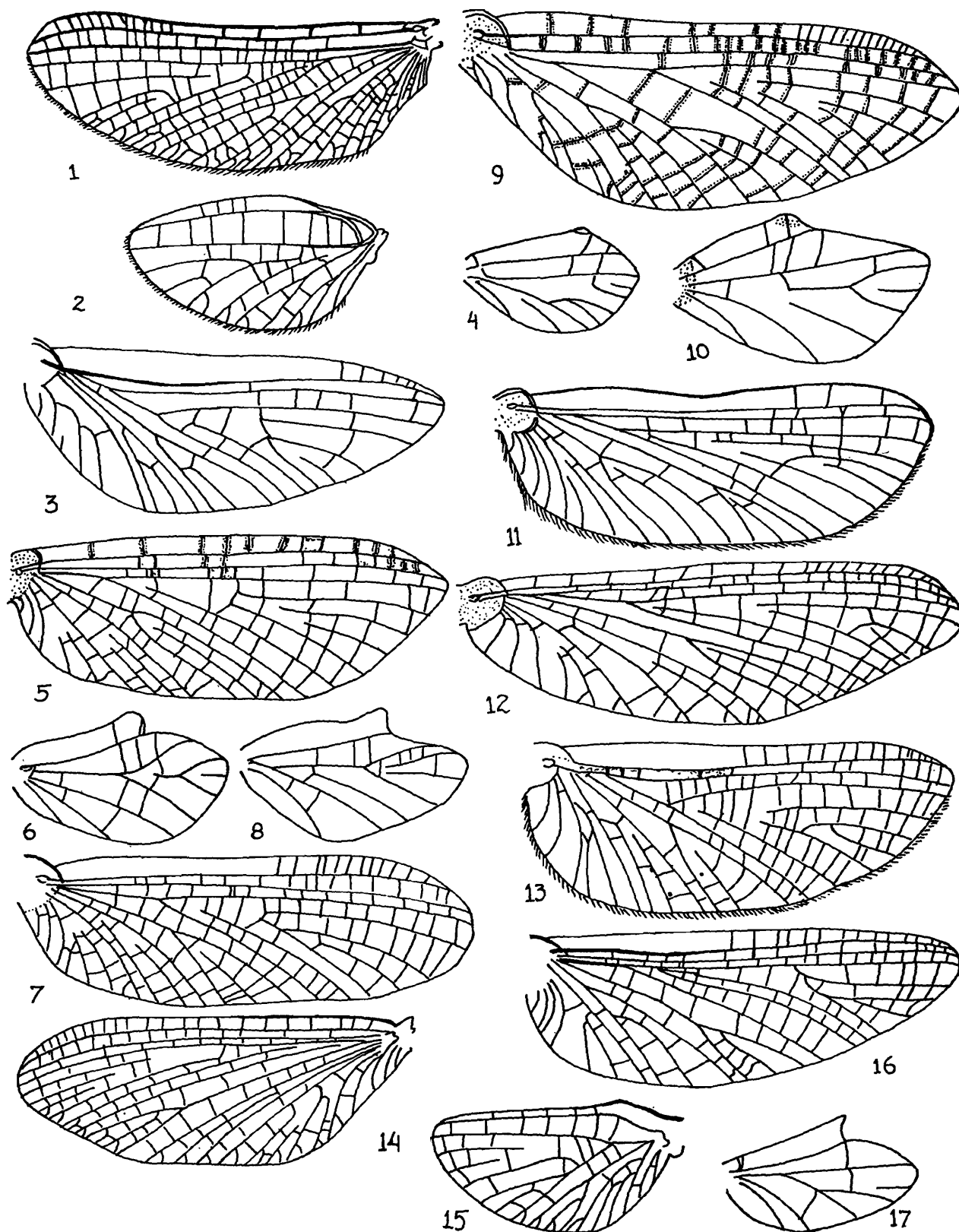
Genital forcep of male 2-3 segmented in the family but all our Leptophlebiids have 3 segmented forcep except *Choroterpes* (*Euthraulius*) *parvula* which has been reported to be 4 segmented but so called 3 and 4 are not completely separated segmented but are faint constriction. Penes lobes simple tubular, may be separate all along their length as in *Notophlebia*, *Isca*, *Indialis badia*, *Gilliesia* or may be closely apposed all along their length as in *Indialis rossi*, *Choroterpes*. Penes is generally straight, may be slightly incurved or curved outwards almost at right angles as in *Gillisia*. Top of penes may have 5-6 denticles as in *Isca* (*Isca*) *purpurea*, apex pointed and finely serrated as in *Notophlebia hyalina* or beset with minute apical hook as in *Thraulius semicastaneus*. In female ovipositor are not well developed, simple, minute, two segmented. 7 sternite is slightly extended, not enough to cover oviduct's opening in two of our forms *Choroterpes* (*Euthraulius*) *parvula* and *Gillea hindustanica*. Ninth sternum may be shallowly cleft as in former, deeply cleft as in latter or may be even entire as in others. Caudal filament well developed usually 3, one median which may be sometimes reduced and two lateral cerci which are almost always relatively longer.

Salient taxonomic points of Indian Leptophlebiids :

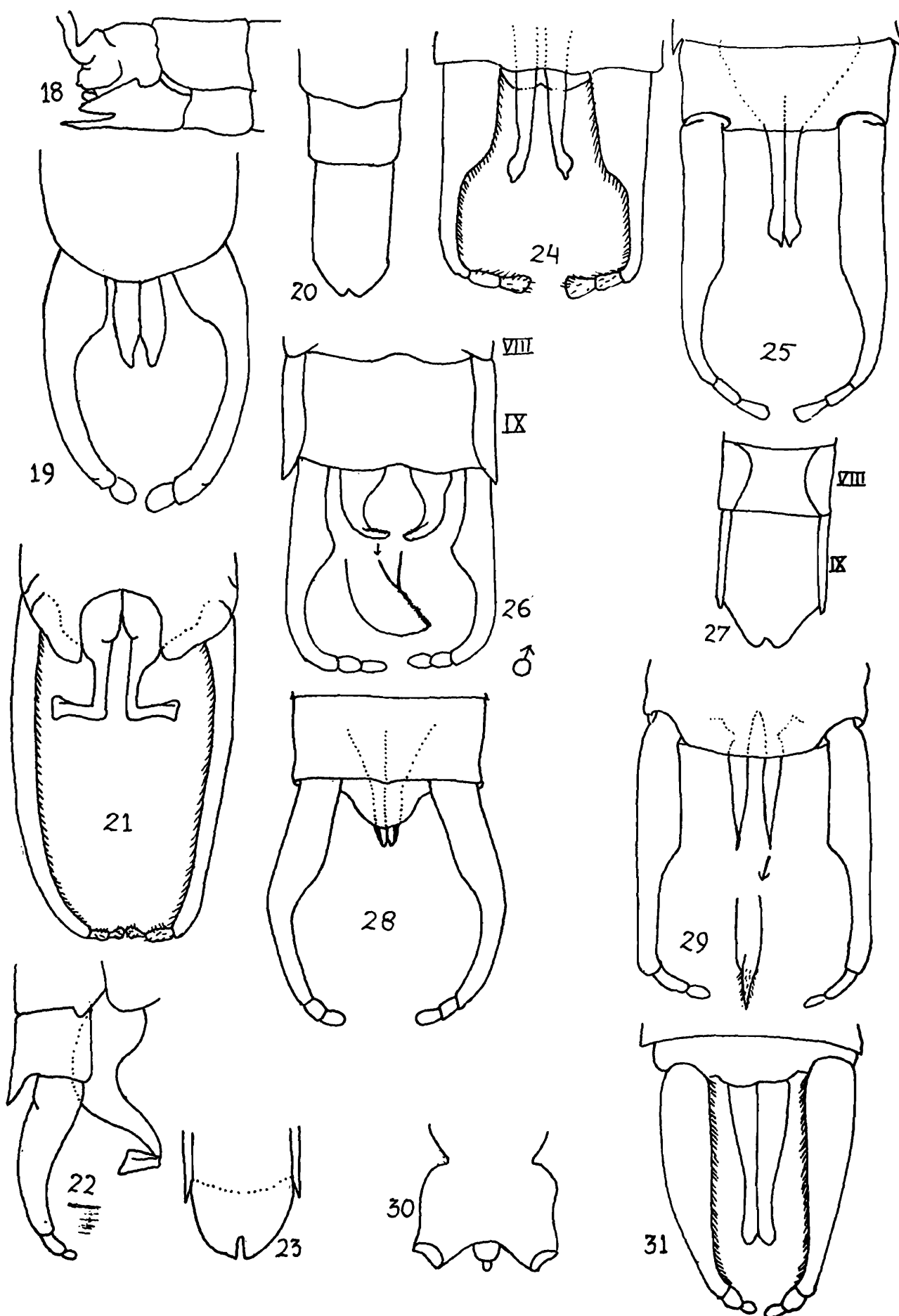
Genus *Atalophlebia* Eaton (1881) has been established with *Ephemera australis* Walker and within our limits it is represented by *A. chialhnia* Dubey (1971) from riverine ecosystem (altni) in Himachal Pradesh at an altitude of 3200 Meters. Within Indian subregion it is represented by one more species is *A. femoralis* (Hagen 1858) from Sri Lanka.

Indian representative of the genus is known only by female imago and is characterized with following main points : Body length 10 mm., brown to blackish brown. Forewing are 9 mm., translucent brown, venation pale, 10-12 ; cross vein in stigmatic area, cross veins many well spread. A_1 separated from A_2 at base, A_2 forked close A_3 . Hindwing is 2 mm. ; 1/5 of former, oval, costal side outwardly arched but without costal process, 20-30 cross veins well spread. Fore leg longest, twice that of body, tarsus 4 segmented. All claws similar, slender, apically hooked. Abdomen dark brown ovipositor simple not well developed.

Choroterpes Eaton (1881) is also represented within our limits by single species under subgenus *Euthraulius* Barnard (1932) namely *C. (E.) parvula* Gillies (1951). It has been recorded inhabiting riverine ecosystem at Sonar near Saugor (Madhya Pradesh). This species is known by male and female imago. Salient features : Body 4-4.5 mm, blackish brown. Eyes of male divided on a short stalk, slightly separated on dorsum. Forewing



1-17 wing : 1,2 Fore wing (F.W.) and Hind Wing (H.W.) of *Atalophlebia chialhnia* ; 3,4 F.W. and H.W. of *Choroterpes (Euthraulus) parvula* ; and H.W 5,6 F.W. and H.W. of *Gilliesia hindustanica* ; 2,8 F.W. and H.W. of *Indialis badia* ; 9,10 F,W, of *I. rossi* ; 11 F.W. *Isca (Isca) purpurea* ; 12 F.W. *Nathanella indica* ; 13 F.W. *Notophlebia hyalina* ; 14,15 F.W. and H.W. of *Thraulodes marhieus* ; 16,17 F.W. and H.W. of *Thraululus semicastaneous*.



18-31 Genitalia: 18 Male *Atalophlebia chialhnia*; 19, 20 Male/Female *Choroterpes (Euthraulus) parvula*; 21, 22, 23, (M), dorsal, lateral, (F) *Gilliesia hindustanica*; 24 (M) *Indialis badia*; 25 (M) *Indialis rossi*; 26, 27 (M), (F) *Isca (Isca) purpurea*; 28 (M) *Nathanella indica*; 29 (M) *Notophlebia hyalina*; 30 (M) *Thraulodes marhieus*; 31 (M) *Thraululus semicastaneus*

colourless hayline, except brown at extreme base. RS and MP are forked at $1/4$ from base to margin, MA forked at half. All forks symmetrical. Cross veins very few mostly in costo-apical portion. Hindwing about $1/4$ of former, spherical, costal projection well developed, rounded, cross vein 4, 2 each in costal and subcostal space. Fore femora dark brown but mid and hind femora has dark spot at middle third and apex. Tarsus 5 jointed. Fore claws apically hooked, others obtuse pad like. Genital forcep 4 segmented penes simple, tubular, contiguous basally, separated apically and tapered. Female's sternum shallowly cleft apically, sternite 7 not extended to cover the oviduct opening.

Gillisia Peters and Edmunds (1970) is a monotypic genus to accommodate the only Indian representative for *G. hindustanica* (Gillies) (= *Thraulius hindustanicus* Gillies). It was initially described from Mirik (Darjeeling, West Bengal) and subsequently recorded from Assam, Arunachal Pradesh ranging at an altitude of 210-1800 meters. Salient features : Body in male 6 mm., white marked with brown and buff but in female it is 6-7 mm ; chocolate brown. Eyes in male divisible into upper blackish grey and lower darker, meet on dorsum. Forewing 7 mm., translucent, speckled, faintly milky in outer fifth of costal and subcostal area. Cross veins are numerous, well spread. MP_2 is independent of MP_1 at base in which this genus differs from other Leptophlebiids as they have either cross vein connecting them or they directly meet to form fork. Hindwing minute ovoid, translucent, without pigmentation, costal projection well developed acute. Radial branch well developed, outerfork absent, cross vein few. Tarsus 5 jointed, fore claw apically hooked, others obtuse pad like. Genital forcep 3 segmented, 9 sternum of female deeply cleft. 7 sternite only slightly elongated to cover oviduct opening.

Indialis Peters and Edmunds (1970) is endemic to India with two species *I. badia* Peters and Edmunds and *I. rossi* Peters of which former genotype. This genus is distinguishable from allied genus *Thraulius* in veins Rs and MP of forewing being forked about equidistant from base to margin in contrast to Rs forked at $1/4$ and MP at $1/2$. Fork of MP are symmetrical rather asymmetrical. In larval stage two are distinguished by Gills 1-7 alike, slender, branched tracheae in contrast to gill 1 with dorsal lanceolate and ventral ovate with fringed margin and 2-7 with both parts ovate with fringed margin. Posterolateral spines are present on 5-9 in contrast to 7-9.

Two Indian representative of the genus are distinguished by following contrasting characters. *I. badia* is known only by its imago which is 4.5 mm. long, brown while that of *I. rossi* has longer body 7.1 mm, with different shade of brown. Eyes in male are divisible in both but in former two eyes meet on dorsum but in latter species separated by a gap equivalent to diameter of one eye. Fore wing in former is 5.8 mm., hayline except brown at base, venation light brown, cubito - anal area normal, cross vein few with extra pigmentation. Latter species in contrast has fore wing 6.5 mm. ; hayline except yellowish brown at base, apically $1/4$ cells at costa and subcosta are translucent, cubitoanal area relatively broad, cross veins many, well spread with additional zone of yellowish brown pigmentation. Hind wing in both are small, oval but costal projection in former is well developed-acute, 2 intercalary between fork of Rs while in latter species costal projection is well developed-rounded, 1 intercalary between fork of Rs. Genital forcep in both are three segmented but in former penes lobes are separate all along with slightly expanded apical lobe while in latter penes lobes closely apposed all along with apical expansion.

Larva of only *I. badia* is known. It has following main features : Small sized, broad bodied, dorsoventrally flattened body-specially in the region of head and thorax, brown but *sutures* and sternites paler. Head is prognathus slightly broader than long. Labrum with dorsal hair and 5 denticles on anteriomedian border. Mandible with 5-6 digital process at its molar surface. Maxillae triangular, 3 segmented and large, tooth like projection on inner margin. Eyes large, rounded, separated by half diameter of one eye. Antennae twice longer than head. Apex of claw hooked apically and denticles on inner side. Progressively larger postero-lateral spines on 5-9. Seven pairs of gills on 1-7, tracheation black, branched.

Isca Gillies (1951) is represented in our country by a single species under subgenus *Isca* Gillies, namely *I. (I) purpurea* Gillies. It has been described from two mountaneous stream at an altitude of Ca. 1350 meters from HongKong. Within our limits, it has also been recorded from a mountain stream at Mirik (West Bengal) at 2200 meters. This species is characterized by following features Body 4.5 - 5 mm. long dark brown. Eyes divisible into upper orange brown, lower dark purple, on a longer stalk, facets very large, dorsally eyes closely placed. Only one pair of wing present, translucent, pinkish-brown, darker pigmentation in costa 1 and subcostal areas. Cross veins few, fine or absent. MA forked symmetrically at half distance from base to margin. Cubitoanal area poorly developed. Hind margin with fringe of fine hairs. Fore leg longest, 1.25 times longer than body, tarsus 5 segmented, fore claws apically hooked others obtuse pad-like. Genital forcep 3 segmented, penes basally contiguous but not fused, then diverging and incurving at apex, 5-6 divides on inner apical end of penes lobes. In female 9 tergite deeply cleft forming bilobed sub-anal plate.

Its larva is prognathus, antennae 2.5 times longer than head. Claws of leg similar, apically hooked, row of denticles on inner side, apical most longest. Seven pairs of gills ventrally on 2-8, 1-6 divided into two slender lamellae with simply unbranched tracheae, 7 unbranched. Abdominal tergites expanded and curved ventrally covering part of sternites. Progressively longer posteriolateral spines on 7-9

In absence of hindwing this genus agrees with other two Leptophlebiids from South India namely *Notophlebia* Peters and Edmunds and *Nathanella* Demoulin. From former it is differentiated by the absence of enlargement of fore wing posteriorly in the anal area and shape of penes with apical denticles instead of straight pointed penes without apical denticle but finely serrated on either sides. From latter it differs in tubular penes closely placed at basal half and separated at apex without denticles and spines. *Isca* is also relatively smaller in body length as well, ranging between 2.2-5 mm. whereas both *Nathanella* and *Notophlebia* range around 7.5 mm.

Nathanella Demoulin (1955) was erected to accommodate single species from Palney and Annamali Hills, Tamilnadu at an altitude of Ca. 1200-2200 meters inhabiting mountaneous stream. This monotypic genus is endemic to India and is known by its male imago, female is yet to be discovered. Its larva was subsequently described by Peters and Edmunds (1970) by association of developing wing pad and nymphal genitalia. It is characterized by following points : Body 7.5-8 mm. brown. Eyes blackish brown, large occupying 3/5 of head, divisible, closely approximated dorsally. Fore leg longest, equal to body. Only forewing is present in which it agrees with two other Leptophlebiid genera *Notophlebia* and

Isca. It also shares former in having few but evenly distributed cross veins. It is distinguishable from these genera in points discussed in previous genus. Forewing 8 mm., hayline, colourless, venation brown, pterostigma dark, cross veins few in apical area, 5 before bulla and 11 beyond, the MP_2 and MP_1 connected by a cross vein Rs forked at $1/4$ and distance from base to margin forks symmetrical. Genitalia brown, gonobase trapeziform, 3 segmented genital forcep, penes tubular, closely approximated at basal half, separated and diverging at apex.

Its larva has prognathus head, antennae twice the maximum length of head. Thorax beset with long hairs. Claws all similar, narrow, hook shaped, one enlarged apical denticles with row of smaller denticles. Abdomen beset with long hairs. Postero-lateral spines are on 7-9, last longest. Gills 1-6, plate like, each with equal sized, shaped lamellae, tracheation branched. Its larva has similarity with that of *Choroterpids* but are distinguishable by the shape of outer margin, presence of hairs on mandibles and prominently large apical denticle to the claws.

Notophlebia Peters and Edmunds (1970) was erected to accommodate single species from Kunjan Khuzi (Tamil Nadu) at an lower altitude of Ca 120 meters. This monotypic genus is also endemic to India and is known only by its male imago. Peters and Edmunds had put it alongwith *Nathanella* and *Isca* in one evolutionary line. All these are restricted to oriental region. Besides disposition of cross veins, the enlargement of fore wing posteriorly and straight tubular, apically pointed penes distinguishes it from other two genera of the evolutionary complex. Other salient points are as follows : Body 7.5 mm., chestnut brown. Eye divisible in upper chestnut brown, lower $3/4$ smaller, black, on a short stalk, meets dorsally. Thorax chestnut brown. Fore claws apically hooked, other obtuse, pad like. Only fore wing present, 8 mm., hayline, colourless except brown basal half of Sc. Membrane of anal area enlarged posteriorly. Cross veins few evenly spaced. Rs forked at $1/6$ and MA at $1/2$ from base, fork symmetrical MP_2 and MP_1 attached by a cross vein at $1/4$ from base to margin. Genital forcep pale, 3 segmented. Penes brown, separated all along, apex sharply pointed, finely serrated.

Thraulodes Ulmer (1920) is yet another genus represented in our country by a single species, namely *T. marhies* Dubey (1970) It has been recorded from a high altitude Ca 3880 m. in lotic ecosystem at Marhi, Pir Panjal range, Himachal Pradesh. It is known only by female imago and is not only sole representative of the genus in India but also neighbouring countries in the subcontinent. It is distinguishable from its counter parts occurring in Palearctic zone in antennae and head are lengthwise related as 40: 5, hind wing being $3/4$ as long as wide and tarsus and tibia of fore leg are length wise related as 3 : 4.

The other salient points of it are as follows : body 9.5 mm., head, thorax dark brown, abdomen yellowish brown. Eyes simple separated dorsally by gap equivalent to three times diameter of an eye. Fore leg longest, tarsus 5 segmented, claws dissimilar. Forewing 12 mm., hayline, veins dark brown, 10 cross veins in stigmatic area, other cross veins many, well spread. A_1 and A_2 separated at base, no free intercalary between Cu_2 and A_1 and between long intercalary and Cu_2 Hindwing 4 mm. hayline, almost globular, M forked, costal process obtuse ill developed, cross veins well spread. Ovipositor 2 segmented, simple minute yellowish.

Thraulius Eaton (1881) is also represented within our limits by only *T. semicastaneus* (Gillies, 1951). This is known to inhabit riverine ecosystem (Mutha) at relatively low altitude at Poona (Maharashtra). The genus was established for European species *T. Bellus* Eaton. Its nearest genus is *Simothraulius* Ulmer, which has no representative in India and is restricted to Borneo, from which it is differentiated in more acute well developed costal spur of hindwing and unserrated penes.

Indian species was originally placed under *Habrophlebiodes* as *H. semicastanea* Gillies. Peters, Gillies and Edmunds (1964) put it under *Masharikella* was synonymised to *Thraulius*. Our species is known only by male imago which is characterised by following salient features : Body 5-6 mm., chestnut brown-darkened at head, thorax. Eyes divisible into upper buff, broad, flat part and lower small, black part. Tarsus 5 jointed. Forewing 5.5 mm., translucent colourless, main veins amber. Stigmatic area with 9-11 simple sinuous veinlets, other veins numerous, very fine, quite well spread except cubito-anal area. Rs forked at 1/4, MA at 1/2, fork symmetrical, MP forked at 1/3-1/4 assymetrical branch. 2 intercalary in cubital area. Hindwing 1/4-1/5 of forewing in length. Costal projection well developed, located at 3/4 distane from base to apex, subcosta upturned, 2 intercalary in cubital area. Cross weins 3- one in middle and two at the level of costal projection. Genital forcep 3-segmented basal longest with inner bend and fringe of hairs. Penes lobes closely placed all along, apex slightly thickened with minute terminal hook.

ENDEMISM AND HIGH ALTITUDE REPRESENTATION

In our faunal component of mayflies, it is evident from above, that all genera and species of Indian Leptophlebiids except *Isca* Gillies are endemic. Last named genus has one Indian representative under subgenus *Isca* Gillies namely *Isca (Isca) purpurea* Gillies which was originally described occurring in Hong Kong with extended distribution in West Bengal, within our limits. There is only one other species of *Isca* occurring in Sri Lanka, among the adjacent countries in Indian subcontinent. This species is under subgenus *Tanycola* Peters and Edmunds (1970) namely *Isca (Tanycola) serendiba* Peters and Edmunds. Thus within family endemism is 90% (9 : 1). This endemism in our mayflies as whole is 5 : 1, 75 species out of total 90 species while in other of major families like *Baetidae* this proportion is 29 species out of 35, *Heptageniidae* 12 out of 13, *Ephemeridae* 10 out of 14. *Ephemerellidae* has all 3 endemic, while *Palingeniidae* and *Polymitareyidae* each has one out of 3 endemic. *Euthyplocidae*, *Potamanthidae*, *Prosopistomatidae*, *Siphonuridae* each are represented by lobe species endemic to our limits. 1/5 or 18 species of our mayflies are known to leave extended distribution in orient, while one among these viz., *Cloeon inscriptum* Bengtsson (*Baetidae*) has extended distribution even beyond orient into Europe.

High altitude representation of Indian *Leptophebiids* is by 2 species beyond 3000 meterm another 3 species occurring in range of 1200-2200 meters. Thus 50% are high altitude inhabitants and all of these occupy different niches in lotic ecosystem of river, streams etc. Srivastava (1979) has indicated that 1/3 or 31 : 90 of Indian mayflies are high altitude inhabitants mostly occurring between 3000-4000meters, though a few occur in transitory altitude of 2000-3000 meters inhabiting torrential streams of Himalayan mountain range. Highest altitudinal record, however, within our mayflies is that of *Ororotsia*

hutchinsoni Traver 1939 (Heptageniidae) recorded occurring at 5927 meters.

Key to Indian species of LEPTOPHLEBIIDAE

- 1. Hind wing present 2
- Hind wing absent.....11
- 2. Costal process to hind wing absent.....3
- Costal process to hind wing present.....4
- 3. 10-12 cross veins to stigmatic area, many cross veins, well spread in fore wing, costal side of hindwing outwardly arched..... *Atalophlebia* (*A. chialhnia*)
- 4. Costal projection of hind well developed, either acute of rounded.....5
- Costal projection in hindwing present but not well developed, only slightly bulging outwards.....10
- 5. Costal process to hindwing acute.....6
- Costal process to hind obtusly rounded..... 9
- 6. Eyes in male divisible, both eyes meeting on dorsum..... 7
- Eyes in male divisible but both eyes are not meeting on dorsum. Body 5-6 mm, Forewing 5.5 mm, translucent, stigmatic are with 9-11 sinuous crossveins, 2 intercalary in cubital area. Penes lobes closely placed all along its length, apex slightly thickened with minute terminal hook.....*Thraulius* (*T. semicastaneous*)
- 7. Penes lobes well separated all along its length, not recurved but slightly expanded at apex, body 4.5 mm brown. Fore wing 5.8 mm., hayline except brown at base, veins light brown, cross veins few, RS forked with two intercalary*Indialis* (*I. badia*)
- Penes lobes contiguous at base but seprated at apical part 8
- 8. Penes lobes reŕurved at apical half to form acute lateral angle, body 6 mm., white. Forewing 7 mm., translucent, venation amber, cross veins numerous well spread, 3 costal vein before bulla.....*Gilliesia* (*G. hindustanica*)
- Penes not recurved at apical half but straight, body 4-4.5 mm., brown. Forewing 4.5 mm., colourless hayline, cross veins few mostly in costo-apical portion of wing. No costal vein before bulla*Choroterpes*(*Choroterpes* (*C*) *parvula*)
- 9. Body 7.1 mm.brown, Forewing 7 mm., veins yellowish cross veins sorrounded by yellowish brown pigments, cubito-anal area relatively broad, penes lobes closely apposed all along, apical lobes slightly expanded, Rs forked with only one intercalary*Indialis* (*crossi*)
- 10. Body 9.5 mm., yellowish-dark brown. Forewing 12 mm., hayline, veins dark brown 10 cross veins in stigmatic area, cross veins many, well spread. No free intercalary between Cu2-A1 and between long intercalary and Cu2. Hindwing 4 mm., almost globular, M forked, cross veins well spread.....*Thraulodes* (*T marhieus*)

11. Vein MP2 attached to MP1 by a cross vein 12.
- Vein MP2 attached to MP1 directly to form a fork, hairs present on the posterior margin of forewing, abdominal terga extended around venter of abdomen, prominently so on segment 7.....*Isca purpurea*
12. Claws of pair alike-each apically hooked with an aposing subapical hook, penelobes closely apposed at basal half, diverging at apex not specially pointed or serrated.....*Nathanella indica*
- Claws of pair dissimilar-one apically hooked other obtuse pad like. Penes lobes well separated , apex pointed and finely serrated.....*Notophlebia hyalina*

SUMMARY

A detailed taxonomic status and salient features of Leptophlebiidae with special reference to the Indian forms comprising of 10 species under 9 genera has been presented. A key to species has also been provided. Endemic component has been shown to be 9 : 1 within family which is 5 : 1 in all our mayflies. Half of the Indian Leptophlebiid are high altitude dweller, 2 species beyond 3000 m. and another 3 species in the range of 1200-2200 meters.

ACKNOWLEDGEMENTS

Author is highly thankful to the Director, Zoological Survey of India, Calcutta for constant encouragement and facilities to bring out this work.

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Table I. Qualitative composition of Indian Ephemeroptera.

Families	India		World		High Altitude			Distribution	
	G	S	G	S	G	S	ES	O	EO
Ametropodidae			1	4					
Baetidae	6	35	17	519	3	15	29	5	1
Baetiscidae			1	12					
Behningiidae			3	5					
Caenidae	1	5	6	81	1	1	4	1	
Ephemerellidae	2	3	7	120	1	2	3		
Ephemeridae	2	14	8	99	1	4	9	5	
Euthyplociidae	1	1	7	12			1		
Heptageniidae	7	13	28	378	6	8	12	1	
Leptophlebiidae	9	10	62	377	2	2	9	1	
Metrotropidae			2	7					
Neophemeridae			2	8					
Oligoneurillidae			9	49					
Palingeniidae	1	3	6	31			1	2	
Polymitarcyidae	2	3	6	70			1	2	
Potamanthidae	1	1	7	27			1		
Prosopistomatidae	1	1	1	11			1		
Siphonuridae	1	1	26	163	1	1	1		
Tricorythidae			13	122					
Total	34	90	213	2146	15	33	72	17	1

EO = Extra Oriental, ES=Endemic Species, G=Genera, O=Oriental S=Species

Table II. FAUNAL COMPONENT OF INDIAN LEPTOPHLEBIIDAE

GENERA	SPECIES	M	F	L	DISTRIBUTION	REMARKS
					ENDEMIC(E) ORIENTAL(O)	
Atalophlebia	chialhnia Dubey	-	+		H. P. (R. Alhni) (E)	3200M
Choroterpes	(euthraulius) harva (Gillies)	+	+	-	M. P. (R. Sonar Br.) (E)	
Gilliesia	Hindustanica(Gillies)	+	+	-	W. B. (Mirik) Assam (E)	210-1800M
Indialis	badia P. & E.	+	-	+	Kerala(Erumels Koratty.) Andhra P. (Kabkam Thannur Pandal r.) (E)	
	Rosi Peters	+			Kerala(Kittikanam) (E)	
Isca	isca Purpurea Gillies	+	+	-	W. B. (Mirik) ; Hongkong (O)	1350M
Nathanella	indica Demolin	+	-	-	Tamil Nadu (Kodai Kanal Palney Hills) (E)	1200M 2200M
Notophlebia	hylina P. & E.	+		-	Tamil Nadu(Khujankhuzi) (E)	120M
Thraulodes	marhiens Dubey		+		H. P.(Near Marhi) (E)	3880M
Thraulius	semicastaneous(Gillies)	+			Maharastra(R. Mutha, Poona) (E)	

M= Male; F= Female; L= Larva.

**NEMATODES FROM WEST BENGAL (INDIA) XXIV.
QUALITATIVE AND QUANTITATIVE STUDIES OF PLANT
AND SOIL INHABITING NEMATODES ASSOCIATED WITH
PADDY CROP IN COOCHBEHAR DISTRICT**

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INTRODUCTION

Baqri *et. al* (1983) published the first paper on the qualitative and quantitative estimations of nematodes associated with paddy crop from Burdwan district of West Bengal. This is the 24th paper of the series on Nematodes from West Bengal and 4th on qualitative and quantitative studies. During November 1984, forty root and soil samples were collected from 13 localities of the following three blocks of district Coochbehar : Toofangaunj, Pundibari and Dinhata. In all, 32 species have been identified. It is evident from the quantitative estimation of important nematode genera that *Hirschmanniella gracilis* (de Man, 1880) Luc & Goodey, 1963 ; *Meloidogyne graminicola* Golden & Birchfield, 1965; *Tylenchorhynchus* spp.; *helicotylenchus* spp. are the important and abundant nematodes in the area surveyed.

MATERIAL AND METHODS

The sampling was made at random. The processing of samples and the quantitative estimation was made as described by Baqri *et. al.* (1983). The nematode population per 200 ml soil was counted from each sample. The nematode population of paddy roots / 10 gm was also estimated.

A. QUALITATIVE STUDY :

In all, 15 species belonging to the Orders Tylenchida and Aphelenchida (Stylet bearing nematodes) have been identified. Apart from this, 17 soil inhabiting or predaceous species of the order Dorylaimida have also been identified. The identified species are listed below:

Order TYLENCHIDA THORNE, 1949

1. *Filenchus* sp.
2. *Malenchus* sp.
3. *Basiria tumida* (Colbran, 1960) Geraert, 1968
4. *Tylenchorhynchus nudus* Allen, 1955
5. *T. mashhoodi* Siddiqi & Basir, 1959
6. *Hoplolaimus indicus* Sher, 1963

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7. *Helicotylenchus crenacauda* Sher, 1966
8. *H. dihystra* (Cobb, 1893) Sher, 1961
9. *Hirschmanniella gracilis* (de Man, 1880) Luc & Goodey, 1963
10. *Meloidogyne graminicola* Golden & Birchfield, 1965
11. *Ditylenchus* sp.
12. *Nothotylenchus* sp.
13. *Macroposthonia ornata* (Raski, 1958) De Grisse, 1955
14. *Gracilacus* sp.

Order APHILENCHIDA

1. *Aphelenchus avenae* Bastian, 1865

Order DORYLALIDA Deman, 1876

1. *Laimydorus siddiqii* Baqri & Jana, 1982
2. *L. baldus* Baqri & Jana, 1982
3. *L. finalis* Thorne, 1975
4. *Laimydorus distinctus* Dey & Baqri, 1986
5. *Calodorylaimus simplex* Baqri & Jana, 1982
6. *Eudorylaimus* spp.
7. *Thornenema mauritianum* (Williams, 1959) Baqri & Jairajpuri, 1967
8. *Discolaimoides bulbiferus* (Cobb, 1906) Heyns, 1963
9. *Aporcelaimellus heynsi* Baqri & Jairajpuri, 1968
10. *Dorylaimellus indicus* Siddiqi, 1963.
11. *D. deviatu*s Baqri & Jairajpuri, 1965
12. *Tylencholaimus obscurus* Jairajpuri, 1939
13. *Discomyctus cephalatus* Thorne, 1939
14. *Proleptonchus clarus* Timm, 1964
15. *Dorylaimoides pakistanensis* Siddiqi, 1964
16. *D. constrictus* Baqri & Jairajpuri, 1968
17. *Neoactinolaimus* sp.

B. QUANTITATIVE STUDY :

The results of the quantitative estimation of important parasitic genera and other nematodes from the surveyed localities of Coochbehar district have been furnished in Table I & II. Table I (Pages 66-68) provides the informations about the surveyed localities , number of samples collected , range with average and percent of frequency of occurrence of important nematode genera separately and other nematodes Table II (Page 69) gives the analysis of range with average , and percent of frequency of occurrence and dominance of potential nematodes in soil and paddy roots at Coochbehar district.

It is evident from table I that the species of the genera *Hirschmanniella*, *Helicotylenchus*, *Tylenchorhynchus* and *Meloidogyne* are widely distributed in the area surveyed. Amongst these species, *Hirschmanniella gracilis* appears to be a key pest of paddy in

Coochbehar because of its high degree of dominance in 70% soil samples. Table II also concludes that *Hirschmanniella gracilis* occurs in 95% and 48% in soil and root samples, respectively. The second important nematodes are the *Helicotylenchus* spp. and *Meloidogyne graminicola* because these have been respectively recorded in 75% and 95% soil samples. Though the frequency of occurrence of *Meloidogyne* is higher but their dominance has been observed only in 5% soil samples. It may further be noted that *Helicotylenchus* spp. dominated in 20% soil samples. The number of *Helicotylenchus* and *Meloidogyne* species recovered from roots was also significant and their occurrence was noted in 20% and 12% root samples respectively. The other important nematodes are *Tylenchorhynchus* spp. Their occurrence in soil and roots was noted in 52% and 30% samples respectively, while they were dominant only in 5% soil samples. The presence of other parasitic nematodes was not significant.

SUMMARY

The present paper reports 32 species of the orders Tylenchida, Aphelenchida and Dorylaimida from Coochbehar district (W. Bengal). The results of the quantitative estimation of different parasitic genera reveal that *Hirschmanniella gracilis* (de Man, 1880) Luc & Goodey, 1963, *Tylenchorhynchus* spp., *Meloidogyne graminicola* Golden & Birchfield, 1965 and *Helicotylenchus* spp., are the important nematode pests associated with paddy crop in the area surveyed.

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TABLE -I
Results of the survey of Paddy crop in Coochbehar district , West Bengal.
Range of nematodes number with its average per 200 ml of soil.
Figures in parenthesis indicate percent frequency of occurrence.

LOCALITY/ VILLAGE					
	Guriarpar	Nayarhat	Chamta	Ghogalkuti Basakpara	Ghogalkuti Nutanbazar
No. of samples collected	1	3	3	2	2
Nematodes					
1. <i>Tylenchorhynchus</i>	20: 20 (100)	10-20:15 (66.67)	40:40 (33.33)	200: 200 (50)	10:10 (50)
2. <i>Helicotylenchus</i>	40: 40 (100)	60-580:320 (66.67)	40-180:93.3 (100)	50 -120:85 (100)	20-200:110 (100)
3. <i>Hirschmanniella</i>	120:120 (100)	20-100: 60 (66.67)	20-340-143 (100)	50-50 (50)	100-260:180 (100)
4. <i>Meloidogyne</i>	20:20 (100)	30-410:175 (100)	40-220:80 (100)	110-180:145 (100)	300-350:325 (100)
5. <i>Other tylenchs</i>	-	20:20 (33.33)	-	-	-
6. <i>Other dorylaims</i>	280-280 (100)	160-520: 303 (100)	280-1060: 547(100)	450-1240: (100)	300-340:320 (100)
7. <i>Saprophagous</i>	40:40 (100)	130-380:260 (100)	50-500 243:3 (100)	150-200: 185 (100)	100-630: 365 (100)

LOCALITY /VILLAGE					
	Chilakhana	Sonari	Baraibari	Singijani Bhataguri	Baladang
No. of samples collected	3	5	2	5	3
Nematodes					
1. <i>Tylenchorhynchus</i>	20-120:70 (66.67)	20-280:128 (80)	20-240:130 (100)	20:20 (20)	190:190 (33.33)
2. <i>Helicotylenchus</i>	20-260:137 (100)	30-220:103 (60)	20-80:50 (100)	40-200:123 (100)	80-220:167 (100)
3. <i>Hirschmanniella</i>	40-160:103 (100)	100-790:446 (100)	260-340:300 (100)	170-1060:428 (100)	140-220:173 (100)
4. <i>Meloidogyne</i>	120-160 :140 (66)	10-440:(250) (80)	30-60:45 (100)	20-380:210 (100)	60-220:130 (100)
5. <i>Macroposthonia</i>	20:20 (33.33)	-	-	-	-
6. <i>Other tylenchs</i>	20-90:50 (100)	-	-	-	-
7. <i>Other dorylaims</i>	280- 370 :337 (100)	180-660: 469 (100)	790-800: 795 (100)	60-500:244 (100)	300-880:577 (100)
8. <i>Saprophagous</i>	40:230 :123 (100)	40-350:214 (100)	20-80:50 (100)	80-320:184 (100)	160-680: 333 (100)

LOCALITY/ VILLAGE			
	Khedkhedia	Chhararkuti	Kharijakakribari
No. of samples collected	4	2	5
Nematodes			
1. <i>Tylenchorhynchus</i>	20-230:125 (50)	-	30-100:73 (60)
2. <i>Helicotylenchus</i>	20:20 (25)	20:20 (50)	70-260:178 (80)
3. <i>Hirschmanniella</i>	280-1090:588 (100)	140:140 (100)	100:900: 462 (100)
4. <i>Meloidogyne</i>	30-390:125 (100)	20-140:80 (100)	10-120:45 (100)
5. <i>Other dorylaims</i>	40-390:245 (100)	130-240 :185 (100)	240-110:498 (100)
6. <i>Saprophagous</i>	190-430:315 (100)	40-140:90 (100)	160-750:366 (100)

TABLE II

Results of the survey of paddy crop in Coochbehar district , West Bengal.

Range of nematodes number (potential parasites) with average per 200 ml soil and 10 gm roots.

Figures in parenthesis indicate percent frequency of occurrence with dominance in soil /occurrence in roots.

Potential nematodes	Soil population	Root population
1. <i>Hirschmanniella</i>	20-1090:311 (95:70)	20-860:160 (48)
2. <i>Helicotylenchus</i>	20-580:127 (75:20)	20-620:128 (20)
3. <i>Meloidogyne</i>	10-440:151 (90:5)	50-340: 180 (12)
4. <i>Tylenchorhynchus</i>	10-280:90 (52.5:5)	20-200:77 (30)

**ON A NEW SPECIES OF THE GENUS *PALPARES* (NEUROPTERA :
MYRMELEONTIDAE) FROM INDIA**

S.K.GHOSH

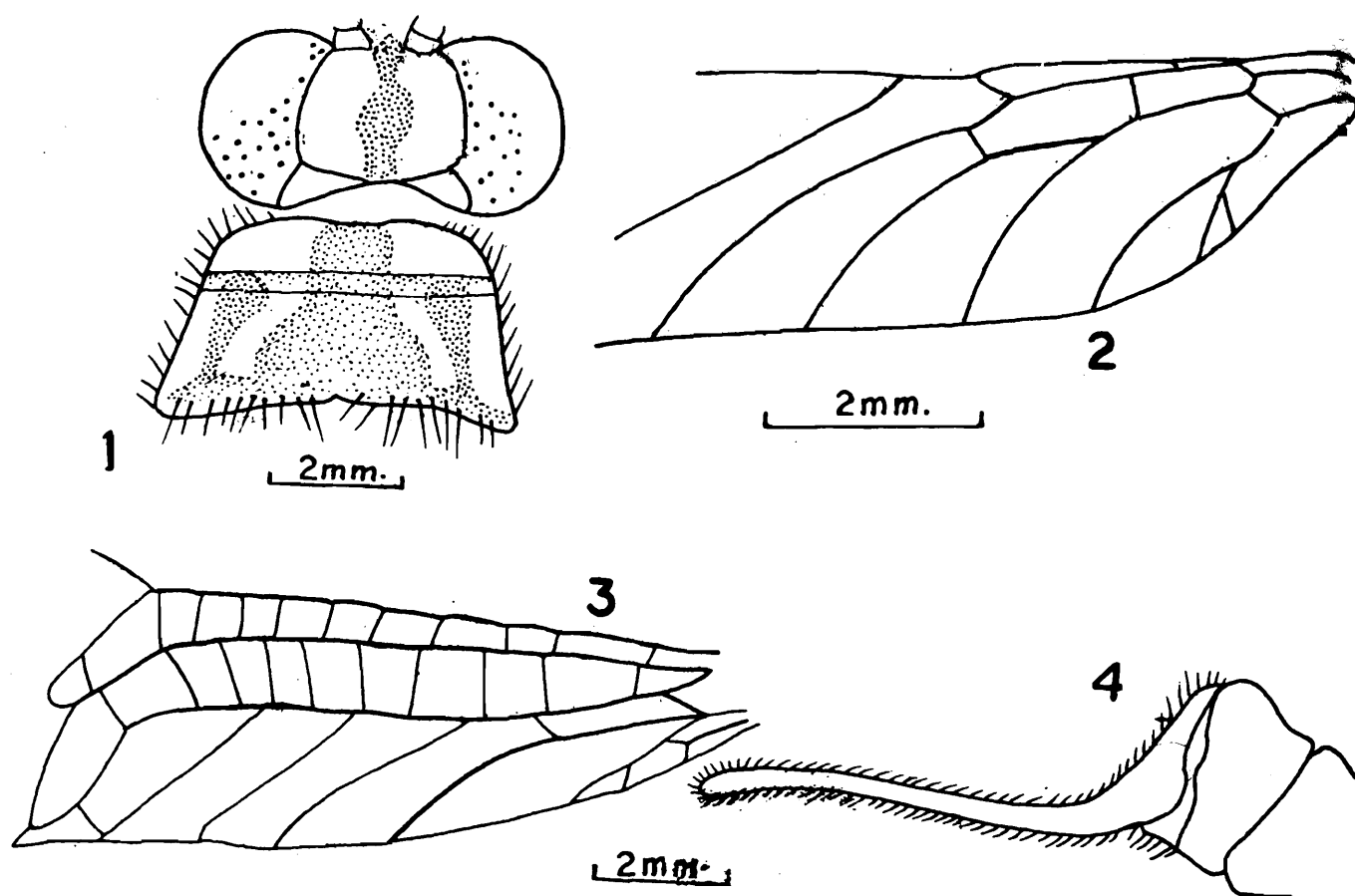
Zoological Survey of India, New Alipore, Calcutta

INTRODUCTION

All the species of the genus *Palpares* Rambur are generally large in size and beautiful neuropterous insects. Their contrasting markings attract the attention of the collectors and therefore every museum has at least, some representatives of this genus in their collections. Banks (1913) has dealt with eleven Indian species of this genus along with illustrations. Later, two species namely, *P. trichogaster* Navas and *P. nobilis* Navas were also described from India. After a long lapse of time, the author, in course of his studies, has encountered an interesting species which is described below as new to science.

***Palpares rajasthanicus* sp. nov.**

Clypeus, frons and palpi : yellow; vertex : yellow with a medially broadened, brown longitudinal stripe; antenna : brown at basal two segments but flagellar segments red brown; thorax : clothed with white hairs; pronotum (fig. 1) : Yellow with a median longitudinal dark brown stripe which is broadly rounded posteriorly, an irregular stripe almost rounded anteriorly lying on either side of median stripe and extending from median suture to posterior margin ; meso- and metanotum black but hind border of mesoscutellum and prescutum of metanotum yellow; Wings (fig. 5) : rather whitish; venation : pale yellowish; forewing (fig. 2.) : costa and radius brown; some of costal veinlets with blank points towards base ; several costal veinlets clouded with brown towards pterostigma; some crossveins between R and Rs clouded brown; with four brown spots - first at furcation of Cu ; second beyond first and lying between media and middle of cubital field; third irregular, extending from first branch of Rs, passing obliquely to the tip of Cu, and continuing upto a short distance towards base of it; fourth one lying beyond pterostigma; other subapical brown band at middle also present; base of forked veinlets at apex and hind margin beyond middle from base clouded with brown ; 3A and 4A connected by a single crossvein (fig.2) ; hindwing : some costal veinlets either wholly clouded brown or with brown points; a spot on cubital fork extending obliquely almost upto tip of 1A; a band beyond cubital spot beginning just below R and extending upto middle of cubital field; an irregular band running transversely from costa and extending almost upto hind margin; an irregular band interrupted at middle lying at apex; 4 or 5 spots at hind margin; 3A connecting 2A by a crossvein near its furcation (fig.3); legs : with white hairs and black bristles; femora dark brown but tibiae yellow; tibial spurs dark brown and equal to two tarsal segments taken together; tarsi dark brown; abdomen : yellowish brown at few basal segments, otherwise dark brown; apex of male abdomen as in fig.4.



Palpares rajasthanicus sp. nov. Fig.1. head and pronotum 2. Part of forewings, female 3. part of hindwing, male. 4. apex abdomen, male (lateral) 5. Holotype, male .

Measurements : Holotype Male : Length of body : 36 mm; forewing : 42 mm; hindwing : 39 mm. Allotype Female : Length of body: 38 mm; forewing : 46 mm, hindwing : 45mm. Paratypes Male, Females: Length of body: 38-42mm; forewing: 46-50mm; hindwing: 45-48mm.

Material examined: 1 Male (Holotype) : India : Rajasthan, Bikaner, Pugal, 20.ix.1960 Coll. M. Chandra, Z.S.I. Reg. No. 1251/H12; 1 Female (Allotype); Loc. and Coll. same as above, date 23.ix.1960, Z.S.I. Reg. No. 1252/H12; 1 (M) (Paratype); Loc. data and Coll. same as for allotype, Z.S.I.Reg.No.1252/ H12; 3 (F) (Paratype) ; Loc. and Coll. same as for male, date 19.ix.1960 Z.S.I.Reg.No.1254-1256/ H12; 1 (F) (Paratype) ; Loc. and Coll. same as above, date 17.ix.1960 Z.S.I.Reg.No.1257/ H12; 1 (F) (Paratype) : Rajasthan, 22.ix,Coll. M. Chandra Z.S.I.Reg.No.1258 / H12. All the types are deposited in the National Zoological Collections of the Zoological Survey of India, Calcutta.

Distribution : India : Rajasthan.

Remarks : The markings of fore-and hindwings differentiate this species from other species of *Palpares*.

SUMMARY

A new species *palpares rajasthanicus* is described from Rajasthan.

ACKNOWLEDGEMENT

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

REFERENCE

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STUDIES ON THE LIZARD AND SNAKES OF NORTH BIHAR

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INTRODUCTION

The present work on the reptiles of north Bihar is based on the material present in the Zoological Survey of India and which was collected by the Senior author from different areas of north Bihar from time to time.

Since the publication of Smith's volumes in the FBI series (1935, 1943), our knowledge on the lizards and snakes of Bihar has increased considerably. Some work on the similar lines has been carried out by Hora (1948) and Acharjee (1955), no comprehensive work in this respect was available so far from north Bihar. The result of present study from this zone revealed the presence of twenty one species (17 genera) belonging to 7 families. Of these, four species constitute the new records from north Bihar.

SYSTEMATIC ACCOUNT

Order 1 SQUAMATA
Suborder (i) SAURIA
Family (1) GEKKONIDAE

1. *Hemidactylus bowringi* (Gray)

Material : 2 exs., Kolassy, Dist. Purnea, 28. 5. 1872. Anderson. (Reg. No. 5642 & 5644)

Measurements : Snout to vent 42 - 51 mm, tail missing.

Distribution : India : Godavari valley ; Sikkim ; Darjeeling ; Elsewhere ; : Burma ; Honkong ; S. China.

Remarks : Back with pale brown small granules intermixed with larger tubercles on posterior side, ventral surface greyish brown. This species is not widely distributed in India and comprises the first record from Bihar.

2. *Hemidactylus brooki* Gray

Spotted House Gecko

Material : 2 exs. Kishengaunje, Dist. Purnea ; 14. 4. 1986 ; S. Ahmed & party ; 1 ex. Mugraha, West Champaran dist. ; 11.10. 1977 ; N.C. Gayen (Reg. No. 23498).

Measurements : Snout to vent 32 - 44 mm ; tail 39 mm.

Distribution : The whole of India Elsewhere : Sri Lanka ; Singapore ; China ; East Indian Archipelago ; North Africa & West Indies.

3. *Hemidactylus flaviviridis* Ruppell

Yellow-Bellied House Gecko

Material : 1 ex. Mugraha, Dist. West Champaran ; 11.10.1977 ; N. C. Gayen (Reg. No. 23497).

Measurements : Snout to vent 71 mm; tail 61 mm.

Distribution : From Punjab to West Bengal. Elsewhere : Iran ; Arabia ; shores of Red Sea.

4. *Hemidactylus frenatus* Schlegel

South Asian Wall Gecko

Material : 3 exs. Forbesgaunge, Purnea Dist. ; 8. 4. 1986 S. Ahmed & party ; 1 ex. vill. Gerabarhi, Katihar Dist., 5. 4. 1986; S. Ahmed & Party ; 3 exs. Dauran, Madhepura dist. ; 20. 4. 1986 ; S. Ahmed & party.

Measurements : Snout to vent 32 - 55 mm ; tail 23 - 43 mm.

Distribution : India : Southern India ; West Bengal. Elsewhere : Sri Lanka ; Vietnam, Laos, Kampuchea ; Hainan ; Yunnan ; Hongkong ; Southern China ; Malaysia ; Australia ; East Africa ; St. Helena.

Remarks : This lizard which is common in southern India has been reported for the first time from Bihar.

Family (2) SCINCIDAE

5. *Mabuya carinata* Schneider,

Brahminy / Common Skink

Material : 1 ex. Manihari village, Katihar dist., 31. 3. 1986, S. Ahmed & party (Reg. No. 24447).

Measurements : Snout to vent 99 mm; tail 122 mm.

Distribution : Indian Peninsula ; Elsewhere : Sri Lanka.

6. *Nabuya macularia* (Blyth)

Bronge Back Skink

Material : 1 ex. Dighikatiar, Katihar dist. ; 2. 4. 1966, S. Ahmed & party ; 1 ex. Barari village, Purnea dist. ; 11. 4. 1986, S. Ahmed & party ; 1 ex. Khursela, Purnea dist., 11. 4. 1986 S. Ahmed & party.

Measurements : Snout to vent 45 - 55 mm., Tail 60 - 89 mm.

Distribution : India : Uttar Pradesh ; Bihar ; West Bengal and Assam. Elsewhere : Thailand ; Burma, Kampochea, South Vietnam ; Malaysia.

7. *Riopa albopunctata* Gray

Material : 1 ex. Bhownaipore village, Purnea dist., 12. 4. 1986 ; S. Ahmed & party ; 1 ex. Gerabari, Katihar dist. ; 5. 4. 1986 ; S. Ahmed & party.

Measurements : Snout to vent 51 - 55 mm. ; tail 26-48 mm.

Distribution : Maharashtra ; Madhya Pradesh ; Uttar Pradesh ; Bihar ; West Bengal ; Orissa, Elsewhere : Nepal.

Family (3) AGAMIDAE

8. *Calotes versicolor* (Daudin)

Blood Sucker

Material : 1 ex. Mirchabari, Katihar dist., 1. 4. 1986, S. Ahmed & party ; 1 ex. Khursela, Purnea dist., 11. 4. 1986, S. Ahmed & party ; 1 ex. Dauran, Madhepura dist., S. Ahmed & party.

Measurements : Snout to vent 84 - 86 mm ; tail 77 - 230 mm.

Distribution : The whole of India; Thailand; Laos; Kampuchea; Vietnam; Afganistan ; Sri Lanka ; Hainan ; Hongkong ; S. China ; Malaysia ; and Sumatra.

9. *Sitana Ponticeriana* Cuvier

Fan-Throated Lizard

Material : 1 ex. Mugraha forest, West Champaran dist., 11. 10. 1977, N.C. Gayen. (Reg. No. 23500).

Measurements : Snout to vent 39 mm, tail 74 mm.

Distribution : The whole of India.

Suborder (ii) SERPENTES

Family (4) COLUBRIDAE

10. *Amphiesma stolata* (Linnaeus)

Striped Keel Back

Material : 1 ex. Manihari village, Katihar dist., 31. 3. 1986 ; S. Ahmed & party ; 1 ex. Khursela, Purnea dist., 11. 4. 1986 ; S. Ahmed & party.

Measurements : Total length 445 - 496 mm. ; tail 102 - 125 mm.

Distribution : The whole of India ; Sri Lanka ; Pakistan ; Southern China ; Hainan ; Vietnam ; Laos ; Kampochea, Amdaman Islands.

11. *Elaphe helena* (Daudin)**Trinket Snake**

Material : 1 ex. caragola, Purnea dist., ? T.S. Hill. (Reg. No.12544).

Distribution : Assam ; West Bengal ; Uttar Pradesh.

Remarks : This snake has been reported for the first time from Bihar.

12. *Enhydris enhydris* (Schneider)**Schneiders Water-Snake/Smooth Water Snake**

Material : 1 ex. Samshergaunge, Katihar dist., 4. 4. 1986, S. Ahmed & party. (Reg. No. 24442).

Measurements : Total length 621 mm., tail 114 mm.

Distribution : Uttar Pradesh ; Bihar ; Andhra Pradesh ; Orissa ; West Bengal ; Assam ; Burma ; Thailand Vietnam, Laos, Kampuchea ; S. China ; Malaysia

13. *Enhydris seiboldi* (Schlegel)

Material : 1 ex. Purualia, Champaran dist., ? M. Mackenzie. (Reg. No. 16614).

Measurements : Total length 485 mm. ; tail broken.

Distribution : India : Delhi ; Maharashtra, Uttar Pradesh ; Bihar ; Kerala ; Assam. Elsewhere : Burma.

14. *Boiga forsteni* (Dumeril & Binron)

Material : 1 ex. Purnea, Purnea dist., ?? (Reg. No. 13542).

Distribution : Sri Lanka and Peninsular India ; Western Ghats ; Ganga valley ; Orissa ; W. Bengal ; Eastern Himalayas.

Remarks : Damaged specimen.

15. *Boiga trigonata* (Schneider)**Indian Gamma / Common Cat Snake**

Material : 1 ex. Kolassy, Purnea dist., 6. 9. 1872, G.W. Shillingford. (Reg. No. 8710).

Distribution : All over India ; Sri Lanka & Pakistan.

16. *Ahaetulla mycterizans* (Linnaeus)

Material : 1 ex. Purnea, Purnea dist., 11. 1880, F. Fedden. (Reg. No. 10977).

Measurements : Total length 1459 mm. ; tail 559 mm.

Distribution : India : Rajasthan ; Bihar ; West Bengal & Assam.

17. *Lycodon aulicus* (Linnæus)

Common Wolf Snake

Material : 1 ex. Purnea, Purnea dist., ? C.R.M. Green. (Reg. No. 13750).

Measurements : Total length 300 mm, tail broken.

Distribution : All over India ; Nepal ; Burma ; Sri Lanka ; Vietnam, Laos, Kampuchea ; Southern China ; Hongkong ; The Maldives Island, the Malaysia and Celebes and the Philippines.

18. *Lycodon striatus* (Shaw)

Material : 1 ex. Siripur, Saran dist., ? M. Mackenzie. (Reg. No. 17557).

Measurements : Total length 356 mm, tail 56 mm.

Distribution : India ; Himachal Pradesh ; Uttar Pradesh ; Bihar. Elsewhere : Sri Lanka ; Pakistan ; Transcaspia.

19. *Argyrogena diadema* (Schlegel)

Material : 1 ex. Purnea, Purnea dist. ?? (Reg. No. 10978).

Distribution : India ; Kashmir ; Rajasthan ; Delhi and Uttar Pradesh. Elsewhere : Baluchistan, Afghanistan, Southern Turkestan and Iran to North Africa.

Remarks : This species is reported for the first time from Bihar.

Family (5) DASYPELTIDAE

20. *Elachistodon westermanni* (Reinhardt)

The snake of Purnea district which is in the collection of Zoological Survey of India, was described by Wall, 1913.

Family (6) ELAPIDAE

21. *Bungarus caeruleus* (Schneider)

Common Indian Krait / Blue Krait

Material : 1 ex. Champaran, Champaran dist. ? Major, A. H. McMohan.

Measurements : 1 ex. Total length 1234 mm ; tail 154 mm.

Distribution : Rajasthan ; Uttar Pradesh ; Madhya Pradesh ; Bihar ; West Bengal ; Orissa ; Andhra Pradesh and Andaman Islands. Elsewhere : Sri Lanka.

SUMMARY

The present work on lizards and snakes of North Bihar reveals the presence of 23 species

belonging to 17 genera under 6 families. Of these, four species have been recorded for the first time from the area.

ACKNOWLEDGEMENT

The authors are thankful to Dr. B.S. Lamba, Joint Director-in-Charge, Zoological Survey of India, Calcutta, for all the facilities, to Dr. S.K. Bhattacharya and Dr. O.B. Chhotani, for encouragement. Thanks are also due to Dr. Q.H. Baqri, Dr. S.K. Gupta, Shri D.P. Sanyal, Shri B. Duttagupta, and Shri N.C. Gayen, for help in various ways in connection with this work.

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CLADOCERAN INVESTIGATIONS IN A POND WITH MACROPHYTES AND ALGAL BLOOMS

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INTRODUCTION

Kovur pond is rectangular with an area of 0.5 ha. and an average depth of 0.75 M. The pond has only one inlet on the northern side and no outlet. It mainly depends on the rain water besides the flow from the inlet coming from Chambarambakkam tank. Kovur is 20 km west of Madras city and fringed with fields. During the period of investigation aquatic macrophytes such as *Pistia* and *Neptunia* were noted. There is no regular fishing in this pond and occasional hook and line catches reveal the following species namely *Puntius* sp. *Channa* sp. and *Mystus* sp.

MATERIAL AND METHODS

Studies were undertaken from October 1979 to March 1982 by collecting monthly samples. For plankton collection 0.25 M. nylon net (0.3 mm. mesh size) was utilised. The net was thrown so that the attached rope (2.55 M.) was in the water and in this manner plankton was collected (Hebert, 1977). For each sample four throws were made. The collected samples were preserved in 5% formalin and made upto 250 ml. From this a subsample of 2 ml. was examined in Sedgewick-rafter cell, for counting purposes. Total number of specimens collected were given for 500 litres of water filtered assuming the filtration efficiency of the net is 100% (Rawson, 1956). For taxonomic studies cladocerans were separated and identified.

Surface water samples collected were analysed for dissolved oxygen and pH. Dissolved oxygen was estimated by Winkler method with azide modification. pH was measured in the field by using wide and narrow range BDH papers. The values were again corroborated in the laboratory by using Philip's pH meter. Transparency values were noted by using a Secchi disc. Further other parameters like depth, air temperature, water temperature and weather conditions were noted.

RESULTS

Physico-Chemical parameters (Table - 1, Page 84)

The air temperature range was between 23.0° and 32.0°C with minimum during December 1981 and maximum in March, 1980. Water temperature range was between 23.5° and 31.5° C with minimum in December 1981 and maximum in April 1980. Depth of water was in the range of 0.60 to 1.20 M. The transparency value could be taken only

upto October 1981. Subsequent to that pond surface was completely filled with *Pistia* and *Neptunia*. The transparency values were in the range of 0.10 to 0.50 M. with minimum in April 1980 and maximum in September 1981. The pH values were in the range of 6.8 to 9.0 with minimum in February 1982 and maximum in March 1980. The dissolved oxygen values were in the range of 0.7 to 7.5 mg/l, with minimum in October 1981 and maximum in March 1980.

Biological factors (Table - 2, Page 85)

The pond can be divided into different periods depending on algal blooms and macrophytes. The first period is between Oct. 1979 to Jan. 1980 during which water was clear without macrophytes and algae. The cladoceran species noted during this period are *Ceriodaphnia cornuta*, *Moina micrura* and *Alona guttata*. During the second phase between Feb. 1980 to July 1980, *Microcystis* bloom was noted. During this period *Ceriodaphnia cornuta* and *Moina micrura* were noted. The third phase from August 1980 to October 1980 during which no bloom was noted. Only these two species of cladocerans namely *Ceriodaphnia cornuta* and *Moina micrura* continued with maximum of *M. micrura* (102375) and maximum of *C. cornuta* (31844). The next phase was noted between November 1980 to January 1981 with algal blooms. During this period also both the species of cladocerans continued to be noted in good numbers. From Feb. 1981 to April 1981, the whole pond was covered with *Pistia* sp. Both the species of cladocerans namely *C. cornuta* and *M. micrura* started diminishing in numbers with *C. cornuta* completely disappearing. On the other hand *Diaphanosoma excisum*, *D. sarsii*, *Chydorus reticulatus*, and *Alona guttata* started appearing. The sixth phase from June 1981 started with contamination of water with many fishes floating. *Pistia* was completely removed. Again after this *Microcystis* started increasing upto July 1981. In this period *C. laticaudata* started appearing in good numbers. *M. micrura* also recorded an increase in numbers and *D. excisum* and *C. reticulatus* continued to occur. In the next seventh phase from Aug. 1981 to March 1982, the pond was completely covered with *Pistia* and *Neptunia*. *C. laticaudata* continued to occur with maximum in Aug. 1981. *M. micrura* showed a decline with absence from Jan. 1982. *D. excisum*, *C. reticulatus* and *A. guttata* were continued to occur. *Macrothrix spinosa* started appearing in the samples.

DISCUSSION

From the results it is probable that *Moina micrura* and *Ceriodaphnia laticaudata* can exist and increase in enormous numbers even at low dissolved oxygen values. Krishnamurthy (1967) also observed that dissolved oxygen values so low as 0 to 2.0 mg/l. were more suitable for the increase of *M. micrura*. On the other hand *C. cornuta* can increase in numbers only at slightly higher dissolved oxygen values from 4.0 mg/l. Raghunathan (1984) has recorded *C. cornuta* in more numbers when the dissolved oxygen values were between 4.0 to 8.1 mg/l. from Chingleput tank. *D. excisum* can increase in numbers in a wide range of dissolved oxygen values from 2.9 to 7.7 mg/l. Other Cladocera such as *C. reticulatus*, *A. guttata* and *M. spinosa* were present in the samples only when the water was covered with macrophytes like *Pistia* and *Neptunia*.

Among the cladocerans few genera are planktonic which live in the open water while a vast majority of them are littoral and live among the weeds and some of them even live on the bottom mud (Michael, 1973). Among the eight species of Cladocerans collected *Moina micrura* and *Ceriodaphnia cornuta* are the two species which are noted to survive during *Microcystis* blooms. *D. excisum* was also noted in small numbers during algal blooms. On the other hand after the spread of macrophytes *C. cornuta* could not survive and *M. micrura* started diminishing. But *C. laticaudata*, *M. spinosa*, *C. reticulatus* and *A. guttata* were noted only along with the macrophytes.

SUMMARY

Cladoceran investigations were carried out in an eutrophicated pond near Madras from October 1979 to March 1982. Eight species of Cladocerans were noted. Composition of Cladocerans varied in accordance with algal blooms and macrophytes. Other parameters like transparency, temperature, pH and dissolved oxygen were also recorded.

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Table 1 : Physicochemical data. Air temperature, Water temperature, transparency, pH and dissolved oxygen.

Month	A. Temp. °C	W. Temp. °C	Transp. M	pH	D. O. mg. / l.
Oct. 1979	27.0	29.0	0.30	8.5	4.1
Nov. 1979	26.0	27.0	0.40	8.0	3.7
Dec. 1979	28.0	27.0	0.35	8.5	4.4
Jun. 1980	26.0	25.5	0.30	8.3	0.8
Feb. 1980	26.5	27.5	0.30	8.2	2.3
Mar. 1980	32.0	29.5	0.20	9.0	7.5
Apr. 1980	30.0	31.5	0.10	8.5	3.9
May 1980	28.5	31.0	0.20	8.0	1.3
Jan 1980	27.0	29.5	0.30	8.0	6.5
Jul. 1980	30.0	29.0	0.20	8.0	5.7
Aug. 1980	29.0	29.6	0.19	7.8	2.35
Sept. 1980	31.0	30.5	0.30	7.9	6.2
Oct. 1980	27.0	28.0	0.20	7.7	5.1
Nov. 1980	26.0	26.0	0.25	7.3	3.7
Dec. 1980	24.0	24.7	0.25	7.7	6.9
Jan. 1981	23.5	25.0	0.30	7.2	6.5
Feb. 1981	24.0	26.5	0.35	7.5	5.2
Mar. 1981	27.0	29.0	0.25	7.3	4.6
Apr. 1981	29.0	29.0	0.35	7.4	1.5
May 1981	29.0	30.0	0.30	7.3	2.9
June 1981	30.0	29.5	0.15	7.6	2.1
July 1981	27.0	27.5	0.15	7.2	1.9
Aug. 1981	28.5	29.5	0.20	6.9	1.4
Sept. 1981	28.5	29.5	0.50	7.0	1.6
Oct. 1981	28.5	27.0	0.30	7.0	0.7
Nov. 1981	26.0	26.5	—	6.9	1.7
Dec. 1981	23.0	23.5	—	6.9	1.2
Jan. 1982	24.5	24.0	—	7.0	0.9
Feb. 1982	26.0	24.5	—	6.8	1.9
Mar.. 1982	29.5	27.0	—	6.9	1.1

Table 2, Biological factors : Cer. c.-*Ceriodaphnia cornuta*., C. lat.-*Ceriodaphnia laticaudata* M.m-*Moina micrura*., D. ex.-*Diaphanosoma excisum*., D. sar-*Diaphanosoma sarsi*, Mac.s.-*Macrothrix spinosa*., Chy.r.-*Chydorus reticulatus*., Al.g.-*Alona guttata*.

Month		Cer.c.	C. lat.	M. m.	D. ex.	D. sar	Mac. s.	Chy. r.	Al. g.	Remarks
Oct.	79	125		250	-	-		-	125	CLEAN
Nov.	79	5875		4125	-	-		-		"
Dec.	79	250	-	500				-		"
Jan.	80	1000		1125	-	-		-	125	"
Feb.	80	8625		5875		-		-		Microcystis
Mar.	80	500	-		-			-	-	"
Apr.	80			16250			-	-		"
May	80	-		24000	-			-	-	"
Jun.	80	10500		31750	-	-		-	-	"
Jul.	80	1125	-	15750		-		-		"
Aug.	80	8250		102375					-	CLEAN
Sep.	80	15042		20625		-		-		"
Oct.	80	31844		9458	-	-		-	-	"
Nov.	80	5833	-	39758	-			-	-	Microcystis
Dec.	80	4875	-	25708		-		-	-	"
Jan.	81	4375		6250		-		-	-	"
Feb.	81	958	-	1000	375		-		-	Pistia
Mar.	81	560		875	281	344		-	-	"
Apr.	81			335	2792	-		125	625	"
May	81			1906				-	-	Waterspoil
Jun.	81		37187	2406		-		500		Microcystis
Jul.	81		7915	21542	125			920	-	"
Aug.	81		43969	4092	1031		-	-	-	Pistia
Sep.	81		7156	2469	2312	-		125	-	"
Oct.	81	-	2844	125	406	-		1031	-	"
Nov.	81	-	14125	594	200		-	250	-	"
Dec.	81		562	250	300	-	375			"
Jan.	82		594			-	532	601	-	"
Feb.	82	-	814		125	-	1312	125	281	"
Mar.	82		625		125	-	125	200	125	"

TAXONOMIC REVIEW OF THE GENUS *BANDICOTA* GRAY AND ITS SPECIES WITH A NOTE ON THE INTRASPECIFIC GEOGRAPHICAL VARIATION IN THE LARGE BANDICOOT RAT, *BANDICOTA INDICA* (BECHSTEIN) [MAMMALIA : RODENTIA]

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INTRODUCTION

Bandicoots are regarded as most serious pests, being responsible for food loss and damage to property (Patnaik 1969, Prakash 1976). A good number of taxonomic papers have been published on the genus *Bandicota* Gray and its species and subspecies. In the present paper a taxonomic review of the genus *Bandicota* and its species occurring in the Indian subcontinent was made. Moreover, during the ecological study of *Bandicota indica* (Bechstein) by the first author, a huge number of specimens were collected from different parts of West Bengal. Based on this material, as well as specimens from all over India present in the Zoological Survey of India and Bombay Natural History Society, a study on the intraspecific geographical variation in *B. indica* was made.

All measurements are given in millimetre and taken according to Ellerman (1961). However, external measurements of earlier material are noted from the labels attached to them. Colours given with initial capital letters in the text have been recognised according to Ridgway's (1886) nomenclature. Population range diagrams have been prepared according to the methods of Dice and Leraas (1936) and Hubbs and Perlmutter (1942).

TAXONOMIC REVIEW

Bandicoots were first separated from Rats (*Mus*) by Gray (1842) under the generic name *Nesokia*. Later, Gray (1873) coined the genus *Bandicota*. Thomas (1907) divided the genus *Nesokia* into three genera and provided the following key :

- A) Size small, tail very short, less than two-third of head and body, mammae 2-2 = 8. Skull short and broad; palatal foramina short *Nesokia* Grey
- B) Size small ; tail fairly long more than two-third of head and body ; mammae irregular (14-18). Skull broad; palatal foramina long *Gunomys* Thomas
- C) Size large; tail long, almost as long as head and body ; mammae 3-3 = 12. Skull long and narrow; palatal foramina long *Bandicota* Grey

Wroughton (1908) followed the treatment of Thomas (*op. cit.*) and recognised altogether six species under the genus *Bandicota*, viz., *B. gigantea*, *B. malabarica*, *B. setifer*, *B. elliotana*, *B. indica* and *B. nemorivaga*. Thomas (1916) and Kloss (1919) described three more species under the genus, viz., *B. savilei*, *B. mordax* and *B. siamensis*

respectively. Kloss (1921) after comparing the characteristics of the genera *Bandicota* and *Gunomys*, opined that the differences were hardly of generic rank and *Gunomys* must be treated as a synonym of *Bandicota*. Ellerman (1941) also regarded *Gunomys* as a synonym of *Bandicota* and listed as many as eight species under it, viz., *B. bengalensis*, *B. gracilis*, *B. indica*, *B. nemorivaga*, *B. savilei*, *B. gigantea* and *B. malabarica*. Later, based on detailed work with huge material present in the British Museum, Ellerman (1947) recognised only two species under the genus and provided the following key :

- 1(2) Bullae smaller, usually less than one-fifth of occipitonasal length; nasals more than one-third of occipitonasal length as a rule; length of palate usually less than 60% of occipitonasal length; occipitonasal length varies between 46 and 68 mm; braincase as a rule proportionately by narrow.*B. indica* (Synonym : *B. gigantea*, *B. savilei*, *B. siamensis*, *B. nemorivaga*, *B. malabarica*).
- 2(1) Bullae larger, normally exceed one-fifth of occipitonasal length; nasals as a rule less than one-third of occipitonasal length; length of palate normally more than 60% of occipitonasal length; occipitonasal length varies between 35 and 49 mm; braincase proportionately wider *B. bengalensis* (Synonym : *B. gracilis*).

Moreover, Ellerman (*op. cit.*) from the study of coloration and external measurements of the different geographical populations of the above two species in the Indian subcontinent, recognised altogether five subspecies of *B. bengalensis*, viz., *B. b. bengalensis*, *B. b. kok*, *B. b. wardi*, *B. b. varius* and *B. b. gracilis*, and three subspecies of *B. indica*, viz., *B. i. indica*, *B. i. nemorivaga* and *B. i. savilei*. Agrawal and Chakraborty (1976) with the help of statistical analysis of the voluminous data available to them, studied the nature and trend of variability of the different geographical populations of *B. bengalensis* and recognised only three subspecies, synonymising *B. b. kok* and *B. b. gracilis* with the nominate subspecies. However, no such detail study with the different geographical populations of *B. indica* was conducted after the revisionary work of Ellerman (*op. cit.*). Tiwari *et al.* (1971) revived *B. i. malabarica* as a separate subspecies from *B. i. indica* on the basis of larger head and body, hind foot, tail, ear and occipitonasal length. From the study of chromosomes, haemoglobin, external and cranial measurements of the specimens from Goregaon and Malad in Bombay, Deoras and Pradhan (1977) opined that *B. gigantea* which was considered as a synonym of *B. i. indica*, should be regarded as a distinct species or at least subspecies of *B. indica*. Marshall (1977) regarded *savilei* as a distinct species of the genus *Bandicota* on the colour and cranial characters. Dr. D. H. Johnson, Dr. M. Bahmanyar and Dr. G. G. Musser are also of the same opinion (personal communication to Dr. Marshall). Honacki *et al.* (1982) in the Mammal species of the world also listed three species of the genus *Bandicota*, viz., *B. bengalensis*, *B. indica* and *B. savilei*. However, the last one does not occur within the Indian territory.

INTRASPECIFIC GEOGRAPHICAL VARIATION IN *BANDICOTA INDICA* (BECHSTEIN)

On the background of above knowledge and having advantage of good series of specimens, it was felt necessary to study in detail the intraspecific geographical variations

in *B. indica*. Altogether, 529 specimens from different parts of the country were examined. In addition, measurements given by Ellerman (1961) have also been included for statistical analysis. The results obtained are summarised below.

Colour and nature of fur : Dorsum of the specimens of *B. i. nemorivaga / elliotana* from the rural region of its range (Thakurpukur, Memari, Sagar Island of West Bengal) is blackish brown, black being prominent; underwool slate grey; fur moderately sparse and harsh in most of the specimens, while spiny in a few; many long, stiff and black hairs present in the mid dorsum; sides lighter, smoke grey or drab grey; chin and undersurface of limbs sparsely haired, but rest of the undersurface covered with thick, short hairs; hairs basally smoke grey, apically pale bluish or whitish with a light blue tinge giving an effect of light bluish when seen from a distance; tail wholly dark; covered with thin, minute spiny hairs particularly on the upper surface; hands and feet wholly dark, except at the bases of nails where minute whitish markings could be noticed.

Specimens of *nemorivaga / elliotana* from the urbanised area of their range (Calcutta, Howrah of West Bengal) are similar to the above description, but instead of black, brown is predominant on the dorsum. Moreover, dorsal hairs are relatively more spiny. No fresh specimens of *nemorivaga / elliotana* from northern Bihar, Assam, Nepal or Nurma could be examined. Old specimens from these localities present in the Zoological Survey of India collection tally with the Calcutta and Howrah specimens, but the undersurface is light grayish or yellowish instead of bluish.

Only the old specimens from the range of *indica / malabarica / gigantea* collected from the different localities of Rajasthan, Gujarat, Uttar Pradesh, Madhya Pradesh, Ardhra Pradesh, Orissa, southern Bihar, Goa, Maharashtra, Karnataka, Tamil Nadu, Kerala and Sri Lanka could be examined. Not much geographical variation in the coloration could be marked except that the specimens from northern India tend to be slightly paler on average than those of southern India. However, dorsum is almost light brown with some blackish patch in some specimens irrespective of geographical range. Specimens of *indica / malabarica / gigantea* particularly those collected in summer or monsoon are very poorly haired and much spiny as compared to those from the range of *nemorivaga* or *elliotana* of the same season. A crest of very long and stiff hairs along the mid-dorsum region is much prominent. Sides almost similar to the dorsum in colour but hairs are very short. Undersurface is very sparsely haired and often naked skin could be seen; colour varies from smoke grey to drab grey. Tail, hands and feet similar to that of the *nemorivaga* and *elliotana* specimens.

External measurements : Specimens of *B. indica* from all the areas of its range are very large and not much difference could be marked among the different populations (Table 1, Page 99). Tail is relatively short in the specimens from the range of *nemorivaga / elliotana* and in 408 out of 463 measureable specimens, it is shorter than head and body, while the tendency is reverse in the specimens from the range of *indica, gigantea* and *malabarica*, tail being longer than head and body, exception in being 24 out of 64 measureable specimens. However, the difference in the relative or absolute length of the tail between the two groups does not hold good even at one standard deviation (Fig. 1, 2). Relative as well as absolute lengths of the hind foot in *nemorivaga / elliotana* specimens

are less than those of the *indica* / *malabarica* / *gigantea* specimens, but again the difference does not hold good even at one standard deviation (Fig. 3).

Cranial characters : Skulls of the specimens from West Bengal, northern Bihar, Assam, Nepal and Burma or in other words from the range of *nemorivaga* / *elliottana* are very large (occipitonasal 57 ± 1.2) and narrow; base of the skull moderately lengthened so that condylobasal length on average slightly less (56.7 ± 2.4) than occipitonasal and out of 398 measureable skulls only in 48, condylobasal exceeds the occipitonasal length. Nasal is moderately long (20.3 ± 1.2) being 35.8 ± 2 per cent of the occipitonasal. Palate is well over half of the occipitonasal (32.6 ± 2). Anterior palatal foramen is long and in most specimens reaching up to the molar toothrow. Zygoma is broad and very powerful. Orbit is large (21.5 ± 1.36). Frontal and parietal are powerfully ridged; ridges extending to the occiput. However, on the posterior part of the parietal, the degree of development of ridges varies from specimen to specimen and is somewhat related to the age. Interparietal is well-developed, rectangular in outline and though in most of the specimens sutures are obliterated, yet demarkating lines could be marked. Dental features agree with the description given by Ellerman (1961). Colour of incisors varies from whitish to orange.

Skulls from the range of *gigantea* (Rajasthan, Gujarat, Uttar Pradesh, parts of Madhya Pradesh), *indica* (Pondicherry, parts of Kerala, Karnataka and Tamil Nadu) and *malabarica* (remaining part of peninsular India and Sri Lanka) are very large and do not differ from each other in the structure. However, the skulls from the range of *indica* are slightly smaller than of the other two on average (occipitonasal : *indica* 56.3 ± 3.2 , *gigantea* 61.1 ± 51.1 , *malabarica* 59 ± 2.5), but the difference is not significant (Fig. 4). Base of the skull is so lengthened in all of them that condylobasal length is slightly longer than occipitonasal length (condylobasal : *indica* 56.86 , *gigantea* 61.24 ± 4 , *malabarica* 59.59 ± 3.2) except in four out of 20 skulls with measureable condylobasal. Rostrum is much elongated so that the absolute length of nasal (nasal : *indica* 22.5 ± 0.8 , *gigantea* 24.4 ± 2 , *malabarica* 24.5 ± 1.1), as well as the relative length of the nasal (nasal as percentage of occipitonasal : *indica* 39.6 ± 1.5 , *gigantea* 39.8 ± 1.7 , *malabarica* 41 ± 1.2) differ significantly from that of *nemorivaga* / *elliottana* specimens (Fig. 5,6). Zygoma is relatively narrow and less powerful. Relative length of bullae in all of them on average is shorter than that of *nemorivaga* / *elliottana* (Table 1). Interparietal is distinct but less developed and almost triangular in outline.

From the above study it is obvious that the supposed size differences between the *B. i. indica* and *B. i. malabarica* are nothing but individual or age variations as the specimens from the same locality in the range of *malabarica* show the same degree of variation between the smallest and largest specimens. Ellerman (1947) also found that "the difference between the smallest *malabarica* skull and largest of the Nilgiri specimens is much smaller than that between the smallest and largest specimens of '*malabarica*' which varies in our material between 56.2 mm and 68.7 mm". From table 1 it is also found that the differences in the head and body, hind foot and ear lengths between the specimens of *indica* and *malabarica* mentioned by Tiwari *et al.* (1971) do not hold good for the subspecific differentiation. Thus, I agree with the Ellerman's (1947) view that *malabarica* is nothing but a synonym of *indica*. The external measurements of the specimens from the range of *gigantea* including the type show that they are relatively larger than the

specimens from the range of *indica* or *malabarica* (Table 1). However, only one or two specimens are available from each locality within the range of *gigantea* except in Kathiawar where a series of seven specimens were found. The series from Kathiawar shows similar range of size variation like the specimens of *malabarica* in many of the localities. Moreover, equally giant or large specimens along with relatively smaller ones are also found in the same ecological niche at Sagar Island.

Deoras and Pradhan (1977) opined that in Bombay, there are two species or at least subspecies of large bandicoot rat, viz., *gigantea* (larger ones), and *indica* (smaller ones), and each has a different niche in the ecosystem. Pradhan *et al.* (1989) regarded *gigantea* as a distinct species. Their conclusion was supported from external and cranial measurements as well as karyological and haemoglobin studies. But as it is obvious that the size variations among the specimens of the same population *Bandicota indica* is too high, it is not worthwhile to designate larger specimens as *gigantea* and smaller as *indica*. Moreover karyological and haemoglobin studies should also be carried out with specimens of different sizes from other parts of the country to draw conclusion about the status of *gigantea*. At the moment owing to lack of any definite external or cranial characteristics, it is worthwhile to maintain *B. indica gigantea* as synonym of *B. i. indica*. Wroughton (1908) maintained *elliottana* as a distinct species from *nemorivaga* on the basis of almost blackish dorsum against brown of the latter. As the specimens from different localities within the range of *elliottana* and *nemorivaga* show considerable colour variation from brown to black, the separation of the two on the basis of colour is not possible and Ellerman (1947) is justified in synonymizing *elliottana* with *nemorivaga*. The specimens of *nemorivaga* (with *elliottana*) differ from the specimens of *indica* (with *malabarica* and *gigantea*) by the combination of a number of characters, like average smaller size, nature of fur, colour of the undersurface, relative length of tail and condylobasal, relative and absolute length of the nasal and shape of the interparietal. Though number of differentiating characters are many and one may incline to give them separate species rank, but most of the characters are on average and there is considerable overlap in each character. From the figures 5 and 6 it is obvious that only the difference in the absolute and relative length of the nasal between the *B. i. nemorivaga* (*elliottana*) and *B. i. indica* (along with *gigantea* and *malabarica*) are significant for subspecific differentiation. Thus, within the Indian range only two subspecies of *B. indica*, viz., *B. i. indica* and *B. i. nemorivaga* should be maintained on the basis of nasal length. Within the Indian limit, former ranges from eastern Rajasthan and Uttar Pradesh, south to Kerala and Tamil Nadu and east to Southern Bihar, while the latter ranges from northern Bihar and West Bengal, east to Manipur. Synonyms of the two subspecies are as follows :

Bandicota indica indica (Bechstein)

- Mus indicus* Bechstein, 1800. *Über Vierf. Thiere*, 2 : 497.
Mus bandicota Bechstein, 1800. *Über Vierf. Thiere*, 2 : 498.
Mus malabarica shaw, 1801. *Genl. Zool.*, 2 : 54.
Mus perchal shaw, 1801. *Genl. Zool.*, 2 : 55.
Mus giganteus Hardwicke, 1804. *Trans. Linn. Soc. Lond.*, 7 : 306.

Fig.1. Graphic comparison of the length of tail in different geographical population.
A=B.i.indica, B=B.i.gigantea, C=B.i.malabarica D=B.i.nemorivaga.

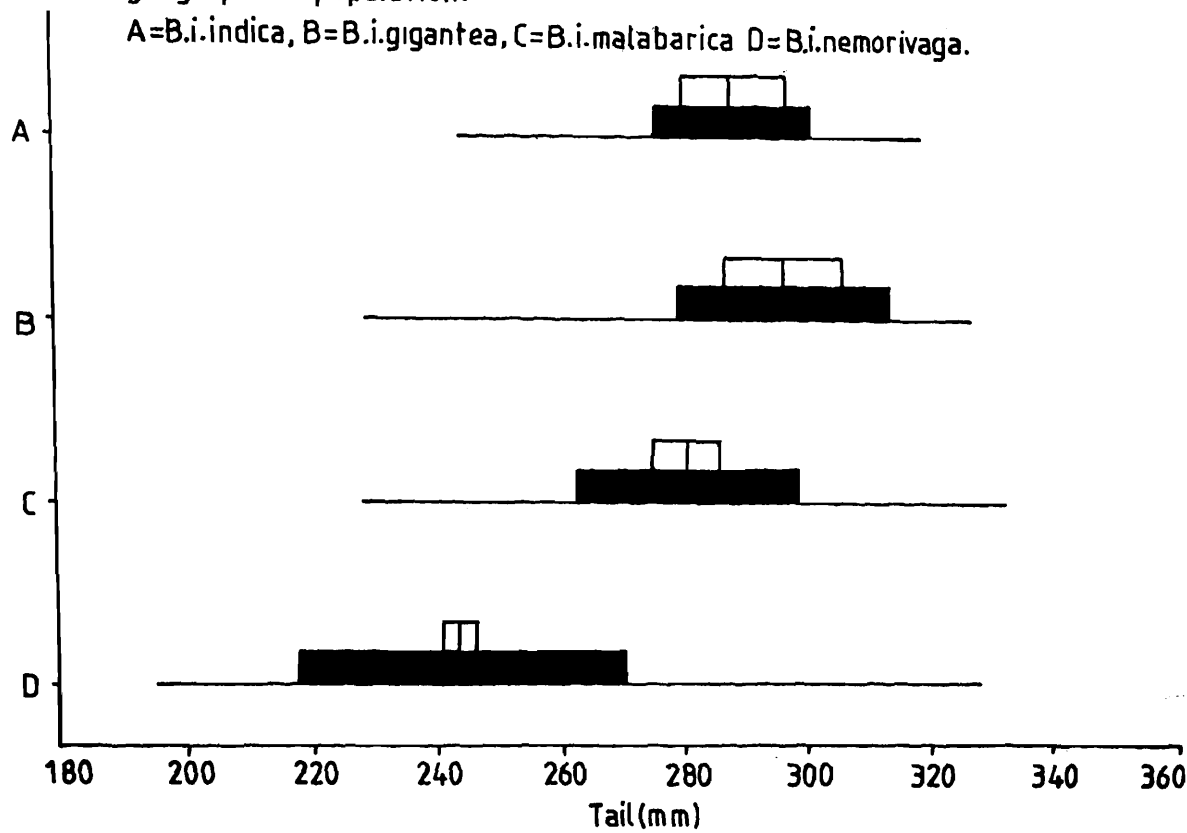


Fig. 2 Graphic comparison of the relative lenth of tail in different geographical populations.

A = B. i. indica.
B = B. i. gigantea
C = B. i. malabarica
D=B i. nemorivaga

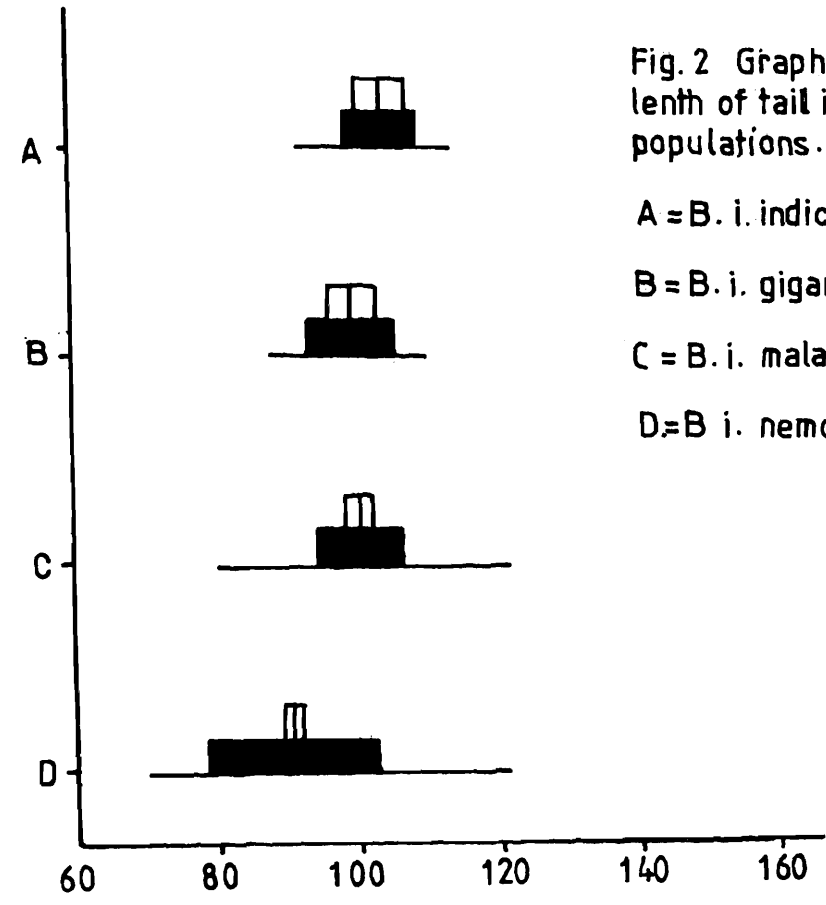


Fig.3. Graphic comparison of the absolute and relative length of hind foot in different geographical population.

A = *B.i.indica*, B = *B.i.gigantea*, C = *B.i.malabarica*, D = *B.i.nemorivage*.

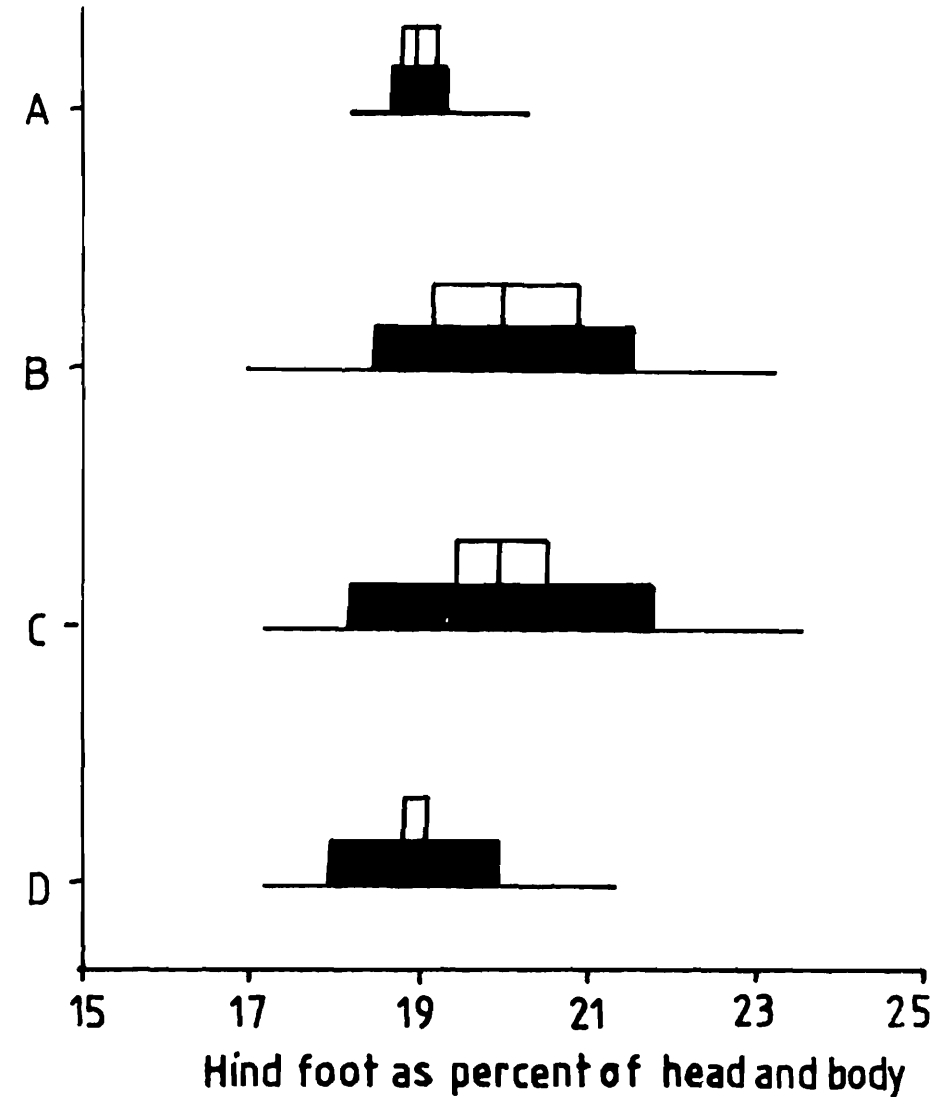
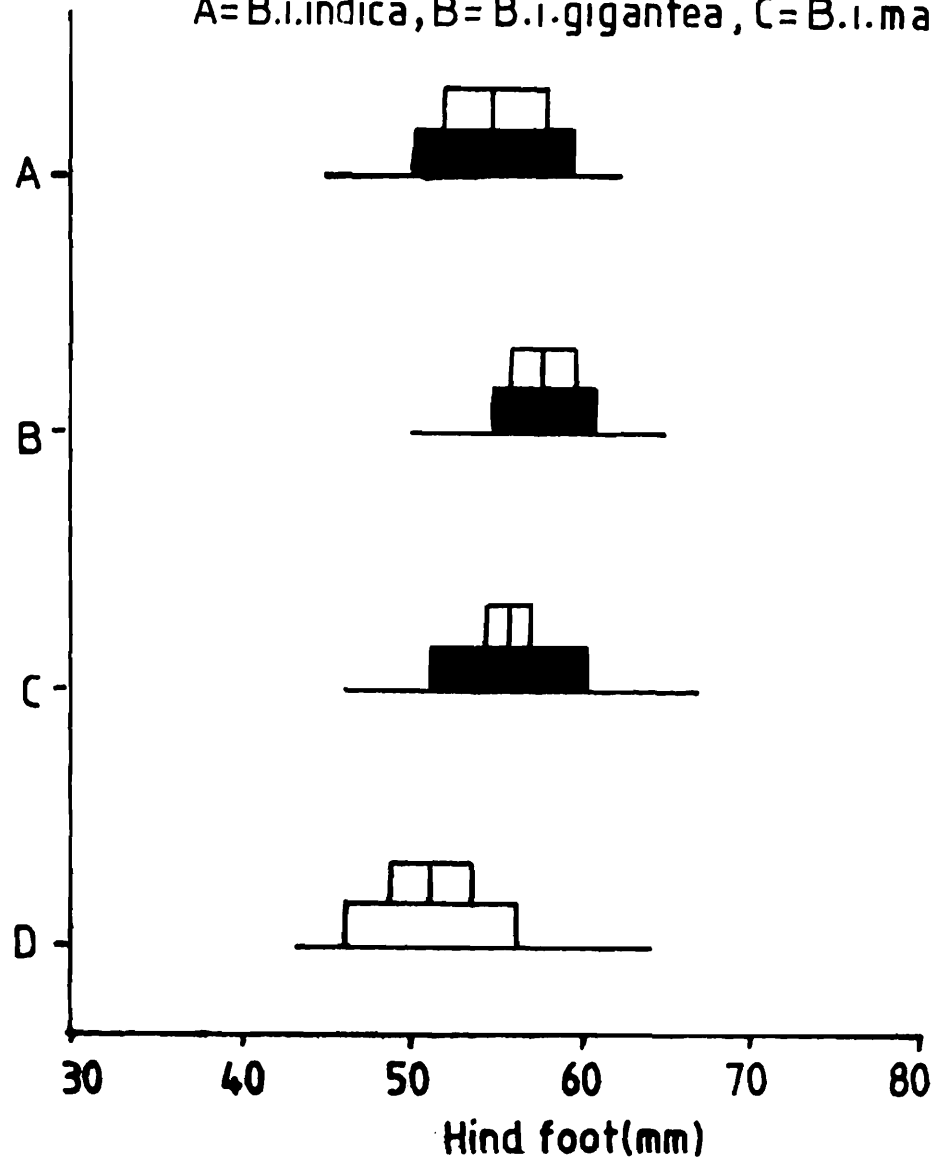


Fig.4. Graphic comparison of occipitonasal length in different geographical populations.
 A = *B.i.indica*, B = *B.i.gigantea*, C = *B.i.malabarica*, D = *B.i.nemorivaga*.

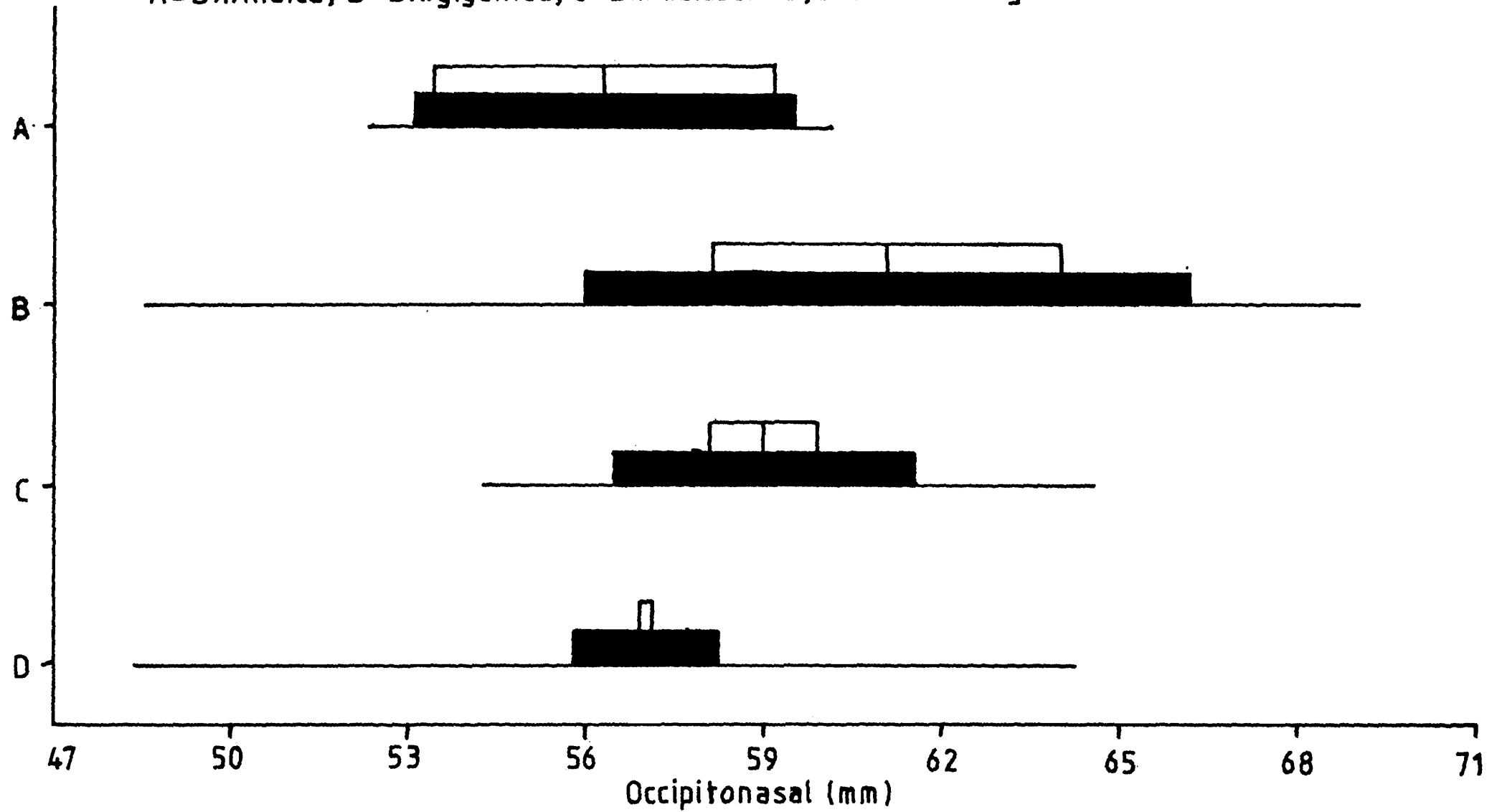


Fig.5. Graphic comparison of nasal length in different geographical populations.

A= *B. i. indica*, B= *B. i. gigantea*, C= *B. i. malabarica*,
D= *B. i. nemorivaga*.

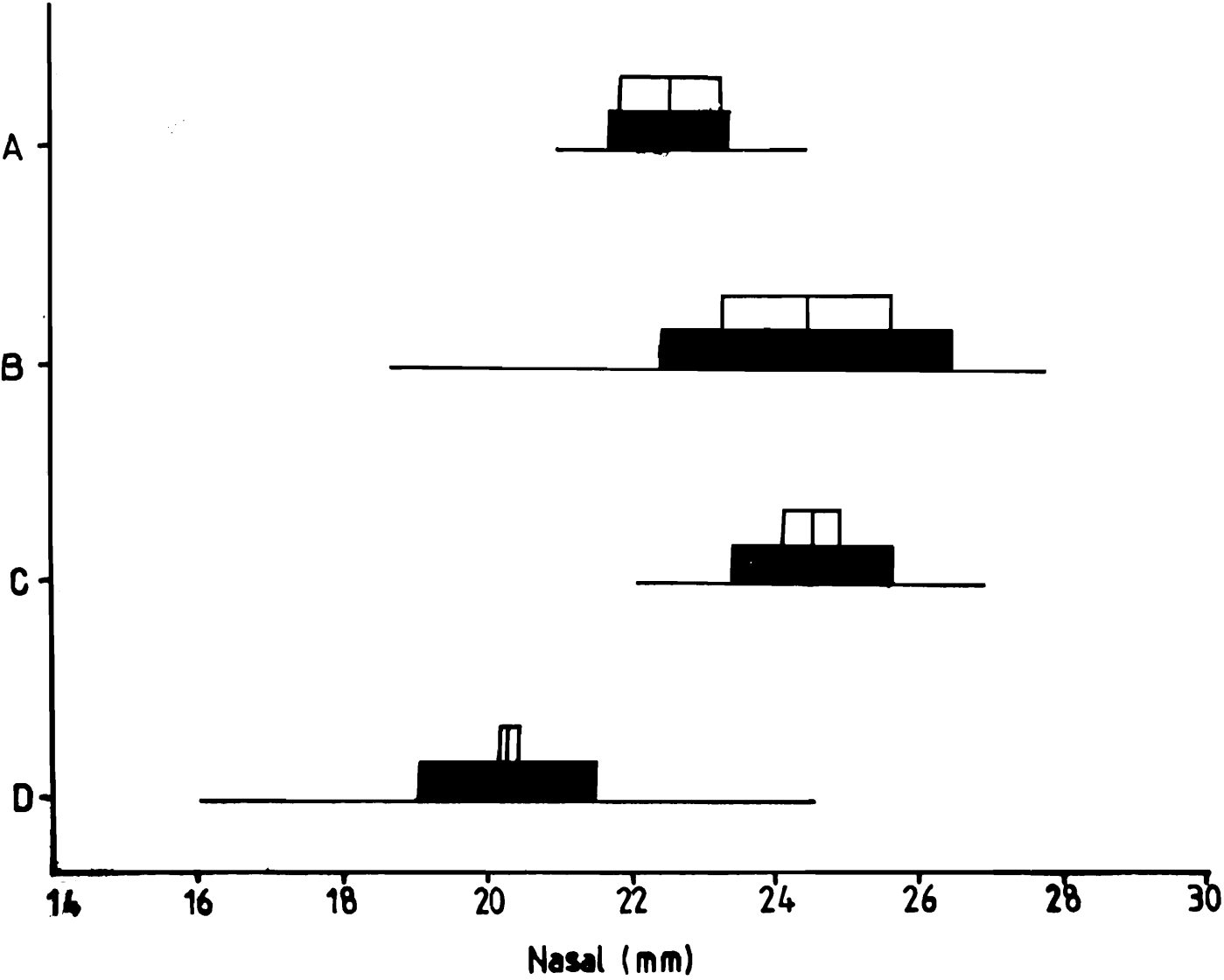
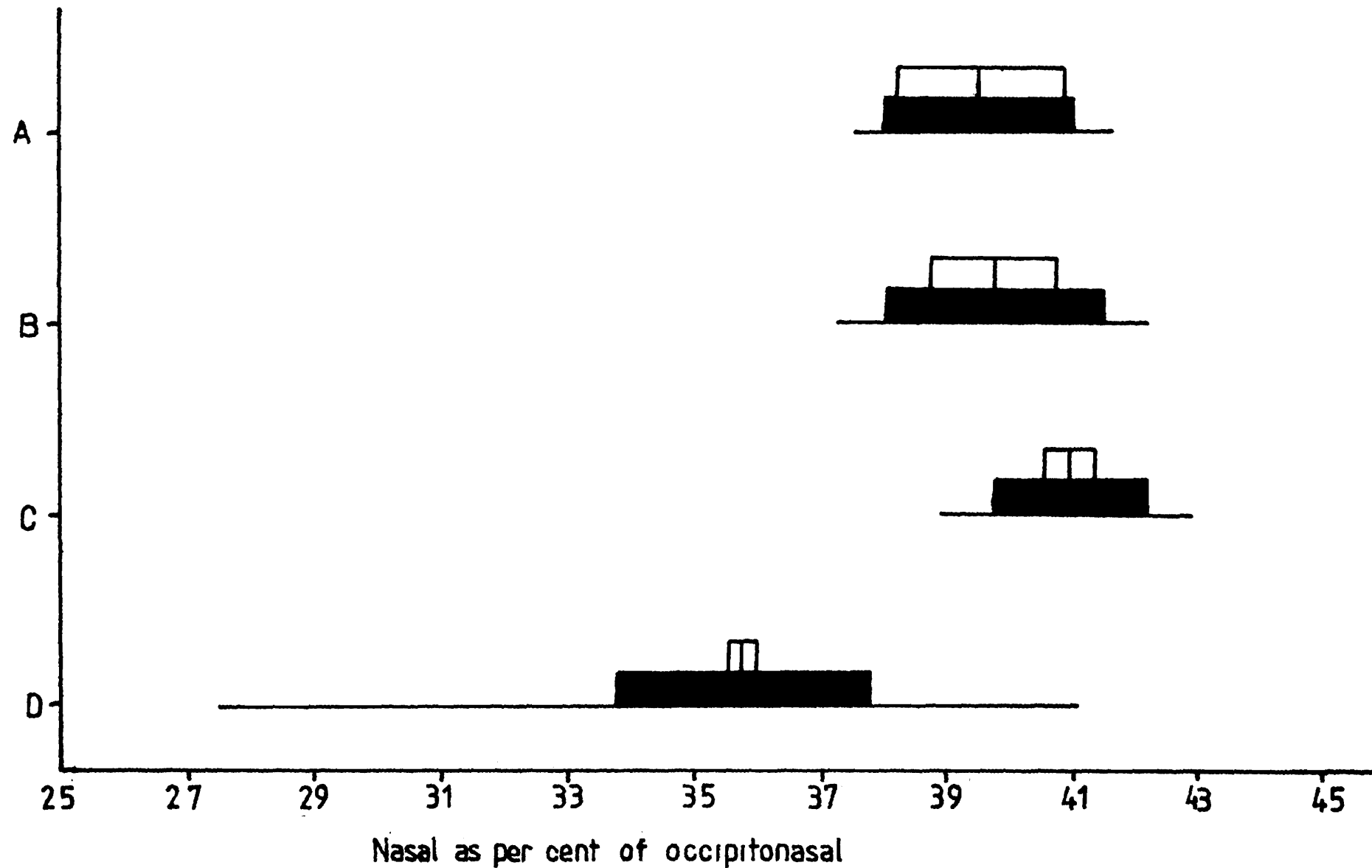


Fig. 6. Graphic comparison of relative length of nasal in different geographical population

A=B.i.indica, B=B.i.gigantea C. B.i malabarica, D= B i.nemorvaga.



***Bandicota indica nemorivaga* Hodgson**

Mus (Rattus) nemorivagus Hodgson, 1836. *J. Asiat. Soc. Beng.*, 5 : 234.

Mus macropus Hodgson, 1845. *Ann. Mag. nat. Hist.*, 15 : 268.

Mus (Nesokia) elliotanus Anderson, 1878. *J. Asiat. Soc. Beng.*, 46 : 231.

Mus Kagii Kuroaka, 1912. *J. nat. Hist. Soc. Taiwan*, 6 : 7. *nom. nud.*

Bandicota mordax Thomas, 1916. *J. Bombay nat. Hist. Soc.*, 24 : 642.

Rattus eloquens Kishida, 1926. *Kyozal no Konponteki Kenkyu*, 144.

Nesokia nemorivaga taiwanus Tokuda, 1941. *Buogeog. Tokyo*, 4 : 74.

SUMMARY

A taxonomic review of the genus *Bandicota* and its species was made. Intraspecific geographical variation in *B. indica* was studied. It was found that differentiating characters among most of the subspecies are marked with individual variations. However, on the basis of nasal length two subspecies, viz., *B. i. indica* and *B. i. nemorivaga* can be distinguished within Indian limit.

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Table 1. External and cranial measurements of different geographical populations of *Bandicota indica*. S. D. = Standard deviation. n=Sample size, Figures in parentheses indicate mean values.

Name	Head and body	Tail	Tail as percent of head and body	Hind foot	Ear	Occipitonasal	Condylbasal
<i>B.i. indica</i>	245-305 (278) n=8 S.D.=17	*245-315 (289) n=8 S.D.=12	92-109 (104) n=8 S.D.=5	45-60 (55) n=8 S.D.=4.5	30-34 (31.5) n=8 S.D.=1.2	52.7-60.5 (56.3) n=5 S.D.=3.2	156.86 n=1
<i>B.i. gigantea</i>	209-366.6 (300) n=13 S.D.=24	**229-330.2 (297) n=13 S.D.=17	90.5-111.5 (99.5) n=13 S.D.=6	50-63 (58) n=12 S.D.=3	28-39 (31) n=12 S.D.=3.5	48.5-68.7 (61.1) n=12 S.D.=5.1	+ 49-66.9 (61.24) n=4 S.D.=4
<i>B.i. malabarica</i>	205-345 (280.5) n=44 S.D.=21	π210-340 (281) n=43 S.D.=18	83-122 (100.4) n=43 S.D.=6	48-70 (56) n=44 S.D.=4.5	26-43 (32) n=44 S.D.=5	54.8-66.3 (59) n=33 S.D.=2.5	@ 55-64 (59.59) n=15 S.D.=3.2
<i>B.i. nemorivaga</i>	210-335 (269) n=464 S.D.=24	ππ 185-317 (244) n=463 S.D.=26	72-118 (90.5) n=463 S.D.=12	46-60 (51.5) n=463 S.D.=5	20-40 (27.5) n=464 S.D.=5.5	48.3-64.1 (57) n=421 S.D.=1.2	\$ 47.2-63.4 (56.7) n=398 S.D.=2.4

* In one specimen tail shorter than head and body ; ** In six specimens tail shorter than head and body ; π In 17 specimens tail shorter than head and body ; ππ In 408 specimens tail shorter than head and body ; 1 Condylbasal more than occipitonasal ; + Condylbasal more than occipitonasal in all the four specimens ; & In 11 specimens Condylbasal is greater than occipitonasal ; \$ In 48 specimens Condylbasal is greater than occipitonasal.

Name	Condylbasal as percent	Palate of occipitnasal	Nasal of occipitonasal	Nasal as percent	Palatal foramen	Bullae	Bullae as percent of occipitonasal	Upper toothrow
<i>B.i. indica</i>	101.2	31.7-35.6 (33.4) n=5 S.D.=1	20.3-24.4 (22.5) n=5 S.D.=0.8	37.6-41.7 (39.6) n=5 S.D.=1.5	10.2-11.7 (10.9) n=5 S.D.=0.3	8.8-10.1 (9.5) n=5 S.D.=0.4	16.6-16.7 (16.65) n=5 S.D.=0.01	9.2-10.9 (9.37) n=5 S.D.=0.4
<i>B.i. gigantea</i>	100.5-103 (101.32) n=4 S.D.=0.4	25.4-38.9 (35.16) n=12 S.D.=3	18.6-27.7 (24.4) n=12 S.D.=2	38.3-42.4 (39.8) n=12 S.D.=1.7	9.1-12.1 (11.25) n=12 S.D.=1	8.9-11 (9.98) n=11 S.D.=0.6	15.3-18.3 (16.53) n=11 S.D.=0.3	9.5-11.4 (10.57) n=11 S.D.=0.6
<i>B.i. malabarica</i>	98.5-103 (100.83) n=15 S.D.=0.6	30.5-39.6 (35) n=27 S.D.=2.3	22-27 (24.5) n=32 S.D.=1.1	38.9-43.4 (41) n=32 S.D.=1.2	10-12.7 (11.48) n=28 S.D.=0.6	8.6-10.7 (9.88) n=26 S.D.=0.3	14.4-18.5 (16.43) n=26 S.D.=0.7	9.4-11.6 (10.2) n=27 S.D.=0.4
<i>B.i. nemorivaga</i>	97.4-102.4 (99) n=398 S.D.=0.8	28.3-36.7 (32.6) n=416 S.D.=2	16-25 (20.3) n=421 S.D.=1.2	27.4-41 (35.8) n=421 S.D.=2	8.7-11.6 (10.3) n=416 S.D.=0.7	8.5-11.5 (9.7) n=402 S.D.=0.6	15.4-18.9 (17.4) n=394 S.D.=1.1	8.2-10.6 (10.3) n=409 S.D.=0.7

**DESCRIPTION OF A NEW SPECIES OF EUTICHURUS
(ARANEAE : CLUBIONIDAE) FROM INDIA**

BIJAN BISWAS
Zoological Survey of India, Calcutta

INTRODUCTION

The family Clubionidae is known from India through the works of Pocock (1900), Gravely (1921,1923), Reimoser (1934), Tikader (1962,1975,1976,1977,1981), Tikader and Biswas (1981) and Biswas (1984), who present a total of 72 species under 14 genera. Recently, Majumder and Tikader (inpress), in their comprehensive work on Clubionidae, added 12 new species to raise the total to 84 from India. While examining some specimens collected from Assam, the author came across a new species of *Eutichurus* which is described in this paper. This, in fact, is the second species of this genus described from the Indian Sub-continent.

The type specimen is deposited in the National Zoological collection of the Zoological Survey of India, Calcutta.

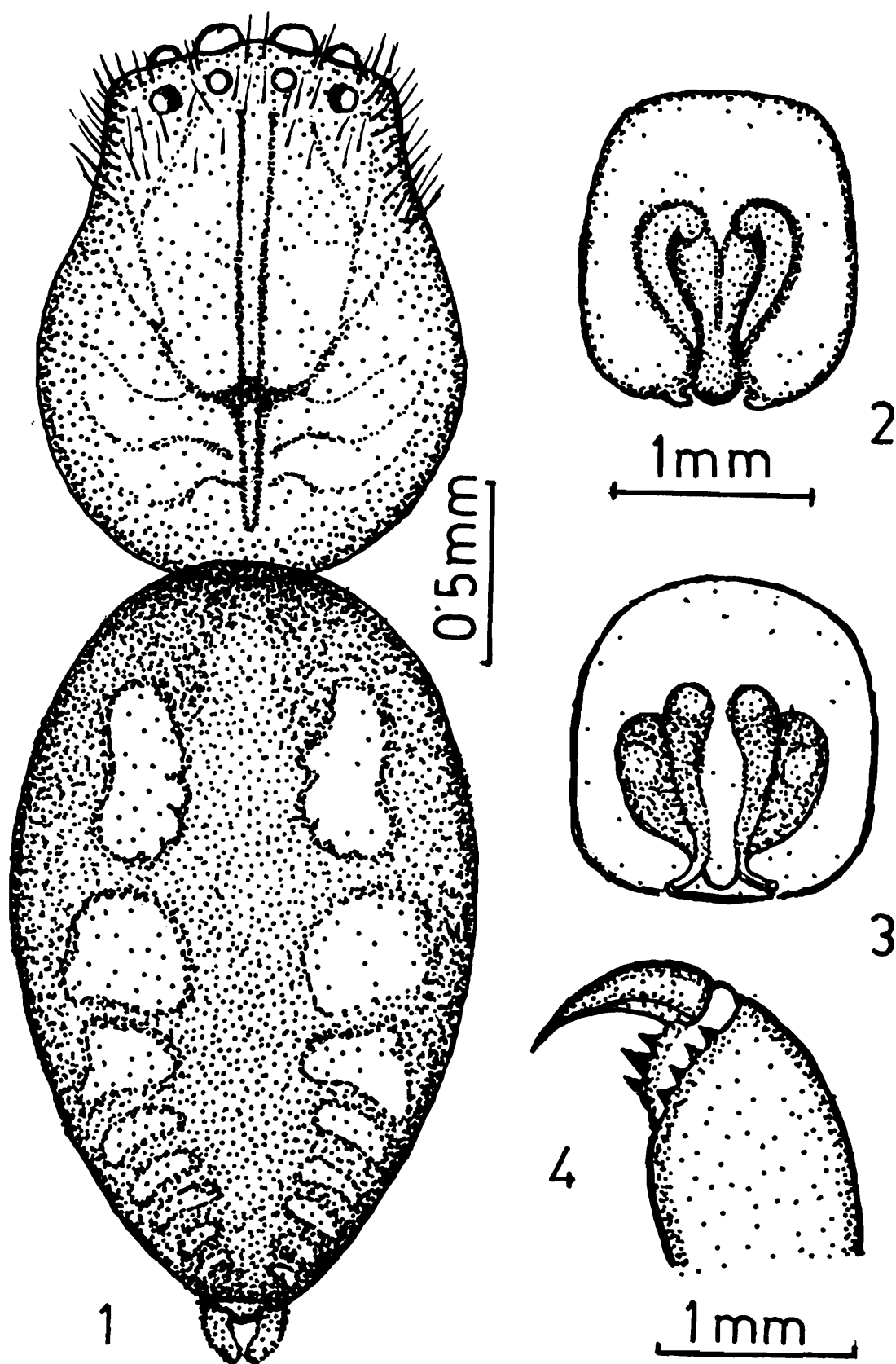
Eutichurus Simon

1897. *Eutichurus* Simon, *Hist. Nat. Araianees* 2, pt. 1 : 88

Characters: Cephalothorax longer than wide, covered with long feathery hair, provided with distinct fovea. Eyes in two rows (anterior and posterior), silvery white in colour, with space between eyes three times longer than diameter of posterior median eyes; anterior row straight or slightly recurved, and posterior row procurved; anterior medians two times larger than posterior medians; both medians remote from laterals and close to each other; ocular quadrangle wider than long. Chelicerae strong and stout, more or less parallel. Maxillae and labium longer than wide; maxillae with no depression at the middle. Sternum heart-shaped, covered by long curved black spine-like hair. Legs not very long, strong and stout: leg formula 1243; coxa and trochanter often covered with yellowish hair; tibia having same length as patella; tibial apophysis of male palp straight or slightly curved. Abdomen elongated in shape, covered with long spine-like hair. Female genitalia with convex and elongated plate, black and hairy anteriorly.

Eutichurus tezpurensis sp.nov.
(Figs. 1-4)

General : Cephalothorax reddish brown; legs brown; abdomen deep brown with yellowish ornamentation. Total length 15.00 mm. Carapace 6.00 mm. long, 5.00 mm. wide; abdomen 8.50 mm. long, 5.40 mm. wide.



Eutichurus tezourensis

1. Dorsal view of female legs omitted. 2. Epigyne. 3. Spermathecae. 4. Left chelicera, retrolateral view.

Cephalothorax : Longer than wide narrow and convex anteriorly, broad posteriorly, covered with fine spine-like hair, with distinct fovea just behind middle of carapace. Clypeus narrow and slanting. Eyes in two rows (anterior and posterior), silvery white in colour, small in size and approximately equal spaced; anterior row slightly recurved, with medians two times larger than posterior medians and close to each other; posterior row recurved, longer than anterior row, with medians smaller than laterals and closer to each other than to the laterals; ocular quadrangle wider than long, narrow anteriorly and broad posteriorly. Chelicerae (Fig. 4) strong and stout, blackish in colour, covered with long black spine-like hair; inner and outer margin provided with four and three teeth respectively. Maxillae and labium longer than wide, maxillae not depressed at middle, anteriorly wider; labium wider posteriorly, narrower and scopulated anteriorly. Sternum heart-shaped, blackish in colour, covered by number of curved black hair. Legs strong and stout and not very long; leg formula 1243; tibiae and metatarsi of I and II provided respectively with four pairs and one pair of ventral spines; femora provided with two pairs of dorsal spines; tarsi relatively short and provided with two claws and thick claw tufts.

Abdomen : Spindle-shaped, longer than wide, covered by long whitish spine-like hair, with blackish patches on either side. Epigyne rounded anteriorly, with conspicuous rounded copulatory opening on either side as in figs. 2,3.

Holotype : Female in spirit, deposited at Zoological Survey of India, Calcutta, Regd. No. 5172/18.

Type locality : Holotype from Tezpur, Assam, India, 14.i.1981, coll. K.Chatterjee.

Distribution : India : Tamil Nadu, Assam.

Remarks : This species resembles *Eutichurus chingliputensis* (in press) Majumder and Tikader but differ from it on the following points : 1. The posterior row of eyes recurved whereas in *E. chingliputensis* procurved. 2. The tibia of legs I and II provided with four pairs of ventral spines whereas in *E. chingliputensis* five pairs. 3. Epigyne and spermathecae also structurally different.

SUMMARY

A new species under the genus *Eutichurus* Simon, *E. tezpurensis*, is described and illustrated from the female sex. This species is the second under this genus described from the Indian Sub-continent.

ACKNOWLEDGEMENT

My thanks are due to Dr. B.S.Lamba, Scientist 'SF', in-Charge, Zoological Survey of India, for proper facilities during the preparation of this paper. Thanks are also due to Dr. B.K.Tikader, Ex-Director, Dr. S.K.Gupta, Scientist 'SD' for suggestions.

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REMARKS ON SOME KNOWN SPECIES OF DIGENETIC
TREMATODES (DIGenea : ACANTHOCOLPIDAE LUHE, 1909)
FROM MARINE FISHES OF INDIA

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INTRODUCTION

The acanthocolpid materials on the basis of which the present study has been made were collected from the fishes of the Arabian Sea and the Bay of Bengal. It includes the material on which the author (1971, 78) had made studies on the family Acanthocolpidae. It also includes the material of the family collected by Dr. T. D. Soota and Party during 1975 - 76. All the 45 slides have been deposited in the Helminthological Collections of the Zoological Survey of India, Calcutta. The drawings have been made with the aid of a camera lucida. All measurements are in micrometers unless otherwise stated.

SYSTEMATIC ACCOUNT

Family ACANTHOCOLPIDAE Luhe, 1909

Genus *Stephanostomoides* Mamaev and Oshmarin,
1966
Stephanostomoides tenuis (Manter, 1963)
Hafeezullah, 1978.

Syn. *Acanthocolpus tenuis* Manter, 1963
Stephanostomoides dorabi Mamaev and Oshmarin, 1966
S. indicus Karyakarte and Yadav, 1976 (n. syn.)
S. sharmai Gupta, S. P. and Gupta R. C. 1980 (n. syn)
(Fig. 1)

Host : *Chirocentrus dorab.* wolfherring, (Pisces : Chirocentridae).

Location : Tuticorin, Mandapam (Gulf of Mannar); Gopalpur, Pondicherry (Bay of Bengal), Mangalore, Kozhikode (Arabian Sea)

Number of specimens : 2+4+2+1+2+4 respectively, total 15, on 8 slides.

Specimens deposited : Z.S.I. Reg. Nos. W7502/1 to W 7509/1.

Remarks : Hafeezullah (1978) showed that the spines of the five rings on the oral sucker of the specimens of the genus *Stephanostomoides* occurring in the fish *Chirocentrus dorab* may be partly or wholly shed off due to maceration or during processing after separating

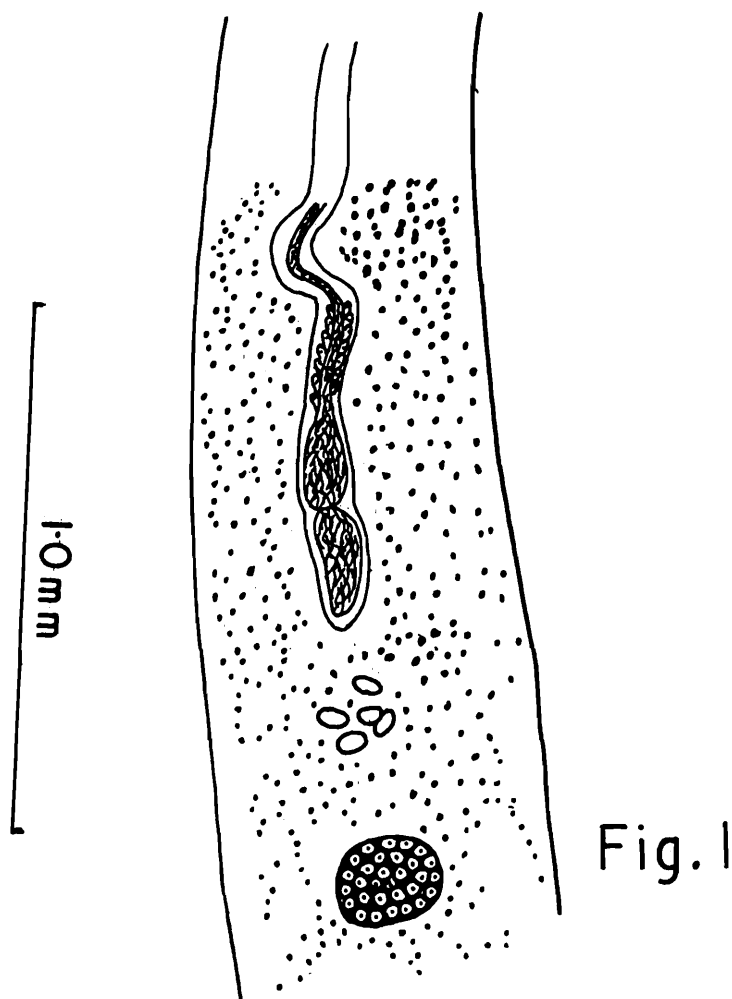


Fig. 1. *Stephanostomides tenuis* (Manter, 1963), showing bipartite internal seminal vesicle.

from the host and thus considered *Acanthocolpus tenuis* Manter, 1963 nothing but *Stephanostomoides tenuis* (Manter, 1963). *Stephanostomoides dorabi* Mamaev and Oshmarin, from North - Vietnam Bay, *S. indicus* Karyakarte and Yadav, 1976 from Arabian Sea, and *S. Sharmai* Gupta, S. P. and Gupta, R. C., 1980 from the Bay of Bengal, all from the fish, *Chirocentrus dorab*, vary insignificantly from *S. tenuis* in various body measurements and egg size. Therefore, they are considered as synonyms of *S. tenuis* (Manter, 1963). Manter (1963), Hafeezullah (1978) Madhavi (1976) and Radhakrishnan and Nair (1979) had specimens of the same species with the five rings of the spines completely lost, and therefore reported their specimens under the genus *Acanthocolpus* as *A. tenuis*. Gupta, V. and Ahmed, J. (1977), while reporting *Stephanostomoides dorabi* Mamaev and Oshmarin, 1966 from the Bay of Bengal in the fish, *Chirocentrus dorab*, state that in their specimens the seminal vesicle is unipartite as compared to the bipartite condition in the original description by Mamaev and Oshmarin (1966). In the present material some of the specimens look to possess unipartite seminal vesicle whereas others (Fig. 1) definitely have bipartite seminal vesicle, *Stephanostomoides tenuis* (Manter, 1963) Hafeezullah, 1978 is the type and the only species in the genus thus far.

Genus *Stephanostomum* Looss, 1899
Metacercaria of *Stephanostomum* sp.
(Figs. 2, 3)

Host : *Tetrodon reticularis*, puffer fish, (Pisces : Tetrodontidae)

Location : Intestine.

Locality : Pondicherry, collected on 8.12.1975.

Number of specimens : One, on slide.

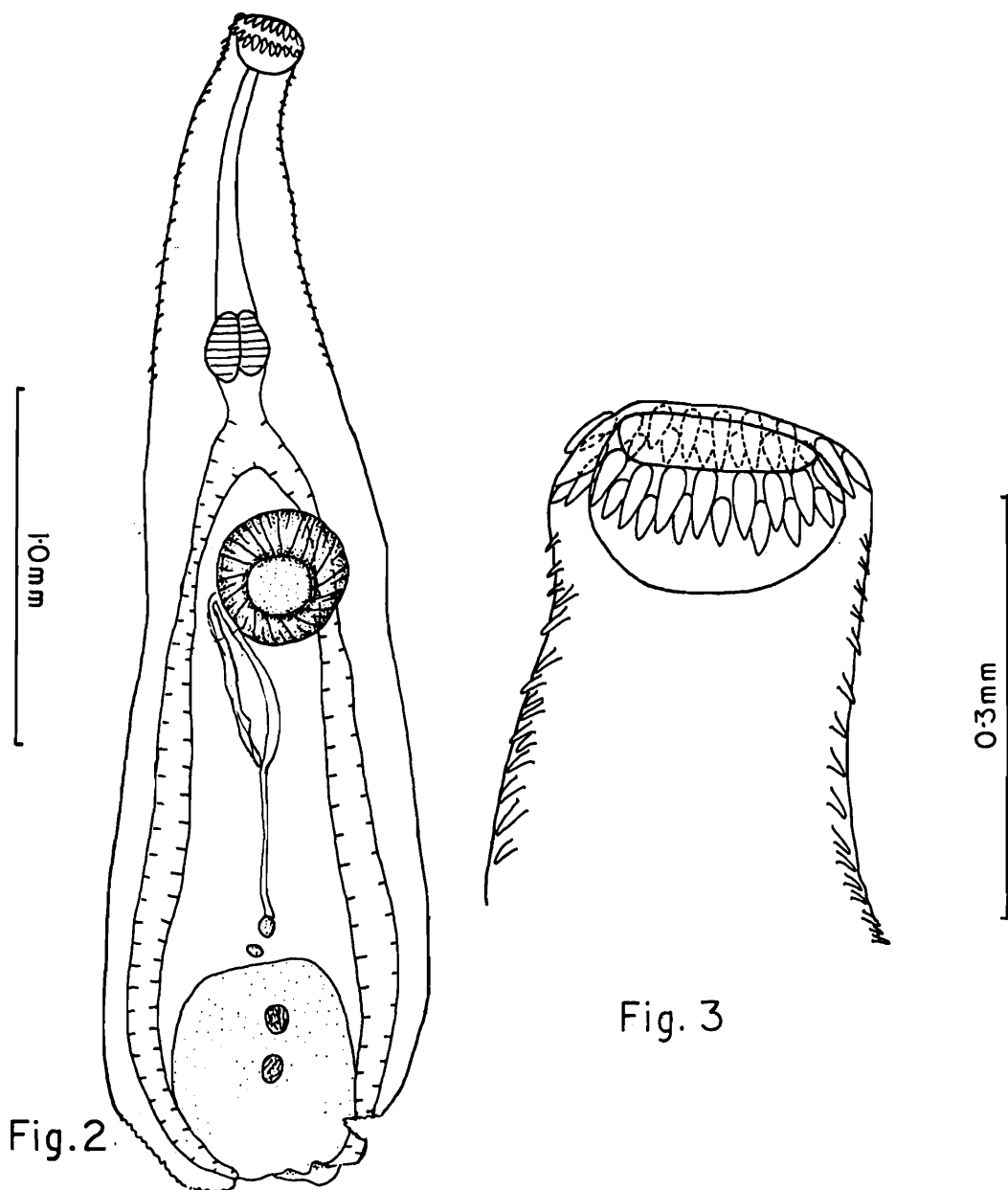


Fig. 2. Metacercaria of *Stephanostomum* sp., entire worm.

Fig. 3. Anterior part of metacercaria of *Stephanostomum* sp., showing two alternating rings of peribuccal spines.

Specimens deposited : Z.S.I. Reg. No. W 7510/1

Description : Body 3.457 mm long, 0.954 mm wide at testicular level, anterior part elongate, posterior part swollen, (at posterior end the material is a bit broken). Tegument armed with spines, closely set in cephalic region, becoming sparse posteriorly. Eye-spot pigment present. Acetabulum 378 in diameter, situated at 1376 from anterior end of the body. Oral sucker 129 long, 189 wide, wider than long, terminal. Mouth terminal. Peribuccal spines 36 in two alternating rings each with 18 spines. Prepharynx 645 long. Pharynx pear-shaped, 224 long, 189 wide; oesophagus present, 155 long; intestine triclad, caecal bifurcation between pharynx and acetabulum; caeca simple extending up to posterior end of body.

Testes 395-430 long, 284-301 wide, entire, situated in swollen part of body, separated from each other. Cirrus sac, long, reaching posteriorly midway between acetabulum and ovary, spines not yet developed on cirrus.

Ovary 258 in diameter, globular, entire, pretesticular, separated from anterior testis, shell gland complex behind ovary. Uterus preovarian, Metraterm long, narrow, as long as cirrus, spines not yet developed on it. Genital atrium long. Genital pore pretesticular.

Excretory pore terminal; excretory vesicle sacciform. Uroproct present.

The number and arrangement of peribuccal spines, wider than long oral sucker, very long prepharynx, presence of a short oesophagus, long and equal cirrus sac and metraterm point to its relationship with *Stephanostomum casum* as reported by Durio and Manter (1969) from New Caledonia.

Genus *Tormopsolus* Poche, 1926

Tormopsolus filiformis Sogandores - Bernal and Hutton, 1959.

Syn. *Tormopsolus rhachicentri* Parukhin, 1965

Tormopsolus spatulatum Bilqeas, 1972

(Figs. 4, 5)

Host : *Rachycentron canadus* (Linn.), Cobia, (Pisces : Rachycentridae).

Location : Intestine.

Localities : Kakinada (Bay of Bengal), Vasco-da-Gama (Arabian Sea).

Number of specimens : 7 + 11, total 18, on 3 slides.

Specimens deposited : Z.S.I. Reg. Nos. W 7511/1 to W 7513/1.

Remarks : *Tormopsolus rhachicentri* Parukhin, 1965 from *Rachycentron canadus* from South China Sea, has a distinct oesophagus and a distinct prepharyngeal part of body. Bilqeas (1972) described *T. spatulatum* with a very long oesophagus and a distinct spatulate prepharyngeal part of forebody from a different fish host, *Cybbium* sp., from Karachi, Arabian Sea. Madhavi's (1976) specimens of *T. filiformis* from *Rachycentron canadus* from Waltair coast (Bay of Bengal) do have spatulate prepharyngeal part of forebody but the statement that her "specimens agree with the original description of *T. filiformis* from the same host" implies that an oesophagus is absent in them or it is

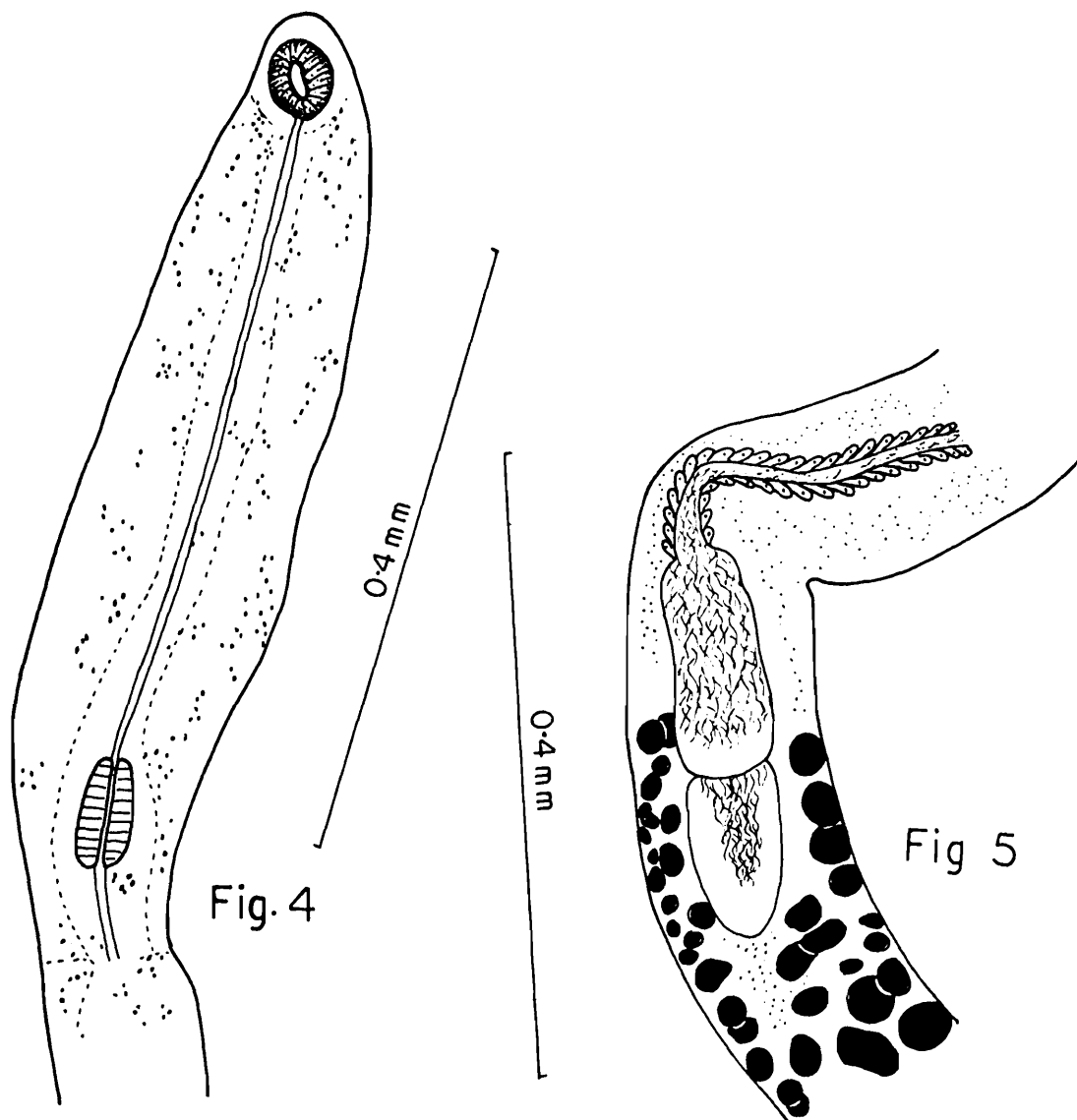


Fig. 4. *Tormopsolus filiformis* ; spatulate prepharyngeal part of forebody.

Fig. 5. *Tormopsolus filiformis* ; bipartite internal seminal vesicle.

indistinctly short. In *T. filiformis* Sogandares - Bernal and Hutton, 1959 from *Rachycentron canadus* from off Madeira, Florida, Gulf of Mexico, an oesophagus is stated to be absent (or indistinct) but from its illustration No. 10A, it appears that the forebody or the prepharyngeal part of the body is comparatively more flattened (if not fully spatulate) than the rest of the body. The absence (or indistinctness) of the oesophagus and incomplete spatulate form of forebody may be due to the contracted condition of the material at the time of killing and fixation. Contrarily, the distinct presence of an oesophagus and the degree of its elongation (as in *T. rhachycentri* Parukhin, 1965 and *T. spatulatum* Bilquees, 1972) as well as the fully spatulate condition of the prepharyngeal part of the body may be due to the degree of relaxation of the specimens at the time of fixation. These implications are evident from the study of the 18 specimens involved in the present study. Further, *T. rhachycentri* has been described to possess a unipartite internal seminal vesicle but the illustration of the species shows a bipartite one. The structure seems to have been studied erroneously. Sometimes the division of the internal seminal vesicle is not seen clearly.

Thus, keeping in view all these implications, I am inclined to believe that my specimens are referable to *Tormopsolus filiformis* Sogandares - Bernal and Hutton, 1959, and *T. rhachycentri* Parukhin, 1965 and *T. spatulatum* Bilquees, 1972 are its synonyms.

Genus *Acanthocolpus* Luhe, 1906
***Acanthocolpus liodorus* Luhe, 1906**

Syn. *A. inqlisi* Gupta, S.P. and Gupta, R.C., 1980 (n. syn.)

A. guptai Gupta, V. and Puri, M., 1981 (n. syn.)

(Fig. 6)

Host : *Chirocentrus dorab*, dorab wolf herring, (Pisces : Chirocentridae)

Location : Intestine.

Localities : Veraval, Bombay, Kozhikode (Arabian Sea).

Number of specimens : 3 + 24 + 25 respectively, total 52, on 15 slides.

Specimens deposited : Z.S.I. Reg. Nos. W 7514/1 to W 7528/1

Remarks : *Acanthocolpus* Luhe, 1906 has a median and immediately preacetabular genital pore. This is basic and constant. In pedunculate and protuberant specimens it is situated in the angle of the body with the peduncle/protuberance, and this is not a deviation from the basic concept. At the same time, it also does not mean that the genital pore is postacetabular in pedunculated specimens. However, in improperly processed or decaying specimens, the genital pore may appear to be situated elsewhere in the base of the peduncle because the genital sinus is tubular with very thin wall and after flattening the specimens it becomes untraceable and the worker erroneously interprets the genital pore to be situated where the genital ducts look to terminate.

Acanthocolpus liodorus Luhe, 1906 is the type species of the genus. Its body is pedunculate, oral sucker smaller than the ventral sucker, genital pore is situated in the angle of the body with the peduncle, the anterior extent of vitellaria is almost up to the middle of the body, posterior extent of the cirrus sac is near the anterior extent of vitellaria, and the gonads are contiguous or slightly separated. Keeping in view this concept of *A. liodorus*, the two species *A. inqlisi* Gupta, S.P. and Gupta, R.C., 1980 and *A. guptai* Gupta, V. and Puri, M., 1981 fall synonyms to the former.

***Acanthocolpus* Luhei Srivastava, 1939**

(Fig. 7)

Host : *Chirocentrus dorab*, dorab wolf herring, (Pisces : Chirocentridae).

Location : Intestine.

Localities : Veraval, Bombay (Arabian Sea), and Pondicherry (Bay of Bengal).

Number of specimens : 1 + 6 + 16 respectively, total 23, on 11 slides.

Specimens deposited : Z.S.I. Reg. Nos. W 7529/1 to W 7539/1.

Remarks : The distinction between *A. liodorus* and *A. Luhei* is crystal clear, as originally mentioned by Srivastava (1939) and later on noted and confirmed by Mamaev and

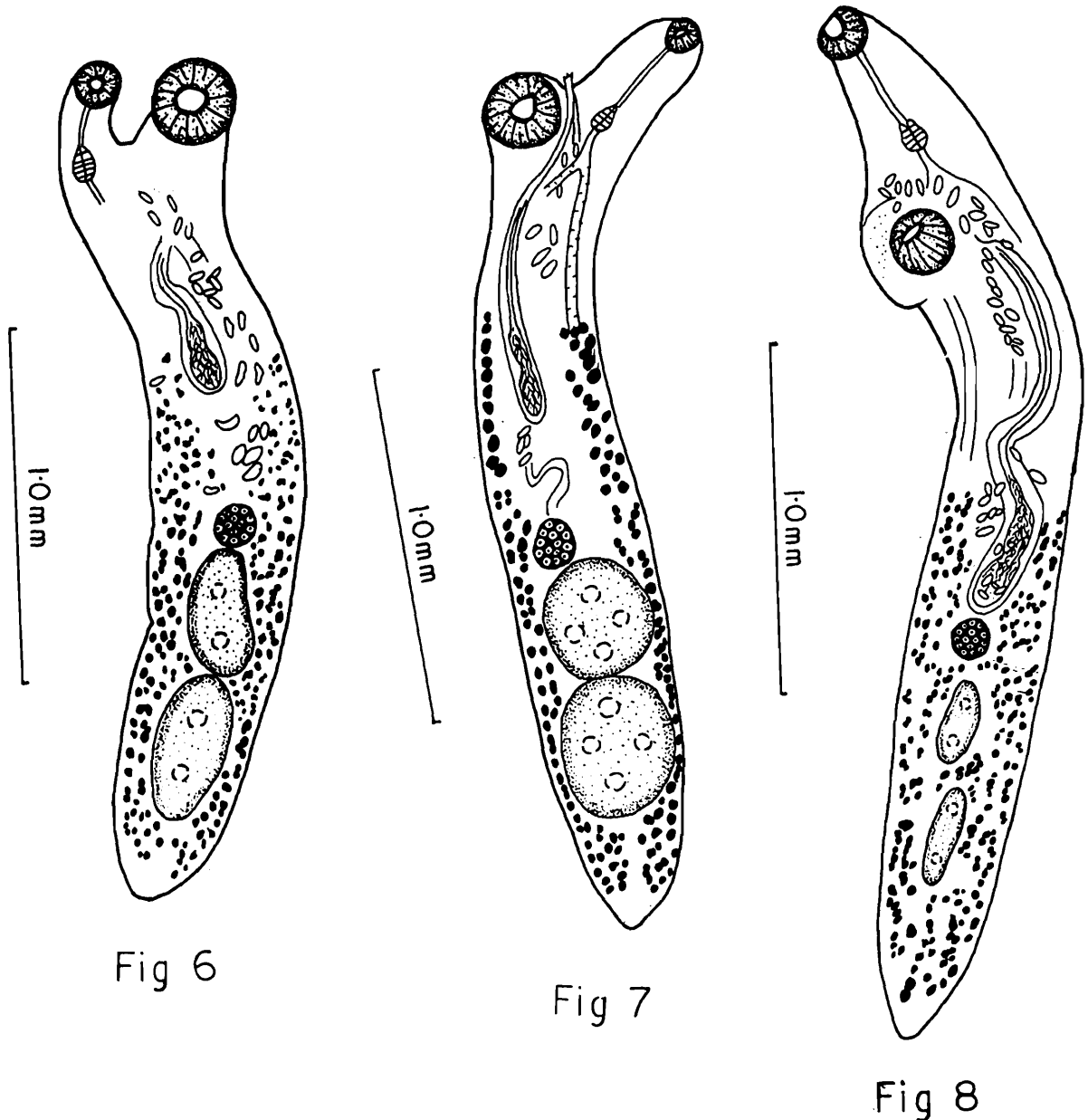


Fig 6

Fig 7

Fig 8

Fig. 6. *Acanthocolpus liodoris* ; entire worm. Fig. 7. *Acanthocolpus luhei* ; entire worm.
 Fig. 8. *Acanthocolpus caballeroi* ; entire worm.

Oshmarin (1966), Hafeezullah (1971, 78), Gupta, A.N. and Sharma, P.N. (1972) and Pandey and Tiwari (1984). The synonymy of *A. luhei* with *A. liodoris* as suggested by Caballero (1952), Yamaguti (1958, 71) and Manter (1963), is based merely on assumption and not on the basis of scientific evidence. The conclusion of the author is reinforced by the fresh fact that the whole population of 16 specimens recovered at Pondicherry from the fish *Chiricentrus dorab* consists of *A. luhei* only, unmixed with any specimen of *A. liodoris*, although the two species may occur together in the same specimen of the fish host. The morphological and anatomical differences as indicated by Srivastava (1939) and re-established by Mamaev and Oshmarin (1966), Hafeezullah (1971, 78), Gupta, A. N. and Sharma, P.N. (1972) and Pandey and Tiwari (1984) are maintained here in the light of fresh evidence. The distinction of *A. luhei* from *A. liodoris* is based on a combination of constant characters. The distinguishing characters between them have never been shown to be

variable. *Acanthocolpus manteri* Pandey and Tiwari, 1984 in the intestine of *Euthynnus* sp. from Bombay coast is quite obviously a synonym of *A. luhei*.

***Acanthocolpus caballeroi* Gupta and Sharma, 1972**

Syn. *Acanthocolpus puriensis* Gupta, V. and Puri, M, 1981 (n. Syn.)

A. lucknowensis Gupta, V. and Puri, M, 1981 (n. Syn.)

(Fig. 8)

Host : *Chirocentrus dorab*, dorab wolf-herring, (Pisces:Chirocentridae)

Location : Intestine

Localities : Chandipur, Konarak and Digba (Bay of Bengal)

Number of specimens : 8 + 8 + 23 respectively, total 39 on 7 slides.

Specimens deposited : Z.S.I. Reg. Nos. W 7540/1 to W 7546/1.

Remarks : Hafeezullah (1978) considered *A. caballeroi* to be a synonym of *A. luhei*, thinking that the difference between them are too meager to warrant a separate species as against *A. luhei*. But, after the appearance of the descriptions of *A. puriensis* and *A. lucknowensis*, the author restudied his acanthocolpid collection and came to the conclusion that there are populations of specimens unmixed with others which can be considered as a separate species intermediate between *A. liodorus* and *A. luhei*. Such specimens represent *A. caballeroi* which is revalidated here. This species is pedunculate and has vitellaria anteriorly extending up to almost mid-body as in *A. liodorus*, and a long cirrus sac whose appreciable part is overlapped by the anterior extent of vitellaria as in *A. luhei*. However, it significantly differs from *A. liodorus* as follows: In *A. liodorus* the cirrus sac is short and the vitellaria begin from behind its swollen base, whereas in *A. caballeroi* the cirrus sac is long and narrow and the vitellaria overlap an appreciable part of it. The postacetabular attenuation of body in unpressed specimens occurs in both species. The shape and structure of suckers are also similar in both of them. Further, *A. caballeroi* materially differs from *A. luhei* in possessing a peduncle rather than a slight protuberance and in having vitellaria up to about midbody only rather than extending much more anteriorly. *A. puriensis* and *A. lucknowensis* are identical and both of them do not differ from *A. caballeroi* at all. Hence, *A. puriensis* and *A. lucknowensis* are synonyms of *A. caballeroi*.

Acanthocolpus orientalis Srivastava, 1939, described from the carangid fish, *Caranx kalla*, from Puri, has been discovered by Madhavi (1976) to possess 32 oral spines arranged in two rows. She recovered specimens from three carangid fishes from Waltair coast, an adjoining locality, and therefore she transferred it to the genus *Stephanostomum* as *S. orientalis* (Srivastava, 1939) Madhavi, 1976.

SUMMARY

The paper deals with interesting observations and consequent remarks of five known species of degenerate trematodes of marine fishes of India belonging to four genera in the family Acanthocolpidae Luhe, 1909. They are : *Stephanostomoides tenuis* (Manter, 1963), metacercaria of *Stephanostomum* sp., *Tormopsolus rhachicentri* Parukhin, 1965,

Acanthocolbus Liodorus Luhe, 1906. *Acanthocalpus Luhei* Srivastava, 1939 and *A. caballeroi* Gupta, A. N. and Sharma, P. N., 1972. As a result of the study, *Stephanostomoides dorabi* Mamaev and Oshmarin, 1966, *S. indicus* Karyakarte and Yadav, 1976 and *C. Sharmai* Gupta, S.P. and Gupta, R. C., 1980 have been found to be synonyms of the type and only species *S. tenuis* (Manter, 1968) Hafeezullah, 1978. A metacercaria of *Stephanostomum* sp. from the puffer fish, *Tetrodon reticularis*, is reported and figured. Its characters indicate that it may be the metacercaria of the species *Stephanostomum casum* (Linton, 1910) Mc arlane, 1934. The species *Tormopsolus filiformis* Sogandares - Bernal and Hutton, 1959 is reported here from the fish *Rachycentron conadus* from the Bay of Bengal and the Arabian Sea, and it is believed that *T. rhachycentri* Parukhin, 1965 and *T. Spatulatum* Bilqeess, 1972 are its synonyms. Contrary to the opinion of Gupta, S. P. and Gupta, R. C. (1980), and Gupta, V. and Puri, M. (1981), it has been shown beyond doubt once again that *Acanthocalpus luhei* Srivastava, 1939 is distinct from the type species, *A. liodorus* Luhe, 1906, in spite of the fact that both these species may be occurring mixed together in one and the same specimen of the fish *Chirocentrus dorab*. Further, *Acanthocalpus caballeroi* Gupta, A. N. and Sharma, P. N., 1972 which was considered by Hafeezullah (1978) as a synonym of *A. luhei* Srivastava, 1939, is resurrected after restudy. It has been shown that *A. inqlisi* Gupta, S. P. and Gupta, R. C., 1980 and *A. guptai* Gupta, V. and Puri, M., 1981 are synonyms of *A. liodorus*; and *A. puriensis* Gupta, V. and Puri, M., 1981 and *A. lucknowensis* Gupta, V. and Puri, M., 1981 are synonyms of *A. caballeroi*.

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SOME BIOECOLOGICAL OBSERVATIONS OF *SPILOSTETHUS HOSPES* (FABRICIUS) (LYGAEIDAE : HETEROPTERA : INSECTA) ON A NEW HOST PLANT , *SOLANUM KHASIANUM* CLARKE

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INTRODUCTION

Spilostethus hospes (Fabricius) is known to use *Calotropis* spp., *Vernonia cinerea*, *Sesbania* sp., *Solanum nigrum*, *S. melongena* (Thangavelu, 1978); *Sorghum vulgare*, *Gossypium* spp. (Nayar, Ananthakrishnan, and David, 1976); *Antirrhinum* sp. (Mukhopadhyay, 1987) as its host plants. Its newly recorded association with *Solanum khasianum* in the North Bengal region of North eastern India is of significance, since this lygaeid bug has from time to time assumed minor pest status. The weed has a wide distribution from Assam hills to Western Ghats and is of medicinal importance as a rich source of the steroid, solasodine from its berries (Santapau and Henry, 1973). Its medicinal value as contraceptive specially for village folks perhaps saves the weed from total deweeding programmes in the tea growing regions, thus giving a scope of wider distribution to this lygaeid bug associated with its new host, which is otherwise reported principally from *Calotropis* spp. in West Bengal (Mukhopadhyay, 1983).

The importance of the present study is to investigate the extent to which the new host plant is being successfully exploited by the lygaeid bug and also to draw a comparison of its life stages when reared simultaneously on the new and the already known host plant, *Calotropis*. The work is also meant for better understanding of the reproductive dependence of this milk-weed bug on the fruits and seed of the new host, as has been found, for its congener, *S. pandurus* on seeds of milk weed (Mukhopadhyay, 1985).

MATERIALS AND METHODS

The bioecological study was carried out during the warmer months July to September, when the temperature varied between 23° C-36° C and humidity between 71% and 100%. For comparison rearing was done simultaneously on the seeds of two of the local host plants, *Calotropis* sp. and *S. khasianum* at the same room temperature and humidity and other laboratory conditions. The fecundity of the bug was observed for females with ten repetitions in constant company of males and dried pulp with seeds of the new host as food.

The stadia and the total post embryonic development period was noted with ten repetitions by rearing the nymphs in glass vials (10 cm x 3 cm) with cotton plugs and water siphons. Observations on the incubation period, hatchability and hatching success were made on ten batches of eggs, each batch constituting randomly collected eggs from the same day of laying.

OBSERVATIONS AND RESULTS

During the course of two year observation (1984 - 1986) in the University campus and surrounding areas *S. hospes* was found to use *Calotropis* sp. as the principal host plant during its flowering and fruiting time but with the dehiscence and withering of the follicles the bugs change over to the damaged and putrefied berries of *S. khasianum* weed, that was abundantly found in the hills and plains of North Bengal. Both adults and nymphs fed mostly on the seeds and stayed inside the hollow fruits. All instars were found associated with the berries, where possibly the adults also laid eggs. Such dependence on a second host plant was usually recorded from late May to late October in the area of study, however, a few early instars of the bug could be seen till most berries withered by early December.

The fecundity of the bug on the new host plant was recorded on an average to be quite high, 172.77 eggs per female (Table 1) with an exception of 786 eggs laid in an isolated case. Laying could continue for hours, punctuated with an interval of 2 min. 30 sec. to 3 min. between two consecutive deposition of eggs. The oviposition rhythm, observed for a month, although showed variability in bursts and breaks amongst the laying individuals (Fig. 1A) yet showed a periodic rhythm with peaks at about every 6th day when plotted as mean eggs per female (Fig. 1B).

Incubation period varied greatly in the same batch of egg but on an average they hatched within 6.7 days. In batches of eggs where hatching continued for 3 to 4 days, the maximum hatching percentage was observed more on the second day than the first. The percentage then gradually diminished on the third and the fourth day. The percentage of successful hatching although showed a wide range for different batches but on an average showed 56.9% success (Table 1). The freshly hatched 1st instar nymphs often sucked up some of the unhatched eggs of the same batch.

The longevity of the laying females on an average exceeded that of males (Table 2). Exceptionally an individual female lived as long as 59 days. The nymphs on an average showed a shorter post-embryonic development period (21.1 days) when reared on *Calotropis* than on *S. khasianum* (25.1 days) (Table 3). The average stadia and the patterns of changes at individual instar level (Fig. 2) showed that development proceeds more efficiently on *Calotropis* than *S. khasianum*, nevertheless all the instars could exploit the latter without any mortality.

TABLE 1. Fecundity, incubation, and hatching of the eggs of *S. hospes* when reared on *S. khasianum*.

	Eggs/ Female	Incubation Period	1st	Hatchability(% on day)			Hatching success %
				2nd	3rd	4th	
Mean	172.77	6.7	32.89	44.63	19.81	18.42	56.9
Range	(52-244)*	(5-9)	(3.5 -	(2.3 -	(2.7 -	(2.1 -	(26.3-
	83.3)	90.9)	69.1)	80.0)	98.0)		
S. D.±	72.02	0.53	26.01	29.02	24.65	34.42	22.05

* Exception 786 eggs in an individual case.

TABLE 2. Longevity of male and female *S. hospes* on *S. khasianum* with break up of pre-, post-, and oviposition periods (in days).

	Pre- Oviposition	Oviposition	Post- Oviposition	Longevity (Female)	Longevity (Male)
Mean	12.6	12.0	1.5	26.1	24.66
Range	(4-23)	(3-23)	(0.0-6)	(12-35)*	(5-47)
S. D. $\pm$	6.11	7.24	2.32	6.53	12.97

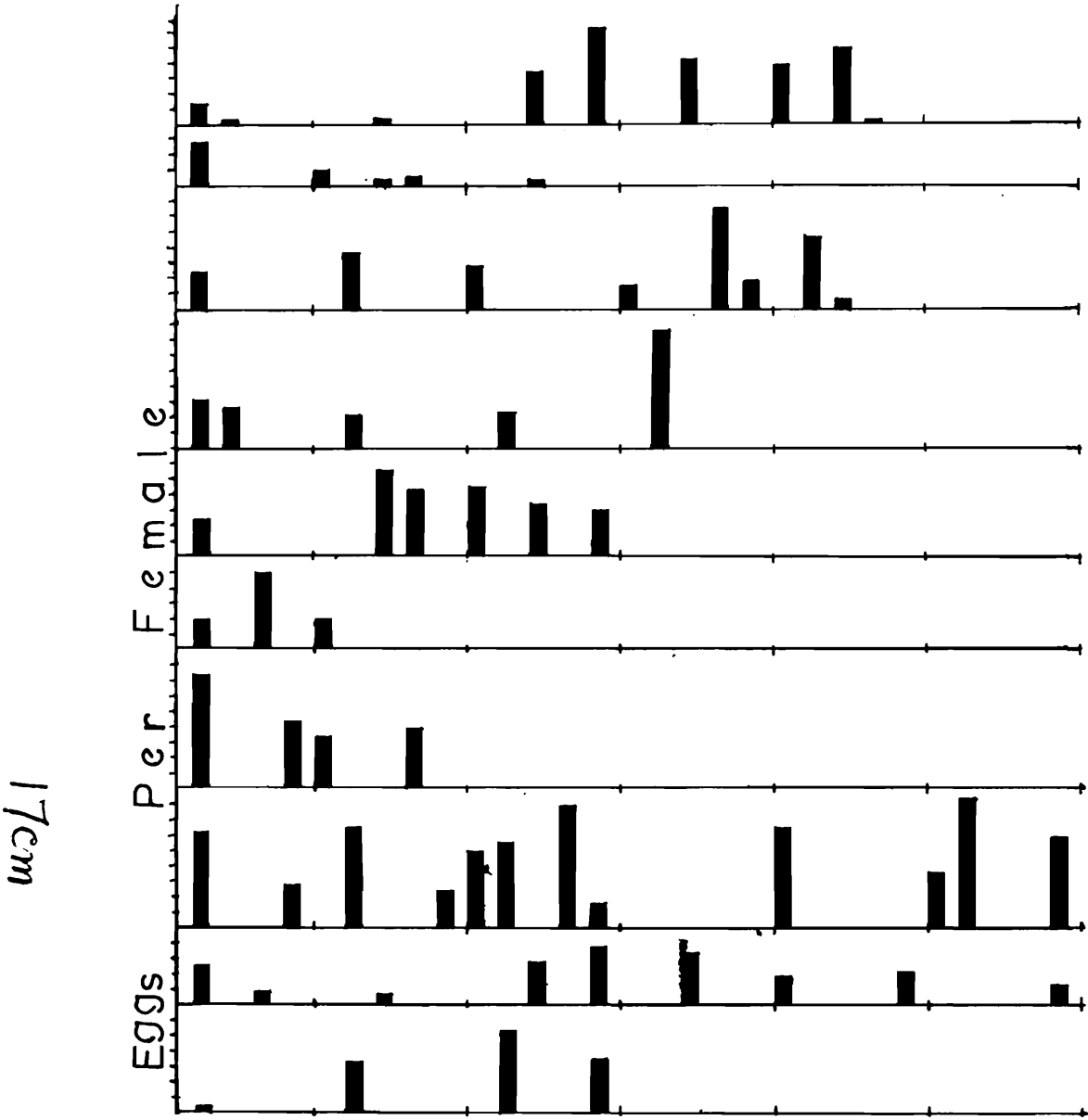
* Exception 59 days in an individual case.

TABLE 3. Comparison of post-embryonic development of the instars of *S. hospes* on two different host plants.

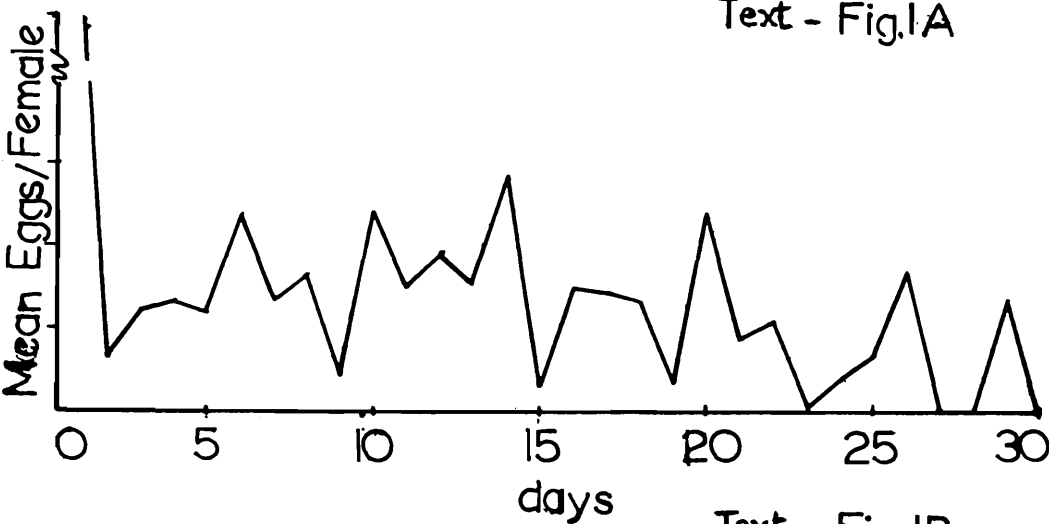
Nymphal development (in days)						
	1st	2nd	3rd	4th	5th	Total
	instar	instar	instar	instar	instar	
(on <i>Calotropis</i>)						
Mean	3.1	3.0	3.0	4.9	7.3	21.3
Range	(3-4)	(2-4)	(2-4)	(4-9)	(6-8)	(20-25)
S. D. $\pm$	0.31	0.47	0.47	1.52	0.82	1.82
(on <i>S. khasianum</i>)						
Mean	3.8	3.4	4.8	5.9	7.2	25.1
Range	(3-4)	(3-4)	(3-6)	(4-8)	(6-10)	(23-28)
S. D. $\pm$	0.42	0.51	0.91	1.52	1.31	1.59

DISCUSSION

The ability to utilize *S. khasianum* as an alternate host plant by *S. hospes* in North Bengal region has a serious implication, as this bug through its new adaptation, gains the capacity to spread along with the new host plant even in the hill regions where *Calotropis* weed is absent. The occurrence of the new host plant, as a reservoir of the pest species in or around cultivated plots seems to have more importance when insect-weed-crop interactions are considered. The prolific and prolonged fruiting period of this weed when compared to a short term fruiting of *Calotropis* in this region surely helps the milk-weed bugs to live actively and multiply for greater part of the year subsisting on the newly available host.

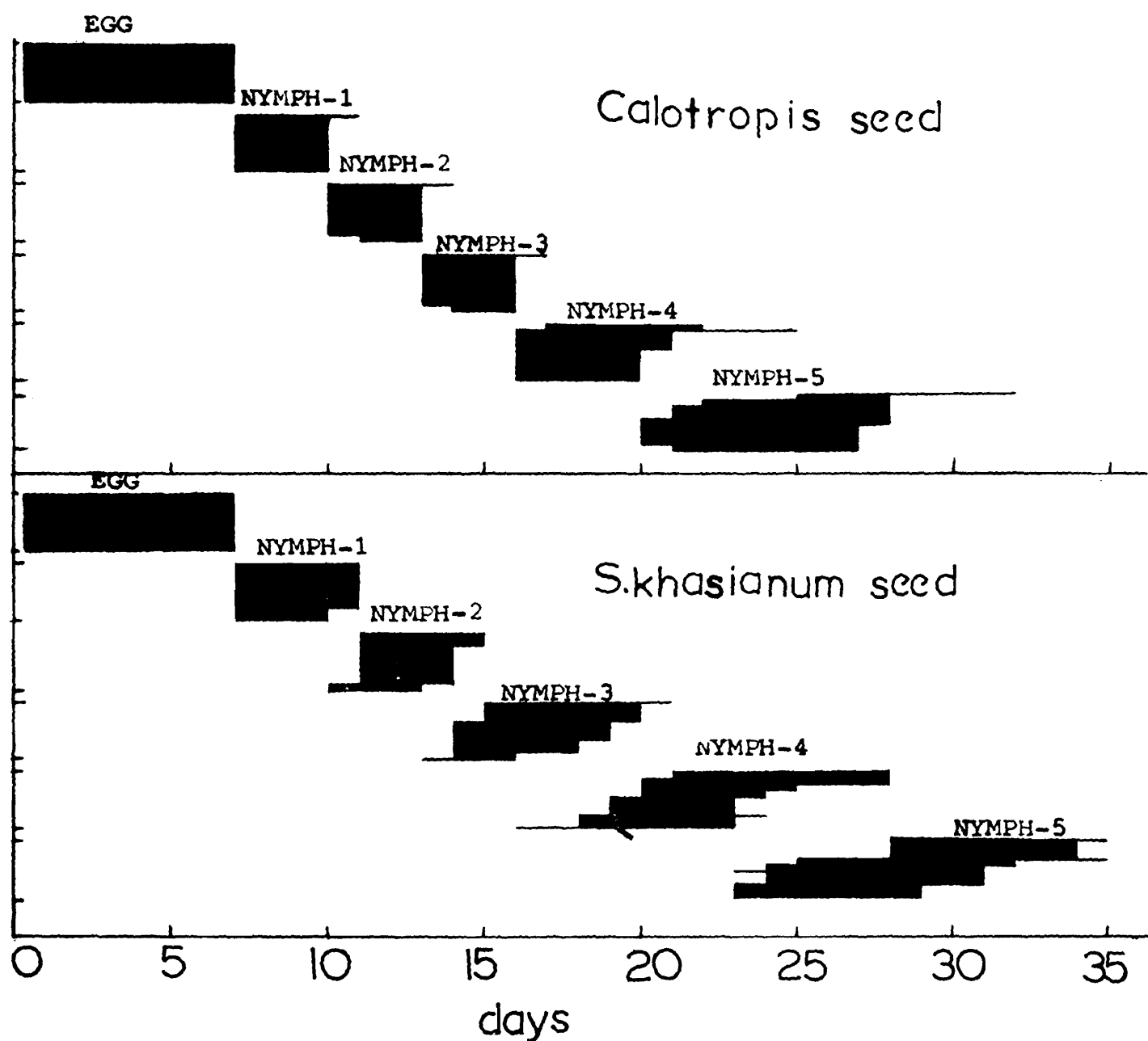


Text - Fig.1A



Text - Fig.1B

Text-Fig. 1A. Oviposition rhythm for ten individuals expressed through bursts (black rectangles) and breaks (blanks) ; each small marking on the ordinate represents ten eggs.
1B. Oviposition trend; each small marking on the ordinate represents five eggs, abscissae-time in days for a month.



Text - Fig. 2.

Text-Fig. 2. Comparison of post-embryonic developmental stages (ten nymphs) on two different hosts; ordinate-number of moulting observed, abscissa-time in days.

The steroidal compound, associated with the fruits of the new host appeared in no way to interfere with the egg production of the bug. The high fecundity and female longevity on this new host although indicated on one hand of its capacity to support some vital life processes, yet a longer post-embryonic development period on the other hand contradicted its efficiency. This is evident through an average shorter stadial period of the *S. hospes* nymphs when reared on *Calotropis* seeds than on *S. khasianum* seeds (Table 3). Nevertheless, the latter (new host plant) showed enough life supporting capacity for the bug, like the already established host, Madar (*Calitropis*). The variation and the difference in the hatching success between batches of eggs were perhaps to some extent affected by the cannibalistic behaviour of the just hatched nymphs that fed on the unhatched eggs of the same batch.

SUMMARY

Spilostethus hospes is recorded to use *Solanum khasianum* as a new host plant in Darjeeling district of North East India. Through this new adaptive switching to the alternate host plant, from the already established host (*Calotropis*), this minor pest gets an opportunity for a wider distribution in the hill regions. All the biological processes like longevity, fecundity, post-embryonic development, and survival potentiality are found to be well carried out using the berries of the new host as a principal diet. In view of such an association a new dimension in the economic aspect of the insect-weed-crop interaction becomes apparent.

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**STUDIES ON CRICKETS (ORTHOPTERA : GRYLLIDAE)
FROM KERALA, INDIA.**

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INTRODUCTION

This study of crickets from Kerala is based on specimens received on loan from the Western Ghats Regional Station, Zoological Survey of India, Kozhikode. Although the collection is small, a considerable variety of taxa are found. This is not surprising as the rain-drenched coast of Kerala and the Western Ghats present ideal habitats for the adaptive radiation of crickets. A total of thirteen species, belonging to nine genera under four subfamilies are dealt with, including three new species under three genera, one new record for India, one new record for South India, and four new records for Kerala State.

Measurements (in mm) are given for the new species, and also for those species in which the variations in measurements are insufficiently known, and/or are found to be significant.

Abbreviations used in this paper are as follows : Type-loc., Type-locality; Coll., Collector; Dist., District; pty., party; pron., pronotum; post. fem., posterior femur; post. tib., posterior tibia ; post met., posterior metatarsus; teg., tegmen; ovip., ovipositor.

SYSTEMATIC ACCOUNT

Family GRYLLIDAE

Genus 1. *Gymnogryllus* Saussure, 1877

1. *Gymnogryllus humeralis* (Walker)

1871. *Gryllus humeralis* Walker, *Cat. Derm. Salt. Br. M.*, 5, Suppl.), 5; *Type-loc.*: Bombay

Material examined : 1 Male, Kozhikode Dist., Eranhipalam; Coll. Mohan Lal, 28.v. 1982.

Distribution : India : Maharashtra, U.P., Goa, Karnataka, Kerala, Tamil Nadu. Sri Lanka ; Malaysia ; Vietnam.

Measurements : Body length: 15; head to tip of teg.: 16.5 ; length with wings: 24.5 ; length of post. fem.: 10; length of teg.: 11.

Remarks : This species is reported earlier from Cochin and Trivandrum and is being here recorded from farther north in Kerala, viz., Kozhikode.

The yellowish lines on the occiput not clearly visible in the specimen before me,

pronotum only feebly widened anteriorly, only 4 external spines on posterior tibiae, and 6-8 denticles on posterior metatarsi; tegmina differ from Chopard's (1969) description in that they extend a little beyond tip of abdomen, mirror is of equal length and breadth, diagonal vein not connected to first chord, and there are 6 (vs 4) free veins in lateral field.

Location of type : British Museum (Natural History), London.

Genus 2. *Teleogryllus* Chopard, 1961

2. *Teleogryllus mitratus* (Burmeister)

1838. *Gryllus mitratus* Burmeister, *Handb. Ent.*, 2 : 34 ; *Type-loc.* : Java.

Material examined : 1 Male, 1 Female, Kozhikode Dist., Kannadi Payil; Coll. K.N. Nair & pty., 7.iii.1984; 1 (M), Wynad Dist., Padari Palam; Coll. S.C. Nahar & pty., 13.iii.1982.

Distribution : India : Assam, Meghalaya, W. Bengal, Bihar, Orissa, U. P., MP., Karnataka, Kerala, Tamil Nadu, Andaman and Nicobar Islands. Sri Lanka; Nepal; China; Burma; Malaysia; Singapore; Thailand; Java; Sumatra; Borneo; Philippines; Vietnam.

Remarks : This species was earlier known as *Teleogryllus testaceus* (Walker) (*vide* Townsend, 1980).

The female from Wynad District shows some characters reminiscent of *T. occipitalis* (Serville), viz. prominent yellow lines on inner margin of eyes, separation of first 4 veins of lateral field from the rest to a greater degree than is normal for this species, and the shorter ovipositor which is, nevertheless, within the range given for this species by Townsend (1980).

Location of Types : British Museum (Natural History), London.

3. *Teleogryllus occipitalis* (Serville)

1838. *Gryllus occipitalis* Serville, *Handb. Ent.*, 2 : 339; *Type-loc.*: Sumatra, Fort de Kock.

Material examined : 1 Male, Kozhikode Dist., Eranhipalam; coll. D.V. Rao, 18.x. 1982.

Distribution : India: Arunachal Pradesh, Assam, Manipur, Meghalaya, Sikkim, W. Bengal, Bihar, U. P., Himachal Pradesh, Gujarat, Maharashtra, M. P., Orissa, Tamil Nadu, Kerala, Andaman Islands. Bhutan ; Nepal ; Tibet ; Bangladesh ; Sri Lanka ; Malaysia ; Japan ; Philippines ; Vietnam ; Thailand ; Java ; Sumatra, Borneo ; Celebes.

Remarks : This widely distributed species, which has undergone recent nomenclatural changes (*vide* Townsend, 1980), has so far remained unrecorded from Kerala. The closest report is from Valparai, Coimbatore District, Tamil Nadu (Chopard, 1969).

Location of neotype : British Museum (Natural History), London.

Genus 3. *Plebeiogryllus* Randell, 1964.4. *Plebeiogryllus guttiventris* (Walker)

1871. *Gryllus guttiventris* Walker, *Cat. Derm. Salt. Br. M.*, 5 (Suppl.) 6 ; *Type-loc.*: India, Bombay.

Material examined : 1 Male, 3 Female, Malappuram Dist., Karipur; Coll. K.N. Nair & pty., 26.vii.1982.

Distribution : India : Manipur, W. Bengal, Bihar, U.P., Maharashtra, Goa, M.P., Karnataka, Kerala, Tamil Nadu, Pondicherry, Orissa. Sri Lanka; Burma; throughout the Oriental Region.

Location of type : British Museum (Natural History), London.

Genus 4. *Modicogryllus* Chopard, 19615. *Modicogryllus signifrons* (Walker) ?

1869. *Gryllus signifrons* Walker, *Cat. Derm. Salt. Br. M.*, 1 : 38; *Type-loc.*: North India.

Material examined : 1 Female, Kozhikode Dist., Eranhipalam; coll. Mohan Lal, 28.v.1982; 1 (F), Kozhikode Dist., Arinkode, Mavoor; Coll. K.N. Nair & pty., 18.vi.1982.

Distribution : India : Bihar, U.P., North India (?). Pakistan ; Upper Burma.

Measurements : Body length : 13.5-14.5 (vs 11-13) ; length of pron.: 3 (vs 2.5-2.6) ; width of pron. : 4.5-5 ; length of post. fem.: 9-10 (vs 8-8.2) ; length of teg.: 8-9 (vs 7-7.5); length of ovip.: 7-8 (vs 9).

Remarks : The two specimens examined agree fairly well with the description by Chopard (1969), except for slightly larger size, and shorter ovipositor. A little doubt remains about the true identity of the specimens because no males were available for comparison and confirmation. The precise collection locality of the type appears to be unknown. Hence, written as North India.

Location of type : British Museum (Natural History), London.

Genus 5. *Velarifictorus* Randell, 1964.6. *Velarifictorus aspersus* (Walker)

1869. *Gryllus aspersus* Walker, *Cat. Dem. Salt. Br. M.*, 39 ; *Type-loc.*: Hong Kong.

Material examined : 1 Male, Kozhikode Dist., Arinkode, Mavoor; Coll. K.N. Nair & pty., 18. vi. 1982 ; 1 (F), Kozhikode Dist., Kodencheri, Chembukdava ; Coll. K. N. Nair & pty., 9. vi. 1982 ; 1 (F) Kozhikode Dist., Thiruvambadi (Mukkam) ; Coll. K. N. Nair & pty., 18.v.1982.

Distribution : India : Arunachal Pradesh, Meghalaya, W. Bengal, U. P., Jammu, Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh. Sri Lanka ; Burma ; Malaysia ; Singapore ; Java ; Borneo ; Hong Kong ; Vietnam ; China.

Remarks : This species is being recorded here for the first time from Kerala. It was known earlier from Valparai, and Shimoga, in the Western Ghats.

One specimen from Arinkode Mavoor has strongly excavated face and mandibles, and it lacks the inverted Y-shaped yellow marking below the anterior ocellus.

Location of type : British Museum (Natural History) London.

7. *Velarifictorus fallax* (Chopard)

1969. *Scapsipedus fallax* Chopard, *Fauna Ind. Grylloidea*, 2: 117; *Type-loc* : India, Karnataka, Nedungadu.

Material examined : 1 Male, Malappuram Dist., Manjeri; Coll. S.C. Nahar & pty., 25. i. 1983.

Distribution : India : Karnataka, Kerala.

Measurements : Body length; 9; length of pron.: 1.8; width of pron ; 3 ; length of post. fem.: 6.2 ; length of post. tib.: 4.5; length of teg.: 5.

Remarks : This small species, with unexcavated face and mandibles, was so far known only from Karnataka (Chopard, 1969; Bhowmik, 1977b). It is being recorded here for the first time from Kerala. The specimen examined bears no tympanum on the internal face of anterior tibiae, and there are only about 8 cells in the apical field of tegmina. In the lateral field the Sc. bears 0-2 branches.

Location of type : Museum National/ d' Histoire Naturelle, Paris.

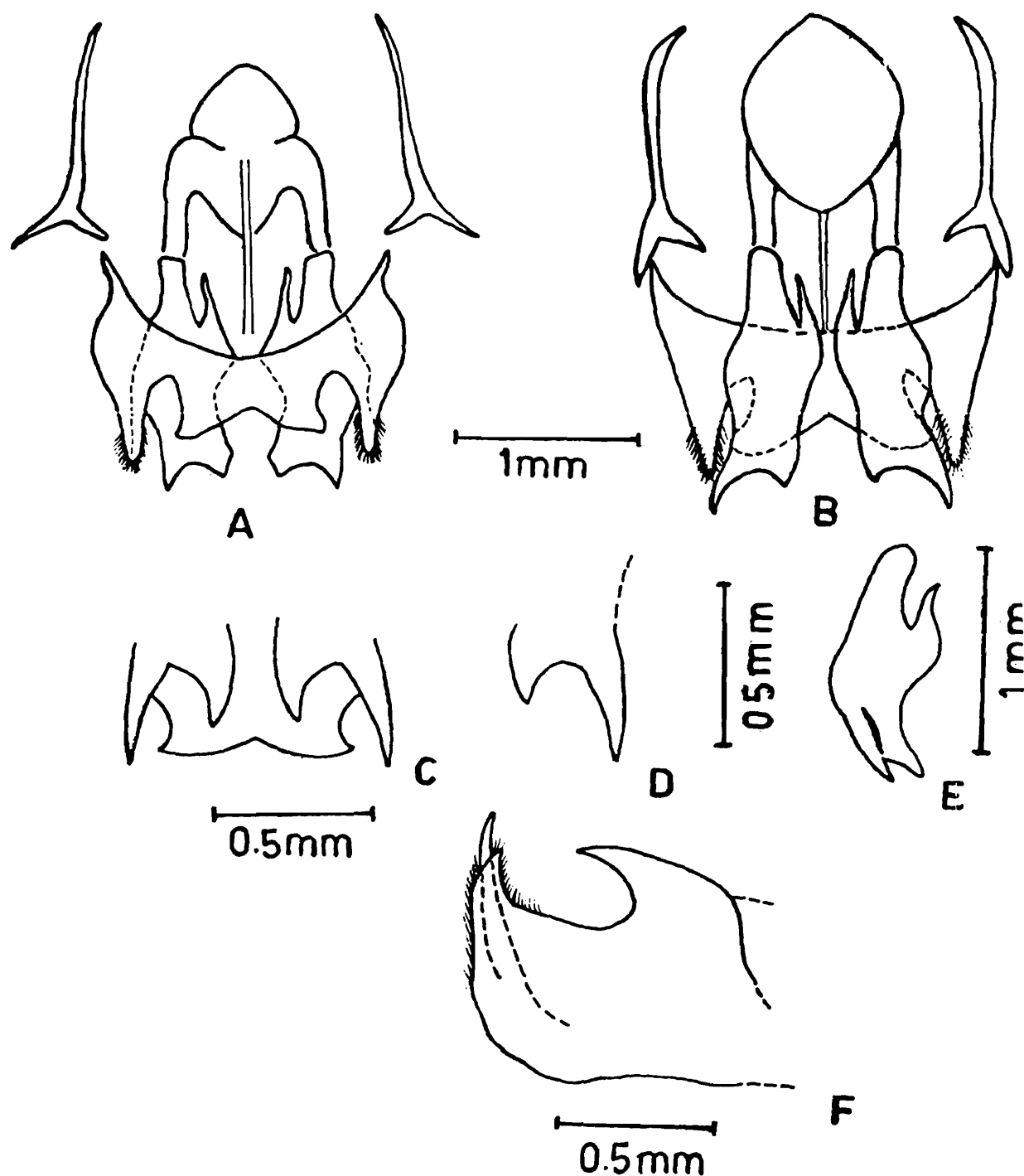
8. *Velarifictorus sahyadrensis* sp. nov.

(Fig. 1, A-F)

Material examined : HOLOTYPE Male, Wynad Dist., Kottappadi ; Coll. K.N. Nair & pty., 27.ix. 1983 ; PARATYPE Male, same data as holotype.

Description : *Male :* *Head* large; occiput reddish-brown, with at least 4 vertical yellow lines, which become prominent as they descend over vertex, the two inner ones approaching the lateral ocelli, the two outer ones the eyes. Eyes small, feebly projecting. Ocelli big, yellow region below anterior ocellus upto straight clypeofrontal suture yellow. Antennae brown. Frontal rostrum prominent, brown, about twice as wide as first antennal segment. Face brown and yellow, its upper part with a wrinkled appearance, broad at base of mandibles, deeply excavated. Mandibles greatly excavated. Maxillary palpi brownish, or partly yellow, fourth segment shorter than third and fifth, the latter club-shaped. *Pronotum* large, rufous-brown, disc with anterior and posterior margins straight, the former may be concave. Lateral lobes depressed in postero-ventral portion. *Legs :* anterior and median legs pubescent, with also many bristles. Anterior tibiae with oval external Tympana, but without internal tympana. Posterior femora stout, with clear, well-marked, diagonal, brown striations on the entire external face and part of internal face. Posterior tibiae with 6 slender spines, which are sharply pointed at their apices, on both superior margins, the internal spines being longer and more curved at apices. Apical spurs very pubescent, the internal

ones more so ; medio-internal apical spur greater than half the length of posterior metatarsus, the superior slightly smaller than that, inferior half the superior. External apical spurs less robust than the internal, the median longest, but shorter than supero-internal; supero-external almost resembling a spine. Posterior metatarsi with 5 external, 6 internal denticles. *Tegmina* : mirror with anterior angle rounded, internal a right-angle or rounded, divided in anterior half by an angulate vein; 2 oblique veins. Diagonal vein long, chords



Text-fig. 1. *Velarifictorus sahyadrensis* sp. nov. Male Genitalia. A. Dorsal view. B. Ventral view. C. Apex of ectoparameres and median projection of epiphallus (Ventral view). D. Ectoparamere (apical part). E. Ectoparamere F. Epiphallus (lateral view).

highly curved, first one connected to mirror by a veinlet, second one almost angulate. Apical field short and wide, with 3-4 veins and small, irregular cells. Lateral field of same colour as dorsal, or paler, with 8-9 rather close veins of which 2 are branches of Sc. *Wings*: micropterous. *Abdomen* : subgenital plate elongate, with rounded apex.

Measurements : Body length: 20; head to tip of teg.: 17.5 length of pron.: 4-4.5 width of pron.: 6-6.2 length of post. fem.: 14.5; length of post. tib.: 11; length of teg.: 10-10.5.

Remarks : The specimens examined are very close to *V. saussurei* (Chopard), described in 1969 from Kerala. The genitalia also show some similarities, but it can be distinguished from that of *saussurei* by the following :

1. Bridge of epiphallus is considerably narrower,
2. Ectoparameres with posterior rounded notch forming two pointed processes, the internal one only very slightly curved inward, while the external one is about twice as long as the internal, almost straight, and sharply pointed (vs highly curved inward in *saussurei*).

Location of type : Presently in the Southern Regional Station, Zoological Survey of India, Madras; to be transferred, in due course, to the National Zoological Collections, Zoological Survey of India, Calcutta.

Genus 6. *Duolandrevus* Kirby, 1906

9. *Duolandrevus nairi* sp. nov.

Material examined : HOLOTYPE Female, Kozhikode Dist., Thakarapar Forest Area; Coll. K.N. Nair & pty., 5.x.1981.

Description : Female : General colouration rufous-brown, with paler legs. *Head* dark rufous-brown, shining, laterally convex. Eyes feebly protruding. Frontal rostrum as wide as first antennal segment, its sides a little diverging behind. Face black, dorso-ventrally short; clypeo-frontal suture very feebly arcuate, grooved. Maxillary palpi yellowish, 5th segment club-shaped, obliquely truncated apically. Pronotum rufous-brown, sides convex, anterior margin distinctly concave, posterior margin almost straight. Disc darker in colour towards antero-lateral, postero-lateral and posterior portions. Lateral lobes black, not very deep, posteriorly ascending strongly. *Legs* strong ; all legs paler than body. Anterior tibiae with tympana of equal size and similar shape on both faces. Posterior femora robust, brown, distally dark brown, internal portion of proximal end, and an area about 5mm proximal to apex paler. Posterior tibiae with 4 external spines and 8-10 denticles proximal to them, and 4 longer more sharply pointed internal spines with 6 denticles based of them. Supero-external apical spur resembles a spine, the median much stouter and about twice the length of superior, inferior a little shorter than median ; superior and median internal apical spurs subequal, at least one and a half times the length of medio-external ; superior more curved, inferior not more than half the median. Posterior metatarsi strong, with 4-5 strong, dark brown denticles. *Tegmina* (right one missing) : very short, extending only very slightly beyond posterior margin of mesonotum, its internal margin highly curved, and about 2 mm away from median line. Dorsal field brown, with 5 not very

conspicuous veins; lateral field with 3 straight, parallel veins. *Abdomen* rufous-brown, with posterior margins of tergites blackish. Subgenital plate narrowing posteriorly, with a deep, broad, U-shaped notch at apex. *Ovipositor* straight, with relatively small apical valves - 1.5 mm long (8.8% of total length) - which are of about the same width as the stem.

Measurements: Body length: 26; length of pron.: 3.8; width of pron.: 6.5 length of post. fem.: 19; length of post. tib.: 15; length of post. met.: 4.5; length of teg.: 1.5; length of ovip.: 17.

Remarks : Only 3 species have so far been described under the genus *Duolandrevus* Kirby. Of these, the female of only *D. rufus* Chopard, is known. The female reported is definitely not of this species, as there are considerable size differences, and tegmina do not meet on the median line as stated by Chopard (1969) for *rufus*. The female recorded by Bhowmik (1970) is also of comparatively small size.

The other two species, *D. coulonianus* (Saussure) and *D. intermedius* Chopard, are known from males only. These too, especially the latter, are substantially smaller than the female at hand.

This is the first find of the genus *Duolandrevus* from the Indian mainland. Bhowmik (1970) has recorded *D. rufus* Chopard (spelt erroneously as *D. rufous*) from the Great Nicobar Island. Other than the above record, the genus seems so far to be restricted to Malaysia, Thailand and Java.

Location of type : Presently in the Southern Regional Station, Zoological Survey of India, Madras; to be transferred, in due course, to the National Zoological Collections, Zoological Survey of India, Calcutta.

Subfamily NEMOBIINAE

Genus 7. *Paranemobius* saussure, 1877

10. *Paranemobius vicinus* Chopard

1982. *Paranemobius vicinus* Chopard, *Rec. Indian Mus.*, 30 : 4 ; *Type-loc.*: Kerala, Parambikulam.

Material examined : 1 Male, Kozhikode Dist., Jeerakapara ; Coll. K.N. Nair & pty., 5. iii. 1983.

Distribution : India : Maharashtra, Karnataka, Kerala.

Measurements : Length of teg.: 2.5.

Remarks : The length of the tegmina of the male specimen before me is shorter than given by Chopard (1969), and by Bhowmik (1977a) for a female nymph.

Location of type : Museum National d'Histoire Naturelle, Paris.

Subfamily SCLEROPTERINAE

Genus 8. *Scleropterus* Haan, 1842

11. *Scleropterus coriaceus* (Haan)

1842. *Gryllus* (*Scleropterus*) *coriaceus* Haan, *Temminck Verhandl. Orth.*, 232 ; *Type-loc.*: Java.

Material examined : 1 Female, Kozhikode Dist., Thiruvambadi (Mukkam) ; Coll. K.N. Nair & pty., 18.v.1982.

Distribution : India : Arunachal Pradesh (?), Assam, U. P. (?), Karnataka (?), Kerala. Burma ; Thailand ; Malaysia ; Java ; Sumatra ; Formosa (?) ; Japan ; Vietnam (?).

Measurements : Head to tip of teg.: 11; width of pron. (anterior margin): 2.5 ; width of pron. (posterior margin) :3.5; length of post fem.: 6; length of teg.: 7.

Remarks : Vasanth (*in press*) has discussed the possible synonymy of *S. punctatus* Brunner with *S. coriaceus* (Haan). Accordingly, the distribution of the former species is also given here with query marks.

The pronotum of the specimen examined is strongly narrowing towards the front, and its posterior width is greater than its length. Posterior tibiae are provided on their superior margins with a large number of denticles - some small, others bigger. No teeth are seen on inferior margins of superior valves of ovipositor.

Location of type : Academy of Natural Sciences of Philadelphia, Philadelphia.

Subfamily PODOSCIRTINAE

Genus 9. *Madasumma* Walker, 1869

12. *Madasumma saussureana* (Chopard)

1878. *Calyptotrypus marginipennis* Saussure, *Mem. Soc. Geneve*, 25 : 583 (non Guerin) ;
Type-loc. : Not known.

Material examined : 1 Female, Kozhikode Dist., Thiruvambadi (Mukkum); Coll. K.N. Nair & pty.; 18.v. 1982.

Distribution : India : Kerala. Sri Lanka.

Measurements : Body length : 17.5 ; head to tip of teg.: 25 length with wings: 30 + (wings broken) ; length of pron.: 4 ; width of pron. (Anterior margin): 3.7; width of pron. (posterior margin): 5.5 ; length of post. fem.: 14.5 ; length of post. tib.: 15 ; length of teg.: 20 ; (ovipositor broken).

Remarks : The specimen examined has a longitudinal brown band on posterior femora which points to *M. marginipennis* (Guerin). The latter species has already been reported from south India, viz., Tamil Nadu and Pondicherry. But it appears to be probable that the present specimen is a *M. saussureana* (Chopard), which is, so far, known only from Sri Lanka, because most characters fit in better with Chopard's (1969) description of *saussureana*, such as, 1. wings being distinctly longer - at least 6 mm - than tegmina, 2. the shape of the subgenital plate, 3. unequal spurs or posterior metatarsi, and 4. lack of yellow veins in lateral field of tegmina. But as the specimen studied is a solitary female, with no comparable male, it is placed with a query mark as *M. saussureana*.

Location of type : Not known.

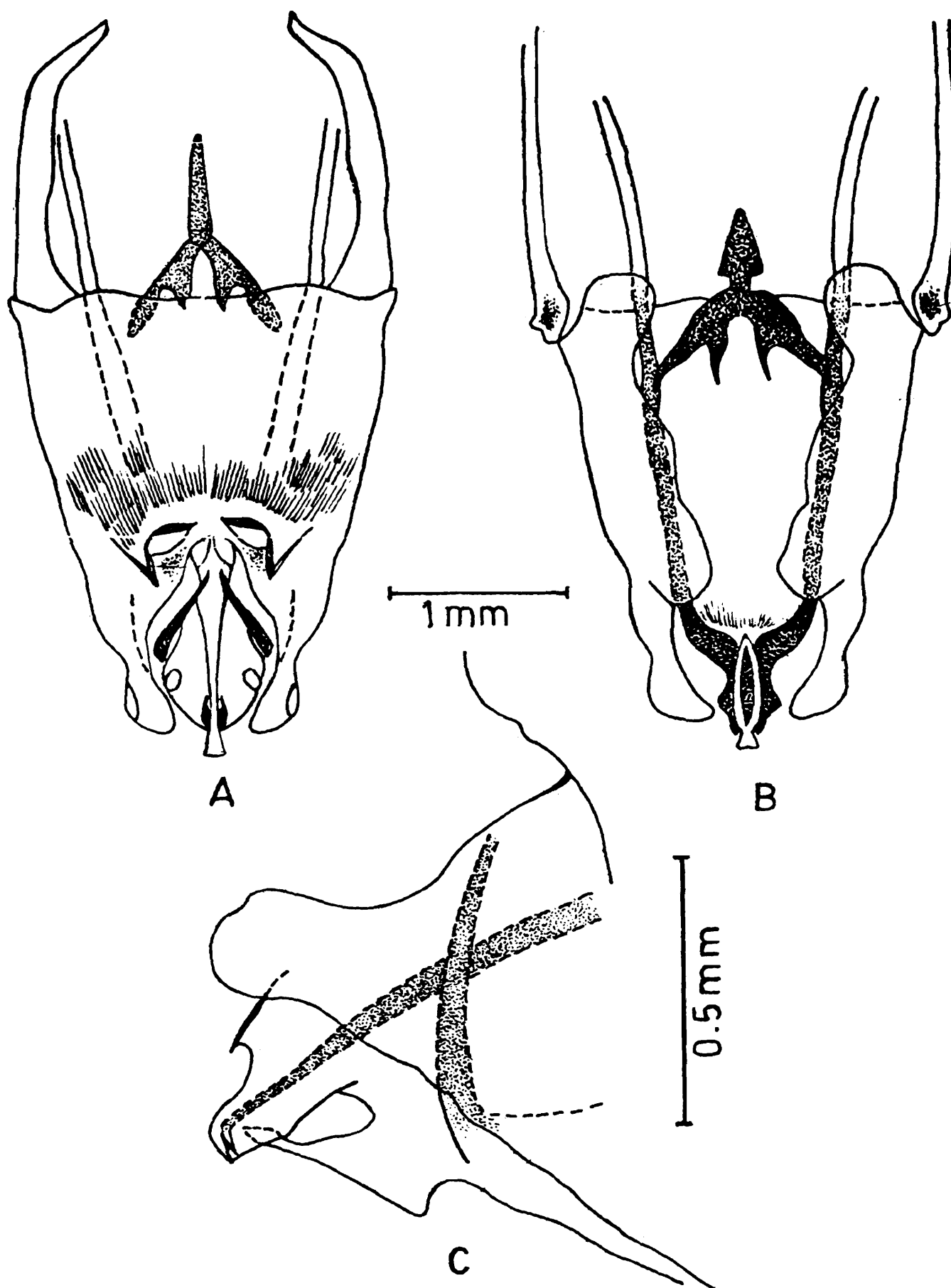
13. *Madasumma keralensis* sp. nov.
(Fig. 2, A-C)

Material examined: HOLOTYPE Male, Cannanore Dist., Kuthupuramba; Coll. K.N. Nair & pty., 27.iii.1983.

Description : *Male* : General colouration yellowish-brown. *Head* brown ; eyes bulging ; ocelli large, orange, close together. Frontal rostrum as wide as first antennal segment. Face triangular, of the same colour as head. Maxillary palpi pubescent, of same colour as rest of face, 3rd and 5th segments equal, the latter funnel-shaped, 4th segment smaller, First antennal segment quite large. *Pronotum* pale brown, more or less smooth, disc longer along median line than on sides, wider along posterior margin than along anterior; anterior margin more or less straight, posterior sinuated. Impresses conspicuous. Lateral lobes concolourous with disc. Legs of same colour as body, pubescent; anterior tibiae swollen in proximal half, external margins with large oval tympana, internal tympana deeply set within a split. Posterior femora somewhat slender; posterior tibiae very pubescent, equal in length to posterior femora, bearing yellow spines with brown apices - 5 on external margin, 6 longer ones on internal margins - and a large number of denticles running down the superior margins of posterior tibiae, except in the very proximal region; number of denticles greater on external margin than on internal. Inferior internal apical spur slender and shortest, median stouter and double its size, superior about one and a half times the length of median ; external apical spurs short and subequal. Posterior metatarsi short, stout and very pubescent, with 3 denticles on supero-external margin, 1 apical denticle on internal margin, and 2 long, stout, pubescent apical spurs - internal one longer than external. *Tegmina* long and narrow, pale brown with a creamy-white spot at extreme antero-external portion, another more or less triangular spot, of the same colour, at antero-external corner of apical field, and 2 narrow creamy patches - one anterior, the other posterior - along lateral edge of dorsal field. Anal field small ; dorsal field with oval mirror ; anterior angle of mirror a little greater than 90° , other angles rounded, divided about the middle by a straight vein which is roughly parallel to antero-internal margin. Diagonal vein straight; chords parallel to each other, the first one connected to anterior angle of mirror by a thin veinlet, and to antero-internal margin by a short, thin veinlet. Oblique veins 6, all originating separately along stridulating vein. Apical field long, with 6 regular veins, and large, squarish areolae. Lateral field with 14-15 parallel veins of which 11-12 are branches of Sc. *Wings* (broken at tip) longer than tegmina. *Abdomen* : subgenital plate long, apically narrowed, pointed, ventrally grooved.

Measurements : Body length : 19.5; head to tip of teg.: 21 length with wings ; 26 + (wings broken) ; length of pron.: 3 width of pron. (anterior margin): 2.5 ; width of pron. (posterior margin) : 3.7 ; length of post. fem.: 12.5; length of post. tib.: 12.5 ; length of teg.: 17.5.

Remarks : In Chopard's (1969) key the present specimen comes closest to *M. saussureana* (Chopard) and *M. soror* Chopard, but differs greatly from both these species in its genital structure. The number of oblique veins (6) is also intermediate between that of *saussureana* (7) and *soror* (5).



Text-fig. 2. *Madasumma Keralensis* sp. nov. Male Genitalia. A. Dorsal view. B. Ventral view. C. Lateral view.

Location of type : Presently in the Southern Regional Station, Zoological Survey of India, Madras ; to be transferred, in due course, to the National Zoological Collections, Zoological Survey of India, Calcutta.

SUMMARY

The paper deals with an account of thirteen species of Gryllidae under nine genera and four subfamilies from Kerala. Of these, three species are new to science. The genus *Duolandrevus* Kirby is recorded for the first time from the Indian mainland, one species is a new record from India, one a new record from south India, and four other species are new records from Kerala state.

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ON AN ACCOUNT OF INDIAN HEPTAGENIIDAE
(EPHEMEROPTERA) WITH KEY TO THEIR IDENTIFICATION

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INTRODUCTION

Mayflies are amphibiotic insect and represent order Ephemeroptera, which inhabit both lotic and lentic ecosystem of our water. Heptageniidae is one of the family of these insects, which in our country is represented by 13 species under 7 genera. It represents almost one seventh of the whole component of Indian mayflies, others are represented by 77 species under 24 genera and 11 families. This is the third biggest, family among Indian Ephemeroptera. World over this family is represented by 378 species under 28 genera (Table - 1, page 144). All the species of this family are endemic to India, though one has extended distribution in orient, thus we have essentially and exclusively oriental element represented under this family. Heptageniidae has 7 species represented in the zone of higher elevation ranging between 1900 to 5297 meters above mean sea level. *Ororotsia hutchinsoni* Traver (1939) has been recorded as larvae in a lentic fresh water lake at an altitude of 5297 m which happens to be highest elevation record for any mayfly within our limits. Of our 13 Heptageniidse, male of 9, female of 12 and larvae of only 1 is known (Table - II, page 145), A key has been formulated to distinguish all 7 genera and 13 species of Indian Heptageniids.

SYSTEMATIC

Heptageniidae is one of the most distinctive family of mayflies represented almost all over the world by 378 species under 28 genera. It comes only next to Baetidae, qualitatively which is represented by 519 species under 17 genera. In contrast Indian Heptageniidae are represented by 13 species under 7 genera. Of these *Rhithrogena* Eaton has been recorded for the first time within our limits (Srivastava & Ray, 1987). Indian Heptageniids, thus, represents only a very small fraction of world's fauna of this group and obviously indicates strong possibility of more representation, as is also true for the whole order, on further detailed investigation of our lotic and lentic ecosystem both at high altitude and plains.

Our knowledge of Indian Heptageniids is due to Dubey (1971), Eaton (1885) Hubbard (1974), Kapur and Kripalani (1963), Kimmins (1937), Ulmer (1920), Walker (1860). Srivastava (1979, 1983) has discussed our high altitude mayflies representation and our endemic component including Heptageniidae. In the Indian sub region (i.e. India, Sri Lanka, Pakistan, Nepal, Sikkim, Bhutan, Bangladesh, Burma) Heptageniids are represented by 16 species under 7 genera (Hubbard and Peters, 1978). Of the 7 genera representing Indian Heptageniids *Cinygmia* Kimmins (1937) and *Ororotsia* Traver (1939) are endemic with sole representative under each genera. *Rhithrogena* has been recorded by *R. parva* (Ulmer). Srivastava and Roy (1987) from Maurbhanj district, Orissa.

Within Indian sub continent the genus is only represented by another species, *R. basiri* Ali (1971) from Swat, Pakistan. In orient it is represented from Taiwan and Java.

Salient features of Heptageniidae :

Demouline (1958) placed this family under superfamily Heptagenioidea alongwith two other families Ametropodidae and Leptophlebiidae. Jensesn (1972) has revised Heptageniidae of the world.

Members of this family are distinguished by following salient points, specially considering our own Heptageniid representatives :

These are medium sized mayfly, smallest being *Rhithrogena parva* with body of male and female measuring respectively 5 and 5.4 mm. While largest recorded is *Afronurus solangensis* Dubey (1971) with female measuring 18 mm in body length. Eyes of both male and female are separated and do not meet on mid dorsal line, this gap is very narrow in male but in female appreciably wide. Eyes are mostly spherical or ovoid in most of the species but are bean shaped in *Afronurus solangensis*. Surface between two eyes inwardly arched in *A. curtus* Dubey (1971). In frontal view the head normally looks triangular as in *A. solangensis* or in some quadrangular like *A. curtus*. The head of *Ororotsia hutchinsoni* Traver (1939) is very distinctively enlarged into prominent lobes which is prominently visible in its frontal aspect. This character coupled with both claws are alike, acutely pointed distinguished it from other genera of the family.

Both fore and hind wings may be present. This family shares 5 tarsal joint character with Baetidae but differs in well developed network of longitudinal and transverse cross veins in both wings. Cross veins in *R. parva* are almost transparent but mostly these are pigmented and in costa and subcosta area thick, dark brown in *A. curtus* but in this extends to the fork of Rs in *Heptagenia nubilial* Kimmins (1937). Cross vein to the stigmatic area vary between 9 - 16. In *O. hutchinsoni* it 9 - 12, 13 in *A. curtus*, 14 in *Epeorus (Epeorus) lahulensis* Kapur and Kripalini (1963), 16 in *A. solangensis*, and maximum 19 in *H. nubilial*. There are 5 - 6 cross vein in costal space before bula in *E. (E.) lahulensis* and *O. hutchinsoni*. Corresponding to the stigmatic area there are 7 - 8 cross veins in the sub costal space of the last named species.

Forewing may be hyaline as in *Cinygmmina assamensis* Kimmins (1937), *Ecdyonurus eatoni* Kimmins, *E. indicus* Hubbard (1974) (= *E. subfuscus* Kimmins), *Heptagenia solangensis* Dubey (1971), *H. nubilial*, *O. hutchinsoni* and *R. parva*. In contrast wings of *A. curtus*, *A. solangensis* and *E. (E.) lahulensis* are translucent. Besides pigmentation of veins wing of *E. eatoni* has a pale brown spot at base and apex of stigmatic area while that of *A. solangensis* has a brownish black band. Size wise forewing is either slighter shortly than body length, say 16 : 18 in *A. solangensis* ; 11 : 12 in *O. hutchinsoni* in female but in male 11 : 10; 7 : 8 in male; 8 : 11 in female of *E. indicus*, or may be slightly bigger in only a few like *A. curtus* which has 12 : 10 ; 13 : 8 in male and 13 : 9 in female of *C. assamensis*, 10 = 11 : 9 in male; 12-16; 9:11 in female of *E. eatoni* ; 10:7.5 in *E. (E.) lahulensis*; 7:5 in male and 9:5.4 in female of *R. parva*.

Hind wing are generally very small, and may be hyaline or translucent in same sequence as in case of fore wing. The hind wing length to forewing length is related as 6:12 in *A. curtus*, 5:16 in *A. solangensis*, 6:13 in *C. assamensis*, 3:10 in *E. lahulensis*, 4:11 in male and 4:13 in female of *H. solangensis* and 1.75 - 2 : 8.5 - 9 in *H. nubila*. Costal projection may not be prominent as in *A. solangensis*, slightly arched outwardly in *A. curtus* but in *E. (E.) lahulensis* there is a preminent outward bulge of costal margin.

Fore legs are longer than rest. Tarsus are 5 jointed, all joints are having moveable articulation. Femora of *A. curtus* are charactersticly curved which is not the case in any other Indian Heptageniids. Claws of each tarsus are similar and out of two claws on each tarsus one is acute, pointed and other is blunt, straight claws of Larvae of *O. hutchinsoni* have 5 pectinations, incidently this is only Indian Heptageniids whose larva is known. Pigmentation band of dark brown colour present on basal, middle, apical region of femora of *E. eatoni*, *E. indicus* and *H. nubilia*.

Abdomen pale to dark brown. In *E. eatoni* there are redish brown marking of definite pattern while in *E. indicus* marking of purplish brown on yellow background. *E. lahulensis* has pale brown to moderate brown but in *H. solangensis* it is dark brown. Segment I-VIII are yellow, IX-X brown in *H. nubilia*. In male of *R. parva* I-IX are pale with mid dorsal markings but in *female* it is absent. Abdomen VII-X are redish brown, besides overlaying olive brown on IX-X in *O. hutchinsoni*.

Genital forcep is invariably 4 segmented. There are no spine to penes lobes in *C. assamensis*. In *E. eatoni* both penes lobes are fused, swollen at apex, stimuli are short, in curved and a strong inner tooth. In contrast penes lobe of *E. indicus* are not fused, constricted apically but not swollen, stimuli are strong, down curved. In *E. lahulensis* penes lobes long, distinctly separated, slightly divergent laterally, beset with number of minuts spines ventrally just below apex. Penes lobes are apically expanded in *H. solangensis* with one short, stout basal spine. Ovipositor may be 1 segmented as in *A. solangensis* or 2 segmented as in *A. curtus*. In *H. solangensis* its curved downward and backwards, is heavily selerotized. In *O. hutchinsoni* sub-anal plate has a medium, wide gaping 'V' shaped cleft. Anal cerei are paired, long, filamentous. These may be only slightly longer than body as in *A. curtus* (10.3:10) or double or more than double as in *C. assamensis* (20:9), *E. eatoni* (25:9-11) *H. solangensis* (22:11), *O. hutchinsoni* (15:10).

Salient taxonomic points of Indian Heptageniids

Genus *A. fronurus* Lestage (1924) was established with *Ecdyonurus peringueyi* Esben - Peterson. Within our limits it is represented by two species, *A. curtus* Dubey and *A. solangensis* both from riverine ecosystem at the altitude of 2900 and 2800 meters respectively. Genus has no other representative in the Indian Sub region. Former of these can be distinguished from latter in small body size (10:18), smaller forewing (12:16), smaller hind wing (4:5). Head quadrangular instead of triangular, 13 cross veins to stigmatic area instead of 16, Femora outwardly curved instead of being straight, ovipositor pale yellow, two segmented instead of dark brown single segmented.

Cinygmina Kimmins (1937) is endemic to India and so far has not been recorded for

extended distribution. It is represented by its genotype, *C. assamensis* (= *Icinygmia assamensis*) from Meghalaya Khasi Hills at much lower altitude of than former genus. By the proportion of foretarsal segment it is distinguished from *Epeorus* and from *Heptagenia* by lengthwise ratio of hind tarsal segments. Penes lobes are apically rounded and are without spines in which it is distinguished from *Ecdyonurus*, which has lateral dilation. It can be distinguished from *Cinygma*, not represented in Indian Sub-continent, in having a pair of small thin chitinous plates instead of small spine.

Ecdyonurus Eaton (1968) is well represented genus from much wider zone than previous two genera. Its genotype is *Ephemera venosa*. Fabricius, by original designation. This genus has 4 representative within our limits namely *E. annulifer* (Walker, 1860) from Khandala Maharastra, *E. bengalensis* (Ulmer, 1920) from Darjeeling (West Bengal) at the altitude of 2178 M., *E. eatoni* Kimmins (1937), *E. indicus* Hubbard (1974) both from Khasi Hills (Meghalaya). Member of this genus generally occupy littoral zone under stones in the lotic ecosystem of rivers, streams etc. Body in general, head and thorax in particular are broad, dorsoventrally flat, Genital forcep of *E. eatoni* is 4 segmented, ochreous, penes lobes fused and swollen at apex with short, incurved stimuli. In contrast in *E. indicus* it is pale, penes lobes not meeting or fused, constricted at apical half, stimuli are short, strong down curved. Genus is represented by only one more species in the Indian sub-continent *E. islamabadicus* Ali (1967).

Epeorus Eaton (1881) was established with *E. torrentium* Eaton as its genotype. Within Indian limits it is represented by *E. (E.) lahulensis* Kapur and Kripalani (1963) from considerable altitude of 3200 m. inhabiting lotic ecosystem of terrential to fast running streams at Sissu, Lahul valley in Himachal Pradesh. The other species of genus represented within our limits was incidently also described from 'Kooloo' (Kulu) Himalaya namely *E. psi* Eaton (1889). This has extended distribution in Taiwan. There is characterstics abdominal markings on abdomen of later species which is absent in former. In contrast former has unlobed penes with short spine present ventrally, just below the apical margin which lacks in latter. Genus has no other additional species represented in the Indian sub-continent.

Heptaegenia Walsch (1963) is rather well distributed genus and has *Palingenia flavescens* Walsch as subsequent designation (Eaton, 1868). It is represented by two species within our limits - *H. nubila* Kimmins (1937) from Khasi Hills (Assam) and *H. solangensis* Dubey (1971) from R. solang, Pir Panel range (Himachal Pradesh) at an altitude of 2800 m. Former has 8 mm. body, 8.5-10 mm. forewing while later has 11 mm. body, 11-12 mm forewing, stigmatic area of forewing has 13-16:19 cross veins and basal 2/3 of penes closely opposed, apical lobe dilated outward into truncate expansion without any spine as compared to penes being closely opposed, not only basal side but all along its length, apical lobs simple expansion and with stout spine at base. Genus has only one more representative in the Indian sub-continent. *H. hazaraensis* Ali, (1970), outside orient known to be distributed in Holarctic land Nearctic quite generally distributed. *Ororotsia hutchinsoni* Traver (1939) was established to accomodate *O. hutchinsoni* Traver which has been recorded from North West Himalaya both from lotic ecosytem inhabiting at Pao and lentic ecosystem inhabiting margin of Ororotse Tso lake at considerable altitude of 5297 m. This is highest altitude record for any Indian mayfly. It is characterized by greatly

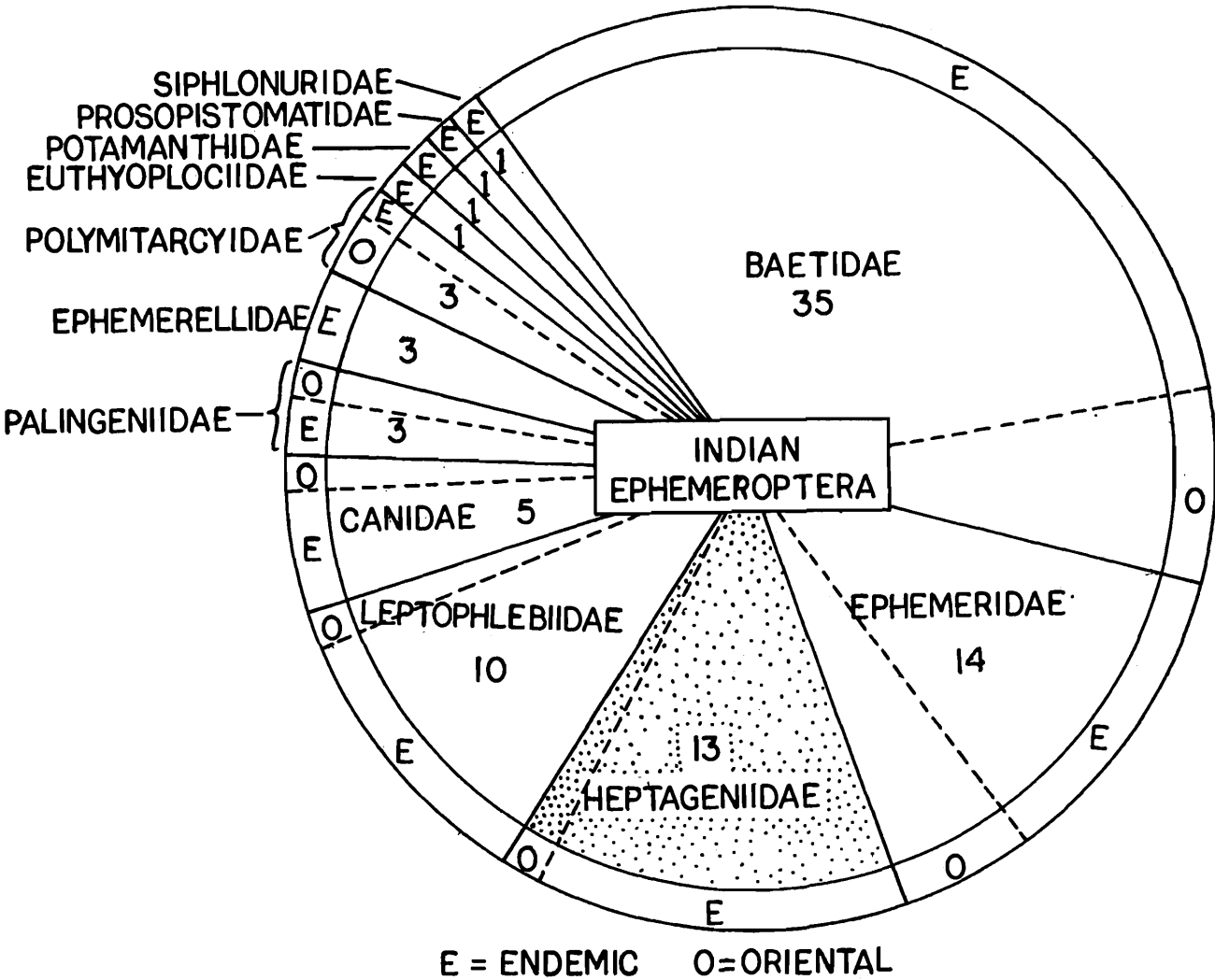
expanded frontal margin of head and similar, acutely pointed on each tarsus. This is only Heptageniid within our limits whose larvae are described. Its larvae has its frontal border of head distinctly emarginate at median line. Gills with much reduced fibrillar portion, lamellae flat, broad, roughly rounded and claws have 5 pectinations. Genus is endemic to India, nevertheless it needs further investigation with possibility of more representation, specially at higher aquatic ecosystems of Himalayas.

Rhithrogena Eaton (1881) is also an established genus with *Baetis semicolorata* Curtis. Within Indian limits it has *R. parva* (Ulmer) as sole representative which has been recorded by Srivastava and Roy (In press) from Talbadh, Maurbhanj district of Orissa. It is small sized mayfly measuring, 5 mm body in male and 5.4 mm in female. Forewing are 7 mm in male and 9 mm in female, cross veins almost transparent, costal margin of wing translucent tinged with yellow. Hind wings are more clear than male. Middorsal abdominal stripe present in male on I-XX, absent in female, claws dissimilar. Genus has only other species represented in Indian sub-continent which is *R. basiri* (1971) described from Swat Pakistan. Genus is also known to occur in Taiwan (Taihorin and Rikyu Island) and Java. Outside Orient it is distributed in Holarctic and in Nearctic, of general distribution.

ENDEMISM AND HIGH ALTITUDE REPRESENTATION

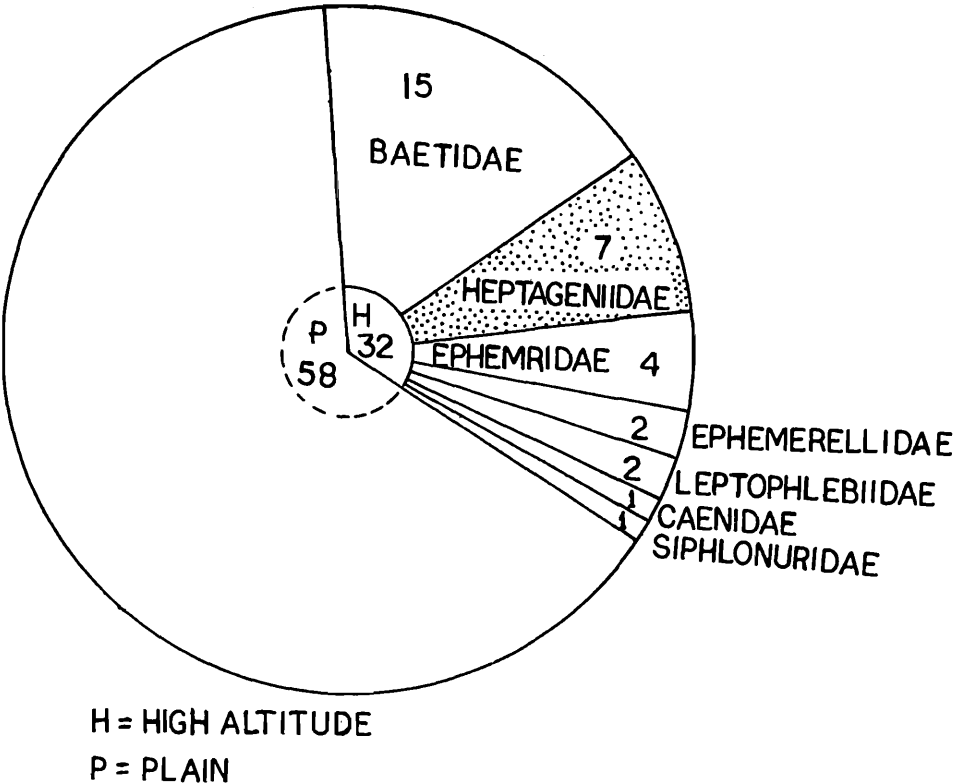
In our faunal component of mayflies, it is evident from above, that genera *Cinygmmina* and *Ororotsia* are endemic to India as compared to other 5 genera viz., *Afronurus*, *Ecdyonurus*, *Epeorus*, *Heptagenia* and *Rhithrogena* have much wider distribution not only in Orient but even beyond it. Species wise following 11 species viz. *Afronurus curtus*, *A. solangensis*, *C. assamensis*, *Ecdyonurus annulifer*, *E. bengalensis*, *E. eatoni*, *E. indicus*, *Epeorus (Epeorus) lahulensis*, *Heptagenia nubilia*, *H. solangensis* *Ororotsia hutchinsoni* are endemic to India while *Epeorus psi* also had endemic origin but has been recorded extended distribution in Taiwan. Only *Rhithrogena parva* (Ulmer) is not endemic to India, though it has only oriental distribution (Taiwan, Java, India). Thus within family Heptageniidae endemism is 90% (9:1). This endemism in our mayflies as whole is 5:1, 75 species out of total 90 species while in other major families like Baetidae this proportion is 29 species out of 35, Heptageniidae 12 out of 13, Ephemeridae 10 out of 14, Ephemerellidae has all 3 endemic, while Palingeniidae and Polymitarcyidae each one out of 3 endemic, Euthyplociidae, Potamanthidae, Prosopistomatidae, Siphonouridae each represented by sole species endemic to our limits. 1/5 or 18 species of our mayflies are known to have extended distribution in Orient, while one among these viz. - *Cloeon inscriptum* Bengtsson (Baetidae) has extended distribution, even beyond orient, into Europe.

High altitude representation of Indian Heptageniids is by 7 species above 2000 Meter between range of 2178 - 5297 Meters. Of these extreme height is for *Ororotsia hutchinsoni* which is highest altitude record for any Indian mayflies. Thus little more than 50% (7 : 6) are high altitude inhabitants and all of these occupy different niches in lotic ecosystem of river, streams etc. Srivastava (1979) has indicated that 1/3 or 31:90 of Indian mayflies are high altitude inhabitants mostly occurring between 3000-4000 Meters inhabiting torrential streams of Himalayan mountain range.



Text.Fig.1 Text Figure 1.

Shows relative preponderance of Heptageniidae and other families of Indian Ephemeroptera & Within each family Endemic Component (R) and with oriental (C) distribution.



Text Fig. 2 Text Figure 2.

Shows proportion of Plain (P) and High Altitude (H) Ephemeroptera of India. Among high altitude members family wise relative prepondance of Hepatageniidae and other 6 families are shown.

KEY TO THE INDIAN SPECIES OF HEPTAGENIIDAE

1. Fore tarsus longer than tibia 2
 - Fore tarsus slightly smaller or equal to tibia.....4
 - Fore tarsus 3/4 shorter than tibia..... .8
2. Fore tarsus is 1 1/2 times long of tibia, 5 tarsal segments are lengthwise related as 8:14:10:5:5, Hind tarsal segments 10:9:7:5:12*Cinygmina* (*C. assamensis*).
 - Fore tarsus is 1 1/4 times long of tibia, 5 tarsal segments are related lengthwise as 10 : 24 : 18 : 13 : 11 and Hind tarsal segments related as 9 : 7 : 5 : 4 : 11:.....
..... *Heptagenia* 3
3. Body 11 mm., 19 cross vein in stigmatic area, forcep base distinctly convex, two penes lobes are closely approximated at basal sides, expanded apically, stout spine at base *H. solangensis*
 - Body 8 mm., 13-16 cross veins in stigmatic area two penes lobes are closely apposed at basal 2/3, apically dilated outwards into truncate expansion, spine absent
.....*H. nubilia*
4. Genital stimuli is in form of small spine, penes lobe dilated laterally.....5
 - Genital stimuli is much reduced to a pair of small chitinous plate.....
..... *Ecdyonoru* 7
5. Fore tarsus almost equal to tibia, 5 tarsal segments related as 9 : 8 : 8 : 7 : 6.....
.....*Epeorus* 6
6. Abdomen with characteristic markings, penes apically unlobed but with short spine present ventrally just below the apical margin.....*E. lahulensis*
 - Abdomen without such markings, penes apically lobed, without spine.....*E. psi*
7. Penes lobes fused all along its length, genital stimuli short, spinous, incurved *E. eatoni*
 - Penes lobes not fused but closely apposed, genital stimuli long, spine strong, down curved *E. indicus* (= *E. subfuscus*)
- 7 A. Annular marking present*E. annulifer*
 - Annular marking absent*E. bengalensis*
8. Body small sized 5-6 mm.....9
 - Body large sized 10 - 18 mm.....10
9. Wings 7 mm., hyaline except costal border which is translucent tinged with yellow. Abd. I-IX pale with mid dorsal markings which is absent in female
.....*Rhithrogena* (*R. parva*)
10. Head prominently enlarged at its frontal aspect*Ororostsia*.....11
 - Head not prominently enlarged at its frontal aspect.....*Afronurus* 12

11. Male 10 mm. female 12 mm. fore wing 11 mm hyaline dark brown at base, redish brown in stigmatic area and corresponding space in Sc., 5-6 cross vein in costa before bulla and 9-12 in stigmatic area, 7-8 cross vein in corresponding space in Sc., claws olive brown, that of larvae with 5 pectinations, subanal plate with median wide gaping 'V' shaped left *O. hutchinsoni*
12. Small body (10 mm), Head in front view quadrangular, 13 cross vein in stigmatic area, mesonotal markings is dark brown, lateral stripe with two almost equal branches, femora of all legs distinctly curved, ovipositor yellow, 2 segmented *A. curtus*
- Larger body (18 mm), Head in front view subtriangular, 10 cross veins in stigmatic area, dirty brown mesonotal stripe with only anterior thickening. Femora not curved, ovipositor dark brown, single segmented..... *A. solangensis*

SUMMARY

A detailed taxenomic status and saliant features of Leptophlebiidae with special reference to the Indian forms comprising of 10 species under 9 genera has been presented. A key to species has also been provided. Endemic component has been shown to be 9:1 within family which is 5:1 in all our mayflies. Half of the Indian Leptophlebiid are high altitude dweller. 2 species beyond 3000 m. and another 3 species in the range of 1200-2200 meters.

ACKNOWLEDGEMENTS

Author is highly thankful to Dr. B. K. Tikadar, Director, Zoological Survey of India, Calcutta for constant encouragements and facilities to bring out this work. Thanks are also due to him for delegating me to the 54 Annual Session of the National Academy of Sciences India and presenting this paper.

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For sake of brevity only most relevant references are indicated, hereunder, and all references mentioned can be found in Hubbard and Peters' catalogue of the Ephemeroptera of the Indian sub-region (1978, Oriental Insects Supplement, No. 9. pp.43).

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Table I : Qualitative composition of Indian Ephemeroptera

Families	India		World		High Altitude			Distribution	
	G	S	G	S	G	S	ES	O	EO
Ametropedidae	-	-	1	4	-	-	-	-	-
Baetidae	6	35	17	519	3	15	29	5	1
Baetiscidae	-	-	1	12	-	-	-	-	-
Behningiidae	-	-	3	5	-	-	-	-	-
Caenidae	1	5	6	81	1	1	4	1	-
Ephemerellidae	2	3	7	120	1	2	3	-	-
Ephemeridae	2	14	8	99	1	4	9	5	-
Euthyplociidae	1	1	7	12	-	-	1	-	-
Heptageniidae	7	13	28	378	6	7	12	1	-
Leptophlebiidae	9	10	62	377	2	2	9	1	-
Metrotropidae	-	-	2	7	-	-	-	-	-
Neolphemeridae	-	-	2	8	-	-	-	-	-
Oligoneurillidae	-	-	9	49	-	-	-	-	-
Palingeniidae	1	3	6	31	-	-	1	2	-
Polymitarcyidae	2	3	6	70	-	-	1	2	-
Potamanthidae	1	1	7	27	-	-	1	-	-
Prosopistomatidae	1	1	1	11	-	-	1	-	-
Siphlanigmatidae	-	-	1	1	-	-	-	-	-
Siphonuridae	1	1	26	163	1	1	1	-	-
Tricorythidae	-	-	13	122	-	-	-	-	-
Total	34	90	213	2146	15	32	72	17	1

EO = Extra Oriental, ES = Endemic Species, G = Genera, O = Oriental S= Species.

Table II: Qualitative composition of Indian Heptageniidae

Genus	Species	M	F	L	Distribution			Remarks
					Endemic	Orient	E.O.	
<i>Afronurus</i>	<i>curtus</i> Dubey	-	+	-	Himachal Pradesh (R. Solang)	-	-	2900 M
	<i>solangensis</i> Dubey	-	+	-	H.P. (R.Solang)	-	-	2800 M
<i>Cinygamina</i>	<i>assamensis</i> Kimmins	+	+	-	Meghalaya (Khasi hills)	-	-	-
<i>Ecdyonurus</i>	<i>annulifer</i> (Walker)	-	+	-	Maharashtra (Khandala)	-	-	-
	<i>bengalensis</i> Ulmer	+	+	-	West Bengal (Darjeeling)	-	-	2178 M
	<i>eatoni</i> Kimmins	+	+	-	Meghalaya (Khasi hills)	-	-	-
	<i>indicus</i> Kimmins	+	+	-	Meghalaya (Khasi hills)	-	-	-
<i>Epeorus</i>	<i>lahulensis</i> Kapur and Kripalani	+	-	-	H.P. (Sissu, Lahul Valley)	-	-	3200 M
	<i>psi</i> Eaton	+	+	-	H.P. (Sissu, Lahul Valley)	Taiwan	-	2743 M
<i>Heptagenia</i>	<i>nubila</i> Kimminis	+	+	-	Meghalaya (Khasi hills)	-	-	-
	<i>solangensis</i> Dubey	+	+	-	H.P. (R. Solang, Pir Panjal R)	-	-	2800 M
<i>Ororostsia</i>	<i>hutchinsoni</i> Traver	-	+	+	N.W.Himalaya (Ororotse lake)	-	-	5297 M
<i>Rhithrogena</i>	<i>parva</i> Ulmer	+	+	-	Orissa (Maurbhanj)	Taiwan Java	-	-
7	13	9	12	1	12	1		

ON A FEW INTERESTING SPECIES OF THE FAMILY
CORYDALIDAE (SUBORDER MEGALOPTERA :
ORDER NEUROPTERA) FROM INDIA

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INTRODUCTION

The paper deals with the description of a new species and also the description of a male and a female of two different species which are for the first time recorded from India. In this connection it may be stated that Needham (1909) described a single female of *Corydalis territans* from sikkim and MacLachlan (1869) described a single immature male from "India orientalis". The author while studying the both unnamed and named collections from North-east India encountered a new species and a male of *C. territans* Needham and a female of *N. latratus latratus* (MacLachlan) which are enumerated below.

1. *Protohermes arunachalensis* sp. nov.

Head : luteus. mandible : with black tip ; occiput : with 4 black spots on either side; pronotum : broad, yellow and with black lateral lines which are interrupted at middle. meso- and metanotum : yellow, each with two black spots and yellow hairs ; wings (fig. 9) : oval; forewing : membrane smoky ; veins blackish except those in the yellow spots areas which are yellow; yellow spots more or less isolated ; smoky brown patch between the two costal veinlets from base to pterostigma present; hindwing : clear, hyaline from base to apex excepting for a squarish black spot at tip of wing; legs : yellow ; fore- and mid tibiae dorsally and also tarsi black ; hind legs completely yellow excepting for brown claws; abdomen (figs. 1-3) : brownish ; male genitalia : appendices superiores short, broad and nearly straight with tips having brush of hairs at inner margin ; genital valve consisting of two long, divergent cylindrical prominences which are double the size of appendix superiores ; appendix inferiores short, claw-like and with black tips.

Measurements : Male (Holotype): length of forewing, 42 mm; length of hindwing, 38 mm.

Material examined : 1 Male (Holotype) ; Arunachal Pradesh, Chief Minister's Bungalow, Itanagar, 27. iv. 1987, Coll. C.B. Prasad, Z.S.I. Reg. No. 1259/H₁₂.

Distribution : India: Arunachal Pradesh.

Remarks : The species closely resembles *Protohermes anticus* (Walker) but differs from it in male genital armature and also by the four spots on either side of the occiput, smoky brown patch between costal veinlets in forewing and squarish black spot at tip of hindwing.

2. *Corydalis territans* Needham

1909. *Corydalis territans* Needham, *Rec. Indian Mus.*, 3 : 193.

Head and body : robust. Head: rufous, rugose ; lateral margin minutely serrulate on its flaring border which is produced behind into a sharp spine and ending anteriorly into a thin, flat, triangular projection behind eye ; vertex elevated, rim at inner side of antenna edged with black. Antenna : broken ; existing two basal segments brownish yellow at base and darkred at apex. Ocelli : 3, closely set and edged with black ; Frons : anterior rim with deep invagination at middle and indented laterally. Mandibles : long, nearly as long as head and with tips crossed, Maxillary palpi : basal and apical segments yellow and other 3 segments black. Pronotum : longer than wide ; finely rugulose transversely; with a long black stripe on each side and also with a transverse stripe anteriorly. Meso-and metanotum : bright yellow at middle and reddish fulvous on either side of it. Wings : membrane brownish. Forewing : costal space narrowed at region of pterostigma ; with hyaline cells between brown bordered costal crossveins ; with hyaline spots - 4 spots between R and first fork of RS, 3 spots between RS and media, one between branches of media, 4 between cubitus and media and 4 between cubitus and anal. Hindwing : mostly hyaline but brown beyond middle of wing and towards apex; very few hyaline spots between R & RS and branches of RS. Legs : rufous beneath and at base ; blackish dorsally and towards apex ; fore femora darker than others. Abdomen: reddish fulvous ; genitalia as in figs. 4-5.

Measurements : Male, length of forewing, 62 mm ; hindwing, 55mm.

Material examined : 1Male : India, Sikkim, Dentam, no other data available.

Distribution : India : Sikkim.

Remarks: The species was described by Needham (1909) from Sikkim based on a single female specimen. The author while studying the named collection has got a male specimen which has been described. The male is for the first time recorded from India.

3. *Neoneuromus latratus latratus* (MacLachlan).

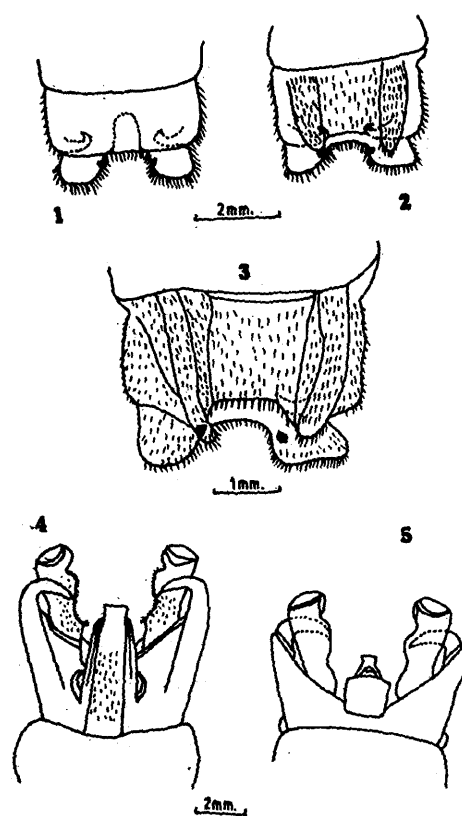
1869. *Neuromus latratus* MacLachlan. *Ann. Mag. nat. Hist.*, (4) 4 : 43.

1910. *Neoneuromus latratus latratus* (MacLachlan), *Cat. colln. Selys*, 5(1) : 26.

Body : red brown. Head : red brown ; dent on either side of posterior part of head black. Ocelli : inner rim black. Antennae : black except first two red brown basal segments. Mandible : black. Maxillary and labial palpi : red brown with apical segments black. Pronotum : with a narrow black streak on either side ; a black lunule anteriorly on outerside of lateral streak. Meso - and metanotum : brownish yellow with yellow wooly hairs. Wings : membrane light smoky brown but forewings darker than hindwings ; longitudinal veins yellow ; crossveins black except between cubito - anal vein of hindwing where the crossveins are yellow ; pterostigma also smoky brown. Legs : tibiae and tarsi black. Abdomen: red brown ; tip of abdomen as in fig. 6.

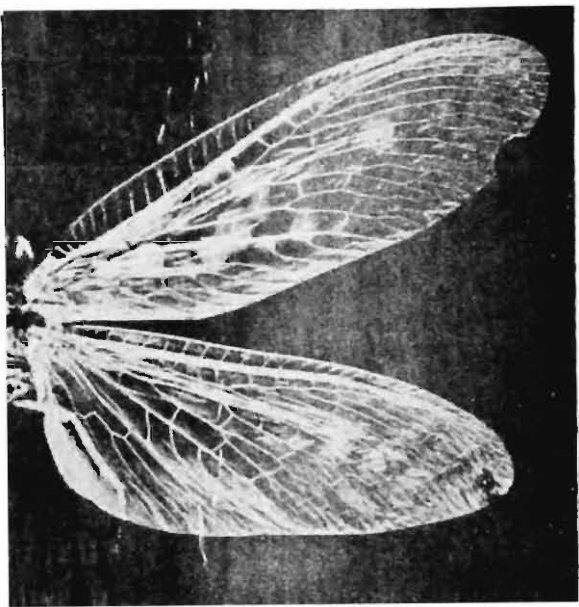
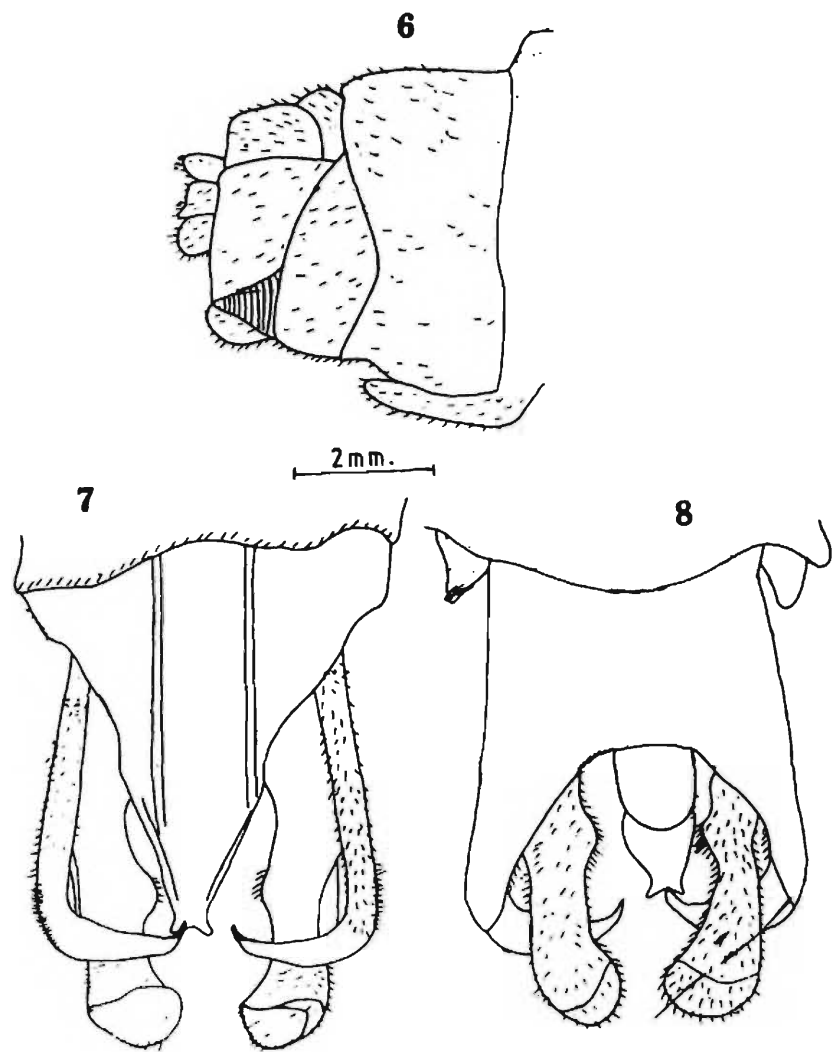
Measurements Female : length of forewing, 66 mm and length of hindwing, 61 mm.

Material examined : 1 Female : India, Meghalaya, Ward Lake, Shillong (Khasi Hills), 29. vii. 1973, Coll. K. Dev.



Figs. 1-3. *Protohermes arunachalensis* sp. nov.

1. Tip of abdomen showing male genital armature (dorsal view) ; 2. same (ventral view) ; 3. Same (ventro-lateral view). Figs. 4-5. *Corydalis territans* Needham 4. Tip of abdomen showing male genital armature (Ventral) ; 5. Same (dorsal).



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Figs. 6-8. *Neoneuromus latratus latratus* (MacLachlan) 6. Tip of abdomen, female (lateral). 7. Tip of abdomen showing male genital armature (ventral) ; 8. Same (dorsal). Fig. 9. fore - and hindwing of *Protohermes arunachalensis* sp. nov.

Distribution : India : Meghalaya

Remarks : MacLachlan (1869) described the species from "India Orientalis" Later, Weele (1910) examined MacLachlan's types and considered it to be a "very immature male" The author, while studying the collections of Meghalaya and Arunachal Pradesh has encountered a single female and a male specimen from the respective States. As the female of the species has been recorded for the first time from India so it has been described along with illustration. The figures (7-8) related to the genitalia in male has also been included as it was described by MacLachlan (loc.cit.) on immature specimen.

SUMMARY

The paper deals with the description of a new species, namely, *Protohermes arunachalensis* and also the descriptions of a male of *Corydalus territans* Needham and a female of *Neoneuromus latratus latratus* (Walker) both of which are for the first time recorded from India.

ACKNOWLEDGEMENT

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

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SHORT COMMUNICATIONS

**ON THE ASSOCIATION OF A PORCELLANID CRAB *POLYONYX* SP. WITH
THE TUBE-DWELLING POLYCHAETE *LOIMIA* MEDUSA (SAVIGNY) IN
THE LAKSHADWEEP WATERS, INDIA.**

Occurrence of a porcellanid crab, *Polyonyx* sp. (Fig. 1) in association with the tube-dwelling polychaete worm, *Loimia medusa* (Savigny) [Terebellidae] (Fig. 2) was observed at Kavaratti, Lakshadweep during March, 1984. Of the six terebellid tube of *L. medusa* examined, only two were found to be associated with the crab, *Polyonyx* sp. The tube

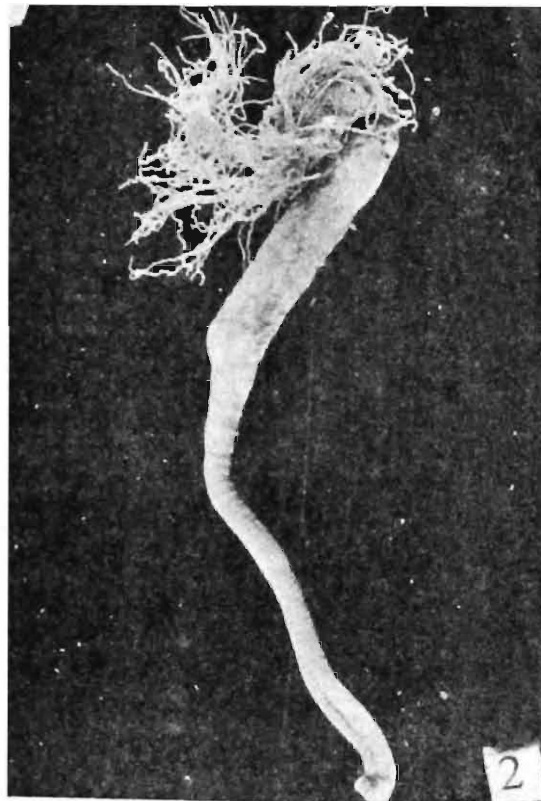
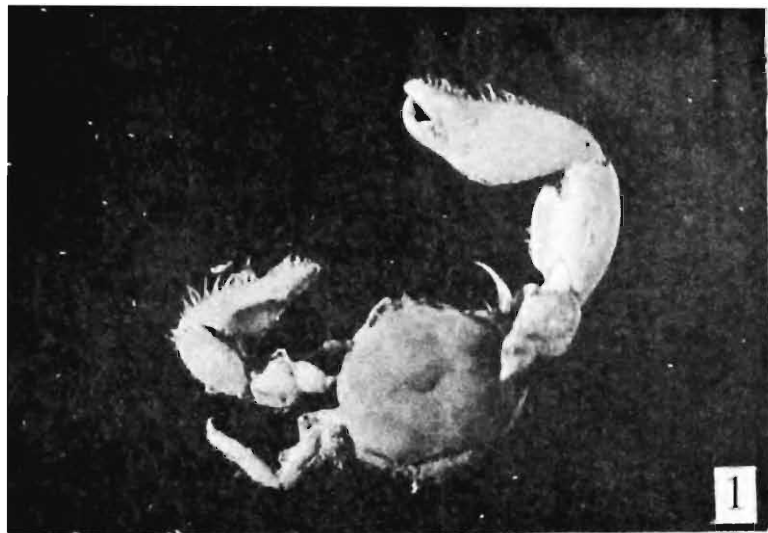


Fig. 1 The commensal porcellanid Crab *Polyonyx* sp.

Fig. 2 The polychaete worm *Loimia medusa* Savigny

measured 35 cm in length and 1 cm in diameter and was located in the intertidal zone of reef area protruding above the ground. The crab occupied the tentacular tuft of the polychaete and had retracted inside passively with the retreat of the polychaete as many times it was disturbed.

Members of the genus *Loimia* are known to build tubes away from rocks. Generally, the tubes are soft which appear untidy and fragile and usually composed of sand, mud, fragments of shells or sponge spicules. But the tubes observed at Lakshadweep were of hard calcareous type and composed of fragments of coral stones and sands. MacGinitie and MacGinitie (1968) stated that none of the polychaetes that live in hard tubes of calcium carbonate harbour commensals. Interestingly, the present situation is an exception to MacGinitie and MacGinitie's observations.

The association of *Polyonyx* with other animals is well documented in the literature. It was briefly reviewed by Sankolli and Shenoy (1965) while reporting on the occurrence of the polychaete worm *L. medusa* in association with a *Polyonyx* sp. in Bombay waters. However, the association of the porcellanid crab, *Polyonyx* sp. with the polychaete *L. medusa* is the first report of its kind from Lakshadweep and the second report from Indian waters.

It appears that the polychaete *Loimia medusa* builds its tube with the material whatever available in the immediately surrounding environment and the crab, *Polyonyx* sp. has the tendency to live in association with other animals.

ACKNOWLEDGEMENT

The authors are grateful to the Director, Zoological Survey of India for providing the facility to carry out this work.

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SHORT COMMUNICATIONS

ADDITION OF CANTHARIDAE IN THE NATIONAL ZOOLOGICAL COLLECTION, ZOOLOGICAL SURVEY OF INDIA.

INTRODUCTION

Fifty examples belong to eight species under five genera of the family Cantharidae have been added to the National Collection which are identified and donated by Dr. Wittmer, Basel Museum, Switzerland.

List of the species added to the collection

1. *Lycocerus trilineatus* Pic; 2. *Lycocerus pubicollis* Pic; 3. *Ichthyurus himaliacus* Champ 4. *Athemus groupe trimaculatus* Hope; 5. *Podabrus eburneus* Bourg.; 6. *Podabrus sikkimensis* Pic; 7. *Asiosilis singularicornis* (Pic); 8. *Asiosilis newtone* (Pic).

1. *Lycocerus trilineatus* Pic

1921. *Lycocerus trilineatus* Pic, *Melanges exot. ent.* 34 : 5.

Material added : 5 exs., Tarkhola, Darjeeling dist., W. B., 20. 4. 1976, A. R. Bhaumik; 1 ex., Rangpo, Darjeeling dist., W. B., Sweeping in bush near stream, 15. 4. 1976, A. R. Bhaumik ; 3 exs., Teesta Bazar, Darjeeling dist., W.B. 18.4.1976, A.R. Bhaumik; 1 ex., Rangpo, Sikkim, 18. 4. 1976, A. R. Bhaumik.

Distribution : India.

2. *Lycocerus pubicollis* Pic

1915. *Lycocerus pubicollis* Pic, *Bull. Soc. Ent. Fr.* : 78.

Material added : 1 ex., Mirik, 32 kms. from Ghoom bhanjang, 4700 ft, W.B., on leaves, 2. 5. 1976, A. R. Bhaumik.

Distribution : Tibet; India.

3. *Ichthyurus himalaicus* Champ.

1920. *Ichthyurus himalaicus* Champ., *Ent. monthl. mag.* LVI : 247, fig. 1, 2.

Material added : 2 exs., Trakhola, Darjeeling dist., W. B., Sweeping nr. Stream, 20. 4. 1976, A. R. Bhaumik ; 1 ex., Rangpo, Darjeeling dist., 450 m., W.B., Sweeping hill side bush, 21. 4. 1976, A. R. Bhaumik. ; 1 ex., Rangpo, Darjeeling dist., W. B., 18. 4. 1976, A. R. Bhaumik ; 1 ex., cc/4 ; 1 ex., Rangpo, Sikkim, 19.4. 1976, A. R. Bhaumik.

Distribution : Himalaya.

4. *Athemus groupe trimaculatus* Hope

1831. *Athemus trimaculatus* Hope in Gray, *Zool. Misc. coll.*, : 26.

Material added : 1 ex., Tarkhola, Darjeeling dist., W. B., Sweeping nr. Stream, 20. 4. 1976, A. R. Bhaumik ; 1 ex., Lolegaon, 1500 m., Darjeeling, W. B., 11. 4. 1976, A. R. Bhaumik ; 1 ex., Solan, 5500ft., H.P., bush, 29. 6. 1975, T. Sengupta ; 1 ex., Mussoorie, Dehra Dun, 6500ft., U.P. bush, 2. 7. 1975, T. Sengupta.

Distribution : India : Kashmir, West Bengal, Uttar Pradesh, Himachal Pradesh; Nepal.

5. *Podabrus eburneus*

1902. *Podabrus eburneus* Bourg., *Bull. Mus. Paris*, VII : 426.

Material added : 1 ex., Tindharia, 856 m., Sweeping, 4.5.1976, A. R. Bhaumik; 1 ex., Ghoombhanjang, 2117 m., Sweeping nr. hill side bushes, 29.4.1976, A.R. Bhaumik.

Distribution : Darjeeling in West Bengal.

6. *Podabrus sikkimensis* Pic

1924. *Podabrus sikkimensis* Pic, *Bull. Mus. Paris*, XXX : 480.

Material added : 1 ex., Lopchu, Darjeeling dist., W.B., on bush, 1.5.1976, A.R. Bhaumik.

Distribution : Sikkim; Darjeeling.

7. *Asiosilis singularicornis* (Pic)

1924. *Silis singularicornis* Pic *Bull. Mus. Paris*, : 477.

1977. *Asiosilis singularicornis* (Pic) : Wittmer, *Entomologica Basiliensia* 2 : 302.

Material added : 1 ex., Jhepi, 37 Kms. from Ghoombhajang, under bark, 3. 5. 1976, A. R. Bhaumik.

Distribution : Darjeeling (-K. Delkeskamp, 1939) and Assam (W. Wittmer, 1977).

8. *Asiosilis newtoni* (Pic)

1927. *Silis newtoni* Pic, *Bull. Soc. Ent. Er.*, : 140.

1977. *Asiosilis newtoni* (Pic) : Wittmer, *Entomologica Basiliensia* 2 : 294 - 295.

Material added : 23 exs., Singla, Darjeeling dist., 400m., 18. 4. 1973, H.S. Sharma; 1 ex., Reung, Darjeeling dist., 18.3. 1973, H.S. Sharma ; 1 ex., Rangpo, Darjeeling dist., 15. 4. 1976, A.R. Bhaumik ; 1 ex., Rangpo, Sikkim, 19. 4. 1976, A. R. Bhaumik.

Distribution : Darjeeling; Sikkim.

SHORT COMMUNICATIONS

NEW RECORDS OF TWO FRESH-WATER CILIATES
(PROTOZOA : CILIATA : HYPOTRICHIDA)
FROM INDIA

Study of the Protozoa collection made during 1972-74, reveals the existance of the two species of ciliates hitherto unrecorded from Indian sub-continent. These are being described in this short communication. The material was fixed in schaudinn's fluid, stained in Heidenhaisiron-haematoxylin, stained in eosin and mounted in D.P.X. medium.

SYSTEMETIC ACCOUNT

Family OXYTRICHIDAE

1. *Oxytricha bifaria* Stokes 1888.

1888. *Oxytrichs bifaria* Stokes, *J. Trenton nat. Hist. Soc.* 1 : 71.

Material :- 1 ex (1 slide). Patta, Solan, H.P. 17. vii. 1972, Reg. No. Pt 63.

Remarks :- Body ellipsoid, Flexible : Right side convex, left side flatened, posterior end pointed, strong cilia or crri-B frontals : 5 ventral, 4 anals : short caudals. Macronucleus in 2 parts. Body 240/ μ m long, 85 μ m width.

Family EUPLOTIDAE

2. *Euplotes carinatus* Stokes, 1888

1888. *Euplotes carinatus* Stokes, *J. Trenton nat. Hist. Soc.* 1 : 71.

Material : 1 ex (1 slide). Solan H.P. 25. vi. 1974 Reg. No. Pt. 82.

Remarks : Body avoid, inflexible, ventral surface convex : longitudinal ridged; Peristome broadly triangular frontal part of adoral zone lies in flat furrors, cirri-9 frontal-ventral, 5 anals, 4 caudals, Macronucleus band like, a micronucleus. Contractile vacuole posterior. Body measuring 65 X 46/ μ m.

REFERENCE

Stokes, A. C. 1888. A preliminary contrinbution toward A history of the freshwater infusoria of the United States. *J. Trenton. nat Hist. Soc.* 1, P. 71.

