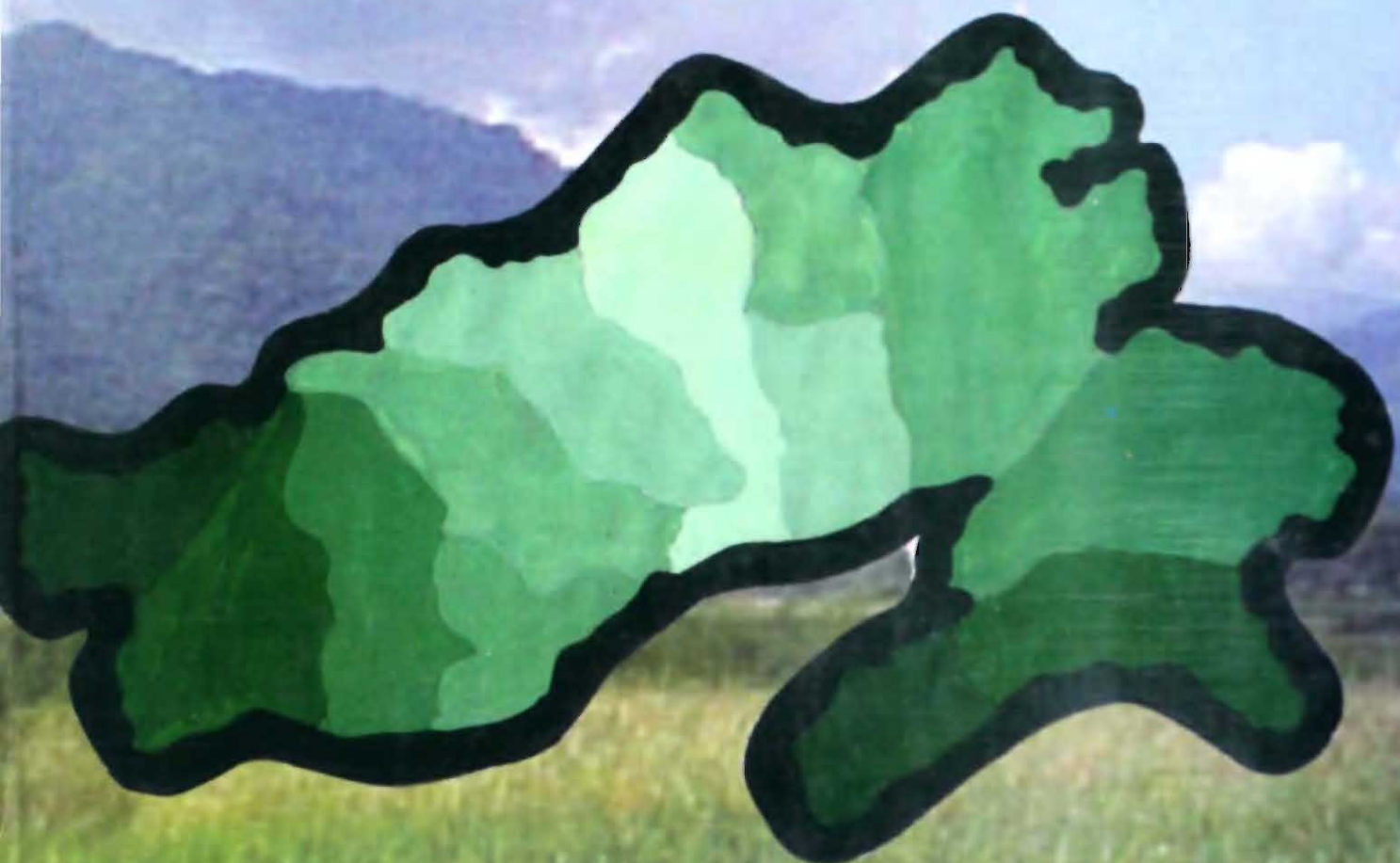
State Fauna Series 13

Fauna of Arunachal Pradesh (Part-2)



ZOOLOGICAL SURVEY OF INDIA

State Fauna Series 13

FAUNA OF ARUNACHAL PRADESH
PART-2

Edited by

The Director
Zoological Survey of India, Kolkata

Zoological Survey of India
Kolkata

CITATION
Editor-Director, 2006. *Fauna of Arunachal Pradesh, State Fauna Series,* **13**(Part-2) : 1-518. (Published by the Director, *Zool Surv. India,* Kolkata).

Published : January, 2006

ISBN : 81-8171-087-8

Co-ordinator

Dr. J.R.B. Alfred

Director
Zoological Survey of India
M-Block, New Alipore, Kolkata-700 053

© *Government of India,* 2006

ALL RIGHTS RESERVED

- No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any from or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior permission of the publisher.
- This book is sold subject to the condition that it shall not, by way of trade, be lent, re-sold hired out or otherwise disposed of without the publisher's consent, in any form of binding or cover other than that in which it is published.
- The correct price of this publication is the price printed on this page. Any revised price indicated by a rubber stamp or by a sticker or by any other means is incorrect and should be unacceptable.

PRICE
India : Rs. 1500.00
Foreign : $ 100 £ 70

Published at the Publication Division by the Director, Zoological Survey of India, 234/4, A. J. C. Bose Road, 2nd MSO Building (13th Floor), Nizam Palace, Kolkata - 700020 and printed at Krishna Printing Works, 106, Vivekananda Road, Kolkata - 700 006.

FAUNA OF ARUNACHAL PRADESH
STATE FAUNA SERIES

PART-2 **2006** **1-518**

CONTENTS

1. PROTOZOA 1-38
A.K. Das, N.C. Nandi and Piyali Chattopadhyay

2. CRUSTACEA : DECAPODA : PALAEMONIDAE AND POTAMONIDAE 39-45
S.K. Ghosh, S.S. Ghatak and T. Roy

3. LEECHES 47-48
C.K. Mandal

4. TREMATODES OF AMPHIBIAN 49-53
P.T. Bhutia

5. INSECTA : COLLEMBOLA 55-65
A.K. Hazra, G.P. Mandal, S.K. Mitra and Miss. B. Bhattacharya

6. INSECTA : ODONATA 67-149
Tridib Ranjan Mitra

7. INSECTA : ORTHOPTERA : ACRIDOIDEA 151-173
S.K. Mandal, A. Dey, and A.K. Hazra

8. BLATTARIA (DICTYOPTERA) 175-190
S.K. Mandal

9. INSECTA : COLEOPTERA : SCARABAEIDAE : COPRINAE (DUNG BEETLES) 191-224
Ram Sewak

10. INSECTA : DIPTERA : NEMATOCERA 225-255
Bulganin Mitra, A.R. Lahiri and M. Mukherjee

11. INSECTA : DIPTERA : BRACHYCERA 257-281
Bulganin Mitra, P. Parui and D. Banerjee

12. INSECTA : DIPTERA : BOMBYLIIDAE 283-295
D. Banerjee and Bulganin Mitra

13. INSECTA : DIPTERA : CYCLORRHAPHA 297-329
Bulganin Mitra, M. Sil, R.S. Mridha & K. Bhattacharjee

14. INSECTA : DIPTERA : SYRPHIDAE 331-354
M. Mukherjee, P. Parui and Bulganin Mitra

15. INSECTA : DIPTERA : MUSCIDAE 355-367
Bulganin Mitra

16. INSECTA : HYMENOPTERA : FORMICIDAE 369-398
S.N. Ghosh, S. Sheela, B.G. Kundu, S. Roychowdhury and R.N. Tiwari

17. INSECTA : HYMENOPTERA : ACULEATA : SPHECIDAE 399-426
B.G. Kundu, S.N. Ghosh and R.N. Tiwari [1]

18. INSECTA : HYMENOPTERA : ACULEATA (VESPIDAE AND APIDAE) 427-448
B.G. Kundu, S.N. Ghosh and S. Roychowdhury

19. ARACHNIDA : SCORPIONIDA, UROPYGI, SCHIZOMIDA AND ONCOPODID OPILIONES (CHELICERATA) 449-465
D.B. Bastawade

20. ORIBATID MITES (ACARI : ORIBATEI) 467-478
A.K. Sanyal, B.J. Sarkar and M.N. Moitra

21. IXODID TICKS (ACARI : IXODIDAE) 479-489
A.K. Sanyal and S.K. De

22. ARANEAE : SPIDERS 491-518
Bijan Biswas and Kajal Biswas

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2) : 1-38, 2006

PROTOZOA

A. K. DAS, N. C. NANDI AND PIYALI CHATTOPADHYAY
Zoological Survey of India, M-Block, New Alipore, Kolkata-700053

INTRODUCTION

Protozoa are unicellular eukaryotic organisms and known to occur in each and every habitats of all terrestrial and aquatic ecosystems of the world. Even then, there is no published report on any freeliving protozoa of Arunachal Pradesh. There are, however, several published reports on parasitic protozoa from this state. Misra (1956), Sen *et al.* (1973) and Dutta *et al.* (1992) published several papers on the prevalence and transmission of human malaria in Arunachal Pradesh caused by protozoan parasites, *Plasmodium falciparum* and *Plasmodium vivax*. Incidence of giardiasis in some human population of Arunachal Pradesh due to infection of another protozoan parasite, *Giardia lamblia* has also been reported by Paul *et al.* (1982). Moreover, information collected from the Disease Investigation Laboratory located at Nirjuli in Itanagar, Arunachal Pradesh (personal communication) reveals that there are many positive cases of coccidiosis in livestocks and poultry of the state due to infection of several species of coccidian parasites belonging to the genera *Eimeria* and *Isospora* as mentioned below :

Sl. No.	Parasitic species	Hosts
1.	*Eimeria brunetti* Levine	Poultry
2.	*Eimeria necatrix* Johnson	Poultry
3.	*Eimeria bovis* (Zublin)	Poultry
4.	*Eimeria tenella* (Railliet and Lucet)	Poultry
5.	*Eimeria ellipsoidalis* Becker & Frye	Cattle, espeially young stock
6.	*Eimeria zuernii* (Rivolta)	Cattle, espeially young stock
7.	*Eimeria debliecki* Douwes	Young Pigs
8.	*Eimeria scabra* Henry	Young Pigs
9.	*Isospora suis* Biester & Murrey	Young Pigs

Four species of symbiotic protozoa, namely, *Pyrsonympha tirapi*, *P. rostrata*, *Dinenympha mukundae* and *D. rayi* have also been reported from the gut contents of a single species of termite host, *Reticulitermes tirapi*, collected from Namdhapa, Arunachal Pradesh (Mukherjee and Maiti, 1988, 1989).

During 1990-92 and in 1999 the scientists of this survey conducted three faunistic surveys in the districts of Lower Subansiri, West Siang, East Siang, Debang Valley, Lohit and Changlang and, collected diversified groups of freeliving and parasitic protozoa. These collections as well as those already known and reported from Arunachal Pradesh comprise 72 species, out of which 43 species are freeliving, 20 species parasitic and 9 species symbiotic. Taxonomic account and district-wise distribution of these species are being dealt with in the present communication. Key to the families, genera and species is also incorporated in the paper for facilitating identification of Protozoa occurring in the state. The systematic list following Levine *et al.* (1980) and taxonomic account of these species are presented under three subheads, namely, freeliving, parasitic and symbiotic protozoa for the convenience of taxonomic treatment.

MATERIAL AND METHODS

Freeliving protozoa were collected from freshwater ponds and streams as well as mosses grown on soil, rocks and trees of different districts of Arunachal Pradesh. Parasitic and symbiotic protozoa were recovered from different host species as mentioned in the following host parasite/symbiote list and taxonomic account.

Freshwater samples were collected along with little algal mass, aquatic weeds, bottom ooze and flocculent matter arising out of aquatic vegetation of the sampling localities. Samples were kept in wide mouthed glass jars. These jars were brought to the laboratory and kept for a few days, with their lids open for considerable increase in Protozoa population. The samples were then thoroughly examined under light microscope from time to time. Freeliving ciliates were examined in living condition by keeping them in natural medium. Sometimes methocyl solution was used for slowing down the movement of the fast moving ciliates for the study of their internal structures *in situ* under light microscope. Sometimes Lugol's solution was added as killing agent and for detecting perepheral organellae. Schaudinn's fluid and Carnoy's fluid were used as fixatives of freeliving ciliates for preparing their permanent slides. The first one is very effective for keeping the exact natural shape of the specimen while the second one is better for studying their nuclear structure. Heidenhain's and Delafield's haematoxylin were used for staining the ciliates. These slides were mounted in DPX.

For the preparation of permanent slides of testaceans (rhizopods) tests were isolated from bottom ooze with the aid of a micropipette. These protozoans were also colected by squeezing different parts of aquatic vegetation including their roots and submerged portion of leaves with the aid of a micropipette. These testaceans were placed on a glass slide covered with thin layer of albumen-glycerol. These were then air dried at room temperature, transferred to xylene for about 10 hours and mounted in DPX.

For collecting moss dwelling protozoa moss samples were scraped from the top soil, rocks and barks of trees with spatula and brought to the laboratory in closed plastic bags. The samples were then processed with nonflooded petridish method as described by Foissner (1987). For that purpose, 1-2 g of field moist subsample taken from each bulk sample was kept in a petridish having 10-15 cm diameter. The sample was then saturated but not flooded with distilled water. After 48 hours about 2-3 ml run off collected after tilting the petridish was thoroughly examined under a compound microscope for cilliates and rhizopods usually at magnification 450 x (ocular 10 x and objective 45 x). Such examination was continued for 2-3 weeks, depending upon the availability of protozoan specimens. Testaceans or ciliated Protozoa observed in the run off were fixed, stained and mounted in the same manner as described earlier for freshwater Protozoa.

For parasitic protozoa hosts were dissected and their gut contents, fluid of the body cavity and smears of lungs, liver and blood were thoroughly examined under a compound microscope. Gut contents were also examined after diluting them with physiological saline. Organ smears and blood smears were drawn on clean and greeze free slides, air dried, fixed and stained with Giemsa or Leishman's stains. The lumen dwelling forms were fixed in Schaudinn's fluid and stained with Heidenhain's iron haematoxylin. Faecal samples of poultry and live stocks were also collected and kept in 2.5 percent potassidium dichromate solution for subsequent sporulation of coccidial oocyst, if any.

For the collection of flagellate symbiotes of termites, the entire gut of the worker caste was removed and gut contents were emptied on clean slides, containing a drop of 0.5 percent saline. For studying internal structures of these flagellates under *in situ* condition 67 percent Lock's solution was used in which these protozoans remain active in living condition for a longer period with their natural shape and size. For preparing permanent slides, these flagellates were fixed in Schaudinn's fluid, stained with Heidenhain's iron haematoxylin and mounted in DPX. For more details Das *et al.* (1993, 1995) may be consulted.

SYSTEMATIC LIST

A. **Freeliving Protozoa**

Phylum	SARCOMASTIGOPHORA
Subphylum	SARCODINA
Class	LOBOSEA
Order	ARCELLINIDA
Family	ARCELLIDAE
Genus	***Arcella*** Ehrenberg

1. ***Arcella discoides*** Ehrenberg

2. ***Arcella vulgaris*** Ehrenberg
Family CENTROPYXIDAE
Genus ***Bullinularia*** (Penard)
3. ***Bullinularia indica*** (Penard)
Genus ***Centropyxis*** Stein
4. ***Centropyxis aculeata*** (Ehrenberg)
5. ***Centropyxis aerophila*** Deflandre
6. ***Centropyxis ecornis*** (Ehrenberg)
7. ***Centropyxis laevigata*** Penard
8. ***Centropyxis minuta*** Deflandre
9. ***Centropyxis platystoma*** (Penard)
10. ***Centropyxis spinosa*** (Cash and Hopkinson)
11. ***Centropyxis sylvatica*** (Deflandre)
Genus ***Cyclopyxis*** (Deflandre)
12. ***Cyclopyxis arcelloides*** (Penard)
Genus ***Plagiopyxis*** Penard
13. ***Plagiopyxis callida*** Penard
14. ***Plagiopyxis minuta*** Bonnet
Family DIFFLUGIIDAE
Genus ***Difflugia*** Leclerc
15. ***Difflugia lismorensis*** Playfair
16. ***Difflugia lithophila*** (Penard)
17. ***Difflugia lobostoma*** (Leidy)
Family NEBELIDAE
Genus ***Heliopera*** Leidy
18. ***Heleopera rosea*** Penard
Genus ***Nebela*** Leidy
19. ***Nebela dentistoma*** Penard
20. ***Nebela tincta*** (Leidy)
Family ?
Genus ***Phryganella*** Penard
21. ***Phryganella acropodia*** (Hertwig and Lesser)
Class FILOSEA
Order GROMIIDA
Family EUGLYPHIDAE
Genus ***Assulina*** Ehrenberg
22. ***Assulina muscorum*** Greef
Genus ***Corythion*** Taranek
23. ***Corythion dubium*** Taranek
24. ***Corythion pulchellum*** Penard
Genus ***Euglypha*** Dujardin
25. ***Euglypha ciliata*** (Ehrenberg)
26. ***Euglypha rotunda*** Wailes
27. ***Euglypha scutigera*** Penard
28. ***Euglypha tuberculata*** Dujardin
Genus ***Tracheleuglypha*** Deflandre
29. ***Tracheleuglypha dentata*** (Vejdowsky)
Genus ***Trinema*** Dujardin
30. ***Trinema complanatum*** Penard
31. ***Trinema enchelys*** (Ehrenberg)
32. ***Trinema lineare*** Penard
Phylum CILIOPHORA
Class KINETOFRAGMINOPHOREA
Order PROSTOMATIDA
Family COLEPIDAE
Genus ***Coleps*** Nitz
33. ***Coleps hirtus*** (Muller)
Family SPATHIDIIDAE
Genus ***Spathidium*** Dujardin
34. ***Spathidium muscicola*** Kahl
Order PLEUROSTOMATIDA
Family AMPHILEPTIDAE
Genus ***Loxophyllum*** Dujardin
35. ***Loxophyllum nimeccense*** (Stein)
Order TRICHOSTOMATIDA
Family PLAGIOPYLIDAE
Genus ***Plagiopyla*** Stein
36. ***Plagiopyla nasuta*** Stein
Order COLPODIDA
Family COLPODIDAE
Genus ***Colpoda*** O. F. Muller
37. ***Colpoda cucullus*** (Muller)
Class OLIGOHYMENOPHOREA
Order HYMENOSTOMATIDA
Family GLAUCOMIDAE
Genus ***Glaucoma*** Ehrenberg
38. ***Glaucoma pyriformis*** (Ehrenberg)
Family PARAMECIIDAE
Genus ***Paramecium*** Hill
39. ***Paramecium bursaria*** (Ehrenberg)

Family FRONTONIIDAE
Genus ***Frontonia*** Ehrenberg
40. ***Frontonia leucas*** (Ehrenberg)
Class POLYHYMENOPHOREA
Order HETEROTRICHIDA
Family METOPIDAE
Genus ***Metopus*** Claparede & Lachmann
41. ***Metopus es*** Muller
Order HYPOTRICHIDA
Family EUPLOTIDAE
Genus ***Euplotes*** Ehrenberg
42. ***Euplotes muscicola*** Kahl
43. ***Euplotes plumipes*** Stokes

B. Parasitic Protozoa

Phylum SARCOMASTIGOPHORA
Subphylum MASTIGOPHORA
Class ZOOMASTIGOPHOREA
Order KINETOPLASTIDA
Family TRYPANOSOMATIDAE
Genus ***Trypanosoma*** Gruby

Parasites	**Species of hosts**
44. ***T. rotatorium*** (Meyer)	***Rana limnocharis***

Order DIPLOMONADIDA
Family HEXAMITIDAE
Genus ***Giardia*** Kuntsler

45. ***G. lamblia*** Stiles	***Homosapiens***

Subphylum OPALINATA
Class OPALINATEA
Order OPALINIDA
Family OPALINIDAE
Genus ***Cepedea*** Metcalf

Parasites	**Species of hosts**
46. ***C. lanceolata***	***Rana limnocharis***

Genus ***Opalina*** Purkinje and Valenter

Parasites	**Species of hosts**
47. ***O. lata*** Bezzenberger	***Rana cyanophlyctes***

Phylum APICOMPLEXA
Class SPOROZOEA
Order EUCOCCIDA
Family EIMERIIDAE
Genus ***Eimeria*** Schneider

(i) Eimeria from avian hosts

Parasites	**Species of hosts**
48. ***E. brunetti*** Levine	***Gallus domesticus***
49. ***E. necatrix*** Johnson	***Gallus domesticus***
50. ***E. tenella*** (Railliet & Lucet)	***Gallus domesticus***

(ii) Eimeria from mammalian hosts

Parasites	**Species of hosts**
51. ***E. bovis*** (Zubin)	***Bos indicus***
52. ***E. debliecki*** Douwes	***Sus scrofa***
53. ***E. ellipsoidalis*** Becker & Frye	***Bos indicus***
54. ***E. scabra*** Henry	***Sus scrofa***
55. ***E. stiedai*** (Lindemann)	Rabbit, ***Oryctolagus*** sp.
56. ***E. zuernii*** (Rivolta)	***Bos indicus***

Genus ***Isospora*** Schneider

Parasites	**Species of hosts**
57. ***I. suis*** Biester & Murray	***Sus scrofa***

Family PLASMODIIDAE
Genus ***Plasmodium*** Marchiafava & Celli

(i) Plasmodium of avian hosts

Parasites	**Species of hosts**
58. ***P. relictum*** (Grassi & Feletti)	***Columba livia***

(ii) Plasmodium of mammals

Parasites	**Species of hosts**
59. ***P. falciparum***	***Homo sapiens***
60. ***P. vivax*** (Grassi & Feletti)	***Homo sapiens***

Phylum CILIOPHORA
Class OLIGOHYMENOPHOREA
Order ASTOMATIDA
Family ANOPLOPHRYIDAE
Genus ***Anoplophrya*** Stein

Parasites	**Species of hosts**
61. ***A. lumbrici*** (Schrank)	***Pheretima*** sp.

Family MAUPASELLIDAE
Genus ***Maupasella*** Cepede

Parasites	**Species of hosts**
62. ***M. nova*** Cepede	***Pheretima*** sp.

Class POLYHYMENOPHOREA
Order HETEROTRICHIDA
Family NYCTOTHERIDAE
Genus ***Nyctotheroides*** Grasse

Parasites	Species of hosts
63. ***N. cordiformis*** (Ehrenberg)	***Rana*** sp.

C. Symbiotic Protozoa

Phylum SARCOMASTIGOPHORA
Subphylum MASTIGOPHORA
Class ZOOMASTIGOPHOREA
Order OXYMONADIDA
Family PYRSONYMPHIDAE
Genus ***Dinenymphs*** Leidy

Parasites	Species of hosts
64. ***D. mukundai*** Mukherjee and Maiti	***Reticulitermes tirapi***
65. ***D. nobilis*** Koidzumi	***R. tirapi***
66. ***D. rayi*** Mukherjee and Maiti	***R. tirapi***

Genus ***Pyrsonympha*** Leidy

Parasites	Species of hosts
67. ***P. grandis*** Koidzumi	***R. tirapi***
68. ***P. rostrata*** Mukherjee and Maiti	***R. tirapi***
69. ***P. tirapi*** Mukherjee and Maiti	***R. tirapi***

Order HYPERMASTIGIDA
Family SPIROTRICHONYMPHIDAE
Genus ***Spirotrichonympha*** Grassi & Foa

Parasites	Species of hosts
70. ***S. porteri*** (Koidzumi)	***R. tirapi***

Family TERANYMPHIDAE
Genus ***Teranympha*** Koidzumi

Parasites	Species of hosts
71. ***T. mirabilis*** Koidzumi	***R. tirapi***

Family TRICHONYMPHIDAE
Genus ***Trichonympha*** Leidy

Parasites	Species of hosts
72. ***T. agilis*** Leidy	***R. tirapi***

SYSTEMATIC ACCOUNT

A. Freeliving Protozoa

Phylum SARCOMASTIGOPHORA
Class LOBOSEA
Subclass TESTALOBOSIA
Order ARCELLINIDA

Key to the families

1. Test membranous and rigid, having a distinct oral aperture ..... ARCELLIDAE

– Test with minerals or organic particles and with an oral aperture 2

2. Test with plates or scales secreted by cytoplasm, sometimes with particles ..... NEBELIDAE

– Test with foreign particles and without plates or scales as above. 3

3. Test possessing axial symmetry, oral aperture at extremity of the test (terminal). ..... DIFFLUGIIDAE

– Symmetry of test dorso-ventral, oral aperture at one side of the test (eccentric) or ventral– ..... CENTROPYXIDAE

Family ARCELLIDAE
Genus ***Arcella*** Ehrenberg

1830. (1832) *Arcella* Ehrenberg. *Abh. K. Akad Wiss. Berlin.* : 40.

Diagnosis : Test membranous, rigid, either smooth or finely reticulate, yellow or brown in colour depending on age, sometimes colourless, oval or circular in ventral view and plano-convex to hemispherical in lateral view, encrusted with chitinous particles; oral aperture central, usually circular, rarely of different shape and inverted like a funnel.

Key to the species

1. Test plano-convex in lateral view, height of test about one-fourth to one-third of its diameter ..... *A. discoides*

– Test hemispherical, evenly convex in lateral view, height of test about half of its diameter ..... *A. vulgaris*

1. ***Arcella discoides*** Ehrenberg

1843. *Arcella discoides* Ehrenberg, *Ber. K. Akad. Wiss.*, Berlin, : 139.

Material examined : 2 exs., Itanagar, Lower Subansiri , 18.ii.1990; 4 exs., Khiti village, Tirap, 13.iii.1990; sev. exs., Rani beel, Passighat, East Siang, 12.ii.1992; 2 exs., Nigam village, Basar, West Siang, 18.ii.1992; 2 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test light yellow, smooth, flattened, circular in ventral view and planoconvex in lateral view; height of the test varying from about one-fourth to one-third of its diameter; oral aperture large and circular.

Distribution : India : Arunachal Pradesh (Lower Subansiri, East Siang, Tirap, West Siang and Debang Valley districts), Meghalaya, Sikkim, Tripura and West Bengal; common in freshwater ponds in bottom ooze; also in mosses.

Remarks : This species has been collected from the bottom ooze of freshwater ponds as well as rock mosses of Arunachal Pradesh and is reported for the first time from this state.

2. ***Arcella vulgaris*** Ehrenberg

1832. *Arcella vulgaris* Ehrenberg, *Abh. Akad. Wiss.*, Berlin, : 40.

Material examined : 3exs., Ganga lake, Itanagar, Lower Subansiri, 18.ii.1990; 2 exs., Rani beel, Passighat, East Siang, 12.ii.1992; 2 exs., Yembung village, Along, West Siang, 14.ii.1992.

Diagnosis : Test light yellow, discoid in ventral view, hemispherical and evenly convex in lateral view; height of the test about half its diameter, surface with 'aeroles'; oral aperture circular, central and often without buccal tube.

Distribution : India : Arunachal Pradesh (Lower Subansiri, West Siang and East Siang districts), Sikkim and West Bengal; in freshwater amongst bottom ooze and in submerged vegetation; also in ground moss grown adjacent to freshwater bodies.

Remarks : This species is reported for the first time from Arunachal Pradesh. The present specimens have been collected from the bottom ooze of some freshwater ponds of the state.

Family CENTROPYXIDAE

Key to the genera

1. Inferior lip of oral aperture extending to superior lip, sometimes covering it partially, test hemispherical or elliptical ..... ***Bullinularia***

– Inferior lip of oral aperture not extending to superior lip 2

2. Oral aperture linear, lunate, superior lip without pores, test hemispherical ..... ***Plagiopyxis***

– Oral aperture rounded or angular, test mostly membranous, with encursted foreign particles or covered with sandy material 3

3. Test swollen at posterior part, oral aperture eccentric ..... ***Centropyxis***

– Test regularly arched, oral aperture centrally located ..... ***Cyclopyxis***

Genus ***Bullinularia*** (Penard)

1907. *Bulinella* Penard, *J. roy. micr. Soc.*, : 274 (Pre-occupied in Mollusca, 1891).

1911. *Bullinula* Penard, *Brit. Antarct. Exp. I Biol.*, **6** : 226.

1953. *Bullinularia* Deflandre, *Traite de Zoology* **1** : 97-148.

Diagnosis : Test smooth, ellipsoidal, flattened on one face, formed of silicious plates; long narrow peristome on flattened surface with a smooth inferior lip and overhanging superior lip; pseudopodia digitate or spatulate, simple or branched.

3. ***Bullinularia indica*** (Penard)

1907. *Bulinella indica* Penard, *J. roy. micr. Soc.*, : 274.

1911. *Bullinula indica* Penard, *Brit. Antarct. Exped. I. Biol.*, 6 : 226.

1953. *Bullinularia indica* (Penard) Deflandre, *Traite de Zoology*, 1 : 97.

Material examined : 3 exs., Sevak Pass, Lohit, 28.ii.1990; Mayodia, Debang Valley, 19.iii.1999.

Diagnosis : Test ellipsoidal, dark brown, composed of small silicious grains and plates cemented on a brown chitinous pellicle; aperture long, arcuate, narrow with inner lip prolonged and incurved and outer lip usually with a row of pores.

Distribution : India : Arunachal Pradesh (Lohit and Dibang Valley districts) and Sikkim; in mosses.

Genus *Centropyxis* Stein

1859. *Centropyxis* Stein, *Abh. K. Bohm. Gesellsch. Wiss.*, 10 : 43.

1929. *Centropyxis* : Deflandre, *Arch. Protistenk*, 67 : 322.

Diagnosis : Test dorso-ventrally flattened, spheroidal at posterior portion and tapering towards apertual region, oral aperture eccentric, typically invaginated without a raised rim.

Key to the species

1. Test furnished with variable number of spines 2

– Test without spines 3

2. Test provided with a few (usually 4-6) divergent spines in a single and somewhat regular row, usually resembling a scrap ..... *C. aculeata*

– Test furnished with usually 6-8 spines frequently curved distributed irregularly on dorsal side.. ..... *C. spinosa*

3. A constriction visible between apertural and post apertural region of the test 4

– Constriction between apertural and post-oral region of the test lacking 5

4. Test prolonged at anterior end resembling a flat lens covering the oral aperture ..... *C. platystoma*

– Apertural region of the test separated from the rest by a perforated diaphragm ..... *C. sylvatica*

5. Test circular or nearly circular in ventral view 6

– Test more or less elliptical, oval or discoidal in ventral view 7

6. Test usually less than 50 µm in diameter, oral aperture slightly invaginated ..... *C. minuta*

– Test comparatively large (usually more than 60 µm in diameter), oral aperture obliquely invaginated and its outer margin broadly rounded ..... *C. laevigata*

7. Test small, 50-70 µm in length, ovoid in ventral view, pear-shaped in lateral view, oral aperture semicircular ..... *C. aerophila*

– Test comparatively large, usually more than 100 µm, discoidal or largely elliptical, mostly irregular in outline, oral aperture circular or round ..... *C. ecornis*

4. *Centropyxis aculeata* (Ehrenberg)

1832. *Arcella aculeata* Ehrenberg, *Abh. Preuss. Akad. Wiss.*, Berlin, : 40.

1857. *Centropyxis aculeata* (Ehrenberg) Stein, *S. Bohm Ges. Wiss., Prague*, 5(10) : 41.

Material examined : 2 exs., Sevak Pass, Lohit, 28.ii.1990; 2 exs., Indira Park, Itanagar, Lower Subansiri, 5.iii.1992; 1 ex., Deban, Changlang, 7.iii.1990; 3 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test compressed, cap-shaped, fundus of test obtusely rounded and furnished usually with 4-6 divergent spines at the border, arranged in a single and somewhat regular row; spines usually resembling scrap; test brownish, frequently encrusted with quartz crystals and sometimes with admixture of diatomes and sand particles.

Distribution : India : Arunachal Pradesh (Lohit, Lower Subansiri, Changlang and Debang

Valley districts), Andhra Pradesh, Meghalaya, Orissa, Rajasthan, Sikkim, Tripura and West Bengal.

Remarks : This species is usually distributed in freshwater tanks amongst vegetation. Penard (1907) recorded this species from rock mosses of the Sikkim Himalaya and, Guru and Das (1983) from soils of Orissa. *C. aculeata* has been collected from freshwater tanks and rock mosses of Arunachal Pradesh and constitutes first record for this state.

5. ***Centropyxis aerophila*** Deflandre

1929. *Centropyxis aerophila* Deflandre, *Arch. Protistenkd.*, **67** : 330.

Material examined : 6 exs., Indira Park, Itanagar, Lower Subansiri, 17.ii.1990; 4 exs., Sevak Pass, Lohit, 28.ii.1990; 3 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test small, 65.73-68.86 µm in length and 65.70-72.90 um in width, ovoid in ventral view and pear-shaped in lateral view, flank of posterior part of the test little arched, often almost straight, fundus spheroidal with dorsal face strongly flattened towards oral aperture, test chitinous, finely punctate and rough, bearing foreign particles, usually vegetable fragments and transparent crystals; oral aperture semi-circular or elliptical.

Distribution : India : Arunachal Pradesh (Lower Subansiri, Lohit and Debang Valley districts), Meghalaya, Sikkim, Tripura and West Bengal, in moss.

Remarks : This is usually a moss dewlling species and recorded for the first time from Arunachal Pradesh.

6. ***Centropyxis ecornis*** (Ehrenberg)

1841. *Arcella ecornis* Ehrenberg, *Abh. Akad. Wiss.*, Berlin : 368.

1879. *Centropyxis ecornis* Leidy, *Freshwater Rhizopods of North America* : pl. 30, figs. 20-24.

1929. *Centropyxis ecornis* : Deflandre, *Arch. Protistenkd.*, **67** : 359.

Material examined : 2 exs., Indira Park, Itanagar, Lower Subansiri, 17.ii.1990; 1 ex., Zerogaon, Lohit, 27.ii.1990; 2 exs., Rani beel, Passighat, East Siang, 12.ii.1002; 4 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test comparatively large, usually more than 200 µm in aquatic habitat and more than 100 µm in dry moss; discoidal or largely elliptical in ventral view, most irregular in outline, without any spine and covered with quartz sand grains; oral aperture usually circular, sometimes irregularly lobed, not very much eccentric.

Distribution : India : Arunachal Pradesh (Lower Subansiri, Lohit, East Siang and Debang Valley districts), Meghalaya, Sikkim and West Bengal; in freshwater and in moss.

Remarks : This species has been collected from freshwater tanks as well as moss biotopes of Arunachal Pradesh and reported for the first time from the state.

7. ***Centropyxis laevigata*** Penard

1890. *Centropyxis laevigata* Penard, *Mem. Soc. Phys.*, Geneva, **31(2)** : 151.

1929. *Centropyxis laevigata* : Deflndre, *Arch. Protistenkd*, **67** : 363.

Material examined : 4 exs., Passighat, East Siang, 10.ii.1992; 7 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test nearly circular in ventral view, usually slightly compressed in one side; in lateral view test nearly hemispherical, being broader at posterior extremity; mouth obliquely invaginated and its outer margin broadly rounded, oral aperture eccentric.

Distribution : Arunachal Pradesh (East Siang and Debang Valley districts) and Sikkim; in moss.

Remarks : This species was collected from soil, rock and wall mosses and constitutes first record for Arunachal Pradesh.

8. ***Centropyxis minuta*** Deflandre

1929. *Centropyxis minuta* Deflandre, *Arch. Protistenkd.*, **67** : 366.

Material examined : 3 exs., Yembung Village, Along, West Siang, 14.ii.1992; 2 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test small, usually less than 50 μm in diameter, circular in ventral view and subspherical in lateral view; oral aperture eccentric and circular.

Distribution : India : Arunachal Pradesh (West Siang and Debang Valley districts), Meghalaya, Orissa, Sikkim, Tripura and West Bengal; in freshwater amongst aquatic vegettion and in moss.

Remarks : This species has been collected from soil and rock mosses in Arunachal Pradesh and reported for the first time from the state.

9. *Centropyxis platystoma* (Penard)

1890. *Difflugia platystoma* Penard, *Mem. Soc. Phys. et Hist. Nat. de Geneva.*

1929. *Centropyxis platystoma* Deflandre, *Arch. Protistenkd.*, 67 : 338.

Material examined : 3 exs., Indira Park, Itanagar, Lower Subansiri, 17.ii.1990; 2 exs., Sevak Pass, Lohit, 28.ii.1990.

Diagnosis : Test prolonged to anterior end, resembling a flat lens covering oral aperture, test elongated and elliptical in ventral view, a constriction most often visible between ventral post oral portion of the test and oral apertures; in lateral view posterior part of the test strongly convex and anterior part more or less flat; oral aperture large, circular; test chitinous and covered with several silicious particles, quartz particles and occasionally small pebbles.

Distribution : India : Arunachal Pradesh (Lower Subansiri and Lohit districts), Meghalaya, Sikkim and Tripura; in moss.

Remarks : This species has been collected from rock mosses and reported for the first time from Arunachal Pradesh.

10. *Centropyxis spinosa* (Cash & Hopkinson)

1905. *Centropyxis aculeata* var. *spinosa* Cash and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa* 1 : 135.

1929. *Centropyxis spinosa* (Cash & Hopkinson) Deflandre, *Arch. Protistenkd.*, 67 : 353.

Material examined : 2 exs., Yebung village, Along, West Siang, 14.ii.1992; 2 exs., Nigam village, Basar, West Siang, 18.ii.1992; 5 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test more or less circular and considerably flat; oral aperture eccentric and irregualrly circular with invaginated borders; test provided with variable number of spines, usually 6-8, spines frequently curved and distributed irregularly on the dorsal side; test chitinous with few quartz crystals or diatom fistules.

Distribution : India : Arunachal Pradesh (West Siang and Debang Valley districts), Meghalaya, Sikkim and West Bengal; in freshwater amongst aquatic vegetation and in bottom ooze; also in ground and rock mosses grown adjacent to water bodies.

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

11. *Centropyxis sylvatica* (Deflandre)

1929. *Centropyxis aerophila* Deflandre var. *sylvatica* Deflandre, *Arch. Protistenkd.*, 67 : 332.

1955. *Centropyxis sylvatica* Bonnet and Thomas, *Bull. Soc Hist. Nat. Toulouse*, 90 : 415.

Material examined : 4 exs., Sevak pass, Lohit, 28.ii.1990; 3 exs., Mayodia, Debang Valley, 19.iii.1999.

Diagnosis : Test yellowish or yellowish brown, in ventral view elliptical, in lateral view test visible in two distinct parts, of which apertural region separated from the rest of the test by a perforated diaphragm; aperture eccentric and elliptical; test chitinous with quartz crystals.

Distribution : India : Arunachal Pradesh (Lohit and Debang Valley districts); in moss.

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

Genus *Cyclopyxis* Deflandre

1929. *Centropyxis* (*Cyclopyxis*) Deflandre, *Arch Protistenkd.*, 67 : 330 & 367.

Diagnosis : As in the key to the genus.

12. ***Cyclopyxis arcelloides*** (Penard)

1902. *Centropyxis arcelloides* Penard, *Fauna Rhiz. du bass du Leman* : 309.

1929. *Centropyxis* (*Cyclopyxis*) *arcelloides* Deflandre, *Arch. Protistenkd.*, **67** : 367.

Material examined : 3 exs., Nigam village, Basar, West Siang, 18.ii.1992; 8 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test circular in ventral view and hemispherical in lateral view, brown, chitinous, covered with small, flat siliceous scale like structures; oral aperture centrally located, circular in shape, faintly invaginated, about half the diameter of that in width.

Distribution : India : Arunachal Pradesh (West Siang and Debang Valley districts), Meghalaya, Sikkim and Tripura; in moss.

Remarks : This species is recorded for the first time from Arunachal Pradesh.

Genus ***Plagiopyxis*** Penard

1910. *Plagiopyxis* Penard, *Rev. Suisse Zool.*, **18** : 936.

Diagnosis : Test hemispherical in dorsal view and ovoid in side view, oral aperture linear, lunate, superior lip without pores.

Key to the species

1. Test small, diameter 40-45 µm, clear and transparent, circular in dorsal view and semi-elliptical in lateral view ..... *P. minuta*

– Test of medium size, diameter 50-135 µm, but usually 90-110 µm, gray, yellow or brown in colour, circular or largely oval in ventral view and hemispherical in lateral view .... *P. callida* Penard

13. ***Plagiopyxis callida*** Penard

1910. *Plagiopyxis callida* Penard, *Rev. Suisse Zool.*, **18** : 936.

Material examined : 5 exs., Indira Park, Itanagar, Lower Subansiri, 5.ii.1992; 6 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test gray, yellow or brown in colour, circular or largely oval in ventral view and hemispherical in lateral view, diameter of the presents material usually 90 µm; inferior lip dipping far into the interior of the test and lips ovarlaping to such extent that aperture very difficult to observe.

Distribution : India : Arunachal Pradesh (Lower Subansiri and Debang Valley districts) and West Bengal; in soil and moss.

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

14. ***Plagiopyxis minuta*** Bonnet

1959. *Plagiopyxis minuta* Bonnet, *Bull. Soc. Hist. Nat. de Toulouse*, **94** : 177.

Material examined : 3 exs., Sevak Pass, Lohit, 18.ii.1990; 8 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test clear and transparent, circular in dorsal view and semi-elliptical in lateral view, diameter 40-45 µm.

Distribution : India : Arunachal Pradesh. (Lohit and Debang Valley districts); in moss.

Remarks : This species has been collected from soil and rock mosses and reported for the first time from India.

Family DIFFLUGIIDAE

Genus ***Difflugia*** Leclerc

1815. *Difflugia* (*Partim*) Leclerc, *Mem. du Mus. Protistenk.*, **2** : 474.

1958. *Difflugia* Gauthier-Lievre and Thomas, *Arch. Protistenkd.*, **103** : 241.

Diagnosis : Pseudopods finger-like, test varying from globular to elongate pyriform or eccentric, oral aperture at the extremity of the test.

Key to the species

1. Test with collar 2

– Test without collar, ovoidal in shape, oral aperture usually quadrilobed but very often trilobed ..... *D. lobostoma*

2. Test spherical to sub-globose, oral aperture circular ..... *D. lithophila*

– Test globular or slightly ovoid, oral aperture characteristically 5 lobed ..... *D. lismorensis*

15. *Difflugia lismorensis* Playfair

1917. *Difflugia lismorensis* Playfair, *Proc. Linn. Soc. New South Wales*. **28** : 633.

Material examined : 2 exs., Nigam village, Basar, West Siang.

Diagnosis : Test globular or slightly ovoid, formed of quartz particles; oral aperture small, characteristically 5 lobed and petelliform, with less prominent collar.

Distribution : India : Arunachal Pradesh (West Siang district) and West Bengal; in freshwater amongst vegetation and in bottom ooze.

Remarks : The present specimens resemble *D. lismorensis* var. *quinquelobata* described by Gauthier-Lievre and Thomas (1958) from Africa. This species is reported for the first time from Arunachal Pradesh.

16. *Difflugia lithophila* Penard

1902. *Difflugia hydrostatica* var. *lithophila* Penard. *Fauna rhizopodigue due bassin du Leman*. Geneva. : 274.

1958. *Difflugia lithophila* Gauthier-Lievre and Thomas. *Arch. Protistenkd.*, **103** : 286.

Material examined : 3 exs., Itanagar, Lower Subansiri, 18.ii.1990; 2 exs., Rani beel, Passighat, East Siang, 12.ii.1992.

Diagnosis : Test ovoid-globular or subglobular drawn out to the pseudostome in the form of a short collar, oral aperture circular, test covered with well arranged stony particles.

Distribution : India : Arunachal Pradesh (Lower Subansiri and East Siang districts), Meghalaya, Tripura and West Bengal; in freshwater in bottom ooze.

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

17. *Difflugia lobostoma* (Leidy)

1879. *Difflugia lobostoma* Leidy. *Freshwater Rhizopods of North America* : 112.

1958. *Difflugia lobostoma* : Gauthier-Lievre and Thomas. *Arch. Protistenkd.*, **103** : 368.

Material examined : 2 exs., Ganga lake, Itanagar, Lower Subansiri, 18.ii.1990; 3 exs., Khiti village, Tirap, 13.iii.1990; 4 exs., Rani beel, Passighat, East Siang, 12. ii. 1992; 2 exs., Nigam village, Basar, West Siang, 18.ii.1992.

Diagnosis : Test ovoidal, covered with angular quartz particles, oral aperture usually quadrilobed in the form of a cross and sometimes trilobed.

Distribution : Arunachal Pradesh (Lower Subansiri, Tirap, East Siang and West Siang districts), Meghalaya, Rajasthan, Tripura and in West Bengal; in freshwater amongst vegetation and in bottom ooze.

Remarks : *D. lobostoma* constitutes first record for this state.

Family NEBELIDAE

Key to the genera

1. Test variously coloured, with a little foreign material at the fundus, an elliptic notch visible near oral aperture in narrow lateral view ..... ***Heliopera***

– Test usually transparent, compressed without any foreign material and with round, oval or irregular plates; oral aperture without any notch as above ..... ***Nebela***

Genus *Heliopera* Leidy

1879. *Heliopera* Leidy. *Freshwater Rhizopods of North America* : 162.

Diagnosis : Test variously coloured, with little foreign material at the fundus, oral aperture elliptical or linear with thin lip, an elliptic notch visible near aperture in narrow lateral view.

18. *Heleopera rosea* Penard

1890. *Heleoptera rosea* Penard. *Mem. Soc. Phys. et. Hist Nat. Geneva*, **31** : 166.

1909. *Heleopera rosea* : Cash, Wailes and Hopkinson, *British Freshwater Rhizopoda and Heliozoa*, **2** : 141.

Material examined : 2 exs., Passighat, East Siang, 7.ii.1992; 2 exs., Mayodia, Debang Valley, 19.iii.1999.

Diagnosis : Test ovoid-elongate, vinous or rose coloured, compressed, lips yellow or light brown; corners of oral aperture obtusely angular; test covered with silicious plates.

Distribution : India : Arunachal Pradesh (East Siang and Debang Valley districts) and Sikkim; in moss.

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

Genus ***Nebela*** leidy

1874. *Nebela* Leidy, *Proc. Acad. Philad.*, : 156.

Diagnosis : Test usually transparent, more or less compressed, ovate, pyriform or elongate in broad view, composed of chitinous circular or oval platelets of uniform or variable sizes.

Key to the species

1. Margin of oral aperture crenulate, test without any neck or lip ..... *N. dentistoma*

– Test with small neck, oral aperture smooth, two lateral pores present ..... *N. tincta*

19. ***Nebela dentistoma*** Penard

1890. *Nebela dentistoma* Penard, *Mem. Soc. Phys. et Hist. Nat. Geneva*, **31** : 162.

1879. *Nebela collaris* (*Partim*) Leidy, *Freshwater Rhizopods of North America*, : pl. 24, fig. 12.

Material examined : 3 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test ovoid to pyriform, compressed, without any neck, margin of aperture crenulate, test covered with small, circular, polygonal or oval transparent plates, usually of uniform size or mixed with angular plates or short rods of chitinous or silicious substance.

Distribution : India : Arunachal Pradesh (Debang Valley district) and Meghalaya; in moss.

Remarks : Das *et al.* (1995) reported this species for the first time from India from mosses in Meghalaya state. This is the second report of this species from this subcontinent and obviously the first record for Arunachal Pradesh.

20. ***Nebela tincta*** (Leidy)

1879. *Hyalosphenia tincta* Leidy, *Freshwater Rhizopods of North America* : 138.

1906. *Nebela tincta* (Leidy) Awerintzew, *St. Petersburg Trav. Soc. Nat.* **36**(2).

Material examined : 5 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test pear-shaped or slightly pyriform, compressed, transparent, with a small neck and oval aperture; test composed of polygonal, round, oval or irregular small platelets of mixed sizes; two lateral pores present.

Distribution : India : Arunachal Pradesh (Debang Valley district); in moss.

Remarks : This is a moss dwelling testacid and recorded for the first time from India.

Family ?

Genus ***Phryganella*** Penard

1902. *Phryganella* Penard, *Fauna Rhizopodigue du Leman*, Kundig, Geneva : 423.

Diagnosis : Test hemispherical, spheroidal and ovoid, with sand grains, minute diatom shells or other foreign elements, aeprture terminal, pseudopods sharply pointed and radiating.

Remarks : Deflandre (1959) placed the genus *Phryganella* under the suborder Reticulo-lobosa mainly based on the shape and nature of pseudopodia, without assigning any family for this genus. Subsequently Bonnet and Thomas (1960) followed the same classification. The same is also followed in the present work.

21. ***Phryganella acropodia*** (Hertwig & Lesser)

1874. *Difflugia acropodia* Hertwig and Lesser, *Arch. Micr. Anat.*, **10** : 107, pl. 2, fig. 6.

1902. *Phryganella hemispherica* Penard, *Fauna Rhizopodigue du bassin du Leman*, Kundig, Geneva, : 421, figs. 1-5.

1960. *Phryganella acropodia* : Bonnet and Thomas, *Fauna terrestre et d'eau douce*, 5 : 43, pl. 4, figs. 81-62.

Material examined : 6 exs., Indira Park, Itanagar, Lower Subansiri, 17.ii.1990; Rani beel, Passighat, East Siang, 12.ii.1992.

Diagnosis : Test hemispherical or subhemispherical in lateral view and circular in aperture view, yellowish or brownish, covered with amorphous scales and also with sand grains; oral aperture large without any invagination, sometimes bordered with larger grains.

Distribution : India : Arunachal Pradesh (Lower Subansiri and East Siang districts), Sikkim and West Bengal; in moss and also in bottom ooze of freshwater bodies.

Remarks : This species was reported for the first time from India by Penard (1907) from the Sikkim Himalaya and subsequently by Das *et al.* (1993; 2000) from West Bengal and Sikkim under the name *Phryganella hemispherica*.

Class FILOSEA
Order GROMIIDA
Family EUGLYPHIDAE

Diagnosis : Test composed of silicious scales or plates cemented together; body hyaline, pseudopodia filiform, often branching, sometimes anastomosing.

Key to the Genera

1. Aperture terminal 2
- Aperture subterminal 4
2. Test hyaline, aperture not bordered by any membrane 3
- Test brown or colourless, aperture bordered by an irregularly dentate membrane ..... ***Assulina***
3. Test without any collar, aperture bordered by regularly arranged serrated or denticulated scales ..... ***Euglypha***
- Test with distinct hyaline collar, denticulate or lacinate, aperture bordered by a dentate neck without scale ..... ***Tracheleuglypha***
4. Test ovoid and formed of circular imbricated silicious scales, aperture circular, oblique and invaginated ..... ***Trinema***
- Test ovoid or subcircular and formed of non-imbricated oval plates, aperture subcircular or oval and oblique ..... ***Corythion***

Genus ***Assulina*** Ehrenberg

1871. *Assulina* (*Partim*) Ehrenberg, *Abh. Akad Berlin*, 246.

1879. *Assulina* Leidy, *Freshwater Rhizopods of North America*, : 224.

Diagnosis : Test brown or colourless, ovoid, glabrous, compressed, composed of elliptical, imbricated silicious scales, arranged more or less regularly in diagonal rows; aperture oval, terminal, truncate or with a short neck, bordered by a thin chitinous finely dentate membrane.

22. ***Assulina muscorum*** Greef

1888. *Assulina muscorum* Greef, *Sitzber Ges nat Marburg*, : 117-118.

1915. *Assulina muscorum* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, 3 : 55.

Material examined : 4 exs., Indira Park, Itanagar, Lower Subansiri, 17.ii.1990; 6 exs., Sevak Pass, Lohit, 28.ii.1990; 2 exs., Deban, Changlang, 7.iii.1990; 2 exs., Passighat, East Siang, 10.ii.1992; 4 exs., Yenbung village, West Siang, 14.ii.1992; 4 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test small, 40-60 µm in length, colourless, oviform, compressed and truncate anteriorly at aperture, composed of imbricated oval scales, usually arranged in alternating diagonal rows, sometimes irregularly; aperture bordered by a thin chitinous membrane with undulate or irregularly denticulate margin.

Distribution : India : Arunachal Pradesh (Lower Subansiri, Lohit, Changlang, East Siang, West Siang and Debang Valley districts), Sikkim and Tripura; in moss.

Remarks : This species is recorded for the first time from Arunachal Pradesh.

Genus ***Corythion*** Taranek

1881. *Corythion* Taranek, *Sitzb. bohm. Ges. Wiss.*, : 232.

1915. *Corythion* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **3** : 96.

Diagnosis : Test small, ovoid or subcircular, hyaline, compressed, formed of nonimbricated oval, silicious plates; aperture subterminal, ventral or oblique, circular or oval.

Key to the species

1. Test subcircular or ovoid, aperture ventral ... . *C. dubium*

– Test oviform, aperture subterminal, oblique... .....*C. pulchellum*

23. ***Corythion dubium*** Taranek

1881. *Corythion dubium* Taranek, *Sitzb. bohm. Ges. Wiss*, : 232.

1915. *Corythion dubium* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **3** : 96.

Material examined : 6 exs., Sevak Pass, Lohit, 28.ii.1990; 4 exs., Nigam Village, Basar, West Siang, 18. ii. 1992; 10 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test ovoid, compressed unsymmetrically, aperture circular or oval, ventral, subterminal and oblique.

Distribution : India : Arunachal Pradesh (Lohit, West Siang and Debang Valley districts), Sikkim and Tripura; in moss.

Remarks : This species constitutes first record for Arunachal Pradesh.

24. ***Corythion pulchellum*** Penard

1890. *Corythion pulchellum* Penard, *Mem. Soc. Geneva*, **31** : 189.

Material examined : 8 exs., Sevak Pass, Lohit, 18.ii.1990.

Diagnosis : Test small hyaline; in broad view oviform, moderately compressed, truncate at anterior extremity; in narrow view rounded posteriorly and tapering sharply towards aperture; aperture oblique, narrowly lenticular.

Distribution : India : Arunachal Pradesh (Lohit district) and Sikkim; in moss.

Remarks : This species was found only in one moss sample and constitutes first record for Arunachal Pradesh.

Genus ***Euglypha*** Dujardin

1841. *Euglypha* Dujardin, *Zooph. Infus.*, : 251.

1962. *Euglypha* Decloitre, *Arch. Protistenkd.*, **106** : 51.

Diagnosis : Test hyaline, ovoid or elongated, circular or elliptical in transverse section, formed of circular, oval or scutiform silicious scales, arranged in alternating longitudinal rows regularly imbricated; aperture terminal brodered by serrated or denticulated scales.

Key to the species

1. Test furnished with cilia, aperture bordered by 8-14 scales, with 3-5 denticulations in each ..... *E. ciliata*

– Test without cilia or spine, aperture bordered by variable number of scales without or with one denticulate projection in each 2

2. Oral aperture bordered with one or two rows of finely serrated scales 3

– Oral aperture not bordered with serrated scales, scales of the test oval, twice as long as broad and slightly imbricated, aperture bordered by 8 non-serrated scales ..... *E. rotunda*

3. Scales of the test scutiform, aperture bordered by two rows of finely serrated scales, having 10-12 scales in each row ..... *E. scutigera*

– Scales of the test circular to broadly oval, oral aperture bordered by one or two rows of 8-10 finely serrated scales ..... *E. tuberculata*

25. ***Euglypha ciliata*** (Ehrenberg)

1848. *Difflugia ciliata* Ehrenberg, *Ber. Acad. Berlin* : 379.

1878. *Euglypha ciliata* Leidy, *Proc. Acad. Philad.*, : 172.

Material examined : 5 exs., Indira Park, Itanagar, Lower Subansiri, 17.ii.1990; 2 exs., Yembung village, West Siang, 14.ii.1992.

Diagnosis : Test oviform, compressed, furnished with short needle like cilia, emerging from margin only or distributed over the entire surface of the test; aperture oval, bordered by scales having 3 or 5 serrations in each.

Distribution : India : Arunachal Pradesh (Lower Subansiri and West Siang districts), Sikkim and Tripura; in moss.

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

26. ***Euglypha rotunda*** Wailes

1911. *Euglypha rotunda* Wailes, *Proc. roy. Irish. Acad.*, **31** : 17.

1915. *Euglypha rotunda* Cash, Hopkinson and Wailes, *The British Freshwater Rhizopoda and Heliozoa*, **3** : 31.

Material examined : 4 exs., Itanagar, Lower Subansiri, 5.ii.1992; 5 exs., Passighat, East Siang, 10.ii.1992; 4 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test oval without any spine, width of the test about half its length, aperture circular bordered by a non-serrated scales with one denticulate projection in each; scales of the test oval, about twice as long as broad, slightly imbricated, imbrication of scales of the test displaying a hexagonal and rectangular pattern on the surface.

Distribution : India : Arunachal Pradesh (Lower Subansiri, East Siang and Debang Valley districts), Meghalaya, Sikkim, Tripura and West Bengal; in moss.

Remarks : This species is very common in moss biotope and recorded for the first time from Arunachal Pradesh.

27. ***Euglypha scutigera*** Penard

1911. *Euglypha scutigera* Penard, *Proc. roy. Irish Acad.*, **31** : 41-42.

1915. *Euglypha scutigera* : Cash, Hopkinson and Wailes, *The British Freshwater Rhizopoda and Heliozoa*, **3** : 7.

Material examined : 4 exs., Indira Park, Itanagar, Lower Subansiri, 17.ii.1990.

Diagnosis : Test oviform without any cilia or spine, not compressed; aperture circular, bordered by two rows of finely serrated scales with one denticulate projection in each scale, 10-12 scales in each row; scales of the test scutiform, disposed of in alternate longitudinal rows.

Distribution : India : Arunachal Pradesh (Lower Subansiri district), Meghalaya, Tripura and West Bengal.

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

28. ***Euglypha tuberculata*** Dujardin

1841. *Euglypha tuberculata* Dujardin, *Zooph. Infus.*, **31** 251.

Material examined : 3 exs., Passighat, East Siang, 10.ii.1992; 2 exs., Nigam village, Basar, West Siang, 18.ii.1992; 5 exs., Debang Valley, 19.iii.1999.

Diagnosis : Test of medium size, elongate oviform with hemispherical crown and glabrous; the body scales circular to broadly oval in shape, oral aperture circular, devoid of neck and broadened by one or two tows of 8-10 finely serrated scales.

Distribution : India : Arunachal Pradesh (East Siang, West Siang and Debang Valley districts), Meghalaya and West Bengal; in freshwater amongst aquatic vegetation and also in moss and *Sphagnum*.

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

Genus ***Tracheleuglypha*** Deflandre

1953. *Tracheleuglypha* Deflandre, *Traite de Zoologie*, **1(2)** : 133.

Diagnosis : As in the key to the genus.

29. *Tracheleuglypha dentata* (Vejdowsky)

1832. *Euglypha dentata* Vejdowsky, *Threi. Org. Brunnenw. Prag.*, : 38-39.

1890. *Sphenodaria dentata* Penard, *Mem. Soc. Geneve*, **31**(1) : 185.

1953. *Tracheleuglypha dentata* (Vejdowsky) Deflandre, *Traite de Zoologie* **1**(2) : 133.

Material examined : 10 exs., Passighat, East Siang, 16.ii.1992; 6 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test oval or pyriform, scales of the test circular or elliptical, imbricating, often presenting a hexagonal design; aperture bordered by transparent chitinous dentate membrane drawn out into finger like processes.

Distribution : India : Arunachal Pradesh (East Siang and Debang Valley districts), Sikkim, Tripura and West Bengal; in moss.

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

Genus *Trinema* Dujardin

1841. *Trinema* Dujardin, *Zooph. Infus.*, : 249.

1915. *Trinema* : Cash, Wailes and Hopkinson, *The British Freshwater Rhizopoda and Heliozoa*, **3** : 85.

Diagnosis : Test small, hyaline, unsymmetrical, oviform or elongate, compressed anteriorly, covered with circular silicious plates, oral aperture circular, oblique or invaginated.

Key to the species

1. Test having nearly equal width in broad view, with semicircular ends; in narrow side view test tapering sharply towards aperture and covered with well marked circular plates .... *T complanatum*

– Test ovoid to elongate 2

2. Test ovoid both in broad and narrow views and covered with easily distinguishable circular plates ..... *T enchelys*

– Test elongate, small, usually homogeneous in appearance ..... *T lineare*

30. *Trinema complanatum* Penard

1890. *Trinema complanatum* Penard, *Mem. Soc. Geneve*, **31** : 187.

Material examined : 10 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test small, hyaline, having nearly equal width in broad view and tapering sharply towards the aperture in narrow side view; test formed of circular, imbricated silicious plates; aperture circular, oblique, invaginated.

Distribution : Arunachal Pradesh (Debang Valley district) and Sikkim; in moss.

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

31. **Trinema enchelys** (Ehrenberg)

1838. *Difflugia enchelys* Ehrenberg, *Infusiousthierchen* : 132.

1878. *Trinema enchelys* Leidy, *Proc. Acad. Philad.*, : 172.

Material examined : 2 exs., Indira Park, Itanagar, Lower Subansiri, 17.ii.1990; 2 exs., Passighat, East Siang, 10.ii.1992; 4 exs., Nigam village, Basar, West Siang, 18.ii.1992; 5 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test hyaline, ovoid, compressed anteriorly, covered with silicious circular plates, aperture circular, subterminal, oblique, invaginated, surrounded by very minute scales.

Distribution : Arunachal Pradesh (Lower Subansiri, East Siang, West Siang and Debang Valley districts), Meghalaya, Sikkim, Tripura and West Bengal; in freshwater amongst aquatic vegetation and in bottom ooze, also in moss.

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

32. *Trinema linere* Penard

1890. *Trinema lineare* Penard, *Mem. Soc. Geneve*, **31** : 187.

Material examined : 10 exs., Sevak Pass, Lohit, 28.ii.1990; Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Test small, hyaline, elongate, smooth, composed of small circular plates, distinguishable near the edges where they may appear as minute undulations; aperture circular, oblique, invaginated.

Distribution : India : Arunachal Pradesh (Lohit and Debang Valley districts), Sikkim, Meghalaya, Tripura and West Bengal; in freshwater amongst aquatic vegetation and in bottom ooze, also in moss.

Remarks : This species constitutes first record for Arunachal Pradesh.

Phylum CILIOPHORA
Class KINETOFRAGMINOPHOREA
Order PROSTOMATIDA

Key to the families

1. Body barrel shaped bearing armoured plates in longitudinal rows, cytostome at anterior end surrounded by slightly longer cilia ..... COLEPIDAE

– Body usually flask-shaped or flattened, with truncate anterior end, without armoured plates as above, cytostome slit-like at anterior end on nonciliated ridge ..... SPATHIDIIDAE

Family COLEPIDAE

Genus ***Coleps*** Nitzch

1817. *Coleps* Nitzch, *Neue Schrift. d. naturf. Ges. in Halle*, 3 : 3.

Diagnosis : Body barrel-shaped, cuticular surface longitudinally and transversely furrowed, forming regularly arranged quadrangular ectoplasmic plates; anterior end truncate, surrounded by teeth-like projections; posterior end rounded, often with spinous projections; cytostome apical, surrounded with slightly longer cilia.

33. ***Coleps hirtus*** (Muller)

1786. *Cercaria hirta* O. F. Muller, *Havnae et Lipsae* : 128.

1817. *Coleps hirtus* : Nitzch, *Neue Schrift. d. naturf. Ges. in Halle*, 3 : 4.

Material examined : 2 exs., Khiti village, Tirap, 13.iii.1990; Rani beel, Passighat, East Siang, 12.ii.1992.

Diagnosis : Body barrel-shaped, body length twice the body width; ectoplasmic plates 18-20 in number; posterior extremity provided with 3 spinous projections; macronucleus spherical, sub-central; contractile vacuole single, located at posterior end of the body.

Distribution : India : Arunachal Pradesh (Tirap and East Siang districts), Jammu & Kashmir, Meghalaya, Rajasthan, Sikkim, Tripura and West Bengal; cosmopolitan, in freshwater.

Remarks : This species constitutes first record for Arunachal Pradesh.

Family SPATHIDIIDAE

Genus ***Spathidium*** Dujardin

1841. *Spathidium* Dujardin, *Histoire Naturelle des Zoophytes Infusoires*, Paris, : 678.

1930. *Spathidium* : Kahl, *Urtiere order Protozoa* (in Dahl's *Tierwelt Dtsch*.). Jena, pt. 18 : 149.

Diagnosis : Flask or sack-shaped, compressed, anterior part slightly narrowed into a neck and truncate, cytostome slit-like, occupying whole of anterior end, ciliation uniform, contractile vacuole posteriorly located.

34. ***Spathidium muscicola*** Kahl

1930. *Spathidium muscicola* Kahl, *Arch. Protistenkd*, 70 377.

Material examined : 4 exs., Deban, Changlang, 7.iii.1990; 3 exs., Itanagar, Lower Subansiri, 5.ii.1992; 3 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Body flask-shaped with truncate anterior end; cytostome narrow, slit-like, occupying anterior end almost completely; macronucleus long, band-shaped, posterior portion of which often recurved.

Distribution : India : Arunachal Pradesh (Changlang, Lower Subansiri and Debang Valley districts), Sikkim, Tripura and West Bengal; in ground and rock mosses.

Remarks : This species is found only in moss biotopes and recorded for the first time from Arunachal Pradesh.

Order PLEUROSTOMATIDA
Family AMPHILEPTIDAE

Diagnosis : Body lanceolate, contractile, cytostome slit-like, located on the convex border of the anterior part of the body.

Genus ***Loxophyllum*** Dujardin

1841. *Loxophyllum (Partim)* Dujardin, *Histoire nat. des. zoophytes infusoires*, Paris : 467.

Diagnosis : Body contractile and flexible, leaf-like, flattened, asymmetrical, pointed at both anterior and posterior ends, ventral side with a hyaline border, extending up to posterior end; macronucleus a single mass or moniliform.

35. ***Loxophyllum niemeccense*** (Stein)

1859. *Opisthodon niemenccense* Stein, *Der Organismus der Infusionsthier*, Leipzig, 1.

Material examined : 2 exs., Itanagar, Lower Subansiri, 18.ii.1990; 2 exs., Yembung village, Along, West Siang, 14.ii.1992.

Diagnosis : Body flat, leaf-like, anterior end acuminate, posterior end somewhat blunt; macronucleus a single mass or moniliform, contractile vacuole one to many.

Distribution : India : Arunachal Pradesh (Lower Subansiri and West Siang districts), Orissa, Sikkim and West Bengal; in freshwater.

Remarks : This species is recorded for the first time from Arunachal Pradesh.

Order TRICHOSTOMATIDAE
Family PLAGIOPYLIDAE

Diagnosis : Body flattened, ciliation uniform, cytostome central at the end of peristome, located in the anterior half of the body.

Genus ***Plagiopyla*** Stein

1860. *Plagiopyla* Stein, *Sitz. Ber. bohn. Ges. Wiss.*, Prague : 57.

Diagnosis : Body elongated oval, flattened; a peristomial groove running transversely from about anterior fourth of ventral surface at right margin and provided with thicker cilia along both margins; cytopharynx at the end of peristome and long; a peculiar "stripe band" loated on dorsal surface; macronucleus rounded and contractile vacuole terminal.

36. ***Plagiopyla nasuta*** Stein

1860. *Plagiopyla nasuta* Stein, *Sitz., Ber. bohn. Ges. Wiss.*, Prague : 58.

Material examined : 3 exs., Rani beel, Passighat, East Siang, 12.ii.1992; 2 exs., Yembung village, West Siang, 14.ii.1992.

Diagnosis : Body reniform or ovoid, narrower anteriorly; cytostome situated near median line at the end of peristome, cytopharynx long; macronucleus round, contractile vacuole single and terminal.

Distribution : India : Arunachal Pradesh (East and West Siang districts), Orissa and West Bengal; in fresh and brackish water.

Remarks : This species constitutes first record for Arunachal Pradesh.

Order COLPODIDA
Family COLPODIDAE

Diagnosis : Body typically reinform with distorted ciliary rows; no conspicuous ciliary tuft present at anterior end.

Genus ***Colpoda*** O. F. Muller

1773. *Kolpoda* O. F. Muller, *Verminum Terrestrium et Fluviatilium seu Animalium Infusorium*, etc., Havniae et Lipsae, : 56-57.

1791. *Colpoda* Gmelin, *Systema Naturae* (ed 13), 1 : 3894.

Diagnosis : Body kidney shaped, laterally flattened, anterior end rounded, twisted from left to right and curved on ventral surface; cytostome located at ventral depression, leading into peristomeal cavity and giving rise to a diagonal groove at dorsal side; a ciliated area present in right edge of cytostome.

37. *Colpoda cucullus* (Muller)

1773. *Kolpoda cucullus* O. F. Muller, *Verminum Terrestrium et Fluviatilium seu Animalium Infusorium*, etc., Havnae et Lipsiae, : 58.

1838. *Colpoda cucullus* Ehrenberg, Die infusionsthierchen als Volkammene Organismen, Leipzig, : 347.

Material examined : 4 exs., Itanagar, Lower Subansiri, 18.ii.1992; 2 exs., Deban, Changlang, 9.iii.1990; 2 exs., Yembung village, West Siang, 14.ii.1992.

Diagnosis : Body typically kidney-shaped, cytostome located about the middle of the body; frontal dentations 8-10, meridians 29-34; macronucleus oval, contractile vacuole single and posterior.

Distribution : India : Arunachal Pradesh (Lower Subansiri, Changlang and West Siang districts), Andhra Pradesh, Assam, Jammu & Kashmir, Karnataka, Maharashtra, Madhya Pradesh, Meghalaya, Orissa, Punjab, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

Remarks : This species commonly occurs in freshwater, soil and ground mosses in India. It has been recorded from the ground mosses of Arunachal Pradesh and it constitutes first report for this state.

Class OLIGOHYMENOPHOREA
Order HYMENOSTOMATIDA
Family GLAUCOMIDAE

Key to the families

1. Oral ciliature characterised by peniculi located deep in buccal cavity, often with ciliated vestibule 2

– Tetrahymenal oral ciliature inconspicuous, vestibule seldom present, buccal cavity large, infraciliary base of second or third membranellae much wider. ..... GLAUCOMIDAE

2. Prebuccal cavity or "vestibulum" conspicuous leading to equatorially located buccal cavity; two peniculi in buccal cavity, cytostome not expansible, contractile vacuole two ..... PARAMECIIDAE

– Prebuccal areas shallow or absent, three peniculi in buccal cavity, cytostome expansible, contractile vacuole single ..... FRONTONIIDAE

Genus *Glaucoma* Ehrenberg

1830. *Glaucoma* Ehrenberg, *Abhandl. d. Konigl. Akad. d Wissensch. zu Berlin*, a. d. j., 1830 (1832) : 42.

Diagnosis : Body ellipsoid, cytostome near anterior end, extending about one-fourth of the length of the body and with conspicuous undulating membrane on right and three membranellae on left.

38. *Glaucoma pyriformis* (Ehrenberg)

1838. *Leucophrys pyriformis* Ehrenberg, *Die Infusionthierchen als Vollkommene Organismen*. 312-313.

1889. *Glaucoma pyriformis* (Ehrenberg) Schewiakoff, *Biblioth. Zoolog.* (Leuckart u. Chun), 5 : 35.

Material examined : 4 exs., Khiti village, Tirap, 13.iii.1990; 5 exs., Rani beel, Passighat, East Siang, 12.ii.1992.

Diagnosis : Body pear-shaped, narrowed but rounded anteriorly, cytostome near anterior fourth of the body, oval, elongated in the direction of long axis of the body and not obliquely placed; cytopharynx short, provided with finger-shaped, protrusible undulating membrane, contractile vacuole single, located near posterior end of the body; macronucleus rounded and more or less centrally placed.

Distribution : India : Arunachal Pradesh (Tirap and East Siang districts), Jammu & Kashmir and West Bengal; in freshwater.

Remarks : This species is recorded for the first time from Arunachal Pradesh.

Family PARAMECIIDAE
Genus *Paramecium* Hill

1752. *Paramecium* Hill, *History of Animals including the several classes of Animalcula visible only by the assistance of microscope*, vol. 3, *Complete book of Natural History*, Osborn, London, : 584.

Diagnosis : Body cigar-shaped, peristome long, broad and slightly oblique, cytopharynx moderately long with a row of very fine cilia attached to its dorsal wall.

39. ***Paramecium bursaria*** (Ehrenberg)

1833. *Loxodes bursaria* Ehrenberg, *Abhandl., d. Konigl. Akad. Berlin, a. d. j.*, : 238.

1836. *Paramecium bursaria* (Ehrenberg) Focke, *Isis*, : 786.

1936. *Paramecium bursaria* (Ehrenberg) : Bhatia, *Fauna of British India including Ceylons and Burma : Protozoa : Ciliophora*, : 148, Taylor and Francis Ltd., London.

Material examined : 2 exs., Khiti village, Tirap, 13.iii.1990; Yembung village, Along, West Siang district, 19.ii.1992.

Diagnosis : Body foot-shaped, compressed, little more than twice as long as broad, rounded and wide posteriorly, narrowest and obliquely truncate at anterior extremity; peristomeal groove flat, infundibulate, very wide anteriorly, extending obliquely from left to right beyond the middle of the body; cytoplasmic layer blue with numerous zoochlorellae; macronucleus oval with a relatively large compact, micronucleus lying close to it, contractile vacuoles two in number.

Distribution : India : Arunachal Pradesh (Tirap and West Siang districts), Jammu & Kashmir and Sikkim; in stagnant water.

Remarks : This species constitutes new record for Arunachal Pradesh.

Family FRONTONIIDAE

Genus ***Frontonia*** Ehrenberg

1838. *Quarsaria (Partim)* Ehrenberg, *Die Infusionsthierchen als Volkommene Organismen*, Leipzig, : 325.

1838. *Frontonia* subgenus, Ehrenberg, *ibid.* : 329.

1858. *Frontonia* Claparede and Lachmen, *Etudes sur les infusoires et les rhizopodes*, Geneve, : 259-260.

Diagnosis : Body ellipsoid with both ends rounded; cytostome lying in the anterior third of the ventral surface; large undulating membrane in the left oral margin; macronucleus oval or ellipsoidal, central and obliquely placed, contractile vacuole single, centrally located, with or without radiating canal.

40. ***Frontonia leucas*** (Ehrenberg)

1838. *Bursaria leucas* Ehrenberg, *Die Infusionsthierchen als Volkommene Organismen*, Leipzig, : 329.

1858-61. *Frontonia leucas* (Ehrenberg) Claparede and Lachman, *Etudes sur les infusoires et les rhizopodes*, Geneva, : 259-260.

Material examined : 4 exs., Rani beel, Passighat, East Siang, 12.ii.1992.

Diagnosis : Body elongated or ovoid, rounded at both ends, cytostome carrying three rows of cilia; post oral groove extending to posterior part of the body; macronucleus ellipsoid with several macronuclei; contractile vacuole single with long radiating canals and located at the middle of the body.

Distribution : India : Arunachal Pradesh (East Siang district), Jammu & Kashmir, Maharashtra, Meghalaya, Orissa, Rajasthan, Tripura and West Bengal; in freshwater.

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

Class POLYMENOPHOREA

Order HETEROTRICHIDA

Family METOPIDAE

Diagnosis : Anterior part of the body uniquely twisted to left and posterior part sometimes tailed and/or bearing tuft of longer cilia.

Genus : ***Metopus*** Claparede and Lachmann

1888. *Metopus* Claparede and Lachmann, *Mem. Inst. Nat. Genevois*, **5** : 1.

1932. *Metopus* Kahl, *Urtiere order Protozoa* (in Dahl's *Tierwelt Dtsch.*), Jena, pt. **25** : 405.

Diagnosis : Body elongated asymmetrical due to tortion at anterior left, band-like anterior peristome never spiralling; cytostome sub-anterior or subequitorial, anterior body part shorter than or equal to posterior body part.

41. *Metopus es* Muller

1786. *Metopus es* Muller, O. F. *Animalcula infusoria fluviatilia et marina, etc., historia*, Havnae et Lipsae, : 126,

1932. *Metopus es* : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.*), Jena, pt. **25** : 416.

Material examined : 4 exs., Passighat, East Siang, 10.ii.1992.

Diagnosis : Body characteristically sigmoid (S-like), comparatively large and slender, cytostome colourless, pellicular striations prominent, macronucleus single and sausage-shaped, contractile vacuole single, terminal and without any raising edge.

Distribution : India : Arunachal Pradesh (East Siang district), Andhra Pradesh, Meghalaya, Orissa, Rajasthan, Sikkim, Tripura and West Bengal; in freshwater.

Remarks : This species constitutes first record for Arunachal Pradesh.

Order HYPOTRICHIDA
Family EUPLOTIDAE

Diagnosis : Ventral cirri typically heavy and conspicuous and arranged in specific localised groups; marginal cirri absent or greatly reduced in number, transverse and frontoventral cirri often tremendously developed, heavy and very conspicuous, oral ciliature prominent, usually extending more than half the length of the body.

Genus *Euplotes* Ehrenberg

1830. *Euplotes* Ehrenberg, *Abhandl. d. Konigl. Akad. d. Wissensch. zu Berlin a. d.* j., 1830 (1832), : 118.

1932. *Euplotes* : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.*), Jena, pt. **25** : 628.

Diagnosis : Body ovoid, peristome well developed and broadly triangular, ventral surface flattened, dorsal surface convex, longitudinally ridged; fronto-ventral cirri more than nine, anal cirri well developed and five in number, caudal cirri four and scattered.

Key to the species

1. Body oval, elongated and macronucleus in the form of inverted 'C' ..... *E. muscicola*

– Body ellipsoid and macronucleus '3' - shaped ..... *E. plumipes*

42. *Euplotes muscicola* Kahl

1932. *Euplotes muscicola* Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.*) Jena, pt. **25** : 637.

1960. *Euplotes muscicola* : Tuffrau, *Hydrobiol.*, **15** : 45.

Material examined : 2 exs., Indira Park, Itanagar, Lower Subansiri, 17.ii.1990; 4 exs., Myodia, Debang Valley, 19.iii.1999.

Diagnosis : Body oval, elongated, peristome narrow, extending up to about three-fourth of anterior left of the ventral surface of the body; peristomeal lip slender and rectilinear; dorso-lateral cirri 10, frontoventral cirri 9, transverse cirri 5 and caudal cirri 4; macronucleus in the form of inverted 'C', angular and somewhat closed.

Description : India : Arunachal Pradesh (Lower Subansiri and Debang Valley districts), Sikkim and Tripura; in ground moss.

Remarks : This is a moss inhabiting ciliate and reported for the first time from Arunachal Pradesh.

43. *Euplotes plumipes* Stokes

1884. *Euplotes plumipes* Stokes, *Amer. mon. micr J* Washington, **5** : 229.

Material examined : 2 exs., Rani beel, Passighat, East Siang, 12.ii.1992.

Diagnosis : Body ellipsoid, ventral surface sufficiently plain, dorsal surface feebly convex, with protruding neck; peristome triangular, extending up to about three-fourth of the middle of dorsal surface of the body, dorsolateral cirri 10, frontoventral cirri 9, transverse cirri 5 and caudal cirri 4; macronucleus '3' shaped.

Distribution : India : Arunachal Pradesh (East Siang district), Rajasthan and West Bengal; in freshwater.

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

B. Parasitic Protozoa

Phylum SARCOMASTIGOPHORA
Subphylum MASTIGOPHORA
Class ZOOMASTIGOPHOREA
Order KINETOPLASTIDA
Family TRYPANOSOMATIDAE

Diagnosis : Body characteristically leaf-like with a single flagellum attached to the body by undulating membrane, kinetoplast relatively small and compact.

Genus ***Trypanosoma*** Gruby

1843. *Trypanosoma* Gruby, *C. R. Acad. Sci.*, **17** : 1134.

Diagnosis : Body flattened, leaf-like, pointed at flagellar end and bluntly rounded or pointed at opposite end; flagellum arising from a blepharoplast running towards opposite end and making the outer boundary of the undulating membrane; polymorphism common; parasitic in the circulatory system of the vertebrates.

Remarks : Only one species of this genus *T. rotatorium* has been collected from Arunachal Pradesh from the frog *Rana limnocharis*.

44. ***Trypanosoma rotatorium*** (Mayer)

1843. *Amoeba rotatorium* Mayer, *Des haematozoaires*, Ph. D. Thesis.

1901. *Trypanosoma rotatorium* Laveran and Mesnil, *C.R. Soc. Biol.*, **53** : 678.

Material examined : Sev. exs., Jyotsnapur village, Changlang, 4.iii.1990.

Diagnosis : Trypomastigote form Pleomorphic with 2-3 longitudinal striations and densely granular cytoplasm in the posterior two-thirds of the body; length of the cell body 29-34 µm.

Host : *Rana limnocharis*; site of infection : blood.

Distribution : India : Arunachal Pradesh (Changlang district), Andaman, Orissa, Goa, Meghalaya, Tripura and West Bengal. Elsewhere : cosmopolitan.

Remarks : *T rotatorium* occurs in several species of frogs and toads. However, in Arunachal Pradesh this species is recovered only from the blood samples of *Rana limnocharis*.

Order DIPLOMONADIDAE
Family HEXAMITIDAE

Diagnosis : Body with two-fold rotational symmetry or bilateral symmetry, karyomastigonts two in number, each mastigont with 4 flagella, one of them recurrent.

Genus ***Giardia*** Kuntsler

1882. *Giardia* Kuntsler, *C. R. Acad. Sci.*, **95** : 347.

Diagnosis : Body pyriform to ellipsoid with anterior end broadly round and posterior end drawn out, bilaterally symmetrical, ventral side with a sucking disc in anterior half, 2 anterior nuclei, 2 slender axostyles and 8 flagella arranged in 4 pairs.

45. ***Giardia lamblia*** Stiles

1915. *Giardia lamblia* Stiles : Boeck and Stiles, 1923, *Studies on various intestinal parasites (especially amoebae) of man*. Bull No. 133 Hyg. Lab., Washington.

Diagnosis : Trophozoite broadly pyriform, dimensions 9-20 µm x 5-10 µm, axostyle needle like, nuclei vesicular and located near anterior margin.

Host : Man, monkeys and pig; site of infection : duodenum, jejunum and upper small intestine.

Distribution : India : Arunachal Pradesh (in all districts); cosmopolitan.

Remarks : This species causes giardiosis in man.

Class OPALINATEA
Order OPALINIDA
Family OPALINIDAE

Diagnosis : Numerous cilia in oblique longitudinal rows over the entire body surface;

cytostome absent, nucleus of one kind ranging from one to many.

Key to the genera

1. Body highly flattened, multinucleate, ellipsoidal in cross section ..... ***Opalina***

– Body cylindrical or pyriform, multinucleate, circular in cross section ..... ***Cepedia***

Genus ***Cepedia*** Metcalf

1920. *Cepedia* Metcalf, *Science*, **52** : 135.

Diagnosis : As in the key.

46. ***Cepedia lanceolata*** (Bezzenberger)

1904. *Opalina lanceolata* Bezzenberger, *Arch. Protistenkd.*, **3** : 165.

1923. *Cepedia lanceolata* Metcalf, *Bull. U. S. Nat. Mus.*, **120** : 137.

Material examined : 4 exs., New Yum Chum, Changlang, 6.iii.1990.

Diagnosis : Body ovoid with anterior end rounded and posterior end elongated into a slender tapering point; lenght of present specimens 90-98 µm, maximum width 25-30 µm; nuclei large, irregularly spherical, generally four, occasionally five in number, lying one behind other in an axial row.

Host : *Rana cyanophlyctis*; site of infection : rectum.

Distribution : India : Arunachal Pradesh (Changlang district).

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

Genus ***Opalina*** Purkinje and Valentin

1835. *Opalina* Purkinje and Valentin, *De Phaemomenogenerali et et fundamentali, etc.*, Bratislaviae : 43.

1923. *Opalina* : Metcalf, *Bull. U. S. Mus.*, **120** : 175.

Diagnosis : As in the key.

47. ***Opalina lata*** Bezzenberger

1904. *Opalina lata* Bezzenberger, *Arch. Protistenkd.*, **3** : 166.

Material examined : 10 exs., Zerogaon, Lohit, 27.ii.1990.

Diagnosis : Body oval, anterior half more or less triangular, dimensions 235-290 µm x 180-220 µm, greatest width near the middle of the body; muclei numerous.

Host : *Rana cyanophlyctis*; site of infection : intestine and rectum.

Distribution : Arunachal Pradesh (Lohit district), Goa and Meghalaya.

Remarks : Some individuals of this species with anterior end narrower and, posterior end broader and rounded are also observed. These forms resemble *Opalina lata* var. *cordata*, described by de Mello (1932) from the intestine of *Rana malabarica* and *R. cyanophlyctis* collected from Goa.

Phylum APICOMPLEXA
Class SPOROZOEA
Order EUCOCCIDA

Key to the families

1. Sporozoites typically enclosed in sporocyst within oocyst, zygote non-motile, homoxenous, merogony and gamogony within hosts, sporogony typically outside, sporozoites never in blood cell ..... EIMERIIDAE

– Sporozoites naked, with three membrane wall, zygote motile (ookinete), sexual phase in mosquito and asexual cycle in tissue and blood cells of vertebrate hosts, distinguished by erythrocytic schizogony .... PLASMODIIDAE

Family EIMERIIDAE

Key to the genera

1. Each oocyst with two sporocysts and each sporocyst with four sporozoites ..... ***Isospora***

– Each oocyst with four sporocysts and each sporocyst with two sporozoites ..... ***Eimeria***

Genus *Eimeria* Schneider

1875. *Eimeria* Schneider, *Arch. zool. Exp. Gen.* **4** : 493.

Diagnosis : Each oocyst with four sporocysts, each sporocyst with two sporozoites; merogony intracellular, sporogony extracellular, occurring in vertebrates, only a few in invertebrates.

Remarks : So far 9 species of *Eimeria* have been collected/reported from Arunachal Pradesh. Out of these, 3 species have been found in the faecal samples of birds and 6 species in those of mammals.

Eimeria from bird hosts

Key to the species

1. Oocyst oval, thin walled, measuring 24-30 µm x 18-24 µm in dimensions ..... *E. brunetti*

– Oocyst broad-ovoid, smooth and double-walled 2

2. Oocyst measuring 15.5-25.0 µm x 10.5-20 µm in dimension, micropyle and oocystic residuum absent ..... *E. necatrix*

– Oocyst measuring 19-26 µm x 16-22 µm in dimension, micropyle present but oocystic residuum absent ..... *E. tenella*

48. *Eimeria brunetti* Levine

1942. *Eimeria brunetti* Levine, *Cornell Vet.*, **32** : 430.

Diagnosis : Oocyst oval, thin walled, 24-30 (26.5) µm in length and 18-24 (20.8) µm in width, sporocysts 11-16 µm x 5-10 µm in dimensions; in sporulated oocyst polar granules present but no residual body formed.

Host : Domestic fowl, *Gallus domesticus*; site of infection : intestine.

Distribution : India : Arunachal Pradesh (Lohit, Tirap, Subansiri, Changlang, East Siang and West Siang districts), Madhya Pradesh and Uttar Pradesh.

Remarks : This species is pathogenic for domestic fowl and causes heavy mortality. Desease Investigation Laboratory at Itanagar, recorded this species from above localities.

49. *Eimeria necatrix* Johnson

1930. *Eimeria necatrix* Johnson, *Ore agric. Exptl. St.*, : 119.

Diagnosis : Oocyst broad-ovoid, smooth and double contoured, measuring 15.5-25.0 (20.3) µm x 10.5-20.0 (16.5) µm, micropyle and oocystic residuum absent; sporocysts elongated, measuring 10 µm x 6 µm, polar body present; first generation schizonts 17.1 µm x 12.9 µm, producing 48 merozoites; second generation schizonts 63 µm x 49 µm, producing 32-132 merozoites; macrogametocyte measuring 13.1 µm x 12.6 µm.

Host : Domestic fowl, *Gallus domesticus*; site of infection : intestine.

Distribution : India : Arunachal Pradesh (Lower Subansiri), Lohit, Changlang, East Siang, West Siang and Tirap districts), Tamil Nadu, Uttar Pradesh.

Remarks : Oocysts of *E. necatrix* bear a close resemblance to those of *E. tenella* but they are more stocky with one end less pointed. *E. necatrix* coccidiosis is frequently associated with tenella - coccidiosis, Disease Investigation Laboratory at Itanagar has recorded this species from above localities.

50. *Eimeria tenella* (Railliet and Lucet)

1891. *Eimeria avium* acut, *Coccidium tenellum* Railliet and Lucet, *Bull. Soc. zool. Fr.*, **16** : 246.

1909. *Eimeria tenella* Fantham. *Proc. zool. Soc. London*, **14** : 43.

Diagnosis : Oocyst broad ovoid measuring 19-26 µm x 16.22 µm, oocystic wall smooth, double-contoured, residuum absent, micropyle present, sporocyst long, 11 µm x 7 µm, with a stieda body, sporocystic residuum granular; sporozoite elongated, comma shaped, 5-9 µm in length.

Host : Domestic fowl, *Gallus domesticus*; site of infection : intestine.

Distribution : India : Arunachal Pradesh (Lower Subansiri, Lohit, Changlang, East Siang, Tirap and West Siang districts), Madhya Pradesh, Uttar Pradesh, Tamil Nadu, West Bengal. Elsewhere : Bangladesh; cosmopolitan.

Remarks : *E. tenella* coccidiosis affects the cacea, causing high mortality due to diarrhoea and extensive capillary bleeding in the caecal wall. Disease Investigation Laboratory at Itanagar has recorded this species from above localities.

Eimeria from mammalian hosts

Key to the species

1. oocysts spherical, subspherical or bluntly ellipsoidal, 14-22 µm x 13-19 µm in dimensions, oocystic wall double layered, smooth, light yellowish green ..... *E. zuernii*

– Oocysts ellipsoidal to ovoid, rough or smoth 2

2. Oocyst ellipsoidal to ovoid, 27-32 µm x 19-24 µm in dimensions, oocystic wall double layered, with a rough pigmented brown outer layer and smooth brownish yellow inner layer .... *E. scabra*

– Oocysts more or less of same shape as above, oocystic wall double layered but outer wall not rough 3

3. Oocysts broadly ovoid with a narrower micropylar end, 23-33 µm x 15-26 µm in dimensions ..... *E. bovis*

– Oocysts ellipsoidal to ovoid with varying dimensions 4

4. Parasitic in domestic pig, oocysts double walled with inner one yellowish brown, 20-29 µm x 14-20 µm in dimensions .... *E. debliecki*

– Parasitic in cattle and rabbit 5

5. Oocyst ellipsoidal to ovoid, 15-26 µm x 12-16 µm in dimensions, oocyst wall double layered, parasitic in cattle ..... *E. ellipsoidalis*

– Oocyst ovoidal to ellipsoidal with micropylar end slightly narrower, 26-40 µm x 16-24 µm in dimensions, oocyst wall thin, parasitic in rabbit ..... *E. stiedai*

51. *Eimeria bovis* (Zublin)

1908. *Coccidium bovis* Zublin (*partim*). *Schweizere Arch. Treiherlk.*, **50** : 123.

1912. *Eimeria bovis* Fiebiger. *Dike Tierischen Parasiten der haus und Nutztiere. Ein Lehrund Handbuch mit Bestimmungstabellen fur Tierarzte und Studierende*. Wein und Lepzing : xvi + 424 pp.

Diagnosis : Oocyst ovoid, 23-33 (28) µm x 15-26 (21) µm in size, with a micropyle at the narrower end, oocystic wall smooth, double layered, residuum and polar granules absent; sporocyst elongated ovoid, 15-17 µm, with a stieda at the narrower end, sporocystic residuum present; sporozoite elongated, banana-shaped, measuring 13 µm x 3 µm in size.

Host : Cattle, *Bos indicus*; site of infection : intestine.

Distribution : India : Arunachal Pradesh (West Kameng, East Kameng, Lower Subansiri, Lohit, Tirap, Changlang, East Siang and West Siang districts), Bihar, Haryana, Maharastra and Uttar Pradesh.

Remarks : Disease Investigation Laboratory at Itanagar has recorded this species from aboove lcalities.

52. *Eimeria debliecki* Douwes

1921. *Eimeria debliecki* Douwes. *Bijdrage tt de Kennis van enkele darmprotozoen der huisdieren in het bijzonder bij schaap en varken. Disc*. Utrecht

Diagnosis : Oocyst ellipsoidal ovoid, 20.2-24.2 µm x 14.20-16.8 µm, smooth walled, micropyle absent, polar granules present, sporocyst elongate ovoid, 13-16 µm x 6-7 µm, sporocystic residuum present, sporozoites elongated.

Host : Domestic pigs (yung ones), *Sus scrofa*, site of infection : intestin.

Distribution : India : Arunachal Pradesh (West Kameng, East Kameng, Tirap, Lower Subansiri, Lohit, Changlang, East Siang and West Siang districts), Madhya Pradesh and Uttar Pradesh.

Remarks : *E. debliecki* commonly occurs in domestic pigs and usually causes severe diarrhoea preceded by mass-shedding of oocysts. In addition to *E. debliecki* Disease Investigation Laboratory, at Itanagar has also recorded *E. suis* and *E. scrofa* from domestic pigs of this state from above localities. These two species are now considered synonyms of *E. debliecki* (Mandal, 1987).

53. ***Eimeria ellipsoidalis*** Becker and Frye

1929. *Eimeria ellipsoidalis* Becker and Frye, *J. Parasit.*, **15** : 175.

Diagnosis : Oocyst ellipsoidal to slightly ovoid, measuring 15-26 (20) µm x 12-16 (14) µm in size, double layered, micropyle present, micropylar cap, residuum and polar granule absent; sporocyst elogate ovoid, 10-13 µm x 5-6 µm, single layered, stieda body barely perceptible; sporozoite elongated, banana-shaped, 11 µm x 2.6 µm in size.

Host : Indian cattle, *Bos indicus*; site of infection : intestine.

Distribution : India : Arunachal Pradesh (West Kameng, East Kameng, Lower Subansiri, Lohit, Tirap, Changlang, East Siang and West Siang districts), Haryana and Uttar Pradesh.

Remarks : *E. ellipsoidalis* causes diarrhoea in calves. Disease Investigation Laboratory recorded this species from above localities.

54. ***Eimeria scabra*** Henry

1931. *Eimeria scabra* Henry, *Univ. Calif. Publ. Zool.*, **36** : 115.

Diagnosis : Oocyst ellipsoidal to ovoid, measuring 27-35 µm in length and 19-25 µm in width; wall bilayered, outer layer thick, rough, brown and pigmented with radial striations and inner layer smooth, brownish yellow; micropyle present, micropylar cap and oocystic residuum absent; sporocyst ovoid 14-18 µm x 7-8 µm, a stieda body and sporocystic residuum present; sporozoite elongated.

Host : Domestic pig, *Sus scrofa*; site of infection : intestine.

Distribution : India : Arunachal Pradesh (West Kameng, East Kameng, Lower Subansiri, Lohit, Changlang, East Siang and West Siang districts), Bihar, Madhya Pradesh, Orissa and Uttar Pradesh.

Remarks : *E. scabra* coccidiosis may cause death due to massive infestation as well as reduction in the host's natural resistance. Disease Investigation Laboratory at Itanagar has recorded this species from above localities.

55. ***Eimeria stiedai*** (Lindeman)

1865. *Monocystis stiedae* Lindeman, *Bull. Soc. Imp. nat. Moscow*, **38** : 381.

1907. *Eimeria stiedai* Kisskaft and Hartmann, *Practicum der Bakteriologie Protozoologie*, Jena.

Material examined : Sev. exs., Itanagar Zoo, Itanagar, Lower Subansiri, 18.ii.1990.

Diagnosis : Oocyst ovoidal to ellipsoidal, 26-40 (35) µm x 16-24 (21) µm, micropyle present, micropylar end of oocyst slightly narrower, oocystic residuum absent; sporocyst ovoid to ellipsoid, 17 µm x 9 µm, sporocystic residuum present.

Host : Rabbit, *Oryctolagus* sp.; site of infection : intestine.

Distribution : India : Arunachal Pradesh (Lower Subansiri district), Jammu & Kashmir, Punjab and Uttar Pradesh.

Remarks : *E. stiedai*, in general, causes hypertrophy of liver.

56. ***Eimeria zuernii*** (Rivolta)

1878. *Cryptospermium zuernii* Rivolta, *Geor. Anat. Fisiol. Patol. Anim.*, Pisa, **4** : 220.

1909. *Eimeria zuernii* Martin, *Rev. Vet.* (Toulouse), **34** : 201.

Diagnosis : Oocyst elliptical to subpherical or bluntly ellipsoidal, 14-22 (17) µm, smooth, double layered, light yellowish green, micropyle, residuum and polar granules absent; sporocyst elogate-ovoid, 8-10 µm by 5-7 µm, stieda body and residuum present; sporozoite 9 µm x 3 µm with a refractile globule.

Host : Cattle (especially young livestock), *Bos indicus*; site of infection : intestine.

Distribution : India : Arunachal Pradesh (West Kameng, East Kameng, Lower Subansiri, Lohit, Changlang, East Siang and West Siang districts), Haryana, Orissa and Uttar Pradesh.

Remarks : *E. zuerni* is pathogenic and most frequently causes coccidiosis in bovines. Disease Investigation Laboratory at Itanagar has recorded this species from above localities.

Genus ***Isospora*** Schneider

1881. *Isospora* Schneider, *Arch. Zool. Exp. Gen.*, 9 : 387.

Diagnosis : Each oocyst with sporocysts and each sporocyst with four sporozoites.

Remarks : One species of *isospora*, namely, *I. suis* has been reported from this state.

57. ***Isospora suis*** Biester and Murray

1943. *Isospora suis* Biester and Murray, *J. Am. Vet. med. Ass.*, **85** : 207.

Diagnosis : Oocyst subspherical, 20-34 (22) µm x 18-21 (19.5) µm, double layered, micropyle and oocystic residuum absent; sporocyst elliptical to cylindrical, 16-18.6 (18) µm x 10-12 (11) µm and each sporocyst with 4 sporozoites.

Host : Domestic pig, *Sus scrofa*; site of infection : intestine.

Distribution : India : Arunachal Pradesh (East Kameng, West Kameng, Lower Subansiri, Lohit, Changlang, East Siang and West Siang districts), Orissa and Uttar Pradesh.

Remarks : *I. suis* does not cause any severe disease but it retards the animal's development to some extent. This species is also recorded by the Disease Investigation Laboratory at Itanagar from the above localities.

Family PLASMODIIDAE

Genus ***Plasmodium*** Marchiafava and Celli

1885. *Plasmodium* Marchiafava and Celli, *Rif. Med.*, Naples. No. **214** : 737.

Diagnosis : Trophozoites ring-shaped, amoeboid in erythrocytes, schizonts (meregony) in erythrocytes and also in various other tissues depending on the species; hemozoin pigment visible with the light microscope usually formed; vectors mosquitoes and phlebotomin flies, parasitic in mammals, birds and reptiles.

Key to the species

1. A sexual cycle in tissue and blood cells of birds, gametocytes round, mature segments with 8-32 merozoites ..... *P. relictum*
   - A sexyal cycle in tissue and blood cells of mammals 2
2. Gametocytes crescent-shaped, infected gametocytes normal or atrophied .... *P. falciparum*
   - Gametocytes round or oval, infected erythrocytes hypertrophied ..... *P. vivax*

Plasmodium of birds

58. ***Plasmodium relictum*** (Grassi and Feletti)

1891. *Haemamoeba relicta* Grassi and Feletti, *Bull. mens Acad. gionia Sci. nat. Catania*, **16** : 16.

1966. *Plasmodium relictum* (Grassi and Feletti) : Garnham : *Malaria parasites and other Haemosporidia*, Blackwall Scientific Publications, Oxford : 522

Material examined : Sev. exs., Zerogaon, Lohit, 27.ii.1990.

Diagnosis : Gametocytes round or oval, pigmented, marked displacement of host cell nucleus; schizonts round with 8-32 merozoites; ring stages in immature reds cells; erythrocytic stages in the peripheral blood.

Host : *Columba livia*; site of infection : tissue and blood cells.

Distribution : India : Arunachal Pradesh (Lohit district) and West Bengal.

Remarks : *P. relictum* is a common avian malarial parasite occurring in a wide range of bird species. However, in Arunachal Pradesh this species has been recovered from the blood smears drawn from various organs of pigeon, *Columba livia*.

Plasmodium of mammals

59. ***Plasmodium falciparum*** (Welch)

1897. *Haepatozoon falciparum* Welch, *Syst. Pract. Med.*, 1 : 17.

1996. *Plasmodium falciparum* (Welch) : Garnham : *Malaria Parasites and other haemosporidia*, Blackwell Scientific Publications, Oxford, : 357.

Diagnosis : Ring forms small, trophozoite rare and compact, schizont irregular, 8-32 merozoites, gametocyte cresent shaped, macrogametocyte 12-14 µm long, no hypertrophy of host erythrocyte,

erythrocytic schizogony at 48 hours interval, paroxysms of chills and fever at every other day.

Host : Man, *Homo sapiens*, site of infection : blood, liver, kidney, spleen, bone-marrow, brain etc.

Distribution : India : Arunachal Pradesh (all districts) and in almost all parts in India as well as in tropics and subtropics.

Remarks : This species is highly pathogenic, causing malignant tertian malaria in man.

60. ***Plasmodium vivax*** (Grassi and Feletti)

1890. *Haemoeba vivax* Grassi and Feletti, *Arch. ital. Biol*, **13** : 297.

1966. *Plasmodium vivax* (Grassi and Feletti) : Garnham : *Malaria Parasites and other Haemosporidia*, Blackwell Scientific Publications, Oxford, : 116.

Diagnosis : Ring forms large, about one third the diameter of erythrocyte, round or oval, usually one in each red cells; trophozoite amoeboid; schizont irregular occupying half to two-third the erythrocyte, 12-24 merozoites, pigment granules small, usually in single mass, schizogony usually at 48 hours interval; gametocyte large, round or ovoid, hypertrophied host erythrocyte stippled with red dots; paroxysms at every day.

Host : Man, *Homo sapiens*; site of infection : blood; liver.

Distribution : India : Arunachal Pradesh (all districts); all over India as well as in tropics, subtropics and warm temperate regions (Garnham, 1966).

Remarks : This species is common in India, causing benign teritan malaria in man.

Phylum CILIOPHORA
Class OLIGOHYMENOPHOREA
Order ASTOMATIDA

Key to the families

1. Body ovoid to elongate ovoid, no endoskeleton, apical hooks or suckers .... ANOPLOPHRYIDAE

– Body cylindrical, rounded at both ends, skeletal fibres short, small anterior spines fixed or mobile .....MAUPASELLIDAE

Family ANOPLOPHRYIDAE
Genus ***Anoplophrya*** Stein

1860. *Anoplophrya* Stein, *Sitz. Ber. bohm. Ges. Wiss.*, : 57.

Diagnosis : Body ovoid or elongate-ovoid, flattened, rounded at both ends, thickly and uniformly ciliated, freeswimming, mouthless, macronucleus mostly band like and axial, contractile vacuole one to several, commensal.

61. ***Anoplophrya lumbrici*** (Schrank)

1935. *Anoplophrua lumbrici* (Schrank) Heidenreich, *Arch. Protistenkd.*, **84** : 319.

Material examined : 6 exs., Deban, Changlang, 7.iii.1990.

Diagnosis : Body elongately oval, both the ends rounded, dorsal side convex, ventral side slightly concave; ciliary striae close, macronucleus ribbon-shaped, extending almost entire length of the body; micronucleus small, spherical, located by the side of macronucleus.

Host : *Pheretima* sp.; *location* : gut.

Distribution : India : Arunachal Pradesh (Changlang district) and West Bengal.

Remarks : This species has so far been reported only once from India by Biswas and Mukherjee (1974) from the host *Pheretima peguyana* collected from West Bengal.

Family MAUPASELLIDAE
Genus ***Maupasella*** Cepede

1910. *Maupasella* Cepede, *Arch. Zool. exp. gen.*, (5) **3** : 408.

Diagnosis : Body ellipsoid with a spinous attaching organellae at anterior end, ciliated densely, macronucleus elongate and ribbon-shaped, contractile vacuole irregularly disposed.

62. ***Maupasella nova*** Cepede

1910. *Maupasella nova* Cepede, *Arch. Zool. exp. gen.*, (5) **3** : 408.

Material examined : 8 exs., Deban, Changlang, 7.iii.1990.

Diagnosis : Body ovoidal, 45-70 μm, dorsoventrally flattened with bluntly rounded anterior end and tapering posterior end; ciliary line longitudinal, cilia fine and densely arranged, macronucleus elongated, ribbon-shaped, granular; micronucleus fusiform, almost centrally placed, contractile vacuoles 8-10 in number, arranged in two rows.

Host : *Pheretima* sp.; *location* : gut.

Distribution : India : Arunachal Pradesh (Changlang district) and West Bengal.

Class	POLYHYMENOPHOREA
Order	HETEROTRICHIDA
Family	NYCTOTHERIDAE

Diagnosis : Body ovoid to slightly reniform, plump; sucker on ventral side lacking.

Genus *Nyctotheroides* Grasse

1928. *Nyctotheroides* Grasse, *Ann. Parasitol.*, **1** : 55.

Diagnosis : Body ovoid, pyriform or reniform, left margin convex, right margin more or less flat, micronucleus always below macronucleus, commensal of anurans.

63. ***Nyctotheroides cordiformis*** (Ehrenberg)

1838. *Bursaria cordiformis* Ehrenberg, *Die Infusionsthierchen als Vollkommene Organismen*, Leipzig. : 328.

1867. *Nyctotherus cordiformis* Stein, *Der Organismus der Infusionsthiere nach eigenen Forschungen in Systematischer Reihenfolge Nearbeitet*, **11** : 338.

1928. *Nyctotheroides cordiformis* Grasse, *Ann. Parasitol.*, **1** : 55.

Material examined : 3 exs., New Yum Chum, Changlang, 6.iii.1990.

Diagnosis : Body reniform, somewhat pointed anteriorly, length of present specimens 90-110 μm, cytopharynx broadly curved, reaching beyond the middle of the body; macronucleus kidney-shaped, micronucleus located below macronucleus and centrally attached to it.

Host : *Rana* sp.; *location* : rectum.

Distribution : India : Arunachal Pradesh (Changlang district), Meghalaya, Goa, Karnataka, Rajasthan and West Bengal.

C. Symbiotic Protozoa

Phylum	SARCOMASTIGOPHORA
Subphylum	MASTIGOPHORA
Class	ZOOMASTIGOPHOREA
Order	OXYMONADIDA
Family	PYRSONYMPHIDAE

Diagnosis : Large or small forms; axostyle of variable thickness running longitudinally down the body; four to eight flagellar cords starting from the anterior tip of the body running spirally backward and becoming free flagella at posterior end.

Key to the genera

1. Body slender, club-shaped or lanceolate, sometimes spirally twisted, end of axostyle fixed at posterior tip of the body or indistinct except at anterior end ..... ***Dinenympha***

– Body pyriform, club-shaped or screw like, spirally twisted, axostyle hanging in the endoplasm and its posterior end being free from the body wall ..... ***Pyrsonympha***

Genus ***Dinenympha*** Leidy

1877. *Dinenympha* Leidy, *Proc. Acad. Nat. Sci Phila*, **29** : 149.

Diagnosis : As in the key to the genus.

Key to the species

1. Body surface almost smooth 2

– Body surface ridged, flagellar cords very much wavy, reaching up to the posterior extremity of the body ..... *D. ravi*

2. Body club-shaped and its anterior portion bend back, axostyle sometimes bifurcated at posterior end ..... *D. mukundai*

– Body shape more or less same as above but anterior portion of the body commonly takeing

the shape of a hook; axostyle not bifurcated at posterior end ..... *D. nobilis*

64. ***Dinenympha mukundai*** Mukherjee and Maiti

1989. *Dinenympha mukundai* Mukherjee and Maiti, *Arch. Protistenkd.*, **137** : 92.

Diagnosis : Body elongately club-shaped with narrow anterior end, posterior end of the body round or tapering to some extent; axostyle distinct, resembling a thin rod, usually with almost uniform thickness and fixed either to the posterior end of the body; axostyle may be folded or bifurcated before terminating to posterior part of the body, nucleus mostly triangular, located towards anterior end.

Host : *Reticulitermes tirapi*; location : gut.

Distribution : Arunachal Pradesh (Tirap district).

Remarks : This species has been described by Mukherjee and Maiti (1989) from the gut of an endemic species of wood-eating termites of India, mentioned above. This host species was collected from Namdhapa National Park, Arunachal Pradesh.

65. ***Dinenympha nobilis*** Koidzumi

1921. *Dinenympha nobilis* Koidzumi, *Parasitology*, **13** : 292.

Material examined : Sev. exs., Namdhapa, Tirap, 15.iii.1990.

Diagnosis : Body club-shaped, gradually thickened towards posterior end, anterior portion of the body turned back, assuming commonly the shape of a hook; axostyle indistinct; body surface smooth, nucleus round, located towards anterior end.

Host : *Reticulitermes tirapi*; location : gut.

Distribution : India : Arunachal Pradesh (Tirap district), Meghalaya and Sikkim.

Remarks : This species has already been reported from Meghalaya and Sikkim by Das, *et al.* (1995, 2000) from the gut of another species of termite, *Reticulitermes assamensis*.

66. ***Dinenympha rayi*** Mukherjee and Maiti

1989. *Dinenympha rayi* Mukherjee and Maiti, *Arch. Protistenkd.*, **137** : 93.

Diagnosis : Body shape as in *D. mukundai*, but slightly twisted near the middle after completion of first turn of flagellar bands; axostyle slender, distinct, slightly thickened at anterior portion and gradually thinner towards posterior extremity and running throughout entire length and protruding out of posterior end of the body; nucleus round or oval and placed at extreme anterior end.

Host : *Reticulitermes tirapi*; location : gut.

Distribution : India : Arunachal Pradesh (Tirap district).

Remarks : The diagnosis of the species is based on the first descriptions of this species (Mukherjee and Maiti, 1989).

Genus ***Pyrsonympha*** Leidy

1877. *Pyrsonympha* Leidy, *Proc. Acad. Nat. Sci. Phila.*, **29** : 148.

Diagnosis : As in the key to the genus.

Key to the species

1. Flagellar cords 4 in number 2
– Flagellar cords 8 in number ..... *P. tirapi*
2. Body club shaped, nucleus ovoidal, located at anterior end of the body ..... *P. grandis*
– Body elongated, nucleus oval and located near the middle of the body ..... *P. rostrata*

67. ***Pyrsonympha grandis*** Koidzumi

1921. *Pyrsonympha grandis* Koidzumi, *Parasitology*, **13** : 281.

Material examined : Sev. exs., Namdhapa, Tirap, 15:iii.1990.

Diagnosis : Body club shaped, slightly curved with pointed anterior and round posterior ends; axostyle thick, well developed and hanging free in the endoplasm, flagellar cords 4 in number; nucleus ovoidal and situated at anterior end of the body.

Host : *Reticulitermis tirapi*; location : gut.

Distribution : India : Arunachal Pradesh (Tirap district), Meghalaya and Sikkim.

Remarks : This species has already been reported from two other North-Eastern States of India (Meghalaya and Sikkim) from the gut of the termite host *Reticulitermes assamensis* (Das *et al.*, 1995, 2000).

68. ***Pyrsonympha rostrata*** Mukherjee and Maiti

1988. *Pyrsonympha rostrata* Mukherjee and Maiti, *Proc. Zool. Soc., Calcutta*. **38** : 41.

Diagnosis : Anterior half of the body elongated while posterior half gradually broadened with rounded posterior margin; axostyle a slender cord, much thickened anteriorly and gradually becoming thin posteriorly, hanging free in the endoplasm; flagellar cords 4 in number, nucleus small, round or oval and located near the middle of the body.

Host : *Reticulitermes tirapi*; location : gut.

Distribution : India : Arunachal Pradesh (Tirap district).

Remarks : This species was described by Mukherjee and Maiti (*op. cit.*) from the gut conternts of an endemic species of Indian termite *Reticulitermes tirapi* collected from Namdhapa National Park, Arunachal Pradesh.

69. ***Pyrsonympha tirapi*** Mukherjee and Maiti

1988. *Pyrsonympha tirapi* Mukherjee and Maiti, *Proc. Zool. Soc., Calcutta*. **38** : 38.

Diagnosis : Body club-shaped, narrowing anteriorly and broadening posteriorly with a round posteriormost margin; axostyle a thin cord of uniform thickness, hanging free in the endoplasm, flagellar cords 8 in number, nucleus large, spherical to kidney shaped, located near the anterior end of the body.

Host : *Reticulitermis tirapi*; location : gut.

Distribution : India : Arunachal Pradesh (Tirap district).

Remarks : This species was also described by Mukherjee and Maiti (*op. cit.*) from the gut of *Reticulitermes tirapi*.

Order : HYPERMASTIGIDA

Key to the families

1. Body regularly ridged transversely, giving its segmented appearance, each ridge provided with a single row of flagella .... TERANYMPHIDAE

– Body not ridged as above 2

2. Flagella arranged in spiral rows, arising from a common point near anterior end of the body, nucleus anchored to rostrum by a nuclear sleeve ..... SPIROTRICHONYMPHIDAE

– Flagella not arranged in spiral rows, posterior end of the body non-flagellated and flagella arising at the posterior limit of flagellated region longest; location of nucleus not as above ....TRICHONYMPHIDAE

Family SPIROTRICHONYMPHIDAE

Diagnosis : Spiral flagellar bands arising from a common point near anterior end of the body; axostyles may be separate or joining to form closely adhering bundle.

Genus ***Spirotrichonympha*** Grassi & Foa

1911. *Spirotrichonympha* Grassi and Foa, *Rend. R Acad Lincei* (5), **20** : 727.

Diagnosis : Body elongate, pyriform, flagella deeply embedded in cytoplasm in anterior region arising from flagellar bands, mass of dense cytoplasm conical and its base indistinct.

70. ***Spirotrichonympha porteri*** (Koidzumi)

1917. *Spironympha porteri* Koidzumi, *Ann. Rep. Inst Sci Govt. Formosa*, **6** : 93.

1921. *Microspironympha porteri* Koidzumi, *Parasitology*, **13** : 268.

Material examined : 8 exs., Namdhapa, Tirap, 15.iii.1990.

Diagnosis : Anterior end of the body cone-shaped and posterior end round with finger-like

prolongation, number of spiral flagellar bands 6-8, hinder portion of the body free from any flagella, nucleus oval, situated at about anterior third of the body; nucleus not suspended freely but connected with anterior tip of the body by means of rostral tube of uniform thickness.

Host : *Reticulitermes tirapi*; location : gut.

Distribution : India : Arunachal Pradesh (Tirap district) and Meghalaya.

Family TERANYMPHIDAE

Genus ***Teranympha*** Koidzumi

1917. *Teranympha* Koidzumi, *Ann. Rep. Inst. Sci. Govt. Formosa*, **6** : 93.

1916. *Metameronympha* Koidzum, *Ann. Rep. Inst. Sci. Govt. Formosa*, **5** : 67.

1916. *Cyclonympha* Dogiel, *Zh. Microbiol.*, **4** : 47.

1921. *Teratonympha* Koidzumi, *Parasitology*, **13** : 260.

Diagnosis : Large, elongate, body ridged regularly and transversely, presenting a metameric appearance, each ridge provided with a single row of flagella; nucleus single, vesicular, enclosed in nuclear sac, fixed to the body wall and base of head, lying on the first apparent segment of the body.

71. ***Teranympha mirabilis*** Koidzumi

1917. *Teranympha mirabilis* Koidzumi, *Ann. Rep. Inst. Sci. Formosa*, **6** : 93.

Material examined : 5 exs., Namdhapa, Tirap, 15.iii.1990.

Diagnosis : Body wider at anterior and gradually tapering towards posterior end, body ridged regularly and transversely, number of ridges varying from 18-30 and sometimes even more; shape and location of nucleus as in the genus.

Host : *Reticulitermes tirapi*; location : gut.

Distribution : India : Namdhapa, Arunachal Pradesh (Tirap district), Meghalaya and Sikkim.

Remarks : In India, this species was earlier reported by Das *et al.* (1995 and 2000) from the termite host *Reticulitermes assamensis* which was collected from two other North-eastern states of India, namely, Meghalaya and Sikkim.

Family TRICHONYMPHIDAE

Genus ***Trichonympha*** Leidy

1877. *Trichonympha* Leidy, *Proc. Acad. Nat. Sci. Phil.*, **29** : 147.

Diagnosis : Body relatively large, subdivided into three regions - rostrum, flagella bearing region behind rostrum and nonflagellated posterior region; flagella arising at posterior limit of non-flagellated region longest extending beyond posterior end of body; parabasal apparatus composed of numerous cords in endoplasm of posterior region.

72. ***Trichonympha agilis*** Leidy

1877. *Trichonympha agilis* Leidy, *Proc. Acad. Nat. Sci. Phil.*, **29** : 147.

Material examined : 6 exs., Namdhapa, Tirap, 15.iii.1990.

Diagnosis : Body more or less spindle shaped or oval, flagellated region occupying about one-third the length of the body, parabasal apparatus basket like comprising numerous slender separate cords, these cords usually meeting just behind the nucleus and occasionally beyond the nucleus; nucleus spheroidal and ellipsoidal, situated near or just beyond the posterior end of the flagellated zone of the body.

Host : *Reticulitermes tirapi*; location : gut.

Distribution : India : Arunachal Pradesh (Tirap district), Meghalaya and Sikkim.

Remarks : In India, this species was earlier recorded from the gut of the termite host, *Reticulitermes assamensis* from Meghalaya and Sikkim (Das *et al.*, 1995, 2000).

GENERAL REMARKS ON TAXONOMIC DIVERSITY AND DISTRIBUTION

Only 72 species of Protozoa are known so far from Arunachal Pradesh. Even then, they represent 3 phyla, 8 classes, 14 orders, 28 families and 39 genera (Table 1) depicting rich taxonomic

diversity of Protozoa in the state. District-wise distribution of each protozoan species of the state is presented in Table 2. In Table 3 number of species belonging to freeliving, parasitic and symbiotic protozoa recorded from each of its eleven districts is shown for quick perusal and analysis.

From Table 3 it is quite evident that the maximum number of protozoan species (32) is recorded from Lower Subansiri. This is closely followed by East Siang (31), West Siang (28) and Debang Valley (28) in descending order. More than 20 species have reported from other three districts, namely, Tirap, Lohit and Changlang. Incidentally all these seven districts were surveyed by the scientists of ZSI. The minimum number of species is reported from Tawang (3) and Upper Subansiri (3). The table also reveals that freeliving protozoa have been collected from seven districts, symbiotic protozoa only from one district, namely, Tirap and parasitic protozoa from all the eleven districts.

Only three species, namely, *Giardia lamblia*, *Plasmodium falciparum* and *Plasmodium vivax* are known to occur in all the districts of the state (Table 2). These are parasitic protozoa causing human disease as already mentioned under taxonomic treatment of each species.

The symbiotic protozoa have been recorded only from one species of termite host, namely, *Reticulitermes tirapi* belonging to the family Rhinotermitidae. Nine species of symbiotic flagellates have been recovered from the gut of this host which was collected only from Namdhapa National Park.

SUMMARY

A comprehensive taxonomic account of all the freeliving, parasitic and symbiotic protozoa reported and collected so far from Arunachal Pradesh has been presented. This includes 72 species belonging to 3 phyla, 8 classes, 14 orders, 28 families and 39 genera. Among these, 43 species are freeliving, 20 parasitic and 9 symbiotic.

Three species of freeliving rhizopods, namely, *Centropyxis sylvatica*, *Plagiopyxis minuta* and *Nebela tincta* are reported for the first time from India. Sixty two species (40 freeliving, 17 parasitic and 5 symbiotic) constitute first records for Arunachal Pradesh.

ACKNOWLEDGEMENT

The authors are grateful to Dr. J.R.B. Alfred, Director, Zoological Survey of India for extending necessary facilities for this work and to Dr. G.K. Srivastava, Addl. Director, ZSI for critically going through the manuscript. The authors are also indebted to Shri P. T. Bhutia, Officer-in-Charge, Arunachal Pradesh Field Station, Zoological survey of India, Itanagar for his earnest effort to collect data of parasitic protozoa of live stocks and poultry of Arunachal Pradesh from the Disease Investigation Laboratory at Nirjuli, Itanagar and send the same to the authors for the present work.

REFERENCES

BISWAS, M. K. and MUKHERJEE, R. N. 1974. On a new record of *Anoplophrya lumbrici* (Schrank) (Protozoa : Ciliata) from a new host *Pheretima penguyana* (Rosa) from Calcutta. *Curr. Sci.* 43(10) : 321.

DAS, A. K., MANDAL, A. K. and SARKAR, N. C. 1993. Freeliving Protozoa. *Zool. Surv. India, Fauna of West Bengal, State Fauna Series*, 3(Part-12) : 1-133.

DAS, A. K., MANDAL, A. K., NANDI, N. C., NANDI, R. and SARKAR, N. C. 1993. Parasitic Protozoa. *Zool. Surv. India, Fauna of West Bengal, State Fauna Series*, 3(Part-12) : 135-467.

DAS, A. K., MANDAL, A. K. and NANDI, N. C. 1993. Symbiotic Protozoa. *Zool. Surv. India, Fauna of West Bengal, State Fauna Series*, 3(Part-12) : 469-551.

DAS, A. K., MANDAL, A. K., TIWARI, D. N. and SARKAR, N. C. 1995. Protozoa. *Zool. Surv. India, Fauna of Meghalaya, State Fauna Series,* **4**(Part-10) : 1-103.

DAS, A. K., TIWARI, D. N. and SARKAR, N. C. 2000. Protozoa. *Zool. Surv. India, Fauna of Sikkim, State Fauna Series,* **9**(Part-4) : 1-36.

DE MELLO, F. 1932. Contribution a l'etude des Infusoires Parasites des Anoures du Malabar. *Rec. Indian Mus.*, **34** : 89-124.

DUTTA, P., BHATTACHARYA, D. R., SHARMA, C. K. and DATTA, L. P. 1992. Anopheline fauna of parts of Tirap district, Arunachal Pradesh with reference to malaria transmission. *Indian J. Med. Res.*, **95**(A) : 245-249.

FOISSNER, W. 1987. Soil Protozoa : Fundamental problems, ecological significance, adaptation in ciliates and testaceans, bioindicators and guide to the literature. In : *Progress in Protistology*, **2** : 69-212, Biopress Ltd.

GAUTHIER-LIEVRE, L. and THOMAS, R. 1958. Les genres. *Difflugia, Pentagonia, Maghrebia et Hoogenraadia* (Rhizopodes testeces) en Afrique. *Arch. Protistenkd.*, **103** : 241-370.

LEVINE, N. D., CORLISS, J. O., Cox, G. E. F., Deroux, G., Grain, J., Honigerg, B. M., Leedsle, G. E., Loeblich, A. R., Lom, J., Lynn, D., Merinfelds, G. E., Page, F. C., Poljansky, G., Sprague, V., Vavra, J. and Wallace, F. G. 1980. A newly revised classification of protozoa. *J. Protozool.*, **27** : 37-58.

MANDAL, A. K. 1987. *Fauna of India and adjacent countries.* Protozoa : Sporozoa : Eucoccidiida : Eimeriidae. *Zool. Surv. India* : 1-460.

MISRA, B. G. 1956. Malaria in Northeast Frontier Agency (India), *Indian J. Malarial.*, **10** : 331-347.

MUKHERJEE, P. and MAITI, P. K. 1988. Two new species of flagellates of the genus *Pyrsonympha* Leidy (Mastigophora : Protozoa) from *Reticulitermes tirapi* Chhotani and Das (Isoptera : Insecta). *Proc. zool. Soc., Calcutta*, **38** : 37-45 (1985) 1988.

MUKHERJEE, P. and MAITI, P. K. 1989. Description of two new species of flagellates of the genus *Dinenympha* Leidy (Mastigophora : Polymastigida) from *Reticulitermes tirapi* Chhotani and Das (Isoptera). *Arch. Protistenkd.*, **137** : 91-96.

PAUL, R. C., DAS, N. C., John, V. M. and Rao, C. K. 1982. Prevalence of intestinal parasitic infection in selected population of Arunachal Pradesh. *J. Com. Dis.*, **14**(4) : 309-312.

SEN, S. K., John, U. M., Krishnan, K. S. and Rajagopal, R. 1973. Studies on malaria transmission in Tirap district, Arunachal Pradesh (NEFA). *J. Com. Dis.*, **5** : 98-110.

Table 1. Protozoan diversity in Arunachal Pradesh
(Fr : Freeliving; Pa : Parasitic; Sy : Symbiotic)

Group	Number of										
	Family			Genus			Species			Host species	
	Fr	Pa	Sy	Fr	Pa	Sy	Fr	Pa	Sy	Pa	Sy
Phylum Sarcomastigophora											
Subphylum Mastigophora	-	2	4		2	5		2	9	2	1
Subphylum Sarcodina	6	-	-	14	-	-	32	-	-	-	
Subphylum Opalinata	-	1	-		2			2	-	2	
Phylum Apicomplexa	-	2		-	3	-	-	13	-	6	-
Phylum Ciliophora	10	3	-	10	3	-	11	3	-	2	
Total	**16**	**8**	**4**	**24**	**10**	**5**	**43**	**20**	**9**	**12***	**1**

* Less than actual total since 3 host species, namely, *Gallus domesticus*, *Bos indica* and *Sus scrofa* are found to harbour more than one species of parasites).

Table 2. District-wise distribution of Protozoan species in Arunachal Pradesh.
(Taw : Tawang; WK : West Kameng; EK : East Kameng; LS : Lower Subansiri; US : Upper Subansiri, WS : West Siang; ES : East Siang; DEB : Debang Valley; LH : Lohit; CH : Changlang; TR Tirap)

Protozoan species	Districts										
	TAW	WK	EK	LS	US	WS	ES	DEB	LH	CH	TR
	1	2	3	4	5	6	7	8	9	10	11
Freeliving Protozoa RHIZOPODS											
1. *Arcella discoides*				+		+	+	+			+
2. *Arcella vulgaris*				+		+	+				
3. *Bullinularia indica*								+	+		
4. *Centropyxis aculeata*				+				+	+	+	
5. *Centropyxis aerophila*				+				+	+		
6. *Centropyxis ecornis*				+			+	+	+		
7. *Centropyxis laevigata*							+	+			
8. *Centropyxis minuta*						+		+			
9. *Centropyxis platystoma*				+					+		
10. *Centropyxis spinosa*						+		+			
11. *Centropyxis sylvatica*								+	+		
12. *Centropyxis arcelloides*						+		+			
13. *Plagiopyxis callida*				+				+			
14. *Plagiopyxis minuta*								+	+		

Protozoan species	Districts										
	TAW	WK	EK	LS	US	WS	ES	DEB	LH	CH	TR
	1	2	3	4	5	6	7	8	9	10	11
15. *Difflugia lismorensis*						+					
16. *Difflugia lithophila*				+			+				
17. *Difflugia lobostoma*				+		+	+				
18. *Heliopera rosea*							+	+			
19. *Nebela dentistoma*								+			
20. *Nebela tincta*								+			
21. *Phryganella acropodia*				+			+				
22. *Assulina muscorum*				+		+	+	+	+	+	
23. *Corythion dubium*						+		+	+		
24. *Corythion pulchellum*									+		
25. *Euglypha ciliata*				+		+					
26. *Euglypha rotunda*				+			+	+			
27. *Euglypha scutigera*				+							
28. *Euglypha tuberculata*						+	+	+			
29. *Tracheleuglypha dentata*							+	+			
30. *Trinema complanatum*								+			
31. *Trinema enchelys*				+		+	+	+			
32. *Trinema lineare*								+	+		
CILIATES											
33. *Coleps hirtus*							+				+
34. *Spathidium muscicola*				+				+		+	
35. *Loxophyllum nimeccense*				+		+					
36. *Plagiopyla nasuta*						+	+				
37. *Colpoda cucullus*				+		+				+	
38. *Glaucoma pyriformis*							+				+
39. *Paramecium bursaria*						+					+
40. *Frontonia leucas*							+				
41. *Metopus es*							+				
42. *Euplotes muscicola*				+				+			
43. *Euplotes plumipes*							+				
Parasitic Protozoa FLAGELLATES											
44. *Trypanosoma rotatorium*										+	
45. *Giardia lamblia*	+	+	+	+	+	+	+	+	+	+	+
46. *Cepedia lanceolata*										+	
47. *Opalina lapta*									+		

Protozoan species	Districts										
	TAW	WK	EK	LS	US	WS	ES	DEB	LH	CH	TR
	1	2	3	4	5	6	7	8	9	10	11
APICOMPLEXA											
48. *Eimeria brunetti*				+		+	+		+	+	+
49. *Eimeria necatrix*				+		+	+		+	+	+
50. *Eimeria tenella*				+		+	+		+	+	+
51. *Eimeria bovis*		+	+	+		+	+		+	+	+
52. *Eimeria debliecki*		+	+	+		+	+		+	+	+
53. *Eimeria ellipsoidalis*		+	+	+		+	+		+	+	+
54. *Eimeria scabra*		+	+	+		+	+		+	+	
55. *Eimeria stiedai*				+							
56. *Eimeria zuernii*		+	+	+		+	+		+	+	
57. *Isospora suis*		+	+	+		+	+		+	+	
58. *Plasmodium relictum*									+		
59. *Plasmodium falciparum*	+	+	+	+	+	+	+	+	+	+	+
60. *Plasmodium vivax*	+	+	+	+	+	+	+	+	+	+	+
61. *Anoplophrya lumbrici*										+	
62. *Maupasella nova*										+	
63. *Nyctotherus cordiformis*										+	
Symbiotic Protozoa FLAGELLATES											
64. *Dinenympha mukundai*											+
65. *Dinenympha nobilis*											+
66. *Dinenympha rayi*											+
67. *Pyrsonympha grandis*											+
68. *Pyrsonympha rostrata*											+
69. *Pyrsonympha tirapi*											+
70. *Spirotrichonympha porteri*											+
71. *Teranympha micrabilis*											+
72. *Trichonympha agilis*											+

Table 3. District-wise distribution of freeliving, parasitic and symbiotic Protozoa (in number of species) in Arunachal Pradesh.

Name of districts	No. of Protozoan species			Total
	Freeliving	Parasitic	Symbiotic	
Tawang	-	3	-	3
West Kameng	-	9	-	9
East Kameng	-	9	-	9
Lower Subansiri	19	13	-	32
Upper Subansiri	-	3	-	3
West Siang	16	12	-	28
East Siang	19	12	-	31
Debang Valley	25	3	-	28
Lohit	11	14	-	25
Changlang	4	17	-	21
Tirap	5	10	9	24

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2) : 39-45, 2006

CRUSTACEA : DECAPODA : PALAEMONIDAE AND POTAMONIDAE

S. K. GHOSH, S. S. GHATAK AND T. ROY
Zoological Survey of India, 27, Jawaharlal Nehru Road, Kolkata-700016

INTRODUCTION

Inspite of so much attention, our knowledge on Crustacean fauna specially Prawns and Crabs of Arunachal Pradesh, is still inadequate. The limits of Arunachal Pradesh region included for the present study is the freshwater bodies ca. 83,573 sq. km. The Palaemonid prawns and Potamonid crabs dealt with in the present work under research programme, were available from the collections of Faunistic surveys of the Arunachal Pradesh conducted by T. Roy & Party and also other unnamed colections, present in the National Zoological Collections of the Zoological Survey of India, Calcutta. These examples comprising seven species of Palaemonid prawns and six species of Potamonid crabs. To breakwise the entire species of Palaemonid prawns and Potamonid crabs of Arunachal Pradesh, the following details of the groupwise strength of species and genus are as follows : seven species belonging to one genus and one family of Palaemonid prawn and six species belonging to six genera and one family of the Potamonid crab.

It is indeed true that fauna of any group is a flexible work tool capable of periodical updating through additions and revisions. However, Palaemonid prawns and Potamonid crabs of Arunachal Pradesh are rich and diverse in nature and therefore, these groups have been studied and reported. Since, Wood-Mason (1872), Alcock (1910) and Bott (1972) monographs on Indian Palaemonid prawns and Potamonid crabs, mention were not made about their occurrances in particular locality of Arunachal Pradesh. In all such cases, they have been cited as authority of occurrences of Palaemonid prawns and Potamonid crabs of Arunachal Pradesh.

Key to species of the Genus *Macrobrachium*

1. Rostrum never extends upto tip of antennular peduncle. ..... *M. handersoni*

– Rostrum extends upto tip of antennular peduncle or exceeds it. 2

2. Rostrum extends upto dip of antennular peduncle. 03

– Rostrum extends in midway between antennular peduncle and antennal scale. 4

3. Presence of proximal keel on dorsal broder of rostrum. ..... *M. choprai*

– Absence of proximal keel on dorsal broder of rostrum. 5

4. Carpus of 2nd peraeopods shorter than merus. ..... *M. assamensis assamensis*

– Carpus of 2nd peraeopods longer than merus. 6

5. Fingers of 2nd peraeopods with dense pubescence. ..... *M. hendersoni platyrostris*

– Fingers of 2nd peraepods without pubescence. ..... *M. altifrons*

6. Upper margin of rostrum with a distal gap between a proximal series of teeth and distal sub-apical teeth. ..... *M. lamarrei*

– Upper margin of rostrum without a distal gap between a proximal series of teeth and distal sub-apical teeth otherwise arranged systematically. ..... *M. dayanum*

SYSTEMATIC ACCOUNT

Class CRUSTACEA
Order DECAPODA
A. Family PALAEMONIDAE

(i) Genus ***Macrobrachium*** Bate

1. *Macrobrachium altifrons* (Henderson)

1893. *Palasmon altifrons* Henderson. *Trans. Linn. Soc. Lond.*, (Zool), (2) **5** : 444, pl. 40, figs. 4-6.

1963. *Macrobrachium altifrons* Tiwari. *Proc. Zool. Soc.*, **16**(2) : 225, figs. 1-8.

Type species : *Palaemon altifrons* Hendersons. *Type locality* : North India.

Material examined : 12 exs. from Remi, East Siang, Coll. T. Roy & Party, 15.10.1998; 6 exs. from Badak, East Siang, Coll. T. Roy & Party; 12.10.1998; 60 exs. from Ciji, West Siang, Coll. T. Roy & Party, 14.10.1998; 65 exs. from Decapam, West Siang, Coll. T. Roy & Party, 15.10.1998; 11 exs. from Raling, East Siang, Coll. T. Roy & Party, 11.10.1998.

Diagnosis : Rostrum short extends usually at the end of distal segment of antennular peduncle, sometimes reaches at the tip of antennal scale, upper edge convex, apex acute, horizontal or slightly upturned. Rostral formula 5-14/1-5 with 1 to 5 teeth on upper edge of carapace behind orbital border. Carapace generally rough except in very young specimens. Second pair of peraeopods strong, subcylindrical, unequal or subequal, longer than total length of body in very large males, otherwise equal to or generally shorter. Carpus thickened distally and shorter than merus. Mobile finger generally more than half as long as palm with 5 or 6 tubercles. Immobile finger with 4 or 5 tubercles. Entire peraeopod covered with spinnules which are small and dense on upper and outer surfaces and larger and less dense on lower and inner surfaces.

Distribution : India : Arunachal Pradesh, Delhi, U.P., Bihar, Assam.

Elsewhere : Nepal, Pakistan.

Remarks : This species is recorded for first time from this area.

2. *Macrobrachium assamensis assamensis* (Tiwari)

1958. *Palaemon assamensis* Tenai. *Rec. Indian Mus.*, **53** (1 & 2) : 297.

1988. *Macrobrachium assamensis assamensis* Jalihal, Shenoy & Sankolli. *Rec. zool. Surv. India, Occ. Paper* No. **112** : 43.

Type species : *Palaemon assamensis Tiwari. Type locality* : Garo Hills, Meghalaya.

Material examined : 32 exs. from Bhalukpong, Coll. T. Roy & Party, 21.10.1997; 20 exs. from Murali Vill., Coll. T. Roy & Party, 14.10.1998; 4 exs. from Badak Vill., Coll. T. Roy & Party, 12.10.1998; 2 exs. from Decapam Vill., Coll. T. Roy & Party, 15.10.1998; 14 exs. from Ruksin, Coll. T. Roy & Party, 13.10.1998; 3 exs. from Raling Vill., Coll. T. Roy & Party, 11.10.1998.

Diagnosis : Rostrum extends not only in between antennular peduncle and antennal scale but also the apex of antennal scale. Rostral formula 7-11/2-5 with 3 teeth on upper edge of carapace behind orbital border. Carapace with scattered, minute prickles. Second pair of peraeopods subequal, subcylindrical. Carpus gradually thickened distally and shorter than merus. Chela more than twice as long as carpus in adult males and less in females and young males. Fingers slightly longer than palm with velvety pubescense along the grooves in adult males, otherwise pubewcense in young males and females. Cutting edge non-gaping with weaker teeth.

Distribution : India : Arunachal Pradesh Chotanagpur, Kharagpur Hills, Bengal, Duars and Torai, Eastern Assam.

Elsewhere : Arakan jyomas; Myanmar; Eastern Nepal; Pegu Yomas.

Remarks : This species is recorded first time and found at lower altitudes.

3. *Macrobrachium choprai* (Tiwari)

1949. *Palaemon choprai* Tiwari. *Rec. Indian Mus.*, **45** (4) : 333.

1950. *Macrobrachium choprai* Holthuis, *Siboga Exped. Monogr.*, **39a** (9) : 261.

Type species : *Palaemon choprai* Tiwari. *Type locality* : Benaras, U. P.

Material examined : 1 ex. from Remi, Coll. T. Roy & Party, 15.10.1998; 1 ex. from Ciji Vill., Coll. T. Roy & Party, 14.10.1998; 1 ex. from Raling Vill., Coll. T. Roy & Party, 11.10.1998.

Diagnosis : Rostrum extends at the end of antennular peduncle and sometimes it extends at the end of antennal scale. Proximal 2/3 of dorsal edge of rostrum forms an elevated, highly convex keel bears 9 to 10 teeth and distal 1/3 being narrow, sharp, bears 1 or 2 teeth. The lower edge of rostrum, bears 4 to 5 teeth and rarely may be 6 teeth. Second persopods are stout, subequal and always longer than body in adult male, merus usually longer than palm and shorter than Carpus. Mobile finger in densely pubscent except towards the tip and along the inner edge. Fixed finger is also pubscent along its dorsal and ventral surfaces, bears a big conical tooth which fits between the two teeth of the mobile finger and fingers when close, there is a more or less narrow gap.

Distribution : India : Arunachal Pradesh, U.P.; Bihar; Assam.

Elsewhere : Hill ranges of North Myanmar.

Remarks : This species is recorded first time from this area and found in the Indo-Gangetic plains only.

4. *Macrobrachium dayanum* (Henderson)

1893. *Palaemon dayanus* Henderson. *Trans. Linn. Soc. Lond.*, (2) **5** : 443, pl. 40, figs 7-13.

1988. *Macrobrachium dayanum* Jalihal, Shenoy & Sankolli. *Rec. zool. Surv. India, Occ. paper No.* **112** : 43.

Type species : *Palaemon dayanus* Henderson. *Type locality* : Northern India.

Material examined : 8 exs. from Ciji Vill., Coll. T. Roy & Party, 14.10.1998; 12 exs. from Decapam Vill., Coll. T. Roy & Party, 15.10.1998.

Diagnosis : Rostrum extends upto tip of antennal scale or exceeds its, generally it is straight and sometimes it may be upturned at its distal end. The number of teeth on rostrum varies according to its length. There are 2 to 3 teeth on carapace behind orbital border. Second paraepods stout, equal or subequal, length about 2/3rds of body in adult male otherwise about half of body in young examples. Carpus longer than merus, shorter or equal to palm. Fingers about 2/3rds the length of palm and densely pubscent. Fixed finger with one conical tooth and mobile finger with two large conical teeth.

Distribution : India : Arunachal Pradesh, West Bengal; Assam; Orissa; Kerala; Madhya Pradesh; Punjab; Uttar Pradesh.

Elsewhere : Pakistan.

Remarks : This species is found not only in plains but also in hills.

5. *Macrobrachium hendersoni* (De Man)

1907. *Palaemon (Parapalaemon) hendersoni* de Man. *Trans. Linn. Soc. Lond. Zool.* (2) **IX** : 446, pl. xxxiii, figs 66-68.

1950. *Macrobrachium hendersoni* Holthuis. *Siboga Exped. Monogr.*, **39a** (9) : 209.

Type species : *Palaemon (Parapalaemon) hendersoni* De Man. *Type locality* : Darjeeling, West Bengal.

Material examined : 4 exs. from Lada, Coll. T. Roy & Party, 2.11.1997; 6 exs. from Pistana, Coll. T. Roy & Party, 27.10.1998; 5 exs. from Darak Vill., Coll. T. Roy & Party, 22.10.1998; 4 exs. from Kaying Vill., Coll. T. Roy & Party, 23.10.1998; 42 exs. from Krouli, Coll. T. Roy & Party, 15.3.1999; 38 exs. from Dambuk, Coll. T. Roy & Party, 13.3.1999; 5 exs. from Khertang, Coll. T. Roy & Party, 20.3.1999; 44 exs. from Hunli Debang Valley, Coll. T. Roy & Party, 14.3.1999.

Diagnosis : Rostrum extends up to end of basal or middle segment of antennular peduncle. Length of peraeopods equal to or rarely exceeds the length of body. Merus longer than carpus, palm longer than carpus. Fingers with deep longitudinal grooves and dense pubescence, generally longer than palm.

Distribution : India : Arunachal Pradesh, Eastern Himalayan region; Vindhya-Satpura Hills, Pachmari.

Elsewhere : North Burma; Yunnan (S. China).

Remarks : Hill stream species found in higher altitudes.

6. *Macrobrachium hendersoni platyrostris* (Tiwari)

1952. *Palaemon hendersoni platyrostris* Tiwari. *Ann. Mag. nat. Hist.*, (12) **5** : 32.

1993. *Macrobrachium hendersoni platyrostris* Kurian & Sebastian. *Prawns and prawn fisheries of India*, P. 76.

Type species : *Palaemon hendersoni platyrostris* Tiwari. *Type locality* : Eastern Himalayan region.

Material examined : 6 exs. from West Kameng, Coll. P. T. Bhutia & Party, 6.10.1993 & 13.10.1993; 90 exs. from Bhalukpong, Coll. T. Roy & Party, 21.10.1997; 2 exs. from Siang Vill., Coll. T. Roy & Party, 14.10.1998; 100 exs. from Tipi Coll. T. Roy & party, 22.10.1997; 11 exs. from Remi, Coll. T. Roy & Party, 15.10.1998; 20 exs. from Badak Vill., Coll. T. Roy & Party, 12.10.1998; 19 exs. from Raling Vill., Coll. T. Roy & party, 11.10.1998; 31 exs. from Tenai, Coll. T. Roy & Party, 12.3.1999; 28 exs. from Paya, Coll. T. Roy & Party, 11.3.1999; 15 exs. from Sunpura, Coll. T. Roy & Party, 10.3.1999; 12 exs. from Chawkhan, Coll. T. Roy & Party, 10.3.1999.

Diagnosis : Rostrum extends upto end of antennular peduncle, deeper than M. hendersoni, upper edge convex, 02 or 03 teeth on carapace behind orbital border, teeth on lower edge drawn back from apex. An adult specimen larger in size than *M. hendersoni*. Other characters are same as *M. hendersoni*.

Distribution : India : Arunachal Pradesh, Darjeeling, South of Peninsular, Chota Nagpur Hills.

Elsewhere : Myanmar.

Remarks : Hill stream species found only in lower altitude.

7. *Macrobrachium lamarrei* (H.M. Edwards)

1837. *Palaemon lamarrei* H. M. Edwards. *Hist. nat. Crust.*, **2** : 397.

1993. *Macrobrachium lamarrei* Kurian & Sebastian. *Prawn & prawn fisheries of India* : 77.

Type species : *Palaemon lamarrei* H. M. Edwards. *Type locality* : Karnataka state.

Materials examined : 150 exs. from Lathao, Lohit Dist., Coll. T. Roy & Party, 18.3.1999; 35 exs. from Deomali, Tirap Dist., Coll. T. Roy & Party, 27.3.1999; 360 exs. from Piyong, Coll. T. Roy & party, 17.3.1999; 23 exs. from Khertang, Coll. T. Roy & party, 20.3.1999; 25 exs. from Namsang, Coll. T. Roy & Party, 26.3.1999.

Diagnosis : Rostrum equal to or slightly longer than antennal scale and upturned distally. Second peraeopods smooth, slender, equal and more than 1/3rd body length. Chela longer than half, shorter than 3/4th of Carpus. Carpus longer than merus and palm, fingers slightly shorter than palm.

Distribution : India : Arunachal Pradesh, Bihar, West Bengal, Orissa, Andhra Pradesh, Tamil Nadu.

Elsewhere : Pakistan, Upper Myanmar.

Remarks : The species is found both in the plains and in the lower hills.

B. Family POTAMONIDAE

(ii) Genus *Sartoriana* Bott.

7. *Sartoriana spinigera* (Wood-Mason)

1871. *Paratelphusa spinigera* Wood-Mason, *J. asiat. soc. Bengal*, **40**(2) : 194, T. 10. F. 1-4.

1910. *Paratelphusa* (*Paratelphusa*) *spinigera* Alcock, *Cat. Ind. Decap. Crust. Indian Museum*, **1**(2) : 72. T. 11. F. 53.

1970. *Sartoriana spinigera* Bott., *Abh. senckenb. natur. Ges.* No. **526** : 39, pl. 4. F. 35-37, pl. 26, F. 38.

Type species : *Paratelphusa spinigera* Wood-Mason. *Type locality* : India, Jessore (Bangladesh) (spinigera), Sibsagar, Assam Trilobate.

Material examined : 1F, and 3MM, Ciji Vill., Malinithan, dist. West Siang, T. Roy & Party, 14.10.1998; 1F and 2MM, Decapam vill., Malinithan, Dist. West Siang, T. Roy & Party, 15.10.1998; 3FF and 1M, Govt. fish seed farm, Lathao, Lohit dist., T. Roy & Party, 18.3.1999.

Distribution : India : Arunachal Pradesh, Tripura : Dullubari, Gondacherra, Udaipur (S. Tripura), Dharmanagar, Kanchanpur, Salema, Bormura, Begon, Khusdinpara, Mannbari, Gerania, Champak Nagar (N. Tripura), Asrambari (W. Tripura); Uttar Pradesh : Sharanpur, Hardwar; Punjab : Jullandar; Orissa : Puri; West Bengal : Calcutta; Assam : kachar; Meghalaya : Simsong River, Garo Hills; Bihar : Dharbhanga, Kissenganj.

Elsewhere : Jessore, Syllet, Karachi.

Remarks : This species is widely distributed and commonly available in the North East India.

(iii) Genus ***Barytelphusa*** Alcock

8. ***Barytelphusa (Maydelliathelphusa) lugubris lugubris*** (Wood-Mason)

1871. *Telphusa lugubris* Wood-Mason, *J. Asiat. Soc. Bengal*, 40(2) : 197. T. 12. F. 5-7.

1910. *Paratelphusa (Barytelphusa) lugubris* Alcock, *Cat. Ind. Decap. Crust. Indian Museum*, 1(2) : 091. T. 12. F. 58.

1910. *Paratelphusa (Barytelphusa) harpax* Alcock, *Cat. Ind. Decap.* Crust. Indian Museum, 1(2) : 95. T. 7, F. 25.

1970. *Barytelphusa (Maydelliathelphusa) lugubris lugubris* Bott. *Abh. Senckneb. natur. Ges.* No. 526 : 34, pl. 3, F. 24-26, pl. 26, F. 15.

Type species : *Telphusa lugubris* Wood-Mason. *Type locality* : Sikkim, Pankabari, 2000 ft.

Material examined : 2FF and 1M Romi near Bilat, Dist. East Siang, Coll. T. Roy & Party, 15.10.1998; 4 MM., Pistana, Dist. Lower Subansiri, Coll. T. Roy & Party, 27.101998; 4MM and 1F, Raling Vill. Dist. East Siang, Coll. T. Roy & Party, 11.10.1998; 5MM and 1F, Bodak Vill. Dist. East Siang, Coll. T. Roy & Party, 12.10.1998; 3MM and 1F, Murali Vill. Dist. East Siang, Coll. T. Roy & Party, 14.10.1998; 2MM and 3FF, Ruksin, Dist. East Siang, Coll. T. Roy & Party, 13.10.1998; 21MM and 7FF, Demoli, Dist. Tirap, Coll. T. Roy & Party, 27.3.1999; 19MM and 10FF, Namsang, Dist. Tirap, Coll. T. Roy & Party, 26.3.1999; 3MM, Regd. No. IV/712, Bhalukpong, Tippi Dist. West Kameng, Coll. P. T. Bhutia, 12.10.1993; 25MM, Dibang Valley Dist. Coll. T. Roy & party, 15.3.1999; 2MM and 2FF, Temaei Dist. Lohit, Coll. T. Roy & Party, 12.3.1999; 27MM and 2FF, Dambuk Dist. Dibang Valley, Coll. T. Roy & Party, 14.3.1999; 2MM and 3FF, Paya, Dist. Lohit, Coll. T. Roy & Party, 11.3.1999; 3MM and 3FF, Hunli, Dibang Valley Dist., Coll. T. Roy & Party, 14.3.1999.

Distribution : India : Arunachal Pradesh, Tripura : Jumpoi Hills, Salema, Boruma (N. Tripura); West Bengal : Darjeeling, Calcutta; Manipur : Manipur Hills; Assam : Dafla Hills, Teesta Valley; Sikkim; Nagaland : Naga Hills; Meghalaya : Cherrapunji, Khasi Hills, Garo Hills (no specific locality).

Remarks : This species also occur commonly in the North East India and also reported herein the first time from Arunachal Pradesh.

(iv) Genus ***Acanthopotamon*** Kemp

9. ***Acanthopotamon martensi*** (Wood-Mason)

1875. *Paratalphusa martensi* Wood-Mason, *Proc. Asiat. Soc. Bengal*, : 230.

1910. *Potamon (Acanthopalphusa) martensi* Alcock, *Cat Ind. decap. Crust. Indian Museum*, 1 (2) : 68. T. 11 F. 62.

1970. *Acanthopotamon martensi* Bott, *Abh. Senckenb natur. Ges.* No. 526. 145. pl. 3. fig. 22, pl. 45. fig 20.

Type species : *Paratalphusa martensi* Wood-Mason *Type locality* : Jessore, Calcutta.

Material examined : 3FF & 1M, Darak Vill., Dist. West Siang, T. Roy & Party, 22.10.1998; 4FF & 2MM from Kayung Vill., Dist. West Siang, Coll. T. Roy & Party, 23.10.1998; 2FF from Pakhu Wildlife sanctuary, Sejora, Dist. West Kameng, Coll. P. T. Bhutia, 6.10.1993.

Distribution : India : Arunachal Pradesh, Meghalaya : Willamnagore, West Garo Hills; Bihar : Darbhanga, Kissangunj; Uttar Pradesh : Lucknow, Benaras; West Bengal : Baranagar near Calcutta, Santipur; Rajasthan : Abjulgar, Bijnor; Assam : Brahmaputra.

Elsewhere : Bangladesh : Hajrapur, Jessore, Purnea, Mangura.

Remarks : This species was first reported from Assam by Alcock (1910). This is the first report of this species from Arunachal Pradesh.

(v) Genus ***Liotelphusa*** Alcock

10. ***Liopelphusa laevis laevis*** (Wood-Mason)

1871. *Telphusa laevis* Wood-Mason, *J. Asiat. Soc.* Bengal, **40** : 201. T. 14, F. 1-6.

1910. *Paratalphusa* (*Liotelphusa*) *laevis* var. *quadrata* Alcock, *Cat. Ind. decap Crust. Indian Museum*, **1** (2) : 111, T. 14, F. 28.

1910. *Paratalphusa* (*Liotelphusa*) *laevis*. Alcock *Cat. Ind. decap. Crust. Indian Museum*, **1** (2) : 109. T. 13, F. 65.

1970. *Liotelphusa laevis laevis* Bott, *Abh. Senckenb. Natur. Ges.* No. **526** : 49 pl. 6, F. 63-65, pl. 27, F. 28, pl. 33, F. 17-20.

Type species : *Telphusa laevis* Wood-Mason. *Type locality* : Sibsagar : Assam (Quadrata), North India (Tescherrapundchi) Cherrapunjee (Laevis).

Material examined : 3FF & 2MM, Lagru R. near PWI Camp. Dist. Upper Siang, Coll. T. Roy & Party, 19.10.1998; 4FF & 2MM from Yamna R., Gobuk Vill., Dist. Upper Siang, Coll. T. Roy & Party, 20.10.1998; 5FF & 5MM from Dirang, Dist. West Kameng, Coll. T. Roy & Party, 27.10.1998; 5FF & 9MM from Khertang, Dist. Changlong, Coll. T. roy & Party, 20.3.1999.

Distribution : India : Arunachal Pradesh, Meghalaya : Cherrapunjee, Shillong, Khasi Hills, Garo Hills; Assam : Sibsagar; West Bengal : Darjeeling; Nagaland : Naga Hills.

Remarks : As many as 49 specimens of the species are reported for the first time from Upper Siang and West Kameng districts of Arunachal Pradesh.

(vi) Genus ***Potamiscus*** Alcock

11. ***Potamiscus decourcyi*** (Kemp)

1913. *Potamon* (*Potamiscus*) *decourcyi* Kemp, *Rec. Indian Mus.*, **8** : 289, pl. 17. Fig. 1-3.

1966. *Potamiscus* (*Potamiscus*) *decourcyi* Bott, *Senckenbergiana biol.*, **47** : 480, Abb. 13.

1970. *Potamiscus decourcyi* Bott, *Abh. Senckenb. naturd.* : Ges. No. **526** : 159, pl. 38, F. 29, pl. 46, F. 27.

Type species : *Potamon* (*Potamiscus*) *decourcyi* Kemp. *Type locality* : (Sibsagar) Assam.

Material examined : 1F & 2MM from Lagru R. near PWD Camp Dt. Upper Siang, Coll. T. roy & Party, 19.10.1998.

Distribution : India : Arunachal Pradesh, Nagaland : Naga Hills; Assam : Sipror valley, 200 km North of Sibsagar.

Remarks : *Potamiscus decourcyi* is reported herein for the first time from Arunachal Pradesh.

(vii) Genus ***Potamon*** Savigny

12. ***Potamon edwardsi*** (Wood-Mason)

1871. *Telphusa edwardsi* Wood-Mason, *J. Asiat. Soc. Bengal*, **40** : 449, T. 37, F. 11-15.

1910. *Potamon* (*Potamon*) *edwardsi hirtum* Alcock, *Cat. ind. decap. Crust. Ind. Mus.*, **1**(2) : 36. T. 10, F. 36.

1966. *Potamon* (*Potamon*) *edwardsi*, *Bott*, *Senckenbergiana biol.*, **47** : 475, Abb. 7 (Lit.)

1970. *Potamon edwardsi* Bott, *Abh. Senckenb. naturd* : *Ges* No. : **526** : 143, pl. 38, F. 18, pl. 48, F. 16.

Type species : *Talphusa edwardsi* Wood-Mason. *Type locality* : Hotha, Tyunan, Kakhyen Hills, Pousee, Upper Burma.

Material examined : 1M & 1F Namsang, dist. Tirap, coll. T. Roy & Party, 26.7.1999.

Distribution : India : Arunachal Pradesh : Namsang, Dt. Tirap.

Elsewhere : Kakhyen Hills, Ponsu, Upper Myanmar.

Remarks : *Potamon edwardsi* is reported for the first time from Arunachal Pradesh.

REFERENCES

ALCOCK, A. 1910. The Indian Freshwater Crabs - Potamonidae. *Cat. Ind. decap. Crust. Ind. Mus.*, **1**(2) : 1-1, 30.

BOTT, R. 1970. Die Subwesserkrabbean von. Europa, Asien, Arustali und ihre Stammesgeschichte. *Abh. senckenb natur. Ges.* No. **526** : 1-338.

D. R. JALIHAL, S. SHENOY & K. N. SANKOLLI. 1988. Freshwater prawns of the genus *Macrobrachium* Bate, 1868 (Crustacea : Decapoda : Palaemonidae) from Karnataka, India. *Rec. zool. Surv. India, Occ. Paper* No. **112** : 1-74.

GHOSH, S. K., T. ROY & S. BHADRA. 1999. Palaemonidae (Crustacea : Decapoda) *Fauna of Meghalaya. State Fauna Series,* **4**(Part-4) : 557-567. (Published by the Director, *zool. Surv. India;* Calcutta.)

GHOSH, S. K. & T. ROY. 2000. Palaemonidae (Crustacea : Decapoda) *Fauna of Tripura, State Fauna Series* **7**(Part-4) : 267-272. *(*Published by the Director, *zool. Surv. India; Calcutta)*

HOLTHUIS, L. B. 1950. The Decapoda of the Siboga Expedition. Part X. The Palaemonidae collected by the Siboga and Snellius Expeditions with remarks on other species. 1. Subfamily Palaemoninae. *Siboga Exped., Monogr.*, **39a**(9) : 1-268.

KEMP, S. W. 1913. Zoological results of the Aben Expedition. *Rec. Ind. Mus.* (Crustacea : Decapoda), **8** : 289-310.

KURIAN, C. V. & V. O. Sebastian. 1993. *Prawns and Prawn Fisheries of India* : 1-267.

ROY, T., S. K. GHOSH & S. S. GHATAK. 2003. Palaemonidae : Potamonidae (Crustacea : Decapoda). *Fauna of Sikkim, State Fauna Series,* **9**(Part 5) : 117-119.

ROY, T., S. K. GHOSH & S. S. GHATAK. 2004. Papaemonidae : Potamonidae (Crustacea : Decapoda) *Fauna of Manipur, State Fauna Series,* **10**(Part 3) : 119-123.

TIWARI, K. K. 1955a. Distribution of Indo-Burmese freshwater prawns of the genus Palaemon Fabr. and its bearing on the Satpura hypothesis. *Bull. natn. Inst. Sci. India,* **7** : 230-239.

TIWARI, K. K. 1955b. Trend of evolution in the *hendersoni* group of species of *Palaemon* Fabr. (Crustacea : Decapoda) *Bull. natn. Inst. Sci. India,* **7** : 189-197.

TIWARI, K. K. 1963. A note on the freshwater prawn, *Macrobrachium altifrons* (Henderson, 1893) Crustacea : Decapoda : Palaemonidae. *Proc. Zool. Soc.* **16**(2) : 225-238.

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2) : 47-48, 2006

LEECHES

C. K. MANDAL
Zoological Survey of India, M-Block, New Alipore, Kolkata-700053

INTRODUCTION

Annelids of Arunachal Pradesh comprise the class Hirudinea. The worms belonging to the class Hirudinea are the leeches. They have annuli in each segment, eye spot, male and female pores, single and median. They bear suckers, possess 'hirudin' - an anticoagulant of blood and are mostly sanguivorous. These hermaphrodite invertebrates generally inhabit in freshwater environment though some are terrestrial and a few marine.

The non-venomous leeches may be used as remedies in throat and inflammatory swelling and blood pressure due to the presence of their property of sucking blood in excess.

Our knowledge on the taxonomy of annelid fauna of Arunachal Pradesh is confined to the contributions of Moore (1924), Moquin-Tandon (1826) and Chandra (1983, 1991) on leeches.

The present report is based on the collections of leeches made from Arunachal Pradesh by the Arunachal Pradesh Hill Station, Zoological Survey of India, Itanagar. The material comprises seven species of leeches.

SYSTEMATIC ACCOUNTS

Class HIRUDNEA

Order ARHYNCHOBDELLAE

Family HAEMADIPSIDAE

Haemadipsa montana Moore, 1927

1927. *Haemadipsa montana* Moore, *Fauna Brit. India, Hirudinea* : 269.

Material examined : Jong Army Camp to PTSO, Tawang District, 1 ex., 24.ix.1997, coll. G. Thirumalai & Party.

Distribution : India : Arunachal Pradesh; Sikkim; West Bengal; Tamil Nadu.

Remarks : This is an endemic species.

Haemadipsa ornata Moore, 1927

Haemadipsa ornata Moore, *Fauna Brit India Hirudinea* : 284.

Material examined : Papu Nallah and around, Itanagar, 1 ex., 3.v.2001, coll. P. T. Bhutia & Party.

Distribution : India : Arunachal Pradesh; Assam; West Bengal.

Haemadipsa sylvestris Blanchard, 1894

1894. *Haemadipsa sylvestris* Blanchard, *Annali Mus Civ Stor. nat. Giacomo Doria,* 2(4) : 113.

Material examined : Ruksin, Pasighat, East Siang District, 1 ex., 28.iii.1997, coll P. T. Bhutia & Party.

Distribution : India : Arunachal Pradesh; Assam; West Bengal; Uttar Pradesh.

Elsewhere : Burma, Indonesia, Sumatra.

Haemadipsa zeylanica zeylanica (Moquin-Tandon), 1826

1826. *Sanguisuga zeylanica* Moquin-Tandon, *Monographie de lafamille des Hirudiness, Montpellier*

Material examined : Jong Army Camp to PTSO Tawwang District, 1 ex., 24.ix.1997, coll. G. Thirumalai & Party.

Distribution : India : Arunachal Pradesh; Himachal Pradesh.

Elsewhere : Sri Lanka.

Haemadipsa zeylanica agilis Moore, 1927

1927. *Haemadipsa zeylanica agilis* Moore, *Fauna Brit. India Hirudinea* : 266.

Material examined : Ruksin, Pasighat, East Siang District, 1 ex., 28.iii.1997, coll. P. T. Bhutia & Party.

Distribution : India : Arunachal Pradesh; Jammu & Kashmir; Himachal Pradesh; Uttar Pradesh.

Elsewhere : Nepal.

Remarks : It is a common land leech of eastern and western Himalayas.

Haemadipsa zeylanica montivindicis Moore, 1927

1927. *Haemadipsa zeylanica montivindicis* Moore, *Fauna Brit. India, Hirudinea* : 267.

Material examined : Papu Nallah and around, Itanagar, 1 ex., 3.v.2001, coll. P. T. Bhutia & Party.

Distribution : India : Arunachal Pradesh; Assam; Sikkim; West Bengal.

Haemadipsa sp.

Material examined : Papu Nallah and around, Itanagar, 1 ex., 3.v.2001, coll. P. T. Bhutia & Party.

SUMMARY

The paper deals with seven species of leeches collected by the staff members of Arunachal Pradesh Field Station, Zoological Survey of India, Itanagar, from Arunachal Pradesh during 1997 to 2002.

ACKNOWLEDGEMENTS

The author remains grateful to the Director, Zoological Survey of India, Kolkata for facilities. Thanks are also due to the Officer-incharge, Arunachal Pradesh Field Station, Zoological Surey of India, Itanagar for providing us with the specimens for study.

REFERENCES

CHANDRA, M. 1991. *The Leeches of India - A Hand Book.* Zoological Survey of India, Kolkata : 1-117.

CHANDRA, M. 1983. A checklist of Leeches of India, *Rec. zool. Surv. India,* **80** : 265-290.

MOORE, J. P. 1924. Notes on some Asiatic Leeches (Hirudinea), principally from China, Kashmir and British India. *Proc. Acad. Nat. Sci., Phillad.,* **81** : 343-388.

MOQUIN-TANDON, 1826. *Monographic de lafamille des Hirudinees,* Montpellier.

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2) : 49-53, 2006

TREMATODES OF AMPHIBIAN

P. T. BHUTIA
Arunachal Pradesh Field Station, Zoological Survey of India, Senki Valley, Itanagar-791113

INTRODUCTION

The state of Arunachal Pradesh, called "the land of rising sun", and located between latitude-26°28' N to 29°30' N and longitude 91°30' E to 97°30' E is the largest state in the North East with an area of 83,743 sq. Km. The state is bounded by China occupied Tibet on the North, Bhutan on the West, Myanmar on the East and Assam on the South.

Digenea of class Trematoda of Phylum Platyhelminthes form a vast group of organisms which are endo-parasitic. The adult of these parasites are found in various body organs of their hosts and are totally dependant on them for food and shelter. Animals like fishes, frogs, reptiles, birds and mammals, many of which form a great part of the food sources for human population or are otherwise useful to the latter are not free from parasitic worms which by their presence make them (i.e. the hosts) unhealthy and unfit for human consumption, thus causing heavy loss to the economy of the country. Many a times these vertebrate hosts serve as reservoir of infection for man also. The importance of these worms from medical and veterinary standpoint, therefore, cannot be minimized.

For long times, amphibians have proved to be an excellent hosts for Trematode parasites. Some of these animals are available throughout the year and are usually found to be harbouring Trematode parasites in them. The most common amphibians like *Euphlyctis cyanophlyctis, Fejervarya limnocharia, Rana tirgina, Bufo melanostictus* are usually examined by various workers in different parts of India. Amphibians feeds on insects, and snails which are the carrier of the trematode larvae. They also get infected with trematodes while consuming plants on which trematodes larvae are encisted.

In India, the major work on exploration and description of several species of amphibian trematodes are reported from Uttar Pradesh (srivastava 1933a, 1934; Singh, 1954; Agrawal,1966, 1968; Gupta and Jehan, 1968; Pandey and Chakraborty, 1968; Mukherjee and Ghosh, 1970) from Kashmir (Kaw, 1941) and from West Bengal (Mukherjee and Ghosh, 1970; Hafeezullah and Dutta, 1985). However, there is no report available on the amphibian trematodes from North Eastern parts of India in general except for the amphibian Trematodes Fauna reported by Diengdoh (1989) and Diengdoh and Taudac (1991) from Meghalaya and states of Arunachal Pradesh in particular. It is, therefore, the first record on systematic and faunistic survey of amphibian digenetic trematodes from the area, resulting into the recovery of parasites referred to here in for the first time.

The material was collected from 8 districts of Arunachal Pradesh namely Upper Subansiri, Lower Subansiri, Lohit, Tirap, East Siang, West Siang, Dibang Valley and Papum pare during 1989 to 2003. Althrough 43 Anuran Amphibian species are reported from Arunachal Pradesh (Chanda 2002), the author could examined only 10 species. They are *Fejervarya limnocharia* (Boie. In Weig), *Limnonectus limnocharis* (Gravenhorst), *Euphlyctis cyanophlyctis* (Schneider), *Bufo melanostictus* Schneider, *Amolops afganus* (Gunther), *Polypedates leucomytax* (Gravenhorst), *Polypedates maculatus* (Grey),

Pterorana khare Kiyaseto & Khare, *Haplobatrachus tigrinus* Daudin, *Rhacophorus maximus* Gunther. Out of 10 species of amphibia examined 7 species were found to harbour the termatode parasites.

SYSTEMATIC ACCOUNT

Class TREMATOD

Order DIGENEA

Family LECITHODENDRIIDAE Odhner, 1910.

Subfamily PLEUROGENETINAE Looss, 1989.

1. ***Pleurogenoides gastroporus*** (Travassos), 1921

1921. *Pleurogenoides gastroporus* Travassos, *Arch. Da. Enc. Sup. De. Aqric. & Med. Vet. Nictitherny,* **5**(1-7) : 73-79.

Material examined : From intestine of *Euphlyctis cyanophlyctis* (i) 3 exs., Daporijo, (Dist. Upper Subansiri), 24-x-89; (ii) 4 exs., Yazali, (Dist. Lower Subansiri), 30-x-89; (iii) 7 exs., Namsai, 14-ii-91; (iv) 5 exs., Wakro village (Dist. Lohit), 15-ii-91; (v) 9 exs., Halipad nallah, Pasighat, (Dist. East Siang) 20-x-92; (vi) 5 exs., 7th mile nallah, Pasight Road (Dist. East Siang), 21-x-92, (vii) 3 exs. Malanithan temple area, (Dist. West Siang), 02-ii-93; (Viii) 3 exs., Nirjuli, (Dist. Papum Pare) 15-ii-93; (ix) 4 exs., Gophur Road, Itanagar, 08-xi-02 from intestine of *Limnonectus limnocharis* 3 exs., Itanagar, (Dist. Papum Pare) 12.ii.03.

Distribution : Previous record : India : U.P. (Allahbad, Varanasi, Bareilly, Sitapur); Maharashtra (Nagpur, Ramtek); Rajasthan (Chitorgarh); Tamil Nadu (Chennai, Poonamalli, Thiruvannamayur, Kunrathur, Kourthalam); Kerala (Punalur).

Elsewhere : Bangladesh (Dacca).

Remarks : *P. Gastroporous* is reported for the first time from Arunachal Pradesh and is found to be not a common trematode of frogs. Simha (1958) however, reported this species from reptillian host *Chamaelion zeylanicus* from Hyderabad.

Subfamily PROSTOCINAE Yamaguti, 1958

2. ***Mehraorchis ranarum*** Srivastava, 1934

1934. *Mehraorchis ranarum* Srivastava, *Bull. Acad. Sci. U. P. Allahbad.,* **3**(4) : 239-256.

Material examined : 12 exs., from intestine of *Euphlyctis cyonophlyctis* (i) 2 exs., Kimin, (Dist. Lower Subansiri. 19-x-89; (ii) 3 exs., Nampong, (Dist. Changlang), 26-iii-91; 2 exs., Deomali, (dist. Tirap), 03-iii-91; (iii) 5 exs., Gohpur Road, Itanagar, (Dist. Papum Pare), 05-iii-93.

Measurements : Body 3.51-3.99×2.49-2.67. Oral sucker 0.38-×0.43×0.42-0.48. Ventral sucker 0.30-0.32×0.33-0.35. Testes two, right one 0.60-0.63×0.65-0.78 and left one 0.64-0.66×0.69-0.69. Cirrus sac 1.02-1.14×0.22-0.24. Ovary 0.42-0.63×0.50-0.66. Eggs 0.0275-0.0325×0.0150-0.0287.

Distribution : Previous record : India : U.P. (Lucknow, Sitapur); Rajasthan (Udaipur); Panjab (Hoshiarpur); A.P. (Hyderabad); West Bengal (Birati); Maharashtra (Ramtek, Nagpur); Bihar (Patna); Tamil Nadu (Chennai); Kerala (Punalur, Tenmala, Andoor).

Remarks : Sinha, Sahay and Prasad (1974) reported this species from bile duct of *Rana tigrina* from Patna. The vittelaria in the present specimen are very prominent and few in numbers this trematode was not frequently encountred.

Subfamily GANEONIAE Yamaguti, 1958

3. ***Ganeo tigrinum*** Mehra and Negi, 1928

1928. *Ganeo tigrinum* Mehra and Negi, *Allahabad Univ. Stud.,* **4** : 63-118.

Material examined : From intestine of *Euphlyctis cyanoplyctis* (i) 2 exs., Kimin, (Dist. Lower Subansiri), 19-x-89; (ii) 5 exs., Daporijo, (Dist. Upper Subansiri), 30-x-89; (iii) 5 exs., Namsai, (Dist. Lohit), 14-ii-91; (iv) 12 exs., Miao, Near Deban, (Dist. Tirap), 18-ii-1991; (v) 2 exs., Nampong, (Dist. Changlang), 21-ii-91; (vi) 3 exs., Deomali, (Dist. Tirap), 04-iii-91; 06 exs, 7th mile nallah, (Dist. East Siang), 19-x-92; 7 exs., Malanithan temple area, Likabali, (dist. West Siang), 02-ii-93; 5 exs., Shantipur, (Dist. Dibang Valley), 06-iv-93; 8 exs., from intestine of *Rana tigrina* (i) 3 exs., Yazali, (dist. Lower Subansiri), 30-xi-89 (ii) 5 exs., Namsai, (Dist. Lohit), 14-ii-91.

Measurements : Body 1.83-4.20×1.01-0.02.

Prepharynx 0.01-0.08×0.01-0.06. Pharynx 0.02-0.13×0.03-0.12. Oesophagus 0.17-0.51×0.02-0.10. Ventral sucker 0.10-0.22×0.09-0.09-0.21. Anterior testis 0.19-0.46×0.22-0.50. Posterior testis 0.21-0.50×0.25-0.65. Ovary 0.13-0.35×0.13-0.37. Eggs 0.020-0.30×0.15-0.020.

Distribution : Previous record : India : U.P. (Bhimatal, Almora, Barailly, Varanasi, Allahbad); Jammu & Kashmir (Srinagar, Salimar); Rajasthan (Jaisalmer, Jodhpur); A.P. (Hyderabad); Maharashtra (Nagpur, Ramtek); Tamil Nadu (Courtlam, Kunrathur, Chennai).

Elsewhere : Bangladesh (Dancca); Mayanmar (Ragoon).

Remarks : Specimens examined by the present authors also exhibit variable shape of excretory bladder i.e. U.V. and Y as described by Gupta (1977).

4. ***Ganeo gazipurensis*** Pandey & chakraborty, 1968

1968. *Ganeo gazipurensis* Pandey and Chakraborty, *Sci. & Cult.*, **34**(5) : 218-219.

Material examined : 1 ex., from intestine of *Fejervrya limnocharia,* Deomali, (Dist. Tirap), 28-ii-91.

Measurements : Body 2.55×0.90. Oral sucker 0.09-0.12 Ventral sucker 0.12×0.12. Prepharynx 0.03. Pharynx 0.12×0.09. Oesophagus 8.33. Intertior testis 0.24×0.24. Posterior testis 0.150×0100.

Distribution : Previous record : India : U.P. (Gazipur).

Remarks : Pandey and Charkaborty erected this species based on a single specimen. The lone specimen collected by the present author is, threrfore, a second record for this species. The present specimen is an immature form, with the presence of Y shaped excretory bladder clearly visible extending upto middle of body length just below ovary.

5. ***Ganeo lucknowensis*** Gupta and Jehan, 1976

1976. *Ganeo lucknowensis* Gupta and Jehan, *Indian J. Helminth.*, **28**(2) : 141-147.

Matearial examined : 1 ex., from intestine of *Fejervrya limnocharia,* Nirjuli, Itanagar (Dist. Papum Pare), 05-ii-92.

Measurements : Body 3.06×1.20. Oral sucker 0.13×0.16. Ventral sucker 0.14×0.16. Pharynx 0.10×0.80. Oesophagus 0.32×0.04. Ovary 0.27×0.32. Single large testis 0.42×0.61. Eggs 0.0250×0.0150.

Distribution : Previous record : India : U.P. (Lucknow).

Remarks : Gupta and Jehan (1976) erected the species based on a single specimen with a single large testis, collected from the urinary bladder of common toad, ***Bufo melanostictus***. The specimen referred to above is, therefore, the second record of the species but collected from the intestine of new host *Fejervarya limnocharia.*

Family PARAMPHISTOMIDAE Fischoeder, 1901

Subfamily DIPLODISCINAE Cohn, 1904

6. ***Displodiscus amphichrus*** Tubangui, 1933

1933. *Diplodiscus amphichrus* Tubangui, *Philipp J Sci.* **52**(2) : 167-197.

Material examined : 24 exs., from intestine of *Euphlyctis cynophlyctis* (i) 2 exs., Damporijo village, 5 Kms, from Daporijo, (Dist. Upper Subansiri), 26-x-89 (ii) 3 exs., Yazali, (Dist. Lower Subansiri), 01-xi-89 (iii) 2 exs., Namsai, (Dist. Lohit), 14-ii-91; (iv) 3 exs., Tibetan camp, Miao, (Dist. Tirap), 22-ii-91, (v) 2 exs., Helipad nallah, Pasighat, (Dist, East Siang), 08-ii-92; (vi) 3 exs., 7th mile nallah, Pasighat, (Dist. East Siang), 20-x-92; (vii) 2 exs., Likabali, (dist. West Siang), 03-ii-92; (viii) 2 exs., near circuit house, Roing, (Dist. Dibang valley), 12-ii-2003. (ix) 3 exs., Indira Gandhi Park, Itanagar (Dist. Papum Pare), 20-ix-02. (x) 2 exs., ZSI colony, Itanagar, (Dist. Papum Pare), 16-viii-03.

Measurements : Body 1.20-3.21×0.93-1.38. Oral sucker 0.20-0.27×0.20-0.36. Oral pouches 0.06-0.18. Oesophagus 0.48 0.16×0.10-0.03. Oesophageal bulb 0.05-0.18×0.04-0.15. Acetabulum 0.78-1.20×0.42-0.72. Testis 0.19-0.44×0.26-0.49. Cirrus sac 0.06-0.16. Ovary 0.08-0.27×0.11-0.32. Eggs 0.075-0.125×0.06-0.08.

Distribution : Previous record : India : U.P. (Allahbad, Lucknow, Almora, Bhimtal, Sitapur, Bareilly); Maharashtra (Ramtek, Bombay); Jammu & Kashmir (Shalimar, Punch, Srinagar, Shupyan, Harwan, Hundwara, Binn); A.P. (Guntur); West Bengal (Howrah); Tamil Nadu (Courtalm, Kunrathur, Chennai); Kerala (Punalur).\

Elsewhere : Philippiness, Manchuria, Korea, Japan.

Remarks : Some of the present specimen shows variation in the shape of ovary and length of intestine.

Familyn PLAGIORCHIIDAE Ward, 1917

Subfamily PLAGIORCHINAE Partt, 1902

7. ***Tremiorchis ranarum*** Mehra & Negi, 1926

1926. *Tremiorchis ranarum* Mehra & Negi *Parasitology,* **18**(2) : 168-181.

Material examined : 10 exs., from intestine of *Rana tigrina* (i) 3 exs., Deomali, (Dist. Tirap), 04-iii-91; (ii) 2 exs., 5 mile nallah, Pasighat, (Dist. East Siang); 27-i-93, (iii) 3 exs., Circuit house, Roing, (Dist. Dibang Valley), 12-iv-93. (iv) 2 exs., Nirjuli, Itanagar (Dist. Papum Pare) 14-ix-02.

Measurements : Body 5.49-1.41×1.11-1.41. Oral sucker 0.20-0.22×0.23-0.27. Pharynx 0.18-0.26×0.12-0.20. Oesophagus 0.59-0.17×0.08-0.14. Ventral sucker 0.34-0.46×0.36 0.48. Anterior testis 0.38-0.40×0.41-0.46. Posterior testis 0.38-0.42×0.49-0.56. Cirrus sac 0.67-0.87×0.16-0.25. Ovary 0.20-0.32×0.8-0.50. Eggs 0.0250-0.275×0.0100-0.0150.

Distribution : Previous record : India : U. P. (Lucknow, Sitapur); Haryana (Karnal); West Bengal (Calcutta); Maharashtra (Ramtek, Jabalpur, aurangabad; Tamil Nadu (Courtlam Kunrathur, Chennai); Kerala (Kulathupuzha, Punalur); Bihar (Patna).

Remarks : The present specimens exhibits variations in the topography and size of testis and cirrus sac.

Family HEMIURIDAE Luhe, 1901

Subfamily HEMIURINAE Ejamont, 1931

8. ***Halipegus mehransis*** Srivastava, 1933.

1933. *Halipegus mehransis* Srivastava, *Bull. Acad. Sci. U.P. Allabhad,* 3(1) : 41-60.

Material examined : 8 exs., (i) 2 exs., from intestine of *Euphlyctis cynophlyctis* Deomali, (Dist. Tirap), 04-iii-91 (ii) 2 ex., from stomach of *Bufo melanostictus,* Deomali, (Dist. Tirap) 05-iii-91; (iii) 2 exs., from intestine of *Rana tigrina,* Banderdewa, Itanagar, (Dist. Papum Pare), 05-ii-92. (iv) 2 exs., Naharlgun (Dist. Papum Pare) 15-x-02.

Measurements : Body 4.05-4.6×1.11-1.15. Oral sucker 0.31-0.35+0.28-0.30. Pharynx 0.14-0.16+0.12-0.14. Oesophagus 0.04-0.06. Testis two, Right testis 0.39-0.41×0.34-0.35. Left testis 0.39-0.40×0.38-0.39. Vesicula seminalis 0.21-0.23×0.20-0.21.Ovary 0.40-0.42×0.38-0.39 Vitellaria in two groups, Right Vitelline gland with four lobes 0.31-0.33×0.29-0.30 Left Vittelline gland with five lobes 0.43-0.44×0.28-0.30. Eggs 0.04.00×0.0175-0.0200.

Distribution : Previous record : India : U.P. (Bareilly, Sitapur); A.P. (Hyderabad); Maharashtra (Ramtek); Nagpur; Bihar (Rachi); Tamil Nadu (Chennai); Kerala (Punalur).

Elsewhere : Myanmar, Ceylon.

Remarks : The Percentage of infection by this parasites was found to be very low, as out of 500 examples of amphibian host examined, only 4 were found to be positive for infestation.

ACKNOWLEDGEMENT

I am thankful to the Director, Zoological Survey of India, for permission to undertake tours in different districts of Arunachal Pradesh and for providing facilities for the study.

SUMMARY

The present paper deals with the study of 154 examples of amphibian digenetic trematodes collected from Districts Upper Subansiri, Lower Subansiri, Papum Pare, East Siang, West Siang, Lohit Tirap, Changlang and Dibang Valley. The study reveals the parasites as belonging to 4 families, 6 sub-families and 8 species spread over 6 genera. All the species recorded herein constitute the first record of their occurrence in Arunachal Pradesh.

REFERENCES

ARGAWAL, V. 1966. Studies on some trematode parasites of frogs from Lucknow, *Indian J. Helminth.*, **18** : 82-90.

AGRAWAL, V. 1968. On some trematode parasites of amphibia from Lucknow, *Rev. Biol. Trop.*, **15** : 1-11.

CHANDA, S. K. 2002. Hand Book Indian amphibians. Published by Director Zoological Survey of India, Kolkata : 1-335.

DIENGDOH, C. R. (1989). Hclminth parasite spectram of amphibian hosts in Meghalaya, Ph. D. thesis. *North-Eastern Hill University,* Shillong, 129.

DIENGDOH, C. R. and TANDON, V. (1991). A new species of polystoma (Manogenea) parasites in rhacophorid amphibians in meghalaya, India, *Helminthologia,* **28** : 173-178.

GUPTA, V. and JEHAN, A. 1978. On two new trematodes parasites of amphibia from Lucknow, *Indian J. Helminth.*, **28**(2) : 141-147.

KAW, B. L. 1950. Studies on Helminthology; helminth parasites of Kashmir, Part I. Trematodes, *Ind. J. Helm.*, **2** : 67-126.

MUKHERJEE, R. P. and GHOSH, R. K. 1970. Studies on some amphibian trematodes from Uttar Pradesh and West Bengal. *Ind. J. Helminth.*, **32**(1) : 67-78.

PANDEY, K. C. and CHAKRABORTY, K. K. 1968. On a new trematode from common Indian frog *Ganeo gazipurensis n. sp. Sci & Cult.*, **34**(5) : 218-219.

SIMHA, S. S. 1958. Studies on the trematode parasites of reptiles found in Hyderabad state, *Z. parasitkde.*, **18** : 6161-218.

SINGH, K. S. 1954. Some trematodes collected in India. *Trans. Amer. Micros.*, **73** : 202-210.

SRIVASTAVA, H. D. 1933a. On new trematodes of frogs and fishes of the United Provinces, India, Part I. 1 New distomes of the family Hemiuridae Luhe, 1901 from North Indian fishes and frogs with a systematic discussion on the family Helepegidae poche, 1926 and the genera *Vitellotrema* Guberlet, 1928 and *Genarchopsis* Ozaki, 1925. *Bull. Acad. Sci. U. P. Allahbad.*, **3**(1) : 41-60.

SRIVASTAVA, H. D. 1933b. On a new trematodes of frogs and fishes of the United Provinces, PartII. Three new trematodes of the subfamily Pleurogenetinae (fam. Lecithodendriidae) from *Rana cyanophlyctis of Oudh. Ibid.*, **b3**(2) : 99-112.

SRIVASTAVA, H. D. 1934. On new trematodes of frogs and fishes of United Provinces, India, Part III. On a new genus *Mehrorchis* and two new species of Pleurogenes (Pleurognetinae) with a systematic discussion and revision of the family Lecithodendriidae. *Ibid.*, **3**(4) : 239-256.

TRIPATHI, J. C and BHUTIA, P. T. 1986. Observation on multiple infestation of Digenetic trematodes in common Indian frog *Rana cyanophlyctis* from Uttar Pradesh Terai. *Proc. Nat. Symp New Dimensions Parasit; Allahbad,* 18-19 Jan. 55-56.

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2) : 55-65, 2006

INSECTA : COLLEMBOLA

A. K. HAZRA, G. P. MANDAL, S. K. MITRA AND MISS. B. BHATTACHARYA
Zoological Survey of India, M-Block, New Alipore, Kolkata-700053

INTRODUCTION

Spring tails are small insects, the largest species attaining a maximum length of 6 mm. The mouth parts are withdrawn into the head capsule; the first abdominal segment bears a ventral pair of basally fused vesicles, the collophore; most species have ventral bifurcate appendage, the tenaculum and furcula, on the third and fourth abdominal segments. With very few exceptions (e.g., *Tomocerus*), juveniles closely resemble adults. Collembola are abundant and ubiquitous, probably exceeding all other insects in numbers of individuals, but their small size and sensitivity to desiccation restrict most species to humid situations.

The first study of Collembola from India is of Ritter (1911), Imms (1912) made significant contribution on Indian Collembola. The knowledge of Indian Collembola was further enriched through the contribution of several workers like Carpenter (1913, 1924), Handschin (1920), Mukherjee (1932), Denis (1936), Salmon (1957), Baijal (1955), Choudhuri (1963, 1966), Yosii (1966a, b), Mitra (1967-1993), Prabhoo (1971) and Hazra (1995).

Mitra (1975), described a new species of *Siera viz., S. arunachala,* from Namdhapa area of Arunachal Pradesh. The present study of Collembolan fauna is based on collection made during 1999 from Arunachal Pradesh by Zoological Survey of India, as a part of the Action Plan on State Fauna.

The present contribution is the first consolidated record of this group of insects from the State of Arunachal Pradesh involving 27 species under 15 genera of 3 families.

SYSTEMATIC ACCOUNT

Order COLLEMBOLA
Suborder ARTHROPLEONA

Key to the Superfamilies of ARTHROPLEONA

1. First thoracic segment dorsally distinct with dorsal setae. ..... PODUROIDEA Womersley, 1933

– First thoracic segment without dorsal setae and frequently more or less reduced or hidden dorsally by mesothoracic segment. ..... ENTOMOBRYODEA Womersley, 1933

Key to the families of PODUROIDEA

1. Pseudocelli present, at least on antennal base or dorsum of fifth abdominal segment. ..... ONYCHIURIDAE, Gervais, 1841

– Pseudocelli absent. ..... HYPOGASTRURIDAE Bourlet, 1839

Key to the families of ENTOMOBRYODEA

1. Hind coxae usually with trochanteral organ. Abdomen IV appreciably longer than abdomen III. Scales present or absent, often ciliated. Furcula well developed. ..... ENTOMOBRYIDAE, Tomosvary, 1882

– Hind coxae without trochanteral organ. Abdomen III and IV usually subequal; the abdomen IV never more than one and one-half times as long as the abdomen III, the other posterior abdominal segments often fused. Scales usually not present. ..... ISOTOMIDAE, Borner, 1913

Key to the subfamilies of ENTOMOBRYIDAE

1. Dentes dorsally crenulated and curving upwards basally in the line with manubrium. .... ENTOMOBRYINAE, Schaeffer, 1896

– Dentes not crenulated, straight and usually forming a basal angle with manubrium. 2

2. Dental scale absent. 3

– Dental spine present on the basal portion of the dentes only. .... TOMOCERINAE, Schaeffer, 1896

3. Eyes and pigment absent; dentes with large dorsal scale without apical lobe. .... CYPHODERINAE, Borner, 1913

– Eyes and pigment present; dentes without dorsal scale and with apical lobe. .... PARONELLINAE, Borner, 1913

Family HYPOGASTRURIDAE

(a) Subfamily HYPOGASTRURINAE

Absence of true pseudocelli and the simplicity of the sense organ of the third antennal segment is best recognised of this family. Mandible with a basal molar plate is easily seen of this subfamily.

This subfamily represents two genus and species from Arunachal Pradesh.

I. Genus ***Hypogastrura*** Bourlet, 1839

1. ***Hypogastrura indovaria*** Salmon, 1970

1970. *Hypogastrura indovaria* Salmon, *Trans. Biol. Sci.*, **12**(13) : 149.

Material examined : Between Bame and Basar, *West Siang distt.* 28.iii.1999, coll. A.K. Hazra, 2 exs.; Fence of Helipad, Tawang, *Tawang distt.* 7.iv.1999, coll. A.K. Hazra, 6 exs.; Hill stream inside Itanagar Zoo, *Phpumpare distt.*, 21.iii.1999, coll. A.K. Hazra, 6 exs.

Diagnostic characters : Body length upto 0.8 mm. Brownish black fields. Sparse to heavy clothing of short and long curved simple setae. Antennae shorter than head. P.A.O. very irregular consist of 4-12 indistinct disconnected lobes. With or without central boss. abd. VI with two long anal spines on papillae. Tenant hairs never clavate. Mucro finely cranulate and spoon-shaped with two distinct lamellae.

Distribution : India : Arunachal Pradesh, Manipur, Mizoram, Sikkim.

II. Genus ***Xenylla*** Tullberg, 1869

2. ***Xenylla obscura*** Imms, 1912

1912. *Xenylla obscura* Imms, *Proc. Zoll. Soc. Londen.*, 80-125.

1970. *Xenylla obscura* Salmon, *Roy. Soc. N. Z. Biol. Sci.*, **12**(13) : 145-152.

Material examined : 2 km away from Muri, *Upper Subansiri distt.*, 25.iii.1999, coll. A.K. Hazra, 1 exs.; way to Daporizo, *Upper Subansiri distt.*, 26.iii.1999, coll. A.K. Hazra, 1 ex.

Diagnostic characters : Body length upto 1.4 mm; elongate in shape; colour indigo-blue, segmental margins and ventral side pale. Antennae ratio as 10 : 12 : 12 : 14. P.A.O. absent. Unguis carinate, without lateral teeth, but with 1, 1, 1 inner tooth near the apex. Unguiculas absent. Ventral tube with 4 + 4 setae. Tenent hair, 2, 2, 2 very long and capitate at the end. Dentes and mucro separated. Mucro short, obtuse anal blunt on apex, with a narrow rounded lamella, which is often very obscure.

Distribution : India : Arunachal Pradesh, Manipur, Nagaland, Sikkim and Maharashtra (Bombay).

Family HYPOGASTRURIDAE

(b) Subfamily NENAURINAE, Salmon, 1964

Mandible without molar plate or absent and easily distinguish from Hypogastrurinae.

III. Genus ***Lobella*** Borner

The genus is represented by single species from Arunachal Pradesh.

3. ***Lobella kraepelini*** Yosii, 1959

1906. *Protanura kraepelini* Borner

1910. *Neanura dubiosa* Ritter

1912. *Neanura pudibunda* Imms

1917. *Protanura spinifera* Carpenter

1959. *Lobella kraepilini* Yosii, *Contr. Biol. Lab. Kyoto. Univ.*, **10** : 1-65.

Material examined : Nechipu, Culvert No. B-89/2, *West Kameng distt.*, 1.iv.1999, coll. A.K. Hazra, 2 exs.; Way to Bame Leni village, *West Kameng distt.*, 1.iv.1999, coll. A.K. Hazra, 6 exs.

Diagnostic characters : Body length upto 2.3 mm. Colour red in living and milky white in alcohol. Antennae Head as 5 : 6. Ant. III and IV are almost fused dorsally. P.A.O. present. Eyes 3 + 3. Mandibles are well developed, triangular in shape and with 6 teeth. Maxillae are elongated, distally 2 toothed and accompanied by a fringed, hyaline lamella, whose apex is surpassing by far the head of the maxillar shaft. A paired tubercle of Abd. VI are also situated far apart to each other, thus giving rise to the species a prominent feature to distinguish it from other related species of the genus.

Distribution : India : Arunachal Pradesh, Mizoram.

Family ENTOMOBRYIDAE

(c) Subfamily ENTOMOBRYINAE, Schaeffer, 1896

Body with hairs or scales or both the chaetotaxy of head and trunk and eye numbers are useful in identifying the members of this family. Dentes crenulated dorsally. Mucrone fulcate with basal spine, it is short and hook-like.

IV. Genus ***Lepidocyrtus*** Bourlet, 1839

The genus is represented by six species from Arunachal Pradesh.

Key to the species of *Lepidocyrtus*

1. VI-th abdominal segment with elongate cerciform tergum. .... *Lepidocyrtus caudatus* Carpenter, 1917

– VI-th abdominal segment without elongate cerciform tergum. 2

2. Dental lobe with accessory apparatus. .... *L.* (*Acrocyrtus*) *malayanus* Yosii, 1959

– Dental lobe without accessory apparatus.... 3

3. Th. II is very prominent and protruded over the head, Abd. II : IV = 1 : 7. .... *L. magnificus* Carpenter, 1917

– Th. II is protruded considerably over the head.

4. Th. II is slightly protruded over the head. Th. II, III as 75 : 25. Abd. III : IV as 3 : 12. .. .. *L.* (*Acrocyrtus*) *heterolepis* Yosii, 1959

5. Mesothorax is moderately hanging over the head. Th. II : III as 2 : 1. Abd. III : IV as 1 : 4..... *L.* (s. str) *curvicollis* Bourlet

– Mesothorax slightly protruded over the head. Th. II/III as 5 : 3. Abd. III/IV as 4 : 13. ... . *L. cyaneus* Tullberg

4. ***Lepidocyrtus caudatus*** Carpenter, 1917

1917. *Lepidocyrtus caudatus* Carpenter, *Rec. Ind. Mus Cal.*, **8**(ix) : 561-568.

Material examined : Road side Fountain on way to Daporizo, *Upper Subansiri distt.*, 27.iii.1999, coll. A. K. Hazra, 1 ex.

Diagnostic characters : Mesonotum slightly prominent, half as long as metanotum. Abd. IV six times as long as Abd. III. Abd. VI. prolonged into a slender cerci form process. Colour pale yellow with violet patches on antennal segments, a violet spot on Th. II and Abd. III, IV and V.

Distribution : India : Arunachal Pradesh, Manipur, Sikkim.

5. ***Lepidocyrtus (Acrocyrtus) malayanus*** Yosii, 1959

1959. *Lepidocyrtus (Acrocyrtus) malayanus* Yosii, *Contr Biol. Lab. Kyoto. Univ.*, **10** : 28.

Material examined : Sangrila, way to Sela top, *Tawang distt.*, 7.iv.1999, coll. A.K. Hazra, 100 exs.

Diagnostic characters : Body length 2.5 mm. Ground colour brownish white, antennal distally with bluish pigment from Ant. II. Eye 6 + 6.

Scales are present dorsally upon Ant. I and II. Ratio of Antennal segs. = 9 : 18 : 11 : 23; Ths II : III = 7 : 3; Abd. III : IV = 1 : 5. Manubrium : dentes = 9 : 8. Dorsal appendix of dental lobe is prominent, Acutely pointed in profile.

Distribution : India : Arunachal Pradesh, Manipur, Sikkim;

Elsewhere : Singapore.

6. ***Lepidocyrtus*** (s. str.) ***magnificus*** Carpenter, 1924

1924. *Lepidocyrtus* (s. str.) *magnificus* Carpenter, *Rec. Ind. Mus. Cal.*, **26** : 285-289.

Material examined : Way to Sessa, Culvert No. R-55/4A, *West Kameng distt.*, 31.iii.1999, coll. A.K. Hazra, 52 exs.

Diagnostic characters : Mesonotum four times as long as metanotum. Abd. IV. Seven times as long as Abd. III. Antennae twice as long as head. colour pale-yellow with Ant. III and IV, edges of Th. II and III and last abdominal segment dark violet. Relatively short III antennal segment. Mucro stout with strong teeth, the dorsal spine-short.

Distribution : India : Arunachal Pradesh, Manipur, Sikkim, Mizoram, Assam, Tripura (West Distt.).

7. ***Lepidocyrtus (Acrocyrtus) heterolepis*** Yosii, 1959

1959. *Lepidocyrtus (Acrocyrtus) heterolepis* Yosii, *Contr. Biol. Lab. Kyoto. Univ.*, **10** : 33.

Material examined : Way to Senge, Dirang, *West Kameng distt.*, 4.iv.1999, coll. A.K. Hazra, 5 exs; Rupa Valley, beside hill slope, *West Kameng distt.*, 1.iv.1999, coll. A.K. Hazra, 50 exs; Fence of Helipad, Tawang, *Tawang distt.*, 7.iv.1999, coll. A.K. Hazra, 6 exs.

Diagnostic characters : Length upto 1.6 mm. Antennae uniformly bluish pigmented. A transverse stripe along the fore margin head. Eyes black. Ant. segment ratio as 15 : 30 : 28 : 48. Th. II is slightly protruded over the head. Th. II, III as 75 : 25. Abd. III : IV as 3 : 12. Manubrium; Dens as 24 : 28. Mucro bidentate, two teeth subequal and with a basal spine.

Distribution : India : Arunachal Pradesh, Manipur.

Elsewheree : Singapore, Malay.

8. ***Lepidocyrtus*** (s. str.) ***curvicollis*** Bourlet

1959. *Lepidocyrtus* (s. str.) *curvicollis* Yosii, *Contr. Biol. Lab. Kyoto. Univ.*, **10** : 23.

Material examined : 2 kms. ahead of Jasowant Garh, way to Sela top, *Tawang distt.*, 6.iv.1999, coll. A.K. Hazra, 100 exs.

Diagnostic characters : Body up to 2.0 mm. Ground colour white with slight brownish tinge. Antennal bluish distally from Ant. II. Basal two segments of each legs slightly pigmented to blue. Eyes black. A black spot is present between eyes. Ant./Head as 2 : 1. Ant. segm. ratio as 1 : 2 : 3. Antennae scaled from the basis until to the basal part of Ant. IV. Meso thorax is moderately hanging ones the dhead. Th. II : III as 2 : 1. Abd. III/IV as 1 : 4. Legs are scaled until to the tibiotarsus. Manubrium : Dens = 25 : 26. Dentes without dental appendix. Mucro bidentate and with a basal spine.

Distribution : India : Arunachal Pradesh.

Elsewhere : Europe (Belgium).

9. ***Lepidocyrtus cyaneus*** (Tullberg) 1869

1959. *Lepidocyrtus cyaneus* Yosii, *Contr. Biol. Lab. Kyoto. Univ.*, **10** : 25.

Material examined : Way to Yazali, *Upper Subansiri Distt.*, 24.iii.1999, coll. A.K. Hazra, 22 exs.

Diagnostic characters : Body length upto 1.0 mm. Legs are coloured on the proximal half of each coxae. Furcula coloured until to the basal part of dentes. Ant. segments ratio as 10 : 19 : 19 : 32. Mesothorax slightly protruded over the head. Th. II : III as 5 : 3. Abd. III : IV as 4 : 13. Dental lobe without appendix. Manubrium : Dens = 10 : 9. manubrium ventrally scaled and with 2 + 2 serrated terminal setae.

Distribution : India : Manipur, Arunachal Pradesh.

Elsewhere : Singapore, Malay, Vietnam.

V. Genus ***Lepidosira*** Schott., 1925

The genus is represented only by single species from Arunachal Pradesh.

10. ***Lepidosira unguserrata*** Salmon, 1970

1970. *Lepidosira unguserrata* Salmon, *Trans. Biol. Sci.*, 12(13) : 145-152.

Material examined : Pine forest near Tazang vill., ZIRO, *Lower Subansiri distt.*, 23.iii.1999, coll. A.K. Hazra, 120 exs.; New Urgeling, Tawang, *Tawang distt.*, 7.iv.1999, coll. A.K. Hazra, 100 exs.

Diagnostic characters : Brownish with deep blue ocellar fields. antennal about three times as long as head, the four segments related as 45 : 90 : 75 : 125. Ant. iv with apical sensory knob. Abd. IV four times as long as Abd. III. A single strong clavate tenent hair subequal to claw in length. Mucro bidentate with slightly curved basal spine; Length upto 2.2 mm.

Distribution : India : Arunachal Pradesh, Sikkim.

VI. Genus ***Dicranocentrus*** Schott, 1925

The genus is represented by two species from Arunachal Pradesh.

Key to the species of *Dicranocentrus*

1. Ant. 5 segmented. Ant. I being subdivided. Ant. IV is elongated, distinctly annulated. .... *D. indicus*

– Ant. 6 segmented, the first two segments being subsegmented and their ratio is as 5 : 23 : 9 : 31 : 70 : x. ..... *D. simplex*

12. ***Dicranocentrus indicus*** Bonet, 1930

1966. *Dicranocentrus indicus* Yosii, *Kyoto Univ. Sci. Expd. Karakoram & Hindukush*, 8 : 330-405.

Material examined : Dirang river bed towards Sangti vill., *West Kameng distt.*, 3.iv.1999, coll. A.K. Hazra, 500 exs.

Diagnostic characters : Body length upto 3.2 mm. Antennae reddish violet. Eye black. antennae '5' jointed. Ant. I being subdivided. Ant. IV is elongated. distinctly annulated. Manubrium is dorsally beset with many plumose setae. No dental spine. Mucro is bidentate equally and with or without a basal spine. Dentes dorsally crenulated and with one blunt, ciliated seta near the basis.

Distribution : India : Arunachal Pradesh, Manipur, Mizoram, Nagaland, Maharashtra (Bombay).

Elsewhere : Formosa, South Pacific Island.

12. ***Dicranocentrus simplex*** Yosii, 1959

1959. *Dicranocentrus simplex* Yosii, *Contr. Biol. Lab. Kyoto. Univ.*, 10 : 41.

Material examined : Way to Bomdila, *West Kameng distt.*, 1.iv.1999, coll. A.K. Hazra, 25 exs.

Diagnostic characters : Body length 1.7 mm. Ground colour whitish. Antennae, legs and ventral side of the body diffusely pigmented to blue. Antennae '6' segmented, the first two segments being subsegmented and their ratio is as 5 : 23 : 9 : 31 : 70 : x. The last segment is lost. Tenant hair is in all legs spiny. Unguiculus lanceolate and prominently acute. furcula well developed. Manu : Dens = 11 : 17. Distal end of the dentes has a smooth portion very long, being about '6' times the mucro in length. Mucro is bidentate.

Distribution : India : Arunachal Pradesh.

VII. Genus ***Sinella*** Brook, 1882

The genus is represented by single species from Arunachal Pradesh.

13. ***Sinella curviseta*** Brook, 1882

1966. *Sinella curviseta* Yosii, *J. Coll. Arts. & Sci. Chiba Univ.*, 4(4) : 461-531.

Material examined : Dirang river bed near Sapper, *West Kameng distt.*, 4.iv.1999, coll. A.K. Hazra, 12 exs.

Diagnostic characters : White with pigment limited to eyes; body with scattering of reddish

pigment granules. Eyes with on separate patches, apical half of the third antennal segment with many extremely minute blunt setae. Clavate tenent hair. Unguis with minute apical tooth, unguiculus acuminate. Basal spine of mucro very long.

Distribution : India : Arunachal Pradesh, Sikkim.

VIII. Genus ***Siera*** Ritter, 1911

14. ***Siera indica*** (Ritter) 1911

1911. *Callistocyrtus indicus* : Ritter,

1930. *Pseudosira indica* Bonet

1911. *Drepanura punctata* : Ritter, Syn.

1936. *Lepidocyrtinus unifasciatus* Denis, Syn

Material examined : Menga cave inside, *Upper Subansiri distt.*, 26.iii.1999, coll. A.K. Hazra, 1 ex.

Diagnostic characters : Body length 1.8 mm. Slender in general form. Body colour brownish with bluish pigments. Yellowish brown pigments cover the whole of abd. II, III ans well as some spots of head and Th. II. Ant. ratio as 7 : 9 : 9 : 45. Antennae scaled dorsally until ant. III. Ant. IV faintly annulated.

Distribution : India : Arunachal Pradesh, Maharashtra.

IX. Genus ***Homidia*** Borner 1906

15. ***Homidia cingula*** Borner, 1906

1906. *Homidia cingula* Borner

Material examined : Way to Bame, *Upper Subansiri distt.*, 28.iii.1999, coll. A.K. Hazra, 52 exs.; Menga Cave surrounding, *Upper Subansiri distt.*, 26.iii.1999, coll. A.K. Hazra, 25 exs.

Diagnostic characters : Back ground yellowish, Blue black pigment forming transverse band on the III-rd and IV-th abdominal segments. Body not compressed. Dental spine '33' in numbers. Apical mucronal tooth smaller than anteapical.

Distribution : India : Arunachal Pradesh, Manipur, Sikkim.

(d) Subfamily CYPHODERINAE Borner, 1913

Members of this subfamily may be distinguished from other Entomobryids by the reduced numbers of ocelli, dental foliate appendages and sometimes dental spines appendage.

X. Genus ***Cyphoderus*** Nicolet, 1842

16. ***Cyphoderus javanus*** Borner 1906

1906. *Cyphoderus javanus* Borner, *Mitt. Nat. Hist. Mus. Hamburg.*, **23** : 180.

1966. *Cyphoderus javanus* Yosii, *Kyoto. Univ. Expd. Karakoram and Hindukush.*, **8** : 381.

1971. *Cyphoderus javanus* Prabhoo, *Oriental. Ins.*, **5**(1) : 38.

Material examined : Sela top on the Moss. *Tawang distt.*, 6.iv.1999, coll. A.K. Hazra, 22 exs.

Diagnostic characters : White without trace of pigment. Eyes lacking, elongated mucro with a well developed lamellated anteapical tooth. Large fringed scale on dens, unguis and unguiculus both have enlarged wing like teeth.

Distribution : India : Arunachal Pradesh, Manipur, Sikkim, West Bengal (Kolkata), Kerala.

Elsewhere : Java, Malaya, Thailand, Japan.

(e) Subfamily : TOMOCERINAE Schaeffer, 1896

Fourth antennal segment shorter than the third easily separates this subfamily from all other Entomobryids.

XI. Genus ***Tomocerus*** Nicolet, 1842

This genus is represented by single species.

17. ***Tomocerus*** (s. str.) ***mitrai*** Prabhoo, 1980

1980. *Tomocerus* (s. str.) *mitrai* Prabhoo and Murlidharan, *Entomon.*, **5**(3) : 207-210.

Material examined : Sangrila, way to sela, *Tawang distt.*, 6.iv.1999, coll. A.K. Hazra, 100 exs., Sela pass down slope, *Tawang distt.*, 6.iv.1999, coll. A.K. Hazra, 1 ex.

Diagnostic characters : Ground colour yellowish white with blue pigment towards lateral margin of thorax and Ant. II-III. Ocellar field deep blue. Body clothed with brownish blunt scales with prominent striation and finely ciliated setae. Dentes with scales on ventral side, towards the distal half two rows of unilaterally plumose setae 8-10 in a rows. Ocelli 6 + 6 unguis of annal type with 5 to 6 teeth. Dental spine brown in colour, finely striated longitudinally in a single row as 3, 1.5, 1. Mucro elongated 4 intermittent teeth on outer lamella and two basal teeth. Outer basal tooth of mucro with a corner toothlet.

Distribution : India : Arunachal Pradesh, Sikkim, Himachal Pradesh (Kulu).

(f) Subfamily PARONELLINAE Börner, 1913

This subfamily can be distinguished from other Entomobryids by the right and short dentes, presence of dental scale appendage on the terminal part of dentes. The mucrones in majority cases are plump, lobed into several teeth and is different in shape from the members of subfamily Entomobryinae.

Key to genera of subfamily PARONELLINAE

1. Body covered with scale. 2
- Body not covered with scale. 4
2. Eye 8 + 8. 3
- Eye reduced in number. .....
3. Basal seta of the outer maxillary ramus is blunt. ..... ***Callyntrura*** Borner
- Basal seta of the outer maxillary ramus is pointed. ..... ***Dicranocrntroides*** Schott.
4. Mucro stout, usually tridented, dentes not annulated. ..... ***Salina*** MacGillivary
- Mucro vestigial, sometimes visible as hooklet fused with dentes, dentes annulated. .....

XII. Genus ***Dicranocentroides*** (Imms, 1912)

The genus is represented by four species from Arunachal Pradesh.

Key to the species of *Dicranocentroides*

1. Body devoid of dark pigmented patches. .... *Dicranocentroides flavescens* Yosii
- Body with distinct dark pigmented patches. 2
2. Ground colour of body brown with faint purple blue pigment all over body. Abd. IV with faint longitudinal strands descending from its anterior margin; tergal margin darkest; Ant. I, II, III each with a pigmented distal ring. .... *D. indica* (Handschin, 1929)
3. Thorax II totally pigmented, Abd. II with its lateral extensions and Abd. IV totally dark, no distinct transverse band on Abd. IV. In living specimens shining metallic golden pigment occurs posteriorly on head, Th. II, Abd. I, II, posteromedially on Abd. IV. .... *D. fasciculatus* Salmon, 1957
- Median patches on Th. II. may be absent but anterior margin always pigmented, Abd. III and its lateral extensions pigmented. Abd IV with medially and posteriorly pigmented transverse band. No shining metallic pigment occurs in living conditions. .... *D. salmoni* Mitra, 1975

18. ***Dicranocentroides flavescens*** Yosii, 1966

1966. *Dicranocentroides fasciculatus* f. n. *flavescens* Yosii. *Res. Kyoto. Univ. Sci. Exped. Karakoram and Hindukush.* 1955. 8 : 333-405.

Material examined : Way to Sessa, *West Kameng distt.*, 31.iii.1999, coll. A. K. Hazra, 52 exs., Hill stream side, Tippi, Bhalukpong, *West Kameng distt.*, 30.iii.1999, coll. A. K. Hazra, 150 exs.

Diagnostic characters : A dark patch, characteristic of the species, present on vertex in between two ocellar fields. Darks patches absent on body. Ocelli 8 + 8. Relative length index of Ant. I : II : III : IV = 15 : 17 : 12 : 19. Ths. II : III = 14 : 8.5. Legs all similar unguiculus lanceolate, acuminate with 2 external teeth. Relative length index of Abds I : II : III IV : V : VI = 5 : 6 : 4 : 39 : 5.5 : 2. Ventral tube long with a row of macrochaetal anteriorly. Manubrium

: Mucrodens = 28 : 38, dentes armed with two closely apposed rows of spines on inner margin; mucro large, parallel sided with '6' teeth. Body length 2-3.5 mm.

Distribution : India : Arunachal Pradesh, Manipur, Nagaland, Mizoram, Kerala.

20. ***Dicranocentroides fasciculatus*** Imms, 1912

1912. *Dicranocentroides fasciculatus* Imms, *Proc. Zool. Soc. London* : 80-125.

1917. *Paronella crassicornis* Carpenter, *Rec. Ind. Mus. Cal.*, **8** : 561-568, New Syn.

1957. *Dicranocentroides fasciculatus* Salmon, *Acta. Zool. Cracov.*, **11**(14) : 313-362.

1975. *Dicranocentroides fasciculatus* Mitra, *Rec. zool. Surv. Ind.*, **71** : 57-95.

Material examined : Way to Sessa, *West Kameng Distt.*, 31.iii.1999, coll. A.K. Hazra, 22 exs., Ganga lake, Itanagar, *Phpumpare distt.*, 20.iii 1999, coll. A.K. Hazra, 25 exs.

Diagnostic characters : Th. II always with reddish to brown pigment. Abds III, IV, V usually dark brown. Head 1 + 1 dark ocellar field; Relative length index of Th II : III = 46 : 32; Relative length index of Abds I : II : III : IV : V : VI = 21 : 21 : 13 : 108 : 9 : 4. Manubrium : Mucrodens = 85 : 122; each dentes armed with an inner row of spines which transit into stiff ciliated setae distally, mucro large with 5-6 teeth.

Distribution : India : Arunachal Pradesh, Nagaland, Manipur, Sikkim, Uttar Pradesh.

21. ***Dicranocentroides salmoni*** Mitra, 1975

1957. *Dicranocentroides fasciculatus* : Salmon, *Acta. Zool. Cracov.*, **11**(14) : 313-362.

1957. *Handschinphysa crassicornis* Sensu Salmon ibid.

1975. *Dicranocentroides salmoni* Mitra, *Rec. zool. Surv. India*, **71** : 57-95.

Material examined : 5 km west of Neharlagoon, Itanagar, *Phpumpare distt.*, 21.iii.1999, coll. A.K. Hazra, 12 exs., police colony, river bed, Itanagar, *Phpumpare distt.*, 19.iii.1999, coll. A.K. Hazra, 10 exs.

Diagnostic characters : Th. III, Abds. I. II. almost always dark pigmented. Antennae subcanal to the length of head and body; Relative length index of Ths. II : III = 14 : 10; Relative length index of Abds I : II : III : IV : VI = 7 : 7 : 4 : 37 : 4 : 2. Manubrium : mucrodens = 28 : 40; each dentes armed with a row of stout spines that beyond three-fourth of its length transit into stiff, mucro large with six prominent teeth. Body length upto 2-3 mm.

Distribution : India : Arunachal Pradesh, Nagaland, Manipur, Meghalaya, Assam, Sikkim.

XIII. Genus ***Salina*** MacGillivary 1894 (Imms, 1912)

The genus is represented by four species from Arunachal Pradesh.

Key to the species of *Salina*

1. Body without any pigment, sometime tergal margins of Th. II, III, abd. I, II darker. .... *S. indica*

– Body always with patches involving blue-black or orange pigment, blue-black patches sometimes suffused with orange pigment. ..2

2. Lateral margins of Th. II, III and Abd. I, II darker; darker pigments intrudes from tergal margin of Abd. II to its postero-dorsal margin. ..... *S. montana* (Imms)

– Pigment does not cover entire surface of any segment. ..... *tricolor tricolor*

– Two longitudinal bands on each side of body formed by patches present on Th. II, III and Abd. I to VI. ..... *S. striata* (Handschin)

22. ***Salina indica*** (Imms), 1912

1912. *Cremastocephalus indicus* Imms, *Proc. Zool. Soc. London* :

1957. *Salina indica* Salmon, *Acta. Zool. Cracov.*, **11**(14) : 313-363 (in part).

1973. *Salina indica* Mitra, *Oriental Ins.*, 7(2) : 159-202.

Material examined : Mofutu, Itanagar, *Phpumpare distt.*, 20.iii.1999, coll. A.K. Hazra, 2 exs.

Diagnostic characters : Ground colour yellowish, overlaid irregularly by violet pigment which usually follows a lateral edges of the terga. Ocelli on black 8 + 8. General clothing of short to medium length cilliated setae with some long, stout, lightly flexed ciliated setae at the apex of mesotergum and along the dorsal surface of the thorax. Apex of dens with scale like appendage. Mucro bearing three plain teeth.

Distribution : India : Arunachal Pradesh, Manipur, Sikkim, Tripura (West and South distts.), West Bengal, Uttar Pradesh.

23. ***Salina montana*** (Imms), 1912

1912. *Cremastocephalus montanus* Imms. *Proc. Zool. Soc. London* : 80-125.

1957. *Salina montana* Salmon, *Acta. Zool. Cracov.*, **11**(14) : 313-362.

1973. *Salina montana* Mitra, *Oriental Insects*, 7(2) : 159-202.

Material examined : Way to Dirang, culvert no. R-40/5, *Upper Subansiri distt.*, 2.iv.1999, coll. A.K. Hazra, 2 exs.

Diagnostic characters : Body length 2 mm. Ground colour of head and body usually white; sometime pale yellow; Head pear-shaped, with 1 + 1 dark ocellar field, each field with 8 + 8 ocelli. Relative length index of the antennal segment = 47 : 67 : 57 : 93; Ths. II : III = 29 : 17; Relative length index of Abds I : II : III : IV : V : VI = 13 : 23 : 4 : 79 : 14 : 8.5; Manubrium : Mucrodens = 58 : 63; Mucro short, broad, prominently lobed into three teeth, dental scale appendage large, striated apically, subequal to the length of mucro.

Distribution : India : Arunachal Pradesh, Manipur, Uttar Pradesh, West Bengal.

24. ***Salina tricolor tricolor*** (Handschin) 1928

1928. *Cremastocephalus tricolor* Handschin, *Treubia* **10** : 245-270.

1929. *Salina tricolor* : Handschin, *Rev. Suisse Zool.*, **36** : 229-262.

1973. *Salina tricolor tricolor* Mitra, *Oriental Ins.*, 7(2) : 159-202.

Material examined : Way to Dirang, culvert no. R-40/5, *Upper Subansiri distt.*, 2.iv.1999, coll. A.K. Hazra, 25 exs.

Diagnostic characters : General ground colour of head and body pale yellow; Abds V and VI with symmetrical patches of orange to dark pigment; antennae pale yellow to dark brown with diffused blue pigment. Head pear shaped dorsally; relative length index of Ants I : II : III : IV = 26 : 33 : 29 : 46; The II : III = 9 : 4; Relative length index of Abds I : II : III : IV : V : VI = 4 : 9 : 1.5 : 29 : 4 : 2.5; Manubrium : Mucrodens = 22 : 25; Mucro deeply lobed into three teeth, dental scale appendage striated longitudinally, subequal to mucro.

25. ***Salina striata*** (Handschin, 1928)

1928. *Cremastocephalus striatus* Handschin, *Treubia* **10** : 245-270.

1929. *Salina striata* Handschin, *Rev. Suisse Zool.*, **36** 229-262.

1961. *Salina striatella* Yosii, *Nature and Life in South East Asia*, **1** : 171-200 (Lapsus for *striata*).

Material examined : Rupa valley, beside hill stream, *West Kameng distt.*, 1.iv.1999, coll. A.K. Hazra, 1 ex. Tippi, Bhalukpong, *West Kameng distt.*, 30.iii.1999, coll. A.K. Hazra, 20 exs.

Diagnostic characters : Body white inclining to pale yellow; Head pear shaped dorsally, 1 + 1 frontal spines present; oceli 8 + 8. Relative length index of Antennal segment = 22 : 33 : 42 : Th. II : III = 15 : 9. Abds I : II : III : IV : V : VI = 8 : 14 : 3 : 41 : 7 : 3; Manubrium : Mucrodens = 28 : 33. Mucro short, broad, prominently lobed into three teeth. Length upto 3 mm.

Distribution : India : Arunachal Pradesh, Assam.

XIV. Genus ***Callyntrura*** Borner, 1906

Single species are recorded from Arunachal Pradesh.

26. ***Callyntrura japonica*** (Kinoshita, 1917)

1954. *Handschinphysa japonica* Yosii

1977. *Callyntrura japonica* Yosii, *Forest Res. Centre. Sepilok, Sand. East Malaysia* : 1-37.

Material examined : Tenga valley beside hill stream, *West Kameng distt.*, 1.iv.1999, coll. A.K. Hazra, 24 exs. Mara Village, *Upper Subansiri distt.*, 26.iii.1999, coll. A.K. Hazra, 10 exs.

Diagnostic characters : Body length is 3 mm. Ground colour of body is cremish white. Head is dark all over the base of the antennae are more deeper in colour. Thorax is obscurely dusky all over along the marginal area of each segments. IV-th abdominal segments bears a narrow transverse patch. Antennal scaled. Ventral tube deeply dark. furca long, scaled dens without spines but with prominent dorsal vescile. Mucro elongated with teeth.

Distribution : India : Arunachal Pradesh, Manipur, Meghalaya.

Elsewhere : Japan.

Family ISOTOMIDAE, Borner, 1913
Subfamily ISOTOMINAE Schaeffer, 1896

Head prognathus, tracheae absent. Antennae inserted in front half of head. P.A.O. usually present; always simple, Mucrones short.

XV. Genus ***Isotomurus*** Borner, 1906

27. ***Isotomurus balteatus*** (Reuter, 1876)

1876. *Isotoma balteatus* Reuter. *Med. Soc. Fauna et. Flora Fenn.*, **1** : 82.

1963. *Isotomurus balteatus* : Yosii, *Contr. Biol. Lab. Kyoto. Univ.*, 15 : 4.

Material examined : 6 km away from circuit house Bomdila, West Kameng distt., 2.iv.1999, coll. A.K. Hazra, 12 exs., Hill stream, Alpa, *Upper Subansiri distt.*, 26.iii.1999, coll. A.K. Hazra, 2 exs., Hill stream side Kodak Vill., Upper Subansiri distt., 26.iii.1999, coll. A.K. Hazra, 2 exs.

Diagnostic characters : Colour with a violettish black pigment which form distinct transverse band on the anterior margin of tergites. Antennal ratio = 10 : 15 : 16 : 26; Ant. IV with two short subapical seme rods. P. A. O. as large as anterior ocellus. Ocelli 8 + 8. Furcula reaches forward to the ventral tube, segments as 5 : 12 : 1. Dens distinctly annulated with dorsal side; mucro with a small apical, 2 large subapical and a large external lateral teeth.

Distribution : India : Arunachal Pradesh, Manipur, Tripura (West distt.), Kerala.

ACKNOWLEDGEMENT

The authors are grateful to the Director, Dr. J.R.B. Alfred, Zoological Survey of India, Calcutta, for encouragement and providing laboratory facilities.

REFERENCES

BAIJAL, H. N. 1955. Two New Species of Collembola, *Agra. Univ. Journ. Sci. Res.*, **4** : 175-177.

DENIS, J. R. 1936. Yale North India Expedition : Report on Collembola. *Mem. Connect. Acad. Arts and Sci.*, **10** : 261-282.

IMMS, A. D. 1912. On some Collembola from India, Burma and Ceylon : with a catalogue of the oriental species of the order. *Proc. Zool. Soc. London*, 80-125.

HAZRA, A. K. 1995. *Fauna of Meghalaya* : *State Fauna Series*, **4**(Part 3) : 13-32.

MITRA, S. K. 1973. A revision of *Salina* Macgillivary, 1894 (Collembola : Entomobryidae) from India. *Oriental Insects Delhi*, **7** : 159-202.

MITRA, S. K. 1974. A critical study on some species of *Callyntrura* Borner, 1906 (Collembola : Entomobrydae : Paronellinae) from India. *Rev. Ecol. Biol. Soc. Paris*, **11** : 397-439.

MITRA, S. K. 1975. Studies on the genus *Dicranocentroides* Imms, 1912 (Collembola : Entomobryidae : Paronellinae) from India. *Rec. zool. Surv. India*, **71** : 57-95.

MUKHERJEE, D. 1932. Description of a new species of Collembola and its anatomy. *Rec. Ind. Mus.*, **34** : 47-49.

PRABHOO, N. R. 1971. Soil and litter Collembola of South India. I. Arthropleona. *Oriental. Ins.* **5** : 1-46.

PRABHOO, N. R. and V. MURLIDHARAN, 1980. A new species of *Tomocerus* (s. str.) (Tomoceridae : Collembola) from India. *Entomon. vol.* **3** : 207-210.

SALMON, J. T. 1957. Some Paronellinae (Collembola) from India. *Acta. Zool. Cracov.*, **11**(14) : 313-363.

SALMON, J. T. 1965. New Onychiurid Collembola from India and New Guinea. *Trans. R. Soc. N. Z. Zool. Soc.*, 225-231.

YOSII, R. 1966. Collembola of Himalaya : *Journal of the College of Arts and Science, Chiba Univ., Vol.* **4** No.(4) : 461-531.

YOSII, R. 1966. On some Collembola of Afghanistan, India and Ceylon, collected by the *Kuphe Exped.* 1960. *Res. Kyoto. Univ. Sci. Exp. Karakoram and Hindukush*, 1955, **8** : 333-405.

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2) : 67-149, 2006

INSECTA : ODONATA

TRIDIB RANJAN MITRA
Zoological Survey of India, M-Block, New Alipore, Kolkata-700053

INTRODUCTION

The order Odonata is an economically important primitive group of insects. They are mentioned as dragonflies and damselflies in popular entomological texts. According to Lt. Col. F.C. Fraser (1933b) "Life in the tropics would soon become unbearable were it not for the beneficient work of vast numbers of dragonflies acting as scavengers of the atmosphere. Some species which take to the wing only after dark or at dusk live entirely on mosquitoes"

The odonates are inhabiting the world for the last 220 million years as evident from their first fossil record on the Carboniferous rocks. It may be noted that since the Jurassic period no appreciable change has taken place in their morphology. Thus indicating their morphological stability through long geological times.

Adults of these insects are known for their cute appearance, sharp eye sight and flight power. These flying machines can fly backward, move vertically upward like a helicopter or stop in turn in the midst of the rapid progression as if they have been rammed into. This could be made possible due to adjustment of the centre of gravity between the bases of wings.

Dragonflies have the highest development of compound eyes (Huxley 1953). Eyes occupy almost the whole of the head. It has been estimated that an eye of an adult dragonfly may contain 10,000 to 28,000 facets. Other parts of the head, *viz.*, labium, labrum, clypeus, frons, occiput etc. are very small. The head is movable in all directions as and when required. It can also be twisted sideways 180°, backward 70°, forward and downward 40°.

The meso-and metathorax are fused to form the synthorax.As a result, legs have been shifted forward to form the basket with the help of spines on legs. These help them to capture prey while on wings and to take rest. The abdomen is relatively long and slender, made up of ten segments. The genitalia is found to be at the tip of the abdomen; only in case of male the copulatory organ is on the second abdominal segment. At the end of the abdomen ovipositor in female and anal cerci on both sexes, occur.

The larvae are aquatic and are of varied form. They all possess highly specialized labium. The labium lies flush beneath the head and thorax and possesses between the mentum and submentum a hinge at which it is folded in two. This organ can be extended at will by opening out. This is also known as the mask and is employed in capturing the prey by means of powerful hooks and jaws, situated at its apex. The mask is variable in shape and sometimes it is used as an important organ for classification.

Imago : Matured adults are mainly used for classification. Immature and larvae are not frequently used. Bodyparts and their characters used in classification are as follows.

The matured adult is made up of a movable head, a prothorax of neck with which the head is attached; the synthorax or the thorax and the abdomen. Three pairs of legs, one pair of which is attached with the prothorax, the other two pairs are attach with the thorax. The wings are four in number and are attached to the thorax. The abdomen is composed of ten segments and carries genitalia and anal cerci or the anal appendages. In male the anal appendages are used for seizing the female for reproduction. the anal segments of the abdomen carries the appendages.

The head : The major part of the head is occupied by two large eyes. They are either united broadly along the middle line as in the family Libelluidae, Aeshnidae or meet at a point as in Corduliidae, slightly separated as in Cordulegasteridae, widely separated as in Gomphidae among anisopterans and in all members of the suborder Zygoptera. eyes of Anisozygopterans are slightly separated like cordulegasterids. In addition to these eyes, there are three tiny ocelli situated between and infront of eyes. Usually ocelli are grouped round a small eminence known as vescicle. Antennae are almost functionless, short and inconspicuous. They are made up of four to seven segments. Since dragonflies are predaceous insects, mouth parts are fit for bitting. Mandibles are with strong incisors and molar teeth. The maxillae are simple, unjointed palp and with a robustly toothed internal lobe. The median lobe of labium is cleft in Zygoptera and in archaic Anisopterans. The lateral lobes are smaller than median one in Zygoptera and archaic forms; while in higher types – it is made up of two segments, a basal and a large movable hook. The occiput lies on the backside of the head between two eyes, fringed with hairs.

The prothorax : It forms the neck. It is composed of an anterior lobe, a collar like narrow structure, a tumid middle lobe forms the greatest part of the prothorax and hindmost is the posterior lobe. The shape and structure of the posterior lobe, its spines and hairs etc. sometimes are used in classification. The posterior lobe helps in the movement of the head in different directions. The prothorax carries the first pair of legs.

The Thorax or the Synthorax : This is formed due to fusion of meso- and metathorax; it lies behind the prothorax. It is oblique; its anterior surface has become the dorsum and bear two pairs of wings, thrusting the legs forward beneath the head. The dorsum of thorax possesses the mesothoracic triangle, the area which sometimes help in the process of species determination; behind the triangle lies the middorsal carinal ridge; on the lateral side, almost below the middorsal carinal suture and above the second pair of legs lies the coloured antehumeral stripe; lower part of the second pair of coxae lies in continuation of the humeral suture and below the humeral suture lies the Antero-lateral suture; it is in continuation of the hinder part of the mesepimeron. Below the mesepimeron lies the metepimeron.

Legs : These are composed of short coxae and trochanter; long femora and tibiae; segmented tarsus and a claw. Femora, tibiae, tarsi are provided with short and long spines. Legs are rarely used for walking. They are mainly used for best and capture of prey.

Wings : Wings are two pairs, one pair forewing and the other pair hindwings. The wings are membranous and have been hard to resist the wind pressure with a network of stiff ribs or veins, sometimes reffered to as nervures. Following veins are named as follows :

1. Costa : Anterior border of the wings.
2. Subcosta : Below the costa and extends upto the node.
3. Radius : From the base to the tip of the wings and lies between the subcosta and the media.
4. Arculus or Arc : A short, oblique, transverse vein near the base of the wings which forms the outer boundary of the basal or the median space.
5. R_{4+5} : One of the branches of the Radius in prolongation of the superior sector of the arc.
6. Sectors of the arc. : Origins of the nervures R_{4+5} and MA.
7. Node : A thick part of the wings situated at an indentation of the costal margin of the wing.
8. Subnode : An oblique vein descending from the node extending obliquely outward into the body of the wing traversing the space lying between R_1 and R_2.
9. Cubital : A name commonly used for

nervure — the anal crossing. (Fraser 19346). Cross veins in the cubital space.

10. Cubital space : A space at the extreme base of the wings situated immediately posterior to the basal space and extending out as far as the base of the discoidal cell.

11. Discoidal cell : A well defined triangular or quadrilateral space situated near the base of the wings immediately distal to the cubital space.

12. Discoidal field : The space lying distal to the discoidal cell and bounded outwardly by the border of the wing. The nervures MA and Cu_2 constitute the anterior and posterior border respectively.

13. Antenodal nervures : Veins lying between the costa and subcosta in the proximal side of the node, i.e., towards the base of the wing.

14. Postnodal nervure : Veins lying between the costa and the radius on the distal side of the node i.e., towards the apex of the wing tip.

15. Median space or the basal space : The space lying between the base and the arc.

16. Submedian space : The space lying under the median and between the wing base and the base of the discoidal cell.

17. Anal bridge : A short vein running parallel to the hinder border of the wing and passing below the discoidal cell.

18. Anal crossing : A short vein situated at the base of the wing and extending from $Cu_{2+}1A$ to the Anal Bridge or hinder border of the wing.

19. Anal loop : Anal area of cells situated at the base of the hindwing in many genera of Anisoptera. Its apex is made up of anal vein.

20. Anal triangle : A triangle at the extreme base of the hindwing in Anisoptera, made up of one or more cells, occurring in male only if it occurs at all.

The abdomen : It lies behind the thorax. It consists of ten segments. The anal appendages are attached to the last segment (10). Genitalia is found to be at the tip of the abdomen. In case of male only the second abdominal segment bears the copulatory organ.

Anal appendages : Males in Zygoptera possess paired superior and inferior appendages. In case of males of Anisoptera a pair of superior and an inferior appendages occur.

Genitalia : In case of males it is situated on the ventral surface of the second abdominal segment; comprised of lamina, a hood like structure closing the genital sac near the thorax; the hamules or hooks used for copulating with the female; an anterior and posterior pair being usually present, variable in shape; the penis, an intricate organ varies greatly in different species; the lobe, a small flask shaped receptacle at the apical border of the segment 2, which is used as receptacle of the sperm. In female the organs consist of, in all Zygoptera and some Anisoptera, a robust ovipositor on the underside of the segment 9, enclosed by a pair of the vulvar scales or plates furnished with styles.

COLLECTION AND PRESERVATION OF ODONATA FOR STUDY PURPOSES

(A) *Benzene Technique* : The imago is collected with the aid of butterfly net, then the specimen is killed with Benzene vapour. To kill the specimens they are put in a glass jar containing cotton soaked with liquid benzene and covered with a blotting paper. Specimens are taken out of jar and exposed to air for making them dry. Dried specimens, then, are put in paper envelope. Before putting them in the envelope the abdomen of the dead specimen is made straight, wings are placed over the back, the envelope may contain blotting paper to soack the body fluid emitted by the dead specimen. The envelope must contain the collection data : Locality (village, district, state, if roadside then the milestone number etc.), date of collection, habitat and name of the collector. Data are to be written in indelible ink. Benzene is volatile and quickly evaporates.

(B) *Acetone Technique* : The second technique is known as the Acetone technique. Imagoes are collected with the aid of butterfly net. Specimens can be killed by drowning the specimens in the Acetone (4%). Before putting in Acetone, the abdomen of the live specimens is to be made straight and wings are to be kept over the thorax. Then the specimens are to be taken in paper envelope. glassine envelope, news paper, cellophane paper or envelopes made of those papers are not preferred for the purpose; regular note book or typing paper are actually preferred. Collection data are to be written on the envelope/ triangle with pencil, since the acetone dissolves several kinds of inks. Now the live specimen within envelope to be drowned in acetone filled jar and to be kept for twenty four hours.

Acetone kills bacteria which causes decomposition, dries the specimens by osmosis, dissolves surface wax layer, which allow the specimens to dry quickly. Several examples can be drowned in the same jar. Acetone is to be thrown out of the jar when the fluid become pale straw colour like urine. Specimens are to be dried in air.

Precaution : Both acetone and benzene are highly inflammable.

Preparation for study : Dead specimens can be studied as such; or they can be prepared for study. Wings are stretched making perpendicular to the thorax; abdomen is to be made straight. Then an entomological pin is inserted through the thorax between the wings. A label containing collection data is prepared with a good paper with indelible ink and placed below the specimen piercing the paper with the pin. Specimens are kept in boxes with insect repellants.

Final preservation : After identification an identification label is to be prepared. The label must contain the name of species and its author, the name of the identifier, registration number and collection data. If the specimen is identified as new to science then the status (Holotype or Paratype etc.) of the specimen is to be written. The specimen should be registered in the Registration book. The registration book must contain everything which has been written on the identification label.

Material and Methods : Adult specimens were collected by different parties from the Head quarter at Calcutta, Eastern Regional Station at Shillong, Meghalaya and Arunachal Pradesh field Station, Itanagar. Specimens were prepared for study. They were studied under dissecting binocular and compared with other identified materials present in the Head quarter of Zoological Survey of India, Calcutta. Literature were consulted for records of distribution and other purposes. Type localities of species, their depositories have not been mentioned in the present article since they are available in the Fauna of British India (1933, 1934 & 1936) by F. C. Fraser. To avoid partiality in the use of field key, efforts have been made to cite important taxonomic feature in the presentation of key for identification of species and subspecies. Important synonyms have been presented and repetition of synonyms have been avoided.

The study area : Arunachal Pradesh, the fauna of which state is under consideration, came into existence as a state in 1972. Indian subcontinent became independent on the August 15, 1947. The present Arunachal Pradesh was included in the Union of India. Till 1972 the area was within "Assam" The present day Arunachal Pradesh

(27.0-29.30 N. & 91.30-97.30 E.) is composed of the Himalayan foot hills and ranges of northern "Assam", east of Bhutan including the Dalfa, Abor, Miri and Mishmi hills, south through the Tirap Frontier tract to the northern most Patkai ranges on the upper Chindwin drainage area. It covers an area of about 83,578 sq. km. Before 1972 the state was known as the North East Frontier Agency (NEFA), consisting of the Kameng, Subansiri, Siang and Lohit divisions.

Geographically the state is divisible into the eastern Himalayan part (excluding the Tirap and part of the Lohit Division) and Purbanchal (Tirap and Lohit Divisions). Drainage is by a number of fast flowing rivers and streams *viz.*, Tsangpo, Brahmaputra, Kameng, Subansiri, Siang, Lohit, Tirap etc.

In the Eastern Himalayan parts one experiences rapid changes in topography and altitudes play important roles in changing the climate within short distances; contrasts in temperature and rainfall between the sheltered valleys, foot hills and mountain tops. The premonsoon showers begin towards the end of March and the monsoon proper continues from May to September. Rains during the winter are regular feature. Months of June and July are considered to be wettest.

The Purbanchal climate reflects characteristic rhythm and as such the year is divisible into four seasons, (a) Winter (December-February), (b) Premonsoon or summer (March-April), (c) Monsoon (May-September), Retreating monsoon (October-November) and January is the coldest month.

SHORT HISTORY

Johansson first recorded odonata, *Rhyothemis variegata variegata* (Linne & Johansson) from India, especially from the Eastern India in 1768. The locality of capture of Johansson's specimen is not clearly known. Fraser (1933b, 1934 & 1936) has not reported any specimen from the localities in present Arunachal Pradesh. Lahiri (1977) first recorded dragonfly from the present Arunachal Pradesh and it is being considered as the starting point. Later on Lahiri (1985, 1987), Lahiri and Das (1991), Lahiri and Sinha (1985, 1991), Bhargava (1989), Mitra (1994,1999), Prasad (1997), Prasad and Varshney (1995), Ram and Prasad (1999) reported 92 species and subspecies spread over 50 genera.

OBSERVATIONS

Following taxa have so far been recorded from the area under study. In the present investigation nintytwo species and subspecies distributed over fifty genera, eleven families and two suborders have been reported.

SYSTEMATIC ACCOUNT

Order ODONATA

Suborder ZYGOPTERA

Superfamily CALOPTERYGOIDEA

Family CALOPTERYGIDAE

Genus ***Echo*** Selys, 1853

1. *Echo margarita margaria* Selys, 1853

Genus ***Matrona*** Selys, 1853

2. *Matrona basilaris basilaris* Selys, 1853
3. *Matrona basilaris nigripectus* Selys, 1879

Genus ***Neurobasis*** Selys, 1853

4. *Neurobasis chinensis chinensis* (Linnaeus, 1758)

Genus ***Vestalis*** Selys, 1853

5. *Vestalis gracilis gracilis* (Rambur, 1842)

Family EUPHAEIDAE

Genus ***Euphaea*** Selys, 1840

6. *Euphaea ochracea ochracea* Selys, 1859

Genus ***Bayadera*** Selys, 1853

7. *Bayadera indica* (Selys, 1853)

Genus ***Anisopleura*** Selys, 1853

8. *Anisopleura lestoides* Selys, 1853

Family CHLOROCPHIDAE

Genus ***Rhinocypha*** Rambur, 1848

9. *Rhinocypha cuneata* Selys, 1853
10. *Rhinocypha immaculata* Selys, 1871
11. *Rhinocypha spuria* Selys, 1879

12. *Rhinocypha quadrimaculata* Selys, 1853
13. *Rhinocypha hilaryae miaoa* Lahiri & Sinha, 1991
14. *Rhinocypha fenestralla fenestrella* Rambur, 1842
15. *Rhinocypha ignipennis* Selys, 1879

Genus ***Libellago*** Selys, 1840

16. *Libellago lineata lineata* (Burmeister, 1839)

Superfamily LESTOIDEA
Family SYNLESTIDAE
Genus ***Megalestes*** Selys, 1862

17. *Megalestes major* Selys, 1862
18. *Megalestes lieftincki* Lahiri, 1979

Family LESTIDAE
Genus ***Lestes*** Leach, 1815

19. *Lestes dorothea* Fraser, 1924
20. *Lestes praemorsus praemorsus* (Selys, 1862)

Genus ***Orolestes*** Mc Lachlan, 1895

21. *Orolestes durga* Lahiri, 1987

Superfamily COENAGRIOIDEA
Family PLATYCNEMIDIDAE
Genus ***Calicnemia*** Strand, 1926

22. *Calicnemia eximia* (Selys, 1863)
23. *Calicnemia pulverulans* (Selys, 1886)

Genus ***Coeliccia*** Kirby, 1890

24. *Coeliccia bimaculata* Laidlaw, 1914
25. *Coeliccia prakritiae* Lahiri, 1985
26. *Coeliccia renifera* (Selys, 1863)

Genus ***Copera*** Kirby, 1890

27. *Copera vitta serapica* (Selys, 1886)

Family COENAGRIONIDAE
Genus ***Ceriagrion*** Selys, 1876

28. *Ceriagrion azureum* (Selys, 1891)
29. *Ceriagrion coromandelianum* (Fab., 1798)
30. *Ceriagrion fallax cerinomelas* Lieftinck, 1927
31 *Ceriagrion olivaceum* Laidlaw, 1914

Genus ***Pseudagrion*** Selys, 1876

32. *Pseudagrion australasiae* Selys, 1876
33. *Pseudagrion rubriceps rubriceps* Selys, 1876

Genus ***Aciagrion*** Selys, 1876

34. *Aciagrion pallidum* Selys, 1891
35. *Aciagrion olympicum* Laidlaw, 1919
36. *Aciagrion approximans* (Selys, 1876)

Genus ***Enallagma*** Charpentier, 1840

37. *Enallagma parvum* Selys, 1876

Genus ***Ischnura*** Charpentier, 1840

38. *Ischnura aurora aurora* (Brauer, 1865)
39. *Ischnura rufostigma mildredae* Fraser, 1927

Genus ***Agriocnemis*** Selys, 1877

40. *Agriocnemis clauseni* Fraser, 1922
41. *Agriocnemis lacteola* Selys, 1877
42. *Agriocnemis pieris* Laidlaw, 1919
43. *Agriocnemis pygmaea pygmaea* (Rambur, 1842)
44. *Agriocnemis rubescens rubeola* Selys, 1877

Genus ***Onychargia*** Selys, 1865

45. *Onychargia atrocyana* Selys, 1865

Suborder ANISOPTERA
Superfamily AESHNOIDEA
Family GOMPHIDAE
Genus ***Anormogmphus*** Selys

46. *Anormogomphus heteropterus* Selys, 1854

Genus ***Phaenandrogomphus*** Lieftinck, 1964

47. *Phaenandrogomphus aureus* (Laidlaw, 1922)

Genus ***Onychogomphus*** Selys, 1854

48. *Onychogomphus biforceps* Selys, 1878
49. *Onychogomphus cacharicus* (Fraser, 1924)
50. *Onychogomphus risi* (Fraser, 1922)
51. *Onychogomphus schmidti* Fraser, 1937

Genus ***Paragomphus*** Cowley, 1934

52. *Paragomphus lineatus* (Selys, 1850)

Genus ***Ictinogomphus*** Cowley, 1934

53. *Ictinogomphus rapax* (Rambur, 1842)
54. *Ictinogomphus pertinax* (Selys, 1854)

Family AESHNIDAE

Genus ***Gynacantha*** Rambur

55. *Gynacantha basiguttata* Selys

Genus ***Anax*** Lech, 1815

56. *Anax guttatus* (Burmeister, 1839)

Superfamily CORDULEGASTEROIDEA

Family CORDULEGASTERIDAE

Genus ***Cordulegaster*** Leach, 1815

57. *Cordulegaster brevistigma brevistigma* (Selys, 1854)

Superfamily LIBELLULOIDEA

Family LIBELLULIDAE

Genus ***Hylaeothemis*** Ris, 1909

58. *Hylaeothemis fruhstorferi apicalis* Fraser, 1924

Genus ***Tetrathemis***

59. *Tetrathemis platyptera* Selys, 1878

Genus ***Cratilla*** Kirby, 1900

60. *Cratilla lineata calverti* Forster, 1903

Genus ***Orthetrum*** Newman, 1833

61. *Orthetrum anceps* (Schneider, 1845)
62. *Orthetrum brunneum brunneum* (Fonscolombe, 1837)
63. *Orthetrum glaucum* (Brauer, 1865)
64. *Orthetrum japonicum internum* Maclachlan, 1894
65. *Orthetrum luzonicum* (Brauer, 1868)
66. *Orthetrum pruinosum neglectum* (Rambur, 1842)
67. *Orthetrum sabina sabina* (Brury, 1770)
68. *Orthetrum testaceum testaceum* (Burmeister, 1839)
69. *Orthetrum triangulare triangulare* (Selys, 1878)
70. *Orthetrum taeniolatum* (Schneider, 1845)

Genus ***Lathrecista*** Kirby, 1889

71. *Lathrecista asiatica asiatica* (Fabricius, 1798)

Genus ***Potamarcha*** Karsch, 1890

72. *Potamarcha congener* (Rambur, 1842)

Genus ***Palpopleura*** Rambur, 1842

73. *Palpopleura sexmaculata sexmaculata* (Fabricius, 1787)

Genus ***Acisoma*** Rambur, 1842

74. *Acisoma panorpoides panorpoides* Rambur, 1842

Genus ***Brachythemis*** Brauer, 1868

75. *Brachythemis contaminata* (Fabricius, 1793)

Genus ***Crocothemis*** Brauer, 1868

76. *Crocothemis servilia servilia* (Drury, 1770)

Genus ***Diplacodes*** kirby, 1889

77. *Diplacodes trivialis* (Rambur, 1842)

Genus ***Indothemis*** Ris, 1911

78. *Indothemis limbata limbata* (Selys, 1891)

Genus ***Neurothemis*** Brauer, 1867

79. *Neurothemis fulvia* (Drury, 1773)
80. *Neurothemis intermedia intermedia* (Rambur, 1842)
81. *Neurothemis tullia tullia* (Drury, 1773)

Genus ***Sympetrum*** Newman, 1833

82. *Sympetrum commixtum* (Selys, 1884)
83. *Sympetrum hypomelas* (Selys, 1884)
84. *Sympetrum orientale* (Selys, 1883)

Genus ***Trithemis*** Brauer, 1868

85. *Trithemis aurora* (Burmeister, 1839)
86. *Trithemis festiva* (Rambur, 1842)
87. *Trithemis pallidinervis* (Kirby, 1889)

Genus ***Rhyothemis*** Hagen, 1867

88. *Rhyothemis variegata variegata* (Linne & Johannson, 1768)

Genus ***Pantala*** Hagen, 1861

89. *Pantala flavescens* (Fabricius, 1798)

Genus ***Tholymis*** Hagen, 1867

90. *Tholymis tillarga* (Fabricius, 1798)

Genus ***Aethriamanta*** Kirby, 1889

91 *Aethriamanta brevipennis brevipennis* (Rambur, 1842)

Genus ***Urothemis*** Brauer, 1868

92. *Urothemis signata signata* (Rambur, 1842)

KEY FOR IDENTIFICATION AND SYSTEMATICS

Key to suborders of the order ODONATA

Thin body; eyes separated from each other; wings remain folded over the back of the thorax while at rest. Fore- and hindwings are almost identical in appearance. Wings are usually petiolated, bases of wings are usually not marketly broad. Pterostigma may or may not be present; discoidal cell four sided ..... ZYGOPTERA

Thick body, eyes united, in some separated from each other, wings, remain stretched (almost perpendicular to thorax) while at rest. Fore- and hindwings are dissimilar in shape. Discoidal cell is divided into superior or hypertriangle and inferior or triangle ..... ANISOPTERA.

Suborder ZYGOPTERA

Diagnostic features : Delicate body; eyes always separate from each other. Head triangular in outline; space between the eyes are occupied by ocelli; vesicle absent. Labium and labrum produced forward. Labium is divided into two lateral lobes and one middle lobe. The middle lobe is fissured. Prothorax variable in shape; discoidal cell quadrilateral. Antenodal veins reduced to primary one or more. Wings are held close together over the back of the thorax while at rest. A pair of superior anal appendages at the end of the 10th abdominal segment and a pair of inferior anal appendages at the sides of the anal orifice. Female with well developed ovipositor.

Larvae variably shaped, possess caudal gills – two to three in number, they are of great variety in shape and size, spine like vesiculated and paddle shaped; breeds in stagnant or slow-flowing water.

Key to superfamilies of suborder ZYGOPTERA

1. Wings with two antenodal veins 2

– Wings with more than two antenodal veins .. .. CALOPTERYGOIDEA

2. Wings with veins IR_3 and R_{4+5} nearer to node than to the arc ..... COENAGRIONOIDEA

– Wings with veins IR_3 and R_{4+5} nearer to the arc than to the node ..... LESTOIDEA

Superfamily CALOPTERYGOIDEA

Diagnostic features : Abdomen usually 25.0-60.0 mm; wings generally coloured, petiolate (sometimes apetiolate); always more than two antenodals (generally more than five); post nodals not in strict alignment with cross veins underneath; more than one intercalated sectors present; especially between the branches of R_3 and MA.

Distribution : Both old and new world.

Key to families of superfamily CALOPTERYGOIDEA

1. Wings distinctly petiolate ..... CHLOROCYPHIDAE

– Wings usually apetiolate, if at all petiolate, petiole is very short 2

2. 1st lateral suture of thorax incomplete and untraceable up to the spiracle ..... EUPHAEIDAE

– 1st lateral suture of thorax complete and well developed, traceable even beyond spiracle ... . CALOPTERYGIDAE

Family CALOPTERYGIDAE

Diagnostic features : Generally medium to large sized (abdomen 25.0-60.0 mm; hind wing 23.0-42.0 mm) insects, with usually metallic green ground colour; the thorax with complete first lateral suture. Wings brilliantly or palely coloured; petioles generally absent, if present, very short; antenodals

more than two; hard to distinguish the primary antenodals; the first and the second series of antenodals usually coinciding; base of discoidal cell is connected to the arc; which is either oblique or angulated. The sectors of arc arising from about the middle of the arc, separated at origin or arising from a common point. The discoida cell, the anal field are variable in shape, extent and neuration.

Distribution : Cosmopolitan.

Key to genera of the family CALOPTERYGIDAE

1. Arc oblique, median space entire ..... ***Vestalis*** Selys
- Arc angulated; median space traversed or reticulated 2
2. Pterostigma absent or if present traversed by a number of veins 3
- Pterostigma present and simple ..... ***Echo*** Selys
3. Wings in both sexes opaque ..... ***Matrona*** Selys
- Only hindwings of both sexes are coloured.. ..... ***Neurobasis*** Selys

Genus *Echo* Selys

1853. *Echo* Selys, *Synop. Calopt.*, : 19.

1934. Fraser, *Fauna Brit. India, Odon.*, 2 : 134.

1984. Davies and Tobin, *Dragonflies of the world, systematic list*, : 6.

1991. Tsuda, *A distributional list of world Odonata*, 1991 : 83.

Diagnostic features : Size large (abdomen 36.0-46.0; hindwing 33.0-37.0 mm); body metallic green with black, wings apetiolate, broad, hyaline or partly opaque, antenodals generally vary from 29-40 and post nodals vary from 55-57 in forewings; 23-30 and 56-64 in hindwings; antenodals of first series coinciding; arc angulated at the level of the 5th antenodal vein, sectors of arc separated at origin and arising from a little below the middle of the arc. Discoidal cell nearly straight, narrow and longer than median space, usually traversed by 7-10 veins; median space and the space are generally traversed by 6-9 and 16-20 veins respectively. The veins R_{2+3} is fused with R_1 near the base. R_3 is nearer to the arc than to the node, distinctly separated from the origin of R_{4+5}. IA is simple, unbranched, anal field with up to 5 or 6 rows of cells. Intercalated sectors are arising at the proximal to the middle of the wing and also present between Cu_2 and IA. Superior anal appendages of male are about one and half times as long as the segment 10; this when seen dorsally appear forcipate with swollen apex and outer border bear a few spines. Inferior appendages are about two-third the length of the superior, narrowing gradually to an acute apex. Terminal fold of the penis large, produced on either side into a moderately long apical process which ending in terminal coil.

Type spcies : *Echo margarita* Selys.

Distribution : India : Arunachal Pradesh, Manipur, Meghalaya.

Elsewhere : Burma (Myanmar), Malayasia.

Echo margarita margarita Selys

1853. *Echo margarita* Selys, *Synop. Calopt.*, : 19.

1854. *Selys Mon. Calopt.*, : 67.

1879. *Selys Bull. Acad. Belg.*, (2)47 : 356.

1890. Kirby, *Cat. Odon.*, : 101.

1917. Laidlaw, *Rec. Indian Mus.*, 13 : 26-28.

1929. Fraser, *J. Bombay nat. Hist Soc.*, 33 : 587-588

1933. *Fauna Brit. India, Odon.*, 2 : 136-137.

1991. Tsuda, *A distributional list of world Odonata*, 1991 : 83.

Material examined : 1F, 4.xi.1971; 1F, 7.xi.1971; Tirap Coll. G. S. Aurora.

Distribution : India : *Present record* : Arunachal Pradesh (Tirap). *Past records* : Meghalaya : Cherrapunji, Khasia Hills (Laidlaw 1917a : Fraser 1934b); Manipur (Mitra 1994).

Remark : It is an eastern Indian species; specimens have been compared with three female specimens from Manipur and found no difference.

Genus *Matrona* Selys

1853. *Matrona* Selys, *Bull. Acad. Belg.* 20 (Annexe), *Synop. Calopt.*, : 17.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 144.

1981. Davies, *Syn. Extnt. Gen. Odon.*, : 20.

Diagnostic features : Large in size (abdomen 42.0-60.0 mm; hindwing 38.0-45.0 mm), metallic green, marked with blue and black. Wings are very broad, opaque blackish or steely blue or partly hyaline apically, usually with 40-65 antenodals, and 80-150 postnodals; primary antenodals not easily distinguishable, antenodals of 1st and 2nd series are coinciding. Pterostigma present in females only, the area is longer than breadth, reticulated, broadend medially; arc angulated, situated at about the level of the 10th antenodal vein; sectors of arc arising from a common point a little below the middle of the arc; discoidal cell narrow, slightly convex towards the costal side, about one and half times as the median space, usually traversed by 8-10 veins; median and cubital spaces usually traversed by about 15 and 30 veins respectively; R_{2+3} is not fused with R_1 at its origin; R_3 arising slightly proximal to the level of the distinctly separated from the origin of R_{4+5}; anal field with up to 5-6 rows of cells; IA strongly forked just after its origin; intercalated sectors many and scattered.

Type species : *Matrona basilaris* Selys

Distribution : India : Arunachal Pradesh, Mizoram and Meghalaya.

Elsewhere : Bangladesh, Burma (Myanmar), China, Formosa, Japan, Thailand, Tibet, Vietnam.

Matrona basilaris Selys

1853. *Matrona basilaris* Selys, *Bull. Acad. Belg.* (*Annexe*) *Syn. Calopt.*, : 17.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 145-146.

Key to subspecies of *Matrona basilaris* Selys

1. In male the length of abdomen 42-85 mm and hindwing 36-42 mm the colour of wings vary from dark brown to blackish steely blue; reticulations and nervures black but the transverse veins from base to node bluish white, basal space traversed by two rows of cells. In female the length of abdomen 50-54 and hindwing 44-46 mm and the wings uniformly dull dark brown; underside of the thorax entirely black ..... *basilaris basilaris* Selys

– In male abdomen length 52-54, hindwing 38-40 mm; wings uniformly dark as far as the apices; sometimes the whole wing is dark metallic steely bronze or bluish; underside of the thorax entirely black .... *basilaris nigripectus* Selys

Matrona basilaris basilaris Selys

1853. *Matrona basilaris* Selys, *Bull. Acad. Belg.* (*Annexe*) *Syn. Calopt.*, : 17.

1934. *Matrona basilaris basilaris*, Fraser, *Fauna Brit. India, Odon.*, **2** : 145-146.

Material examined : 1M, 10.x.1966, Dalli village, Siang, coll. S. K. Tandon and G. S. Arora; 1M, 31.x.1966, Basak village, Siang, coll. S. K. Tandon and G. S. Arora; 1F, 15.x.1966, Kambong village, Siang, coll. S. K. Tandon and G. S. Arora.

Distribution : India : *Present record* : Arunachal Pradesh (Siang). *Past records* : Shillong (Fraser 1919a), Khasi hills (Selys 1891), Cherrapunji (Laidlaw 1917a).

Elsewhere : Bangladesh, Burma (Myanmar), Formosa, Sanghai (Fraser 1929b, 1934b), Puepoli, Leito (Selys 1891), China (Needham 1930), Yunnan (Moore 1878), Hainan, Japan, Ryuku islands (Lieftinck *et. al.* 1984).

Matrona basilaris nigripectus Selys

1879. *Matrona basilaris race nigripectus* Selys, *Bull. Acad. Belg.*, (2) **47** : 147.

1934. *Matrona basilaris nigripectus* Fraser, *Fauna Brit. India, Odon.*, **2** : 147.

Material examined : 1M, 3.xi.1971, Tirap, coll. G. S. Arora; 2F, 7.xi.1971, Tirap, coll. G. S. Arora.

Distribution : India : *Present record* : Arunachal Pradesh (Tirap). *Past records* : Khasi hills (Fraser 1929b; 1934b), Mizoram (Mitra 1994).

Elsewhere : Burma (Myanmar) (Fraser 1929b, 1934b).

Genus *Neurobasis* Selys

1853. *Neurobasis* Selys, *Bull. Acad. Belg.*, 20 (*Annexe*) *Syn. Calopt.* : 17.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 119.

1981. Davies, *Synop. Extnt. Gen. Odon.*, : 20.

Diagnostic features : Large dragonflies (abdomen 42.0-51.0 mm; hindwing 32.0-40.0 mm); metallic green marked with blue, yellowish and black; wing apetiolate, broad and hyaline; but in males forewing partly opaque metallic blue green; commonly 31-42 antenodals on either wing in both sexes and postnodals in males vary from 50-65 and 68-80 in fore- and hindwings respectively; in females 24-29 postnodals in hindwing and in forewings 50-65. Primary antenodals are not easily distinguishable. Pterostigma is absent in males and commonly in the forewings of females; but when present in females it is suboval and may or may not be reticulated; arc angulated, situated at the level of the tenth antenodoal vein; sectors of arc arising from a common point at about the middle of the arc discoidal cell convex in costal side, a little smaller than the median space; both discoidal cell and median space are traversed by ten nervures; cubital space is traversed by twenty veins. R_{2+3} not fused with R_1 at its origin, R_3 arising a little proximal to the subnodus; IR_3 arising much nearer to the arc than to the node; well separated from the origin of R_{4+5}; anal field with five or six rows of cells; IA simple, not branched, intercalated sectors many and scattered. In males superior anal appendages are subequal to segment 10, forcipate broad at base and at distal half, outer border bear a few spines; inferiors a little shorter than the superiors, broadened at base, narrowing thereafter to an acute apex. terminal fold of penis large, apical process with short and pointed external branch.

Distribution : India : Throughout India.

Elsewhere : Australia, Bangladesh, Burma (Myanmar), China, Hongkong, Indonesia, Laos, Malayasia, Nepal, Papua New Guinea, Philippines, Sri Lanka, Thailand, Vietnam.

Neurobasis chinensis chinensis (Linnaeus)

1758. *Libellula chinensis* Linnaeus, *Sys. Nat.*, **10** : 545.

1750. Edwards, *Nat. Hist. Birds*, **3** : 112 (fig.)

1842. *Calopteryx chinensis* Rambur, Ins. Nevrop., : 226.

1890. *Neurobasis chinensis* Kirby, *Syn. Cat. Neur. Odon.*, : 102.

1915. *Neurobasis chinensis chinensis*, Ris, *Tijdschr. Ent.*, **58** : 6.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 121-124; 1954 Lifetinck, *Treubia*, **22** (suppl.) : 23.

Material examined : 1M, 23.iii1973, Bhalukpong, coll. S. K. Tandon, 2M, 27.x.1966-28.x.1966, Subansiri, coll. S. K. Tandon & G. S. Arora, 1M, 27.x.1966, Bella village, coll. S. K. Tandon & G. S. Arora; 1M, 28.x.1971, Tirap coll. G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Bhalukpong, Bella village, Subansiri, Tirap). Past records : Saidya, N. E. Assam, Dejoo, North Lakhimpur (Laidlaw 1914), Bengal, Assam (Fraser 1929b), Manipur (Lahiri 1977b), Mizoram (Lahiri 1979); Meghalaya (Lahiri 1987), Singbhum (Bhasin 1953), Uttar Pradesh (Kumar 1982), Dehra Dun, Lachhiwala, Nainital, Bhimtal (Bhasin 1953), Garhwal hills (Prasad 1974); Coorg Deccan, Kanara, Malabar, Palni Hills (Fraser 1934b), Annaimalai, Bolovumpattis, Cochin, Nilgiris, Travancore (Fraser 1931), Silent valley (Rao and Lahiri 1983).

Elsewhere : Burma (Bhasin 1953, Fraser 1929b; Laidlaw 1914); Indo-china (Liefitnck 1971), Nepal (Asahina 1955; Kiauta and Kiauta 1982a; St. Quentin 1970); Thailand (Kiauta and Kiauta 1982b); Yunan (Moore 1878); China, Philippines, Celebes (Selys 1891), Bangladesh, Hongkong, Laos, Indonesia, Malayasia, Sri Lanka, Vietnam (Tauda 1991).

Remarks : Specimens agree with the description of the species present in the fauna of British India but when compared with specimens of Andhra Pradesh (Eastern Ghats) a male from the latter differs from the specimens of Arunachal Pradesh having greenish white labium and whitish labrum.

Genus *Vestalis* Selys

1853. *Vestalis* Selys, *Bull. Acad. Belg.*, **20** (annexe) (*Syn. Calopt.*) : 24

1934. Fraser, *Fauna of British India, Odon.*, **2** : 124

1954. Lieftinck, *Treubia*, **22** (suppl.) : 21.

1981. Davies, *Synop. Extnt. Gen. Odon.*, : 21.

Diagnostic features : Large in size (generally abdomen 35.0-59.0 mm; hindwing 31.0-42.0 mm); metallic bronze, blue or green marked with yellow or black, occassionally pruinosed. Wings apetiolate, moderately broad, hyaline, but tinted with yellow or opaque black at apices; generally 17-37 antenodals and 36-85 postnodals; primary antenodals not easily distinguishable; pterostigma absent; arc oblique, situated at the level of the 4th antenodal; sectors of arc arising from a common point on lower half; discoidal cell convex above and little longer than the median space; discoidal cell traversed, median space entire, cubital space traversed by 8-10 (rarely 4) veins; R_{2+3} fused with R_1 at its origin; R_3 arising much nearer to arc, than node, slightly separated from origin of R_{4+5}; anal field with up to 4 rows of cells; IA pectinate intercalated sectors a few and generally restricted to the apical half of the wing. Male superior anal appendages a little longer than segment 10, forcipate broad at base and in distal half; outer border bear a few spines, usually with a variably developed basal spine and notch at apex; inferiors about two-third the length of superiors, narrowing gradually from base to apex; terminal fold of penis large, rather elongated with its apical process rather short, curved outwards and each bear a median curved spins on outer border.

Type-species : *Calopteryx luctuosa* Burmeister.

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Gujarat, Karnataka, Kerala, Manipur, Maharashtra, Meghalaya, Mizoram, Uttar Pradesh, Tamil Nadu and West Bengal.

Elsewhere : Bangladesh, Burma (Myanmar), China, Indonesia, Kampuchea, Laos, Malayasia, Nepal, Thailand, Tibet, Vietnam.

Vestalis gracilis gracilis (Rambur)

1842. *Calopteryx gracilis* Rambur, *Ins. Nevrop.*, : 224.

1854. *Vestalis gracilis* Selys & Hagen, *Mem. Soc. Sci. Liege.* **9** : 84.

1934. *Vestalis gracilis gracilis*, Fraser, *Fauna Brit. India, Odon.*, **2** : 126-128.

1954. Lieftinck, *Treubia*, **22** (suppl.) : 22.

Material examined : 2MM, 28.iv.1981, Debang north; 1F, 28.iv.1981, Nr. Label, coll. S. Biswas.

Distribution : India : Present record : Arunachal Pradesh (Deban, North, Nr. Label). Past records : Abor hills, Sibsagar, Gopaldhara (Laidlaw 1917a), North Lakhimpur, Upper Assam (Laidlaw 1914), Singhbhum (Bhasin 1953), Arunachal Pradesh (Lahiri 1985), Western Ghats (Fraser 1924b), Bengal, Assam, Eastern Ghats (Fraser 1929b), Annamalai, Bolovumpattis, Cochin, Coorg, Deccan, Kanara, Malabar, Nilgiris, Travancore (Fraser 1931), Meghalaya (Lahiri 1987), Madhya Pradesh (Prasad 1996a), Andaman Islands (Chhotani *et. al.*).

Elsewhere : Annam, Tonkin (Fraser 1929b); Burma (Selys 1891, Laidlaw 1914, 1917a); Thailand (Kiauta and Kiauta 1983b), Titayavan 1979); Tibet (Selys 1891); Yunnan (Moore 1878); Bangladesh, Kampuchea, Laos, Malayasia, Nepal, Vietnam (Tsuda 1991).

Family EUPHAEIDAE

Diagnostic features : Usually medium to large size dragonflies; ground colour of body neither glistening nor metallic. The lateral suture of the thorax is incomplete. Wings are often coloured. Stalk of wings are usually absent, if exists very small; antenodals always more than two. Base of discoidal cell is connected with the radius by the arc. The arc is angulated. Sectors of arc are separated or slightly united. They arise from the middle of the arc. The vein IA is curved; the discoidal cell is short; several rows of cells in anal field; origin of R_3 in relation to subnode is variable; primary antenodals are not easily distinguishable.

Distribution : India : Arunachal Pradesh, Assam, Himachal Pradesh, Karnataka, Kerala, Manipur, Meghalaya, Nagaland, Punjab, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Afghanistan, Bangladesh, Bulgaria, Burma (Myanmar), China, Cyprus, Greece, Hongkong, Hungary, Indonesia, Iraq, Iran, Israel,

Japan, Kampuchea, Laos, Malayasia, Nepal, Pakistan, Philippines, Russia (Soviet), Syria, Taiwan, Thailand, Turkey, Yugoslavia, Vietnam.

Key to genera of family EUPHAEIDAE

1. Petiolation of wings present 2

– Petiolation of wings almost absent ..... ***Euphaea*** Selys

2. R_{2+3} fused with R_1 near its origin ..... ***Bayadera*** Selys

– R_{2+3} not fused with R_1 near its origin..... ***Anisopleura*** Selys

Genus ***Bayadera*** Selys

1853. *Epallage* group *Bayadera* Selys, *Bull. Acad. Belg.*, 20 (Annexe) *Syn. Calopt.*, : 49.

1854. *Bayadera* Selys, *Mon. Calopt.*, : 162.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 78.

1981. Davies, *Synop. Extnt. Gen. Odon.*, : 23.

Diagnostic features : Medium to large size dragonflies (abdomen 30-42 mm; hindwing 29-34 mm); body black marked with greenish yellow or blue, occasionally partly pruinosed; wings hyaline, enfumed or tipped with black; node is in the middle of the wings; petiolation of the wing extended from about halfway from base to arc and to the level of the first antenodal nervure; 1 cubital nervure in all wings; pterostigma long and narrow. Abdomen longer than wings; anal appendages considerable longer than the segment 10; superior anal appendages forcipate; inferior conical tapering to a fine spot.

Type-species : *Epallage indica* Selys.

Distribution : India : Arunachal Pradesh, Himachal Pradesh, Meghalaya, Sikkim, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, China, Japan, Nepal, Taiwan, Thailand.

Bayadera indica (Selys)

1853. *Epallage indica* Selys, *Bull. Acad. Belg.*, 20 (annexe) *Syn. Calopt.*, : 49.

1890. *Bayadera indica*, Kirby, *Syn. Cat. Neur. Odon.*, : 108.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 79-81.

Material examined : 1M, 24.ix.1984, Tonga, West Kameng, coll. R. N. Bhargava.

Distribution : India : Present record : Arunachal Pradesh (West Kameng). Past records : Arunachal Pradesh (Prasad 1997); Darjeeling (Laidlaw 1917a, Quentin 1936); N. E. India; North Bengal (Fraser 1928b); Sikkim (Prasad and Ghosh 1984); Almora, Dehra Dun, Kaligad, Raniket (Bhasin 1953), Chamoli, Garhwal, Pauri, Tehri, Uttar Kashi, Kangra (Singh and Prasad 1974).

Elsewhere : Bangladesh, China (Tauda 1991), Nepal (Kiauta 1975, St. Quentin 1970).

Genus ***Anisopleura*** Selys

1853. *Anisopleura* Selys, *Synop. Calopt.*, : 48

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 84

1981. Davies, *Synop. Extnt. Gen. Odon.*, : 23.

Diagnostic features : Medium size to large dragonflies (abdomen 30-40 mm, hindwing 27-34 mm); wings of both sexes generally hyaline or not at most apices tipped with black in males; petiolation of wings extending a little distal to the basal antenodal nervure especially in hindwings. Costal border of wings of males with an abrupt angulation outwards at a point near discoidal cell or about one-third the distance from base to node; node is situated about the middle of the wing; arc markedly angulated. Abdomen always longer than wings. Thorax robust.

Type-species : ***Anisopleura lestoides*** Selys.

Distribution : India : Arunachal Pradesh, Assam, Meghalaya, Punjab, Sikkim, West Bengal.

Elsewhere : Bangladesh, China, Nepal, Thailand, Vietnam.

Anisopleura lestoides Selys

1853. *Anisopleura lestoides* Selys, *Synop. Calopt.*, : 48.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 86-87.

Material examined : 2MM, 10.x.1966; 2F, 12.x.1966, Dalli vill., Siang, coll. S. K. Tandon and G. S. Arora; 1M, 11.x.1966, Rimi vill., Siang, coll. S. K. Tandon and G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Siang). Past records : Arunachal Pradesh (Prasad 1997); Darjeeling, Gopaldhara (Laidlaw 1917a), Assam, Bengal, Sikkim, (Fraser 1928b); Dehra Dun (Kumar & Prasad 1977); Garhwal hills (Prasad 1974); Mussorie, Chakrata, Kempti falls (Bhasin 1953).

Elsewhere : Bangladesh (Tsuda 1991), Nepal (Kiauta & Kiauta 1982a).

Genus ***Euphaea*** Selys

1840. *Euphaea* Selys, *Mon. Lib. Eur.*, : 20.

1991. Tsuda, *A distributional list of world Odonata*, 1991 : 80.

1994. Mitra, *Rec. zool. Surv. India, Occ. Pap.* No., 170.

1890. *Pseudophaea*, Kirby, *Synop. Cat. Neur. Odon.*, : 109.

1934. *Allophaea* Fraser, *Fauna Brit. India, Odon.*, **2** : 95-98.

Diagnostic features : Specimens vary from medium to large size (abdomen 25-47.0 mm, hindwing 23-40.0 mm); usually red marked with yellow, green, blue, sometimes partly pruinosed. The first lateral suture of the thorax is incomplete. The wings are expanded, occassionally eufumed with reddish or greenish brown, fore- and hindwings of male partly or entirely saffronated or opaque brown with metallic lusture; those types of markings are usually absent in females or when present they are less defined and limited to base of wings. The numbers of antenodals and postnodals vary from 15-36 and 27-49 respectively. Primary antenodals are not easily distinguishable. Pterostigma is longer than its width; swollen medially. The arc is angulated or straight lying between the second and the seventh antenodals. The sectors of arc arise from the middle of the arc and separated at origin; discoidal cell short, less than half the length of the median space, traversed by 1-3 cross veins, median space entire; cubital space traversed by 2-5 crossveins. The vein R_{2+3} fused with R_1 near its origin. R_3 arises variably either proximally or distally to sybnodus; IR_3 arises from a point equidistant from the arc and the nodus; sometimes it originates at a point nearer to the node but well separated from R_{4+5}. Petiolation is almost absent; cells of the anal field variably arranged up to eight rows.

Distribution : India : Arunachal Pradesh, Assam, Karnataka, Kerala, Manipur, Meghalaya, Mizoram, Nagaland, West Bengal.

Elsewhere : China, Hongkong, Indonesia, Japan, Kampuchea, Laos, Malayasia, Myanmar (Burma), Nepal, Philippines, Taiwan, Thailand, Vietnam.

Euphaea ochracea ochracea Selys

1859. *Euphaea ochracea* Selys, *Bull. Acad. Belg.*, (2) **7** : 443.

1931. Laidlaw, *J. F. Malay States*, **16** : 180.

1954. Lieftinck, *Treubia*, **22** (suppl.) : 17.

1934. *Allophaea ochracea*, Fraser, *Fauna Brit. India, Odon.*, **2** : 96-98.

Material examined : 1M, 27.x.1971, tirap, coll. G. S. Arora; 1M, 28.x.1971, Tirap, coll. G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Tirap). Past records : Arunachal Pradesh (Mitra 1994), Assam, Cachar, Shillong (Fraser 1929a), Darjeeling (West Bengal), Manipur (Mitra 1994).

Elsewhere : Malaya Peninsula (Laidlaw 1917a); Burma, Malacca, Siam, French Indo-china Annam (Fraser 1929a); Nepal, Thailand (Tsuda 1991).

Remarks : The specimens do not vary from the description present in the Fauna of British India as well as specimens from Darjeeling and Manipur.

The nearest ally, *Euphaea ochracea brunnea* (Selys) is a doubtful form of this species; since several characters viz. size, colour pattern etc. are too variable in both to separate from the other.

Family CHLOROCYPHIDAE

Diagnostic features : Usually small dragonflies (abdomen 12-25 mm; hindwing 15-32 mm), short body with non-metallic colour, clypeus distinct, markedly projected forming the epistome; wings longer than abdomen. Wings in male often coloured

but rarely in females; petiolation not reaching the level of the arculus; primary antenodals distinguishable 5-10 secondaries but none is proximal to the primaries. R_{2+3} usually strongly arched forwards near origin, intercalary sectors present. Base of discoidal cell connected to the radius by the arc; arc angulated (oblique), situated in a line with the distal primary antenodals crossvein, sectors of arc arising from above the middle of the arc and arc separated either at origin or from a common point.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Kashmir, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu; Uttar Pradesh, West Bengal, Andamans and Nicobars.

Elsewhere : Angola, Australia, Benin, Burkina-Faso, Burma, Cameroon, Central African Republic, Congo, Cote'd' ivorie, Ethiopea, Gabon, Ghana, Indonesia, Japan, Kenya, Laos, Liberia, Malawi, Mali, Mozambique, Nepal, Nigeria, Philippines, Papua & New Guinea, Senegal, Sierra Leon, Solomon Islands, Sri Lanka, South Africa, Sudan, Taiwan, Tanzania, Thailand, Togo, Uganda, Vietnam.

Key to genera of the family CHLOROCYPHIDAE

1. Mesothoracic triangle absent or reduced or uncoloured when present; sectors of arc arising from a common point ..... ***Libellago*** Selys
- Mesothoracic triangle present, sectors of arc separated at origin ..... ***Rhinocypha*** Rambur

Genus *Libellago* Selys

1840. *Libellago* Selys, *Mon. Lib. Eur.*, : 200.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 58.

1954. Lieftinck, *Treubia* **22**, (suppl.) : 2.

1991. Tseuda, *A distributional list of world Odonata*, : 74.

Diagnostic features : Small dragonflies (abdomen 12-22 m; hindwing 15-26 mm) red or black marked with orange, blue or green colour. Mesothoracic triangle absent or reduced and uncoloured. Wings long and narrow, hyaline, partly tinted with yellow and marked with black or blackish-brown in males; usually 4-7 antenodals and 8-18 postnodals in all wings; distinct primary antenods; sometimes these are absent in forewings of males. Discoidal cell short. A little less than half the length of the median space entire, cubital space traversed by 2 to 5 veins, R_3 arising well distal to the subnodus; IR_3 arising from a point nearer the arc than the node and in close proximity to the origin of R_{4+5}; *Ab* arising from the inner wing margin, either proximal of distal to the level of the first primary antenodas crossvein, one or two rows of cells in anal field; femora and tibiae are usually pruinosed; male superior anal appendages pincer like and twice as long as abdominal segment 10, inferior anal appendages obtuse, less than half the length of the superiors. The vulvar scale very robust.

Type-species : *Calopteryx lineata* Burmeister.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Karnataka, Kashmir, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Uttar Pradesh, West Bengal, Andaman and Nicobars.

Elsewhere : Burma (Myanmar), Indonesia, Malayasia, New Guinea, Philippines, Thailand, Vietnam.

Libellago lineata lineata (Burmeister)

1839. *Calopteryx lineata* Burmeister, *Handb. ent.*, **2** 826.

1840. *Libellago lineata* Selys, *Mon. Lib. Eur.*, : 200.

1934. *Libellago lineata lineata*, Fraser, *Fauna Brit. India, Odon.*, **2** : 60-63.

1954. Lieftinck, *Treubia*, **22** (suppl.) : 3.

Material examined : 1M, 20.v.1966, Tamen, Subansiri, coll. A. N. T. Joseph.

Distribution : India : Present record : Arunachal Pradesh (Subansiri). Past records : Arunachal Pradesh (Prasad 1997); Gopaldhara, Assam (Laidlaw 1917a); Cachar, Dehra Dun (Fraser 1928a, 1934b), Rajasthan (Prasad & Thakur 1981), Madhya Pradesh (Bastar) (Prasad 1996a), Maharashtra (Prasad 1996b), Nicobars (Laidlaw 1917a).

Elsewhere : Burma, Java (Fraser 1928a, 1934b, Selys 1899); Formosa (Needham 1930); Borneo, Taiwan (Lieftinck *et al.* 1984); China, Laos, Nepal, Philippines, Thailand, Vietnam (Tsuda 1991).

Genus ***Rhinocypha*** Rambur

1842. *Rhinocypha* Rambur, *Ins. Nevrop.*, : 232.

1934. Fraser, *Fauna Brit. India. Odon.*, **2** : 5.

1954. Lieftinck, *Treubia*, **22** (suppl.) : 7.

1981. Davies, *Synop. Extnt. Gen. Odon.*, : 22.

Diagnostic features : It is a large genus of small to medium size (abdomen 15-28.0 mm; hindwing 17-32.0 mm) dragonflies. It includes some of the most beautiful species of the order. Their wings display an immitable play of sparkling of colours, ranging from blue, green, violet to gorgeous fiery coppery red. It is to be noted that the colours of the wings of the species of *Rhinocypha* are entirely due to iridescence. By the transmitted light the wings merely show varying shades of brown. The body parts are also coloured red and blue or yellow of many shades. They are said as living gems. A triangle in the mesothorax, which may extend as far as base of wings or only up to one fourth the distance. The colour of the triangle is usually pink, blue or green in males; in females black bordered with colours as in males. Wings narrow or moderately dilated, hyaline or partly opaque. The opaque area may be marked with metallic blue, violet, green or coppery. Antenodals 12-25 and post nodals 20-48 in forewings, discoidal cell is more than half the length of the median space, usually traversed by 2-7 veins; cubital space traversed by 3-8 veins. Sectors of arc arising from about middle of the arc and separated at origin. IA not undulated at its origin; R_2 and IR_3 not fused with R_{4+5} and node nearer to base than apex; Cu_2 nearly straight or making a curve costal wards after leaving the discoidal cell; IA undulated; no intercalated sectors between Cu_2 and IA. Abdomen broad, depressed especially in males, short segments 1 and 2 are very short but others are nearly equal in length. Anal appendages all are similar; superior twice the length of the segment 10, cylindricall slightly broader at base, curved pincer like, towards one another at apices; inferior very short, more robust, cylindrical blunt at apices.

Type-species : *Rhinocypha tincta* Rambur.

Distribution : India : Arunachal Pradesh, Assam, Meghalaya, Nagaland, Orissa, Punjab, Sikkim, Uttar Pradesh, West Bengal.

Elsewhere : Australia, Bangladesh, Burma (Myanmar), China, Hongkong, Japan, Laos, Nepal, Papua New Guinea, Philippines, Solomon Islands, Taiwan, Thailand, Vietnam.

Key to species of the genus *Rhinocypha* Rambur

1. Wings coloured in male; in female palely enfumed throughout with diversified colours which are not easily distinguishable while in wings; but distinctly visible while at rest and wings are folded over back 2

– Wings uncoloured in both sexes; wings with 15 to 16 antenodals; discoidal cell with 5 to 6 traversing veins, pterostigma blackish brown; outer or costal part paler or yellowish. Thorax black, marked with bright yellow as follows : a fine antehumeral stripe, an upper humeral stripe which is incomplete below; a small upper spot near first suture. Mesothoracic triangle very large, pale blue, extends from the anterior border of thorax to alar sinus. Abdomen black, marked with yellow; a small spot on each segment 2-5 ventrolateral stripe, not extending as far as apex of segments 3 to 6 may be lost or very faint. Females almost agree with males, mesothoracic triangle black, outlined with yellow, pterostigma black bounded by white. ..... *immaculata* Selys

2. Dorsal mesothoracic triangle extending as far as root of the wings 3

– Dorsal mesothoracic triangle obsolete, thorax velvety black, marked with orange, as follows. A tiny upper antehumeral spot, a fine linear posthumeral stripe broadly broken above, incomplete below, a short linear spot on upper part of first lateral suture, an elongate oblique lateral orange stripe on each side on lower part of thorax, broadly broken into two anterior border of metepimeron. Wings semi-opaque from node to apices, this area appears dark brown by transmitted light with two rows of

vitreous spots which vary in tint from mother-of-perl to palest peach-bolssom pink or pale blue; the spot nearest the base about 14 cells long, one cells long, one cell row wide, begins about 6 cells proximal to the node and ends distally about 2 to 4 postnodal cells beyond the node lying between MA and R_{4+5}; outer row consisting of three long stripes, similarly coloured, the costal stripe the longest of three, lying between IR_2 and R_3. Posterior stripe lying between Cu_2 and MA. Pterostigma dark yellowish brown, framed in black; 16 to 18 antenodals; petiolation begins nearer to the level of proximal antenodal than the level of arc. In female wings palely enfumed greenish-yellow, antenodals 20. Abdomen in male black, first two segments marked with orange; in female the markings extends upto the segment 6 .... *ignipennis* Selys

3. Hindwings of male opaque with vitreous spots. The large apical vitreous spots separated from the costal border by not more than one to two cells 4

– Wings hyaline, palely enfumed with greenish yellow marked with adequate/opaque black and vitreous violet areas as follows : forewing entirely hyaline; pterostigma black, hindwings with apex broadly black; inner border of opaque limited to the level of middle of pterostigma to hind border of wings and finally continued as a narrow border along hind edges of the wings for about its apical fourth. At a short distance from the proximal end of the pterostigma is seen as a narrow opaque black fascia, nearly broadly broken at its middle into a small quadrate or angular spot lying between R_2 and IR_3 and a markedly irregular spot confluent with a narrow black brodering of the wing. Petiolation of wings begins opposite the second antenodal vein. In female wings palely enfumed throughout, tinted slightly with yellow, especially at base .... *hilarye miaoa* Lahiri & Sinha

– Apical vitreous spot separated from the costal border by three rows of cells 5

4. Apical vitreous spot separated from the costal border by not more than one to two rows of cells. Wings opaque, from apices to about 5 to 7 cells proximal to node; base hyaline, palely saffronated; opaque area in forewing occupying roughly about costal half of wings. hind border of this area begins 4 cells proximal to node and runs obliquely back and out from this point in a very irregular and serrate manner, leaving a vitreous streak of pale violaceous anterior to the discoidal which deeply indents the opaque area and runs inward to a little beyond inner end of the discoidal cell; inner border of the opaque area, posterior to the discoidal cell, R_1 and R_3 and is separated from the hinder two and extends beyond others. Posterior spots confluent extending to within one cell row of hind border of wings. A preapical spot extends from R_1 to nearly hind border of the wings. In female wings are hyaline, evenly enfumed throughout, so that they appear brown when overlapping and folded over dorsum ..... *cuneata* Selys

5. The wings hyaline at base, opaque black for about distal three-fourths, the hyaline area tinted with yellow, opaque area practically steely green, marked with vitreous spots which also glow emerald-green, lilaceous, mother-of-perl or a beautiful rose-pink, according to angle from which viewed. The opaque area in the forewing extends up at the apex as far as pterostigma. The opaque area in the forewing occupies anterior three-fourths of the wings. The hyaline area posterior to it in this wing and for some distance proximaly at the base is a beautiful peacock blue vitreous area. The dark area has a very irregular border basally and is markedly serrated behind. In the hindwing the opaque area begins 4 cells proximal to node and extends back in ragged manner. At the apex of the wing and situated exactly beneath the pterostigma, is a spot; pterostigma black, broadly lilaceous beneath in the hindwing. In female wings faintly and evenly enfumed, tinted with yellow at base..... ..... *fenestrella fenestrella* Rambur

6. Two-thirds of the apical vitreous spot lying under the line of pterostigma. Wings opaque black with a steely blue-green reflexes in outer three-fourths, marked vitreous spots and areas

of lilaceous purple. In forewings the opaque area covers three-fourths, the vitreous area posterior to it having a beautiful violaceous reflex; border of opaque area markedly serrate; inwardly it begins four cells proximal to node and has markedly jagged border; in the hindwings the same area begins 2 cells proximal to node and is indented by 2 vitreous areas. In female wings evenly enfumed and palely saffronated throughout ..... *spuria* Selys

– Apical vitreous spot lying partly proximal to the line of pterostigma. In the forewing the opaque area covers the costal three-fourths, its hind border markedly serrate and its inner border which extends 4 cells proximals to the node. The area posterior to the black area are vitreous and peacock blue or purple according to the angle of view. Hindwing broader than the forewing and dilated at middle, opaque black, with dark plum coloured steely reflex and marked with vitreous area. A vitreous apical spot much broader than long, bounded by R_2 costalwards, overlapping by one row of cells IR_3 posteriorly its inner and outer borders serrate a medial row of spots at the inner border of the opaque area is very irregular. Vitreous spots and areas in hindwing purple or emarled green according to an angle from which viewed. In female wings moderately deeply and evenly enfused brown .... *quadrimaculata* Selys

Rhinocypha immaculata Selys

1879. *Rhinocypha immaculata* Selys, *Bull. Acad. Belg.*, (2) **47** : 385.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 35-36.

Material examined : 1M, Pading vill., Siang, 11.x.1996, coll. S. K. Tandon and G. S. Arora; 1M, Bamo vill., Siang, 30.x.1996, coll. S. K. Tandon and G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Siang). Past records : Arunachal Pradesh (Prasad 1997), Meghalaya (Lahiri 1987), Manipur (Mitra 1994).

Elsewhere : Bangladesh (Tsuda 1991).

Rhinocypha ignipennis Selys

1853. *Rhinocypha cuneata* Selys, *Bull. Acad. Belg.*, (*Synop. Calopt.*) **20** : 60.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 9-12.

Material examined : 4M, 1F, 23.iii.1973, Bhaluk pong, coll. S. K. Tandon, 1M, 23.x.1966, Tappi, Siang, coll. S. K. Tandon & G. S. Arora; 1M, 10.x.1966, Dalli village, coll. S. K. Tandon & G. S. Arora; 1M, 23.x.1966, Subansiri Bridge, coll. S. K. Tandon & G. S. Arora; 2MM, 4.v.1966, Pinjali, West Kameng, coll. A. N. T. Joseph; 1M, 1F, 6.v.1966, Tamen, Subansiri, coll. A. N. T. Joseph; 2MM, 18.v.1966, Tamen, Subansiri, coll. A. N. T. Joseph; 1M, 27.x.1966, Daporijo, Subansiri, coll. S. K. Tandon & G. S. Arora; 2FF, 30.x.1966, Bama vill., Siang, coll. S. K. Tandon & G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Bhaluk pong, Dalli vill., Daporijo, Subansiri, Siang, Kameng). Past records : Gopaldhara, Darjeeling, (Laidlaw 1917a); Arunachal Pradesh (Lahiri 1977a, 1979).

Elsewhere : China (Chao 1981; Needham 1930); Tibet (Fraser 1927); Yunnan (Moore 1878).

Rhinocypha fenestrella fenestrella Rambur

1842. *Rhinocypha fenestrella* Rambur, *Ins. Nevrop.*, : 236.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 17-30.

1954. Lieftinck, *Treubia*, **22** (suppl.) : 10.

1994. *Rhinocypha fenestrella fenestrella*, Mitra, *Rec. zool. Surv. India, Occ. Pap.* No. **106** : 26.

Material examined : 1M, 18.v.1966, Tameng, Subansiri, coll. A.N.T. Joseph.

Distribution : India : Present record : Arunachal Pradesh (Subansiri). Past records : Arunachal Pradesh (Ram & Prasad 1999); Sikkim Narbong valley (Laidlaw 1917a); Darjeeling (Laidlaw 1917a, St. Quentin 1936).

Elsewhere : Burma (Selys 1891); Malacca, Malaya, Paulo Penang Isle (Fraser 1927), scattered in southern Asia, absent in Great Sunda Island (Lieftinck 1948).

Rhinocypha spuria Selys

1879. *Rhinocypha spuria* Selys, *Bull. Acad. Belg. Sci.*, (2) 47 : 388.

1934. Fraser, *Fauna Brit. India, Odon.*, 2 : 12.

Material examined : 1M, 10.ix.1984, Tipi, West Kameng, coll. R. N. Bhargava.

Distribution : India : Present record : Arunachal Pradesh (Kameng). Past records : Arunachal Pradesh (Ram & Prasad 1999); Nagaland (Bhasin 1953), Assam, Mizoram (Mitra 1994), Meghalaya (Lahiri 1987).

Elsewhere : Burma (Myanmar) (Fraser 1927).

Rhinocypha quadrimaculata Selys

1853. *Rhinocypha quadrimaculata* Selys, *Bull. Acad. Belg.* 20 (Annexe) *Syn. Calopt.*, : 60.

1934. Fraser, *Fauna Brit. India, Odon.*, 2 : 14-17.

Material examined : 1M, 3.xii.1969, Daphabhum, coll. J. M. Julka; 1M, 2.vi.1981, Namdhapa, coll. S. Biswas; 1M, 2FF, 28.x.1971, Nampong, Tirap, coll. G. S. Arora; 1M, 25.x.1981, way to Subansiri, coll. S. K. Gupta & M. Prasad.

Distribution : India : Present record : Arunachal Pradesh (Daphabum, Namdhapa, Subansiri, Tirap). Past records : Arunachal Prdesh (Ram & Prasad 1999); Meghalaya (Lahiri 1987); Dejoo, North Lakhimpur, Silonibari (Laidlaw 1914); Kashmir, Sikkim (Fraser 1934b); Manipur, Orissa (Mitra 1994); Almora, Buxa, Dehradun, Mothronwala, Ramgarh (Bhasin 1953).

Elsewhere : Bangladesh (Tsuda 1991), Burma (Myanmar) (Fraser 1927); Nepal (Asahina 1955; Kiauta & Kiauta 1982a; St. Quentin 1970); Thailand (Titayavan 1979).

Super family LESTOIDEA

1957. Lestinoidea Fraser, *Reclassification of the order Odonata*, NSW, : 53.

Fraser (1933) has reported the subfamily Lestinae in the family Coenagriidae. In that subfamily he has included genera occurring in India are : *Lestes* Leach, *Platylestes* Selys, *Ceylonolestes* Kennedy, *Indolestes* Fraser and *Sympecma* Charpentier. In 1957 Fraser in his reclassification has raised the subfamily into the level of the family Lestidae which includes *Sympecma, Indolestes, Platylestes, Orolestes* and *Lestes*. He has brought *Orolestes* McLachlan from another subfamily Synlestinae, reported in 1933. finally, in reclassification he has described a new superfamily Lestinoidea, covering the previously described Synlestinae, Lestinae and Megapodagrionae. The subfamilies have been raised to the level of families, only Chlorolestidae has been used in place of the subfamily Synlestinae. During the description of the superfamily Lestinoidea, Fraser (1957) has cited the Legion Lestes Selys and legion Podagrion Selys pars 1862. Since the name *Lestes* plays a key role in naming the superfamily, the late Dr. Lieftinck was of opinion that the name of the superfamily should be Lestoidea (Lahiri 1987), instead of Lestinoidea. Davies and Tobin (1984) have accepted the name Lestoidea. In the present paper Lestoidea has been used.

Diagnostic features : Usually medium to large sized dragonflies, hind margin of the posterior lobe of prothorax rounded. Wings petiolated, antenodals two, usually IR_3 and R_{4+5} both originating nearer to the arc than the node; sometimes IR_3 originates at a point midway between the arc and the node; intercalated sectors usually at the apical part of the wing.

Distribuion : Cosmopolitan.

Key to families of superfamily LESTOIDEA

1. Cu_2 strongly arched towards the costa at origin ..... SYNLESTIDAE

– Cu_2 without any distinct arch towards the costa at origin ..... LESTIDAE

Family LESTIDAE

Diagnostic features : Size small to large (Abdomen 21-57.0 mm; hindwing 18-39.0 mm); wings hyaline, tinted with yellow or those of males sometimes banded with dark or blackish brown; discoidal cell well formed and separated from inner wing margin; at the point of *ac;* pterostigma usually considerably longer than broad.

Larva : According to Lieftinck (1939a) median lobe of labium with an incompletely developed, very narrowly incised or closed; lateral lobes greatly expanded, usually distinctly concave, mesal origin very irregularly and deeply cleft. Lateral setae present. Antennae long and slender, basal joints of usual size and appearance, pedicel elongate, not conspicuously longer than distalia, gizzard with four major and four minor folds. Caudal gills very long, subparallel, apices ellipsoidal, rounded or bluntly pointed. Secondary trochanters apparently at right angles to the main axis. Pedicel of caudal gills unapparent, annular, gill cauducas, cucoids inconspicuous.

Distribution : Cosmopolitan.

Key to genera of the family LESTIDAE

1. R_3 arising after 7 or more cells beyond node ..... ***Orolestes*** McLachlan

– R_3 arising at most after 4 cells beyond node ..... ***Lestes*** Leach

Genus ***Orolestes*** McLachlan

1895. *Orolestes* McLachlan, *Ann. Mag. nat. Hist.*, (6) **16** : 21.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 25.

1987. Lahiri, *Rec. zool. Surv. India, Occ. Pap.* No. **99** : 60.

Diagnostic features : Large dragonflies (Abdomen 47-60.0 mm; hindwing 28-39.0 mm); blue green or yellowish marked with brown or black or metallic green; posterior lobe of prothorax rounded in either sex; wings hyaline or partly opaque brown; usually 19-24 postnodals in forewing; 17-20 in hindwings; arc situated at the level of the distal antenodal, pterostigma narrow 4-7 times as long as broad, rectangular, slightly swollen, at the middle, hardly or not at all braced; IR_3 and R_{4+5} arising closer to the arc than node; R_3 arising after 7 or more cells beyond node in hindwing distance of R_5 from arc to the point of origin of R_{4+5} and subnode; discoidal cell with inner margin about twice as long as costal margin; discoidal cell in hindwing subequal to that in forewing; inner distal angle of discoidal cell acute; ab arising from the inner marging at a point where ac meets it.

Type-species : *Orolestes malayai* McLachlan.

Distribution : India : Arunachal Pradesh, Meghalaya, West Bengal.

Elsewhere : Brunei, Indonesia, Kampuchea, Laos, Malayasia, Taiwan, Thailand, Vietnam.

Orolestes durga Lahiri

1987. *Crolestes durga* Lahiri, *Rec. zool. Surv. India, Occ. Pap.* No. **99** : 61.

Remark : The species differs from *Orolestes selysi* McLachlan due to its smaller size (abdomen 52.5-53.0 mm and hindwing 33-35 mm) in having uncoloured wings and also in the shape of the anal appendages, specially that of superiors. It is closer to *Orolestes wallacei* (Kirby) of Malayasia in respect of wing colour and general features but it differs from wallacei due to larger size and details of body markings, the shape of anal appendages and that of the penis.

Material examined : 1M, (Paratype), 3.xi.1969, Sunpura, coll. S. K. Tandon.

Distribution : India : Present record : Arunachal Pradesh (Sunpura). Past records : Arunachal Pradesh, Meghalaya (Lahiri 1987).

Genus ***Lestes*** Leach

1815. *Lestes* Leach, *Edinb. Encycl.*, **9** : 137.

1917. Tillyard, *Biology of dragonflies*, : 276.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 29.

Diagnostic features : Medium to large sized dragonflies (Abdomen 24-52.0 mm; hindwing 17-40.0 mm) blue, green, yellow or occassionally partly pruinosed; posterior lobe of prothorax rounded or sometimes shallowly tripartite. Wings hyaline, rarely partly enfumed, usually 9-16 postnodals; arc situated at the level of distal antenodal nervure; pterostigma rectangular, a little swollen at the middle, two to five times as long as broad, braced; IR_3 and R_{4+5} arising closer to arc, R_3 within four to five cells after the node; distance of R_5 from the arc to the point of origin of R_{4+5} and subnode in hindwing; discoidal cell with inner margin about twice as long as costal margin with inner distal angle acute; the discoidal

cell of hindwing nearly as long as to one and half times long as that of forewing; *ab* arising from the inner wing margin from or slightly proximal to the point where *ac* meets it.

Type-species : *Lestes sponsa* (Hansemann, 1823)/*Lestes barbara* (Fabricius, 1798).

Discussion on type-species : Kirby (1890) has reported/declared *Lestes sponsa* (Hansemann, 1823) as the type-species for the genus *Lestes*, Leach, 1815. This was followed by Fraser (1933), Davies (1981), Davies and Tobin (1984) and Lahiri (1987). But Lieftinck (1954), Tsuda (1986, 1991) have contended that the type-species for the genus is *Lestes barbara* (=*Agrion barbarus* Fabricius, 1708). Leach (1815) has separated *Lestes* from *Agrion* on the basis of British specimens. Both *Agrion barbarus* and *Agrion sponsa* occur in Great Britain. Pinhey (1980) has stated "In a long rambling paper (1848-1849), issued in many parts, Hagen discussed miscellaneous genera and in brief allusion to *Lestes barbara* gave this as the type of *Lestes*, an almost casual remark which later led to confusion on this all important matter, its importance has been emphasized by the cosmopolitan range of the genus *Lestes*." It is interesting to note that while Leach had been busy in segregating *Lestes* from *Agrion*, *Agrion barbarus* Fabricius was in the literature, but not *Agrion sponsa* Hansemann. *A. sponsa* was reported in 1823, i.e., eight years after Leach's separation of *Lestes* from *Agrion*. Hence it is justifiable to consider *Lestes barbara* as the Type-species of the genus *Lestes* instead of *Lestes sponsa* Hansemann.

Distribution : Cosmopolitan.

Key to species genus *Lestes* Leach

1. Labium yellow, labrum torquise-blue, bases of mandible glossy brown, head mat black, pruinosed over lower and back part eyes; thorax black on dorsum, marked by a pair of dark green metallic antehumeral stripes. Wings hyaline or palely enfumed in adults only; pterostigma dark reddish brown or blackish brown covering two cells; 10-12 postnodals in all wings. Abdomen pale blue, marked on dorsum with bronzed green, coppery metallic changing to mat black on the hinder segments. In case of female the abdomen is greenish yellow. Anal appendages in male superiors as long as segment 9, slightly longer than segment 10, pale yellow or ochreous with the base of the apex black, forcipate, finely spined on the outer border near apex, which is blunt and curved in strongly; inferiors much shorter, apposed at base where they are very broad and rounded, then abruptly contracted to form a short, cylinderical process tipped with stiff whitish hairs. In female anal appendages creamy white, shortly conical pointed. Abdomen (30-35 mm), hindwing (20-22 mm) .... *praemorsa decipiens* Kirby

– Labium whitish yellow, labrum, cheeks, bases of mandibles and frons torquoise-blue, rest of head mat black. Thorax black, pruinosed white laterally, citron-yellow beneath. Pterostigma black, 15-16 antenodals in forewings, 14-15 in the hindwings. Abdomen blue or greenish-blue marked with black; in case of female the thorax is olivaceous-green, pale greenish-yellow laterally. Anal appendages larger than segment 10; bluish-green during life, pale yellow after death; broadly black at base and apex running straight back, the apices turned down and inwards, basal half expanded on the inner side with a robust inner basal spine; inferiors much shorter, widely separated thick at base with a short process at apex tipped with white hairs. In case of female anal appendages small, conical; pointed and black. abdomen 36.0-42.0 mm; hindwing 23.0-27.0 mm ....*dorothea* Fraser

Lestes dorothea Fraser

1924. *Lestes dorothea* Fraser, *Rec. Indian Mus.* **26** 484

1933. *Fauna Brit. India, Odon.*, **1** : 35-36.

Material examined : 5M, 5F, Namdhapa Biosphere Reserve, 5-6.iv.1981, coll. S. Biswas.

Distribution : India : Present record : Arunachal Pradesh (Namdhapa Biosphere Reserve). Past records : Arunachal Pradesh (Lahiri 1985), Meghalaya (Lahiri 1987), Mizoram (Prasad 1997), Assam, Coorg (Fraser 1933c).

Elsewhere : Nepal (Kiauta 1975).

Lestes praemorsus decipiens (Kirby)

1862. *Lestes praemorsa* Selys, *Bull. Acad. Belg.*, (2) **13** : 320.

1933. *Lestes praemorsus praemorsus*, Fraser, *Fauna Brit. India, Odon.*, **1** : 30-33.

1999 Ram and Prasad, *Rec. zool. Surv. India.*

1893. *Lestes decipiens* Kirby, *J. Linn. Soc. London, zool.*, **24** : 565.

1991. *Lestes praemorsus decipiens*, Tsuda, *A distributional list of world Odonata*, 1991 : 62.

Material examined : 6MM, Sunloru, Subansiri, 3.iii.1969, coll. S. K. Tandon.

Distribution : India : Present record : Arunachal Pradesh (Subansiri). Past records : Arunachal Pradesh (Ram & Prasad 1999); Mungpoo (Darjeeling district of West Bengal), Sibsagar, Assam (Laidlaw, 1920), Coorg, Nilgiris (Fraser 1924b); Deccan, Kanara, Malabar (Fraser 1931).

Elsewhere : Burma (Myanmar) (Fraser 1929c; Selys 1891); Ceylon (Sri Lanka) (Fraser 1929c); China (Needham 1930); Indonesia (Pinhey 1980); Singapore, Thailand, Nepal (Tsuda 1991).

Family SYNLESTIDAE

1917. *Synlestinae* Tillyard, *Biology of dragfonflies*, : 117.

1920. Laidlaw, *Rec. Indian Mus.*, **19** : 187.

1933. Fraser, *Fauna Brit. India*, **1** : 19.

1926. *Synlestidae*, Tillyard, *Insects of Australia and Newzealand*, : 28.

1938. Tillyard & Fraser, *Aust. Zool.*, **9** : 125-196.

1991. Tsuda, *A distributional list of world Odonata*, 1991 : 58.

1994. Mitra, *Rec. zool. Surv. India, Occ. Pap.* No. **166** : 27.

1999. *Rec. zool. Surv. India. Occ. Pap.* No. **170** : 44.

1957. *Chlorolestidae* Fraser, *A Reclassification of the order Odonata*, NSW. : 55.

N. B. : The family has sometimes been referred to as Chlorolestidae (Fraser 1957, Davies & Tobin 1984, Lahiri 1987, Prasad & Varshney 1995, Hämäläinen 1999) a name based on that of the oldest described genus included *Chlorolestes* described by Selys (1862 : *Bull. Acad. R. Belge* (2) 14 : 33; the type species *Chlorolestes conspicus* Selys) and *Synlestes* described by Selys (1869 : *Soc. ent. Belg.* ii : Lxxvi; type species *Synlestes weyerii* Selys). Fraser (1957) proposed the family name Chlorolestidae which contains subfamilies Chlorolestinae and Megalestinae. Chlorolestinae includes *Synlestes* Selys. But already Tillyard (1917 : *Biology of dragonflies*) defined Synlestinae in the family Lestidae. The subfamily includes *Synlestes* and *Chlorolestes*. Practically this is the first family rank treatment. Tillyard (1926) raised the subfamily to the family Synlestidae. Tillyard and Fraser (1938) accepted the proposal. So after separation from the family Lestidae and elevation to the family rank, the valid name is family Synlestidae Tillyard. The family includes genera *viz.*, *Chlorolestes* Selys, *Ecchlorolestes* Barnard, *Epilestes* Kennedy, *Megalestes* Selys, *Phyloestes* Christiansen, *Sinolestes* Needham, *Synlestes* Selys. Similar opinion is hold by Dr. S. Tauda and it has been used by Lieftinck *et. al.* (1984), Tsuda (1991).

Diagnostic features : Large dragonflies (Abdomen 43-65.0 mm), wings hyaline, sometimes coloures dark or blackish brown; discoidal cell distinct; IR_3 and R_{4+5} arising from points nearer the node than the arc; sometimes IR_3 arises from a point midway between the arc and the node, while R_{4+5} arises from the point, little proximal to the point of origin of IR_3; Cu_2 strongly arched towards the costa. Anal vein arises from the inner wing-margin either at a point proximal to the arc and discoidal cell, being at about the level of *ac* or below the cell far distal to *ac*, pterostigma longer than broad.

Distribution : India : Arunachal Pradesh, Assam, Meghalaya, Mizoram, Punjab, Sikkim, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, Bhutan, Botswana, Burma (Myanmar), China, Haiti, Lesotho, Malawi, Mozambique, Nepal, Swaziland, South Africa, Taiwan, Thailand, Zimbabwe.

Genus ***Megalestes*** Selys

1862. *Megalestes* Selys, *Bull. Acad. Belg. Sci.*, (2) **13** : 293.

1933. Fraser, *Fauna Brit. India, Odon.*, 1 : 20.

1999. Mitra, *Rec. zool. Surv. India. Occ. Pap.* No. 170 : 11.

Diagnostic features : Large dragonflies (Abdomen 43-65.0 mm; Hindwing 30-38.0 mm), body usually metallic green, with yellow marks, wings long and narrow, transparent, colourless, sometimes with enfumation. Postnodals in forewings 15-25 and in hindwings 12-18, arc at the level of the distal antenodal nervure; IR_3 arising from about a point midway between the arc and the node; R_{4+5} arising from a point a little proximal to IR_3. Pterostigma elongated, middle part swollen; *ab* arising from a point proximal to the point where *ac* meets it. Superior anal appendages of males equal to or little longer than the segment 10; forcipate with a basal subquadrate projection, inner margin sometimes dilated and with a subapical expansion. Inferior anal appendages about one-third as long as superiors, triangulars or spherical and either variously shaped basal spine or with divaricate spine at the apex.

Type-species : *Megalestes major* Selys.

Distribution : India : Arunachal Pradesh, Assam, Meghalaya, Mizoram, Uttar Pradesh, Punjab, Sikkim and West Bengal.

Elsewhere : Bangladesh, Bhutan, Burma (Myanmar), China, Nepal, Taiwan, Thailand.

Key to species of genus *Megalestes* Selys

1. Wings hyaline, uncoloured, palely enfumed at apices, pterostigma black, (yellow to brown in tenerals), 16-21 postnodals in forewings, 13-16 in hindwings; abdomen dull metallic green on dorsum and sides; the sides of the segments 1, 2, and 3 pale yellow, segments 9-10 pruinosed white. Anal appendages; superiors slightly longer than the segment 10, forcipate, apex meet of cross each other broad at base, a robust spine on the innerside at junction of apical and medial thirds; inferiors rudimentary, rounded and with a moderately robust spine directed upwards and analwards. .... *major* Selys

– Wings entirely enfumed with brown; discoidal cell narrow, with costal margin a little less than hind margin. Pterostigma dark brown, braced; postnodals 24 in forewing, 22-24 in hindwing. Abdomen dark bronze-brown, almost black on segments 7-9 and 10 glossy black. Superior anal appendages subequal to segment 10 of abdomen, forcipate, cylinderical and well separated at base, narrowing thereafter to a point less than half the length of the organ.. ..... *lieftincki* Lahiri

***Megalestes major* Selys**

1862. *Megalestes major* Selys. *Bull. Acad. Belg.*, (2) 13 : 293.

1933. Fraser, *Fauna Brit. India, Odon.*, 1 : 21-23.

1999. Mitra, *Rec. zool. Surv. India, Occ. Pap.* No. 170 : 11.

Material examined : 1F, 25.ix.1984, Rupa, West Kameng; 2M, 28.ix.1984, Jameri, West Kameng, coll. R. N. Bhargava.

Distribution : India : Present record : Arunachal Pradesh (Kameng). Past records : Arunachal Pradesh (Ram & Prasad 1999), Mizoram (Mitra 1994), Gopaldhara, Pashoke, Darjeeling (Laidlaw 1919); Assam, Sikkim, Mawphlong (Fraser 1929c); Shillong (Asahina 1963, Fraser 1929c); Kumaon, Bhimtal (Laidlaw 1920); Dehra Dun, Mukteswar, North Punjab Hills (Fraser 1929c); Garhwal hills (Prasad 1974).

Elsewhere : Burma (Myanmar), Tonkin (Laidlaw 1920a); Formosa (Laidlaw 1920, Needham 1930); Nepal (Fraser 1929c, Kiauta 1975); Bhutan Lieftinck 1977).

***Megalestes lieftincki* Lahiri**

1979. *Megalestes lieftincki* Lahiri, *Oriental Ins.*, 13 119-132.

1994. Mitra, *Rec. zool. Surv. India, Occ. Pap.* No. 166 : 27.

Material examined : 1M, (Holotype), 30.xi.1975, Tahila, coll. K. R. Rao.

Distribution : Known only from the type-locality (Arunachal Pradesh; Tahila).

Superfamily COENAGRIONOIDEA

Diagnostic features : Dragonflies with narrow petiolated wings, primary antenodals present and

usually solitary excepting a few aberrant genera in which a few additional antenodals may be present at the costal area only, distal to the primaries; arc usually in line with the distal to the primary nervure, in some genera (*viz.*, *Agriocnemis* Selys, *Argiocnemis* Selys, *Mortonagrion* Fraser etc.) distal to the distal antenodal nervure. Postnodals for the greater part in line with the cross veins immediately beneath the post nodals. Pterostigma diamond shaped sometimes the shape and size vary in between fore- and hindwings of the same specimen and in between the sexes also.

Distribution : Cosmopolitan.

Key to families of the superfamily COENAGRIONOIDEA

1. Doscoidal cell elongate, anterior and posterior sides subequal, apex rather obtuse; anal vein separating from the wing border proximal to *ac*, which has lies about the midway between the two antenodals; veins MA and IR_3 running straight for the greater part of their length, only zigzagged apically or not at all .... PLATYCNEMIDIDAE

2. Discoidal cell short, anterior side shorter than the posterior; anal vein separating from the wing border at various levels either proximal to or at distal to the vein *ac;* veins MA and IR_3 markedly zigzagged for greater part of their length ..... COENAGRIONIDAE

Family PLATYCNEMIDIDAE

1863. *Platycnemis* Selys. 4me egion, *Bull. Acad. Belg.*, (2) **16** : 150.

1929. *Platycneminae* Fraser, *J. Bombay nat. Hist. Soc.*, **33** : 835.

1957. *Platycnemididae* Fraser, *A Reclassification of the order Odonata*, : 45.

Diagnostic characters : Fraser (1957) has recorded the family Platycnemididae is made up of a heterogenous collection of genera agreeing only in the shape of discoidal cell and well formed Cu_2 and IA.

Node is situated at about one-third of the wing length from the base, sometime slightly more or less but never as close as one-fourth. Pterostigma small, more or less trapezoidal, generally strongly braced. Transverse arrangement of corss veins distal to subnode very complete, the only main veins which are zigzagged being IA, the distal part of MA and more rarely the distal part of IR_3. Discoidal cell elongate, its costal side little shorter than posterior so that the distal angle is very rarely acute or subacute. Cu_2 and IA always present and well developed. Arc at the level of the distal antenodal nervure but occasionally slightly distal to that level. Legs usually long and slender but in some shorter and more robust. Superior anal appendages very variable, often forcipate or subforcipate; inferiors variable, rarely forcipate. Species should be described on differences and genera on relationships.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Mizoram, Uttar Pradesh, sikkim, Tamil Nadu, West Bengal; Andaman and Nicbar Islands.

Elsewhere : Albania, Angola, Austria, Bangladesh, Belgium, Bhutan, Burgaria, Burma (Myanmar), Cameroon, Checkoslovakia, China, Congo, Tote d' ivoris, Denmark, Egypt, Ethiopea, Finland, France, Gabon, Germany, Great Britain, Greece, Hongkong, Hungary, Indonesia, Iraq, Italy, Japan, Korea, Kampuchea, Kenya, Laos. Lebanon, Liberia, Luxembourg, Madagascar, Malawi, Malayasia, Mozambique, Namibia, Nepal, Netherlands, Nigeria, Norway, Oman, Papua New Guinea, Philippines, Portugal, Russia (USSR), Romania, Singapore, Senegal, Solomon Is., Seychelles, Sierra Leon, South Africa, Spain, Syria, Sudan, Sri Lanka, Swaziland, Sweden, Switzerland, Taiwan, Thailand, tunisia, Turkey, Uganda, Vietnam, Yemen, Yugoslavia, Zambia, Zaire, Zimbawe.

Key to genera of the family PLATYCNEMIDIDAE

1. Tibiae of males dilated; ab terminates proximal to ac 2

– Tibiae of males not dilated; ab terminates at the level of ac ..... ***Coeliccia*** Kirby

2. Costal side of the discoidal cell of the forewing fairly shorter than the posterior side .... ***Calicnemia*** Strand

– Costal side of the discoidal cell of the forewing equal to the posterior side ..... ***Copera*** Kirby (Copera vittata serapica Selys)

Abdomen 28.0-34.0 mm; Hind wing 16.0-18.0 mm. Two hind pairs of tibiae yellow reddish or brownish, only moderately dilated; superior anal appendages at least half the length of inferiors; posterior lobe of prothorax of female with a pair of divergent slender, forwardly directed spines. Wings hyaline, pterostigma less elongated, than in *Copera marginipes*, squarred, outwardly dark reddish brown; 10-13 postnodals in forewing, 10-11 in hindwings; in case of female 14 post-nodals in forewing and 12 in hindwings. Superior anal appendages of male pale blue or creamy white as long as segment 10; conical depressed, acute and tapered at apex. In female the anal appendages brownish white conical pointed, surmounting a large conical protuberance.

Genus ***Coeliccia*** Kirby

1890. *Coeliccia* Kirby, *Syn. Cat. Neur. Odon.*, : 128.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 132.

1954. Lieftinck, *Treubia*, **22** (Suppl.) : 45.

1958. Lieftinck, *Nova Guniea*, **9** : 284.

1981. Davies, *Synop. Extnt. Gen. Odon.*, : 10.

Diagnostic feature : Medium sized (usually with abdomen 24.0-46.0; hindwing 22.0-33.0 mm); black marked with white or bluish or yellowish; posterior lobe of prothorax rounded or trapezoidal, deeply or shallowly notched, while in some cases a pair of horn like process are present. Wings hyaline, cells are mostly quadrate generally 11-23 postnodals in forewing R_{4+5} arising a little proximal to node IR_3 arising a distal to the level of node, but position of these veins varies in different species. discoidal cell elongate, costal side shorter than the posterior side, distal side oblique so that the distal angle of the discoidal cell is acute. Sectors of arc slightly separated at origin, arising from the lower end of the arc, divergent from origin. The nervure *ac* situated at a level of a slightly nearer the distal antenodal nervure. *ab* always present and always complete continued on as IA. This vein extends for a long distance. Petiolation begins slightly proximal to the vein *ac*. The nervure Cu, extending for a short distance beyond the end of IA, 20 or more cells in length. Pterostigma small, oblique, diamond shaped, poorly braced. 2-3 cells between the discoidal cell and the nervure descending from the node.

Abdomen slim, cylinderical, broadened at the extreme base and gradually broadens from the segment 7 to end. Anal appendages variably but inclined to be rather homogeneous superiors usually broad at base, acute at apex and furnished with an inner subapical spine, inferiors longer tha superiors broad at base, abruptly tapered and subcylinderical slightly continuous, subacute or acute at apex.

Type species : *Platycnemis membranipes* Rambur.

Distribution : India : Arunachal Pradesh, Assam, Himachal Pradesh, Manipur, Meghalaya, Nagaland, Sikkim, West Bengal.

Elsewhere : Bangladesh, Burma (Myanmar), China, Hongkong, Indonesia, Japan, Kampuchea, Laos, Nepal, Philippines, Singapore, Taiwan, Thailand, Vietnam.

Key to species of the genus *Coeliccia* Kirby

1. Dorsum of thorax palest blue laterially, the former with a pair of oval blue spots lying in close apposition to the anterior half of the middorsal carina; a narrow oblique black stripe on each side bordering the mesepimeron anteriorly, beneath creamy white. Wings hyaline, pterostigma blackish brown, proximal border very oblique, R_{4+5} arising proximal to subnode, 18 to 20 postnodals in forewings, 17 to 18 in the hindwings; abdomen dark reddish brown on dorsum; all segments pale yellow on lateral sides; anal appendages creamy white in male, in female pale yellow .... *bimaculata* Laidlaw

– Thorax on dorsum velvety black, marked with pale blue or pale greenish yellow, a broad oval spot on each side of the middorsal carina,

separated by the black carinal ridge; beneath entirely black. Wings hyaline, pterostigma black; 18-20 postnodals in forewings; 16-18 in the hindwings of male; in case of female 20-21 postnodals in forewings and 18 to 19 in the hindwings. In male R_{4+5} arises from a point slightly proximal to the subnode; in female the distance of origin of R_{4+5} and subnode is more than in males. Abdomen black; anal appendages creamy white in female it is black ..... *renifera* (Selys)

2. Thorax black, marked with blue beneath thorax also blue; the blue humeral stripe swollen at the rear end; wings hyaline, pterostigma black; 18-20 postnodals in forewings, 16-21 in hindwings. Abdomen black, marked with yellow; superior anal appendages a little longer than the segment 10, gently narrowed apically, the apices bluntly rounded and slightly divergent, inner margin with a small subbasal and a larger median tooth; inferiors little longer than superiors, ungulate, broad at base, narrowing and slopping toward apically .... *prakritiae* Lahiri

Coeliccia bimaculata Laidlaw

1914. *Coeliccia bimaculata* Laidlaw, *Rec. Indian Mus.*, **8** : 341.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 154.

1997. Prasad, *Opusc. zool. flumin*, **154** (1997) : 3.

Material examined : 1M, Daporijo, West Kameng, 24.xii.1965. coll. Raj Tilak.

Distribution : India : Present record : Arunachal Pradesh (Kameng). Past records : Arunachal Pradesh (Prasad 1997), Abor Hills (Laidlaw 1917b), Deejoo, upper Assam (Laidlaw 1914), Tura, Garo Hills (Fraser 1933a; 1933b; Lahiri 1987).

Elsewhere : Bangladesh (Tsuda 1991).

Coeliccia renifera (Selys)

1886. *Trichocnemis renifera* Selys, *Mem. cour. Acad. Belg.*, **38** : 119.

1890. *Coeliccia renifera* Kirby, *Syn. Cat. Neur.*, : 128.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 156.

1997. Prasad, *Opusc. zool. flumin*, **154** (1997) : 3.

Material examined : 4M, 25-26.x.1981, Upper Subansiri, coll. S. K. Gupta (The species has been reported by Prasad).

Distribution : India : Present record : India : Arunachal Pradesh (Subansiri). Past record : Pashoke, Darjeeling (West Bengal) (Laidlaw 1917), Arunachal Pradesh (Prasad 1997), Gopaldhara, Assam (Fraser 1932a, 1933b); Uttar Pradesh Bhasin (1953).

Elsewhere : Nepal (Kiauta 1975; St. Quentin 1970); Bangladesh (Tsuda 1991).

Coeliccia prakritiae Lahiri

1985. *Coeliccia prakritiae* Lahiri, *Rec. zool. Surv. India*, **82** (1-4) : 61-67.

1994. Mitra, *Rec. zool. surv. India, Occ. Pap. No.*, **166** : 28.

Material examined : 4MM (Holotype & Paratype), 2.v.1981 Namdhapa Biosphere Reserve, coll. S. Biswas & party.

Distribution : Known only from the type locality.

Genus *Calicnemia* Strand

1926. *Calicnemia* Strand, *Arch. Naturgesch.*, **92A** : 146.

1954. Lieftinck, *Treubia*, **22** (Suppl.) : 45.

1958. Lieftinck, *Nova Guinea*, **9** : 284.

1981. Davies, *Synop. Extant Gen. Odon.*, : 9.

1893. *Calicnemis* Selys, *Bull. Acad. Belg.*, (2) : 161, 159 (nom. preocc.).

1933. Fraser, *Fauna Brit. India Odon.*, **1** : 171.

Diagnostic characters : Abdomen 27-36 mm; Hindwing 21-29 mm; coloured red or bright chrome-yellow marked with black or more rarely black partially obscured by pruinescence. Wings hyaline, rounded at apices never fulcate, discoidal cell elongate, costal side is approximately three fourths the length of the posterior; distal side about half as long as the basal and very oblique. So that the cell is acutely pointed at its lower distal angle, sectors of arc arising from the lower end of the

arc and arc divergent from the origin. The vein *ac* situated slightly nearer to the level of distal antenodal nervue; *ab* always present and complete, continued on as IA, which later on extends for about three fourths the length of wings Cu_2 nearly 20 cells more in length, extends for a short distance beyond the end of IA; R_{4+5} arising well proximal to the level of the subnode, IR_3, a little distal; petiolation begins well proximal to the level of *ac*, three cells between the discoidal cell and the nervure descending from the subnode. Pterostigma subquadrate, diamond shaped, braced. Head narrow, occiput simple, in both sexes; abdomen cylinderical, moderately robust and appendages homogeneous superiorly nearly as long as inferiors, ending into two long branches. One of which simulates a long robust subbasal ventral spine, the other is directed straight back to form the apex of the appendage; inferiors long, tapered, sinuous closely resembling those of the species included in the genus *Coeliccia* Kirby.

Type species : *Calicnemia eximia* Selys.

Distribution : India : Arunachal Pradesh, Assam, Sikkim, Uttar Pradesh, West Bengal.

Elsewhere : Afghanistan, Bangladesh, Bhutan, Burma (Myanmar), China, Hongkong, Laos, Malayasia, Nepal, Taiwan, Vietnam.

Key to species of the genus *Calicnemia* Strand

1. Hindwings 25 mm; labium white bases of mandibles genae and clypeus glossy black; rest of head matblack, pruinosed in different parts; in female a post ocular yellow stripe on back of occiput and beneath head entirely black. Prothorax black, middle lobe pruinosed purplish. Thorax black but due to prunescence appear blue, laterally the whole of the side bluish, except the post-lateral suture, which is not pruinosed; in female the lateral side of the thorax pale greenish yellow or pale bluish green with a black stripe; wings hyaline, pterostigma dark reddish brown framed in thick black nervures, 18 postnodals in forewings, 16 in the hindwings; 3 cells between the discoidal and the nervure descending from the subnode; in female 16 postnodals in forewings and 14 in the hindwings, abdomen black, thinly pruinosed; abdomen of female and tenerals are not pruinosed ..... *pulverulans* Selys

– Hindwings 21-23 mm in male, 23-25 in female. Labium pale ochreous, labrum, basis of mandibles, genae, and upper surface of head as far backward as the level of the posterior ocelli, bright vermillion red, occiput black in female the ground colour is yellow and the head with a thick black band tranversing the vertex and frons. Prothorax black without pruinescence. Thorax black, the lateral sides are marked with yellow. Wings hyaline, pterostigma reddish brown; 14-17 postnodals in forewings, 13 in hindwings; in females 17-18 postnodals in forewings and 16 in hindwings; abdomen bright vermillon red; in female dark enfumed ochreous, changing to black on the terminal segments ..... *eximia* Selys

Calicnemia pulverulens (Selys)

1886. *Calicnemis pulverulans* Selys, *Mem. Cour.* **38** 133.

1890. Kirby, *Cat. Odon.*, : 31.

1917. Laidlaw, *Rec. Indian. Mus.*, **13** : 322

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 175-177

1991. *Calicnemia pulveulans*, Tsuda, *A distributional list of Wrold Odonata*, : 51.

Material examined : 1M, 24.xii.1965, West Kameng, coll.

Distribution : India : Present record : Arunachal Pradesh (West Kameng). Past record : Sikkim (Fraser, 1932b, 1933b; Selys 1891); Darjeeling (Laidlaw 1917b); North Bengal (Fraser, 1932b, 1933b); Uttar Kashi, Tehri Garhwal (Singh & Prasad, 1974).

Elsewhere : Burma (Myanmar) (Selys 1891); Bangladesh, Nepal (Tsuda 1991).

Calicnemia eximia (Selys)

1863. *Calicnemis eximia* Selys, *Bull. Acad Belg* (2) **16** 160.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 174-175

1984. *Calicnemia eximia*, Lieftinck, *Odonatologica*, **13** 361

1991. Tsuda, *A distributional list of World Odonata*, 1991 : 51.

Material examined : 1F, 24.iv.1981, Namdhapa Biosphere reserve, coll. S. Biswas, 1M, 22.x.1966, Siang, coll. S. K. Tandon and G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Siang; Namdhapa Biosphere reserve) Past record : Darjeeling, Sikkim (Fraser 1932b), Arunachal Pradesh (Lahiri 1977); Meghalaya (Lahiri 1987, Mitra 1999); Uttar Pradesh (Bhasin 1953); Kumaon (Laidlaw 1917b); Himachal Pradesh (Lieftinck 1984).

Elsewhere : Nepal (St. Quentin 1970); China (Chao 1981; Needham 1930); Taiwan, Afghanistan (Lieftinck *et al* 1984); Bangladesh (Tsuda 1991).

Genus ***Copera*** Kirby

1863. *Psilocnemis* Selys, *Bull. Acad. Belg.*, (2) **16** : 168. (nom. preocc.).

1890. *Copera* Kirby, *Cat. Neur. Odon.*, : 129.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 191.

Diagnostic features : Medium sized (usually with abdomen 28.0-37.0 mm; hindwing 15.0-24.0 mm), blackish white or rarely reddish marked with black or brown; second segment of antenna as long as or longer than the hind segment; posterior lobe of prothorax simple in both sexes; rounded or deeply notched in females; wings hyaline; pterostigma a little longer than broad, 11-15 postnodals in forewing; 9-13 in the hindwing; IR_3 arising at the level of the subnode; origin of R_{4+5} slightly proximal to the level of the subnode; discoidal cell with costal side and inner margin subequal. Tibiae of males sometimes dilated; in female at is never dilated; anal appendages of male variable; superiors triangular or rounded, sometimes hooked subapically as long as or much shorter than the segment 10; inferiors longer than the superiors, ungulated or tapering to an acute apex, curved inwards.

Type-species : *Platycnemis marginipes* Rambur.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nicobars, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, Burma (Myanmar), China, Hongkong, Indonesia, Japan, Kampuchea, laos, Malaysia, Nepal, Philippines, Taiwan, Thailand, Vietnam.

Copera vittata serapica Selys

1863. *Psilocnemis vittata* Selys, *Bull. Acad. Belg.*, (2) **16** : 170.

1886. *Mem. Cour. Acad. Belg.*, **38** : 121-122.

1890. *Copera vittata* Kirby, *Syn. Cat. Neur. Odon.*, : 129.

1936. Fraser, *Fauna Brit. India, Odon.*, **1** : 198-201.

1991. *Copera vittata serapica*, Tsuda, *A distributional list of World Odonata*, : 53.

Material examined : 1M, 19.x.1966, New Jining, Siang, coll. S. K. Tandon & G. S. Arora; 1F, 5.iii.1969, Namsai, coll. S. K. Tandon.

Distribution : India : Present record : Arunachal Pradesh (Siang, Namsai). Past records : Meghalaya (Lahiri, 1987) Assam (Sibsagar) (Bhasin 1953), Bengal (Fraser 1933b), Arunachal Pradesh (Mitra 1994); Annaimalai (Fraser 19), Cochin (Laidlaw 1917b), Coorg, Malabar, Nilgiris, Wynaad (Fraser 1924a); Nicobar (Fraser 1933b); Silent valley (Rao & Lahiri 1983).

Elsewhere : Bangladesh, Burma (Myanmar), Indonesia, Malayasia, Nepal, Thailand (Tsuda 1991).

Family COENAGRIONIDAE

1890. Coenagrioninae, pass, Kirby, *Cat. Odon.*, p. 119; *Coenagrioninae* (Minus group *Platycnemis*) Munz, 119, *Mem. Amer. Ent. Soc.* No., **3** : 21, 41.

1926. *Coenagrioninae*, Tillyard, *Insects of Australia and New Zealand;* : 76, 77.

1929. Fraser, *J. Bombay nat. Hist. Soc.*, **33** : 834.

1930. Needham, *Zool. Sinica* Ser. A. vol., **11** : 238.

Diagnostic characters : Dragonflies of small size, thinly built body, variably coloured, rarely metallic; wings narrow, rounded at apex, hyaline, rarely coloured; position of *ac* varies, accessory basal post costal nervure absent petiolation usually beginning at or a little proximal to the level of *ac*;

ab always present and complete; IA present Cu_2 variable in length, discoidal cell elongate, distal end very acute, costal side is always much shorter than the posterior; sectors of arc arising from the lower end of the arc and separated at origin; R_3 usually arising about midway between the node and the pterostigma; origin of R_{4+5} well proximal to the oblique nervure descending from the subnode; IR_3 in continuation of the nervure; no intercalated sectors excepting IR_2. Abdomen of moderate length; segments 8 to 10 becoming progressively shorter, the last segment (10) sometimes bear two dorsal tubercles and very often emarginate. Anal appendages variable in genera and species; superior shorter as well as sometimes longer than the inferiors, which is often rudimentary.

Distribution : Cosmopolitan.

Key to genera of the family Coenagrionidae

1. Tubercles on apical border of segment 10 present ..... ***Ischnura*** Charpentier

– Tubercles on apical border of segment 10 absent 2

2. Arc situated at the level of distal antenodal nervure 4

– Arc situated fairely distal to the level of distal antenodal nervure 3

3. Small species, 6-8 postnodal nervures in forewings ..... ***Agriocnemis*** Selys

– Moderately large species with abdomen about 30 mm in length; 10-12 postnodals in forewing, 8-9 in hindwings; thorax black on dorsum wings hyaline; abdomen pale blue laterally; heavily marked with black on dorsum; anal appendages black; the superiors pale brown on the inner side, obtuse at apex, curved very gently downwards; inferiors much shorter less than half the length of the superiors conical as seen in profile broad at base and with minute black at apex .... *Argiocnemis rubescens* rubeola Selys

4. *ab* (anal bridge) arises from the hind border of the wing at the point where *ac* meets it 5

– *ab* arises at a point proximal to the point where *ac* meets it. Length of abdomen 23 mm and hindwings 17.0mm, 10-12 postnodals in forewings; 10 in the hindwings; abdomen black, thorax velvety black. Female without a robust ventral apical spine on segment 8; post-ocular coloured spots absent; superior anal appendages in male undulate slightly shorter than segment 10, in case of female short, pointed, conical and black. .... *Onychargia atrocyana* Selys

5. A prominent ridge on frons; no post ocular coloured spots on head; head and thorax of uniform colour without any dark marking .... ***Ceriagrion*** Selys

– No ridge on frons, post ocular coloured spots on the head present; head and thorax not uniform colour; usually with black or dark markings 6

6. Pterostigma in forewings larger than that in the hindwings; abdomen usually very long and slender; in female an apical small ventral spine on the border of the segment 8 .... ***Aciagrion*** Selys

– Pterostigma in fore- and hindwings of the same size; abdomen not unduly long and slender, in female no apical ventral spine on the border of the segment 8; but there is horn like structure in the prothorax ..... ***Pseudagrion*** Selys

Genus *Ceriagrion* Selys

1976. *Ceriagrion* Selys, *Bull Acad Belg*. (2) 42 525.

1933. Fraser, *Fauna Brit. India, Odon*. 1 313

Diagnostic characters : Medium sized (Abdomen 28-38 mm; Hindwing 18-25 mm) dragonflies. Head narrow, with well defined frontal ridge, post-ocular coloured spots always absent; thorax long and narrow, posterior lobe of prothorax simple; in case of female it is entirely free of any armature; wings hyaline pterostigma lozenge shaped, narrow, oblique at both ends, braced covering about one cell; 10-15 postnodal nervures in forewings and 8-13 in hindwings; sectors of arc arising from the lower end of the arc, divergent from their origins; *ab* always present and complete

arising from the point where *ac* meets it; *ac* is much nerarer the proximal antenodal nervure; *ab* continued as the nervure IA, but an angulation is present at the junction of the two; R_{4+5} arises well proximal to the oblique vein descending from the node; IR_3 in continuation of that nervure. Abdomenslender, cylindrical, legs short, tibial spinae short; anal appendages variable; but generally the superiors short and hooked the inferiors longer, conical and tapering to a point.

Type species : *Ceriagrion coromandelianum* (Fabricius).

Distribution : India : Andaman Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nicobar Is., Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : Algria, Angola, Australia, Austria, Bangladesh, Belgium, Benin, Botswana, Burkiana Faso, Burma, Central Africa, China, Congo, Cote d' ivoie, Egypt, Ethiopea, France, Gabon, Germany, Ghana, Great Britain, Guinea-Bissau, Hongkong, Hungary, Indonesia, Italy, Japan, Kampuchea, Kenya, Korea, Laos, Peoples Democratic Republic, Liberia, Madagascar, Malayasia, Malawi, Mali, Mauritius, Morocco, Mozambique, Namibia, Nepal, Netherlands, Niger, Nigeria, Pakistan, Papua New Guinea, Philippines, Reunion, Senegal, Seychelles, Singapore, Sierra Leone, Solomon Islands, Somalia, South Africa, Sudan, Syria, Swaziland, Taiwan, Tanzania, Togo, Vietnam, Zaire, Zimbabwe.

Key to species of genus *Ceriagrion* Selys

1. Abdomen bright citron yellow without margings in case of males in females abdomen uniformly olivaceous, with an ochreous or golden brown on dorsum, which deepens somewhat on the hinder segments; segment 10 deeply emerginate on dorsum; anal appendages in male citron-yellow or ochreous, the inferiors tipped with black; superiors about half the length of segment 10, subquadrate and seen from above, but in the corners gently rounded and the inner ending in a minute black popint; the whole shaped like a pullet's head, the spine representing the small black beak seen in profile, subtriangular or briefly ungulate; inferiors about half as long as superiorsl slopped strongly upwards, broad at base, then abruptly narrowed and tapering rapidly to an acute point which is slightly upturned, seen from below, the bases meeting but apices are widely separated and turned in slightly. In case of female the colour of the anal appendages olivaceous or golden brown, conical pointed, as long as segment 10; prothorax and thorax uniformly olive green; beneath more or less thinly pruinosed white; Wings hyaline, 10-12 postnodals in forewings, 10-11 in hindwings .... *coromandelianum* (Fabr.)

– Anbdomen pale azure blue; segments 9-10 marked with black on dorsum; in case of female black colour on the segment 9 & 10 absent; prothorax and thorax of male uniform pale blue, paling to white beneath; in female the ventral side of thorax pruinosed white in adults. Wings hyaline, pterostigma amber tinted; 12-15 postnodals in forewings, 12 to 13 in hindwings in male and in female 13-14 in forewings and 12-13 in hindwings. Anal appendages reddish brown; superiors about half the length of the segment 10, conical, coated with long hairs at apex and on inner side, the apex expanding and turned inwards and downwards, with a twist on the long axis of appendages and ending below in a minute tooth; inferiors of the same length directed very steeply up towards the superiors broad at base tapering to a button like point; in female it is very short ..... *azureum* (Selys)

– Abdomen uniform olivaceus brown, paling to yellowish beneath. Prothorax and thorax pale olivaceous, paler on the sides and under surface white; wings hyaline, in adults palely enfused; pterostigma palest brown; 15 post nodals in forewing, 13 in hindwings; *ab* arises at the level of *ac*. anal appendages brown; superiors shorter than segment 10, triangular as seen from the dorsum and hollowed out on the inner side the apex rather broadly rounded and coated with long hairs seen from side shaped like a prunning knife; the apex is bent under and

ending in a small tooth. The inferiors slopping strongly, upto meet the superiors, broad at base and tapering to a point; in female it is brownish red, short conical .... *olivaceum* Laidlaw

Abdomen, in male, pale lemon-yellow, black marking from segments 6 to 10; in case of female the abdomen olivaceous-brown on dorsum or with a reddish or carneous tint on segment 1 to 4 basal half of segment 5 and from that point to segment 10 black; prothorax and thorax olivaceous-green on dorsum yellow on the sides, citron-yellow, beneath thorax but in case of female the beneath of the thorax and first two segments of the abdomen pruinosed white; wings hyaline, 13 to 15 postnodals in forewings and 12-13 in the hindwings; *ab* arises from a point distinctly proximal to *ac* in all wings and sexes, anal appendages black, very short in female; in case of male the superiors slightly shorter than segment 10, conically triangular as seen in profile with an obtuse apex, hood-shaped as seen from above; the outer side straight, the inner slightly sinuous and ending below in a small tooth, the apex thickly coated with hairs; inferiors of the same length directed obliquely upwards and backwards, tapering to an acute apex, which bears a small inwardly directed tooth ..... *fallax cerinomelas* Lieftinck

Ceriagrion coromandelianum (Fabricius)

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

1876. *Ceriagrion coromandelianum*, Selys, *Bull. Acad. Belg.*, (2) **42** : 528.

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

Material examined : 1M, 8.ix.1986, Bordumsa, West Kameng, coll. R. N. Bhargava.

Distribution : India : Arunachal Pradesh (Kameng). Past records : Chilka Lake, (Fraser & Dover 1922, Laidlaw 1915); Calcutta, Purneah, Sibsagar (Laidlaw, 1916b) Dibrugarh (Laidlaw, 1914) Buxa, Pusa (Bhasin 1953); Tripura (Lahiri 1957a) Assam, Mizoram (Lahiri 1979); Bihar (Prasad & Varshney 1988), Meghalaya (Lahiri 1987); Uttar Pradesh (Ram et al 1983); Dehra Dun, Mothronwala, (Bhasin 1953); Agra (Baijal & Agarwal 1955); Garhwal Hills (Prasad 1974) Bolovumpattis, cochin, Coorg, Deccan, Kanara, Malabar, Nilgiris (Fraser 1931); Tamil Nadu (Kumar 1990; Miller 1990), Andhra Pradesh (Joseph & Satyarani 1988), Manipur (Mitra in press), Madhya Pradesh (Bastar) (Prasad 1996a). Elsewhere : Burma (Bhasin 1953, Laidlaw 1916b), Ceylon (= Sri Lanka) (Lieftinck 1955; 1971), China (Needham 1930), Indo-China (Laidlaw 1916b); Nepal (Kiauta & Kiauta 1982b; St. Quentin 1970); Pakistan (Tsuda 1991).

Ceriagrion azureum (Selys)

1891. *Pseudagrion azureum* Selys, *Ann. Mus. Civ. Genova*, (2) **10** (30) : 513.

1933. *Ceriagrion azureum*, Fraser, *Fauna Brit. India, Odon.*, **1** : 328.

Material examined : 2M, 1F, 6.iv.1981, Namdhapa, coll. S. Biswas.

Distribution : India : Present record : Arunachal Pradesh (Namdhapa Biosphere). Past records : Arunachal Pradesh (Lahiri 1985); West Bengal (Pashoke), Khasi Hills (Fraser 1933b); Bankura (West Bengal) (Mitra in press); Mizoram (Mitra, 1994).

Elsewhere : Bangladesh, Burma (Myanmar), China, Laos, Nepal, Thailand (Tsuda, 1991).

Ceriagrion fallax cerinomelas Lieftinck

1914. *Ceriagrion fallax* Ris, *Ent. Mitteil.*, **3**(2) : 47.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 321.

1927. *Ceriagrion cerinomelas* Lieftinck, *Tijdschr. Ent.*, **70** : 88.

1991. *Ceriagrion fallax cerinomelas*, Tsuda, *A distributional list of World Odonata*, 1991 p. 26.

Material examined : 3M, 25.x.1981, Upper Subansiri, coll. S. K. Gupta; 2M, 27.x.1984, West Kameng, coll. R. N. Bhargava (the species has been recorded by Prasad 1997).

Distribution : India : Present record : Arunachal Pradesh (Upper Subansiri & Kameng). Past records : Hilly tracts of Assam, Simla Hills, Bengal, Sikkim (Fraser 1933b); Bankura (West Bengal) (Mitra in press), Manipur (Asahina, 1967,

Lahiri 1977b) (Meghalaya (Lieftinck *et al* 1984; Lahiri 1987; Mitra 1999).

Elsewhere : Bangladesh (Dasgupta 1957); China (Chao 1981; Needham 1930); Nepal (Kiauta 1975); Tibet (Fraser 1933b); Taiwan (Lieftinck *et al* 1984); Burma, Malaya (Asahina 1967).

Ceriagrion olivaceum Laidlaw

1914. *Ceriagrion olivaceum* Laidlaw, *Rec. Indian Mus.*, **9** : 345.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 324-325.

1983. *Ceriagrion olivaceum olivaceum*, Mitra, *Ent. mon. Mag.*, **119** : 29.

Material examined : 1M, 1F, 23.xii.1965, Elephant Flat Kameng, coll. S. K. Bhattacharya and party; 1M, 28.x.1966, Subansiri bridge, coll. S. K. Tandon & party; 2M, 28.x.1985, Bhalukpong, Kameng, coll. G. K. Srivastava, 4MM, 2FF, 4.xii.1985, Pakhuli Sanctuary, East Kameng district, coll. R. N. Bhargava; 1M, 29.xii.1985, Kalaktang, West kameng district, coll. R. N. Bhargava; 1F, 7.i.1986, Khellong West Kameng district, coll. R. N. Bhargava; 1F, 21.iii.1973, Seasa, coll. S. K. Tandon.

Distribution : India : Present Record : Arunachal Pradesh (Kameng, Subansiri & Seasa). Past records : Assam (Lahiri 1979; Laidlaw 1916b); Lieftinck 1948); Bengal (Lieftinck 1948), Buxa (Bhasin 1953); Coorg, Deccan Wynaad (Fraser 1931), Nilgiris (Kimmins 1966); Poona, Satara (Fraser 1924b); Manipur, Tripura and West Bengal (Mitra in press), Madhya Pradesh (Bastar) (Prasad 1966).

Elsewhere : Kochin hills, Burma (Myanmar) (Fraser 1933b); Bangladesh, Kampuchea, Laos, Malayasia, Nepal, Thailand, Vietnam (Tsuda 1991).

Genus ***Pseudagrion*** Selys

1876. *Pseudagrion* Selys, *Bull. Acad. Belg.*, (2) **42** : 409.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 274.

1954. Lieftinck, *Treubia*, **22** (Suppl.) : 56.

1964. Pinhey, *Revta. Ent. de Mocambique*, **7** : 5-196.

1981. Davies, *Synop. Extnt. Gen. Odon.*, : 3.

Diagnostic characters : Medium to large sized dragonflies (Abdomen 23.0-39.0 mm; Hindwing 16.0-29.0 mm) usually bright blue, marked with black or red, orange or green etc nonmetallic, less commonly dull coloured black, brown or pruinosed. Post ocular coloured spots are generally present posterior lobe of prothorax of male wiothout any process, but in female two small hooks, sloping strongly forward on the dorsum of the middle lobe. Wings hyaline, pterostigma similar in the fore- and hindwings, lozenge shaped, narrow, oblique at both ends, braced. Postnodals are 9-15 in forewings, 7-10 in hindwings; discoidal cell acutely pointed at the distal ends; sectors of arc arising from the lower end of the arc divergent from the origin; arc situated at the level of the distal antenodal nervure; *ab* always present and complete, and continued on as the nervure IA; but an angulation at the junction of the two; R_{4+5} arises well before the vein descending from the subnode; IR_3 at that level; *ac* situated considerably nearer the level of the proximal antenodal nervure. Abdomen thin and slender, anal appendages are variable as long as or shorter than segment 10, the inferiors much shorter; superiors of ten forked or notched at apex and with or without spines at base inferiors simple, conical.

Type species : *Pseudagrion furcigerum* (Rambur).

Distribution : India : Andaman Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Haryana, Karnataka, Kashmir, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Nicobars Islands, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : Angola, Australia, Bangladesh, Burma (Myanmar), Cameroon, Celebes, China, Ivory coast, Java, Luzon, Mudagascar, Marques Is., Nayotte Is., Natal, Nigeria, Palestine, Papua, Philippines, Senegal, Siberia, Sierra Leone, Sri Lanka (Ceylon), Solomon Islands, Sunda Islands, Syria, Timor, Transval, Upper Congo, West Africa, Zambia, Zmbezi, Zimbabwe.

Key to species of genus *Pseudagrion* Selys

1. Prothorax pale blue, dorsum of middle lobe marked with black crown, exposing three blue

spots; thorax azure blue the middorsum of male with black band; female with pale blue on dorsum tinted with ferruginous. Wings hyaline, pterostigma in male pale yellow to brown; very oblique outwardly; in female the pterostigma golden yellow; 11 postnodals in forewing and 9 in hindwing. Abdomen pale azure blue, marked with black on the segment 1-7; 8 and 9 are entirely blue; segment 10 with an x-shaped marks in female segment 10, blue without any marking. Anal appendages, superiors black; about half the length of the segment 10, with the apex hooked strongly inward and deeply excavate on inner side as seen from the dorsum inferiors blue, very short, conical, rounded at apex; in female the anal appendages brownish, minute conical .... *australasiae* Laidlaw

– Prothorax black, marked with blue, thorax olivaceous green, with golden tings as far back as first lateral suture. Wings hyaline, pterostigma reddish brown; 10 postnodals in forewing. 9 in the hindwing; dorsum of abdomen broadly marked with black; 1 and 2 olivaceous green above, azure blue laterally. Superior anal appendages as long as segment 10, black, inferiors paler, in female shorter than segment 10, conical white process .... *rubriceps rubriceps* Selys

Pseudagrion rubriceps rubriceps Selys

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

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

1954. *Pseudagrion rubriceps rubriceps*, Lieftinck, *Treubia*, **22** (Suppl.) : 60.

1983. Mitra, *Ent. mon. Mag.*, **119** : 29.

Material examined : 1M, Itanagar (visual record) (Ram & Prasad 1999).

Distribution : India : Present record : Arunachal Pradesh (Itanagar). Past records : Assam (Lahiri 1979); Calcutta (Mitra 1983), Howrah, Hooghly (Ram et al 1982), Bihar (Prasad & Varshney 1988); Meghalaya (Lahiri 1987); Chandigarh (Tyagi 1984); Uttar Pradesh (Ram et al 1983), Dehra Dun, Lachiwala, Mothronwala, Nalapani (Bhasin 1953), Garhwal Hills (Prasad 1974); Rajasthan (Prasad and Thakur 1981); Madhya Pradesh, Raipur (Bhasin 1953), Nagpur (Laidlaw 1919), Poona (Fraser 1924b), Bolovom pattis, Coorg, Deccan, Kanara, Malabar, Nilgiris (Fraser 1931); Tamil Nadu (Kumar 1990); Orissa; Tripura (Mitra 1994); Madhya Pradesh (Bastar) (Prasad 1996a).

Elsewhere : Burma, Palon (Laidlaw, 1916a, Selys 1891); Formosa; Indo-China (Fraser 1933b); Java (laidlaw 1916a); Pakistan (Khaliq & Yusuf 1993); Bangladesh; Nepal; Philippines; Thailand (Tsuda 1991).

Pseudagrion australasiae Selys

1876. *Pseudagrion microcephalum race australasiae* Selys, *Bull. Acad. Belg.*, (2) **42** : 491 : 506.

1919. *Pseudagrion bengalense* Laidlaw, *Rec. Indian Mus.*, **16** : 192-193.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 282-284

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

1954. Lieftinck, *Treubia*, **22** (Suppl.) : 56.

Material examined : 1F, 4.v.1966, Hapoli, Subansiri Div., coll. A. N. T. Joseph; 1F, 14.x.1966, Siram Bridge, Siang, coll. S. K. Tandon & G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Subansiri & Siang). Past record : Assam, Bengal (Fraser 1933b), Calcutta, Howrah (Dasgupta 1957; Ram et al 1982); Manipur (Lahiri 1977b); Meghalaya (Lahiri 1987); Madhya Pradesh (Prasad 1996).

Elsewhere : Australia (Laidlaw 1916a), Burma (Myanmar) (Fraser 1933b), Bangladesh, Indonesia, Kampuchea, Malayasia, Nepal, Singapore, Thailand (Tsuda 1991).

Genus ***Aciagrion*** Selys

1891. *Aciagrion* Selys, *Ann. Mus. Civ. Genova*, (2) **10**(30) : 509.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 333.

1954. Lieftinck, *Treubia*, **22** (Suppl.) : 6.

1981. Davies, *Synop. Extnt. Gen. Odon.*, : 5

1991. Tsuda, *A distributional list of World Odonata*, 1991 : 17.

Diagnostic characters : Medium sized (Abdomen 23.0-34.0 mm; hindwing 15.0-24.0 mm) dragonflies, very slender built, coloured blue or violaceous, marked with black, less commonly pale, non metallic; post-ocular coloured spots present; posterior lobe of prothorax simple and rounded. Thorax slim; wings hyaline, very narrow and subacute at apex; pterostigma differing fore- and hindwings; that of forewing nearly double the size of the hindwing narrow, diamond shaped, distal and proximal side very oblique in forewing; postnodals numbering 9-14 in forewings; 8-11 in hindwings; arc situated at the level of distal antenodal nervure; *ab* originates at the point where *ac* meets it and continued as the nervure IA, but their junction is strongly angulated; R_{4+5} arising before the nervure descending from the subnode; IR_3 in continuation of that nervure, abdomen varies from moderate to a great length superior anal appendages in male shorter than the segment 10; occasionally notched at apex; inferior appendages short or rudimentary, generally shallowly notched and sometimes with a prominent tooth at apex.

Type species : *Pseudagrion hisopa* Selys.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Goa, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, West Bengal.

Elsewhere : Angola, Australia, Bangladesh, Botswana, Burma (Myanmar), China, Congo, Cote d' ivorie, Gabon, Indonesia, Japan, Kampuchea, Korea, Liberia, Malayasia, Malawi, Mozambique, Nepal, Papua New Guinea, Pakistan, Singapore, Sri Lanka, Taiwan, Thailand, Tanzania, Uganda, Zambia, Zimbabwe, Zaire.

Key to the species of genus *Aciagrion* Selys

1. Large species with abdomen more than 30.0 mm in length 2

– Medium sized species with abdomen not more than 25.0 mm in length; posterior lobe of prothorax trilobate behind; black markings on dorsum of segments 2 and 10 very broad. Prothorax pruinosed on the tarsal sides; thorax black on dorsum as far lateral as the anterolateral suture, pruinosed below; Wings hyaline, pterostigma brownish, framed in black nervures; 10 postnodals in forewings, 9 in the hindwings; abdomen thin,, segment 1 black on dorsum, blue obscured with pruinescence at the sides segments 2-7 black on dorsum with variable thickness, 8-9 azure blue; in female segments 8 and 9 black on dorsum, blue in the sides; in female segment 10 black; in female it is entirely blue .... *approximans* (Selys)

2. Prothorax black on dorsum but pale yellow or carneous, laterally and across the posterior lobe; thorax black on dorsum, marked with broad pale blue antehumeral stripe, laterally pale blue changing to pale yellow on the side and beneath, wings hyaline pterostigma pale brown; 12-13 postnodals in forewings; 11 in hindwings; abdomen pale blue at basal and anal segments, pale yellow on the medial black varies in different abdominal segments. Anal appendages in male carneous of palest blue, tipped with black; in female short, conical pointed at apex, black, superiors as long as segment 10, triangle as viewed from above, broad at base, apex pointed; inferiors considerably shorter, than superiors ending in an angulate process..... ..... *olympicum* Laid

– Prothorax brown on dorsum, the anterior lobe pale lobe, laterally pale whitish brown; thorax warm brown on dorsum. Wings hyaline 10-12 postnodals in forewings 9-10 hindwings. Pterostigma, very small, pale brown in both sexes. Abdomen thin, long and slender; segments 1 & 2 almost white. With a large black spot on the dorsum; in female segment 2 with an arrow head black mark on dorsum; in male 3-7 segments white laterally and with a narrow black apical rings; in female segments 3 to 7 warm reddish brown on dorsum; in male 8 to 10 pale azure blue unmarked; in female these are almost white, sometimes pinkish or palest blue ..... *pallidum* Selys

Aciagrion approximans (Selys)

1876. *Pseudagrion microcephalum race approximans* Selys, *Bull. Acad.* Belg., (2) **42** : 507.

1919. *Aciagrion approximans*, Laidlaw, *Rec. Indian Mus.*, **16** : 172, 187.

1924. Laidlaw, *Proc. U. S. Nat. Mus.*, **46** : 498.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 343.

1919. *Aciagrion tillyardi* Laidlaw, *Rec. Indian, Mus.*, **16** : 172.

1977. Lahiri, *Orient Ins.*, **13** (1 & 2) : 121.

1999. Ram and Prasad, *Rec. zool. Surv. India.*

Material examined : 2M, 20.xi.1975, Tahila, coll. K. R. Rao (deposited in the Eastern Regional Station, ZSI, Shillong) (The specimen has been reported by Lahiri 1979).

Distribution : India : Present record : Arunachal Pradesh (Tahila). Past records : Shillong, Tura (Laidlaw 1924); Cherrapunjee (Laidlaw 1919), Nagaland (Bhasin 1953), Khasi Hills (Fraser 1933c), Arunachal Pradesh (Lahiri 1979, Ram and Prasad 1999), Manipur (Lahiri 1977b), Sikkim (Mitra 1994), West Bengal (Sinha & Chakraborty 1996).

N. B. *Aciagrion tillyardi* Laidlaw has been reported to occur in N. E. India and Indonesia. This discontinuous distribution of a non-migratory species in well populated *A. approximans* Selys zone and Laidlaw the describer of the species as well as the first reviser has synonymised it with *A. approximans*, raise doubts on the authenticity of identification of later days workers. Hence *A. approximans* (Selys) has been accepted here.

Aciagrion olympicum Laidlaw

1919. *Aciagrion olympicum* Laidlaw, *Rec. Indian Mus.*, **16** : 171, 184-186.

1924. Laidlaw, Proc. *U. S. Nat. Mus.*, **46** (Art. 10) : 4, 8.

1933. Fraser F. C., *Fauna Brit. India, Odon.*, **1** : 337-339.

1994. Mitra, *Rec. zool. Surv. India, Occ. Pap.* No. **166** : 320.

Material examined : 2M, 2F, 13.v.1966, Lower Subansiri, coll. A. N. T. Joseph; 1M, 1F, 15.v.1966, Lower Subansiri, coll. A. N. T. Joseph, 1M, 1F, 13.xi.1985, Upper Subansiri, coll. G. K. Srivastava (The specimen has been reported by Prasad 1997).

Distribution : India : Past records : Arunachal Pradesh (Lower & Upper Subansiri). Past records : Arunachal Pradesh (Prasad, 1997); Darjeeling (Fraser 1933, Laidlaw 1919); Sikkim (Fraser 1933).

Elsewhere : Nepal (Tsuda 1991).

Aciagrion pallidum Selys

1891. *Aciagrion pallidum* Selys, *Ann. Mus. Civ. Genova.* (2) **10**(30) : 512.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 344-345.

1994. Mitra, *Rec. zool. Surv. India, Occ. Pap.* No. **166** : 32

Material examined : 1M, 28.x.1985, Bhalukpong, West kameng, coll. G. K. Srivastava; 1F, 8.xi.1985, Poing, Debang valley, coll. G. K. Srivastava; 4MM, 5FF, 14.xii.1985, Pakhui Sanctuary, East Kameng, coll. R. N. Bhargava; 1M, 4FF, 7.i.1988, Khelong, West Kameng, coll. R. N. Bhargava.

Distribution : India : Present records : Arunachal Pradesh (East & West Kameng). Past records : Assam (Lahiri 1979, Laidlaw 1924), Dibrugarh, N. E. Assam (Laidlaw 1914); Darjeeling, Nurbong, Bottom of Mahanadi Valley (Laidlaw 1919); Sikkim (Lieftinck 1948); Arunachal Pradesh (Lahiri 1979); Bihar (Prasad & Varshney 1988); Meghalaya (Lahiri 1987); Poona, Satara, Western Ghats (fraser 1933b); Khandala, Mahabaleswar (Fraser 1924b); Mormugao, Portugeese India (Laidlaw 1919); North Kanara, Nagpur (Laidlaw 1924); Deccan (Fraser 1931); Garhwal Hills (Prasad 1974); Uttar Pradesh (Kumar 1982, Ram *et al.* 1983); Orissa; Tripura (Mitra 1994, 1999); Madhya Pradesh (Prasad 1996a).

Elsewhere : Burma (Laidlaw 1924, Lieftinck 1948); Copabo (Selys 1891): Nepal (Asahina 1955); Kampuchea, Thailand, Vietnam (Tsuda 1991).

Genus *Enallagma* Charpentier

1840. *Enallagma* Charpentier, *Lib. Europ.*, 21.

1876. Selys *Bull. Acad. Relg.* (2) **41** : 496.

1890. Kirby, *Cat. Odon.*, : 145.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 371.

Diagnostic characters : Small (usually

abdomen 17.0-20.0 mm, hindwing 11.0-22.0 mm); generally black, marked with blue green, non-metallic; sometimes partly pruinosed; post ocular spots present; posterior lobe of prothorax usually simple and rounded. Wings hyaline; colour and shape of pterostigma same in both fore- and hindwings; 7-15 postnodals in forewings; 6-10 in hindwings; arc situated at the level of the distal antenodal nervure; *ab* always present and complete, arising well proximal to the level of *ac* which generally lies between two antenodals; *ab* continued as IA but an angulated present at the junction of the two; R_{4+5} arises well proximal to the level of the vein descending from the node; IR_3 in continuation of that nervure. Abdomen moderately short slender, slightly tumid at base and again at terminal segments; segment 8 in female with ventral apical stout spine.

Type species : *Enallagma cyathiagerum* Charpentier.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Karnataka, Kashmir, Orissa, Manipur, Meghalaya, Maharashtra, West Bengal.

Elsewhere : Afghanistan, America, Africa, Europe, Cuba, Japan, Madagascar, Maldives, Central Asia, Sri Lanka, West Indies, Zanzibar.

Enallagma parvum Selys

1876. *Enallagma parvum* Selys, *Bull. Acad. Belg.*, (2) **41** : 537.

1890. Kirby, *Cat. Odon.*, : 147.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 376-378.

1994. Mitra, *Rec. zool. Surv. India, Occ. Pap.* No. **166** : 32.

Material examined : 1F, 26.x.1991, Jairampur, Tirap, coll. G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Tirap). Past records : Meghalaya (Lahiri 1987; Mitra 1999), Sikkim, Assam, Duars of Bengal (Fraser 1933); Calcutta (Lahiri & Mitra 1976); Manipur (Lahiri 1977b); Western ghats (Fraser 1924b); Uttar Pradesh (Ram et al 1983); Bihar, Orissa (Mitra in press), Madhya Pradesh (Prasad 1996a).

Elsewhere : Burma (Myanmar), Ceylon (Sri Lanka) (Lieftinck 1971), Nepal (St. Quentin 1970); Thailand (Tsuda 1991).

Genus ***Ischnura*** Charpentier

1840. *Ischnura* Charpentier, *Lib. Europa*, : 20.

1876. Selys, *Bull. Acad. Belg.*, (2) **41** : 259.

1933. Fraser, *Fauna Brit. India Odon.*, **1** : 346.

Diagnostic characters : Small dragonflies (usually abdomen 20.0-25.0 mm, hindwing 13.0-18.0 mm), yellow, blue, green or reddish marked with black; post-ocular coloured spots present female polychromatic; wings hyaline; pterostigma of males shaped and coloured differently in fore- and hindwings of the forewings variable even in the species level; 8-12 postnodals in forewings 6-9 in hindwings; arc situated at or slightly distal to the level of distal antenodal nervure; IR_3 arising at the level of subnode; orogin of R_{4+5} well proximal to the level, discoidal cell with inner margin twice or little less than twice; *ab* arises well proximal to the point where *ac* meets it; *ab* continues as the nervure IA but an angulation present at the junction of the two. Abdomen moderately short and robust tumid at base in many species abruptly narrowed and cylinderical from segment 3, then dilating again from the apical end of the segment 7 to the end; segment 10 with two prominent tubercles on dorso-apical border; anal appendages variable; segment 8 of female bear a ventral apical spine.

Type-species : *Ischnura pumilo* Charpentier.

Distribution : India : Andaman Is., Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kashmir, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : Both old and new world.

Key to the species of the genus *Ischnura* Charpentier

1. Prothorax bronzed black on dorsum, laterally blue, anterior lobe blue; in female palest yellow on the sides and almost white beneath; thorax bronzed black on dorsum as far as midway

between the humeral and antero-lateral suture, marked with a narrow grass green antehumeral stripes; wings hyaline; pterostigma differing in fore- and hindwings; that of forewing slightly broader than long kite shaped. rose-red for its proximal part, hyaline for the distal aprt, posterior border black, anterior border white, outer border yellow; hindwing much smaller about half the size uniform pale grey. Abdomen citron-yellow; segments 8-10 azure blue; in female the abdomen is black on dorsum but in segments, 8-10 yellow on dorsum .... *aurora aurora* (Brauer)

– Prothorax black on dorsum, ochreous on the sides; thorax broadly black on dorsum, extending as far as outwardly half way to the antero-lateral suture, laterally blue; wings hyaline, pterostigma narrow, diamond shaped, acutely pointed at outer and especially, bright tawny with proximal borders black, distal yellowish; abdomen variable colour in different segments; segment 1 pale green, with a black spot; segment 2 greenish basally changing to orange, with black spot on dorsum; segments 3 to 6 bright reddish orange, with a narrow apical black ring; 7 to 10 black; 8 with an azure blue spot on dorsum .... *rufostigma mildredae* Fraser

Ischnura aurora aurora Brauer

1865. *Ischnura aurora* Brauer, *Verh. zool-bot. Ges. Wien.*, **15** : 510.

1933. *Ischnura delicata*, Fraser, *Fauna Brit. India, Odon.*, **1** : 360.

1991. *Ischnura aurora aurora*, Tsuda, *A distributional list of World Odonata*, **1991** : 34.

Material examined : 1M, 11.ix.1984, Tipi, West Kameng district, coll. R.N. Bhargava; 14 MM, 17.ix.1984, Dirang, West Kameng, coll. R.N. Bhargava; 1M, 27.ix.1984, Darang, West Kameng, coll. R.N. Bhargava.

Distribution : India : Present record : Arunachal Pradesh (West Kameng). Past records : Bengal (Selys 1891); Arunachal Pradesh, Assam (Lahiri 1979), Manipur (Lahiri 1977b); Barkuda Island (Fraser & Dover 1922); Bihar (Prasad & Varshney 1986); Meghalaya (Lahiri 1987); Dehra Dun (Mothronwala, Nalapani, Gorakhpur, Surpur (Bhasin 1953); Garhwal Hills (Prasad 1974); Rajasthan (Prasad & Thakur 1981); Conoor, Ooty Lake (Fraser 1924), Bolovumpattis, Cochin, Coorg, Deccan, Kanara, Malabar, Nilgiris (Fraser 1931); Silent Valley (Rao & Lahiri 1983); Tamil Nadu (Kumar 1990); Nagpur (Laidlaw 1919); Mizoram (Mitra 1994), Madhya Pradesh (Prasad 1996).

Elsewhere : Bhamo, Iado (Selys 1891); Ceylon (Sri Lanka) (Laidlaw 1916b, Lieftinck 1971, Selys 1891); Nepal (Kiauta 1975; St. Quentin 1970), China (Needham 1930); Afghanistan, Bangladesh, Indonesia, Iran, Japan, Pakistan, Philippines, Thailand, Taiwan, (Tsuda 1991); Australia (Laidlaw 1916b, Selys 1891); Micronesia (Lieftinck 1962); New Zealand (Penniket 1960); Tahiti (Selys 1891).

Ischnura rufastigma mildredae Fraser

1927. *Ischnura mildredae* Fraser, *Rec. Indian Mus* **29** 87-88.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 366-368

1994. *Ischnura rufostigma mildreadae*, Mitra, *Rec. zool Surv. India, Occ. Pap.* No. **166** : 32.

Material examined : 2M, 28.x.1985, Bhalukpong, West Kameng, coll. R. N. Bhargava. (The species has been reported by Prasad, 1997).

Distribution : India : Present record : Arunachal Pradesh, (Bhalukpong, Kameng). Past records : Arunachal Pradesh (Prasad, 1997); Manipur (Mitra 1975); Orissa (Mitra 1999).

Elsewhere : Burma (Myanmar) (Fraser 1927b); Nepal (St. Quentin 1970); Hongkong (Tsuda 1991).

Genus *Agriocnemis* Selys

1869. *Agriocnemis* Selys, Pollen & Van Dam, *Faune Madagascar Ins.*, : 24.

1877. Selys *Bull. Acad. Belg.*, (2) **43** : 142

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 379

1981. Davies, *Synop. Extn. Gen. Odon.*, : 7.

Diagnostic characters : Small (abdomen 13.0-20.0 mm, hindwing 9.0-17.0 mm) dragonflies, whitish, bluish or reddish, marked with black, sometimes pruinosed; post ocular coloured spots present; females polychromatic; posterior lobe of

prothorax varies in male and female; the lobe is variable in females of different species. Thorax short and robust. Wings hyaline; pterostigma may be similar or dissimilar in shape and size in fore- and hindwings; postnodals 5 or 6 or more rarely 9, discoidal cell acutely pointed at the distal end, sectors of arc arising at the lower end of the arc, divergent at origin; arc situated distal to the level of the distal atenodal nervure; ab always present and complete, arising from the proximal level of the *ac; ab* continued as the nervure IA; but an angulation present at the junction of the two; R_{4+5} arises well before the oblique nervure descending from the subnode; IR_3 in continuation of the nervure. Abdomen slim, cylinderical and dilated towards the anal end. Anal appendages varies with the species.

Type-species : *Agriocnemis rufipes* Selys (as per decision of the Commission, Mitra 1983).

Distribution : India : Andaman Is., Andhra Pradesh, Assam, Bihar, Gujarat, Himachal Pradesh, Haryana, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Mizoram, Meghalaya, Nicobar Is., Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Afghanistan, Angola, Australia, Bangladesh, Botswana, Burma (Myanmar), Cameroon, Central African Republic, China, Congo, Cote d' ivorie, Djibouti, Egypt, Ethiopia, Fiji, Gabon, Hongkong, Indonesia, Israel, Japan, Kampuchea, Kenya, Liberia, Libya, Madagascar, Malawi, Malayasia, Mali, Mauritius, Mozambique, Namibia, Nepal, New Caledonia, Pakistan, Papua New Guinea, Philippines, Rwanda, Samoa, Senegal, Seychelles, Sierra-Leone, Singapore, Solomon Is., South Africa, Sri Lanka, Sudan, Swaziland, Zambia.

Key to species of the genus *Agriocnemis* Selys

1. Labrum metallic, vertex and occiput black, occiput with very small rounded green post ocular spot, prothorax black on dorsum the anterior lobe, lower part of sides and the extreme edge of posterior lobe apple green; in extreme edge; in female (adult) prothorax brick red unmarked, middle portion of the hind lobe of prothorax not humped; thorax black on dorsum, in female black on dorsum, but the antehumeral stripe bordered outwardly by a reddish brown or dark violaceous stripe, laterally green, abdomen 1-6 segments brick-red marked with bronzed black in female bright yellow on segments 2-6; wings hyaline, pterostigma pale yellow in forewings, black in the hindwings superior anal appendages longer than the inferiors .... *pygmaea pygmaea* (Rambur)

– Labrum non-metallic 2

2. Abdomen dark blue, labrum torquoise blue; prothorax black on dorsum and sides, anterior lobe narrowly pale blue, posterior lobe squarely produced at the middle portion. Thorax black on dorsum as far as lateral as midway between the humeral and lateral suture. Wings hyaline, pterostigma pale yellow, centred with greyish, framed in thick black nervures; 8-10 postnodals in forewings, 6-7 in hindwings; in case of female 10-12 postnodals in forewings and 9 in hindwings; abdomen azure blue, marked with black on segments from 1-6, 7 blue 8-10 apical black, the intersegmental joints blue; in female segments 1-2 azure blue, 3-7 bluish green, 8-10 entirely black; anal appendages blue, superior ungulate, obtusely pointed as seen in profile narrow and bluntly pointed as seen from above, the apex slightly turned inwards; a robust ventral spine curved downwards and inwards; inferiors shorter; in case of female anal appendages are short, conical and carneous ..... *clauseni* Fraser

– Abdomen palest blue, with restricted black markings 3

2. Wings, hyaline, pterostigma pale blue in hindwings, on the upper surface, but with the hinder three-fourths black beneath; black in the forewings with a fine blue line along the costal border above, but entirely black beneath, in female the pterostigma pale yellow, centred with greyish and framed in thick black nervures the anterior border paler, more than twice as long as broad. Abdomen pale blue, almost white on the proximal segments marked with black as follows : segment 1 subapically

expanding dorsal spot; segment 2 with thick middorsal stripe; 3 with a narrow middorsal stripe; in female azure blue, dorsum of all segments except 10 broadly black. Anal appendages pale blue, superiors broadly triangular as seen in profile and obtusely pointed, inferiors very much shorter, broad and stunted with robust spine, directed upward and another slightly, shorter and directed inward .... *lacteola* Selys

3. Wings hyaline, pterostigma pinkish or pale yellow with black or grey in the centre, especially in hindwings; in female pterostigma golden yellow suffused with grey at the centre. Abdomen pale blue deeper in distal four segments, marked with black as follows : Segment 1 broadly black on dorsum, segment 2 with anchorshafed marking; segments 3 and 4 black on middorsal carina, 6-7 with a black stripe; segments 8-10 unmarked; in male the abdomen is broadly black on segment 1 to 9 segment 10 at the base only. Anal appendages pinkish or pale blue, superiors slightly longer than segment 10; inferiors tipped with black, in female it is short conical blue .... *pieris* Laidlaw

Agriocnemis pygmaea pygmaea (Rambur)

1842. *Agrion pygmaea* Rambur, *Ins. Neurop.*, : 272.

1864. Brauer, *Verh. zool. bot. Ges. Wien.* **14** : 161.

1994. *Agriocnemis pygmaea pygmaea*, Mitra. *Rec. zool. Surv. India, Occ. Pap. No.*, **166** : 32.

Material examined : 1M, 1F, 23.iii.1969, Bhalukpong, coll. S. K. Tandon; 1F, 15.iii.1969, Namsai, coll. S. K. Tandon; 1F, 3.iii.1969, Sunpura, coll. S. K. Tandon; 1M, 21.iii.1973, Sessa, coll. S. K. Tandon, 1M, 28.iii.1973, Bhalukpong, West Kameng, coll. S. K. Tandon; 3MM, 2FF, 10.ix.1984, Tipi West Kameng, coll. R. N. Bhargava; 2MM, 1F, 17.ix.1984, Dirang, West Kameng, coll. R. N. Bhargava; 2MM, 2FF, 27.ix.1984, Dedza, West Kameng, coll. R. N. Bhargava.

Distribution : India : Present record : Arunachal Pradesh (West Kameng). Past records : Arunachal Pradesh, Assam, Mizoram (Lahiri 1979), Manipur (Lahiri 1977b), Meghalaya (Lahiri 1987); Calcutta (Selys 1891); North Lakhimpur (laidlaw 1914), Barkuda Island (Fraser & Dover 1922, 1996), Uttar Pradesh (Ram et al 1983); Madhya Pradesh (Prasad 1966a), Dehra Dun, Lachiwala (Bhasin 1953), Rajasthan (Bose & Mitra 1976); Bolovumpattis, Cochin, Coorg, Deccan, Kanara, Malabar, Nilgiris, Travancore (Fraser 1931); Tamil Nadu (Kumar 1990), Nicobar Is., (Hagen 1858; Selys 1891); Bihar, Orissa, Sikkim, West Bengal (Mitra in press).

Elsewhere : Old World.

Agriocnemis lacteola Selys

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

1933. Selys, *Fauna Brit. India, Odon.*, **1** : 381-383.

1983. Mitra, *Ent. mon. Mag.*, **119** : 29.

Material examined : 1F, 14.iii.1969; 3F, 15.iii.1964; 4F, 16.iii.1969, Sitapari, coll. S. K. Tandon.

Distribution : India : Present record : Arunachal Pradesh (Sitapari). Past records : Bengal (Selys 1877); Dibrugarh, N. E. Assam, Dejoo North Lakhimpur (laidlaw 1914); Purnea district of Bihar (Laidlaw 1919); Hasimara, Jalpaiguri, Margharita, Nowgong, Dibrugarh, Sikkim (Fraser 1933c), Arunachal Pradesh (Lahiri 1977a), Assam (Lahiri 1979), Meghalaya (Lahiri 1987), Madhya Pradesh (Bastar) (Prasad 1996).

Elsewhere : China, (Klots 1947; Needham 1930); Thailand (Asahina 1982b); Bangladesh, Hongkong, Nepal (Tsuda 1991).

Agriocnemis pieris Laidlaw

1919. *Agriocnemis pieris* Laidlaw, *Rec. Indian Mus.*, **16** 179-180.

1933. Fraser, *Fauna Brit. India, Odon.*, **1** : 384-385.

1983. Mitra, *Ent. mon. Mag.*, **119** : 29.

Material examined : 1M, 14.x.1966; Simibridge, Siang Division, coll. S. K. Tandon & G. S. Arora; 1F, 14.x.1966, Jinning, Siang Division, coll. S. K. Tandon & G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Siang). Past records : West Bengal, Calcutta (Lahiri & Mitra, 1976); North Kanara (Laidlaw 1919); Coorg, Malabar, Wynaad

(Fraser 1924b); Nilgiris (Fraser 1931); Western ghats, South Kanara (Fraser 1933), Silent Valley (Rao & Lahiri 1983); Bombay (Laidlaw 1914), Madhya Pradesh (Bastar) (Prasad 1996a).

Agriocnemis clauseni Fraser

1922. *Agriocnemis clauseni* Fraser, *Mem. Deptt. of Agric. India*, (Ent.) 7 : 53-55.

1933. Fraser, *Fauna Brit. India, Odon.*, 1 : 390-392.

Material examined : 1M, 10.v.1966, Dejoo, Subansiri, coll. A. N. T. Joseph.

Distribution : India : Present record : Arunachal Pradesh (Subansiri), Past records : Assam, Bengal (Fraser 1933b), Meghalaya (Lahiri 1997).

Elsewhere : Burma (Myanmar) (Bhasin 1953; Fraser 1933b), Bangladesh, Nepal, Thailand (Tsuda 1991).

Genus ***Argiocnemis*** Selys

1877. *Argiocnemis* Selys, *Bull. Acad. Belg.*, (2) **43** : 135.

1890. Kirby, *Syn. Cat. Neur. Odon.*, : 159.

1919. Laidlaw, *Rec. Indian Mus.*, **16** : 182.

1933. Fraser, *Fauna Brit. India, Odon.*, 1 : 405.

1981. Davies, *Synop. Extnt. Gen. Odon.*, : 7.

Diagnostic characters : Medium sized dragonflies (Abdomen 28.0-32.0 mm; hindwing 16.0-20.0 mm); coloured blue-green, yellowish or red, marked with black, sometimes pruinosed; post ocular coloured spots present; posterior lobe of prothorax tripartite. Wings hyaline, pterostigma similar in fore- and hindwings, small covering about one cell, nearly twice as long as broad, distal side oblique; 10-12 postnodal nervures in forewings, 8-10 in hindwings; sectors of arc arising from the lower and of the arc, divergent at origin, arc situated distal to the level of distal antenodal nervure; *ab* always present and complete, arising well proximal to the level of *ac; ab* continued as IA; but an angulation present at the junction of the two R_{4+5} arising well proximal to the level of oblique nervure descending from the subnode; IR_3 in continuation of that nervure; Abdomen slim and cylinderical, dilating slightly towards the end segments. Superior anal appendages as long as segment 10, broad and obtuse, curving slightly downwards as viewed in pale profile inferiors very small and aborted.

Distribution : India : Arunachal Pradesh, Assam, Meghalaya and West Bengal.

Elsewhere : Australia, Bangladesh, Borneo, Burma (Myanmar), Celebes, Malayasia, Papua New Guinea, Philippines, Thailand, Vietnam.

Type-species : *Argiocnemis rubescens* Selys

Argiocnemis rubescens rubeola Selys

1877. *Argiocnemis rubescens* Selys, *Bull. Acad. Belg.*, (2) **43** : 136.

1877. *Argiocnemis rubeola* Selys, *Bull. Acad. Belg.*, (2) **43** : 137.

1933. *Argiocnemis rubescens*, Fraser, *Fauna Brit. India, Odon.*, 1 : 406-408.

1994. *Argiocnemis rubescens rubeola*, Mitra, *Rec. zool. Surv. India Occ. Pap. No.*, **116** : 32.

Material examined : 2M, 20.iv.1981; 2M, 1F, 6.iv.1981, Namdhapa Biosphere Reserve, coll. S. Biswas.

Distribution : India : Present record : Arunachal Pradesh (Namdhapa). Past records : Dejoo, North Lakhimpur (Laidlaw 1914), Assam, Bengal (Fraser 1933b); Meghalaya (Lahiri 1987).

Elsewhere : Bangladesh, Burma (Myanmar), Indonesia, Malayasia (Tsuda 1991).

Genus ***Onychargia*** Selys

1865. *Onychargia* Selys, *Bull. Acad. Belg.*, (2) **20** : 416.

1933. Fraser, *Fauna Brit. India, Odon.*, 1 : 416.

1954. Lieftinck, *Treubia*, **22** (suppl.) : 53.

1981. Davies, *Synop. Extnt. Gen. Odon.*, : 8.

Diagnostic characters : A monotypic genus, dragonflies of medium size (Abdomen 23.00 mm; Hindwing 17.00 mm); colour black or bronzed purple, marked with bright citron-yellow in subadult but immaculate in full adults. Post ocular coloured spots, absent; posterior lobe of prothorax rounded in male; middle portion of thorax in female is greatly prolonged; thorax short and robust wings hyaline, pterostigma nearly half as long again as broad, costal and posterior sides equal or subequal;

distal side more oblique than proximal; 10 to 12 postnodals in forewings, 10 to 11 in hindwings; sectors of arc arising from the lower end of arc; arc situated opposite the distal antenodal nervure; *ab* always present and complete arising far proximal to the level of the *ac* or even the level of the proximal antenodal nervure and continued as IA, but with marked angulation at the junction of the two; *ac* situated considerably near the proximal antenodal nervure, R_{4+5} arising well proximal to the level of oblique nervure descending from the subnode, IR_3 in continuation of that nervure. Abdomen short and robust, cylinderical but slightly dilated at base and anal ends; segment 10 deeply emarginate at the middorsum and with two tubercles at the apical border.

Type-species : *Onichargia atrocyana* Selys.

Distribution : India : Arunachal Pradesh, Assam, Manipur, Orissa, Karnataka, Kerala, West Bengal, Madhya Pradesh.

Elsewhere : Bangladesh, Burma (Myanmar), Malayasia, Borneo, Ceylon (Sri Lanka), Thailand, Hongkong, Indonesia, Nepal, Singapore, Vietnam.

Onychargia atrocyana Selys

1865. *Onychargia atrocyana* Selys, *Bull. Acad. Belg.*, (2) : 416.

1933. Fraser, *Fauna Brit. India, Odon.*, 1 : 417-418.

1954. Lieftinck. *Treubia*, 22 (Suppl.) : 53.

Material examined : 1M, 15.iii.1969, Namsai, coll. S. K. Tandon.

Distribution : India : Present record : Arunachal Pradesh. Past records : Dejoo, North Lakhimpur, Upper Assam (Laidlaw 1914); Sibsagar, Assam (Laidlaw 1919), Bengal (Fraser 1933b), Manipur, Orissa (Mitra in press), Coorg (Fraser 1924b, 1931), Malabar (Fraser 1933b), Madhya Pradesh (Prasad 1996a).

Elsewhere : Burma (Myanmar) (Fraser 1933b, Lieftinck 1971), Malayasia (Brooks 1981), Borneo (Lieftinck 1971), Ceylon (Sri Lanka) (Fraser 1924a, Lieftinck 1971), Thailand (Kiauta 1983b), Bangladesh, Hongkong, Indonesia, Nepal, Singapore, Vietnam (Tsuda 1991).

Suborder ANISOPTERA

Diagnostic characters : The name signifies that wings are dissimilar, eyes may or may not be separated. Head compact, more or less globular or broad and slightly flat. Vesicle more or less developed, occassionally highly specialized and with the ocelli arranged in a triangle around it; lateral lobes of labium are usually larger than the middle lobe; the median lobe may have or have not a median fissure. Prothorax and thorax are well built. The wings are usually dissimilar; hindwing is usually broadly dilated at the analend and differ markedly in details of basal venation from the forewing; discoidal cell split into two triangular cells, a superior or the hypertrigone and an inferior (hereafter called discoidal cell); pterostigma always present narrow and of variable length nearly always braced antenodal and postnodals are not very large number; costal subcostal series may or may not coincide. Wings in portion of rest held horizontally putwards or even deflected strongly down was never closed over dorsum. Tenth abdominal segment with a pair of superior anal appendages present, but only a single inferior appendage which may be simply triangular or bifurcated into two branches, the latter is in close apposition or strongly divaricate. Male genitalia variable, lamina usually arched, both hamules or the posterior one well developed; ovipositor in females are usually small and in conspicuous. These dragonflies breed in both still and running waters. The larvae breath by rectal gills; caudal gills entirely absent.

Distribution : Both world.

Key to Superfamilies of the suborder ANISOPTERA

Adult characters are overlapping hence Fraser (1957) used larval characters for segregating superfamilies. It is therefore, suggested Anisoptera (adult) should be segregated family wise which are easier in the field identification.

Key to families of ANISOPTERA (adults)

1. Eyes widely or slightly separated, head expanded laterally or eyes meeting at a point 2

- Eyes united, head globular 3

2. Discoidal cell different in fore- and hindwings; that of hindwing more elongate than that of forewing; median space never traversed; eyes widely separated ..... GOMPHIDAE

- Discoidal cells of fore- and hindwings are equal in shape and size, or if dissimilar than the median space is traversed; eyes not widely separated or meeting at point .... CORDULEGASTIRIDAE

3. Discoidal cells nearly of the shape and size in fore- and hindwings and situated equally distant from the arc; costal and subcostal antenodals are not in alignment; two primary robust antenodals present; middle lobe of labium fissured ..... AESHNIDAE

- Discoidal cells of fore- and hindwings differ in shape, size and position, that of forewings situated far distal of the arc costal and subcostal antenodals nervures coinciding, the robust primary antenodals absent; middle lobe of labium not fissured but ovarlapped by the lateral lobes ..... LIBELLUIIDAE

Superfamily AESHNOIDEA

Diagnostic characters : Eyes separated or overlapped to each other vesicle not distinctly differentiated; occiput large or small; trapezoidal or triangular; male genitalia with well developed hamules, costal and subcostal antenodals not coinciding; well developed primary antenodals.

Distribution : Cosmopolitan.

Key to families of superfamily AESHNOIDEA

1. Eyes widely separated, discoidal cells unequal, that of hindwing more elongate than that of forewing ..... GOMPHIDAE

- Eyes widely ovarlapped to each other; discoidal cells approximately of the same size in fore- and hindwings ..... AESHNIDAE

Family GOMPHIDAE

Diagnostic characters : Large or medium sized dragonflies; The head is like Zygoptera transversely elongated eyes always well separated, vesicle low and not usually well defined. colour yellow or black marked with yellow or green, non-metallic. Fraser (1934b, 1957) opined that the members of the family are casily distinguishable with the help of their black and yellow colour. Moreover, according to him, "Species from dry zones and desert areas are mainly yellowish, whilst those from regions of heavy rainfall, such as the Western Ghats of India or the hilly tracts of Assam and Burma, are glossy black, with rather restricted bright greenish yellow markings. In their natural habitat these colours are markedly cryptic and serve to protect the insects (Fraser 1934b). Wings moderately broad, never petiolate, hyaline; hindwing in male strongly angulated at the tornus, in female rounded. Venation more or less close; large number of antenodals; costals and subcostals are not in strict alignment; the two primary antenodals present; discoidal cell traversed or entire, differ in shape in fore- and hindwings, the subtriangle, a cell posterior to the discoidal cell appear for the first time; and posterior to this, although in a very rudimentary condition there may be a compact groups of cells enclosed by the anal veins represent the anal loop usually 1-4 cross veins in the cubital space; 2-8 cross veins between Rs and MA in hindwing median space entire. The abdomen is variable in shape, especially in regard to the terminal segments, the sides of which may be foliated, dilated or elongated. "The anal appendages of the male are specialized, the inferior being strongly bifid and its branches either widely splayed or closely apposed anal parallel. The female ovipositor is rudimentary and oviposition is accomplished by merely dipping the end of the abdomen in fast running water; the ova are swept off and sink to the bottom of the stream (Fraser 1957).

Distribution : Widely distributed in both hemispheres.

Key to genera of the family GOMOPHIDAE

1. Discoidal cell, hypertrigone and subtrigones of forewing traversed .... ***Ictinogomphus*** Cowley

– Discoidal cell, hypertrigones and subtrigones are entire 2

2. Hindwing not excavated at base, with tornus rounded in both sexes ..... ***Anormogomphus*** Selys

– Hindwing more or less excavated at base, with tornus more or less angulated 3

3. Wings narrow at base; basal abdominal segments quite slender ..... ***Phaenandrogomphus*** Lieff

– Wings narrow at base, basal abdominal segments not slender 4

4. Hypertrigone in the hindwing shorter than the space lying between the node and the origin of IR_3 ..... ***Onychogomphus*** Selys

– Hypertrigone in the hindwing shorter than the space lying between the node and the origin of IR_3 ..... ***Paragomphus*** Cowley

Genus *Ictinogomphus* Cowley

1842. *Ictinus* Rambur, *Ins. Navrop.*, : 171.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 370.

1934. *Ictinogomphus* Cowley, *Entomologist*, **67** : 274.

1981. Davies, *Synop. Extrt. Gen. Odon.*, : 34.

Diagnostic character : Large (Abdomen 51.0 mm; Hindwing 41.0 mm) and robust built; colour black marked citron yellow or greenish yellow; head large; frons strongly angulated, occiput simple or slightly concave and fringed with short hairs. Wings close venation, membrane long and narrow, anal triangle 5- celled; arc situated between the first and second antenodal nervures; 10-12 cross veins in the space from the arc to the bifurcation of Rs in forewings and 6-7 veins in the hindwings; 2 rows of post anal cells in forewings, 5 to 6 in the hindwings; an anal loop of 4-5 cells is present; nodal index is very high; primary antenodals are the first and the seventh; discoided cell in forewings subequlateral; discoidal cell traversed; 1A in forewing is slightly or not pectinate; Cu_2 and 1A in hindwings are parallel to wing border; 2-4 cubital nervures in forewings; 2 in hindwings; subtrigone in the forewing 2 celled; in hindwing entire or traversed. Several strong intercalated nervures present. Abdomen dilated at the basal segments and narrow, cylinderical from segments 3 to 7 with leaf like lateral protections. Anal appendges; superior is half as long as segment 10; narrow pointed at apex; the inferiors are very much shorter, deeply bifid; the two branches are rather widely divaricate.

Type-species : *Diastatoma rapax* Rambur.

Distribution : India : Andaman Is., Arunachal Pradesh, Assam, Bihar, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Australia, Angola, Bangladesh, Burma (Myanmar), Botswana, Cameroon, Central African Republic, China, Cote d' ivorie, Indonesia, Japan, Korea, Kenya, Malayasia, Malawi, Mozambique, Namibia, Nepal, Pakistan, Papua New Guinea, Philippines, Soviet Russia, Somalia, Senegal, Sierra Leone, Singapore, South Africa, Sri Lanka (Ceylon), Tanzania, Thailand, Togo, Uganda, Zaire, Zambia, Zimbabwe.

Key to species of the genus *Ictinogomphus* Cowley

1. Segments 8 with a basal yellow ring, prothorax black marked with yellow; thorax laterally yellowish green with a median broad blackstripe and the posterior border of the metepimeron narrowly yellow; in the female the lateral black band is always spotted. Wings hyaline, old individuals with faint enfumation. In female a dark brown basal marking as far as the first antenodal, Pterostigma black, discoidal cell in forewings with 4 cells; of hindwings 3 cells; anal triangle 5 celled Abdomen black marked with bright yellow, segment 1 with an apical dorsal stripe, confluent with a large triangular spot on dorsum of segment 2 ..... *rapax* (Rambur)

– Segment 8 without a basal yellow ring, prothorax black, unmarked, thorax laterally with two median oblique blackstripe more or less confluent at their middles. Wings hyaline but extreme basal part is tinted with brown; discoidal all of forewing made up of three cells, that of hindwings with 2 or 3 cells ..... *pertinax* (Selys)

Ictinogomphus rapax (Rambur)

1842. *Diastatoma rapax* Rambur, *Ins. Nevrop.*, : 169.

1934. *Ictinus rapax*, Fraser, *Fauna Brit. India, Odon.*, **2** : 373-376.

1983. *Ictinogomphus rapax*, Mitra, *Ent. Mon. Mag.*, 119-130.

Material examined : 1M, 14.x.1981, Siang, coll. S. K. Tandon.

Distribution : India : Present record : Arunachal Pradesh (Siang). Past records : Barkuda Islands (Fraser & Dover 1922); Bhubaneswar (Dasgupta 1957); Calcutta (Dasgupta 1957, Laidlaw 1922, Mitra 1983), Cachar (Bhasin 1953), Chhota Nagpur (Laidlaw 1922); Haflong (Bhasin 1953); Howrah (Dasgupta 1957); Mursidabad (Laidlaw 1922); Uttar Pradesh (Ram et. al 1983), Rajasthan (Bose & Mitra 1976; Tyagi & Miller 1991); Gwalior, Sangor (Baijal & Agarwal 1955); Bombay, Poona (Fraser 1924b); Bolovumpattis, Cochin, Coorg, Decan, Kanara, Malabar, Nilgiris (Fraser 1931); Tamil Nadu (Kumar 1990), Andaman Is. (Fraser 1924a).

Elsewhere : Bangladesh (Chowdhury & Akhteruzzaman 1981); Burma (Myanmar) (Fraser 1923c; Lieftinck 1971); China (Needham 1930); Nepal (St. Quentin 1970).

Ictinogomphus pertinax (Selys)

1854. *Ictinus pertinax* Selys, *Bull. Acad. Belg.*, **21**(2) : 80.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 377-378.

1982. *Ictinogemphus pertinax*, Ram *et al. Rec. zool. Surv. India*, **80** : 179.

Material examined : 1M, 14.x.1981, Siang, coll. S. K. Tandon & G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Siang), Past records : Howrah (Ram *et. al.* 1982); Palamau (Mitra in press).

Elsewhere : Burma (Fraser 1934b; Williamson 1907); China (Fraser 1934b; Reowe 1981); Taiwan (Lieftinck *et. al.* 1984); Japan, Nepal (Tsuda 1991).

Remark : Although Fraser (1934b) reported its occurrence in Malayasia but neither Lieftinck (1954) nor Tsuda (1991) confirmed.

Genus *Anormogomphus* Selys

1854. *Anormogomphus* Selys, *Bull. Acad. Belg.*, **21** (part 2) : 60.

1857. Selys, *Mon. Gomph.*, : 102.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 172.

Diagnostic characters : Medium sized (Abdomen 25-31 mm; hindwing 22-25 mm); frons prominently angulated, occiput flat and simple. Pale coloured, uniform and almost without marking. Wings hyaline, reticulation open, base of hindwing rounded, tornus absent, membrane vestigeal, anal triangle single celled, arc situated between the first and second antenodal nervures, 1 or 2 cross veins between the sectors of arc from the arc to bifurcation of Rs in forewings; 1 in the hindwing; one row of post anal cells in forewings, 2 to 3 in hindwings; and loop absent; primary antenodal nervures are the first and the fourth; discoidal cells entire. IA in forewing not pecbinate, Cu_2 and IA in hindwing nearly parallel to termen; only one cubital nervures in all wings; abdomen slightly tumid at base, terminal segments in male slightly dilated, in female of even width and cylinderical throughout. Anal appendages very short, superiors conical widely divaricate and furnished with a robust basal verntral spine; inveriors deeply cleft into two widely divaricate branches.

Type-species : *Anormogomphus heteropterus* Selys.

Distribution : India : Arunachal Pradesh, Bihar, Himachal Pradesh, Uttar Pradesh.

Elsewhere : Afghanistan, Iran, Iraq, Persia.

Anormogomphus heteropterus Selys

1854. *Anormogomphus heteropterus* Selys, *Bull. Acad. Belg.*, **21** : 61.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 174-176.

Material examined : 1F, 25.x.1971, Jairampur, tirap. coll. G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Tirap). Past records : Bihar (Fraser 1934b); Kangra (Prasad 1976); Doon Valley (Singh & Prasad 1976).

Elsewhere : Pakistan (Fraser 1934b).

Genus ***Paragomphus*** Cowley

1906. *Mesogomphus* Forster, *Wiel baden. Jahr. Ver. Nath.*, **39** : 323.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 228.

1934. *Paragomphus* Cowley, *Entonologist*, **67** : 201.

Diagnostic characters : Medium sized (Abdomen 27-40 mm; hindwing 24-31 mm); colour for the most part of the body sandy yellow, marked with shades of brown and black; more rarely black marked with bright yellow. Wings reticulation close, tornus angulated in males and rounded in females; membrane very narrow and triangle usually 4 celled, arc situated between the first and the second antenodal nervure, generally 12-16 antinodals in forewings, 9-11 in hindwings, the first and the fifth are primary antenodals. Pterostigma elongated a little swollen medially; discoidal cell entire and situated at a point which is one cell distal to the level of the arc. Only 2 cross veins between sectors of arc to the bifurcation of Rs in the forewings, five in hindwings. Anal loop absent, the first post anal cell extending proximally to about the middle of the base of the subtrigone; IA in forewing pectinate with a maximum of four cells between it and the margin of the wing. Cu_2 and IA parallel to margin of hindwing. Only one cubital nerve in all wings. Abdomen of male tumid at base, narrow and cylinderical from segment 3 to base of segment 7; from this point the segments are dilated again; segment 8 and 9 bear broad lateral wing like projections; in female there is no such dilation. Anal appendages of male long and curled, short inferior has its branches very closely opposed.

Type-species : *Paragomphus cognatus* Rambur.

Distribution : India : Andhra Pradesh, Arunachal Pradesh,. Bihar, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

Elsewhere : Afghanistan, Algeria, Bangladesh, Botswana, Burma (Myanmar), Cameroon, Central African Republic, China, Congo, Cote d' ivorie, Egypt, Equatorial Guinea, Ethiopea, France, Gabon, Indonesia, Iran, Italy, Kenya, Laos, Liberia, Madagascar, Malawi, Malayasia, Morocco, Mozambique, Namibia, Phillipines, Portugal, Saudi Arabia, Somalia, South Africa, Spain, Swaziland, Syria, Tanzania, Thailand, tunisia, turkey, Yemen, Zambia, Zaire, Zimbabwe.

Paragomphus lineatus (Selys)

1850. *Gomphus lineatus* Selys, *Rev. Odon.*, : 386.

1934. *Mesogomphus lineatus*, Fraser, *Fauna Brit. India, Odon.*, **2** : 230-234.

1994. *Paragomphus lineatus*, Mitra, *Rec. zool. Surv. India, Occ. pap. no.*, **166** : 33.

Material examined : 1M, 14.x.1981, Lekhabali, Siang, coll.

Distribution : India : Present record : Arunachal Pradesh (Siang). Past records : Bihar (1924c), Chhotanagpur (Laidlaw 1922), Sikkim (Prasad & Ghosh 1984), Meghalaya (Lahiri 1987), Arunachal Pradesh (Prasad 1997), Orissa (Mitra 1994), Dehra Dun (Bhasin 1953, Fraser 1924c, 1934b), Poona (Fraser 1919a, 1924c, 1934b, Laidlaw 1922), Bollovumpattis, Coorg, Deccan, Kanara, Malabar, Nilgiris (Fraser 1931), Bangalore, Khandala, Madras, Trichinapally (Fraser 1934b).

Elsewhere : Burma (Bhasin 1953), Ceylon (Laidlaw 1922), Nepal (Kianta 1974, Williamson 1907), South East Turkey (Schneider 1985a), Afghanistan, Bangladesh, Iran, Syria (Tsuda 1991).

Genus ***Phaenandrogomphus*** Lieftinck

1964. *Phaenandrogomphus* Lieftinck, *zool Verh.*, **69** 6

1991. Tsuda, *A distributional list of World Odonata*, 1991 : 108.

1994. Mitra, *Rec. zool. Surv. India, Occ. Pap No.*, **166** 33.

Diagnostic characters : Large (Abdomen 38-39 mm; hindwing 31-32 mm) dragonflies, black marked with yellow, Wings hyaline, Pterostigma dark ocineous framed in black nervures, braced covering 3-4 cells, anal triangle 4 celled, anal field in hindwing 4 cells deep. Abdomen yellow with broad subdorsal black strips or black rings and sometimes oval spots. Anal appendages

Onychogomphus type. Genitalia - lamina projecting markedly, broadly arched and cupped behind.

Type-species : *Phaenandrogomphus aesthenes* Lieftinck.

Distribution : India : Arunachal Pradesh, Meghalaya.

Elsewhere : Malayasia, Thailand, Vietnam.

Phaenandrogomphus aureus (Laidlaw)

1922. *Onychogomphus aureus* Laidlaw, *Rec. Indian Mus.*, **24** : 406-407.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 254-256.

1994. *Phaenandrogomphus aureus*, Mitra, *Rec. zool. Surv. India Occ. Pap.* No., **166** : 33.

Material examined : 1M, 12.x.1966, Dalli village, coll. S. K. Tandon & G. S. Arora, 1F, 13.v.1966, Tippi, Subansiri, coll. A. N. T. Joseph; 1M, 27.x.1966, Bella village, Subansiri, coll. S. K. Tandon & G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Siang, Subansiri), Past records : Tura, Garo hills, Meghalaya (Fraser 1934b), Songeak, Meghalaya (Lahiri 1987).

Remark : Endemic to North-East India.

Genus ***Onychogomphus*** Selys

1854. *Onychogomphus* Selys, *Bull. Acad. Belg.*, **21**(2) : 30.

1857. Selys, *Mon. Gomph.*, : 15.

1907. Williamson, *Proc. U.S. Nat. Mus.*, **33** : 275.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 239.

1991. Tsauda, *A distributional list of World Odonat*, 1991 : 104.

1934. *Lamelligomphus* Fraser, *Fauna Brit. India, Odon.*, **2** : 269.

Diagnostic characters : Large (Abdomen 39-45 mm; hindwing 30-38 mm), black or brown marked with yellow or green; frons angulated, Occiput usually simple or slightly concave posteriously. Reticulation very close, tornus markedly angulated, base of hindwing deeply excavate, membrane obsolete, anal Triangle 4 celled, 2 rows of post anal all in forewing, 4 in hindwings. The first and the fifth are two primary antenodals, hypertrigone, subtrigone and discoidal cell entire. Abdomen of male robust, variable in length, tumid at base and then moderately narrow.

Type-species : *Onychogomphus forcipatus* (Linne).

Distribution : India : Arunachal Pradesh, Assam, Bihar, Karnataka, Kerala, Tamil Nadu, West Bengal.

Elsewhere : Afghanistan, Albania, Algeria, Angola, Austria, Belgium, Burgaria, Burma, Cameroon, China, Congo, Czechoslovakia, Denmark, Finland, France, Germany, Greece, Hungary, Hongkong, Indonesia, Iran, Iraq, Italy, Israil, Japan, Kenya, Laos, Lebanon, Luxembourg, Madagascar, Malayasia, Morocco, Mozambique, Netherlands, Norway, Poland, Portugal, Romania, South Africa, Spain, Sweden, Switzerland, Syria, Taiwan, Tanzania, Thailand, Tunisia, Turkey, Yogoslavia, Zambia.

Key to species of the genus *Onychogomphus* Selys

1. Humeral stripe present and complete; abdominal segments 3 to 6 with citron-yellow, oval middorsal spot; large specimen (abdomen 41 mm; hindwing 32 mm); labium dark brown; thorax black, marked with greenish yellow as follows - a complete mesothoracic collar confluent with a stripe on lower part of middorsal carina; a dorsal oblique stripe not joined to the mesothoracic collar and a humeral stripe. Laterally yellow, marked with two broad black stripes. Abdomen tumid at base; thin and cylinderical as far as segment 8, the apex of which is abruptly dilated and contain yellow spot; segment 9 and 10 narrower than segment 8 and black. Anal appendages - superiors yellow, black at tips, inferiors black. .... *biforceps* Selys

2. Humeral stripe vestigeal, larger specimens (Abdomen 45 mm; hindwing 36 mm). Labium pale yellow, abdominal segments 3 to 6 black marked with yellow; thorax black marked with yellow as follows - a mesothoracic collar interrupted in the middle line, an oblique

antehumeral stripe extending from the alarsinus, but not meeting the mesothoracic collar; abdomen tumid at base as far as segment 2; narrow and cylindrical from segment 3 to 7, 8 very expanded; 9 and 10 narrower than 8. Superior anal appendages yellow, inferiors black ..... *risi* (Fraser)

3. Humeral stripe absent. Labium dirty yellow. Thorax black marked with yellow as follows - a narrowly interrupted mesothoracic collar, antehumeral stripes confluent with the mesothoracic collar and forms an inverted 7. Whole of metepimeron yellow. Abdomen black marked with yellow; a middorsal yellow stripe tapering from segment 1 to the transverse sutine on 3; segments 4 to 7 broad basal rings in complete below and covering nearly one-fourth of the segments; 8 with a small baso-dorsal spot. ..... *cacharicus* (Fraser)

Onychogomphus cacharicus (Fraser)

1924. *Lamelliogomphus cacharicus* Fraser, *Mem. Dept. Agric. India, (Ent.)* 8(8) : 81-83.

1934. Fraser, *Fauna Brit. India, Odon.*, **21** : 275-276.

1991. *Onychogomphus cacharicus*, Tsuda, *A distributional list of World Odonata*, : 104.

1994. Mitra, *Rec. zool. Surv. India, Occ. Pap.* No., **166** : 33.

Material examined : 1M, 15.x.1966, Pyring village, siang, coll. A. N. T. Joseph.

Distribution : India : Present record : Arunachal Pradesh (Siang). Past records : Cachar, Assam (Fraser 1934b, Kimmius 1966).

Remark : Endemic to North East India.

Onychogomphus risi (Fraser)

1922. *Gomphus risi* Fraser, *Mem. Dept. Agric. India, (Ent.)* 7(7) : 73-74.

1934. Fraser, *Fauna Brit. India, Odon.*, **2** : 273-275.

1991. *Onychogomphus risi*, Tsuda, *A distributional list of World Odonata*, **1991** : 105.

1994. Mitra, *Rec. zool. Surv.* Sndia, *Occ. Pap.* No., **166** : 33.

Material examined : 1M, 16.x.1966, Mambong, Siang, coll. A. N. T. Joseph, 1M, 27.x.1966, Bella village, Subansiri, coll. A. N. T. Joseph, 1M, 31.xi.1985. West Kameng, coll. S. Biswas.

Distribution : India : Present record : Arunachal Pradesh (Siang, Subansiri, West Kameng). Past records : Hasimara, Duars of Bengal (Fraser 1924c); Darjeeling (Fauna 1923, 1924c); Doon Valley (Singh & Prasad 1976b).

Elsewhere : Nepal (Tsuda 1991).

Onychogomphus biforceps Selys

1878. *Onychogomphus biforceps* Selys, *Bell. Acad. Belg.* (2) : **46** : 420.

1991. Tsuda, *A distributional list of World Odonata*, **1991** : 104.

1934. *Lamelligomphus biforceps*, Fraser, *Fauna Brit. India Odon.*, **2** : 271-272.

Material examined : 1M, 12.x.1966, Dalli village, Siang, coll. S. K. Tandon & G. S. Arora; 1F, 13.v.1966, Subansiri, coll. A. N. T. Joseph; 1M, 27.x.1966, Subansiri coll. A. N. T. Jospeh.

Distribution : India : Present record : Arunachal Pradesh (Siang & Subansiri). Past records : Arunachal Pradesh (Mitra 1994), Tura, Garo Hills (Fraser 1934b; Laidlaw 1922).

Remark : Endemic to North-East India.

Family AESHNIDAE

Diagnostic characters : Medium to large dragonflies, variable in colour and markings, non metallic. eyes broadly contiguous, the head is practically globular, lateral and middle lobe of labium with a slight incision or a longitudinal groove. Occiput small and triangular. Wings long, moderately broad, base of hindwing in male are moderately excavate, rarely rounded at tornus in both sexes; discoidal cells approximately equal and made up of 2 to 7 or more, rarely numerous cells, situated at the same distance in fore- and hindwings; subtrigone absent or weakly developed and loop present. Anal triangle in the hindwings of male present (absent in some genera), membrane well defined, supplementary nervures Rspl and Mspl present and situated at a variable distance from IR_1 and MA respectively. Abdomen not smaller than wings, tumid at base, usually constricted at segment 3, then more or less even

width and cylindrical to end; anal appendages variable in length and shape; a robust complete ovipositor in the female which is often augmented by accessory apparatus formed from the tenth segment of abdomen and spined beneath or produced ends as the dentigerous plate. Male genitalia hidden, variably overlapped by the expanded targite of the second abdominal segment.

Distribution : Widely distributed in both hemispheres.

Key to genera of the family ASEHNIDAE

1. Base of hindwing without a notch; tornus of hindwing angulated in male rounded in female; anal triangle present in male, absent in female. ..... ***Gynacantha*** Rambur
2. Base of hindwing more or less deeply notched, tornus rounded in both sexes, anal triangle always present. ..... ***Anax*** Leach

Genus ***Gynacantha*** Rambur

1842. Gynacantha Rambur, *Ins. Nevrop.*, : 209.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 94.

Diagnostic characters : Large (Abdomen 40-58 mm; hindwing 34-50 mm) with homogenous colouring of dull browns and greens, long thin male anal appendages and forked characters of dentigerous plate of female. Head large, globular, broadly contiguous eyes; thorax comparatively small. Wings long and broad, closely reticulated, Base of hindwing of male short, narrowed, obtusely notched, tornus angulated in male, rounded in female. Discoidal cell narrow, 5-7 celled similar in shape and size in both wings. Anal triangle 3 celled, IR_3 forked a little proximal to the side of the pterostigma and with 3 rows of cells between the branches of the fork; 4 to 7 rows of cells between IR_3 and Rspl; 1 row of cells between the origins of Cu_2 and IA in hindwing; 6 to 10 cubital nervure in all wings; basal space entire, hypertrigone traversed in all wings. Abdomen tumid at base, oreilletes large, abdomen constricted in segment 3 and then narrow even width to the end.

Type-species : *Gynacantha subinterrupta* Rambur.

Distribution : India : Arunachal Pradesh, Assam, Karnataka, Kerala, Meghalaya, Orissa, Sikkim, Tamil Nadu, West Bengal.

Elsewhere : Angola, Argentina, Austria, Bangladesh, Bahamas, Benin, Bolivia, Botswana, Brazil, Burkina Faso, Cameroon, Cayman Islands, Central African Republic, Comoros, Congo, Cote d' ivorie, Cuba, China, Costa Rica, Equador, Equatorial Guinea, Elsalvador, Fiji, French Guiana, Gabon, Guatemala, Guinea, Haiti, Hondurus, Hongkong, Indonesia, Japan, Kampuchea, Kenya, Korea, Liberia, Madagascar, Malawi, Malayasia, Mexico, Mauritius, Mozambique, Nepal, New Caledonia, Nicaragua, Nigeria, Panama, Papua New Guinea, Paraguay, Peru, Puertorico, Philippines, Samoa, Sierra Leone, Singapore, Somalia, South Africa, Taiwan, Thailand, Tanzania, Togo, Trinidad and Tobago, USA, Venezuella, Vanuatu, Zaire, Zambia.

Gynacantha basiguttata Selys

1882. *Gynacantha basiguttata* Selys, *Ann. Soc. Espan.*, **11** : 20.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 107.

1991. Tsuda, *A distributional list of World Odonata*, : 123.

1999. Mitra, *Rec. zool. Surv. India, Occ. Pap.* No. **170** : 29-30.

Material examined : 1F, 11.xii.1982, Deban, Tirap, coll. S. Biswas.

Distribution : India : Present record : Arunachal Pradesh (Tirap). Past record : Arunachal Pradesh, Meghalaya (Lahiri & Das 1991); Bengal, Sibsagar, Assam (Fraser 1936).

Elsewhere : Bangladesh, Myanmar, Indonesia, Malayasia, Philippines, Thailand (Tsuda 1991).

Diagnostic characters : Abdomen 50 mm, hindwing 50 mm. Labium yellowish, labrum, face and frone uniform olivaceous, thorax reddish brown on dorsum, olivaceous green on side, wings hyaline, marked at base with a dark reddish brown spot in subcostal space upto the first antenodal and extends in the median space, Abdomen very tumid at base, markedly constricted at segment 3, black marked with yellow. Anal appendages very long and very slim, dilating steadily towards apex and finally acuminate.

Genus *Anax* Leach

1815. *Anax* Leach, *Edinb. Encycl.*, 9 : 137.

1936. Fraser, *Fauna Brit. India, Odon.*, 3 : 134.

Diagnostic character : Large (Abdomen 46-62 mm, hindwing 46-55 mm) dragonflies, variably coloured; head very large and globular, frons with sharp crest, occiput small. thorax robust. wings long and broad with pointed apices, tornus rounded in both sexes, membrane distinct reticulation close, discoidal cell elongate, traversed, that of forewing usually made up of 6 cells and in hindwing 5; subtrigone absent, anal triangle absent, arc situated near the proximal primary antenodal; anal loop may be quadrate or subquadrate made up of 10 to 12 cells in rows of 3 or 4; IR_3 not forked; Rspl and Mspl. strongly curved, 4 to 6 rows of cells between them and IR_3; 2 rows of cells between origins of Cu_2 and IA in hindwing; 4 to 7 cubital nervures in all wings R_3 makes an abrupt curve towards the pterostigma near the apex of the wings. Usually 13-21 antenodals and 10-15 postnodals in fore and hindwings. Abdomen tumid at base, slightly constricted at segment 3, then cylinderical or slightly constricted; oreillet absent in make; segments 4 to 8 with supplementary lateral ridges. Male superior anal appendages broadly lanceolate, bluntly rounded at apices, with a small spine on the outside of apex and a very strong ridge on the upper surface; inner surface towards the apex coated with hairs. Inferior appendages quadrate, much shorter than superiors, very broad and more or less deeply notched at apical border and armed at each outer corner with two or more robust imbricated spines. Female with shorter anal appendates or rarely of the same length, lanceolate or knife shaped; dentigerous plate rounded, coated with hairs and with short spines.

Type-species : *Anax imperator* Leach.

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Assam, Kashmir, Karnataka, Kerala, Meghalaya, Maharashtra, Punjab, Tamil Nadu, West Bengal.

Elsewhere : Afghanistan, Algeria, Angola, Argentina, Australia, Austria, Bahamas, Barbados, Bhutan, Belgium, Bolivia, Botswana, Brazil, Burgaria, Burma (Myanmar), Cameroon, Canada, Cayman Island, China, Checkoslovakia, Caparerde, Colombia, Comoros, Costarica, Cuba, Cyprus, Dominica, Dominican Republica, Egypt, Euqtorial Guinea, Equador, Ethiopia, France, French Guinea, Gabon, Germany, Ghana, Great Britain, Greece, Guam, Guinea, Haiti, Hawai, Hongkong, Hungary, Iran, Irak, Italy, Jamaica, Japan, Kenya, Korea, Liberia, Libya, Lichtenstein, Luxembourg, Malawi, Mariana Is., Martinique, Mexico, Mozambique, Palan, Panama, Papua New Guinea, Peru, Philippines, Poland, Portugal, Puertorico, Romania, Russia (Soviet), Saudi Arabia, Senegal, Seychelles, Siera Leone, Somalia, South Africa, Sudan, Surinam, Syria, Swaziland, Taiwan, Thailand, Trinidad, tobago, Togo, Turkey, USA, Uruguay, Zaire, Zambia, Zimbabwe.

Anax guttatus (Burmeister)

1839. *Aeschna guttata* Burmeister, *Handb. Ent* 2 840

1867. *Anax guttatus*, Hagen, *Verh. zool-bot. Ges. Wien*, 16 : 39.

1936. *Fauna Brit. India, Odon.*, 3 : 140-142.

Material examined : 1M, 5.v.1966, Subansiri, coll. S. Biswas.

Distribution : India : Present record : Arunachal Pradesh (Subansiri), Past records : Calcutta (Ram et. al. 1982); Arunachal Pradesh (Mitra 1994); Chilka Lake, Ganjam district (Fraser 1921b); North Lakhimpur (Laidlaw 1974), Meghalaya (Lahiri 1987), Darjeeling (Laidlaw 1921), Glenburi, Nilgiris, Punjab (Bhasin 1953), Coorg, Deccan, Kanara, Malabar, Nilgiris (Fraser 1931), Assam, Coorg, Nilgiris, Annaimalai Hills, Madras, Waltair (Fraser 1936).

Elsewhere : Myanmar, Siam, Sumatra, (Fraser 1936), Borneo, Ceylon, Malaya Peninsula (Laidlaw 1923), Formosa (Needham 1930), Japan (Ikezaki 1971), Taiwan (Lieftinck *et. al.* 1984), Queensland (Martin 1908), Micronesia (Lieftinck 1962), Africa (Pinhey 1962), Seychelles (Blackman & Pinhey 1967).

Superfamily CORDULEGASTEROIDEA

Diagnostic characters : Inner margins of eyes either slightly separated or meeting at a point.

labium with middle lobe cleft or notched at the middle, occiput small and triangular. Wings similar or dissimilar in both sexes; hindwing usually broader than forewing, hyaline or coloured at base, subtrigone indistinct, median space entire or traversed; anal loop variable - rudimentary or well developed, the primary antenodals are first, second, eighth and the tenth. Prothorax small and hidden by the head. thorax well built; abdomen cylindrical or compressed in female; usually tumid at base but variable at apex, as long as wing, sometimes longer as well as shorter than females. Oreillets present or absent, genital parts entirely hidden as viewed in profile; lamina depressed, arched, notched or quadrate. Ovipositor variable. Anal appendages variable.

The superfamily is represented by the only family Cordulegasteridae. Hence the description and distribution of the superfamily and family are same.

Distribution : India : Arunachal Pradesh, Assam, Himachal Pradesh, Karnataka, Kashmir, Kerala, Meghalaya, Punjab, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Albania, Algeria, Austria, Bangladesh, Belgium, Burgaria, Burma, Canada, China, Checkoslovakia, Costarica, Elsalvador, France, Germany, Greece, Guatemala, Hungary, Iran, Iraq, Italy, Japan, Korea, Lebanon, Lichtenstein, Luxembourg, Malayasia, Mexico, Netherlands, Nepal, Philippines, Portugal, Pakistan, Romania, Russia (Soviet), Spain, Sweden, Switzerland, Syria, Taiwan, Thailand, Turkey, USA, Vietnam.

Genus ***Cordulegaster*** Leach

1815. *Cordulegaster* Leach, *Edinb. Encycl.*, **9** : 136.

1936. Fraser, Fauna Brit. India, *Odon.*, **3** : 30.

Diagnostic characters : Large (Abdomen 48-55 mm; hindwing 41-44 mm) dragonflies, eyes meeting at a point, occiput small, slightly raised, labium with lateral and midlobe subequal, the outer lobe denticulate on innerside, the middle lobe cordate, cleft at its middle, frons raised to the level of the occiput. thorax robust, wings broad and long, reticulation very close; base of hindwing excavate, pterostigma long; discoidal cells are equal in both wings; antenodals and postnodals are 20 in number; discoidal field in forewing begins with two rows of cells; IA in both wings markedly pectinate and undulate and loop fairly well defined; sectors of the arc arising from the middle of the arc, separated at origin, 1 or 2 cubital nervures, anal triangle large, formed of five cells, median space entire. Abdomen long, cylindrical, dorsoventrally tumid at base, slightly constricted at segment 3, compressed and expanded from base of segment 6 to apical end of segment 8. Anal appendages slightly shorter than segment 10, slightly divaricate, acuminate with one or two ventral spines beneath the superiors; inferior appendages quadrate shorter than superiors.

Type-species : *Cordulegaster boltoni boltoni* (Donovan).

Note : Fraser (1936) reported *Cordulegaster annulatus* Latereille as the type-species. Tsuda (1991) synonymised *C. annulatus* Latreille with *C. b. boltoni* (Donovan).

Distribution : India : Assam region including Arunachal Pradesh, Uttar Pradesh, Punjab, West Bengal.

Elsewhere : Afghanistan, Albania, Algeria, Austria, Belgium, Burgaria, Canada, Czechoslovakia, Costarica, China, Denmark, Elsalvador, Finland, Frances, Greece, Germany, Guatemala, Hungary, Iran, Iraq, Italy, Lebanon, Liechtenstein, Luxemburg, Mexico, Morocco, Nepal, Netherlands, Norway, Pakistan, Portugal, Romania, Russia (Soviet), Sweden, Switzerland, Spain, Syria, Turkey, Tunisia, U. K., USA, Yugoslavia.

Cordulegaster brevistigma brevistigma (Selys)

1854. *Thecagaster brevistigma* Selys, *Bull. Acad. Belg.*, (2)**21** : 103.

1936. *Cordulegaster brevistigma brevistigma*, Fraser, *Fauna Brit. India, Odon.*, **3** : 32-35.

Material examined : Recorded from literature.

Distribution : India : Present record : Arunachal Pradesh. Past records : Arunachal Pradesh (Ram & Prasad 1999); Darjeeling,

Turzum (Fraser 1923a), Chakrata, Cachar (Bhasin 1953), 'Kashmir to Assam' (Fraser 1936).

Elsewhere : Nepal (Tsuda 1991).

Superfamily LIBELLULOIDEA

"Forms belonging to this superfamily are the most dominant and most highly developed venationally of the whole order Odonata" (Fraser 1957).

Eyes are united, globular head, without any sinous projection at the posterior border. Labium with unfissured median lobe, overlapped by the lateral lobes. Thorax is not as broad as in forms belonging to Cordulegasteridae, may or may not be metallic colour; tibiae may or may not be with membranous keel on the flexor surface. Wings are usually hyaline and uncoloured but in some genera are partly coloured and opaque; the hindwing is much broader at base than the forewing and either angulated or rounded in males but always rounded in females. The shape and position of the discoidal cell vary in fore- and hindwings; in forewing it is always distal to the arc in hindwing may be at the level, as well as slightly proximal to that level of the arc. Anal loop usually highly developed in the hindwing; *Rspl.* and *Mspl.* are usually running parallel or concave to IR_3 and MA respectively. The anal appendages of the male are almost homogenous in Libelluidae but in many genera of the family Corduliidae they are highly specialized.

Distribution : Cosmopolitan.

Families : Fraser (1957) considered four families - Synthemidae, Corduliidae, Macrodiplactidae and Libellulidae. Fraser *(Op. cit)* isolated *Macrodiplax*, *Urothemis*, *Aethriamanta* and *Selysiothenus* from other species of the subfamily Libellulinae and made separate family Macrodiplactidae. But this proposal has not got support from other international authorities. Hence Macrodiplactid group has been treated under Libellutidae.

Family LIBELLULIDAE

Diagnostic characters : Small to medium sized dragonflies, often coloured but rarely metallic, sexes usually differing strongly in colour and markings. Eyes more or less contiguous, globular; vesicle prominent. wings rather short, pointed at the apex; discoidal cell in forewing often markedly narrowed and elongate in the breadth of the wing, usually traversed; anal loop usually marked elongated and stocking shaped. Abdomen extremely variable in shape, usually shorter than wings, usually depressed, cylindrical, triquetral or dillated, the eighth segment of abdomen of female frequent by dillated or with wing like expansions laterally. Anal appendages simple, rarely specialized; vulvar scale very small and inconspicuous.

Distribution : Cosmopolitan.

Key to genera of the family LIBELLULIDAE

1. Sectors of arc united at origin in forewing; venation close 2

– Sectors of arc divergent at origin in forewing; venation open 21

2. Base of discoidal cell in hindwing distal to the arc; costal side of the discoidal cell in forewing angulated; anal loop ill developed 3

– Base of discoidal cell in hindwing at the level of the arc; costal side of the discoidal cell in forewing not angulated; anal loop well developed 4

3. 9-12 antenodals in forewing ..... ***Tetrathemis*** Selys

– 14 or more antenodal in forewing ..... ***Hylaeothemis*** Ris

4. Anal loop open; abdomen broad at base, then tapering gradually to the end; hindwing with an opalescent white spot ..... ***Thoymis*** Hagen

– Anal loop closed; shape of abdomen variable, colour of wings variable 5

5. Distal nervure in forewing complete 6

– Distal nervure in forewing incomplete 9

6. Posterior lobe of prothorax fringed with stiff hairs 7

- Posterior lobe of prothorax without hairs..... ..... ***Cratilla*** Kirby

7. Upper surface of frons metallic..... ..... ***Brachydiplax*** Brauer

- Upper surface of frons non-metallic 8

8. Only 6 antenodals in the forewing ....***Acisoma*** Rambur

- 12 or more antenodals in the forewing..... .....***Orthetrum*** Newman

9. Cu_2 separated from the posterior angle of the discoidal cell ..... ***Indothemis*** Ris

- Cu_2 in proximity with the posterior angle of the discoidal cell..... 10

10. Posterior lobe of prothorax erect and with hairs. 14

- Posterior lobe of prothorax small and without hairs 13

11. Borders of the discoidal field in forewing converge at the wing margin .... ***Sympetrum*** Newman

- Borders of the discoidal field in forewing divergent at the wing margin 12

12. Blackish brown mark in the node of the wings ..... ***Palpopleura*** Rambur

- Wings usually hyaline (sometimes parts of wings coloured) .... ***Diplacodes*** Kirby

13. Sectors of arc in forewing separated at the origin and united in hindwings ....***Rhyothemis*** Hagen

- Sectors of arc in fore- and hindwings arising from a common stalk 14

14. Discoidal field converge at the wing border. 15

- Discoidal field diverge at the wing border.... 16

15. A supplementary nervure IR_2 between R_2 and R_1 ..... ***Pantala*** Hagen

- No supplementary nervure between R_2 and R_3 ..... ***Trithemis*** Kirby

16. Pterostigma bicolourous (Black & White) ....***Bradinopyga*** Kirby

- Pterostigma unicolourous 17

17. Only 1 cubital nervure in all wings 18

- 2 or more cubital nervures in all wings .... ***Neurothemis*** Brauer

18. Red, ochreous or pale yellow coloured species 19

- Variably coloured species 20

19. Smaller species (Abdomen 18-20 mm); $6^1/_2$ to $7^1/_2$ antenodals in forewings .... ***Brachythemis*** Brauer

- Larger species (Abdomen 24-26 mm); $9^1/_2$ or more antenodals in forewings ....***Crocothemis*** Brauer

20. Arc in proximation with second antenodal, one row of cell between IR_3 and *Rspl*..... .....***Lathrecista*** Kirby

- Arc lies between the second and the third antenodals; 2 rows of cells between IR_3 and *Rspl*.....***Potamarcha*** Karsch

21. Subtrigone in forewing single celled ....***Aethriamanta*** Kirby

- Subtrigone in forewing three celled ....***Urothemis*** Brauer

Genus ***Hylaeothemis*** Ris

1909. *Hylaeothemis* Ris, *Cat. coll. Selys, fasc.*, **9** : 19, 63-64.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 260.

Diagnostic characters : Small or medium sized (Abdomen 23-32 mm; hindwing 28-33 mm) dragonflies, coloured usually black marked with blue or yellow. Head globular, eyes shortly contiguous, frons with deep sulcus, vesicle slightly bifid. thorax not broad; Wings hyaline, node much nearer apex of wing than base, costal side of the discoidal cell of the forewing angulated, that of the hindwing may or may not be angulated; discoidal field in forewing begins with a single row of cell and continue for some distance. Cu_2 in hindwing widely separated from the posterior angle of the discoidal cell. One or two cubital nervures in forewing, 2 or 3 in hindwing; A row

of cell between IR_3 and *Rspl.* Abdomen slim, cylinderical, segments 7 to 9 very slightly dilated.

Type-species : *Hylaeothemis clementia* Ris (Fraser 1936), *Hylaeothemis frushstorferi* (Karsch) (Tsuda 1991).

Distribution : Arunachal Pradesh, Karnataka, Kerala, Orissa, Tamil Nadu, Kampison Himalaya (U.P.).

Elsewhere : Indonesia, Malayasia and Sri Lanka.

Hylaeothemis frushstorferi apicalis Fraser

1909. *Hylaeothemis frushstorferi* Ris. *Cat. coll. Selys fasc.*, **9** : 64-65.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 161-162.

1991. *Hylaeothemis frushstorferi apicalis*, Tsuda, *A distributional list of World Odonata*, 1991 : 157.

Material examined : 2MM, 2.v.1981, Namdhapa Sanctuary, Gibbon Island, coll. S. Biswas.

Distribution : India : Present record : Arunachal Pradesh (Namdhapa). Past records : Arunachal Pradesh (Lahiri 1985), Orissa (Mitra 1994), Annaimalai, Cochin, Coorg, Malabar, Marcera, Nilgiris, Travancore (Fraser 1931).

Elsewhere : Ceylon (Sri Lanka) (Fraser 1936).

Diagnostic characters : Abdomen (23-32 mm), Hindwing (28-33 mm) Labium bright yellow, middle lobe black, labrum bright ochreous frons and vesicle brilliant metallic blue or bluish green. Posterior lobe of prothorax azure blue, thorax black marked with pale blue. wings hyaline, occasionally short yellow rays in subcostal and cubital spaces; antenodals 14-17 in forewings, 11-13 in hindwings; postnodals 8-12 in forewings, 11-12 in hindwings. Abdomen slim black marked with pale blue.

Genus ***Tetrathemis*** Brauer

1868. *Tetrathemis* Brauer. *Versh. zool. bot. Ges. Wien.*, **18** : 182.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 248.

Diagnostic characters : Small (abdomen 14-21 mm; hindwing 18-24 mm) dragonflies, black marked with citron yellow. Eyes meeting broadly frons rounded, shallowly notched about. Posterior lobe of prothorax large, rounded emerginate and fringed with long hairs, thorax small, narrow; wings hyaline; reticulation rather close, discoidal all at the same level and its costal side markedly agnulated; arc situated between the first and second antenodal nervures, 7-9 antenodals, *Rspl.* weakly built, one row of cells between IR_3 and *Rspl.* 1 to 3 cubital nervures in all wings; discoidal field in forewings made up of single row of cells anal loop poorly developed. Abdomen shorter than wings, cylindrical, somewhat dilated at both ends.

Type-species : *Tetrathemis irregularis irregularis* Brauer.

Distribution : India : Arunachal Pradesh, Karnataka, Kerala, Meghalaya, Tamil Nadu, West Bengal.

Elsewhere : Angola, Australia, Burma (Myanmar), Cameroon, Central Africa, Camoros, Congo, Cote d' ivorie, Gabon, Ghana, Guinea, Indonesia, Liberia, Madagascar, Malayasia, Malawi, Mozambique, New Guinea, Nigeria, Philippines, Somalia, Tanzania, Thailand, Zambia, Zimbabwe.

Tetrathemis platyptera Selys

1878. *Tetrathemis platyptera* Selys, *Mitt. Mus. Dresden* : 316.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 250-251

Material examined : 1M, 1F, 10.x.1971 & 10.xi.1971, tirap, coll. G. S. Arora, 1M, 26.x.1966, Subansiri, coll. S. K. Tandon & G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Subansiri & Tirap). Past records : Arunachal Pradesh (Ram & Prasad, 1999), Bengal (Ris 1909a), Meghalaya (Lahiri 1987), Annaimalai, Bolovompattis, Cochin, Coorg, Kanara, Malabar, Nilgiris (Fraser 1931), Travancore Hills (Fraser 1936).

Elsewhere : Myanmar, Java, Malacca, Siam, Sumatra (Fraser 1936), China, Indonesia, Malayasia, Thailand (Tsuda 1991).

Diagnostic characters : Abdomen (14-18 mm), Hindwing (18-24 mm), Labrum black, front

of frons citron-yellow, upper part and lateral parts brilliant metallic prussian blue; prothorax black; Thorax black with bronze-green reflection, marked broadly with citron-yellow, wings hyaline, the forewings faintly tinted with yellow at base and hindwing very broadly and deeply so to as far as one or two cells distal to node, Nodal index 6-9/ 9-6/5-7/7-5; 1 or 2 cubital nervures in forewings; 2 or 3 in hindwings. Abdomen black, marked with citron-yellow. Anal appendages black.

Genus ***Cratilla*** Kirby

1900. *Cratilla* Kirby, *Ann. Mag. Nat. Hist.*, (7)**4** : 542.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 284.

Diagnostic characters : Dragonflies of moderate size (Abdomen 26-32 mm; hindwing 34-42 mm). coloured black, marked with yellow or metallic blue or bronzed black, wings hyaline or partly opaque. Wings long narrow, reticulation close, antenodal 16 or more, post nodals 11, discoidal cell of forewing narrow, traversed, hypertrigones entire, discoidal field begins with 3 rows in forewings; 1 or 2 rows of cells between IR_3 and *Rspl*, anal loop elongate.

Type-species : *Cratilla metallica* (Brauer).

Distribution : India : Arunachal Pradesh, Orissa, Uttar Pradesh, Kerala, West Bengal.

Elsewhere : Burma (Myanmar), Borneo, Malacca, Malayasia, New Guinea, Philippines, Sri Lanka, Sundaic Archipelago.

Cratilla lineata calverti Forster

1903. *Cratilla lineata* Forster, *Ann. Mus. Hungar.*, : 537.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 286-288.

1991. *Cratilla lineata calverti*, Tsuda, *A distributional list of World Odonata*, 1991 : 149.

Material examined : 1M, 24.iii.1973, Chandan Forest, coll. S. K. Tandon; 1M, 22.iii.1973, Elephant Flat, coll. S. K. Tandon.

Distribution : India : Present record : Arunachal Pradesh, Orissa (Mitra 1994), West Bengal (Duars & Darjeeling) (Fraser 1936), Dehra Dun (Singh & Prasad 1974), Garhwal Hills (Prasad 1974), Malabar (Ris 1909b).

Elsewhere : Formosa (Needham 1930), Java, Malacca, Mindanao, New Guinea, Perak (Ris 1909b), Palon, Philippines, Sumatra (Selys 1891), Malayasia (Fraser 1936), Burma, China, Indonesia, Kampuchea, Malayasia, Nepal, Singapore, Thailand (Tsuda 1991).

Diagnostic characters : Abdomen 30-32 mm, Hindwing 37-41 mm, Labrum, face and frons creamy yellow; upper surface of frons dark metallic blue or metallic green; prothorax black, posterior lobe yellow; Wings hyaline, pterostigma yellow; 2 rows of cells between IR_3 and *Rspl.*, antenodals in forewing 17-20, in hindwings 12-15; postnodals 10-13 in forewings and in hindwings 12-14. Abdomen black, marked with bright ochreous. Anal appendages black.

Genus ***Orthetrum*** Newman

1833. *Orthetrum* Newman, *Ent. Mag.*, **1** : 511.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 291-292.

Diagnostic characters : Moderate sized (Abdomen 22-36 mm, Hindwing 25-41 mm) dragonflies. Head moderately large, frons with well developed crest in both sexes. Posterior lobe of prothorax large, erect and fringed with long hairs. Thorax robust with variable colour and markings. Wings long and reticulation close; node lying nearer pterostigma than base of wing, trigone 3-celled; discoidal field with three rows of cells at the beginning and widely dilated at the wing border. One row of cell between IR_3 and *Rspl.*, number of antenodals not less than 12 in forewing. Abdomen distinctly or slightly tumid at base, triquetral in section. Anal appendages libelluline type.

Type-species : *Libellula coerulescens* Fabricius

Distribution : India : Throughout India.

Elsewhere Afghanistan, Albania, Algeria, Angola, Australia, Austria, Bangladesh, Belgium, Benin, Botswana, Burgaria, Burkina Faso, Burma, Cameroon, Chad, Czechoslovakia, China, Cote d' ivorie, Cyprus, Denmark, Egypt, Ethiopea, Equatorial Guinea, Finland, France, Gabon, Germany, Ghana, Greece, Guinea-Bissau, Hongkong, Hungary, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kampuchea,

Kenya, Morea, Laos, Lebanon, Lesotho, Liberia, Libya, Lichtenstein, Luxembourg, Madagascar, Malawi, Malayasia, Maurities, Mongolia, Morocco, Namibia, Nepal, Netherlands, Niger, Nigeria, Norway, Oman, Pakistan, Papua New Guinea, Philippines, Poland, Portugal, Romania, Russia (Soviet), Sahara, Samoa, Senegal, Singapore, Siera Leone, Somalia, South AFrica, Togo, Tunisia, Turkey, U. K., Vanuatu, Vietnam, Zaire, Zambia, Zimbabwe.

Key to species of genus *Orthetrum* Newman

1. Males coloured red, females brownish or ochreous 2

– Males brownish or black, often pruinosed, yellow markings, females vary in colour 3

2. In males face ochreous to pale reddish brown, frons anteriorly and above dark brown, vesicle and occiput dark reddish brown, prothorax and thorax reddish-brown to dull purple due to pruinescence; wings hyaline, reddish brown basal markings extending distalwards in hindwings to first antenodal nervure nearly as far as the tornal angle; only a vestige of this in forewing. Abdomen bright vermillion red in subadult and females, it is purplish red due to pruinescence .... *pruinosum neglectum* Rambur

– Males face, frons yellowish or pale brown; frons scarlet red in front; prothorax and thorax ferruginous; in females red colour is replaced by ochreous, wings hyaline, in males a golden amber coloured marking at the base of hind wings; in female a vestige of this occurs. Abdomen bright red, broad, at base tapered gradually to anal end .... *t.testaceum* (Burmeister)

3. Abdomen enormously swollen at the base and then tapered abruptly and compressed laterally to the end; greenish-yellow marked with black; not pruinosed; Cu_2 rather widely separated from the posterior angle of the discoidal cell, arising from its distal side; anal area, adjoining membrane of the hindwing tinted with amber yellow; female similar to male .... *s. sabina* (Drery)

– Abdomen not enormously swollen at base and slimmed abruptly and variable 4

4. Abdomen never enormously swollen at base, never very slim, mostly with pruinosed abdomen and thorax. Thorax velvety blackish-brown; wings in male with a triangular black mark; in female it is absent and abdomen not pruinosed, borders of segment 8 dilated, vulvar scale obsolete. ..... *t. triangulare* Selys

– Base of hindwing of male without a triangular mark 5

5. Cu_2 in hindwings arising from the distal side of the discoidal cell away from the posterior angle prothorax blackish brown; thorax pale olivaceous green; abdomen dorsoventrally dilated at base, then narrowed and tapered, pruinosed pale azure blue, except at sides of the segment 1, 2 and base of three which are bright yellow. In female thorax palest green with black sutures; abdomen greenish yellow; sides of segment 8 broadly dilated, ventral plate on the 9th a little enfumed .... *luzonicum* (Brauer)

– Cu_2 in the hindwing arising from the posterior angle of the discoidal cell 6

6. Thorax and abdomen pruinosed blue in adult males; single row of cells between IR_1 and *Rspl.*, abdomen laterally and dorsoventrally broad at base and tapered gradually to as far as anal end, triquetral in cross section. Wings hyaline, tinted with brownish in old adults; membrane white, costal and many antenodals pale yellow ..... *border anceps* Schreider)

– Two or more rows of cells between IR_1 and *Rspl.* costal end of antenodals black 7

7. Wings hyaline, extreme base tinted with dark amber yellow to as far as the cubital nervure and well into the anal triangle in hindwing. In matured specimens wings are palely evenly enfumed with brown; in female wings are similar for male. In male abdomen is pruinosed pale dirty blue from segment 1 to 8, the rest is black. In female the abdomen is reddish brown with a broad greenish yellow strife on mid dorsum of abdominal segments extending from segments 1 to 7; 8 to 10 black on mid-dorsum ..... *glaucum* (Brauer)

- Wings hyaline, but tinted with brownish in old adults especially towards the apices and along the posterior part of wings, membrane pure white. Pterostigma ochreous between black nervures. Costal ends of many antenodals pale yellow. Thorax pruinosed in male, dorsum of female olivaceous brown .... *b. brunneum* (Fonse)

7. Wings hyaline even in old adults, membrane narrow and ochreous, nervures yellow; prothorax and thorax uniformly pulverulent blue; in female and subadult male prothorax dark brown, thorax palest brown .... *taeniolatum* (Sch.)

- Abdomen short and broad, almost white with pruinescence, thorax with two broad greenish or bluish stripes, more or less obscured with pruinescence. Face and frons olivaceous green; prothorax black; thorax olivaceous green; wings hyaline or amber yellow tinted at the extreme base of hindwings. In female thorax and abdomen without pruinescence .... *japonicum internum* Mcl.

Orthetrum brunneum brunneum (Fonscolombe)

1837. *Libellula brunneum* Fouscolombe, *Ann. Ent. Soc. France*, **6** : 141.

1936. *Orthetrum brunneum brunneum*, Fraser, *Fauna Brit. India, Odon.*, **3** : 294-295.

Material examined : 1F, 9.v.1966, Subansiri, Kimin, coll. A. N. T. Joseph; 9M, 2F, 10.v.1966, Dejoo, coll. A. N. T. Joseph; 1F, 11.x.1966, Siang coll. S. K. Tandon & G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Siang, Subansiri, Dejoo). Past recrods : Arunachal Pradesh (Mitra (1994); Assam (Fraser 1918b), Singhbhum (Bhasin 1953), Kashmir (Calvert 1898, Mani et. al. 1955), Almora (Bhasin 1953), Garhwal Hill (Prasad 1974); Doon Valley (Singh & Prasad 1976b).

Elsewhere : Quetta (Fraser 1918), Asia Minor (Fraser 1936), Afghanistan (Dumont 1975), Burma (Bhasin 1953), Algeria, Egypt (Tsuda 1991), Belgium, Bavaria, Germany (Korman 1966), Constantinopol, Holland, Italy, Madrid, Portugal, Smarkhand, Sicily, Tashkent (Ris 1909b), Poland (Mielewczyk 1979), Albania, Austria, Belgium, Burgaria, Switzerland, Czechoslovakia, Cyprus, Germany (Tsuda 1991).

Orthetrum anceps (Schneider)

1845. *Libellula anceps* Schneider, *Stett. Ent. Zeit.*, **6** : 111.

1936. *Orthetrum anceps*, Fraser, *Fauna Brit. India, Odon.*, **3** : 295-296.

Material examined : 7MM, 2.x.1966, 6.x.1966, 8.x.1966, 12.x.1966; 3M, 24.x.1966, Siang, coll. S. K. Tandon & G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Siang). Past records : Arunachal Pradesh (Mitra 1994); Mizoram, Sikkim, West Bengal (Mitra in press).

Elsewhere : Afghanistan, Albania, Algeria, Burgaria, Cyprus, Egypt, France, Greece, Iran, Iraq, Israel, Italy, Lebanon, Libya, Morocco, Nepal, Romania, Russia (Soviet), Syria, Tunisia, Yugoslavia (Tsuda 1991).

Orthetrum luzonicum (Brauer)

1868. *Libellula luzonica* Brauer, *Verh. zool. bot. Ges. Wien,*. **18** : 169.

1936. *Orthetrum chrysostigma luzonicum*, Fraser, *Fauna Brit. India, Odon.*, **3** : 298-300.

1994. *Orthetrum luzonicum*, Mitra, *Rec. zool. Surv. India, Occ. Pap. No.*, **166** : 38.

Material examined : 2M, 9.v.1966, Kimin, Subansiri; 1F, 15.v.1966, Hapoli, coll. A.N.T. Joseph.

Distribution : India : Present record : Arunachal Pradesh (Subansiri, Hapoli). Past records : Arunachal Pradesh (Ram & Prasad 1999); Assam, Orissa, West Bengal (Mitra in press); Bengal, Coimbatore (Fraser 1936); Chakrata, Lakhimpur, Nagaland (Bhasin 1953), Sibsagar, Khasi Hills (Ris 1909b); Uttar Pradesh (Kumar 1982), Kulu, Manali (Singh et. al. 1955); Kanara (Prasad 1976), Deesa (Ris 1909b), Annaimalai, Coorg, Deccan, Malabar, Nilgiris, Palni, Travancore (Fraser 1931), Neelambur, Nedengayam, (Bhasin 1953).

Elsewhere : Myanmar (Fraser 1918, 1936),

Tennasserim (Lieftinck 1948), Tonkin (Ris 1909b), Ceylon (Ris 1909b, Fraser 1936), Philippines, Luzon, Malayasia (Ris 1909b), Nepal (St. Quentin 1970), Sumatra, Sumba (Ris 1909b), Afghanistan, Bangladesh, China, Hongkong, Indonesia, Japan, Malayasia, Thailand, Taiwan, Vietnam (Tsuda 1991).

Orthetrum sabina sabina (Drury)

1770. *Libellula sabina* Drury. *Ill. Exot. Ins.*, **1** : 114.

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

1954. *Orthetrum sabina sabina*, Lieftinck, *Treubia*, **22** (Suppl.) : 137.

Material examined : 1M, 4.x.1966,Siang coll. S. K. Tandon & G. S. Arora; 1M, 6.x.1966, Lekhabali, coll. S. K. Tandon & G. S. Arora; 1M, 12.x.1966, Dalli Village, coll. S. K. Tandon & G. S. Arora; 5MM, 10.v.1966, Dejoo, Subansiri, coll. A. N. T. Joseph, 1M, 15.v.1986, Hapoli, coll. A. N. T. Jospeh; 1M, 2.x.1966, Balliwari, coll. S. K. Tandon & G. S. Arora; 1M, 2.x.1966, Bholigaon, coll. S. K. Tandon & G. S. Arora; 1M, 7.x.1966, Lekhabali, Siang, coll. S. K. Tandon & G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Siang, Subansiri, Balliwari, Bholigaon, Dalli Village, Hapoli). Past records : Arunachal Pradesh, Assam (Lahiri 1979); Meghalaya (Lahiri 1987, Mitra 1999); Abor Hills (Laidlaw 1914), Barkuda Island (Fraser & Dover 1922); Buxa, Gorakhpur, Pusa, Ramgarh, Sibsagar, Sahadra (Bhasin 1953); Calcutta (1983), Dhanbad (Kumar & Prasad 1977), Manipur (Lahiri 1977b), Tamil Nadu (Kumar & Khatri 1985), Tripura (Lahiri 1977a; Mitra & Sen 1975), Waltair (Mitra 1976), Mizoram, Nagaland (Mitra 1994), Doon Valley (Singh & Prasad 1976b), Kangra (Prasad 1976), Gwalior (Baijal & Agarwal 1955), Nagpur (Mitra 1988), Annaimalai, Bolovumpattis, Cochin, Coorg, Deccan, Kanara, Malabar, Nilgiris, Palmis (Fraser 1931), Silent Valley (Rao & Lahiri 1983), Bombay (Fraser 1924b), Andamans (Fraser 1924a, Chhotani *et. al.* 1983), Nicobar (Mitra 1995), Rajasthan (Bose & Mitra 1976).

Elsewhere : Asia Minor (Fraser 1924a), Myanmar (Lieftinck 1948), Bhamo (Selys 1891), Bangladesh (Chowdhury & Akhteruzzaman 1981), China (Klots 1947, Needham 1930, Ris 1909b); Ceylon (Fraser 1918), Cyprus (Selys 1891), Formosa, Indo-China, Java, Mindanao (Ris 1909b), Mesoptamia (Fraser 1924a), Philippines (Fraser 1924a, Kiauta & Kiauta 1983a); Nepal (Asahia 1955, Kiauta 1975, St. Quentin 1970); Iran (Blom 1982), Syria (Ris 1909b), Thailand (Titayavan 1979), Yunnan (Moore 1878); Tropical Africa (Selys 1891); North Africa (Fraser 1924a), Somaliland (Carfi 1974), Queensland, New Guinea, Sydney (Ris 1909b); Polynesia (Selys 1891), Celebes, Ciram (Ris 1909b), Micronesia (Lieftinck 1962); Singapore (Kiauta & Kiauta 1982b).

Orthetrum japonicum internum Mc Lachlan

1894. *Orthetrum japonicum internum* Mc Lachlan, *Ann Mag. Nat. Hist.*, (6) **13** : 431.

1936. Fraser, *Fauna Brit. India, Odon.*, **2** : 304-305

Material examined : 1M, 11.x.1985, Roing, Diband Valley, coll. B.C. Saha.

Distribution : India : Present record : Arunachal Pradesh (Dibang Valley). Past records : Arunachal Pradesh (Prasad 1997); Kurseong, Khasi Hills (Fraser 1918, Ris 1909b); Assam (Mitra 1994), Nagaland, Shillong, Arakot, Chakrata (Bhasin 1953); Kashmir (Fraser 1918, Mani *et. al.* 1955), Kulu (Singh *et. al.* 1955); Doon Valley (Singh & Prasad 1976b); Kangra (Prasad 1976).

Elsewhere : Bangladesh, Sylhet (Bhasin 1953), Burma, Tonkin (Ris 1909b); China Szechuen (McLachlan 1896), Nepal (Kiauta 1975; St. Quentin 1970); Tibet, Yatung (Ris 1909b); Ta Chien Lu (Kimins 1968); China (Chao 1981), Japan, Pakistan, Thailand, Taiwan, Vietnam, Korea (Tsuda 1991).

Orthetrum taeniolatum (Schneider)

1845. *Libellula taeniolatum* Schneider, *Stett Ent Zeit* **6** 111.

1936. *Orthetrum taeniolatum*, Fraser, *Fauna Brit India, Odon.*, **3** : 296-298.

Material examined : 1M, 20.xii.1965, Rupa Camp, S. K. Bhattacharya & A. N. T. Joseph.

Distribution : India : Present record : Arunachal Pradesh. Past records : Arunachal Pradesh (Ram & Prasad 1999); Bihar, Sikkim, West Bengal (Mitra in press); East India (Ris 1909b); Dehra Dun, Mothronwala, Nalapani; Mussorie, Kempti falls, Saharanpur, Ranipur (Bhasin 1953); Rajasthan (Prasad & Thakur 1981), Muree, Kashmir (below 5000') (Ris 1909b), Kangra (Prasad 1976); Anaimalai, Bolovumpattis, Coorg, Deccan, Kanara, Malabar, Nilgiris, Palnis, Travancore (Fraser 1931), Campbell Pore (Schneider 1985), Deesa, Jubbalpore, Niam, Jami-Kalibagh (9000') (Ris 1909b), Poona (Fraser 1924b).

Elsewhere : Burma (Fraser 1918), Baluchistan (Fraser 1919b); Ceylon (Fraser 1918); Dobar, Goolis Mets (Kimmins 1968); Iran (Blom 1982); Nepal (Kiauta 1974), Greece, Turkey (Schneider 1985); Somali (Carfi 1974).

Orthetrum glaucum (Brauer)

1965. *Libellula glauca* Brauer, *Verh. zool-bot. Ges. Wien.*, **15** : 1012.

1936. *Orthetrum glaucum*, Fraser, *Fauna Brit. India, Odon.*, **3** : 307-309.

Material examined : 1M, 4.v.1966, Siang, coll. A. N. T. Joseph; 1M, 2.v.1981, Namdhapa, coll. S. Biswas; 1M, 12.x.1966, Siang, coll. S. K. Tandon & G. S. Arora; 2F, 15-19.x.1966, Siang, coll. S. K. Tandon & G. S. Arora; 4M, 1F, 20-30.x.1966, Siang, coll. S. K. Tandon & G. S. Arora; 1F, 1M, 10-13.v.1966, Subansiri, coll. A. N. T. Joseph; 4M, 4.xi.1971, Subansiri, coll. G. S. Arora, 2, 15.v.1966, Hapoli, coll. A. N. T. Joseph, 1M, 19.v.1966, Subansiri, coll. A. N. T. Joseph; 1M, 4.x.1966, Tamen, coll. A. N. T. Joseph.

Distribution : India : Present record : Arunachal Pradesh (Siang, Subansiri, Namdhapa, Hapoli), Past records : Arunachal Pradesh, Assam, Manipur, Mizoram, Sikkim, Tripura, West Bengal (Mitra in press); Sikkim (Selys 1891), Darjeeling (Ris 1909b; St. Quentin 1936); Calcutta (Dasgupta 1957); Meghalaya (Lahiri 1987); Almora, Dehra Dun, Nalapani, Tahl (Bhasin 1953), Chakrata (8000') (Singh & Baijal 1954), Kangra (Prasad 1976b); Garwal Hills (Prasad 1974); Annaimalai, Coorg, Deccan, Mamara, Malabar, Nilgiris, Palnis, Travancore (Prasad 1931); Poona (Fraser 1924b); West Coast (Fraser 1936).

Elsewhere : Burma (Laidlaw 1914), Tennasserim (Lieftinck 1948; Ris 1909b, Selys 1891)' Borneo, Ceylon, China, Indo-China, Java, Lombok, Moluquas (Ris 1909b), Nepal (Asahina 1955, St. Quentin 1970); Sumatra, Toungoo (Selys 1891); Malayasia (Brooke 1981), Philippines (Fraser 1936), Thailand (Tityaran 1979); Tainan (Lieftinck *et. al.* 1984); Hongkong, Indonesia, Japan, Thailand, Vietnam (Tsuda 1991).

Orthetrum testaceum testaceum (Burmeistu)

1839. *Libellula testacea* Burmeister, *Handb. Ent.*, **28** : 859.

1936. *Orthetrum testaceum testaceum*, Fraser, *Fauna Brit. India, Odon.*, **3** : 309-310.

Material examined : 1M, 14.v.1966, Ziro, Subansiri, coll. A. N. T. Joseph.

Distribution : India : Present record : Arunachal Pradesh (Ziro). Past records : Arunachal Pradesh (Ram & Prasad 1999), Orissa (Mitra 1994).

Elsewhere : Bangladesh (Chowdhury & Akhteruzzaman 1981); Burma (Fraser 1918, Ris 1909b); Bhamo, Sumatra (Selys 1891), China (Klots 1947; Needham 1930); Borneo (Ris 1909b, Selys 1891); Formosa, Indo-China, Java, Palwan, Penang, Philippines (Ris 1909b); Singapore, (Kiauta & Kiauta 1982b); Taiwan (Lieftinck *et. al.* 1984); Celebes (Fraser 1936, Ris 1909b); Indonesia, Malayasia, Thailand, Vietnam (Tsuda 1991).

Orthetrum triangulare triangulare (Selys)

1878. *Libellula triangulare* Selys, *Mitt. Mus. Dresden.*, :314.

1909. *Orthetrum triangulare triangulare*, Ris, *Cat. coll. Selys. fasc.*, **9** : 181: 243-244.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 305-307.

Material examined : 1M, 2.v.1981, Namdhapa, coll. S. Biswas; 1M, 17.v.1966, Subansiri, coll. A. N. T. Joseph; 3, 24.x.1966, Tachidome, coll. S. K. Tandon & G. S. Arora; 3M, 4.xi.1971, Khansa, Tirap, coll. G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Namdhapa, Subansiri, Tachidomi, Tirap). Past records : Arunachal Pradesh, Assam (Lahiri 1979); Manipur, Mizoram, Sikkim, West Bengal (Mitra in press), Darjeeling, Khasi Hills, Sikkim (Ris 1909), Buxa, Sibsagar (Bhasin 1953), Muree, Kashmir (Fraser 1918, Mani et. al. 1955); Chakrata (8000') (Singh & Baijal 1954); Almora, Arakot, Bhatronj, Chakrata, Dehra Dun, Kempti Falls, Nalapani, Sadia (Bhasin 1953); Conoor, Coorg, Nilgiris, Ooty (Fraser 1924b); Annaimalai, Bolovumpattis, Deccan, Kanara, Malabar, Palni Hills, Travancore (Fraser 1931), Tamil Nadu (Kumar 1990).

Elsewhere : Myanmar (Fraser 1918, Laidlaw 1914, Ris 1909); Leito (Selys 1891), Tennasserim (Lieftinck 1948); Ceylon (Ris 1909, Fraser 1918); Nepal (Kiauta 1974); Afghanistan, China, Laos, Thailand, Vietnam (Tsuda 1991).

Orthetrum pruinosum neglectum (Rambur)

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

1936. *Orthetrum pruinosum neglectum*, Fraser, *Fauna Brit. India, Odon.*, **3** : 311-312.

Material examined : 3MM, 1F, 1.v.1966-15.v.1966, Kameng, A. N. T. Joseph & S. Biswas; 1M, 10.v.1966, Dejoo Subansiri, coll. A. N. T. Joseph; 1F, 13.v.1966, Ziro Subansiri, coll. A. N. T. Joseph; 2M, 20.v.1966, Tameng, Subansiri, coll. A. N. T. Joseph; 2M, 1F, 27.x.1966, Bella village, Subansiri, coll. S. K. Tandon & G. S. Arora; 1M, 25.x.1971, Jairampur, Tirap, coll. G. S. Arora; 1M, 2.xi.1966, Lekhabali, Siang, coll. S. K. Tandon & G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Kameng, Siang, Subansiri, Tirap). Past records : Arunachal Pradesh, Assam, Manipur, Mizoram (Lahiri 1979); Meghalaya (Lahiri 1987); Tripura (Lahiri 1977a); Buxa, Nagaland (Bhasin 1953); Barkuda Island (Fraser & Dover 1922); Upper Assam (Laidlaw 1914), Darjeeling (Ris 1909); Bhubaneswar (Dasgupta 1957); Kulu, Manali, (Singh *et al.* 1955); Dehra Dun (Bhasin 1953); Kashmir (Ris 1909); Garhwal Hills (Prasad 1974); Kangra (Prasad 1976); Rajasthan (Prasad & Thakur 1981); Gwalior (Baijal & Agarwal 1955); Betul, Chhindwana (Mitra 1988); Annaimalai, Bolovumpattis; Cochin, Coorg, Deccan, Kanara, Malabar, Nilgiris, Palnis, Travancore (Fraser 1931); Madras (Ris 1909); Silent Valley (Rao & Lahiri 1983); Andaman Island (Fraser 1924a).

Elsewhere : Annam (Ris 1909); Burma (Fraser 1918; Laidlaw 1914); Ceylon (Fraser 1918, 1924a, Lieftinck 1971); Hongkong (Ris 1909); Java Selys 1891); Nepal (St. Quentin 1970, Kiauta & Kiauta 1982a); Philippines (Selys 1891); Yunnan (Ris 1909); Celebes (Selys 1891); Afghanistan, Bangladesh, Burma, China, Indonesia, Japan, Laos, Malayasia, Singapore, Thailand, Taiwan, Vietnam (Tsuda 1991).

Genus ***Lathrecista*** Kirby

1889. *Lathrecista* Kirby, *Trans. zool. Soc. Lond.*, **12** : 264.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 280.

Diagnostic characters : In the Indian subcontinent only the nominate subspecies occurs. Medium sized (Abdomen 27-32 mm; hindwing 33-37 mm) dragonflies; head moderately large, eyes broadly confluent; frons angulated at the crest; prothorax with small posterior lobe, thorax strong wings long and narrow; reticulation close, node situated nearer the pterostigma than the base; antenodals no less than 15½; discoidal cell of forewing narrow, traversed, situated slightly distal to the level of the discoidal cell in the hindwing; discoidal cell of the hindwing entire; sectors of the arc arising from a common stalk, Cu_2 arising from the posterior angle of the discoidal cell; arc lying at the second or between the second and third antenodal nervures, subtrigone in forewing three celled; single cubital nervures in all wings, 1 or 2 rows of cells between IR_1 and Rspl. anal field of hindwing broad; anal loop very long and closed; segment 8 of female not dilated laterally; borders of segment 9 prolonged analwards and ventralwards; the ventral plate of the segment 9 prolonged analwards and its apex curled strongly upwards.

Type-species : *Libellula asiatica* Fabricius.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Karnataka, Kerala, Manipur, Maharashtra, Tamil Nadu, West Bengal.

Elsewhere : Australia, Myanmar, China, Fiji, Indonesia, Japan, Malayasia, New Caledonia, Papua New Guinea, Philippines, Samoa, Singapore, Solomon Is., Sri Lanka, Taiwan, Thailand.

Lathrecista asiatica asiatica (Fabricius)

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

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

Material examined : 1F, 4.x.1966, Siang, coll. S.K. Tandon & G.S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Siang). Past records : Arunachal Pradesh (Mitra 1994); Assam, Sibsagar (Bhasin 1953); Calcutta (1983); Howrah (Dasgupta 1957); Barkuda Island (Fraser & dover 1982); Coorg, Khandala, Nilgiris, Palnis (Fraser 1924b); Deccan, Malabar (Fraser 1931); Bombay, Poona (Fraser 1918); Bihar, Manipur, Orissa (Mitra 1994).

Elsewhere : Bhamo (Selys 1891); Ceram, Celebes, Ceylon, Indo-China, Linda, New Guinea, Philippines, Luzon (Ris 1909); Samoa, Sundaic Archipelago (Fraser 1931); Taiwan (Lieftinck *et. al.* 1984); Myanmar, China, Fiji, Indonesia, Japan, Malayasia, Philippines, Papua New Guinea, Samoa, Singapore, Sri Lanka, Taiwan, Thailand (Tsuda 1991).

Diagnostic character : As per genus.

Genus ***Potamarcha*** Karsch

1890. *Potamarcha* Karsch, *Berlin Ent. Zeit.*, **33** : 370.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 288.

Diagnostic characters : Moderate sized (Abdomen 29-32 mm; Hindwing 33-35 mm), coloured blackish brown, marked with yellow; markings sometimes partly or wholly obscured by blue, pruinescence. Eyes widely contiguous, frons with deep sulcus, Prothorax very small; thorax broad wings hyaline, sometimes the apices are brownish, reticulation close, node nearer pterostigma than base, antenodals not less than $14^{1}/_{2}$; discoidal cell in forewing traversed hypertrigone entire, subtrigones 3 celled; one cubital nervure in all wings; 2 rows of cells between IR_3 and *Rspl.*, Cu_2 and MA diverging at wing margin in forewing. Pterostigma and membrane large.

Type-species : *Libellula congener* Rambur.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal and West Coast of India.

Elsewhere : Australia, Bangladesh, Burma, China, Hongkong, Indonesia, Kampuchea, Laos, Malayasia, Nepal, Philippines, Thailand, Taiwan, Vietnam.

Potamarcha congener (Rambur)

1842. *Libellula congener* Rambur, *Ins. Nevrop.*, : 70.

1936. *Potamarcha obscura*, Fraser, *Fauna Brit. India, Odon.*, **3** : 389-391.

1991. *Potamarcha congener*, Tsuda, *A distributional list of World Odonata*, : 175.

Material examined : 1M, 13.v.1966, Ziro, coll. A. N. T. Joseph; 1M, 3.iii.1966, Sunpura, coll. S. K. Tandon.

Distribution : India : Present record : Arunachal Pradesh (Sunpura, Ziro); Past records : Arunachal Pradesh, Assam, Orissa (Mitra 1994); Calcutta (Ram *et. al.* 1982); Chilka Lake (Laidlaw 1915b); Darjeeling (St. Quentin 1936); Manipur (Lahiri 1977b); Balasore (Dasgupta 1957); Buxa, Banki, Gorakhpur, Nagaland, Singhbhum (Bhasin 1953); Nilgiris, Poona, Khandala, Coorg (Fraser 1924b); Tamil Nadu (Kumar 1990); Annaimalai, Cochin, Coorg, Deccan, Kanara, Malabar (Fraser 1931); Chihindwara (Mitra 1988); West Coast of India (Fraser 1936).

Elsewhere : Australia, Bangladesh, Burma, China, Hongkong, Indonesia, Kampuchea, Laos, Malayasia, Nepal, Philippines, Sri Lanka, Thailand, Taiwan, Vietnam (1991).

Diagnostic characters : Face and frons of adults steely black or brown; in females and subadults face and frons are olivaceous yellow. thorax black and often preinosed; yellow lines are

visible in subadults and females. Other characters are as per genus.

Genus ***Palpopleura*** Rambur

1842. *Palpopleura* Rambur, *Ins. Nevrop.*, : 126, 129.

1936. Fraser, *Fauna Brit. India, Odon.*, 3 : 316.

Diagnostic characters : Small dragonflies; coloured yellow with dark markings, abdomen pruinosed blue, in adult and with wings more or less coloured and marked with black, brown and yellow, the forewing with costal border bear base sinuously curved. Eyes moderately contiguous, frons angulated at crest and with shallow sulcus; vesicle large, notched. Posterior lobe of prothorax large and fringed with long hairs. Wings marked in both sexes. Discoidal cell in forewing traversed, sectors of arc stalked, Cu_2 arising from the posterior angle of the discoidal cell in hindwings; 3 or 4 rows of cells in the discoidal field of forewing; 1 or 2 rows of cells between IR_3 and *Rspl.* Pterostigma large, membrane rather short.

Type-species : *Palpopleura vestita* Rambur.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Karnataka, Kerala, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

Elsewhere : Afghanistan, Angola, Bangladesh, Benin, Botswana, Burkina Faso, Burma, China, Cote d' ivorie, Ethiopea, Gabon, Guinea, Hongkong, Kenya, Laos, Liberia, Malawi, Madagaskar, Mali, Mozambique, Namibia, Nepal, Siera Leone, Senegal, Somalia, South Africa, Sudan, Sri Lanka, Swaziland, Tanzania, Thailand, Togo, Vietnam, Zaire.

Palpopleura sexmaculata sexmaculata (Fabricius)

1787. *Libellula sexmaculata* Fabricius, *Mant. Ins.*, 1 : 338.

1936. *Palpopleura sexmaculata sexmaculata*, Fraser, *Fauna Brit. India, Odon.*, 3 : 318-320.

Material examined : 1M, 24.iii.1973, Chandan Forest, coll. S. Biswas; 2F, 15.v.1966, Hapoli, subansiri, coll. A. N. T. Joseph; 2MM, 15.v.1966, Hapoli, Subansiri, coll. A. N. T. Joseph; 2MM, 14.v.1966, Ziro, subansiri, coll. A. N. T. Joseph; 1M, 17.v.1966, Palmer Bridge, 1M, 1F, 27.x.1966, Bella village, coll. S. K. Tandon & G. S. Arora; 8MM, 4FF, 31.x.1966, Basar village, coll. S. K. Tandon & G. S. Arora; 1M, 20.xi.1971, Changland, Tirap, coll. G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Subansiri, tirap), Past records : Arunachal Pradesh (Mitra 1994); Pusa, Shillong (Fraser 1919d); Darjeeling, Sikkim (ris 1910); North Lakhimpur (Laidlaw 1914); Manipur, Mizoram (Lahiri 1979); Meghalaya (Lahiri 1987); Nainital, Dehra Dun, Mothronwala, Singhbhum (Bhasin 1953); Garhwal Hills (Prasad 1974); Kangra (Prasad 1976a); Tamil Nadu (Kumar 1990); Kodai Kanal, Palni, Nilgiris, Wynaad (Fraser 1924b); Annaimalai, Cochin, Coorg, Malabar, Travancore (Fraser 1931).

Elsewhere : Annam (Ris 1910); Burma (Laidlaw 1914); Leito, Puspoli, Monts Carin (Selys 1891); Ceylon (Fraser 1919d); China (Chas. 1981; Needham 1930); Indonesia, Malayasia (Fraser 1936); Nepal (Asahina 1955; Mahato 1988; St. Quentin 1970); Yunnan (Moore 1978); Afghanistan, Hongkong, Laos, Thailand, Vietnam (Tsuda 1991).

Diagnostic characters : Frons and vesicle brilliant metallic blue, prothorax dark brown; thorax pale greenish-yellow, marked with dark brown and black; wings hyaline, marked with black; hindwings usually tinted with yellow from base to proximal end of pterostigma; antenodals 10-11 in forewings, 7-8 in hindwings. Abdomen pruinosed light blue.

Genus ***Acisoma*** Rambur

1842. *Acisoma* Rambur, *Ins. Nevrop.*, : 26

1936. Fraser, *Fauna Brit. India, Odon.*, 3 : 329.

Diagnostic characters : Small size (Abdomen 15-20 mm; hindwing 16-23 mm) black or brown marked on blue ground colour; posterior lobe of prothorax emarginate, large and fringed with long hairs; thorax narrow small. Wings hyaline, sometimes marked with golden yellow or blackish brown at base; 6 to 8 and 5 to 6 antenodals in forewings and hindwings; reticulation open; discoidal cell entire, subtrigone 3-celled; sectors of arc fused for a short distance; 1 cubital nervure in all wings, Cu_2 in hindwing widely separated

from the posterior angle of the discoidal cell 1 row of cell between IR_3 and *Rspl.* Abdominal segment 1 to 5 laterally and widely dilated and then abruptly slimmed and cylindrical from segment 6 to 10.

Type-species : *Acisoma panorpoides* Rambur.

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal, Nicobar Island.

Elsewhere : Afghanistan, Algeria, Angola, Bangladesh, Botswana, Burma, Cameroon, Celebes, China, Central African Republic, Congo, Cote d' ivorie, Egypt, Guinea, Hongkong, Indonesia, Japan, Kenya, Liberia, Libya, Madagascar, Malayasia, Mali, Mozambique, Nepal, Nigeria, Philippines, Senegal, Singapore, Sierra Leone, Sri Lanka, South Africa, Taiwan, Tanzania, Thailand, Tunisia, Zaire, Zambia, Zimbabwe.

Acisoma panorpoides panorpoides Rambur

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

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

Material examined : 1F, 27.x.1966, Bella village, Subansiri, coll. S. K. Tandon & G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Subansiri). Past records : Assam, Mizoram, Orissa, Tripura (Mitra in press); Arunachal Pradesh, Assam (Lahiri 1979); Meghalaya (Lahiri 1987); Manipur (Lahiri 1977b); Calcutta (Dasgupta 1957, Mitra 1983); Sibsagar (Bhasin 1953); Rajasthan (Prasad & Thakur 1981); Doon Valley (Singh & Prasad 1976); Garhwal Hills (Prasad 1974); Kangra (Prasad 1976); Poona (Fraser 1924b); Cochin, Deccan, Kanara, Malabar (Fraser 1931); Tamil Nadu (Kumar 1990); Gwalior (Baijal & Agarwal 1985); Great Nicobar (Mitra 1995).

Elsewhere : Bangladesh, Sylhet (Dasgupta 1957); Burma (Laidlaw 1914); Bhamo, Loo-Choo, Palon, Toungoo (Selys 1891); Ceylon (Fraser 1919d); China (Chao 1981; Needham 1930); Southern Japan, Taiwan (Lieftinck 1971); Thailand (Kiauta & Kiauta 1983b); Nepal (Kiauta 1975); Celebes, Moluccans (Lieftinck 1971); Afghanistan, Phillipines, Singapore (Tsuda 1991).

Diagnostic characters : Small species; thorax azure blue marbled with black, which colour forms an intricate pattern of heiroglyphics on dorsum and sides; wings hyaline, antenodals 7 in forewings, 6 in hindwings; Abdomen azure blue, marked with black, segments 8-10 entirely nlack, dorso-ventrally swollen first three to four segments; Anal appendages acute at apex and spined beneath; the inferiors very broadly triangular. Female is almost identical to the males.

Genus ***Brachythemis*** Brauer

1868. *Brachythemis* Brauer, *Verh. zool-bot. Ges. Wien.*, **18** : 367.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 363.

Diagnostic characters : Dragonflies with small to medium sized abdomen (18-23 mm) and hindwing (20-26 mm), colour ochreous to red; vesicle high, notched at apex, prothorax with small and naked posterior lobe; thorax robust; wings short, rather rounded at apex in males wings are partly coloured golden yellow; in female wings are hyaline, sometimes hindwings very palely tinted with yellow at the extreme base; sectors of arc are very shortly fused in origin; $6^1/_2$ to $7^1/_2$ antenodals in forewings, Cu_2 arising either at or slightly distal to the posterior angle of the discoidal cell in hindwing; 1 cubital nervure in all wings; 1 or 2 rows of cells between IR_3 and *Rspl.*

Type-species : *Libellula contaminata* Fabricius.

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Manipur, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

Elsewhere : Algeria, Angola, Bangladesh, Botswana, Burma, Benin, China, Cote d' ivorie, Egypt, Ethiopea, Equatorial Guinea, Guinea, Hungary, Indonesia, Iran, Iraq, Israel, Italy, Japan, Laos, Madagascar, Malawi, Mali, Malayasia,

Morocco, Mozambique, Namibia, Nepal, Niger, Philippines, Portugal, Senegal, Singapore, Somalia, South Africa, Saudi Arabia, Sri Lanka, Sudan, Syria, Tanzania, Thailand, Tunisia, Togo, Taiwan, Zaire, Zambia, Zimbabwe.

Brachythemis contaminata (Fabricius)

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

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

Material examined : Ram & Prasad (1999) reported on the basis of Bhargava's (1989) record of 1M, 11.ix.1984, Tipi, West Kameng.

Distribution : India : Present record : Arunachal Pradesh (Kameng). Past records : Arunachal Pradesh (Ram & Prasad 1999); Assam, Saidya (Laidlaw 1914); Gauhati (Fraser 1921a); Calcutta (Dasgupta 1957); Barkuda Island (Fraser & dover 1922); Uttar Pradesh (Ram *et. al.* 1982); Agra, Gwalior (Baijal & Agarwal 1955); Doon valley (Singh & Prasad 1976); Garhwal Hills (Prasad 1974); Kangra (Prasad 1974); Poona, Khandala (Fraser 1924b); Cochin, Coorg, Deccan, Kanara, Malabar, Nilgiris (Fraser 1931); Tamil Nadu (Kumar 1990).

Elsewhere : Bangladesh, Chittagong (Chowdhury & Akhteruzzaman 1981), Bhamo, Mandalaya, Toungoo (Selys 1891); Indo-China, Malaya Peninsula (Fraser 1919e); Nepal (Kiauta 1975; St. Quentin 1970); China, Ceylon, Philippines, Taiwan (Lieftinck 1971); Hongkong, Japan, Laos, Malayasia, Singapore, Thailand, Vietnam (Tsuda 1991).

Genus ***Crocothemis*** Brauer

1868. *Crocothemis* Brauer, *Verh. zool.-bot. Ges. Wien.*, **18** : 367.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 343.

Diagnostic charecters : Medium to large (Abdomen 23-35 mm; hindwing 26-38 mm) dragonflies; with homogenous appearance, usually with a red colour body of adult males, yellow or straw colour body of female and subadults. Wings hyaline, bases ar coloured for a short distance, eyes shortly contiguous, frons with a deep sulcus; prothorax with small posterior lobe, non-emerginate and without hairs. Thorax robust bearing the wings with apices pointed, antenodals in forewing $7^1/_2$ to $14^1/_2$ cubital nervure in all wings; Cu_1 arising from the posterior angle of the discoidal cell in the hindwing; subtrigone in forewing 3-celled; 1 or 2 row of cells between IR_3 and *Rspl.* Abdomen broad at base and gradually tapered towards the end; triquetral in section.

Type-species : *Libellula servilia* Drury.

Distribution : India : Arunachal Pradesh, Andhra Pradesh, Assam, Bihar, Gujarat, Himachal Pradesh, Karnataka, Kerala, Kashmir, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : Afghanistan, Algeria, Angola, Australia, Austria, Bangladesh, Benin, Belgium, Botswana, Burgaria, Burkina Faso, Burma, Cape Verde, Central Africa Republic, Czechoslovakia, China, Cote d' ivorie, Cyprus, Cameroon, Ethiopea, France, Gabon, Germany, Great Britain, Greece, Guinea, Hongkong, Hungary, Indonesia, Iraq, Iran, Italy, Japan, Jordan, Kenya, Korea, Laos, Lesotho, Liberia, Luxembourg, Madagascar, Morocco, Malawi, Mozambique, Namibia, Nepal, Netherlands, Niger, Nigeria, Oman, Papua New Guinea, Philippines, Portugal, Rhodesia, Russia (Soviet), Swaziland, Switzerland, Solomon Island, Saudi Arabia, Senegal, Sierra Leone, Singapore, South Africa, Sudan, Taiwan, Tanzania, Thailand, Togo, Tunisia, USA, Yugoslavia, Zaire, Zimbabwe.

Crocothemis servilia servilia (Drury)

Libellula servilia, Drury, *Ill. Exot Ins.*, **1** 112-113

Material examined : 1M, 23.iii.1973, Bhalukpong, coll. S. K. Tandon; 1F, 4.v.1966, Kameng, coll. A. N. T. Joseph; 4F, 26.x.1966, 1F, 27.x.1966, 2M, 28.x.1966, Daporijo, coll. S. K. Tandon & G. S. Arora.; 1M, 25.xi.1966, Tirap, G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Bhalukpong, Daporizo, Kameng, Siang, Subansiri, Tirap). Past records : Arunachal Pradesh, Assam, Manipur, Mizoram, (Lahiri 1979); Shillong (Pinhey 1979a); Pusha,

Singhbhum (Bhasin 1953); Barkuda Island (Fraser & Dover 1922); Bengal (Selys 1981); Kohima (Lahiri *et al.* 1970); Uttar Pradesh (Kumar 1982; Ram *et al.* 1983); Garhwal Hills (Prasad 1974); Kangra (Prasad 1976); Chandanpur, Dehra Dun, Gonda, Gorakhpur, Mothronwala, Ramgarh, Saharanpur (Bhasin 1953); Doon Valley (Singh & Prasad 1976b); Bombay, Khandala, Poona (Fraser 1924b); Gwalior, Saugor (Baijal & Agarwal 1955); Chhindwara (Mitra 1988); Coorg, Deccan, Kanara, Malabar, Nilgiris (Fraser 1931); Silent Valley (Rao & Lahiri 1983).

Elsewhere : Burma (Fraser 1919d); Bhamo, Shesagoo, Sumatra, Toungoo (Selys 1891), Basara (Fraser 1919d); Rockhampton (Brauer 1869), China (Needham 1930), Malayasia (Brooks 1981), Formosa (Needham 1930); Nepal (Kiauta & Kiauta 1982a; St. Quentin 1970); Singapore (Kiauta & Kiauta 1982b); Thailand (Kiauta & Kiauta 1983b); Yunnan (Moore 1878); Philippines (Kiauta & Kiauta 1983a); Korea, Laos, Singapore, Thailand, Taiwan, (Tsuda 1991); Florida (Paulson 1978a, b); Suez (Fraser 1919c); Turkey (Schneider 1985a).

Genus ***Diplacodes*** Kirby

1889. *Diplacodes* Kirby, *Trans. zool. Soc. Lond.*, **12** : 263.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 331.

Diagnostic characters : Small to medium size (Abdomen 14-25 mm, hindwing 17-29 mm); greenish yellow with black markings in subadults or black with or without pruinescence in adults; wings hyaline or partly enfumed or marked with black. Eyes contiguous for a short distance, frons with deep sulcus and without sharply defined crest. Prothorax with a large posterior lobe, fringed with long hairs. Thorax narrow, wings are relatively short but broad; reticulation close, discoidal cell in forewing entire or traversed; discoidal cell of hindwing entire; sectors of arc shortly fused in forewing but with a long fusion in the hindwing; arc situated between the first and the second antenodal nervures. $6^1/_2$ to $9^1/_2$ antenodals in the forewings, 1 cubital nervure in all wings; Cu_2 in the hindwings widely separated from the posterior angle of the discoidal, 1 row of cells between IR_3 and *Rspl* abdomen slightly dilated at base, then slim and triquetral to the end, cylinderical in female.

Type-species : *Diplacodes lefebvrei* (Rambur).

Distribution : India : Arunachal Pradesh, Andhra Pradesh, Andaman Is., Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Orissa, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : Afghanistan, Algeria, Australia, Bangladesh, Botswana, Burkina Faso, Burma (Myanmar), Cameroon, China, Cote d' ivorie, Egypt, Fiji, Guinea, Guinea-Bissau, Indonesia, Italy, Iraq, Japan, Kampuchea, Kenya, Laos, Liberia, Libya, Madagascar, Malawi, Mali, Mariana Island, Mauritius, Malayasia, Morocco, Mozambique, Namibia, Nepal, New Guinea, New Caledonia, New Zealand, Niger, Papua New Guinea, Portugal, Palau, Qarter, Reunion, Samoa, South Africa, Senegal, Somalia, Saudi Arabia, Seychelles, Spain, Sudan, Swaziland, Sri Lanka (Ceylon), Syria, Thailand, Togo, tunisia, Turkey, Tanzania, Vanuatu, Zambia, Zimbabwe.

Diplacodes trivialis (Rambur)

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

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

Material examined : 1F, 24.iii.1973, Chandan Forest, coll. S. Biswas; 1F, 16.iii.1969, Namsai, coll. S. K. Tandon; 1F, 3.v.1966, tipi, West Kameng, coll. A. N. T. Joseph; 1F, 6.x.1966, Lekhabali, Siang, coll. S. K. Tandon & G. S. Arora, 1M, Pedding vill., 11.x.1966, coll. S. K. Tandon & G. S. Arora; 1M, Kimin, 4.xi.1981, coll. S. K. Gupta.

Distribution : India : Present record : Arunachal Pradesh (Chandan Forest, Namsai, Tipi, Kameng, Lekhabali, Siang, Pedding vill., Kimin). Past records : Arunachal Pradesh (Mitra 1994); Chilka Lake (Laidlaw 1915); Assam, Manipur, Mizoram (Lahiri 1979); Tripura (Lahiri 1977a); Calcutta, Puri (Dasgupta 1957); Barkuda Is. (Fraser & Dover 1922); Meghalaya (Lahiri 1987); Uttar Pradesh (Ram *et. al.* 1983); Kangra (Prasad 1976); Doon Velley (Singh & Prasad 1976); Bhandara, Raipur (Bhasin 1953); Chhindwara, Seoni (Mitra 1988); Mahabaleswar (Fraser 1921b); Madras (Dasgupta 1957); Annaimalai,

Bolovumpattis, Cochin, Coorg, Deccan, Kanara, Malabar, Nilgiris (Fraser 1931); Silent Valley (Rao & Lahiri 1983); Andaman Is. (Fraser 1924a).

Elsewhere : Myanmar (Laidlaw 1914), Bhamo, Japan, Mandalaya, Malay (Selys 1891); Tenasserim (Lieftinck 1948); Chittagong (Chowdhury & Akhteruzzaman 1981); Ceylon, Rochampton (Brauer 1869); China, Formosa (Needham 1930); Philippines (Asahina 1968, Kiauta & Kiauta 1983a); Nepal (Asahina 1955; Kiauta 1975; St. Quentin 1970); Taiwan (Lieftinck *et. al.* 1984); Micronesia (Lieftinck 1962); Australia (Tsuda 1991).

Diagnostic character : As per genus.

Genus ***Indothemis*** Ris

1909. *Indothemis* Ris, *Cat. Coll. Selys, Fasc.*, **9** : 29.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 338.

Diagnostic characters : Moderate size (Abdomen 22-26 mm, hindwing 27-32 mm) colour blackish in adult and black marked with yellow in subadults. Eyes broadly contiguous, frons with well defined crest and sulcus. Prothorax with a small posterior lobe, thorax robust. Wings hyaline, may be with a mark at the extreme base, discoidal cell in forewing entire, traversed, that of hindwing entire, with the base at the level of the arc; sectors of arc with a long fusion arc situated between the first antenodal and the second antenodal nervures, 1 cubital nervure in all wings, $8^1/_2$ to $12^1/_2$ antenodals in forewing, Cu_2 in hindwing arising from or separated from the posterior angle of the discoidal cell; discoidal field diverging at the wing border; subtrigone single celled; 1 row of cell between IR_3 and *Rspl.* Abdomen slim amd cylinderical, but slightly broader at base and tapered very gradualy to the end.

Type-species : *Libellula carnatica* Fabricius (=*Libellula caesia* Rambur).

Dsitribution : India : Arunachal Pradesh, Assam, Karnataka, Maharashtra, Mizoram, Orissa, Tamil Nadu, West Bengal.

Elsewhere : Burma (Myanmar), Malayasia, Singapore, Sri Lanka (Ceylon), Thailand.

Indothemis limbata limbata (Selys)

1891. *Trithemis limbata* Selys, *Ann. Mus. Civ. Genova.* (2) 10(30) : 463.

1936. *Indothemis limbata limbata*, Fraser, *Fauna Brit India. Odon.*, **3** : 341-342.

Material examined : 1M, 5.v.1966, Denling, East Kameng, coll. A.N.T. Joseph.

Distribution : India : Present record : Arunachal Pradesh (Siang). Past records : Assam, Mizoram, Orissa, West Bengal, Coorg (Fraser 1924b).

Elsewhere : Burma (Myanmar), Malacca, Siam (Fraser 1936); Malayasia, Singapore (Tsuda 1991).

Diagnostic characters : Apices of wings finely bordered with blackish-brown $11^1/_2$ to $12^1/_2$ antenodals in forewing, base of hindwing with broad blackish-brown opaque triangular marking. Vesicle of head purplish steely reflex, prothorax, thorax and abdomen uniformly dark black, anal appendages black.

Genus ***Neurothemis*** Brauer

1867. *Neurothemis* Brauer, *Verh. zool.-bot. Ges Wien*, **17** : 6.

1936. Fraser, *Fauna Brit. India, Odon.*, **5** : 350.

Diagnostic characters : Small to medium size (Abdomen 16-26mm, hindwing 20-32 mm). Head moderately large, eyes rather, shortly contiguous, frons rounded; prothorax with small posterior lobe, arched and slightly emerginate with a few hairs; thorax robust, wings hyaline or partly or wholly coloured; often very close reticulation; secondary reticulation often present in coloured area, antenodals in forewing $11^1/_2$ or more; forewing with more than 1 cubital nervure; in hindwing 1 or more. 1 row of cells between IR_1 and *Rspl.* Abdomen short, slightly dilated dorso-ventrally at base and then slim and tapered very gradually to the end; rather compressed and sub-cylinderical in female.

Type-species : *Libellula fulvia* Drury.

Distribution : India : Arunachal Pradesh, Andhra Pradesh, Assam, Bihar, Himachal Pradesh,

Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Manipur, Mizoram, Nicobar Island, Orissa, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : Austrtalia, Bangladesh, Burma (Myanmar), China, Hongkong, Indonesia, Japan, Kampuchea, Laos, Malayasia, Nepal, Papua New Guinea, Russia (Soviet), Singapore, Solomon Is., Sri Lanka, Taiwan, Thailand, Vanuatu.

Key to species of genus *Neurothemis* Brauer

1. Antenodals in forewing not less than 30; wings opaque reddish brown, except for an irregular triangular area at apices of wings which is clear and uncoloured, labium creamy yellow, labrum bright ochreous; face, frons, vesicle reddish brown prothorax, thorax, abdomen uniform reddish-brown, many forms of females from isochrome to heterochrome are available. In female wings clear amber yellow with a dark ray in the sub-costal space which extends on costal space ..... *fulvia* (Drury)

– Antenodals in forewing less than 30 2

2. Small species, abdomen not more than 20 mm, labium blackish brown, labrum, face frons, vesicle and occiput black; prothorax, thorax and abdomen are black in males, In females labium creamy white; labrum, face, frons pale olivaceous or greenish yellow; occiput olivaceous with bright citron yellow spot behind. Prothorax and thorax greenish yellow. In male wings hyaline at the apical half and the basal half opaque steely blue black, which extends in both wings from costal border to near the posterior end in a curve. A glistening white band bordering the opaque band. In andromorphic female the black portion is dark brown without opalescent white spot. in heteromorphic female the colour from base of wing to node blackish-brown .... *tullia tullia* (Drury)

– Larger specimen with abdomen never less than 21.0 mm; yellowish colour prevalent in the body; dorsum of thorax ferruginous with well defined reddish brown humeral stripe; yellow in base of wings not sharply defined and pale in colour ..... *intermedia intermedia* (Rambur)

Neurothemis fulvia (Drury)

1773. *Libellula fulvia* Drury, *Ill, Exot. Ins.*, **2** : 84.

1936. *Neurothemis fulvia*, Fraser, *Fauna Brit. India, Odon.*, **3** : 353-354.

Material examined : 1F, 28.x.1966, Daporijo, Subansiri, coll. S. K. Tandon & G. S. Arora; 1F, 11.ix.1971, Deomali Forest, Tirap, coll. G. S. Arora; 1F. 10.i.1981, Gara, Siang, coll. S. K. Gupta.

Distribution : India : Present record : Arunahcla Pradesh (Siang, Subansiri, Tirap). Past records : Arunachal Pradesh, Assam, Manipur, Mizoram, Orissa, Tripura and West Bengal (Mitra 1999), Dejoo, North Lakhimpur, Dibrugarh, N. E. Assam (Laidlaw1914), Assam, Manipur (Lahiri 1979); Sibsagar, Buxa, Singhbhum (Bhasin 1953); Meghalaya (Lahiri 1987); Saugor (Baijal & Agarwal 1955); Annaimalai, Cochin, Deccan, Kanara, Malabar, Nilgiris, Travancore (Fraser 1931); Silent Valley (Rao & Lahiri 1983); Calicut (Selys 1891); Bombay, Poona (Bhasin 1953); Doon Valley (Singh & Prasad 1976).

Elsewhere : Bangladesh (Sylhet), Myanmar, Bhamo, Palon, Teinzo (Selys 1891), China (Klots 1947, Needham 1930); Malayasia (Brooks 1981; Lieftinck 1954); Nepal (Ashaina 1955; Kiauta 1975; St. Quentin 1970); Taiwan (Lieftinck *et. al.* 1984).

Neurothemis intermedia intermedia (Rambur)

1842. *Libellula intermedia* Rambur, *Ins. Nevrop.*, : 91.

1936. *Neurothemis intermedia intermedia*, Fraser, *Fauna Brit. India, Odon.*, **3** : 357-358.

Material examined : 3F, 13.iii.1969, Lohitpur, coll. S. K. Tandon; 1M, 1F, 11.xi.1971, Deomali forest, Tirap, coll. G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Lohit and Tirap). Past records : Arunachal Pradesh, Assam (Lahiri 1979); Meghalaya (Lahiri 1987); Sikkim (Lieftinck 1948); Singhbhum, Buxa (Bhasin 1953); Chandanpur, Gorakhpur, Surpur (Bhasin 1953), Doon Valley (Singh & Prasad 1976b); Kangra (Prasad 1976); Bombay, Deccan, Kanara, Malabar, Nilgiris (Fraser 1931); Silent Valley (Rao & Lahiri 1983); Chhindwara (Mitra 1988); Bihar, Manipur, Orissa, Tripura, West Bengal (Mitra in press).

Elsewhere : Myanmar, Ceylon (Fraser 1919d, Lieftinck 1971), Nepal, (Kiauta 1975, St. Quentin 1970); Bangladesh, China, Thailand (Tsuda 1991).

Neurothemis tullia tullia (Drury)

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

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

Material examined : 1M, 27.x.1971, Tirap coll. G. S. Arora; 1M, 11.xii.1969, Daphabhum Expedition, Glo-village, coll. M. Julka; 1M, 1.xii.1983, Miao, coll. S. Biswas.

Distribution : India : Present record : Arunachal Pradesh (Tirap). Past records : Arunachal Pradesh, Assam, Orissa, Tripura, West Bengal (Mitra 1994); North Lakhimpur (Laidlaw 1914); Bengal (Selys 1891); Barkuda Island (Fraser & Dover 1922); Tripura (Lahiri 1977a); Assam (Lahiri 1979); Pusa (Bhasin 1953); Meghalaya (Lahiri 1987); Uttar Pradesh (Ram *et. al.* 1983); Bharatpur (Baijal & Agarwal); Doon Valley (Singh & Prasad 1976); Kangra (Prasad 1972); Bangalore, Madras, Nilgiris (Fraser 1919d); Coorg, Coimbatore, Kallar, Nilgiris, Wynaad (Fraser 1924b); Silent Valley (Rao & Lahiri 1983); Tamil Nadu (Kumar 1990); Bhandara (Bhasin 1953).

Elsewhere : Myanmar, Teinzo, Sylhet, Tibet, China (Selys 1891); Haiwan (Needham 1930, Selys 1891); Indo-China (Lieftinck 1948); Thailand (Lieftinck 1971); China (Rowe 1981); Taiwan (Lieftinck *et. al.* 1984); Hongkong; Sri Lanka, Malayasia (Tsuda 1991).

Genus ***Sympetrum*** Newman

1853. *Sympetrum* Newman, *Ent. Mag.*, **1** : 511.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 370.

Diagnostic characters : Small to medium size (abdomen 18-35 mm; hindwing 20-40 mm), coloured yellow or ferrugenous with marks or different colours, black or brown; posterior lobe of prothorax large emerginate as a collar and provided with hairs; thorax strong, wings hyaline, sometimes marked with yellow, brown or black; usually $6^1/_2$ to $11^1/_2$ antenodals in forewings and 5-6 in hindwings and 6-11 postnodals. Pterostigma about 4-5 times longer than breadth; discoidal cell appears like bilateral triangles traversed; arc situated between the 1st and the 2nd antenodals; only 1 cubital nervure in all wings, rarely 2 in the hindwing; Cu_2 and MA strongly converging in the wing margin; sectors of arc arise from a common stalk. Abdomen slim or narrowly fusiform towards the anal end, cylinderical and triquetral insection.

Type-species : *Libellula vulagta* Linn.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Gujarat, Kashmir, Kerala, Manipur, Meghalaya, Mizoram, Rajasthan, Sikkim, Tamil Nadu, West Bengal.

Elsewhere : Afghanistan, Alaska, Algeria, Australia, Bangladesh, Belgium, Belize, Bolivia, Botswana, Burgaria, Burma (Myanmar), Canada, Czechoslovakia, Chile, China, Cote d' ivorie, Congo, Costa Rica, Cyprus, Denmark, Egypt, El Salvador, Finland, France, Gambia, Germany, Great Britain, Greece, Guatemala, Guyana, Haiti, Hondurus, Hungary, Iran, Iraq, Ireland, Italy, Japan, Korea, Lesotho, Libya, Lichtenstein, Luxumbourg, Madagascar, Malawi, Mexico, Morocco, Mozambique, Namibia, Nepal, Netherlands, Norway, Pakistan, Poland, Portugal, Romania, Russia (Soviet), Saint Helena, Saudi Arabia, Somalia, Spain, Sudan, South Africa, Syria, Sweden, Taiwan, Tanzania, Tunisia, Turkey, USA, Venezuela, Yugoslavia, Zambia, Zimbabwe.

Key to species of genus *Sympetrum* Newman

1. $6^1/_2$ to $7^1/_2$ antenodals in forewing; thorax dark olivaceous on dorsum; suffused with ferrugenous, laterally bright citron yellow in subadults, changing to dull oilvaceous in upper part in full adult stage; humeral and posterolateral suture narowly black; wings hyaline, with extreme bases tinted with amber yellow deepest in subcostal and cubital spaces. Abdomen red above and black beneath; in female the colours are paler than male; the abdomen ocherous with darker sutures .... ***commixtum*** (Selys)

– $8^1/_2$ to $10^1/_2$ antenodals in forewings 2

2. Thorax golden brown on dorsum with broad black humeral stripe which is bordered with

warm-redish brown; laterally two broad bright citron yellow stripes, separated by a broad black stripe on posterolateral suture. Wings tinted with amber-yellow at the extreme base like the former species. Abdomen bright reddish ochreous above black beneath. Females resembles males, only differing in markings of the abdomen where is an additional subdorsal black stripe extending from base of segment 2 to 7 confluent with the black underside .... *hypomelas* (Selys)

– Thorax ferrugenous, brighter red on dorsum and with humeral and lateral narrow black stripes or lines, Wings palely enfumed and with a bright amber yellow, marking at base; the extent of which is variable. Abdomen scarlet-red on dorsum, black beneath females resembles males, greenish antehumeral stripe, humeral stripe bordered dark reddish brown, abdomen with black interrupted subdorsal stripes on segments 2 to 9 .... *orientale* (Selys)

Sympetrum commixtum (Selys)

1884. *Diplax commixta* Selys, *Ann. Soc. Ent. Belg.*, **28** : 38.

1936. *Sympetrum commixtum*, Fraser, *Fauna Brit. India, Odon.*, **3** : 372-373.

Material examined : 2MM, 19.xi..1965, near Tenga River, West Kameng, coll. S.K. Bhattacharya & A.N.T. Joseph; 1F, 20.xii.1965, Rupa, Kameng, coll. S.K. Bhattacharya & a. N.T. Joseph; 1M, 28.x.1981, Hapoli, Ziro, Subansiri, coll. S.K. Gupta and M. Prasad.

Distribution : India : Present record : Arunachal Pradesh (Kameng, subansiri). Past records : Arunachal Pradesh, Gujarat (Ram & Prasad 1999); Deesa, Yusimarg, Kashmir (Fraser 1936).

Elsewhere : Pakistan (N. W. India) (Fraser 1936); Nepal (Tsuda 1991).

Sympetrum hypomelas (Selys)

1884. *Diplax hypomelas* Selys, *Ann. Soc. Ent. Belg.*, **28** : 37.

1936. *Sympetrum hypomelas*, Fraser, *Fauna Brit. India, Odon.*, **3** : 373-374.

Material examined : 1M, 20.x.1084, Seasa, West Kameng, coll. R.N. Bhargava.

Distribution : India : Present record : Arunachal Pradesh (Kameng). Past records : Arunachal Pradesh (Lahiri 1979, Ram & Prasad 1999); Assam, Bengal, Khasi Hills, Sikkim (Fraser 1919d); Bihar, Manipur Mizoram (Mitra 1994).

Elsewhere : Bhutan (Fraser 1935); Burma, Copabo, Puepoli (Selys 1891); Nepal (St. Quentin 1970); Tibet (Fraser 1919d); China (Needham 1930); Bangladesh (Tsuda 1991).

Sympetrum orientale (Selys)

1883. *Diplax orientale* Selys, *Ann. Soc. Ent. Belg.*, **27** : 140.

1936. *Sympetrum orientale*, Fraser, *Fauna Brit. India, Odon.*, **3** : 375.

Material examined : 1M, 1F, 20.x.1981, Way to Kiang, Siang, coll.; 1M, 1F, 19.xii.1983, Namdhapa, coll. S. K. Biswas.

Distribution : India : Present record : Arunachal Pradesh (Siang). Past records : Sadiya, N. E. India, Assam (Laidlaw 1914); Bengal, Khasi Hills (Fraser 1919c).

Elsewhere : China, Nepal (Tsuda 1991).

Genus ***Trithemis*** Brauer

1868. *Trithemis* Brauer, *Verh. zool. -bot. Ges. Wien.*, **18** : 176.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 331.

Diagnostic characters : Small to medium size (Abdomen 19-32 mm; hindwing 24-36 mm), coloured black, reddish or olivaceous brown to dark brown. Eyes moderately contiguous, frons with or without distinct crest; rounded in female, vesticle broad, depressed. Prothorax with small posterior lobe, thorax rather narrow, legs variable, moderately long and robust, except *T pallidinervis* Kirby in which legs are long and slim. Wings are long, reticulation usually close (in *T pallidinervis* it is colse); discoidal cell in forewing traversed and that of hindwing entire; subtrigone in forewing three celled; sectors of arc with a long fusion at origin; arc situated

between the first and the second antenodal nervures, $8^1/_2$ - $15^1/_2$ antenodals in forewing, 1 cubital nervure in all wings; Cu_2 arising from the posterior angle of the discoidal cell in hindwing; discoidal field converges strongly in the wing margin; 2 rows of cells between IR_3 and Rspl; pterostigma short; abdomen and genitalia variable in species.

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Algeria, Angola, Bangladesh, Benin, Botswana, Burkina Faso, Burma (Myanmar). Cameroon, China, Congo, Cape verde, Cote d' ivorie, Egypt, Ethiopea, Gabon, Greece, Guinea, Hongkong, Indonesia, Iraq, Iran, Israel, Italy, Japan, Kampuchea, Kenya, Laos, Liberia, Libya, Malawi, Malayasia, Mauritius, Mali, Morocco, Mozambique, Namibia, Nepal, Niger, Oman, Papua New Guinea, Philippines, Pakistan, Portugal, Qatar, Reunion, Saudi Arabia, Senegal, Sierra Leone, Somalia, South AFrica, Spain, Sri Lanka, Sudan, Syria, Swaziland, Tanzania, Taiwan, Trinidad, Turkey, United Arab Emirates, Vietnam, Zambia, Zimbabwe.

Key to species of the genus *Trithemis* Brauer

1. Labium blackish brown or pale brown; labrum dark olivaceous brown or dirty yellow, front of frons dark brown; thorax and abdomen violaceous-black or olivaceous or bright yellow; bases of hindwing with a small dark brown spot; neuration black; prothorax blue, thorax coated with purplish pruinescence; abdomen with segment 1-3 with a bluish pruinescence; in female a narrow black stripe, expands slightly at apical ends of segments and at jugal suture. Anal appendages black .... *festiva* (Rambur)

2. Labium dark ochreous with lobes blackish, labrum dark brown, face, front of frons ochreous; thorax and abdomen violaceous crimson, base of hindwing with small reddish brown spot; neuration crimson, in male, in female bright yellow to brown; prothorax reddish brown; anterior half of middle lobe and base of posterior lobe black, abdominal segment 10 marked with black at base .... *aurora* (Burm.)

3. Labium pale yellow, front of frons yellow or pale brown; upper surface of frons and vesicle with metallic lusture. Prothorax dark brown or black, a large yellow lateral and middle spot on middle lobe. Thorax olivaceous brown on dorsum and upper part of sides. Wings hyaline, reticulation reddish, pterostigma bicolourous, bright amber yellow basal marking of the wing; basal segments of abdomen slightly tumid, anal appendages yellow ..... *pallidinervis* (Kirby)

Trithemis aurora **(Burmeister)**

1839. *Libellula aurora* Burmeister. *Handb. Ent.*, **2** 859

1936. *Trithemis aurora*. Fraser. *Fauna Brit India. Odon.* **3** : 383-385.

Material examined : 2MM, 4.v.1966, Kameng, coll. A. N. T. Joseph; 1M, 2.x.1966, 1M, 7.x.1966, Siang coll. S. K. Tandon and G. S. Arora; 2FF, 22.x.1966, Siang, coll. S. K. Tandon and G. S. Arora; 1M, 8.x.1966, Siang, coll. S. K. Tandon and G. S. Arora; 1M, 25.x.1971, 1M, 28.x.1971, Tirap, coll. P. T. Cherian and G. S. Arora; 2MM, 1F, (.xi.1971, 3MM, 10.xi.1971, 1M, 11.xi.1971, coll. G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Kameng, Siang, Tirap). Past records : Arunachal Pradesh (Lahiri 1979, Ram & Prasad 1999); Darjeeling (St. Quentin 1936); Dejoo, North Lakhimpur, Saidya, N. E. Assam (Laidlaw 1914); Buxa, Singhbhum (Bhasin 1953), Calcutta, Howrah, 24 Parganas district of West Bengal (Ram *et al.* 1982); Meghalaya (Lahiri 1987); Uttar Pradesh (Ram *et al.* 1983); Rajasthan (Bose & Mitra 1976); Dehra Dun, Nalapani (Bhasin 1953); Garhwal (Prasad 1974); Kangra (Prasad 1976); Balaghat, Bhandara (Bhasin 1953); Betul, Chhindwara (Mitra 1988); Bombay (Fraser 1919e); Annaimali, Bolovumpattis, Cochin, Coorg, Deccan, Kanara, Malabar, Nilgiris (Fraser 1931); Madras (Fraser 1919f); Silent Valley (Rao & Lahiri 1983); Andaman Is. (Chhotani *et. al.* 1983).

Elsewhere : Bhamo, Teinzo (Selys 1891); Ceylon (Lieftinck 1971); China, Formosa (Needham 1930); Nepal (St. Quentin 1970); Malayasia (Brooks 1981); Pakistan (Karachi) (Fraser 1919f); Philippines (Kiauta & Kiauta 1983a); Timor, Celebes (Lieftinck 1971); Thailand (Titayavan 1979); Singapore (Kiauta & Kiauta 1982b); Taiwan (Lieftinck *et. al.* 1984); Hongkong, Indonesia, Japan, Kampuchea, Laos, Singapore, Vietnam (Tsuda 1991).

Trithemis festiva (Rambur)

1842. *Libellula festiva* Rambur, *Ins. Nevrop.*, : 92.

1936. *Trithemis festiva*, Fraser, *Fauna Brit. India, Odon.*, **3** : 387-389.

Material examined : 1M, 24.iii.1973, Chandan Forest, coll. S. Biswas; 2MM, 8.x.1966, 1M, 14.x.1966, Siang, coll. S. K. Tandon & G. S. Arora; 1M, 9.v.1966, Subansiri, coll. A. N. T. Joseph.

Distribution : India : Present record : Arunachal Pradesh (Chandan Forest, Siang, Subansiri). Past records : Arunachal Pradesh (Lahiri 1979; Ram & Prasad 1999); Dejoo, North Lakhimpur, Upper Assam (Laidlaw 1914); Manipur, Mizoram (Lahiri 1979), Meghalaya (Lahiri 1987); Almora, Bishanpur, Dehra Dun, Mothronwala, Nalapani, Saharanpur (Bhasin 1953); Rajasthan (Prasad & Thakur 1981); Garhwal Hills (Prasad 1974); Kangra (Prasad 1976); Anaimali, Bolovumpattis, Cochin, Coorg, Deccan, Kanara, Malabar, Nilgiris, Palnis, Travancore (Fraser 1931); Tamil Nadu (Kumar 1990).

Elsewhere : Myanmar (Laidlaw 1914); Borneo, Ceylon, Formosa, Indo-China (Fraser 1919f); Malayasia (Lieftinck 1954); Nepal (Asahina 1955, St. Quentin 1970); Philippines, Sumatra (Selys 1891); Afghanistan, Hongkong, Iraq, Kampuchea, Laos, Singapore, Thailand, Vietnam (Tsuda 1991); Taiwan (Lieftinck *et al.* 1984); New Guinea (Lieftinck 1971).

Trithemis pallidinervis (Kirby)

1889. *Sympetrum pallidinervis* Kirby, *Trans. Zool. Soc. Lond.*, **12** : 327.

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

Material examined : 1M, 1F, 15.x.1981, Seji, Siang, coll. S. K. Gupta and M. Prasad.

Distribution : India : Present record : Arunachal Pradesh (Siang). Past records : Arunachal Pradesh (Ram & Prasad 1999); Dibrugarh, N. E. Assam (Laidlaw 1914); Barkuda Island (Fraser & Dover 1922); Calcutta (Dasgupta 1957, Mitra 1983); Nagaland, Pusa, Allahabad, Dehra Dun, Lachiwala, Mussorie (Bhasin 1953); Puri (Dasgupta 1957); Meghalaya (Lahiri 1987); Garhwal Hills (Prasad 1974); Kangra (Prasad 1976); Rajasthan (Prasad & Thakur 1981); Khandala, Nilgiris, Palni (Fraser 1924b); Madras, Bombay, Deesa, Poona (Fraser 1919f).

Elsewhere : Bhamo, Myanmar, Mandalaya, Palon, Toungoo (Selys 1891); Tenasserim (Lieftinck 1948); Ceylon, Tibet (Fraser 1919f); China, Formosa (Needham 1930); Nepal (St. Quentin 1970); Taiwan (Lieftinck 1971); Philippines (Kiauta & Kiauta 1983a, Lieftinck 1971); Indonesia, Malayasia, Singapore, Thailand (Tsuda 1991).

Genus ***Rhyothemis*** Hagen

1867. *Rhyothemis* Hagen, *Stett. Ent. Zeit.*, **28** : 232.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 419.

Diagnostic characters : Small to medium size (Abdomen 15-27 mm, hindwing 21-38 mm), black, metallic blue green marked with brown or yellow; vesicle rounded; prothorax with small posterior lobe. Thorax small. Wings variable, broad at base, pointed at apex, reticulation close; broadly marked with black and golden amber or with steely blue-black; discoidal cell in forewings traversed, that of hindwing entire; sectors of arc separated at origin in forewings, shortly fused at the origin in the hindwing; arc situated between the first and second antenodals, sometimes almost at the level of first antenodal; $7^1/_2$ to $10^1/_2$ antenodals, Cu_2 arising from the posterior angle of the discoidal cell in the hindwing; broders of discoidal field converge or parallel at the wing border; subtrigone in forewing absent or many celled; 1 or 2 rows of cells between IR_3 and *Rspl.* Abdomen short, markedly compressed in both sexes.

Type-species : *Libellula phyllis* Sulzer.

Distribution : India : Andhra Preadesh, Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Algeria, Angola, Australia, Bangladesh, Benin, Botswana, Burma (Myanmar), Cameroon, China, Cote d' ivorie, Egypt, Fiji, Gabon, Guam, Guinea, Guinea-Bissau, Hongkong, Indonesia, Japan, Kerala, Liberia, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Nepal, New Caledonia, Oman, Papua New Guinea, Philippines, Reunion, Samoa, Senegal, Sierra Leone, Singapore, Seychelles, Solomon Is., Sri Lanka, Syria, Taiwan, Tanzania, Tunisia, Vietnam, Zaire, Zambia, Zimbabwe.

Rhyothemis variegata variegata (Linnaeus)

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

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

Material examined : 1M, 10.v.1966, Subansiri, A.N.T. Joseph.

Distribution : India : Present record : Arunachal Pradesh (Subansiri). Past records : Arunachal Pradesh (Mitra 1994); Manipur (Mitra 1994); Sibsagar (Bhasin 1953); Barkuda Island (Fraser & dover 1922); Meghalaya (Lahiri 1987); Calcutta (Fraser 1919f); Uttar Pradesh (Ram *et. al.* 1983); Kangra (Prasad 1976); Saugor (Baijal & Agarwal 1955); Cochin, Coorg, Deccan, Malabar, Nilgiris (Fraser 1931); Bangalore, Madras, Bombay (Fraser 1919f).

Elsewhere : Sylhet, Dacca (Bhasin 1953); Chittagonj (Chowdhury & Akhteruzzaman 1981); Annam, Burma, Bhamo, Mandalaya (Fraser 1919f); Teinzo (Selys 1891); Borneo (Lieftinck 1948); Ceylon, Malayasia (Fraser 1936); China (Klots 1947); Nepal (Kiauta 1975; St. Quentin 1970); Yunnan (Moore 1878); Vietnam (Tsuda 1991).

Diagnostic characters : Wings marked with black and amber yellow, different in both sexes, male with wings tinted with yellow, forewings with spots at node, discoidal cell, apex and middle of R_3; hindwing with spots like that of forewings and two broad longitudinal basal bands. Female with broader, shorter wings, forewing hyaline from middle to apex, basal half with broad black markings, hindwing with broad irregular markings to as far as pterostigma; apex hyaline.

Genus ***Tholymis*** Hagen

1867. *Tholymis* Hagen, *Stett. Ent. Zeit.*, **28** : 221.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 410.

Diagnostic characters : Medium to large size (Abdomen 28-35 mm, hindwing 31-39 mm), coloured yellow, reddish and ochereous, with wings partly coloured or opalescent. Eyes broadly contiguous prothorax with a very small posterior lobe, thorax broad; wings moderately long and broad, reticulation close. discoidal cell in forewing traversed, that of hindwing entire, its base very slightly proximal to the level of arc. Sectors of arc with a long fushion in both wings; arc lying between the 1st and 2nd antenodals; 10 to $11^1/_2$ antenodals in forewings, 1 cubital nervure in all wings; Cu_2 arising from the posterior angle of the discoidal cell in hindwing or slightly separated from it. Borders of discoidal field divergent at the wing border. 2 rows of cells between IR_3 and Rspl; subtrigone in forewing 3 or 4 celled; borders of anal loop open at its apex. Abdomen tumid at base and then tapered gradually to the end.

Type-species : *Libellula tillarga* Fabricius.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Laccadives, Madhya Pradesh, Maharashtra, Nagaland, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Angola, Australia, Bangladesh, Botswana, Brazil, Burkina Faso, Burma (Myanmar); Cameroon, Central Africa, Chile, China, Colombia, Costa Rica, Cote d' ivoroe, Cuba, Dominion Republic, Equador, Guatemala, Guinea Bisau, Gyana, Indonesia, Japan, Jamaica, Kampuchea, Kenya, Laos, Liberia, Madagascar, Malawi, Marian Is., Malayasia, Marshall Is.,

Mauritius, Mexico, Mozambique, Micronesia, Namibia, Nepal, Niger, Nigeria, Panama, Palau, Papua New Guinea, Peru, Philippines, Puertorico, Reunion, Samoa, Senegal, Seychelles, Singapore, Somalia, Sri Lanka, Sudan, South Africa, Taiwan, Togo, Trinidad, USA, Venezuella, Vietnam, Zaire, Zambia, Zimbabwe.

Tholymis tillarga (Fabricius)

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

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

Material examined : 2MM, 1F, 7.ii.1973, Lekhabali, siang, coll. R. S. Pillai.

Distribution : India : Present record : Arunachal Pradesh (Siang). Past records : Arunachal Pradesh (Lahiri 1977a); Dejoo, North Lakhimpur, Assam (Laidlaw 1914), Barkuda Is. (Fraser & Dover 1922); Meghalaya (Lahiri 1987); Uttar Pradesh (Ram *et. al.* 1983); Kangra (Prasad 1976); Trichur (Baijal & Agarwal 1955); Bolovumpattis, Cochin, Coorg, Deccan, Kanara, Malabar, Nilgiris (Fraser 1931); Poona (Fraser 1919b); Laccadives (Fraser 1924b).

Elsewhere : Chittagonj (Chowdhury & Akhteruzzaman 1981); Myanmar, Bhamo (Selys 1891); China (Klots 1947); Ceylon, Indo-China, Indo-Malayasia, Thibet (Fraser 1920b); Nepal (Kiauta & Kiauta 1982a); Micronesia (Lieftinck 1962); Japan, Kampuchea, Laos, Vietnam (Tsuda 1991); Garamaba National Park (Pinhey 1966b); Mocambique (Pinhey 1981b); Malawi (Pinhey 1966a; 1979b); Ethiopea (Pinhey 1981a); Tanzania (Pinhey & Pinhey 1984); Cameroon (Pinhey 1974a); Somali (Carfi 1974); Madagascar (Fraser 1956); America (Borror 1945); Australia (Tsuda 1991).

Diagnostic characters : Frons and vesicle ochreous, but often with crimson flush in male, in female head olivaceous, without reddish tinge, prothorax and thorax golden yellow or olivaceous with reddish suffusion. Wings in male hyaline with a broad fan shaped smoky golden brown fascia, extending from node to base in the hindwing, the fascia bordered with broad opalescent white spot; in female opalescent white spot absent. Abdomen bright rust red on dorsum. Anal appendages ochreous or reddish.

Genus ***Aethriamanta*** Kirby

1889. *Aethriamanta* Kirby, *Trans. Zool. Soc. Lond.*, **12** : 262.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 444.

Diagnostic characters : Small (Abdomen 17-20 mm; hindwing 23-26 mm), eyes broadly contiguous, frons rounded without a distinct crest. Prothorax with a small posterior lobe, thorax rather small. Wings short, moderately and comparatively broad, reticulation open, discoidal cells entire, sectors or arc in forewing arise from a common point and separated thereafter; in hindwing sectors are united for a short distance; only 6 antenodals widely spaced; 1 cubital nervure in all wings; Cu_2 arising from the posterior angle of the discoidal cell in hindwing; subtrigone in forewing a single celled; 1 row of cells between IR_3 and *Rspl.* Abdomen short and depressed, broadly fusiform in male, nearly cylinderical in female.

Type-species : *Libellula brevipennis* Rambur.

Distribution : India : Arunachal Pradesh, Assam, Karnataka, Kerala, Orissa, Tamil Nadu, West Bengal.

Elsewhere : Angola, Australia, Bangladesh, Burma (Myanmar), Botswana, Indonesia, Kenya, Liberia, Madagascar, Malawi, Malayasia, Mozambique, New Guinea, Singapore, Solomon Is., Senegal, Sri Lanka, South Africa, Tanzania, Thailand, Uganda, Zaire, Zambia, Zimbabwe.

Aethriamanta brevipennis brevipennis (Rambur)

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

1936. *Aethriamanta brevipennis brevipennis*, Fraser, *Fauna Brit. India, Odon.*

Material examined : 1F, 30.v.1966, Mahagaon, coll. A.N.T. Joseph.

Distribution : India : Present record : Arunachal Pradesh (Mahagaon). Past records : Arunachal Pradesh, Orissa, West Bengal (Mitra 1994); Calcutta (Selys 1891); Bengal, Chilka Lake, Ganjam (Fraser 1920a); Assam (Fraser 1936); Howrah (Dasgupta 1957); Coorg, Malabar, Palghat (Fraser 1924b; 1931).

Elsewhere : Myanmar, Ceylon (Fraser 1920a); Bhamo, Sylhet (Selys 1891); Malayasia (Lieftinck 1954); Thailand (Tsuda 1991).

Diagnostic character : Labium yellow, labrum black, thorax chocolate brown, in male, in female it is golden olivaceous; wings hyaline, tinted with deep golden amber at base, dark opaque rays in cubital, costal and subcostal space. Abdomen red in male; golden olivaceous in female. Anal appendages red in male, black in female.

Genus ***Urothemis*** Brauer

1868. *Urothemis* Brauer, *Verh. Zool.-bot. Ges. Wien.*, **18** : 175.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 441.

Diagnostic characters : Medium size (abdomen 25-31 mm; hindwing 34-38 mm), coloured black or red, ochreous. eyes broadly contiguous, frons rounded at crest and cut into two conical eminence by a very deep sulcus. Prothorax with small posterior lobe, thorax robust. Wings long and moderately broad, reticulation rather open, Sectors of arc separated at origin, arc lies between the 1st and the 2nd antenodal nervure; 7 antenodals in fore- and hindwing; Cu_2 arising from the posterior angle of the discoidal cell in hindwing; 1 cubital nervure in all wings; subtrigone 3 celled; 1 row of cells between IR_3 and *Rspl.* Abdomen slightly dilated dorso-ventrally at base and tapered gradually to end.

Type-species : *Libellula bisignata* Rambur.

Distribution : India : Arunachal Pradesh, Assam, Karnataka, Kerala, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Australia, Algeria, Bangladesh, Botswana, Burkina Faso, China, Cote d' ivorie, Egypt, Ethiopea, Guinea, Indonesia, Israel, Kampuchea, Kenya, Liberia, Madagascar, Malawi, Mali, Mauratiana, Mozambique, Namibia, Niger, Nepal, Oman, Papua New Guinea, Philippines, Senegal, Sierra Leone, Singapore, Somalia, South Africa, Sudan, Sri Lanka, Taiwan, Tanzania, Thailand, Tunisia, Vietnam.

Urothemis signata signata (Rambur)

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

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

Material examined : 1M, 8.x.1966, Sigi, Siang. coll. A.N.T. Joseph.

Distribution : India : Present record : Arunachal Pradesh (Siang). Past records : Arunachal Pradesh (Prasad 1997); Assam, Bengal (Fraser 1920a); Calcutta (Mitra 1983); Barkuda Island (Fraser & Diver 1922); Bhubaneswar (Dasgupta 1957); Meghalaya (Lahiri 1987); Cochin, Coorg, Deccan, Kanara, Malabar (Fraser 1931); Bangalore, Madras, Bombay, Poona (Fraser 1920a); Uttar Pradesh (Ram *et. al.*).

Elsewhere : Myanmar, Indo-China, Malayasia (Fraser 1936); China, Formosa (Needham 1930); Nepal (Kiauta 1974); Ceylon (Fraser 1920a); Thailand (Titayavan 1979); Vietnam 1991).

Diagnostic characters : Labrum ochreous in male, golden yellow in female, prothorax dark reddish brown, thorax red on dorsum in male or golden brown in female. wings hyaline with crimson reticulation, extreme base of forewing golden amber; a broader dark amber coloured spot at base of hindwing. Abdomen blood red in male, usually greenish olivaceous sometimes red on dorsum in female, Anal appendages reddish.

Genus ***Pantala*** Hagen

1861. *Pantala* Hagen, *Syn. Neur. Amer.*, : 141.

1936. Fraser, *Fauna Brit. India, Odon.*, **3** : 413.

Diagnostic characters : Large size robust build (Abdomen 26-36 mm; hindwing 36-39 mm), ochreous or reddish and pale yellow in colour, wings hyaline; eyes contiguous, frons broad and divided into two halves by a large deep sulcus; thorax robust. Abdomen robust, slightly dilated at basal segments. Wings long, broad at base, narrow and almost pointed at apex; discoidal cell in forewings traversed, in hindwing entire; sectors of arc with a long fusion, antenodals in forewings never less than $12^1/_2$; 1 cubital nervure in forewings and 2 in hindwings; discoidal field converging at the wing margin; subtrigone in forewing 3 or 4 celled, anal loop long and its borders are closed. Pterostigma in hindwing is smaller than that of forewings.

Type-species : *Libellula flavescens* Fabricius.

Pantala flavescens (Fabricius)

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

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

Material examined : 1M, 24.x.1966, Siang, coll. S. K. Tandon & G. S. Arora.

Distribution : India : Present record : Arunachal Pradesh (Siang). Past records : Arunachal Pradesh, Assam (Lahiri 1979); Lakhimpur, Upper Dihing, Sibsagar, Dehra Dun (Bhasin 1953); Chilka Lake, Midnapore (Dasgupta 1957), Barkuda Is. (Fraser & Dover 1922); Calcutta (Mitra 1983); Meghalaya (Lahiri 1987); Uttar Pradesh (Kumar 1982); Western Himalaya (Kumar & Prasad 1981; Singh 1955); Garhwal (Prasad 1974); Kashmir (Calvert 1898); Rajasthan (Prasad & Thakur 1981); Andaman Is. (Fraser 1924a); Nicobar Is. (Brauer 1864); Mahabaleswar (Fraser 1921d); Bolovumpattis, Cochin, Coorg.

Elsewhere : Myanmar, Bhamo, Puepoli, Toungoo (Selys 1891); Bangladesh, Chittagong (Chowdhury & Akhteruzzaman 1981); China, Peeking (Rowe 1981); Malayasia (Brooke 1981); Nepal (Asahina 1955; Kiauta 1975; St. Quentin 1970); Yunnan (Moore 1878); Pamir, (Wojtusiak 1974); Singapore (Kiauta & Kiauta 1982b); Ceylon (Lieftinck 1971b); Somali land (Carfi 1874); Mauretiana (Dumont 1976); Mocambique (Pinhey 1981b); Garamna National Park (Pinhey 1966b; 1979b); Zambezi river (Pinhey 1979a); Malawi (Pinhey 1966a); Angola (Pinhey 1961); Ethiopea (Pinhey 1981a); Mt. Mlanje, Karonga, Salim Bay (Pinhey 1979c); Principe, Sao, Tome, Fernando, Po (Pinjey 1974a); Ngamiland (Pinhey 1967); Seychelles (Blackman & PInhey 1967); Madagascar (Fraser 1956); Argentina (Jurizitza 1981); Florida (Beller 1978); Texas (Donnely 1978); Uruguay (De Abenante & Philippi 1982); Venezuella (Garrison 1983); Cuba, Cayo Avalos (Carfi 1975); Afghanistan, Australia, Barmuda, Bolivia, Botswana, Canada, Chile, Cote d'ivorie, Fiji, France, Iran, Iraq, Japan, Kenya, Philippines, Papua New Guinea, New Caledonia, South Africa, Vanuatu, Panama, Soviet Russia, Zaire (Tsuda 1991).

ACKNOWLEDGEMENT

The author is grateful to J.R.B. Alfred, Director, Zoological Survey of India, G.K. Srivastava, Additional Director, Dr. S.K. Mitra, Joint Director both retired of the same department for facilities and encouragements. The author is thankful to M. Prasad, Scientist-C and A. R. Lahiri, Assistant Zoologist for their kind help in identifications and other courtesies, to Prof Dr. B. Kiauta, S.I.O., Holand, Dr. S. Tsuda of Japan and Shri Rati Ram, Publicatin and Production Officer for several courtesies.

REFERENCES

ASAHINA, S. 1955. Dragonflies. In *Flora and Fauna of Himalayas of Nepal*, : 291-300. Ed. E. Khiara.

ASAHINA, S. 1963. Notes on three Indian Dragonfly species. *Akitu*, **11** : 21-22.

ASAHINA, S. 1967. A revision of the Asiatic species of the damselflies of the genus *Ceriagrion* (Odonata : Agrionidae). *Jap. J. Zool.*, **15** : 255-334.

ASAHINA, S. 1968. Records and notes on Philippines Odonata *Jap. J. Zool.*, **15** : 349-376.

BAIJAL, H. N. and J. P. AGARWAL 1955. Opuscula Libellulogica. I. *Agra Univ. J. Res.*, (*Sci.*) **4** : 453-470.

BHARGAVA, R. N. 1989. On a collection of Odonata from West Kameng district, Arunachal Pradesh. *Indian Odonatol*, **2** : 45-46.

BHASIN, G. D. 1953. Odonata. In Roonwal, M. L. *et. al.* A systematic catalogue of the main identification entomological collection of the Forest Research Institute, Dehra Dun, Part 9-21. *Indian Forest Leafl.*, **121**(3) : 63-69.

BLACKMAN, R. A. A. and E. C. G. PINKEY 1967. Odonata of the Seychelles and other Indian Ocean Island groups, based primarily on the *British University Expedition of* 1964-65. *Arnoldia*, **3** : 1-38.

BROOKS, S. J. 1981. Dragonfly records from Malayasia *Notal. Odonatol.*, **1** : 113-114.

CALVERT, P. P. 1898. Odonata (Dragonflies) from the Indian Ocean and from Kashmir, collected by Dr. W. L. Abbot. *Proc. Acad. nat. Sci. Philad.*, **1** : 141-154.

CARFI, S. 1974. Contribution to the knowledge of Somalian Odonata. *Monitore zool. ital (N. S.) Suppl.*, **5** : 141-181.

CHAO, H. F. 1981. Odonata. In S. CHEN (ed.) *Insects of Xiang*. Vol., **1** : 53-55; China Sc. Press, Peaking (Chinese with English summary).

CHHOTANI, C., A. R. LAHIRI and T. R. MITRA 1983. Contribution to the Odonata (Insecta) fauna of the Andaman and Nicobar Islands with description of two new species. *Rec. zool. Surv. India*, **80** : 467-494.

CHOWDHURY, S. H. and M. AKHTERUZZAMAN 1981. Dragonfly (Odonata : Anisoptera) larvae from Chittagong. *Bangladesh. J. zool.*, **9** : 131-144.

CORBET, P. S. 1962. A biology of dragonflies pp. xvi + 1-247. H. F. & G. Witherby, London.

DASGUPTA, J. 1957. Cytological studies on the Indian dragonflies *Proc. zool. Soc. Calcutta*, **10** : 1-65.

DAVIES, D. A. L. 1981. A synopsis of the extant genera of the Odonata. *S.I.O. Rapid Communications*. No. **3** : I+XII+1-59. Utrecht.

DAVIES, D. A. L. and P. TOBIN 1984. The dragonflies of the World : A systematic list of the extant species of Odonata. Vol. 1 Zygoptera, Anisozygoptera. *Soc. Int. Odonatol. rapid Comm.*, (Suppl.) **3** : X+1-127.

DAVIES, D. A. L. and P. TOBIN 1985. Ibid. Vol. 2. Anisoptera. *Soc. Int. Odonatol. rapid Comm.*, (Suppl.) **5** : IX+1-151.

DUMONT, H. J. 1975. A note on some dragonflies from Afghanistan. *Odonotologica*, **4** : 243-248.

FRASER, F. C. 1918. Indian dragonflies part 3. *J. Bombay nat. Hist. Soc.*, **26** : 141-171.

FRASER, F. C. 1919(a). Descriptions of four new Indian Odonata. *Rec. Indian Mus.*, **16** : 451-459.

FRASER, F. C. 1919(b). Description of new Indian Odonata larvae and exuvae. *Rec. Indian Mus.*, **16** : 459-467.

FRASER, F. C. 1919(c). Notes on Odonata collected in Seistan and Baluchistan in winter. *Rec. Indian Mus.*, **3** : 79-82.

FRASER, F. C. 1919(d). Indian dragonflies part 4. *J. Bombay nat. Hist. Soc.*, **26** : 488-517.

FRASER, F. C. 1919(e). Indian dragonflies part 5. *J. Bombay nat. Hist. Soc.*, **26** : 734-744.

FRASER, F. C. 1919(f). Indian dragonflies part 6. *J. Bombay nat. Hist. Soc.*, **26** : 919-932.

FRASER, F. C. 1920(a). Some new Indian dragonflies. *J. Bombay nat. Hist. Soc.*, **27** : 147-150.

FRASER, F. C. 1920(b). Indian dragonflies part 8. *J. Bombay nat. Hist. Soc.*, **27** : 253-269.

FRASER, F. C. 1921(a). Indian dragonflies part 9. *J. Bombay nat. Hist. Soc.*, **27** : 492-498.

FRASER, F. C. 1921(b). Indian dragonflies part 11. *J. Bombay nat. Hist. Soc.* **28** : 107-122.

FRASER, F. C. 1923(a). Indian dragonflies part 15. *J. Bombay nat. Hist. Soc.*, **29** : 36-47.

FRASER, F. C. 1923(b). Indian dragonflies part 17. *J. Bombay nat. Hist. Soc.*, **29** : 659-680.

FRASER, F. C. 1924(a). Report on a collection of dragonflies (Odonata) from the Andaman Islands. *Rec. Indian Mus.*, **26** : 409-414.

FRASER, F. C. 1924(b). A survey of the Odonata (Dragonfly) fauna of Western India with specieal remark on the genera *Macromia* and *Idionyx* and description of thirty new species with Appendices I & II. *Rec. Indian Mus.*, **26** : 423-522.

FRASER, F. C. 1924(c). Indian dragonflies part 18. *J. Bombay nat. Hist. Soc.*, **29** : 982-1006.

FRASER, F. C. 1927(a). Indian dragonflies part 27. *J. Bombay nat. Hist. Soc.*, **32** : 183-196.

FRASER, F. C. 1927(b). Description of twei 'y new Indian dragonflies *Rec. Indian Mus.*, **29** : 63-90.

FRASER, F. C. 1928(d). Indian dragonflies part 30. *J. Bombay nat. Hist. Soc.*, **32** : 683-691.

FRASER, F. C. 1928(b). Indian dragonflies part 31. *J. Bombay nat. Hist. Soc.*, **33** : 47-59.

FRASER, F. C. 1929(a). Indian dragonflies part 32. *J. Bombay nat. Hist. Soc.*, **33** : 288-301.

FRASER, F. C. 1929(b). Indian dragonflies part 33. *J. Bombay nat. Hist. Soc.*, **33** : 576-597.

FRASER, F. C. 1929(c). Indian dragonflies part 34. *J. Bombay nat. Hist. Soc.*, **33** : 834-850.

FRASER, F. C. 1931. Additions to the survey of the Odonata (Dragonfly) fauna of Western India with descriptions of nine new species. *Rec. Indian Mus.*, **33** : 443-474.

FRASER, F. C. 1932(a). Indian dragonflies part 39. *J. Bombay nat. Hist. Soc.*, **35** : 645-656.

FRASER, F. C. 1932(b). Indian dragonflies part 40. *J. Bombay nat. Hist. Soc.*, **36** : 141-151.

FRASER, F. C. 1933(a). Indian dragonflies part 41. *J. Bombay nat. Hist. Soc.*, **36** : 607-617.

FRASER, F. C. 1933(b). *Fauna of British India including Ceylon and Burma*, Odonata, vol. 1, : xiii + 428 Taylor & Francis Ltd.

FRASER, F. C. 1934(a). Indian dragonflies part 42. *J. Bombay nat. Hist. Soc.*, **37** : 553-572.

FRASER, F. C. 1934(b). *Fauna of British India including Ceylon and Burma*, Odonata. vol. **2** : XIII + 398. Taylor & Francis Ltd, London.

FRASER, F. C. 1936. *Fauna of British India including Ceylon and Burma*, Odonata. vol. **3** : XII + 461. Taylor & Francis Ltd, London.

FRASER, F. C. 1956. Insectes : Odonates Anisopteres. Faune de Madagascar. : 125. Publications de L' Institut de Recherche Scientifique Tananrive Tsimbazaza.

FRASER, F. C. 1957. A Reclassification of the Order Odonata. : 1-133 Royal Zoological Society of New South Wales.

FRASER, F. C. and C. Dover 1922. The dragonflies of Barkuda Island *Rec. Indian Mus.*, **24** : 303-311.

GLOYD, L. K. 1983. The type-species of the genus *Paragomphus* Cowley 1934 (Anisoptera : gomphidae) *Notul. Odonatol.*, **2** : 12-13.

HAGEN, Dr. 1858. Odonata. In Hagen Dr. Synopsis der Neuroptera Ceylon, *Verh. zool. bot. Ges. wien.*, **8** : 478-481.

HAMALAINEN, M. P. - Mohanraj and K. Veena Kumari. Additions to the Odonata fauna of Andaman and Nicobar Islands. *Notul. Odonatol*, **5**(3) : 27-29.

HUXLEY, J. S. 1953. Evolution in Action. : 167. A Pelican Book.

IKEZAKI, Y. 1971. First record of *Anax guttatus* from Nagasaki Prefecture. *Tommbo*, **14** : 27 (Japanese, English abstract).

JOSEPH, A. N. T. and I. SATYARANI 1983. On a small collection of Odonata from Andhra Pradesh, India. *Rec. zool. Surv. India*, **85** : 439-450.

KHALIQ, A. and M. YOUSUF 1993. Coenagrionidae (Zygoptera : Odonata) of Pakistan. II. Subfamily Pseudagrionidae. *Pakistan J. Zool.*, **25** : 159-164.

KIAUTA, B. 1974. Introduction to insect cytotaxonomy I. *The Netherland Centre for Alpine Biological Research Univ. of Utrecht.* : xii.+81.

KIAUTA, B. 1975. Cytotaxonomy of dragonflies with specieal reference to the Nepalese fauna. *Nepal Research Centre, Kathmandu and Univ. of Utrecht.* : x+76.

KIAUTA, B. and M. KIAUTA 1982a. The chromosome numbers of sixteen dragonfly species afrom the Arun valley, eastern Nepal. *Notul. Odonatol.*, **1** : 143-145.

KIAUTA, B. and M. KIAUTA 1982b. The chromosome numbers of eleven dragonfly species from Singapore. *Notul. Odonatol.*, **1** : 164-165.

KIAUTA, B. and M. KIAUTA 1983a. Further notes on Philippines Odonata Karyotypes. *Notul. Odonatol.*, **2** : 14-15.

KIAUTA, B. and M. KIAUTA 1983b. The Chromosome numbers of some Odonata from Thailand. *Notul. Odonatol.*, **2** : 27-29.

KIMMINS, D. E. 1966. List of Odonata Types described by F. C. Fraser now in the British Museum (Natural History). *Bull. Br. Mus. nat. Hist.*, (*Ent.*) **18** : 173-227.

KIMMINS, D. E. 1968. A list of Type specimens of Libellulidae and Corduliidae (Odonata) in the British Museum (Natural History) *Bull. Br. Mus. nat. Hist.*, (*Ent.*) **22** : 277-305.

KIRBY, W. 1890. A synonymic catalogue of the Neuroptera Odonata of dragonflies with appendix of fossil species London, : 202.

KLOTS, E. B. 1947. Chinese dragonflies (Odonata) in the American Museum of Natural History *Am. Mus. Novit. no.*, **1341**. : 1-13.

KORMAN K. 1966. Beiterag zur Odonaten fauna der Umgebung von Karlaruhe. *Beitr. naturk. Forsch. S. W. Deutschl.*, **25** : 133-139.

KUMAR, Anil, 1990. Odonata of Vedanthangal water bird sanctuary, Tamil Nadu with notes on their field ecology. *J. Bombay nat. Hist. Soc.*, **87** : 320-323.

KUMAR, A. 1982. An annolated list of Odonata from the Pithoragarh district, Western Himalaya, Uttar Pradesh, India. *Notul. Odonatol.*, **1** : 145-147.

KUMAR, A. and M. PRASAD 1977. Last instar larvae of two Odonata species from Western Himalayas. *Entomon.*, **2** : 225-230.

KUMAR, A. and T. C. KHATRI 1985(a). On a small collection of Dragonflies (Odonata) from the Eastern Ghats, Tamil Nadu I. *Eastern Ghats Insects,* **1** : 6-9.

KUMAR, A. and T. C. KHATRI 1985(b). Ibid. II. *Eastern Ghats Insecta,* **2** : 23-25.

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

LAHIRI, A. R. 1977(b). On a collection of Odonata from Manipur with new records. *Rec. zool. Surv. India*, **72** : 409-418.

LAHIRI, A. R. 1979. Odonata (Insceta) from different states of northeastern India. *Oriental Ins.*, **13** : 119-132.

LAHIRI, A. R. 1985. Insecta : Odonata. In : Fauna of Namdhapa, Arunachal Pradesh. A proposed Biosphere Reserve. *Rec. zool. Surv. India,* **82** (1-4) : 81-87.

LAHIRI, A. R. 1987. Studies on the Odonata fauna of Meghalaya. *Rec. zool. Surv. India, Occ. Pap.* No., **99** : 1-402.

LAHIRI, A. R. and C. SINHA 1985. A new synonym in Indian *Rhinocypha* Rambur with a review of the species groups *fenestrella* and *bifasciata* (Odonata : Chlorocyphidae) *Bull. zool. Surv. India,* **7** : 33-36.

LAHIRI, A. R. and C. SINHA 1991. A review of Indian Chlorocyphidae (Insecta : Odonata) with additional notes on taxonomy and distribution for some species and description of a new subspecies. *Rec. zool. Surv. India,* **89** : 257-268.

LAHIRI, A. R. and S. DAS. 1991. Observations on the epicranieoorbital complex on some Indian Aeshnidae (Odonata : Aeshinidae) *Rec. zool. Surv. India.*, **89** : 155-166.

LAHIRI, A. R. and T. R. MITRA, 1976. Notes on some damselflies of Calcutta. (Odonata : Zygoptera) *Ent. News.*, **87** : 295-298.

LAIDLAW, F. F. 1914. Odonata. In Zoological Results of the Abor Expedition 1911-1912. *Rec. Indian Mus.*, **8** : 335-349.

LAIDLAW, F. F. 1915a. Notes on Oriental dragonflies in the Indian Museum No. 2. *Rec. Indian Mus.*, **11** : 337-339.

LAIDLAW, F. F. 1915b. Fauna of Chilka Lake no. 2. Odonata. *Mem. Indian Mus.*, **5** : 179-180.

LAIDLAW, F. F. 1916a. Notes on Oriental dragonflies in the Indian Museum No. 4. The genus *Pseudagrion. Rec. Indian Mus.*, **12** : 21-25.

LAIDLAW F. F. 1916b. Notes on Indian Odonata. *Rec. Indian Mus.*, **12** : 129-136.

LAIDLAW, F. F. 1917a. A list of the dragonflies recorded from the Indian Empire with special reference to the collection of the Indian Museum. Part I. The Family Calopterygidae. *Rec. Indian Mus.*, **13** : 23-40.

LAIDLAW, F. F. 1917b A list of the dragonflies recorded from the Indian Empire with special reference to the collection of the Indian Museum. Part II. The Family Agrionidae. *Rec. Indian Mus.*, **13** : 321-348.

LAIDLAW, F. F. 1919. A list of the dragonflies recorded from the Indian empire with specieal reference to the collection of the Indian Museum. Part II. *Rec. Indian Mus.*, **16** : 169-195.

LAIDLAW, F. F. 1920a. A list of the dragonflies recorded from the Indian Empire with special reference to the collection of the Indian Museum. Part III. *Rec. Indian Mus.*, **19** : 145-163.

LAIDLAW, F. F. 1921. A list of the dragonflies recorded from the Indian Empire with special reference to the collection of the Indian Museum. *Rec. Indian Mus.*, **22** : 75-91.

LAIDLAW, F. F. 1922. A list of the dragonflies recorded from the Indian Empire with special reference to the collection of the Indian Museum. Part V. The Subfamily Gomphinae. *Rec. Indian Mus.*, **24** : 367-426.

LAIDLAW, F. F. 1923. The dragonflies (Odonata) of Burma and Lower Sian III subfamily Aeschninae. *Proc. U. S. natan. Mus.*, **62** (Art. 21) : 1-29.

LAIDLAW, F. F. 1924. Notes on Oriental dragonflies of the genus *Aciagrion Proc. U. S. natn. Mus.*, **66** (Art. 19) : 1-9.

LEACH, W. E. 1815. Entomology. pp. 57-172 (In Brewater's Edinburg Encyclopaedia, 9, Ediburg). (Original not consulted).

LIEFTINCK, M. A. 1939(a). On the true position of the genus *Orolestes* McLachman with notes on *O. wallaci* (Kirby), its habits and its life history (Odonata : Lestidae). *Treubia*, **17** : 45-61.

LIEFTINCK, M. A. 1948. Odonata. In Entomological results from the Swedish Expedition 1934 to Burma and British India. *Ark. For. Zool.* **41A** No. **10** : 1-23.

LIEFTINCK, M. A. 1954. Handlist of Malayasian Odonata. *Treubia*, **22** (Suppl.) : xiii+1-202.

LIEFTINCK, M. A. 1955. Synopsis of the dragonflies (Odonata) of Ceylon. *Zool. Medded. Leiden*, **34** : 67-87.

LIEFTINCK, M. A. 1962. Odonata. *Insects of Micronesia*. **5** : 1-95. Berince P. Bishop Museum. Honolulu, Hawaii.

LIEFTINCK, M. A. 1971. Odonata from Ceylon. *Entomologica Scand. Suppl.*, **1** : 188-207.

LIEFTINCK, M. A. 1977. Odonata. Ergebnisse der Bhutan - Expedition 1972 des Natuurhistorischen Museums in Basel. *Entomologica Basiliensia*, **2** : 11-37.

LIEFTINCK, M. A. 1984. Further notes on the specific characters of *Calicnemia* Strand with a key to the males and remarks on some larval forms (Zygoptera : Platycnemididae) *Odonatologica*, **13** : 351-375.

LIEFTINCK, M. A., J. C. Lien and T. C. Maa. 1984. Catalogue of Taiwanese dragonflies (Insecta : Odonata) : 1-81. Asian Ecological Society, Taichung, Taiwan, R.O.C.

LIEFTINCK, H. 1981. Zur Taxonomie einiger *Crocothemis* - Arten nebst Beischreibung einer Art von Madagascar (Anisoptera : Libellulidae) *Odonatologica,* **10** : 109-116 (English Abstract).

MCLACHLAN, R. 1986. On Odonata from the province of Szechuen, in Western China and from Moupin in eastern Tibet. *Ann. Mag. nat. Hist.*, **17**(6) : 364-374.

MAHATO, M. 1988. Dragonfly inventory of the surveys in eastern and mid-western Nepal with records of five species new to the fauna of Nepal (Odonata) *Opusc. zool. flumin.*, **29** (1988) : 1-9.

MANI, M. S., S. Singh, V. K. gupta and H. N. Baijal 1955. Entomological Survey of the Himalayas Part IX first annotated checklist of insects from the North West (Punjab) Himalayas. *Agra. Univ. J. Res., (Sci.)* **4** : 471-512.

MARTIN, R. 1908. Aeschnines. *Cat. Colln. Selys fasc.*, **18** : 1-84.

MIELEWCZYK, S. 1979. Ein neuer Fundort von *Orthetrum brunneum* (Fonscolombe) Und die Verbreitung der Art in Pollen (Anisoptera : Libellulidae) *Notul. Odonatol.*, **1** : 59-61.

MILLER, P. L. 1990. Dragonflies of the campus at Madurai Kamraj University, Tamil Nadu, India. *Notul. Odonatol,* **3** : 160-165.

MITRA, T. R. 1975(a). Note on a collection of Odonata from Manipur (India) *Ent. News.*, **86**(9 & 10) : 213-216.

MITRA, T. R. 1975(b). A review of Indian species of *Agriocnemis* Selys (Insecta : Odonata : Zygoptera : Coenagriidae) with a note on *Agriocnemis nainitalensis* Sahni. *J. zool. Soc. India, B. S. Chauhan comm. vol. Bhubaneswar,* pp. 403-409.

MITRA, T. R. 1976. On a collection of Odonata (Insecta) from Waltair. *Newsl. zool. Surv. India,* **2** : 265-267.

MITRA, T. R. 1983. A list of the Odonata of Calcuta. *Entomologists' mon. Mag.*, **119** : 29-31.

MITRA, T. R. 1988. Note on the Odonata fauna of Central India *Rec. zool. Surv. India*, **83** : 69-81 (1986).

MITRA, T. R. 1994. Observations on the habits and habitats of adult dragonflies of eastern India with special reference to the fauna of West Bengal. *Rec. zool. Surv. India, Occ. Pap. No.* **166** :
1-40.

MITRA, T. R. 1995. Additions to the Odonata fauna of the Great Nicobar Island, Indian Ocean. *Opusc. zool. flumin.*, **129** : 1-6.

MITRA, T. R. 1999. Geographical distribution and Zoogeography of Odonata (Insecta) of Meghalaya. India, *Rec. zool. Surv. India, Occ. Pap. No.*, **170** : 1-63.

MITRA, T. R. 2002 Geographical distribution and Zoogeography of Odonata of eastern India. *Memoirs zool. Surv. India,* Calcutta, vol. **19** No. (1) : 1-208

MITRA, T. R. and G. C. Sen 1975. First records of Dragonflies (Odonata : Anisoptera) from Tripura (India). *Entomologists' Rec. J. Var.*, **87** : 119-120.

MOORE, F. 1878. Neuroptera. In J. Anderson (1878) *Zoological Results of two expeditions to the Western Yunnan in 1868-1875.* London. Vol. **1** : 915-916.

NEEDHAM, J. G. 1930. A Manual of the dragonflies of China. *Zool. India, Ser.* A. Vol. **11** : 346+11.

PAULSON, D. R. 1978(a). An Asiatic dragonfly *Crocothemis servilia* (Drury) established in Florida. (Anisoptera : Libellulidae) *Notul. Odonatol.*, **1** : 9-10.

PAULSON, D. R. 1978(b) Additional record of *Crocothemis servilia* (Drury) from Florida (Anisoptera : Libellulidae) *Notul. Odonatol.*, **1** : 29-30.

PENNIKET, J. G. 1966. Keys to the nymphs and adults of the New Zealand Odonata. *Rec. Centerbury Mus.*, **8** : 87-92.

PINHEY, E. C. G. 1962. A Descriptive catalogue of the Odonata of the African Continent (upto December 1959) Part 1. *Publcos. cult. Co. Diam. Angola*, **59** : 1-161.

PINHEY, E. C. G. 1966(a). Checklist of dragonflies (Odonata) from Malawi with descriptions of new *Teinobasis* Kirby. *Arnoldia*, **2** : 1-24.

PINHEY, E. C. G. 1966(b). Odonata. *In Explor parc. natn. de la Garamba Miss H. de Saegar. Fascicule*, **45** : 1-114.

PINHEY, E. C. G. 1974(a). Odonata of the North West Cameroons and particularly of the islands stretching southwards from the Guinea Gult *Bonn. zool. Beitr.*, **25** : 179-212.

PINHEY, E. C. G. 1979(a). The status of a few well known African Anisopterous dragonflies (Odonata) *Arnoldia. Rhod.*, **8** : 1-7.

PINHEY, E. C. G. 1979(b). Additions and corrections to the 1966 checklist of dragonflies (Odonata) from Malawi. *Arnoldia. Rhod.*, **8** : 1-14.

PINHEY, E. C. G. 1980. A revision of the African Lestidae (Odonata) *Occas. pap. natn. Mus. Rhod. B. Nat. Sci.*, **6** : 327-479.

PINHEY, E. C. G. 1981(a). Odonata collected in Ethiopea Anisoptera pp. 5-56. In some results of the first and second Italian Zoological Mission to Ethiopea, sponsored by the National Academy of Lencei (1973 and 1975) Academia nazionale Die Lencei Rome. Quaderno No. 253.

PINHEY, E. C. G. 1981(b). Checklist of the Odonata of Mocambique *Occas. pap. natnl. Mus. Rhod. Nat. Sci.*, **6** : 557-631.

PINHEY, E. C. G. and N. Pinhey, 1984. A preliminary list of the Odonata collected by Dr. J. Kielland in Tanzania for Dr. M. A. Lieftinck *Odonatologica*, **13** : 129-138.

PRASAD, M. 1974. The Odonata of Garhwal Hills, *Bull. Ent.*, **15** : 41-55.

PRASAD, M. 1976. Odonata of district Kangra (Himachal Pradesh) *Rec. zool. Surv. India*, **71** : 95-119.

PRASAD, M. 1996(a). Studies on the Odonata fauna of Bastar, Madhya Pradesh, India. *Rec. zool. Surv. India*, **95** : 165-213.

PRASAD, M. 1996(b). An account of the Odonata of Maharashtra State, India, *Rec. zool. Surv. India*, **95** : 305-327.

PRASAD, M. 1997. Further additions to the Odonata fauna of Arunachal Pradesh, Eastern India, *Opusc. Zool. Flumin.*, **154** : 1-6.

PRASAD, M. and R. K. Varshney 1988. The Odonata of Bihar, India, *Rec. zool. Surv. India, Occ. Pap.*, **110** : 1-45.

Prasad, M. and R. K. Varshney 1995. A checklist of the Odonata of India including data on larval studies. *Oriental Ins.*, **29** : 385-428.

PRASAD, M. and R. K. Thakur 1981. Further additions to the Odonata (Insecta) fauna of Rajasthan. *Jantu.*, **1** : 26-28.

PRASAD, M. and S. K. Ghosh, 1984. A note on the Odonata (Insceta) from Sikkim, India, *J. Bombay. nat. Hist. Soc.*, **80** : 435-438.

RAM, R. and M. Prasad, 1999. On the collection of Odonata from Arunachal Pradesh, India, *Rec. zool. Surv. India*, **97** : 113-132.

RAM, R, V. D. Srivastava and M. Prasad, 1982. Odonata (Insecta) fauna of Calcutta and surroundings. *Rec. zool. Surv. India*, **80** : 169-196.

RAM, R, V. D. Srivastava and M. Prasad, 1983. A note on a collection of Odonata from eastern Uttar Pradesh, India. *Notul. Odonatol.*, **2** : 15-16.

RAO, K. R. and A. R. Lahiri, 1983. First records of Odonata (Arthropoda : Insecta) from Silent Valley and New Amarambalam reserved forests *J. Bombay nat. Hist. Soc.*, **79** : 557-562.

RIS, F. 1910. Libellulinen 3. *Cat. Coll. Selys Fasc.*, **11** : 244-384.

ROWE, J. 1981. Notes on a small dragonfly collection from China. *Notul. Odonatol.*, **1** : 123-124.

St. Quentin, D. E. 1936. Libellen aus dem District Darjeeling nebst Beschreibung einer neuen *Chlorogomphus* - Art. *Knowia,* **15** : 102-105.

St. QUENTIN, D. E. 1970. Odonata aus Nepal. *Khumbu Himl.* **3** : 389-411.

SCHNEIDER, W. 1985(a). Dragonfly records from S. E. Turkey (Insecta : Odonata) *Senckenbergiana biol.*, **66** : 67-78.

SCHNEIDER, W. 1985(b). The types of Orthetrum anceps (Schneider 1845) and the status of *Orthetrum ramburii* (Selys 1843) *Senckenbargiana biol.*, **66** : 97-104.

SELYS, LONGCHAMPS, E. De 1977. Synopsis des Agrioninesme Legion, Agrion, (Sults etfin). Les generes *Telebasis*, *Agriocnemis* et *Hemiphtebia.* Bruxelles, pp. 1-65.

SELYS, LONGCHAMPS, E. De 1891. Odonates in 'Viaggio Di Leonardo Fea in Birmania e Regioni Viocine. *Annali Mus. Civ. Stor. nat. Giacomo Doria.* Serie 2 Vol. **10** : 433-518.

SINGH, A. and M. PRASAD 1974. New records of Odonata from North-West India. *J. Bombay nat. Hist. Soc.*, **70** : 403-405.

SINGH, A. and M. PRASAD 1976. Odonata of Doon Valley Anisoptera. *Rec. zool. Surv. India,* **70** : 21-38.

SINGH, S. and H. N. BAIJAL 1954. Entomological survey of the Himalayas II - on a collection of Odonata. *Agra Univ. J. Res. Sci.*, **3** : 385-400.

SINGH, S., H. N. Baijal, V. K. Gupta and K. Mathew 1955. Entomological survey of the Himalayas. Part XIV. Notes on some inscets collected by the second entomological expedition to the North

West Himalayas (1955) with description of three new species of Odonata. *Agra Univ. J. Res. Sci.*, **4** (suppl.) : 741-766.

SINHA, C. and P. Chakraborty 1996. *Aciagrion approximans* (Selys) (Insecta : Odonata : Conagrionidae) a new record from West Bengal, India, *Sci. & Cult.*, **62** : 258.

TILLYARD, R. J. 1917. The biology of dragonflies (Odonata or Paraneuroptera) (Cambridge Univ. Press.). pp XI + 396.

TILLYARD, R. J. 1926. The insects of Australia and New Zealand pp. XI+560. August & Robertson Ltd.

TILLYARD, R. J. and F. C. Fraser 1938. A reclassification of the order Odonata based on some new interpretations of the venation of the dragonfly wing. *Aust. Zool.*, **9** : 125-196.

TITAYAVAN, M. 1979. A note on the Odonata of Chiang Mai Valley, Northern Thailand. *Notul. Odonatol.*, **1** : 65-67.

TSUDA, S. 1991. A distributional list of world Odonata, 1991 Osaka Pref. pp. 1-362.

TSUDA, S. 2000 Ibid pp. VIII + 1-430.

TYAGI, B. K. 1984. List of Odonata of the Chandigarh Union Territory and the Chandigarh shiwalik outcrops, India. *Notul. Odonatol.*, **2** : 61-62.

TYAGI, B. K. and P. L. Miller 1991. A note on the Odonata collected in South Western Rajasthan, India. *Notul. Odonatol.*, **3** : 134-135.

WILLIAMSON, E. B. 1907. The dragonflies (Odonata) of Burma and Lower Siam - II. The subfamilies Cordulegasterinae, Chlorogomphinae, Gomphinae. *Proc. U. S. natn. Mus.*, **33** : 267-317.

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, **13**(Part-2) : 151-173, 2006

INSECTA : ORTHOPTERA : ACRIDOIDEA

S. K. MANDAL, A. DEY, AND A. K. HAZRA
Zoological Surgvey of India, 'M' Block, New Alipore, Kolkata 7000 53

INTRODUCTION

The short-horned grasshoppers family Acrididae and Pyrgomophidae belong to superfamily Acridoidea of the order Orthoptera. Hancock (1913) and recently Tandon *et al.* (1976), Tandoan and Khera (1978) have recorded some species of Acridoidea from Arunachal Pradesh. Besides this work, so far no serious efforts has been made to study of this group of insects from this state. The present work initiated to make a systematic study of Acridoidea fauna with special reference to its detailed distribution, chiefly based on large collections made by various survey parties of the Zoologucal Survey of India, under a scheme of the Department for intensive faunistic survey of Arunachal Pradesh. Authors have also examined the earlier collections present in the National Zoological Collections.

The present paper deals with 44 species of grasshoppers over 2 famillies and 33 genera. This is the first comprehensive report on the Acridoidea fauna of Arunachal Pradesh in which key to families, genera and species are given. We have also given notes for identification and distributional records of individual species. The arrangement of families and subfamilies is after Dirsh (1961) and (1975).

SYSTEMATIC LIST

Order ORTHOPTERA

Super family ACRIDOIDEA

Family PYRGOMORPHIDIAE

1. *Atractomorpha Burri* Bolivar
2. *Atractomorpha himalayica* Bolivar
3. *Atractomorpha psittacina affinis* De Haan
4. *Atractomorpha angusta* Karsch
5. *Mekongiella wardi* (Uvarov)
6. *Tagasta indica* Bolivar

Subfamily GOMPHOCERINAE

7. *Mesopsis cylindricus* (Kirby)
8. *Aulacobothrus lutipes* Walker
9. *Phonogaster cariniventris* Henry

Subfamily OEDIPODINAE

10. *Heteropternis respondens* (Walker)
11. *Pternosicta cinctifemur* (Walker)
12. *Sphingonotus longipennis* Saussure
13. *S. indus* Saussure
14. *Trilophidia annulata* (Thunb.)

Subfamily ACRIDINAE

15. Acrida exaltata (Walker)
16. *A. indica* Dirsh
17. *Gonista filata* (Walker)
18. *Holopercna darjeelingensis* (Bolivar)
19. *Ceracris nigricornis* (Walker)
20. *C. striatus* Uvarov
21. *Phlaeoba infumata* Brunner
22. *P. antennata* Brunner
23. *P. sikkimensis* Rammae
24. *P. assama* Rammae

Subfamily OXYINAE

25. *Oxya hyla hyla* Serville
26. O. *hyla intricata* (Stal)
27. *O. fuscovittata* (Marschall)
28. *O. japonica japonica* (Thunberg)
29. *Hygracris palustris Uvarov*

Subfamily COPTACRIDINAE

30. *Coptacra foedata* (Serville)
31 *Eucoptacra praemorsa* (Stål)
32. *Apalacris varicornis* Walker

Subfamily HEMIACRIDINAE

33. *Spathosternum pr. prasiniferum* (Walker)
34. *Gesonula punctifrons* (Stål)

Subfamily EYPREPOCNEMIDINAE

35. *Eucnemidia charlottae* Ramme
36. *Eyprepocnemis rosea*
37. *Choroedocus robustus* (Serville)

Subfamily CYRTACANTHACRIDINAE

38. *Patanga succincta* (Linnaeus)
39. *Chondracris rosea* (De Geer)

Subfamily CATANTOPINAE

40. *Catantops erubescens* (Walker)
41 *Catantops pinguis innotabilis (Walker)*
42. *Xenocatantops humilis humilis* (Serville)
43. *Stenocatantops splendens* (Thunberg)
44. *Tauchira* sp.
45. *Oxytauchira* sp.
46. *Utnacris* sp.

Subfamily TROPIDOPOLINAE

47. *Oxyrrhepes obtusa* Willemse

SYSTEMATIC ACCOUNT

Order ORTHOPTERA
Superfamily ACRIDOIDEA

Key to families

1. Foveolae of the vertex contiguous, superior and forming the extermity of the fastigium; stridulatory mechanism absent ..... PYRGOMORPHIDAE

– Foveolae lateral or inferior, never forming the tip of the fastigium; stridulatory mechanism present. ..... ACRIDIDAE

Family PYRGOMOPRHIDAE

Key to genera

1. Brachypterus or fully winged; pronotum not abruptly flared in dorsal view specially in female; more than one transeverse sulcus distinct 2

– Apterous; pronotum abruptly flared in dorsal view specially in famale; one transverse sulcus distinct ..... ***Meckongilla*** Kevan

2. Tegmina long and narrow, body moderately slender ..... ***Atractomotpha*** Saussure

– Tegmina rather short and broader, body very robust ..... ***Tagasta*** Bokivar

Genus ***Atractomorpha*** Saussure, 1862

Key to species

1. Eyes comparatively short, roundish oval or ovoid; lateral pronotal lobes, except in roubust form, a membranous is present in the metazoan, speciallly in female 2

– Eyes comparatively long, elongate, oval; lateral pronotal lobes without a membranous area in metazoan; more robust form with colour hind wings 3

2. Body robust and some what large for the genus; lateral pronotal lobes without a membranous area in metazoan; hind wings usually colourless or very pinkish at base ..... *himalayica* Bolivar

– Body normally more slender, rather small to the genus; lateral pronotal lobes usually with distinct membranous area in metazona, specially in female; hind wings normally tyrian pink or light malloe purple magenta at base 4

3. Body rather short-and moderately stout; fastigium of vertex short; outer face of.... hind femora strongly convex and keeled; male subgenital plate blunt in profile at apex ..... *burri* Bolivar

– Body very slender; fastigium of vertex narrow and slender; outer face of femora slightly convex and keeled; male subgenital plate

some-what point in profile .... *psittacina affinis* (Haan)

4. Size small; membranous area in metazoan in lateral pronotal lobes usually very distinct in both sexes .....*crenulata* (Fabricius)

– Larger than above; fastigium of vertex often comparatively long; membranous area in metazoan less distinct than above .... *angusta* Karsch

1. *Atractomorpha himalayica* (Bolivar)

1905. *Atractomorpha himalayica* Bolivar, *Bol. Soc. Espan. Hist. Nat.*, **5** : 198, 204.

1969. *Atractomorpha himalayica* Kevan and Chen, *Zool. J. Linn. Soc.*, **48** : 152, 160.

Material examined: Debang valley district: 1 ♀, Roing, 26.i.2000, coll. S.K. Mandal; 1 ♀, Koronu north, 1.ii. 2000, coll. S.K. Mandal.

Diagnosis : Body robust and large; lateral pronotal lobe neither a membranous area in metazona; eyes comparatively short, roundish oval; hind femora with external face strongly keeled and convex; hind wings usually colourless or very faintly pinkish.

Distribution : India Arunachal Pradesh and West Bengal.

Elsewhere : Bangladesh; Southwards to Malaya and South to Indo-China and Nepal.

Remarks : This species is restricted to the Himalaya. Uvarov (1927) reported this species from Darjeeling district (West Bengal).

2. *Atractomorpha burri* Bolivar

1905. *Atractomorpha burri* Bolivar, *Bol. Soc. Espan. Hist. Nat.*, **5** : 197, 203

1969. *Atractomorpha burri* : Kevan and Chen, *Zool. J. Linn. Soc.*, **43** : 158, 160.

Material examined : West Kameng district : 1 ♂, Tanga valley, 21.xii. 1965, coll.S.K. Bhattacharhya; 2 ♀ ♀, Bhalukpong, 23.xii. 1965, coll. S.K. Tandon; 1 ♀, Charduar, 28.xii. 1965, coll. S.K. Bhattacharya. *West Siang Diatrict* : 1 ♂, Lekhabali, 6.xii. 1966, coll. S.K. Tandon; 4 ♀ ♀, Kambang, 18.x. 1966, coll. S.K. Tandon; 3 ♀ ♀, Dulla Tappi, 23.x.1966, Coll. S.K. Tandon; 1 ♀, Old jinning, 20.x. 1966, coll. S.K. Tandon. Upper Subansiri district : 1 ♀, Daporijo, 27.x. 1966, coll. S.K. Tandon. *Debang Valley district* : 3 ♀ ♀, Santipur, 3.iii. 1969, coll. S.K. Tandon; 2 ♂ ♂, Sadiya Road, 8.iii. 1969, coll. S.K. Tandon; 1 ♂, Lalitpur Road, 13.iii. 1969, coll. S.K. Tandon; 2 ♂ ♂, Chaukka Road, 16.iii. 1969, coll. S.K. Tandon.

Diagnosis : Body short and robust; fastigium of vertex as long as eye; lateral pronotal lobe in metazoan without membranous area; hind wing long, tyrian pink to light mallow purple at base.

Distribution : India : Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim amd West Bengal.

Elsewhere : Bangladesh; Bhutan, Indonesia; Malayasia.

Remarks : In general it is widely distributed in northern part of India. This species is also reported in the Acridoidea fauna of West Bengal Hazra *et al.* (1993).

3. *Atractomorpha angusta* Karsch

1888. *Atractomorpha angusta* Karsch, *Ent Nachr* . **14** 328.

1969. *Atractomorph angusta* : Kevan and Chen, *Zool J Linn. Soc.*, **48** : 187.

Material examined : Uppersubansiri district : 2 ♀ ♀, Lekhabali, 6.x. 1966, coll. S.K. Tandon; 1 ♂, Tarak village, 18.x. 1966, coll. S.K. Tandon; 1 ♂, 1 ♀, Pakha camp, 26.x. 1966, coll. S.K. Tandon; 1 ♂, Subansiri bridge, 28.x. 1966, coll. S.K. Tandon.

Diagnosis : Body a little small; fastigium of vertex narrow apically and less flat dorsally; hind wings at the base rose red or rose coloured.

Distribution : India : Arunachal Pradesh, Andamans Isls.

Elsewhere : Myanmar; Indo-China; Malayasis; Nepal; Northern Bangladesh; Sumatra.

Remarks : Membranous area in metazoan of lateral pronotal lobe usually faintly distinct.

4. ***Atractomorpha psittacina affinis*** (Kirby)

1914. *Atractomorpha psittacina* Kirby, *Fauna of Brit. India* : 182.

1969. *Atractomorpha psittacina affinis* : Kevan and Chen, *Zool. J. Linn. Soc.*, **48** : 185.

Material examined : Upper Subansiri district : 1♂, Dejoo, 10 v. 1966, coll. A.N.T. Joshep.

Diagnosis : External diagnostic features are so similar to *Atractomorpha psittacina,* the only difference is shortness of the eye; aedeagal valves larger.

Distribution : India : Arunachal Pradesh, Assam.

Elsewhere : Bangladesh; Celebes; Indonasia; Malyasia; Myanmar; Philippines Islands; South Chaina and Thailand.

Remarks : This species is recorded only from Arunachal Pradesh in India.

Genus ***Tagasta*** Bolivar, 1905

5. ***Tagasta indica*** Bolivar, 1905

1905. *Tagasta indica* Bolivar, *Bol. Soc. Esp. Hist. Nat.*, **5** : 112, 113.

Material examined : West Siang district : 1♂, Old jining, 20.x.1966, coll. S.K. Tandon; 1♀ Dulla tappi, 22.x.1966, Coll. S.K. Tandon; 2♂♂, 4♀♀, Dulla Tappi, 23.x.1966, coll. S.K. Tandon. Upper Subansiri district : 2♂♂, 2♀♀, Pakha camp, 26.x.1966, coll. S.K. Tandon 1♂, 5♀♀ Bella village, 27.x.1966, coll. S.K. Tandon.

Diagnosis : Body very robust and stout; rugulose, punctate; fastigium of vertex equilaterally triangular; antennae inserted near the eyes; pronotum rounded in front, obtusely angulated behind; median carinae not so prominent and lateral carinae almost obsolete; wings one fifth shorter and hyaline.

Distribution : India : Arunachal Pradesh, Mizoram, Nagaland, Sikkim and West Bengal.

Elsewhere : Bhutan.

Remarks : This species is reported in Acridoidea fauna of West Bengal Hazra *et al.* (1993).

Genus ***Mekongiella*** Kevan, 1966

6. ***Mekongiella wardi*** (Uvarov)

1937. *Mekongia wardi* Uvarov, *J.Linn. Soc. London (Zool)*, **40** : 281.

1440. *Mekongiana wardi* : Uvarov, *Ann. Mag. Nat. Hist.*, (11) **6** : 111.

1966. *Mekongiella wardi* Kevan, *Canad. Ent.*, **98** : 1278.

Material examined : Upper Subansiri district : 10♂♂, 8♀♀, 26.xii.1974, J.M. Julka.

Diagnosis : Size small; body broad strongly depressed; frontal profile straight; pronotum abruptly flared in dorsal view, with one distinct transverse sulcus in female, ovipositor valves short, broad and stout.

Distribution : India : Arunacahl Pradesh.

Elsewhere : S. Tibet.

Remarks : No specimen of this species has been found during present study. We have studied spcimens present in the National Zoological Collections. It is found only from a single locality.

Family ACRIDIDAE

Key to the subfamilies

1. Prosternal tubercle usually absent 2

– Prosternal tubercle present 5

2. Sound producing mechanism represented by articulated or non-non articulated stridulatory serration on innerside of hind femur 3

– Sound producing mechanism not represented such serration or pegs on inner side of hind femur 4

3. Sound producing mechanism represented by unarticulated serration on inner side of hind femur ..... TRUXALINAE

– Sound producing mechanism represented by row of articulated stridulatory pegs on innerside of hind femur .... GOMPHOCERINAE

4. Head with acute angle of frons; tegmina without intercalary vein (if present, weak, irregular and not serrated even in male) ..... ACRIDINAE

– Head rounded in profile, face almost verticle, rarely oblique and tegmina always with an intervein in median area .... OEDIPODINAE

5. Radial area of tegmina with a series of regular, parallel stridulatory veinlets .... HEMIACRIDINAE

– Stridulatory veinlets of radial area of tegmina absent; if apterous, the tympanum (at least rudimentary) present 6

6. Lower external lobe of hind knee with spine like apex ..... OXYINAE

– Lower external lobe of hind knee with apex rounded, angular or subacute but not spine-like 7

7. Last abdominal terga in male (in majority genera) with well developed furcula; supra-anal plate mostly with attenuate or trilobate at apex; subgenital plate with transeverse fold ..... COPTACRIDINAE

– Last abdominal terga in male without well developed furcula; supra-anal plate variable; subgenital plate without transverse fold 8

8. Mesosternal inter space closed ....TROPIDOPOLINAE

– Mesosternal interspace open 9

9. Mesosternal lobes rounded or obtuse-angular or acute-angular 10

– Mesosternal lobes-rectangular ....CYRTACANTHACRIDINAE

10. Dorsum of pronotum flat or weakly tectiform, with median and lateral carinae linear (lateral carinae sometimes obliterated); male cercus with strongly compressed, lobiform or subacute, down curved at apex .... EYPREPOCNEMIDINAE

– Dorsum of pronotum of variable shape; lateral carinae, if present, not linear; male circus variable, but not with strongly compressed, lobiform or subacute, down curved at apex ..... CATANTOPINAE

Subfamily GOMPHOCERINAE

Key to genera

1. Fastigium with acute apex; frontal ridge with obtuse lateral carinae 2

– Fastigium with truncate apex; frontal ridge without lateral carinae .... ***Dnopherula*** Karsch

2. Dorsum of head behind the middle of eye with 7 carinae including the strong median one; abdomen with distinct longitudinal ridges 3-5 ..... ***Phonogaster*** Henry

– Dorsum of head without extra carinae, except median and lateral carinae; abdomen without any distinct longitudinal ridges .... ***Mesopsis*** Bolivar

Genus ***Mesopsis*** Uvarov, 1921

7. ***Mesopsis cylindricus*** (Kirby)

1914. *Aswathamanus cylindricus* Kirby. *Fauna British India*, Orthopt : 101.

1921. *Mesopsis cylindricus* : Uvarov, *Ann. Mag Nat Hist* (9) 7 : 482.

Material examined : Upper Siang district : 1♂, Lekhabali, 2.xi. 1966, coll. S.K. Tandon.

Diagnosis : Body long and cylindrical; head and pronotum smooth; fastigium of vertex very long, extending as far beyond the eyes as the length of pronotum, antennae much widened and flattened towards the base and tapering

towards the apical part; tegmina and wings very long and pointed; middle legs short, hind legs slender.

Distribution : India : Arunachal Praesh, Andhra Pradesh, Bihar and Orissa.

Remarks : Most remarkable characters of the species are ensiform antennae and long body with pointed tegmina. This species is newly recorded from Arunachal Pradesh.

Genus ***Phonogaster*** Henery, 1940

8. ***Phonogaster carniventris*** Henrey

1940. *Phonogaster carniventris* Henry, *Trans. R. ent. Soc. Lond.* **90**(19) : 510.

Material examined : 1♂, Z.S.I. Campus, Itanagar, 27.v.2000, coll. B. Mitra.

Diagnosis : Body long and slender, head elongate, much longer than pronotum; pronotum with strongly tricarinate, dorsum of head behind the middle of eye with seven carinae including the strong median one; tegmina extended beyond the hind leg, wings less than half tegminal length acutely pointed; hind femur provided with a row of stridulatory pegs in the inner side; supra-anal plate triangular, cerci short and conical in male; in female ovipositor short.

Distribution : India : Arunachal Pradesh, Andhra Pradesh, Sikkim, Tamil Nadu and Tripura.

Remarks : This species is limited in distribution. We have found it only from Itanagar. It is newly recorded from Arunachal Pradesh.

Genus ***Dnopherula*** Karsch, 1896

9. ***Dnopherula (Aulacobothrus) descisus*** (Walker)

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

1921. *Aulacobothrus descisus* Uvarov, *Ann. Mag. Nat. Hist.*, 7(9) : 482.

Material examined : Nil.

Diagnosis : Size small; fastigium of vertex almost subtraingular; abdomen carinated above; general colour brownish, a pale stripe usually runs starting from fastigium of vertex to end of pronotum; tegmen rufotestaceous; tibiae with 12 small black spines on each carina.

Distribution : India : Arunachal Pradesh, Maharastra.

Remarks : No specimen of this species has been recorded during the present study. However, we have studied the material present in our National Zoological Collection.

Subfamily ACRIDINAE

Key to genus

1. Head conically ascending; fastigium of vertex broad and laminate ..... ***Acrida*** Linnaeus.
- Head not asceniding; fastigium of vertex not so broad 2
2. Lateral carinae of pronotum divergent posteriorly 4
- Lateral carinae of pronotum straight, continous 3
3. Body very slender; head with a little long; apex of tegmina acutely sharpened ..... ***Gonista*** Bolivar
- Body not slender; head not as above; apex of tegmina obliquely truncate ..... ***Phlaeoba*** Stål
4. Body large and robust ..... ***Holopercna*** Karsch
- Body medium and normal ..... ***Ceracris*** Walker

Genus ***Acrida*** Linnaeus, 1758

Key to species

1. Fastigium of vertex broadly rounded at apex; transverse sulcus slightly before the middle of pronotum disc ..... *exaltata* Walker
- Fastigum of vertex obtuseangulated at apex; transverse sulcus beyoud the pronotum disc ..... *indica* Dirsh

10. *Acrida exaltata* (Walker)

1859. *Truxalis exaltata* Walker, *Ann. Mag. Nat. Hist.* (3) 4 : 222.

1954. *Acrida exaltata* : Dirsh. *Bull. Soc. Fouad Ent.*, 38 : 149.

Material examined : West Kameng district : 1 ♀, Tanga road, 19.xii.1965, coll. S.K. Tandon; 2 ♀♀, Dunn bridge, 21.iv.1969, coll. A.N.T. Joshep; 4 ♀♀, Dalung, 23.iv.1966, coll. A.N.T. Joshep; 3 ♀♀, Salari, 22.vi.1966, coll. K.C. Jayram; 3 ♀♀, Saliri, 3.vii.1966, coll. S. Biswas. Lower Subansiri district : 1 ♂, Tamen, 20.v.1966, coll. A.N.T. Joshep; Upper Subansiri : 2 ♂♂, 2 ♀♀, Lekhabali, 6.x.1966, coll. S.K. Tandon; 2 ♂♂, Tarak, 18.x.1966, coll. S.K. Tandon; 3 ♀♀, Daporijo, 28.x.1966, coll. S.K. Tandon. 3 ♀♀, Banderdewa, 19.x.1998, coll. S.K. Mandal; West Siang district : 1 ♂, Kambang, Pering, 1.x.1966, coll. S.K. Tandon; 1 ♂, New Jinning, Tarak, 18.x.1966, coll. S.K. Tandon.

Diagnosis : Head conically ascending, basal part narrow; fastigium of vertex broad, laminate and truncate at extremity, transverse sulcus of pronotum present about the middle of pronotal disc; wings slightly shorter than tegmina; male subgenital plate in profile, comparatively long and more elongated; colour green or pale yellow.

Distribution : India : Arunachal Pradesh, Andhra Pradesh, Bihar, Madhya Pradesh, Jammu and Kashmir, Kerala, Orissa, Rajasthan, Tamil Nadu.

Elsewhere : Afghanistan; Bangladesh; Iran; Pakistan; Saudi Arabia; South Tibet; Yemen and West Aden.

Remarks : This species will be present in many areas from which it has not yet been recorded.

11. *Acrida indica* Dirsh

1954. *Acrida indica* Dirsh, *Bull. Soc. Fouad. Ler Entom.* 38 : 151.

Material examined : Lower Subansiri district : 1 ♀, Itanagar, coll. nil.

Diagnosis : Size larger than the preciding species; head robust strongly broadened at basal part; lateral carinae of pronotum straight and almost parallel, slightly convergent forwards; transverse sulcus beyond the middle of pronotal disc; elytron a little produced beyond the hind knee, broad and short; wings shroter than elytron, broad with obtuse apex; subgenital plate broad, moderately long, in profile with large obtuse projection in the basal part.

Distribution : India : Arunachal Pradesh, Assam, Gujrat, Kashmir and Maharstra.

Elsewhere : Afghanistan; Arabia; Ceylon; S.E. Persia; S.E. Tibet; W. Aden; Yemen.

Remarks : The present records from Arunachal Pradesh extends the distribution range of this species in North eastern region. This species is first time recorded from Arunachal Pradesh.

Genus *Ceracris* Walker, 1870

Key to species

1. Face and pronotum coarsely punctured; hind femur externally with a narrow, but always distinct blackish fascia just before the preapical pale ring ..... *nigricornis* Walker

– Face and pronotum smooth; hind femora without blackish fascia before the pale ring ..... *striata* Uvarov

12. *Ceracris nigricornis nigricornis* (Walker)

1870. *Ceracris nigricornis* Walker, *Cat. Derm. Salt Brit Mus.*, 4 : 791.

1925. *Ceracris nigricornis nigricornis* : Uvarov, *Ent Mitt Berlin*, 14 : 13.

Material examined : West Siang district : 5 ♂♂, 2 ♀♀, Old jining, 20.x.1966, coll. S.K. Tandon; 4 ♂♂, 1 ♀, Dulla, Tappi, 22 and 23.x. 1966, coll. S.K. Tandon; 6 ♂♂, 5 ♀♀, Tachidom, 24.x.1966, coll. S.K. Tandon; 5 ♂♂, 2 ♀♀ Bame, 30.x.1966, coll. S.K. Tandon; 7 ♂♂, Basar, 30 and 31.x.1966, coll. S.K. Tandon. *Upper Subansiri district* : 1 ♂, 2 ♀♀, 27 & 28.x.1966, coll. S.K. Tandon. Lohit district : 3 ♂♂, 2 ♀♀, Wakro 2 & 4.xii.1971, coll. J.M. Julka.

Diagnosis : Size medium; brownish green or olive green in colour; face and prontum coarsely punctured, tegmina brown, anal field apple green or olive green in colour, hind femora reddish, especially below with a narrow pale pre-apical ring preceded by narrow blackish ring; hind tibae dirty bluish, with the base black, a pale pre basal ring followed by black ring.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Tamil Nadu, Uttar Pradesh and West Bengal.

Elsewhere : Afghanistan.

Remarks : This species occurs mostly in thick forest regions.

13. ***Ceracris striata*** Uvarov

1925. *Ceracris striata* Uvarov, *Ent. Mitt.*, **14** : 16.

Material examined : Lower Subansiri district : 1 ♀ Banderdewa, 19.x.1996, coll. S.K. Mandal.

Diagnosis : Size rather small; compressed; tegmina with only a sharp defined narrow sulphurous stripe in scapular area ; anal area greenish or only lightly paler than the rest of the tegmina; metazoan heavily punctuered; hind femora without fascia before the pale ring; hind tibiae black below, blackish blue above with the usual colour pattern near the base.

Distibution : India : Arunachal Pradesh, Mizoram.

Elsewhere : Myanmar.

Remarks : This species is rather limited in distribution and we have found only in lower Subansiri district. This specis is newly recoded from Arunachal Pradesh.

Genus ***Gonista***

14. ***Gonista filata*** (Walker)

1870. *Mesopsis filatus* Walker, *Cat. Derm. Salt. Brit. Mus.*, **5** : 502.

1914. *Gelastorrhinus (?) filatus* : Kirby, *Fauna. Brit. India*, **1** :

1985. *Gonista filata* : Bhowmik, *Rec. zool. Surv. India*, *Occ. Paper* No. **78** : 216.

Material examined : East Siang : 2♂♂, Sibiamukb, 9.i.2001, coll. S.K. Mandal.

Diagnosis : Body long and narrow; head more or less equal to pronotum; fastigium of vertex rather long and obtusely angulated; antennae long, slender and ensifrom; tegmina very long, narrow, very acute; wings hyaline more or less shorter than the tegmina.

Distribution : Arunachal Pradesh, Andhra Pradesh.

Elsewhere : China.

Remarks : This species is recorded first time from Arunachal Pradesh, Previously it is recorded from Andhra Pradesh (Araku valley) Bhowmick (1983).

Genus ***Holopercna*** Karsch, 1891

15. ***Holopercna darjeelingensis*** (Bolivar)

1914. *Sjoestedtia darjeelingensis* Bolivar, *Bol. Trab. Mus. Cienc. nat. Madr.*, **20** : 77.

1927. *Sjoestedtia darjeelingensis* Uvarov, *Rec. India Mus.*, **29**(4) : 234.

1984. *Holopercna darjeelingensis* : Jago, *Trans. Amer. Ent. Soc.*, **109** : 78.

Material examined : Upper Subansiri district : 1 ♀, Daporijo, 26.x.1966, coll. S.K. Tandon; 1 ♂, Daporijo, Basar village, 31.x.1966, coll. S.K. Tandon. West Siang District : 1 ♀, Lekhabali, 6.x.1966, coll. S.K. Tandon; 1 ♂, ♀, Siji river bank, 7.x.1966, coll. S.K. Tandon; 1 ♂, ♀, Kambang, 15 & 16.x.1966, coll. S.K. Tandon; 1 ♀, Tappi, 23.x.1966, coll. S.K. Tandon. Lohit district : 5♂♂, 1 ♀, Wakro, 1.xii.1969 coll. J.M. Julka.

Diagnosis : Medium size; lateral carinae of pronotum diverging in metazoan; fastigium moderately concave; posterior femora slender; general colour brown, mottled with dark and yellowish spaces and stripes; eyes brownish; posterior femur slender with whitish yellow, with dark spots on carinae and carinulae.

Distribution : India : Arunachal Pradesh, Assam, Himachal Pradesh, Sikkim, Uttar Pradesh and West Bengal.

Remarks : This species is fairly distributed in Arunachal Pradesh. and at is generally found in grassy areas.

Genus ***Phlaeoba*** Stål, 1860

Key to species

1. Wings more or less fuscous at apex 2
- Wings hyaline at apex, pronotum very rugulose and striated 3
2. Antennae unicolors ..... *infumata* Brunner
- Antennae ringed or tipped with obscure yellow ..... *Antennata* Brunner
3. Prozona without dark rectangular tubercles ..... *sikkiminensis* Ramme
- Prozona with 4 dark rectangular tubercles ..... *assama* Ramme

16. ***Phlaeoba infumata*** Brunner

1893. *Phlaeoba infumata* Brunner, *Annali Mus. Civ. Stor. Nat. Giacomo Doria*, **33** : 124

1914. *Phlaeoba infumata* Brunner, *Fauna Brit. India, Orthopt.*, : 103.

1968. *Phlaeoba infumata* : Bey Bienko, *Rev. Ent. URSS*, **47** : 125.

Material examined : West Kameng district : 1♂, 1♀, Bhalukpong, 6.v.1996, coll. S.K. Mandal; Upper Subansiridistrict : 1♂, Dejo, 10.v.1966, A.M.T Joshep; 1♀, Tamen, 20.v.1966, coll. A.N.T. Joshep; 2♀♀, Bela village, 27.x.1966, coll. S.K. Tandon; 1♂, Dapirojo, 27.x.1966, coll. S.K. Tandon; 1♀, Subansiri Bridge, 28.x.1966, coll. S.K. Tandon; Lower subansiri district : 1♂, Zero, 13.v.1966, coll. A.N.T. Joshep; 1♀, Itanagar, Chimpu, 17.x.1966, coll. S.K. Mandal. West Siang district : 1♂; 2♀♀, Dali village, 10-11.x.1966, coll. S.K. S.K. Tandon; 1♂, 1♀, Kambang, 16.x.1966, coll. S.K. Tandon 3♀♀, Tappi, 23.x.1966, coll. S.K. Tandon. Debang valley district : 2♂♂, 4♀♀, Roing, 29.i.2000, coll. S.K. Mandal; 1♂, Tejoo road, Koronu, coll. S.K. Mandal.

Diagnosis : Body medium size; fastigium above with a continous median carina extending along the head and pronotum; antennae ensiform as long as head and pronotum together; subgenital plate of male acute apex; colour brownish.

Distribution : India : Arunachal Pradesh, Andhra Pradesh, Bihar, Delhi, Haryana, Himachal Pradesh, Madhya Pradesh, Meghalaya, Orissa, Punjab, Sikkim, Tripura, Uttar Pradesh and West Bengal.

Elsewhere : S.China; Malacca; Myanmar; E. Nepal.

Remarks : *Phlaeoba infumata* is well distributed in Arunachal Pradesh. This species is widely distributed throughout plains and hilly region of cultivated fields. It is reported in fauna of West Bengal (1993), Meghalaya (1995)

17. ***Phlaeoba antennata*** Brunner

1893. *Phlaeoba antennata* Brunner, *Annali Mus civ Stor Nat. Giacomo Doria*, 33 :

1914. *Phlaeoba infumata* : Brunner, *Faun Brit India, Orthopt.*, : 102.

Material examined : Upper Subansiri district : 1♂, 2♀♀, Bellavillage, 26.x.1966, coll. S.K. Tandon: 1♀, Daporijo, 27.x.1966, coll. S.K. Tandon; 1♀, Subansiri Bridge, 28.x.1966, coll. S.K. Tandon; Lower Subansiri district : 1♂, Itanagar, 23.viii.1998, coll. A.R. Lahiri; West Siang distric : 1♂, Lekhabali, 6.x.1966, coll. S.K. Tandon; 2♂♂, 1♀, Lohitpur Road, 13.iii.1966, coll. S.K. Tandon, 2♂♂, 1♀, Mandhum, Tangapani, 17.iii.1969, coll. S.K. Tandon.

Diagnosis : Body medium size; colour olive brown, a broad yellow band running from the vertex to the end of the tegmina, at least in male; antennae ensiform, with black tipped; pronotum smooth with all three carinae well marked; tegmina narrow; wings bluish, hyaline at base, infumated at apex.

Distribution : India : Arunachal Pradesh, Assam, Mizoram, Nagaland, Kerala, Rajasthan, Sikkim, West Bengal.

Elsewhere : Bangladesh; Borneo; Myanmar;

China; Hainan Island; Ise. of Penang; Malaya Peninsula; Perak; Tonking; Sumatra.

Remarks : This species is found mainly in the forest regions of North East India.

18. ***Phlaeoba sikkimensis*** Ramme

1914. *Phlaeoba sikkimensis* Ramme, *Mitt. Zool. Mus. Berlin.* **25**(1) : 13.

Material examined : Lower Subansiri district : 1♂, Itanagar, Chimpu, 13.x.1996, coll. S.K. Mandal; Papum Pare district : 1♂, 1♀, Chessa, Sonajuli, 20.x.1996, coll. S.K. Mandal; Debang valley district : 1♂, Roing, 27.i.2000, coll. S. K. Mandal.

Diagnosis : Size a little large; fastigium as long as broad with longitudinal ridge in the middle; antennae broad at base narrowed apically; pronotum with sharp middle and lateral carinae; lateral carinae parallel; posterior margin of pronotum obtuse; tegmina reaching 1/3rd of the posterior femur; anal plate deeply grooved at basal half in male; subgenital plate tapering.

Distribution : India : Arunachal Pradesh, Sikkim.

Elsewhere : Eastern Nepal.

Remarks : It is newly recorded from Arunachal Pradesh.

19. ***Phlaeoba assama*** Ramme

1941. *Phlaeoba assama* Ramme, *Mitt. Zool. Mus. Berlin*, **25**(1) : 9.

Material examined : East siang district : 1♂, Passighat, 17.i.2000, coll. S.K. Mandal; Debang valley district : 2♀♀, Roing, 27.i.2000, coll. S.K. Mandal.

Diagnosis : Fastigium longer than broad and acutely rounded in front, no other carina on the fastigium except median carina; antennae about 1/4th longer than head and pronotum; prozona with 4 dark rectangular tubercles; tegmina reaching upto posterior knees.

Distribution : India : Arunachal Pradesh and Assam.

Remarks : This species is newly recorded from Arunachal Pradesh.

Subfamily OEDIPODINAE

Key to Genara

1. Median carina of pronotum cut by two grooves ..... ***Trilophildia*** Stål

– Median carina of pronotum cut by one groove 2

2. Transverse vein in apical part of tegmina oblique and arranged zigzag .... ***Pternoscincta*** Saussure

– Transverse vein in apical part of tegmina erect, cells square and oblong 3

3. Tegmina with dark and light patches; wings yellowish at base and darker towards outside ..... ***Heteropternis*** Stål

– Tegmina without dark and light patches; wings bluish at base and dark band form of a quarter circle towards out-side .... ***Sphingonotus*** Fieber

Genus ***Trilophidia*** Stål, 1873

20. ***Trilophidia annulata*** (Thunberg)

1815. *Gryllus annulatus* Thunberg, *Mem. Acad. Sci. St. Petersb.*, **5** : 234.

1965. *Trilophidia annulata* : Hollis, *Trans. R. ent. Soc. London*, **117**(8) : 251.

Material examined : Lower Subansiri district : 1♂, Banderdewa, 19.x.1966, coll. S.K. Mandal; 1♂, Itanagar, 27.vi.2000, coll. B. Mitra. Upper Subansiri district : 1♀, Zero, 2.vi. 2000, coll. B. Mitra; 1♀, Daporijo, 4.x.2000, coll. B. Mitra. Papumpare district : 1♂, Chessa, 21.x.1996, coll. S.K. Mandal; Debang valley district : 1♂, Roing, 25.i.2000, Coll. S.K. Mandal; 1♀, Roing north, 26.i.2000, coll. S.K. Mandal; 1♀, Deopani river Road, 27.x.2000, S.K. Mandal; 1♀, Koronu, Teju road, 2.ii.2000, coll. S.K. Mandal.

Diagnosis : Body small size; colour brown or grey with black marking, pubescent beneath; pronotum rugose, with a high median carina,

forming two teeth in front, and with lateral carinae; tegmina grey, some times with indistinct brown bands; hind tibiae with a pale band towards the base and with a slight pale band beyond the middle.

Distribution : India (widely distributed).

Elsewhere : Bangladesh, Borneo, Japan, Java, Korea, Malaya, Mongolia, Myanmar, Pakinstan, Philippines, Sarawak, Singapore, Sri Lanka, Sumatra, Taiwan and Thailand.

Remarks : This species is a bare ground species. It is distributed almost all over the country.

Genus ***Heteropternis*** Stål, 1873

21. ***Heteropternis respondens*** (Walker)

1859. *Acrydium respondens* Walker, *Ann. Mag. nat. Hist.*, 4(3) : 223.

1914. *Heteropternis respondens* : Kirby, *Faun. Brit. India, Orthoptera*, : 128.

Material examined : West Kameng district : 1♂, Tanga river bed, 19.xii.1965, coll. S.K. Bhattacharja; Debang valley district : 1♀, Debang, 23.iv.1966, coll. A.N.T. Joshep. 1♂, 1♀, Roing, 31.i.2000, coll. S.K. Mandal.

Diagnosis : Body medium in size; head smooth or a little granulated; principal sulcus placed some what before the middle; tibiae with unequal internal spines; wings yellowish at base and darker towards out side.

Distribution : Arunachal Pradesh, Bihar, Orissa, Tamil Nadu, Uttar Pradesh.

Elsewhere : China; Java, Myanmar; Malakka; South East Asia; Sri Lanka and Sumatra.

Remark : This species is found in low vegetation along the streams in thick tropical and subtropical region.

Genus ***Pternoscirta*** Saussure

22. ***Pternoscirta cinctifemur*** (Walker)

1859. *Acridium cinctifemur* Walker *Ann. Mag. Nat. Hist.*, 4 (3) : 223.

1914. *Pternoscirta cinctifemur* : Kirby, *Faun. Brit India. Orthopt.* 1 : 134.

Material examined : Debang valley district : 1♂, Koronu, 2.ii.2000, coll. S.K. Mandal.

Diagnosis : Body medium size; pronotum and abdomen with a continuous median carina; posterior femora stout; valves of ovipositor short and slightly curved head and pronotum brown in colour wings red from the base another half smoky hyaline, margins with more deep cloudy; posterior tibiae with 9 or 10 black spines.

Distribution : India : Arunachal Pradesh, Assam, Goa, Meghalaya, Orissa, Tamil Nadu and West Bengal.

Elsewhere : Eastern Nepal; and Sri Lanka.

Remarks : Not very common. This species is found from a single locality. It is newly recorded from Arunachal Pradesh.

Genus ***Sphingonotus*** Feiber, 1852

Key to species

1. Wings from the middle, followed by a broad dark band, curving from costa to above the middle ..... ***longipennis*** Saussure

– Wings from the middle, followed by a narrow dark brown band upto the anal angle..... ..... ***indus*** Saussure

23. ***Sphingonotus longipennis*** Saussure

1884. *Sphingonotus longipennis* Saussure, *Mem Soc Phycs. His. Nat. Geneva*, **28** (9) : 197, 203

Material examined : Debang valley district : 1♀, loc. nil. 21.x. 1912, coll. S.W. Kemp.

Diagnosis : Body medium size; wings bluish in the middle, followed by a broad black band, curving from the middle of the costa to above the anal angle; hind femora blue; tibiae alternatively banded with blue and black.

Distribution : India : Arunachal Pradesh, Assam, Himachal Pradesh, Jammu and Kashmir, Punjab and West Bengal.

Elsewhere : East Nepal; Mongolia; N. Africa; South East Tibet.

Remarks : The member of the genus are typically geophilous. This species is limited in distribution.

24. ***Sphingonotus indus*** Saussure, 1884

1884. *Sphingonotus indus* Saussure. *Mem. Soc.Geneva*, **28** (9) 204.

1914. *Sphingonotus indus* : Kirby, *Faun. Brit. India, Orthopt.*, : 156.

Material examined : Lohit district : 1♂, 1♀, Deban 13.xii. 1982, coll. A.K. Hazra; 1♂, Zero camp, 30 kms. North east of Mio, 14.xii.1982, coll. A.K. Hazra.

Diagnosis : Body smaller size than the previous species; wings from the middle followed by brown band which extends from costa to anal angle.

Distribution : India : Arunachal Pradesh.

Remarks : This species is very similar to *S.longipennis*. It is limited in distribution.

Subfamily OXYINAE

Genus ***Oxya*** Serville, 1831

Key to genera (Male)

1. Supar-anal plate with a tubercle on each side of a median apical process, making the plate appear weakly trilobate 2

– Supra-anal plate without lateral tubercles ..... *japonica japonica*

2. Cercus laterally compressed, hardly narrowing towards apex, which is weakly bifurcate ..... *fuscovittata* (Marschall)

– Cercus conical or if compressed then narrowing towards apex, which is obtuse or truncata 3

3. Inner tooth like of lophi of epiphallus usually well developed ..... *hyla hyla* Serville

– Inner-toothlike of lophi of epiphallus usually not well developed ..... *hyla intricata* Stal

(Female)

1. Anterior margin of tegmen with a dense row of short bristles extending from costal buldge almost to apex of tegmen; ovipositor valves with long teeth, the apical ones curved 2

– Anterior margins of tegmen only weakly or not at all spined or bristled; valves of ovipositor with short teeth .... *japonica japonica* (Thunberg)

2. Ventral surface of subgenital plate almost completely flat or weakly concave, apperaring to widen posteriorly .... *fuscovittata* (Marschall)

– Ventral surface of subgenital plate flat or concave, only in median posterior half, not widened posteriorly 3

3. Ventral surface of subgenital plate with two longitudinal ridges extending forwards from posterior margin, these ridges often toothed ..... *hyla hyla* Serville

– Ventral suface of subgenital plate without longitudinal ridges or with only slight traces of them apically and they are not at all spined ..... *hyla intricata* (Stal)

25. ***Oxya hyla hyla*** Serville

1831. *Oxya hyla* Serville, *Ann. Sci. nat. (Zool.)*., **22** : 287.

1969. *Oxya hyla hyla* : Hollis, *Bull. Br. Mus. Nat. Hist. (Ent.)*, **26**(7) : 282.

Material examined : Upper Subansiri district : 1♂, Bella village, 27.x.1966, coll. S.K. Tandon; 1♀, Daporijo, 28.xi.1966, coll. S.K. Tandon. West Siang district : 1♂, 2♀♀, Lekhabali, 6-7.x.1966, coll. S.K. Tandon; 1♀, Kambang, 14.x.1966, coll. S.K. Tandon; 1♀, Old jinning, 20.x.1966, coll. S.K. Tandon; 1♀, Dulla Tappi, 22.x.1966, coll. S.K. Tandon.

Diagnosis : Body finely rugulose, shiny; size small; supra-anal plate with small tubercles; cercus with subacute apex; subgenital plate with two longitudinal ridges extending forwards from posterior margin in female.

Distribution : India : Arunachal Pradesh, Andhar Pradesh, Assam, Bihar, Goa, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Meghalaya, Orissa, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh.

Elsewhere : Afghanistan; Africa; Bangladesh; Madagaskar; Nepal; Pakistan; Persia; Sri Lanka.

Remarks : This species is associated with crops, vegetables, grasses, etc. especially in moist areas.

26. *Oxya hyla intricata* (Stål)

1860. *Acridium (Oxya) intricatum*, Kong. *Svens. Fragatten Eugenes Reca Omkring Jor den Stockhalm*, 3 : 335.

1971. *Oxya hyla intricata* : Hollis, *Bull. Brit. Mus. Nat. Hist.*, **26** : 28.

Material examined : West Siang district : 1♀, Lekhabali, 7.x. 1966, coll. S.K. Tandon; 1♂, Dalicamp, 10.x. 1966, coll. S.K. Tandon.

Diagnosis : Size small; fastigium of vertep with widely rounded, two black borders runs from the lateral surface of the eye and runs upto the end of pronotum; inner lophi of epiphallus are normally poorly developed as almost absent in male; In female, subgenital plate is without longitudinal ridge and not spined at all except at posterior margin.

Distribution : India : Arunachal Pradesh, Orissa.

Elsewhere : Japan; Myanmar.

Remarks : This species is limited in distribution.

27. *Oxya japonica japonica* (Thunberg)

1824. *Gryllus japonica* Thunberg, *Mem. Acad. Sci. St. Petersb.* 9 : 429.

1914. *Oxya japonica japonica* : Hollis, *Bull. Brit. Nat. Hist. (Ent.)*, 26(7) : 302.

Diagnosis : Supra anal plate of male rounded, triangular, with well developed basal folds; cercus with conical, truncate or subtruncate apex; in female, ventral surface of subgenital plate with a deep median longitudinal cavity posteriorly, median pair spines on posterior margin well developed.

Distribution : India : Arunachal Pradesh, Andaman Is., Karnataka. Meghalaya, Uttar Pradesh.

Elsewhere : Bangladesh; Borneo; Myanmar; Celebes; China; W. Malayasia; Sumatra: Taiwan; Thailand and Timor.

Remarks : It is commonly occurs at the edge of water on grassy plants in mountain region.

28. *Oxya fuscovittata* (Marschall)

1836. *Gryllus fuscovittata* Marschall, *Ann. Wein. Mus Naturg.*, 1 : 211.

1970. *Oxya fuscovittata* : Hollis, *Bull. Brit. Mus Nat Hist. (Ent.)* **26** : 289.

Material examined : West Kameng district : 1♀, Saitan Bridge, 1.x.1966, coll. S.K. Tandon. West Siang district : 6♂♂, 7♀♀, Lekhabali, 4, 7x.1966, coll. S.K. Tandon; 2♀♀, Dullatappi, 23.x.1966, coll. S.K. Tandon; 1♂, Subansiri Bridge, 28.x.1966, coll. S.K. Tandon; 1♀, Bame village, 30.x.1966, coll. S.K. Tandon.

Diagnosis : Integument finely pited and shiny; female large in size; cercus in male compressed and weakly bifurcate; in female ventral surface of subgenital plate almost completely flat or weakly concave.

Distribution : India : Arunachal Pradesh, Andhra Pradesh Jammu and Kashmir, Madhya Pradesh, and West Bengal.

Elsewhere : Afghanistan; Pakistan; US.S.R. South West.

Remarks : This species is reported in Fauna of West Bengal (1993), and Meghalaya, (1995).

Genus *Hygracris* Uvarov, 1921

29. *Hygracris palustris* Uvarov

1921. *Hygracris palustris* Uvarov, *Ann. Mag Nat Hist. London*, (9) 7 : 506.

Diagnosis : A very longer than Oxya and very robust; both upper and lower genicular lobe of hind femur spined; lateral carinae not distinct; prostrnal tubercle broadened, flattened at the base and narrow at apex; tegmina and wings well developed; cerci in male, notched at apex.

Distribution : India : Arunachal Pradesh, Assam, Bihar and Sikkim.

Remarks : This species is recorded on the basis of literature Tandon and Khera (1978).

Subfamily COPTACRIDINAE

Key to genera

1. Antennae nearly three times as long as the head and pronotum together, eyes rather prominent ..... ***Apalacris*** Walker

– Antennae less than twice the length of head and pronotum together; eyes not prominent 2

2. Frontal costa or ridge distinctly widened between the antennae ..... ***Eucoptacra*** Bolivar

– Frontal costa or ridge parallel-sided, not or scarcely wider between antennae ..... ***Coptacra*** Stål

Genus ***Apalacris***

30. ***Apalacris varicornis*** Walker

1870. *Apalacris varicornis* Walker, *Cat. Derm. Salt. Brit. Mus.* **4** : 642.

1913. *Apalacris varicornis* Kirby, *Faun. Brit. India, Orthopt.*, : 238.

Material examined : Debang valley district : 1♂, Roing, 25.i. coll. S.K. Mandal; 1♂, Roing north, 27.i.2000, coll. S.K. Tandon. Tirap district : 1♂, Deban, 27 kms. from Miao, 14.xii.1982, coll. S. Biswas; Papumpare district : 1♂, Chessa, Tarajuli, 22.x.1966, coll. S.K. Mandal.

Diagnosis : Medium size; brownish or olivaceous green in colour; antennae reddish brown at base, light coloured at apex; prosternal tubercle pointed; pronotum with median carina with three sulci; hind femur with two oblique transverse black bands and coloration yellow, hind tibiae red.

Distribution : India : Arunachal Pradesh, Assam, Mizoram, Sikkim and West Bengal.

Elsewhere : Bangaladesh; Borneo; China; Japan; Java; Malaya; Perak; Sumatra; Tonkin; Vietnam; Yunan.

Remarks : This species is collected from dense forest or vegetation.

Genus ***Coptacra*** Stål

31. ***Coptacra foedata*** (Serville)

1839. *Acridium foedata* Serville, *Hist. Nat. Ins. Orth.* : 662.

1957. *Coptacra foedata* : Willemse, *Publties natuurh. Hist. Genoot. Limberg*, **10** : 448.

Material examined : West Kameng district, 1♂, Derling forest, 5.iv.1966, coll. A.N.T. Joshep; 2♀♀, Dunn Dridge, 21.iv.1966, coll. A.N.T. Joshep; *Upper Subansiri district* : 1♀, Dejoo, 10.v.1966, coll. A.N.T. Joshep; 1♂, Tamen, 19.v.1969 coll. A.N.T. Joshep; 2♀♀, Bcla villagc, Daporijo, 27.x.1966, coll. S.K. Tandon; 3♂♂, 7♀♀, Subansiri bridge, 28.x.1966, coll. S.K. Tandon. East Siang district : 1♀, Bame village, 30.x.1966, coll. S.K. Tandon.

Diagnosis : Body rugosely punctate; fastigium of vertex sub-horizontal, and narrow anterly; prosternal spine conical, straight and apex pointed; tegmina with anterior and posterior margin nearly parallel; hind femur relatively long; colour brown or yellowish brown.

Distribution : India : Arunachal Pradesh, Meghalaya, Sikkim.

Elsewhere : China; Indo China; Japan; Myanmar; Philipines; Taiwan.

Remarks : It is a very common species generally found in fallen leaves.

Genus *Eucoptacra* Bolivar, 1902

32. ***Eucoptacra praemorsa*** (Stal)

1861. *Acridium (Catantops) praemorsa* Stal, *Kongl. Freg. Eug. Reas. Omkring Jorden, Insects* : 330.

1914. *Eucoptacra praemorsa* : Kirby, *Faun. Brit. India, Orthopt. (Acrididae)* : 240.

Material examined : West Kameng district : 1♀, Tippi, 11.xi. 1997, coll. A.K. Sanayal.

Diagnosis : Size medium; tegmina with a indication of white collous stripe near the middle

and obliquely truncate at apex; posterior femora without distinct black spot in or near the middle of supra external area; subgenital plate of female with the hind margin broadly rounded or triangularly expanded.

Distribution : India : Arunachal Pradesh, Kerala, Maharastra, Sikkim, Tamil Nadu.

Elsewhere : China; Myanmar; Taiwan and Tenesserim.

Remarks : This species is newly recorded from Arunachal Pradesh. The occurrence of this grasshopper from Arunachal Pradesh is very interesting from the point of view of its distribution.

Subfamily HEMIACRIDINAE

Key to Genera

1. Prosternal tubercle conical; fastigium of vertex elongate, projecting far infront of eyes; pronotum not distinctly tricarinate.... ..... ***Gesonula*** Uvarov

– Prosternal tubercle spathulate; fastigium of vertex not much produced before the eyes, parabolic or obtusely angular; pronotum distinctly tricarinate..... ..... ***Spathosternum*** Krauss

Genus *Gesonula* Uvarov, 1940

33. *Gesonula punctifrons* (Stål)

1860. *Acridium (Oxya) punctifrons* Stål. Kong. *Fragatten Eug. Resa. Omkring Jorden*, **3** : 336.

1963. *Gesonula punctifrons* : Mischenko. Locusts and grasshoppers of U.S.S.R. and adjacent countries. *Catantopinae, Leningrad* : 172.

Materil examined : West Siang district : 1♂, Kambang, 16.x.1966, coll. S.K. Tandon; 1♂, Lekhabali, 17.x.1966, coll. S.K. Tandon.

Diagnosis : Medium size; fastigium rather long; antennae longer than head and pronotum together; two black line runs from the lateral sides of the eye and upto the lateral sides of the tegmen; pronotum long narrow and rugulose; apical part of hind tibiae modified for swimming.

Distribution : India : Arunachal Pradesh, Assam, Goa, Kerala, Madhya Pradesh, Maharastra, Manipur, Meghalaya, Punjab, Tamil Nadu and West Bengal.

Elsewhere : Bangladesh; Borneo; China; Japan; Malacca; Myanmar; Philppines; Sri Lanka; Taiwan; Thailand; Tonking.

Remarks : This species is generally found adjacent to paddy fields, ponds etc. and damage water hycanth in India. It is also reported in the fauna of West Bengal (1993) and Meghalaya (1995).

Genus *Spathosternum* Krauss, 1877

34. *Spathosternum prasiniferum prasiniferum* (Walker)

1871. *Heteracris prasinifera* Walker, *Cat Derm Salt Brit Mus.*, **5** *Suppl.* : 65.

1936. *Spathosternum prasiniferum* : Tinkham. *Lingnan Sci. Journ. Canton*, **15** : 51.

Material examined : Debang valley district : 1♀, Santipur, 2.iii.1969, coll. S.K. Tandon; 5♂♂, 4♀♀, Dumbuk, 5.iii.1969, coll. S.K. Tandon; 1♂, Deopani, 6.iii.1969, Coll. S.K. Tandon; 1♂, 1♀, Sadiya road, 8.iii.1969, coll. S.K. Tandon; 2♂♂, 4♀♀, Digaru road, 11.iii.1969, coll. S.K. Tandon; 6♂♂, 4♀♀, 15.iii.1969, coll. S.K. Tandon; 12♂♂, 11♀♀, Roing, 28.i.2000, coll. S.K. Mandal; 8♂♂, 4♀♀, Roing north, 31.i.2000, coll. S.K. Mandal; 10♂♂, 2♀♀, Koronu, 2.ii.2000, coll. S.K. Mandal. Upper Subansiri district : 1♀, Daporijo 26.x.1966, coll. S.K. Tandon; 1♂, Daporijo, 4.vi.2000, coll. B. Mitra. Lower Subansiri district : 1♀, Itanagar, 27.v.2000, coll. B. Mitra.

Diagnosis : Head considerably shorter than pronotum; antennae short, not reaching the posterior margin of pronotum; hind femora with a rounded ventral genicular lobe; broad blackish or dark green stripe running behind the lower part of the eyes and below the lateral carinae of pronotum.

Distribution : India : Arunachal Pradesh, Andhra Pradesh, Bihar, Goa, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharastra, Orissa, Rajasthan, Tamil Nadu.

Elsewhere : Myanmar; S.E. China; Thailand and Vietnam.

Remarks : This species occurs almost throught India and is associated with most grass habitation. It is also reported in the Acridoidea fauna of West Bengal Hazra *et al.* (1993) and Maghalaya Hazra *et al.* (1995).

Subfamily EYPREPOCNEMIDINAE

Key to genera

1. Prosternal tubercle bilobed or tongue shaped at apex; tegmina and wings rudimentary .. .. ***Eucnemidia*** Ramme

– Prosternal tubercle simple, not bilobed at apex; tegmina and wings well developed 2

2. Body very large; and strongly compressed laterally on apical half .... ***Choroedocus*** Bolovar.I.

– Body not so large ....***Eyprepocnemis*** Fieber

Genus ***Eyprepocnemis*** Fieber, 1853

35. ***Eyprepocnemis rosea*** Uvarov

Material Examined : Debang valley district : Roing, 24.i.2000, coll. S.K. Mandal.

Diagnosis : Size medium; wings at the base with pinkish tinge in colour; posterior tibiae with red in colour.

Distribution : India : Arunachal Pradesh, Assam, Andhra Pradesh, Himachal Pradesh, Meghalaya and Uttar Pradesh.

Remarks : This single species is newly recorded from Arunachal Pradesh.

Genus ***Eucnemidia*** Ramme, 1941

36. ***Eucnemidia charlottae*** Remme

1941. *Eucnemidia charlottae* Ramme, *Mitt. Zool. Mus. Berlin*, **25** : 210.

Material examined : Lower Subansiri district : 1 ♀ Itanagar, 14.xii.1985, coll. R.N. Bhargava.

Diagnosis : Moderately large in size; colour of body brown or light brown, blackish brown form below; antennae with a light colour pre-apical ring; margins of frontal ridge, below the median ocelli, with streaks of blackish brown.

Distribution : India : Arunachal Pradesh and Tripura.

Elsewhere : Myanmar.

Remarks : This species is newly recorded from Arunachal Pradesh. We have found a single specimen from Lower Subansiri district.

Genus ***Choroedocus*** Bolivar, 1914

37. ***Choroedocus robustus*** (Serville)

1839. *Acridium robustum* Serville, *Ins. Orth.*, : 647.

1921. *Choroedocus robustus* : Uvarov, *Trans. Ent. Soc. London*, **69** : 109.

Material examined : West Kameng district : 1 ♀, locality, nil, 23.xii.1965, coll. S.K. Tandon; West Siang district : 1 ♀, Dali, 11.x.1966, coll. S.K. Tandon; 1 ♀, Kambang, 14.x.1966, coll. S. K. Tandon; 1 ♀, New jining, 20.x.1966, coll. S. K. Tandon; Upper Subansiri district : 3 ♀ ♀, Daporijo, coll. S.K. Tandon; Tirap district : 2 ♀ ♀, Khousaling road, 5.xi.1971, coll. G.S. Arora; 2 ♀ ♀, Deomali forest, 9.xi.1971, coll. G.S. Arora.

Diagnosis : Body large in size; median segment almost twice as long as wide; median carina of pronotum cut by 3 sulci; prosternal tubercle generally tapering apically, weakly incurved; tegmina extending beyond the hind supra-anal plate tongue shaped, apex broadly runded, subgenital plate gradually tapering, apex truncate; cerci wide thick, strongly compressed, incurved and downwards.

Distribution : India : Arunachal Pradesh, Assam, and West Bengal.

Elsewhere : Bangladesh.

Remarks : This large brightly colored species is specialized for live on leaves of tropical forest vegetation.

Subfamily CYRTACANTHACRIDINAE

Key to genera

1. Prosternal tubercle strongly curved backward, inflated in middle, with conical apex ..... ***Chondracris*** Uvarov

– Prosternal tubercle almost cylindrical with rounded apex; subgenital plate large, curved, upwards and apex pointed in male .... ***Patanga*** Uvarov

Genus ***Chondracris*** Uvarov, 1923

38. ***Chondroacris rosea*** (de Geer)

1773. *Acrdium roseum* De Geer, *Mem. Hist. Ins.*, **3** : 488

1914. *Cyrtacanthacris rosea* : Kirby, *Faun. Brit. India, Orthoptera* (Aididae) : 230.

1922. *Chondracris rosea* : Uvaro, *Bull. ent. Res.*, **14** : 39.

1975. *Chondracris rosea* : Tandon, *Dr. B.S. Chauhan Comm. Vol. Zool, Soc. India* : 230.

Material examined : East Kameng district : 1♂, Rohung village, 7.iv.1961, coll. K.C. Jayram; West Siang district : 1♂, New Jinning, Tarak, 18.x.1966, coll. S.K. Tandon; 1♂, Tappi, 24.x.1966, coll. S.K. Tandon; 1♀ Kambang, 15.x.1966, coll. S.K. Tandon; Upper Subansiri district : 1♂, 2♀♀, Daporijo, 26.x.1966, coll. S.K. Tandon.

Diagnosis : Size large; body robust; fastigium of vertex strongly sloping; median carina of pronotum moderately raised in prozona and low, straight in profile in metazoana; metazoana feebly tectiform, disc forming distinct angles with the lateral lobes; wings hyaline with the base rose; hind tibiae and tarsi red.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Madhya Pradesh, Manipur, Orissa, Sikkim, Tamil Nadu, Tripura and Uttar Pradesh.

Elsewhere : Bangladesh; Bhutan; China; Hainan Islands; Indonesia; Java; Korea Manchura; Philippines; Taiwan; Thailand and Vietnam.

Remarks : This species occurs mostly in thick forest regions.

Genus ***Patanga*** Uvarov, 1923

39. ***Patanga succincta*** (Johansson)

1763. *Gryllus Locusta succincta* Johansson, *Centuria Insectorum rariorum, Amoenitates Academicae*, **6** : 398

1923. *Patanga succincta* : Uvarov, *Ann Mag Nat. Hist.*, (9) **12** 364.

Material examined : West Kameng district : 2♀♀, Chang village, 14.iv.1961, coll. K.C. Joyram; 2♀♀ Dirang, 19.vii.1961, coll. S. Biswas; 2♀♀, Bomdila, 30.vi.1961, coll. K.C. Joyram; 2♂♂, 2♀♀, Tanga river side 19.xii.1965, coll. S.K. Tandon; 2♀♀, Saitan bridge, 23.iv.1966, coll. A.N.T. Joshep; Lower Subansiri district : 1♂, 2♀♀, Zero, 13.v.1966, coll. A.N.T. Joshep.

Diagnosis : Body size large; Pronotum shorter; hind margin obtuse to rectangular; tegmina with straight venetation in apical part, transverse vein forming almost right angle with principal veins; male subgenital plate long, curved upward, apex pointed; colour pale with grey brown or more or less uniformly greyish or brownish.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Delhi, Goa, Himachal Pradesh, Jammu and Kashmir, Laccadive Island, Maharastra, Meghalaya, Orissa, Rajasthan; Tamil Nadu, Uttar Pradesh and West Bengal.

Elsewhere : S. Arabia; Borneo; China; Hainan; Japan; Java; Malayasia, Myanmar; Philippines; Sri Lanka; Sumatra; Taiwan and Tonkin.

Remarks : In the past, this species was a major pest of many crops in swarming phase but in Arunachal Pradesh, it is found in solitary phase or non-swarming phase and it is less harmful.

Subfamily CATANTOPINAE

Key to genera

1. Tegmina and wing well developed and extending beyond the hind knee lobe 2

- Tegmina and wing extending above the hind knee or brachypterus 4

2. Prosternal tubercle cylindrical and rounded at apex; pronotum subcylindrical .... ***Catantops*** Schaum

- Prosternal tubercle neither cylindrical nor with rounded apex; pronotum nor with rounded apex; pronotum not subcylindrical 3

3. Pronotum not constricted in the middle; prosternal tubercle laterally compressed..... ..... ***Stenocatantops*** Dirsh and Uvarov

- Pronotum constricted in the middle; prosternal tubercle conical..... ..... ***Xenocatantops*** Dirsh

4. Pronotum relatively long, narrow and less broad; prosternal tubercle with distinctly three or two tubercle at apex 5

- Pronotum selliform and metazoan widened posteriorly; prosternal tubercle with three feebly tuberculate ..... ***Utnacris***

5. Fastigium of vertex relatively long and as long as broad; interocular distance distinctly broader than first antennal joint .... ***Oxytauchira*** Ramme

- Fastigium of vertex not as above; interocular distance in male about twice as broad as first antennal joints ..... ***Tauchira*** Stal

Genus ***Catantops*** Schaum

Key to species

1. Wings at base bright pink in colour; black longitudinal stripe along the upper carinula; of hind femur ..... *erubasens* (Walker)

- Wings at base colourless to weakly greenish; black longitudinal stripe absent .... *pinguis innotabilis* (Walker)

40. ***Catantops erubescens*** (Walker)

1870. *Catantops erubiscens* Walker : *Ann. Mag. Nat. Hist. London*, (11) **10** : 129.

1914. *Catantops erubiscens* : Kriby, *Faun. Brit. India, Orthoptera*, **1** : 253.

Material examined : Upper Subansiri district : 1♂, Daporijo, 4.vi.2000, coll. B. Mitra.

Diagnosis : Size medium; hind femur with bright red in inner side and *a* single black prosternal tubercle thick and obtuse; wings hyaline and rosy at base.

Distribution : India : Arunachal Pradesh, West Bengal.

Remarks : This species is newly recorded from Arunachal Pradesh. It is previously recorded from West Bengal (North).

41. ***Catantops pinguis innotabilis*** (Walker)

1870. *Acridium innotabile* Walker, *Cat. Derm. Satl. Br. Mus.*, **4** : 629.

1953. *Catantops pinguis innotabilis* : Dirsh, *Tijdschr, Ent.*, **96**(3) : 233.

Material examined : Debang valley district : 1♂, Santipur, 2.iii.1969, coll. S.K. Tandon; 1♀, Lohitpur road, 13.iii.1969, coll. S.K. Tandon; East Siang district : 2♂♂, 1♀, D. Erimg sactuary, 18.i.2000, coll. S.K. Mandal.

Diagnosis : *Diagnosis* : Lateral lobe of pronotum without coloured pattern; external disc of hind femur withour black median spot below upper carinula; male cercus more upcurved, with more broadened at apex and more projecting upper apical angle.

Distribution : India : Arunachal Pradesh, Andhra Pradesh, Assam, Bihar, Delhi, Goa, Laccadive Islands, Himachal Pradesh, Jammu and Kashmir, Kerala, Madhya Pradesh, Meghalaya, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal.

Elsewhere : Afghanistan, Bangladesh, Borneo, China, Hong Kong, Indo-China, Japan, Java, Kambodia, Korea, Malaya, Maldive Islands Myanmar, Nepal; New Guinea, Pakistan, Philippines, Sumatra Thailand; Tibet and Yunan.

Remarks : This species is limited in distribution in Arunachal Pradesh and we have found in Debang valley district and East siang district.

Genus ***Xenocatantops*** Dirsh & Uvarov, 1953

42. ***Xenocatatpops humilis humilis*** (Serville)

1939. *Acridium humile* Serville *Ins. Orth* : 662.

1953. *Xenocatantops humilis humilis* : Dirsh and Uvarov, *Tijdschr. Ent.*, **96** : 237.

Material examined : West Kemeang district : 2♀♀, Bhairob Kundo, 5.iii.1961, coll. K.C. Jayram; 3♀♀, Kalakrang, 17.iii.1961, coll. K.C. Jayram; 1♂, Chang village, 14.iv.1961, coll. K.C. Jayram; 2♂♂, 2♀♀, Kameng river valley, 19.iv.1961, coll. K.C. Jayram; 1♂♀, Sergaon, 5.v.1961, coll. K.C. Jayram; 1♀, Daphlako bank, 31.v.1961 coll. K.C. Jayram; 1♀, Dirang, 24.vii.1961, coll. K.C. Jayram; West Siang district : 2♀♀, Lekhabali, 6 & 7.x.1966, coll. S.K. Tandon; 2♂♂, 9♀♀, Dali, 10.x.1966, coll. S. K. Tandon; 2♀♀, Sriram bridge, 14.x.1966, coll. S.K. Tandon; 1♂, 2♀♀, New Jinning, 18.x.1966, coll. S.K. Tandon; 2♂♂, 2♀♀ Old Jinning, 18.x.1966, coll. S. K. Tandon; 36♂♂, 48♀♀, Dulla Tappi 22-24.x.1966, coll. S.K. Tandon; Debangvalley district : 1♀, Roing, 26.i.2000, coll. S.K. Mandal; 1♂, Koronu, 31.i.2000, coll. S.K. Mandal; 1♂, Koronu north, 2.ii.2000, coll. S.K. Mandal; *Lower Subansiri district* : 1♂, Itanagar, 27.v.2000, coll. S.K. Mandal; B. Mitra; *Upper Subansiri district* : 1♂, 7♀♀, Basar, 4.x.1966, coll. SK. Tandon; 4♀♀, Basar, 31.x.1966, coll. S. K. Tandon; 2♂♂, 4♀♀, Daporijo, 4.vi.2000, coll. B. Mitra. *Lohit district* : 2♀♀, Choukham, 22.xi.1969, coll. J.M. Julka; 4♂♂, 2♀♀, Wakhro, 2 & 3.xii.1969, coll. J.M. Julka.

Diagnosis : Body medium size, slender, frons in profile straight, moderately slopping backwards; pronotum constricted in middle; male circus with rounded apex; pronotum and thoracic markings much lighter.

Remarks : It is generally found in large numbers in the bushy areas and in the fields of maize and paddy near the forest zone especially when crops are mature.

Genus ***Stenocatantops*** Dirsh and Uvarv

43. ***Stenocatantops splendens*** (Thunderg)

1815. *Gryllus splendens* Thunberg, *Mem. Acad. Sci. St.-Petersh.*, **5** : 236.

1953. *Stenocatantops splendens* : Dirsh & Uvarov, *Tijschr Ent.* **96**(3) : 237.

Material examined : West Kameng district : 1♂, Kalaktang, 17.iii.1961, coll. K.C. Jayram, 1♂, Tanga valley, 21.iv.1966, coll. S.K. Tandon; 4♂♂, Saitan bridge, 23.iv.1966, S.K. Tandon; 1♀, Derling, 5.v.1966, coll. S.K. Tandon; 1♂ Tamen, 20.v.1966, coll. S.K. Tandon; 2♀♀ Jamiri, 14.x.1966, coll. S.K. Mandal; Lower Subansiri district : 1♂, Zero, 2.vi.2000, coll. B. Mitra; Upper Subansiri district : 3♀♀, Subansiri bridge, 11.x.1966, coll. S.K. Tandon; West Sing district : 1♀, 11.x.1966, coll. S.K. Tandon; Debang valley district : 1♂, Roing, 5.iii. 1969, coll. S.K. Tandon; 1♂, Sadiya road, 8.iii.1969, coll. S.K. Tandon; 2♂♂, 1♀, Teju road, 10 & 13.iii.1969, coll. S.K. Tandon; 1♀, Digaru road, 11.iii.1969, coll. S.K. Tandon; 3♂♂, Roing, Deopani, 29.i.2000, coll. S.K. Mandal; 2♀♀ Koronu, 1.ii.2000, coll. S.K. Mandak.

Diagnosis : Size medium; body more slender; body elongated; middle joints of antennae about twice or three times as long as broad; prosternal tubercle strongly curved and inclined backwards in profile; colour brown or brownish testaceous.

Distribution : India : Arunachal Pradesh, Andaman & Nicobar Islands, Assam, Madhya Pradesh, Meghalaya, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Borneo; Celebes; China; Hainan; Java; Korea; Malaya; Maluccas Island; Myanmar; Philippines; Sri Lanka; Sumatra; Thailand.

Remarks : This species is widely distributed in India.

Genus ***Tauchira*** Stal, 1878

Material examined : Lower Subansiri district : 1♂, Zero, 1.vi.2000, coll. B. Mitra.

Diagnosis : Medium size; Fastigium of vertex in male about as long as broad; interocular distance about twice as broad as basal joints of antennae; stridulatory vein present; prosternal tubercle broad, strongly transverse with the apex widened bearing three small obtuse teeth; elytra reaches upto the end of the abdomen.

Distribution : India :Arunachal Pradesh.

Remarks : Only one male of this genus has been collected in Arunachal Pradesh ie. from Lower Subansiri district. This genus is newly recorded from Arunachal Pradesh

Genus ***Oxytauchira*** Ramme, 1941

Dignosis : Fastigium of vertex relatively long, as broad; its lateral margins from the middle narrowing anteriorly, the apex narrow, obtuse; pronotum relatively longer and less broad; prosternal tuberele with two tubereles.

Distribution : India : Arunachal Pradesh.

Remarks : This genus is included on the basis of literature Tandon and Khera (1978). It was not available during the survey.

Genus ***Utnacris*** Sp. Ramme, 1941

Diagnosis : Size medium; brachypterus; head smooth with scattered, punctured; pronotum selliform, rugose; fastigium of vertex slopping forwards; prosternal tubercle transverse, with the apex feebly trilobate; posterior tibiae with few spines and without apical spines.

Distribution : India : Arunachal Pradesh.

Remarks : This genus is included from literature, Tandon and Khera (1976).

Subfamily TROPIDOPOLINAE

Genus ***Oxyrrhepes*** Stal, 1873

44. ***Oxyrrhepes obtusa*** (de Haan)

1842. *Acridium (Oxya) obtusum* de Haan. *Verh. Nd. Overz. Bezitt. Orth.*, : 155

1929. *Oxyrrhepes obtusa* : Willemse, *Treubia*, **10** : 463

Material examined : East Kameng district : 1 ♀, Amatulla, 8.II.1966, coll. K.C. Jayram.

Diagnosis : Body medium size; vertex with median and two lateral longitudinal darker small spots; elytra and wings reaching behind the apex of hind femur; supraanal plate long and triangular with pointed apex; circus slender and only reaching a little behind the supraanal plate.

Distribution : India : Arunachal Pradesh, Karnataka, Madhya Pradesh, Orissa, Rajasthan Sikkim and Tamil Nadu.

Elsewhere : Myanmar; Indonesia; Sri Lanka, Taiwan.

Remarks : This species is newly recorded from Arunachal Pradesh.

SUMMARY

A detailed report of the Acridoidea fauna of Arunachal Pradesh is given here for the first time. It is based on collection made by scientists of the Zoological Survey of India. In all 44 species belonging to 2 families and 33 genera are reported, of which 10 species are recorded for the first time form Arunachal Pradesh. Notes on indentification and general distribution of each species is also given. The distribution of each species within Arunachal Pradesh is traced and supported by distributional district wise table.

ACKNOWLEDGEMENTS

We offer our grateful thanks to Dr. J.R.B. Alfred, Director, Zoological Survey of India, Kolkata, for his encouragement and interest in this work. Our thanks are also due to officers and Staff of the survey for the collection of these interesting material from Arunachal Pradesh.

REFERENCES

DIRSH, V.M. 1954. Revisison of species of genus *Acrida* Linne (Orthoptera : Acrididae) *Bull. Soc. Fouad Entom. Cario.*, **38** : 107-160.

DIRSH, V.M. 1956. Preliminary revision and review of the group Catantopinae (Orthoptera : Acrididae). *Publcoes Cult. Co. Diam. Angola,* **28** : 11-150.

DIRSH, V.M. 1961. A Preliminary revision of the families of Acridoidea (Orthoptera : Insecta). *Bull. Br. Nus. Nat. Hist. (Ent.)* **10**(9) : 351-419.

DIRSH, V.M. 1975. Classification of the Acridomorphid Insects. *F. W. Classey Lte. Faringdon, Oxon.* VII+171.

HANCOCK, J.L. 1913, Zoological results of the Abor expechlion, orthoptera. *Rec. Indian Mus.*, **8** : 311-316, pl. 15.

HAZRA, A.K. SHISHODIA, M.S. 1985. Orthoptera occurring in Namdhapa (Insecta : Orthoptera). *Rec. zool. Surv. India,* **82**(1-4) : 15-32.

HAZRA, A.K. TANDON, S.K., SHISHODIA, M.S., MANDAL, S.K. DEY. A. 1993. Acridoidea (Insecta : Orthoptera) of West Bengal, *Fauna of West Bengal, State Fauna Series* **3**(Part-4) : 287-354.

HAZRA, A.K. TANDON, S.K., SHISHODIA, M.S., MANDAL, S.K. DEY. A. 1995. The Acridoidea (Insecta : Orthoptera). *Fauna of Meghalaya, State Fauna Series,* **4**(part-3) : 209-275.

HOLLIS, D. 1971. A Preliminary revision of the genus *Oxya* Audinet Serville (Orthoptera : Acridoidea). *Bull. Br. Mus. Nat. Hist. (Ent.),* **26**(7) : 269-343.

KEVAN, D.K. Mce. and CHEN, Y.K. 1969. A revised synopsis of the genus *Atractomorpha* Saussure,1842 (Orthoptera: Pyrgomorphidae) with an account of the African aberrans-group. *Zool. J. Linn. Soc.*, **48** : 141-198.

TANDON, S.K. and KEVAN, D.K. 1976. On the occurrence of the subtribe Mekongiella (Orthoptera : Acridoidea : Pyrgomorphidae) in India, **10**(A) : 589-592.

TANDON, S.K. and KHERA, S. 1978. Ecology and Distribution of Grasshoppers (Orthoptera : Acridoidea) in Arunachal Pradesh., *Mem. School. Ent., No.* **6** : 73-89.

UVAROV, B.P. 1927. Some Orthoptera of the families Mantididae, Tettigoniidre and Acrididae from ceylon; *Spolia Selan,* **14** : 84-114.

Table : Showing district-wise distribution of Acridoidea (Orthoptera) reported from Arunachal Pradesh.

Order ORTHOPTERA Super familyACRIDOIDEA Family PYRGOMORPHIDAE	Tawang	West Kameng	East Kameng	Papumpare	Lower subansiri	Upper subansiri	West Siang	Upper Siang	East Siang	Debang valley	Lohit	Changlang	Tirap
Atractomorpha burri		+				+				+			
A. himalayica								-		+	-		
A. angusta						-	+						
A. psittacina affinis						+					-	-	
Tagasta indica						+	+	-					
Mekongiella wardi						+		-					-
Family ACRIDIDAE Subfamily GOMPHOCERINA													
Mesopsis cylindricus								+					
Dnopherula (Aulacobotherus) decisus													
Phonogaster cariniventris					+								
Subfamily OEDIPODINAE													
Heteropternis respondens	+									+			
Pternosicta cinctifemur										+			
Trilophidia annulata				+	+	+				+			
Sphingonotus longipennis										+			
Sphingonotus indus											+		
Acrida exaltata		+				+	+						
Acrida indica					+								-
Gonista filata									+				
Holopercna darjeelingensis						+	+				+		
Ceracris nigricornis						+	+				+		
C. striatus					+								
Phlaeoba infumata		+			+	+	+			+			
P. antennata					+	+	+				+		
P. sikkimensis					+					+			
P. assama									+	+			
Subfamily OXYINAE													
Oxya hyla hyla						+	+						
O. japonica japonica													
O. hyla intricata							+						
O. fuscovittata							+						
Hygracris palustris													+
Subfamily COPTACRIDINAE													
Apalacris varicornis				+						+			+
Coptacra foedata		+						+	+				

Table Contd.

Order ORTHOPTERA Super family ACRIDOIDEA Family ACRIDIDAE	Tawang	West Kameng	East Kameng	Papumpare	Lower subansiri	Upper subansiri	West Siang	Upper Siang	East Siang	Debang valley	Lohit	Changlang	Tirap
Eucoptacra praemorsa		+											
Subfamily HEMIACRIDINAE													
Gesonula punctifrons				-			+						
Spathosternum prasiniferum prasiniferum					+			+		+			
Subfamily EYPREPOCNEMIDINAE													
Eyprepocnemis rosea										+			
Eucnemidia charlottae					+								
Choroeodocus robustus		+				+	+						
Chondracris rosea			+			+	+						
Patanga succincta	-	+			+								
Subfamily CATANTOPINAE													
Catantops erubescens						+							
Catantops pinguis innotabilis									+	+			
Xenocatantops humilis humilis		+			+	+	+			+	+		
Stenocatantops splendens		+			+	+	+			+			
Tauchira sp.					+								
Oxytauchira sp.		+					+						
Utnacris sp.		+	-			+							
Tropidopolinae													
Oxyrrehepes obtusa			+					-					
Subfamily CYRTACANTHACRIDINAE													
Patanga succincta													
Chondracris rosea													

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2) : 175-190, 2006

BLATTARIA (DICTYOPTERA)

S. K. MANDAL
Zoological Survey of India, M-Block, New Alipore, Kolkata-700053

INTRODUCTION

Blattaria (Dictyoptera) popularly known as 'Cockroaches' constitutes an interesting house hold important group of insects. About 4000 species are known from world, of which 152 species are recorded from India. Cockroaches are found in or on the ground, among the low vegetation and debris, but some inhabit in caves and some species live near water. These insects, generally, are omnivorous.

Earlier works on Indian blattids are by Kirby (1904), Shelford (1906, 1910a, and 1910b), Hanitsch (1915, 1929), Bruijning (1948), Princis (1966, 1969 and 1971) and Roth (1979a, 1979b). No comprehensive work on this group from the area is available. Therefore, the present study is undertaken, based on the named and unnamed specimens preserved in the Department collected by several survey parties in recent years.

The present paper deals with 20 species, distributed over 6 families and 14 genera. It is provided with key to families, genera and species. The classification is followed here after Rehn (1951) and Princis (1960).

General morphology of Blattaria

Head is usually hypognathous; antennae almost filiform and is usually well developed; clypeus and labrum large; mouth parts mandibulate; prothorax bears dorsally a large shield like pronotum; forewings modified into more or less thickened tegmina with marginal costal vein; abdomen consists of 11 segments of which 11th segment is reduced; first sternum is small, the 9th (Males) and 7th (Females) sterna are large to form the subgenital plate; male genital complex, asymmetrical and largely concealed by the 9th abdominal sternum which bears a pair of styles; female with reduced ovipositor concealed by enlarged 7th abdominal sternum, cerci unsegmented or segmented; legs similar to each other; coxae large and rather closely approximated; tarsi almost always 5-segmented.

Suborder BLATTARIA

Key to families

1. Anteroventral margin of the middle and hind femora with spine; ninth sternite of male specialized or unspecialized 2

– Anteroventral margin of the middle and hind femora without spine, or rarely 1-4 spines; ninth sternite of male variable 5

2. Subgenital plate of male symmetrical with 2 styles; females with valve devided longitudinally. ..... BLATTIDAE

– Subgenital plate of male not as above; female with subgenital plate without valves 3

3. Supraanal plate of male more or less quadrate; in female broadly rounded and lobate .... EPILAMPRIDAE

– Supraanal plate of both sexes triangular or entire. 4

4. Cerci long and slender, extending well beyond the supraanal plate; legs long and slender .... BLATTELLIDAE

– Cerci short, not projecting much beyond the supraanal plate; legs more or less stocky .... BLABERIDAE

5. Body strongly arched; anteroventral margin of front femur with piliform spines ..... DEROCALYMMIDAE

– Body flat; anteroventral margin of front femur without spine or with 1-3 spines ..... PANESTHIDAE

Family BLATTIDAE

Key to genera

1. Tegmina and wings of both sexes well developed (25-34 mm. long) or absent 2

– Tegmina and wings usually reduced, rarely both developed but if they are within 16 mm. long 3

2. Pronotum broad behind middle, sides deflexed ..... ***Periplaneta*** Burmister

– Pronotum broad before middle, sides not deflexed ..... ***Homalosilpha*** Stal

3. Male first abdominal tergum with a large dense, setal specialization medially; arolia moderately developed ..... ***Hebardina*** Haan

– Male first abdominal tergum without such specialized, arolia subobsolate ..... ***Blatta*** Linnaeus

Genus ***Periplaneta*** Burmeister, 1838

1838. *Periplaneta* Burmister, *Hand. Ent.* **2**(2) : 502.

Key to species

1. Humeral area of tegmen yellow; hind margin of supraanal plate weakly excised in male ... . *australasiae* (Fabricius)

– Humeral area of tegmen not yellow; hind margin of supraanal plate with a deep v-shaped excised in male ..... *americana* (Linnaeus)

1. ***Periplaneta australasiae*** (Fabricius)

1775. *Blatta australasiae* Fabricius, *Syst. ent.*, : 271.

1948. *Periplaneta australasiae* : Bruijning, *Zool. Meded.*, **29** : 110.

1965. *Periplaneta australasiae* : Princis, *Orthopterorum Catalogus*, Part **7** : 447.

Material examined : *Papumpare district* : 2MM, Chessa, 19.x.1996, coll. S. K. Mandal; *Lower Subansiri district* : 1M, Itanagar, 17.x.1996, coll. S. K. Mandal; *Changlang district* : 1F, Miao, 5.v.1981, coll. S. Biswas (Z. S. I. Regd. no. 5518/H5); *Tirap district* : 1F, Taliha, 18.xi.1974, coll. J. M. Julka.

Diagnosis : *Male* : Size medium; head with vertex a little exposed; pronotum subelliptical, all angles broadly rounded; supraanal plate with hind margin weakly excised; cerci rather short and acute; subgenital plate convexely rounded at hind margin, anteroventral margin of front femur with a row of spines which become smaller towards apex and a few large spines apically.

Colour : General colour reddish brown; tegmina with a narrow yellow stripe at humeral area.

Female : Subgenital plate with narrow valves.

Measurement (in mm.) : Male, Female : Body length 27'0-29'0, 26'7-27'9; pronotum length 6'5-7'0; pronotum width 8'5-9'0, 8'0-9'0; tegmen length 25'5-26'6, 26'0-27'0.

Distribution : India : Arunachal Pradesh.

Elsewhere : Australia; Borneo; Java; Myanmar; Sumatra.

Remarks : This species differs superficially from *P. americana* by the presence of yellowish humeral stripe on the tegmen.

2. ***Periplaneta americana*** (Linnaeus)

1758. *Blatta americana* Linnaeus, *Syst. Natura* (10th Bl.) **1** : 34.

1868. *Periplaneta americana* : Walker, *Cat. Blatt. Brit. Mus.* London, : 124.

1966. *Periplaneta americana* : Princis, *Orthopterorum Catalogus*, Part **7** : 405.

Material examined : *Papumpare district* : 7MM, 3FF, 2M N, Chessa, 9.x.1996, coll. S. K. Mandal; *Lower Subansiri district* : 2MM, Chimpu, 17.x.1996, coll. S. K. Mandal; *East Siang district* : 1M, D. Ering Sanctuary, Sibiamukh, 19.i.2000, coll. S. K. Mandal; 1M, 2FF, 2M N, 1F N, Passighat, Anchal ghat, 21.i.2000, coll. S.K. Mandal.

Diagnosis : *Male* : Large size; head with vertex exposed, interocular space smaller than the distance between the antennal sockets; pronotum flattened, smooth and all the angles broadly rounded; tegmina extend beyond the apex of the abdomen by 4 to 7 mm; supraanal plate with hind margin deeply excised; subgenital plate weakly rounded at hind margin; anteroventral margin of front femur with a row of spines which decreases towards the distal end.

Colour : Pronotum with a narrow yellow band at lateral and another broad at the hind margin; tegmina uniformly reddish brown.

Female : Subgenital plate with wide valves.

Measurement (in mm.) : Male, Female : Body length 28'3-33'0, 29'5-33'8; Pronotum length 7'4-8'8, 8'3-9'0; Pronotum width 9'0-10'6, 10'0-10'9; Tegmen length 27'2-29'5, 27'3-30'0.

Distribution : Cosmopolitan.

Remarks : This species thrives in tropical and subtropical climates.

Genus ***Homalosilpha*** Stal, 1874

1874. *Homalosilpha* Stal, *Bihang Sv. Vet. Akad. Handl.*, 2(13) : 13.

3. ***Homalosilpha ustulata*** (Burmeister)

1838. *Periplaneta ustulata* Burmeister, *Handb. Ent.*, 2(2) : 503.

1966. *Homalosilpha ustulata* : Princis. *Orthopterorum Catalogus*, Part 8 : 458.

Material examined : *West Kameng district* : 2MM, 1F, Tanga road, 18.vii.1965, coll. S.K. Tandon; 1F, Tanga river bed, 18.xii.1965, coll. S. K. Bhattacharya and A.N.T. Joseph. *West Siang district* : 1F, Ego, 10.ii.1985, coll. G. K. Srivastava (Z.S.I. Regd. no. 1097/H5); 1M, Siram bridge, 14.x.1966, coll. S. K. Tandon. *East Siang district* : 1M, 1F, Panji, 16.i.1912, coll. Kemp (Z.S.I. Regd. no. 474/HI and 475/HI). *Debang valley* district : 1F, Deopani, 6.iii.1965, coll. S. K. Tandon; 2MM, 3FF, Sadiya road, 8.iii.1969, coll. S.K. Tandon (Z.S.I. Regd. no. 5122 to 5125/H5).

Diagnosis : *Male* : Size medium : head with vertex exposed; pronotum wide before the middle; postereolateral corners of all tergal segments with tooth like projections; supraanal plate small, deeply excised at hind margin; subgenital plate symmetrical with equal styles; anteroventral margin of front femur with a row of stout spines, of which largest one situated near the middle.

Colour : Dark reddish; pronotum yellow on all sides, disc with two black curved longitudinal stripes medially.

Female : Supraanal plate with notch at posterior margin; subgenital plate convex at hind margin.

Measurements (in mm.) : Male, Female : Body length 24'0-28'0, 25'0-28'5; pronotum length 6'0-7'2, 6'5-7'1; pronotum width 7'2-7'9, 7'8-8'4; tegmen length 24'0-24'5, 27'0-29'5.

Distribution : India : Arunachal Pradesh, Andaman and Nicobar Is., Assam, Orissa, Sikkim, West Bengal.

Elsewhere : Borneo; Celebes; Java; Myanmar; Sumatra.

Remarks : Usually found in kitchens and corners of the rooms. It is a household pest. This species is easily separated from *Periplaneta* by its pronotal structures and colour pattern.

Genus ***Hebardina*** Bey-Blenko, 1938

1938. *Hebardina* Bey-Blenko, *Ann. Mag. nat. Hist.*, (11)1 : 234.

4. ***Hebardina concina*** (De Haan)

1842. *Blatta (Periplaneta) concina* De Haan, In *Temminck Verchand. Natural Geschied. nederl Overz. Besitt.*, 16 : 15.

1996. *Hebardina concina* : Princis. *Orthopterorum Catalogus*, Part 8 : 466.

1990. *Hebardina concina* : Roth. *Mem. Victoria Mus* 50(2) : 363.

Material examined : *West Kameng district* : 1F, Vairab Kundo, 30.v.1961, coll. K. C. Jayram, *Lower Subansiri district* : 1M, 2FF, Kimin, 11.v.1966, coll. A.N.T. Joseph (Z.S.I. Regd. no. 5388-5390/H5); *West Siang district* : 1M, Megha

basti, 8.x.1966, coll. S. K. Tandon; 2MM, 3FF, Dali village, 10 & 12.x.1966, coll. S. K. Tandon; *East Siang district* : 1M, 3FF and 2M N and 3F N, D. Ering Sanctuary, Sibiamukh, 19.i.2000, coll. S.K. Mandal. *Lohit district* : 1F, Daphabhum expd. Sizi village, 8.x.1966, coll. S.K.Tandon & G.S.I. (Z.S.I. Regd. no. 385/H5); *Changlang district* : 2MM, Nampang, 8.x.1971, coll. G. S. Arora; Tirap district : 1F, Deomali forest, 9.x.1971, coll. G.S. Arora; 1M, Jairampur, 28.x.1971, coll. G.S. Arora.

Diagnosis : *Male* : Size small; head and vertex a little exposed; ocular space greater than the space between the antennal sockets; pronotum with lateral margin rounded; tegmina and wings usually reduced, squami form or rounded, at least three targa exposed; first abdominal tergum with a large, dense setal specialization in the middle; supraanal plate small and transverse; subgenital plate small, hind margin transverse with two styles; anteroventral margin of front femur with feebly curved spines which abrupt decreases in size towards the apex; tarsal claws symmetrical and arolia moderately developed.

Colour : Head, pronotum and tegmen black.

Female : Larger than male.

Measurement (in mm.) : Male, Female : Body length 12'5-13'7, 13'0-15'0; pronotum length 3'2-3'5, 3'4-3'65; pronotum width 4'1-4'5, 4'4-4'7; tegmen length 5'9-8'5. 5'0-8'2.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Gujarat, Meghalaya, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal.

Elsewhere : Australia; Borneo; Celebes; Japan; Java; Malakka; Myanmar; Philippines; Sumatra; Thailand and Vietnam.

Remarks : This is widely distributed species and easily recognised by its squami form tegmina.

Genus ***Blatta*** Linnaeus, 1758

1758. *Blatta* Linnaeus, *Systema naturae*, 1(10th ed.), Holmiae : 424.

5. ***Blatta orientalis*** Linnaeus

1758. *Blatta orientalis* Linnaeus, *Systema naturae*, 1(10th ed.); Holmiae : 424.

1966. *Blatta orientalis* : Princis, *Orthopterorum Catalogus* part **8** : 475.

Material examined : *Debang Valley district* : 1M, Kornu, 1.ii.2000, coll. S. K. Mandal. *Tirap district* : 1M, Daphabum Expd. Tihun, 13.xii.1969-70 (alt. 4160'), coll. J. M. Julka (Z.S.I. Regd. no. 9059/H5).

Diagnosis : *Male* : Size small; head and vertex exposed; pronotum with anterior margin convexely rounded, hind margin truncate; tegmina and wings reduced, covering only about two thirds of the abdominal terga; supraanal plate transeverse, shallowly concave at the hind margin; subgenital plate symmetrical, interstyler margin convexely rounded; anteroventral margin of hind femur with small spinnules and terminating with 1 or 2 distal spines; arolia subobsolate.

Colour : Brown.

Female : Tegmina usually extend only to about the middle of the terga; supraanal plate with a medio-longitudinal ridge and distal margin angulate.

Measurement (in mm.) : Male, Body length 9'5; pronotum length 4'0; tegmen length 4'5.

Distribution : Cosmopolitan.

Remarks : This is the first record of the species from this state. It is a cosmopolitan species and one of the most important domestic pest and thrives in tropical and subtropical climates all over the World.

Family EPILAMPRIDAE

Key to genera

1. Head with vertex covered by pronotum. ..... ***Morphna*** Shelford
- Head with vertex not covered by pronotum. 2
2. Wings truncate or acuminate at apex. ..... ***Rhabdoblatta*** Kirby
- Wings rounded at apex. ..... ***Stictolampra*** Hanitsch

Genus ***Morphna*** Shelford, 1910

1910. *Morphna* Shelford, *Gen. Ins.*, **101** : 6.

6. ***Morphona amplipennis*** (Walker)

1868. *Epilampra amplipennis* Walker, *Cat. Blatt. Brit. Mus.*, London : 196.

1904. *Molytris amplipennis* : Kirby, *Syn. Cat. Orth.*, London, **1** : 114.

1967. *Morphna amplipennis* : Princis, *Orthopterorum Catalogus*, part **11** : 648.

Material examined : *Papumpare district* : 1F, Chessa, 23.x.1996, coll. S. K. Mandal; Upper *Subansiri district* : 1F, Leme King (alt. 1400'), 4.xii.1974, coll. J. M. Julka; *West Siang district* : 1F, Rotung, 24.xii.1911, coll. Kemp.

Diagnosis : *Female* : Size large; body rather depressed; head and vertex covered by pronotum, interocular space smaller than the distance between the antennal sockets; pronotum trapizoidal, wider than length, biggest wide beyond the middle; tegmina and wings extends just beyond the abdomen; supraanal plate quadrate, posterior margin with a groove medially; cerci moderately long; subgenital plate broad, hind margin shallowly incurved; anterior margin of front femur with 3 to 4 spines ending with 2 large spines.

Colour : Testaceous; antennae deep brown; pronotum with deep brown sculpture medially; tegmina with some black spots.

Distribution : India : Arunachal Pradesh.

Remarks : This species is endemic to India. The author have studied only female specimens of this species collected from West Siang district, Upper Siang district and Papumpare district.

Genus ***Rhabdoblatta*** Kirby, 1903

1903. *Rhabdoblatta* Kirby, *Ann. Mag. nat. Hist.*, (7)**12** : 276.

7. ***Rhabdoblatta riddley*** (Kirby)

1903. *Heterolampra ridleyi* Kirby, *Ann. Mag. nat. Hist.*, (7)**12** : 278.

1948. *Epilampra ridleyi* : Bruijning, *Zool. Meded.*, **29** : 40, 121.

1967. *Rhabdoblatta ridleyi* : Princis, *Orthopterorum Catalogus*, Part **11** : 672.

Material examined : *Papumpare district* : 1M, Chessa, 23.x.1996, coll. S.K. Mandal.

Diagnosis : *Male* : Size large, head and vertex exposed; pronotum elliptical, broader than long; tegmina densely reticulated, costal area slightly oblique with numerous veins; supraanal plate broad, deeply notched in the middle; subgenital plate symmetrical with undulated hind margin; anteroventral margin of front femur with 3 spines near the proximal margin and another 2 near distal end.

Colour : Head light reddish; pronotum gray, sides subhyaline grey and rather dark in the middle; tegmina light grey with numerous deep brown spots.

Measurement (in mm.) : Male : Body length 39'0; pronotum length 9'0; pronotum width 12'0; tegmen length 38'0.

Distribution : India : Arunachal Pradesh, Meghalaya and West Bengal.

Elsewhere : Java; Malakka and Myanmar.

Remarks : This species generally occurs in forest, specially in the hilly regions. It is recorded for the first time from the state.

Genus ***Stictolampra*** Hanitsch, 1930

1930. *Stictolampra* Hanitsch, *Bull. & Ann. Soc. ent Belg* **70** : 257.

8. ***Stictolampra plicata*** (Navas)

1904. *Opisthoplatis plicata* Navas, *Bol. Soc. aragon cienc nat.*, **3** : 130.

1967. *Stictolampra plicata* : Princis, *Orthopterorum Catalogus*, Part **11** : 683.

Material examined : Debang Valley district : 1M N, Roing, 25.i.2000, coll. S.K. Mandal. Lohit district : 1M, 1F N. Daphabum expd. Wokhro, 3.xii.1969, J. M. Julka.

Diagnosis : Nymph : Head with vertex exposed; pronotum punctured, anterior margin parabolic, hind margin with obtusely angulated; tegmina and wings absent; supraanal plate semiorbicular, a minute medium dentation on the hind margin, subgenital plate symmetrical.

Colour : Brown.

Distribution : India Arunachal Pradesh, Bihar, Karnataka, Kerala, Madhya Pradesh, Tamil Nadu, Uttar Pradesh and West Bengal.

Elsewhere : Borneo; Java and Malayasia.

Remarks : This species is recorded for the first time from this state.

Family BLATTELLIDAE

Key to genera

1. Tegmina and wings with discoidal vein forked beyond the middle point..... ***Blattella*** Caudell

– Tegmina and wings with discoidal vein forked before the middle .... ***Hemithyrsocera*** (Fabricius)

Genus ***Blattella*** Caudell, 1903

1903. *Blattella* Caudell. *Proc. Ent. Soc. Washington* **5** : 234.

Key to species *Blattella*

1. Supraanal plate semicircular in male .... *germanica* (Linnaeus)

– Supraanal plate triangular in male..... ..... *humbertiana* (Saussure)

9. ***Blattella germanica*** (Linnaeus)

1767. *Blatta germanica* Linnaeus, *Syst. naturae*, **1**(2) (ed. 12) : 688.

1895. *Phylodromia germanica* : Tepper, *Trans. R. Soc. S. Aust.*, **19** : 150.

1969. *Blattella germanica* : Princis, *Orthopterorum Catalogus*, Part **13** : 807.

Material examined : *Papumpare district* : 13FF, Chessa, 20.x.1996, coll. S.K. Mandal; 1M, 1F, Chessa, Balijan, 23.x.1996, coll. S.K. Mandal, *West Kameng district* : 2MM, 1F, Jigang, 13.x.1996, coll. S.K. Mandal; *Lower Subansiri district* : 2MM, 6FF, Banderdewa, 19.x.1996, coll. S.K. Mandal; *Upper Subansiri district* : 1M, Daporijo, 28.x.1966, coll. S.K. Tandon; *West Siang district* : 1M, Lekhabali, 7.x.1966, coll. S.K. Tandon; 2MM, Dali camp, 12.x.1966, coll. S.K. Tandon; 3FF, New Jinning, 19-20.x.1966, coll. S.K. Tandon; *East Siang district* : 1F, D. Ering sanctuary, Sibiamukh, 19.i.2000, coll. S.K. Mandal; *Debang Valley district* : 2MM, Roing, 27.i.2000, coll. S.K. Mandal; *Tirap district* : 3MM, Deomali, 9.xi.1971, coll. G.S. Arora; 1F, Namdapha survey, Hornbill, 13.iv.1981, coll. S. Biswas.

Diagnosis : *Male* : Size small; head and vertex a little exposed; interocular space 3/4 wide between antennal sockets; pronotum transverse; tegmen elongated, subcosta shorter than anal field, discoidal vein forked before the middle; supraanal plate semicircular subtriangular; subgenital plate asymmetrical left side concavely excavated with a pair of small similar, cylindrical styles; supraanal plate triangular, its hind margin with convexely rounded; anteroventral margin of front femur armed with a row of heavy spines which decreases in length distally and terminate with 2 or 3 large spines; arolim about half of the length of the claws.

Colour : Testaceous; pronotum with a pair of dark longitudinal stripes.

Female : Subgenital plate slightly rounded at hind margin.

Measurement (in mm.) : Male, Female : Body length 10'5-11'5, 9'8-11'0; tegmen length 10'0-11'0, 9'4-10'0.

Distribution : Cosmopolitan.

Remarks : *Blattella germanica* is a widely distributed cosmopolitan species.

10. ***Blattella humbertiana*** (Saussure)

1863. *Polyzosteria humbertiana* Saussure, *Mem. Soc. Geneva*, **17** : 131.

1969. *Blattella humbertiana* : Princis, *Orthopterorum Catalogus*, Part **13** : 842.

Material examined : *West Kameng district* : 1M, Saitan bridge, 23.iv.1966, coll. A.N.T. Joseph; *Papumpare district* : 2MM, 2FF, Chessa, 23.x.1996, coll. S.K. Mandal; *Lower Subansiri district* : 2MM, 2FF, Chimpu, 19.x.1996, coll. S.K. Mandal. *East Siang district* : 1M, D. Ering sanctuary, 19.x.2000, coll. S.K. Mandal; *Debang Valley district* : 1M, Deopani, 6.iii.1969, coll. S.K.

Tandon; 3MM, 2FF, Roing, 26.i.2000, coll. S.K. Mandal. *Lohit district* : 1F, Namdhapa, Wakhroo, 4.xii.1969, coll. G.S. Arora.

Diagnosis : Male : Size small; head and vertex exposed, interocular space less than 3/5 wide between antennal sockets; supraanal plate triangular and extends beyond the subgenital plate, hind margin convexly rounded; subgenital plate asymmetrical, hind margin a little convex; sexual gland present on 7th abdominal tergum.

Colour : Brownish; head yellow, abdomen yellowish brown, each segment with a rectangular dark brown spots on each side which are connected by narrow stripe of similar colour.

Female : Supraanal plate small, triangular, subgenital plate with hind margin broadly convex.

Measurements (in mm.) : Male, Female : Body length 9'5-11'0, 10'0-11'8; pronotum length 3'0-

Distribution : Widely distributed in the whole world.

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

Genus ***Hemithyrsocera*** Saussure, 1893

1893. *Hemithyrsocera* Saussure, *Soc. ent.*, 8: 57.

11. ***Hemithyrsocera palliata*** (Fabricius)

1798. *Blatta palliata* Fabricius, *Supplementum Entomologiae Systematica* (Hafniae) : 186.

1995. *Hemithyrsocera palliata* : Roth, *Invertebr. Taxon.* 9 : 966.

Material examined : *Papumpare district* : 2FF, Chessa, Sonajali, 20.x.1996, coll. S. K. Mandal (Z.S.I. Regd. no. 9060/H5 and 9061/H5), *Lower Subansiri district* : 2FF, Dejoo, 10.v.1966, coll. G. S. Arora (Z.S.I. Regd. no. 5131/H5 and 5134/H5), *Tirap district* : 1M, Joyrampur, 27.vii.1971, coll. G. S. Arora (Z.S.I. Regd. no. 5511/H5).

Diagnosis : Male : Size small; head with vertex a little exposed; interocular space slightly less than distance between ocellar spots; pronotum subelliptical; tegmina and wings fully developed, hind wings with radial vein branched forked before the middle; supraanal plate with hind margin convexely rounded; subgenital plate with large, densely spined processes on the hind margin; anteroventral margin of front femur with a short row of piliform spinules.

Colour : Pronotum disc with large reddish brown to black macula reaching anterior margin to hind margin with partly broad yellowish band.

Female : Supraanal plate with convexely rounded hind margin.

Measurements (in mm.) : Male, Female : Body length 9'0-10'0, 8'5-9'3; pronotum length 3'0-3'4, 3'2-3'5; tegmen length 10'5-11'2, 9'3-10'2.

Distribution : India : Arunachal Pradesh, Assam, Karnataka, Sikkim, Tamil Nadu and Tripura.

Elsewhere : Borneo; Myanmar; Mallakka; Java; Sumatra and Thailand.

Remarks : This species is first time recorded from this state.

Family BLABERIDAE

Key to genera

1. Anteroventral margin of front femur with a short row of piliform spinules on distal third or less; without long proximal or terminal spines ..... ***Paranauphoeta*** Brunner

– Anteroventral margin of front femur fringed with regularly placed hairs; long terminal or proximal spines present .... ***Pycnoscelus*** Linnaeus

Genus ***Paranauphoeta*** Brunner, 1865

1865. *Paranauphoeta* Brunner, *'Nouveau Systeme des Blattaires'* (G. Braumuller : Vienna) : 397.

12. ***Paranauphoeta indica*** Sausure & Zehntner

1895. *Paranauphoeta indica* Saussure and Zehntner, *Rev suisse. Zool.* Geneva, 3 : 16.

1964. *Paranauphoeta indica* : Princis, *Orthopterorum Catalogus*, Part 6 : 24.

Material examined : *West Siang district* : 1M, 1F, Rotung (Abor expd.), 23.xii.1911, coll.

Kemp; 2M, 1F nympha, Rotung, 28.xii.1911, coll. Kemp.

Diagnosis : *Male* : Size medium; head and vertex exposed; pronotum with anterior margin rounded, hind margin straight and lateral margin convexely rounded, widest behind the middle; tegmina and wings fully developed, reaching beyond the abdomen; supraanal plate with anterior margin shallowly convex; subgenital plate weakly asymmetrical, styles elongated, similar and widely separated, behind the right style and its posterior corner sharply produced; anteroventral region of front femur without spines, subobsolete arolae placed between the claws.

Colour : Pronotum black, laterally with a thin yellow *border;* along the costal margin and at the base of the tegmen with golden yellow spots.

Female : Supraanal plate broadly rounded; subgenital plate with its lateral margin below cerci concavely excavated.

Measurements (in mm.) : Male, Female : Body length 28'0-31'0, 28'6-21'5; pronotum length 6'5-6'8, 6'5-6'7; tegmen length 27'0-30'7, 27'5-29'9.

Distribution : India : Arunachal Pradesh, Assam, Sikkim and West Bengal.

Remarks : This species is included on the basis of literature review.

Genus ***Pycnoscelus*** Scudder, 1862

1862. *Pycnoscelus* Scudder, *Best J. nat. Hist.* **7** : 421.

13. ***Pycnoscelus surinamensis*** (Linnaeus)

1758. *Blatta surinamensis* Linnaeus, *Syst. naturae,* (10th ed.) 1 : 424.

1903. *Pycnoscelus surinamensis* : Trans. *Am. ent. Soc.*, **29** : 131, 136.

1964. *Pycnoscelus surinamensis* : Princis, *Orthopterorum Catalogus*, Part **6** : 264.

Material examined : *West Kameng district* : 1F, Bhalukpong, 6.v.1966, coll. A.N.T. Joseph (Z. S.I. Lot. 5150/H5); *West Siang district* : 1F, Lekhabali, 2.xi.1966, coll. S.K. Tandon (Regd. no. 5144/H5); 1F, Tamen, 16.v.1966, coll. S.K. Tandon; Debang Valley district : 1F, nymph, Roing, 25.i.2000, coll. S.K. Mandal; Lohit district : 1F, 2.xi.1966, coll. S.K. Tandon.

Diagnosis : *Female* : Size medium; vertex and head exposed, ocelli large, approximate to the eye; interocular space narrower than distance between the antennal sockets; pronotum laterally rounded, posterior margin a little rounded; tegmen and wings extending scarcely upto the apex of the abdomen; subgenital plate large with unequally rounded at apex; anteroventral margin of front femur with row of slender piliform hairs and terminates in one large distal spine.

Colour : Pronotum dark with pale anterior and lateral margins.

Measurements (in mm.) : Female : Body length 15'5-17'8, pronotum length 5'5-6'0; pronotum width 6'0-7'2; tegmen length 10'0-17'5.

Distribution : Cosmopolitan.

Remarks : So far only the female of this species has been recorded.

Family DEROCALYMIDAE

Genus ***Periphaerus*** Serville, 1831

1831. *Periphaerus* Serville, *Rev. moth. des. Orthopt.* : 17.

Key to species

1. Penaltimate segment with two furrow in front ..... *armadille* Serville

– Penaltimate segment with 3 furrows in front. ..... *altus* Walker

14. ***Perisphaerus armadillo*** Serville

1831. *Perisphaerus armadillo* Serville, *Rev. moth. des. Orthopt.* : 133.

1947. *Perisphaerus armadillo* : Princis, *Opusc. ent.*, **12** : 51.

1964. *Perisphaerus armadillo* : Princis, *Orthopterorum Catalogus*, Part **6** : 205.

Material examined : *East Siang district* : 1F, Sadiya (Abor expd.), 28.xi.1911, coll. Kemp. (Regd, no. 5669/14).

Diagnosis : Female : Body medium size; smooth; head exceedingly covered by pronotum, pronotum large depressed, anterior margin obtusely rounded and hind margin truncate; tegmen and wings absent; supraanal plate small, hind margin with convexely rounded; subgenital plate similar, cerci not extended beyond the margin of supraanal plate; anteroventral margin of front femur with small hairy spines.

Colour : Deep brown.

Measurements (in mm.) : Female : Body length 16.5; pronotum length 5'0; pronotum width 8'5.

Distribution : India : Arunachal Pradesh.

Elsewhere : Borneo; Celebes; Malakka; Malayasia; New Guinea and Sumatra.

Remarks : Single female specimen is present in the National Zoological Collection (Calcutta) identified by Hebard.

15. ***Perisphaerus altus*** Walker

1868. *Perisphaeria altus* Walker, *Cat. Blatt. Britt. Mus.*, London : 170.

1895. *Perisphaeria himalayae* Sauss & Zehnt, *Revue suisse de zoologie*, 3(1) : 36.

1964. *Perisphaerus altus* : Princis, *Orthopterorum Catalogus*, Part 6 : 204.

Material examined : *West Siang district* : 1F, Rotung (Abor expd.), 21.xii.1911, coll. Kemp. (Z.S.I. Regd. no. 582/H5).

Diagnosis : Size medium; strongly arched shaped body; head excidingly covered by pronotum, interocular space smaller than the distance between the antennal sockets; pronotum large, depressed medially, with unequal disc, anterior margin of pronotum slopping downward; tegmen and wing absent; abdominal segment small, unequal; supraanal plate transverse; subgenital plate small; cerci small not reaching the end of supraanal plate.

Colour : Deep brown in colour.

Measurements (in mm.) : Female : Body length 15'0; pronotum length 6'2; pronotum width 7'8.

Distribution : India : Arunachal Pradesh.

Family PANESTHIDAE

Key to genera

1. Lateral margin of abdominal tergite 7 crenulate or dentate ..... ***Salganea*** Stal
2. Lateral margin of abdominal tergite 7 generally straight ..... ***Panesthia*** Serville

Genus ***Salganea*** Stal, 1879

1879. *Salganea* Stal, *Ofvers. K. Sven. Vetenskapsakad Foerh.*, **34** : 37.

Key to species

1. Tegmina and wings fully developed; anteroventral margin of front femur with 1-3 spines ..... *raggei* Roth
- Tegmina and wings reduced, anteroventral margin of front femur without spine .... *biglumis* Saussure

16. ***Salganea raggei*** Roth

1979. *Salganea raggei* Roth, *Aust. J. zool. Suppl. Ser.* No. 69 : 30.

Material examined : *West Siang district* : 1M, Kobo (Abor expd.), 18.xii.1911, coll. Kemp (under rotton wood); 1F, nymph, (abor expd.), Rotung 1400', date nil.xii.1911, coll. Kemp; 1F, nymph, Non-gpriang, (abor expd.), 23.xii.1911, coll. Kemp; Debang Valley district : 1F, Mishmi hills, Delai valley, Che Che, 22.xi.1936, coll. M. Steele.

Diagnosis : Male : Size large; pronotum with anterior margin V-shaped emargination, a small tubercle present behind the margin on either side of line; laterocaudal angle of abdominal segment 6, a short blunty rounded oblique spine; supraanal plate with hind margin 8-16 subequal teeth; anteroventral margin of front femur 1-3 spines.

Colour : Black.

Measurements (in mm.) : Male, Female : body length 29'0-45'0, 30'0-49'0; pronotum length 6'3-7'0, 8'0-11'5; pronotum width 9'0-13'5, 10'0-14'0

Distribution : India : Arunachal Pradesh, Assam, Meghalaya, Nagaland, Sikkim and Uttar Pradesh.

Elsewhere : Bangladesh; Bhutan; China; Indo-China; Hainan; Laos; Nepal; Taiwan; North Thailand and South Vietnam.

Remarks : This species occurs mostly in North East India and Uttar Pradesh.

17. ***Salganea biglumis*** (Saussure)

1895. *Panesthia biglumis* Saussure, *Rev. Suisse Zool.*, **3** : 319.

1957. *Salganea bigulmis* : Bey-Bienko, *Entomol. Obozr.*, **36** : 902.

Material examined : *West Kameng district* : 1M, 1F, Bomdila, 22.iv.1966, coll. A. N. T. Joseph.

Diagnosis : Male : Size medium; head and vertex a little exposed; pronotum convex, anterior margin with a V-shaped mesal excision, a pair of small widely separated tubercles present on the disc; tegmina with lateral pads, subtriangular, not quite reaching the hind margin of metanotum; wings reduced; anterolateral corners of tergite 6 and 7 with a small hole, lacking of associated setae; supraanal plate with hind margin 9-12 unequal teeth; subgenital plate minutely exposed; anteroventral margin of front femur without spine.

Colour : Head thorax and abdominal tergites black.

Female : Subgenital plate with hind margin bluntly rounded unequal width teeth.

Measurements (in mm.) : Male, Female : Body length 22'0-21'3; pronotum length 4'9, 4'4; pronotum width 7'8, 7'3.

Distribution : India : Arunachal Pradesh, Sikkim and West Bengal.

Remarks : *Salganea biglumis* is recorded here for the first time from this state. It is generally found in forest area.

Genus ***Panesthia*** Serville, 1831

1831. *Panesthia* Serville, *Ann. Sci. nat.*, **22** : 38.

Key to Species

1. Punctations on the surface of supraanal plate and 7th abdominal tergite stellate like .... *stellata* Saussure

– Punctation on the surface of the supraanal plate and 7th abdominal tergite not stellate like..... 2

2. Tegmina with dark large macula on the basal half; anterolateral corner of 5th abdominal tergite with a transeverse groove .... *flavipennis* Wood Mason

– Tegmina black to brown; anterolateral corner of 5th abdominal tergite without a transverse groove; nymphs with a broad yellowish band on the meso and metanotum ....*angustipennis cognata* Bey-Bienko

18. ***Panesthia stellata*** Saussure

1895. *Panesthia stellata* Saussure, *Rev. Suisse Zool.*, : 313.

1979. *Panesthia stellata* Roth, *Aust. J. Zool.*, Suppl, Ser., No. **74** : 63.

Material examined : *Papumpare district* : 2M N, Chessa, 23.x.1996, coll. S. K. Mandal; *West Siang district* : 1M, 3F N, Kobo, (abor expd), 30.xi.,3.6.xii.1911, coll. Kemp; *East Siang district* : 1F, Passighat, 17.1.2000, coll. S. K. Mandal; 1M, D. Ering sanctuary, Sibiamukh, 19.i.2000, coll. S. K. Mandal; *Debang Valley district* : 1M, Koronu, 1.ii.2000, coll. S. K. Mandal.

Diagnosis : Size large; head finely punctate, vertex exposed; pronotum flattened, transverse, widest below the middle, anterior half slightly depressed with 2 oblique grannular mounds; tegmina and wings fully developed, extending beyond the abdomen; tergite 7 densely punctate, space between the punctate a stellate shape; supraanal plate densely covered with stellate like punctations; subgenital plate narrow but broadly exposed; anteroventral margin of front femur with a small distal spine.

Colour : Head black; pronotum shiney black.

Female : Anterior margin of pronotum weakly concave and without mesal elevation.

Measurements (in mm.) : Male : Female : Body length 26'5-32'0, 26'0-35'0; pronotum length 5'5-7'6, 5'6-7'5; pronotum width 10'0-12'0, 9'5-12'0; tegmen length 27'0-30'0, 28'0-34'0.

Distribution : India : Arunachal Pradesh, Assam, Meghalaya, Nagaland, Sikkim and West Bengal.

Elsewhere : Bangladesh; Bhutan and Myanmar.

Remarks : The stellate like punctations on the terminal abdominal segments of nymphs and adults are specific characters for the species.

19. ***Panesthia flavipennis*** Wood-Mason

1876. *Panesthia flavipennis* Wood-Mason, *J. Asiat. Soc. Bengal*, **45** : 190.

1979. *Panesthia flavipennis* : Roth, *Aust. J. Zool. Suppl. Ser.* No. **74** : 119.

Material examined : West Kameng district : 1F, N. Bhalukpong, 23.xii.1965, coll. S. K. Bhattacharjee & A. N. T. Joseph; Upper Subansiri district : 1M, 1F, N. Kampass, 27.i.1975, coll. J. M. Julka; West Siang distcrict : 1, Upper Rotung (abor expd.), 5-10.xi.1912, coll. Kemp; 2MM, Rotung, 1400', 18-23.x.1911, coll. Kemp; Tirap district : 1F, Gibbans land, Namdhapa, 20.xii.1982, coll. S. Biswas (Z.S.I. Regd. No. 1012/H5).

Diagnosis : Male : Size large; head and vertex a little exposed; pronotum with anterior margin widely and moderately excavated, laterally thickened into distinct tubercles; tegmina and wings fully developed; anterolateral corners of abdominal tergite 6 and 7 with nonsetose small holes; supraanal plate with anteriorhalf punctate, hind margin subentire or with broad shallow rounded crenulations; subgenital plate broadly exposed, upturned. Anteroventral margin of front femur without spine.

Colour : Black; tegmina with a large macula on basal half.

Female : Pronotum lateral margin not all thickened and without tubercle.

Measurements (in mm.) : Male, Female : Body length 35'0-39'0, 32'5-38'0; pronotum length 8'5-10'0, 7'7-9'2; pronotum width 12'0-15'0, 12'5-13'6; tegmen length 27'0-30'0, 28'0-31'5.

Distribution : India : Arunachal Pradesh, Nagaland.

Elsewhere : Myanmar.

Remarks : This is a interesting species and differs from the other known species of this genus in respect of small non setose holes present in anterolateral corners of abdominal tergites 6 and 7.

20. ***Panesthia angustipennis cognata*** Bey-Bienko

1969. *Panesthia cognata* Bey-Bienko, *Entomol. Rev.*, **84** : 529.

1979. *Panesthia angustipennis cognata* : Roth, *Aust. J. Zool.* (Suppl. Ser) no. **74** : 42.

Material examined : *Papumpare district* : 1F, nymph, Chessa, 23.x.1996, coll. S. K. Mandal; *West Siang district* : 1M, 2F, nymph, Janakmukh, 600' (In rotton wood) Abor expd. coll. Kemp; 1F, nymph, Rotung, Abor expd. 1400' (Under bark), 23.xii.1911, coll. Kemp; 1F, nymph, Kobo, Abor expd. 400' (under bark), 8.xii.1911, coll. Kemp; *Debang valley district* : 1M, nymph, Koronu, 1.ii.2000, (Under bark), coll. S. K. Mandal; *Lohit district* : 2MM, Tihun (Daphabhum expd.), 10.xii.1969, coll. J. M. Julka.

Diagnosis : Male : Size large; head densely punctate, vertex usually exposed, foveolate pronotum flattened to subconvex, anterior margin slightly convex, mesal disc tubercles small to large; tegmen and wings extending about the end of abdomen; abdominal tergite 7 with lateral margin a little concave, posterior angle small, acute and directed posteriorly; supraanal plate with hind margin serulate, lateral angles acute; subgenital plate broadly exposed; anteroventral margin of front femur with minute distal spines.

Colour : Head and pronotum black; tegmina dark brown.

Female : Vertex not foveolate; pronotum with anterior margin a little excavated.

Measurements (in mm.) : Male, Female : Body length 25'0-30'6, 28'4-40'5; pronotum length 6'0-8'3, 5'0-8'0; pronotum width 10'0-13'0; tegmen length 25'0-30'5, 26'5-38'0.

Distribution : India : Arunachal Pradesh, Assam, Meghalaya and Sikkim.

Elsewhere : Bhutan; Myanmar; China, Laos; North Vietnam; Thailand and Tibet.

Remarks : Nymphs always have two pairs of rusty yellow spots on the meso and motanotum.

SUMMARY

This paper deals with 20 species, distributed over 14 genera and 6 families. Six species are recorded here for the first time from Arunachal Pradesh. Key for identification of families, genera and species of Blattaria (Dictyoptera) have been provided. The distribution maps are also given for each species known from various districts of Arunachal Pradesh.

ACKNOWLEDGEMENT

The author is grateful to Dr. J.R.B. Alfred, Director, Zoological Survey of India, for laboratory facilities and to Dr. G.K. Srivastava, Additional Director (Retd.) for various suggestions. I am also thankful to Dr. S. K. Mitra, Joint Director (Retd.) for helping in many ways to complete this work. Thanks are also due to officers and staff members of the survey for the collection of this interesting material from Arunachal Pradesh.

REFERENCES

BRUIJNING, C.E.A. 1948. Studies on Malayan Blattidae. *Zool. Meded. R. Mus. Nat. Hist.*, Leiden, **29** : 1-174.

HANITSCH, R. 1915. Malayan Blattidae. *J. Straits Branch R. Asiat. Soc.* **69** : 17-178.

HANITSCH, R. 1929. Fauna of Sumatrensis. *Tijdschript. Voor. Entomologie*, **72** : 263-302.

IMM'S, A. D. 1977. General Text Book of Entomology., **2** (Part 3) : viii + 1345 pp. (london), Revised by Richards, O. W. & Devis, R. G.

KIRBY, W. F. 1904. A synonymic catalogus of Orthoptera., *Brit. Mus. Nat. Hist.*, **1** : 1-501.

PRINCIS, K. 1960. *Zur. Systematic der Blatterien. EOS*, **36** : 427-449.

PRINCIS, K. 1966. Blattariae, Suborder : Blattoidea; Fam. Blattidae, Nocticolidae. In *'Orthopterorum Catalogus'* (Ed. M. Beier) Part **8** : 402-614. (W. Junk : The Hague).

PRINCIS, K. 1969. Blattariae, Suborder : Epilamproidea : Fam. Blattellidae. In *'Orthopterorum Catalogus'* (Ed. M. Beier.) Part **13** : 711-1038. (W. Junk : The Hagus).

PRINCIS, K. 1971. Blattariae, Suborder : Epilamproidea : Fam. Ectobidae. In *'Orthopterorum Catalogus'* (Ed. M. Beier), Part **14** : 1039-1224. (W. Junk : The Hagus).

REHN, J. W. H. 1951. Classification of the Blattaria as indicated by their wings. *Mem. Amer. Soc. Philad.*, no. **15** : 1-134.

ROTH, M. L. 1979a. A taxonomic revision of the Panesthinae of the world. The Genera *Salganea* Stal, *Microdiane* Kirby and *Caparia* Stal (Dictyoptera : Blattaria : Blaberidae) *Aust. J. Zool.* Suppl. Ser. no. **69** : 1-201.

ROTH, M. L. 1979b. A taxonomic Revision of the Panesthinae of the world. The genera *Panesthia* Serville and *Miopanesthia* Serville (Dictyoptera : Blattaria : Blaberidae). *Aust. J. Zool. Suppl.* Ser. no. **74** : 1-276.

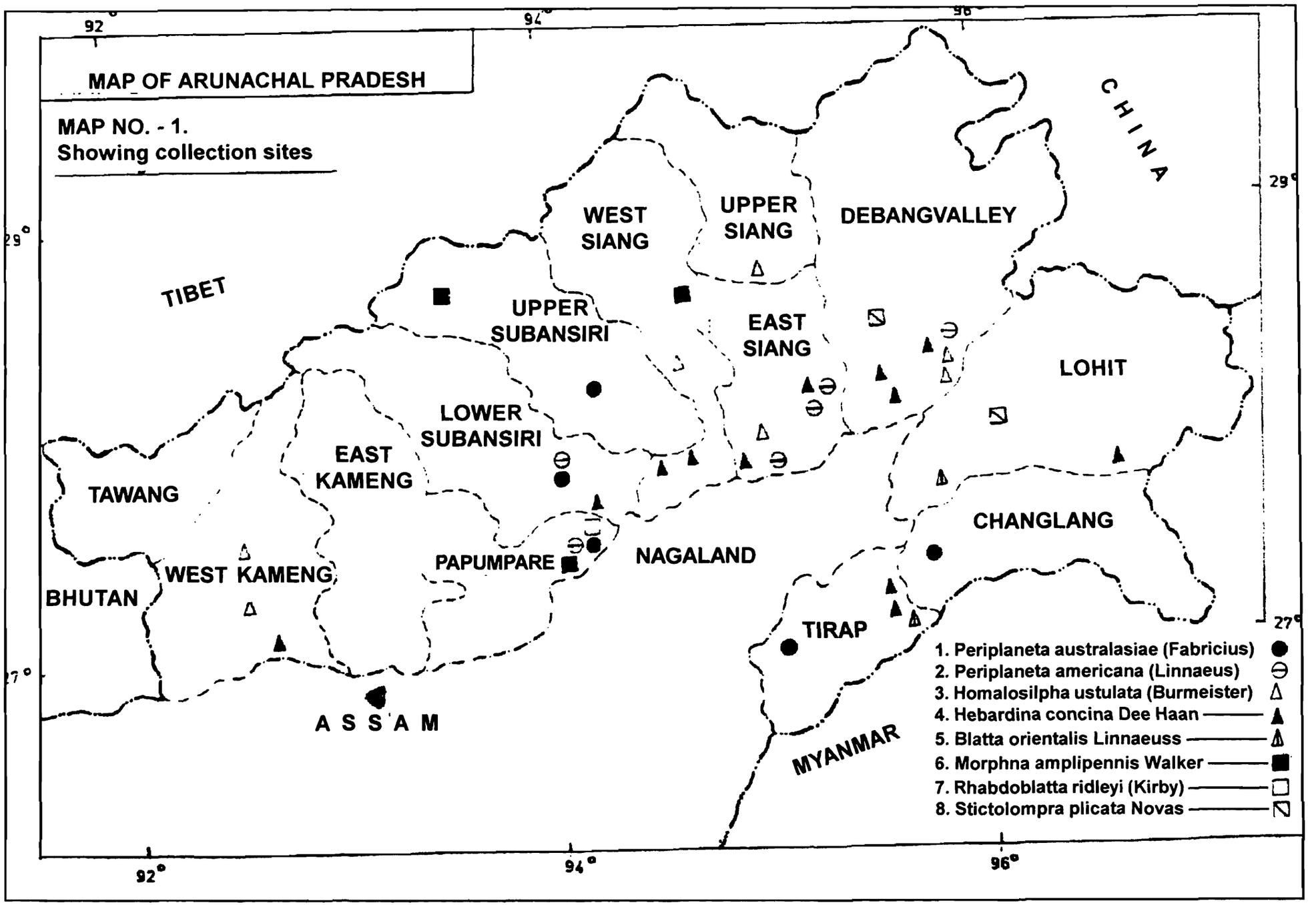
SHELFORD, R. 1906. Studies of the Blattidae, *Trans. Ent. Soc. London*, Part II : 231-79.

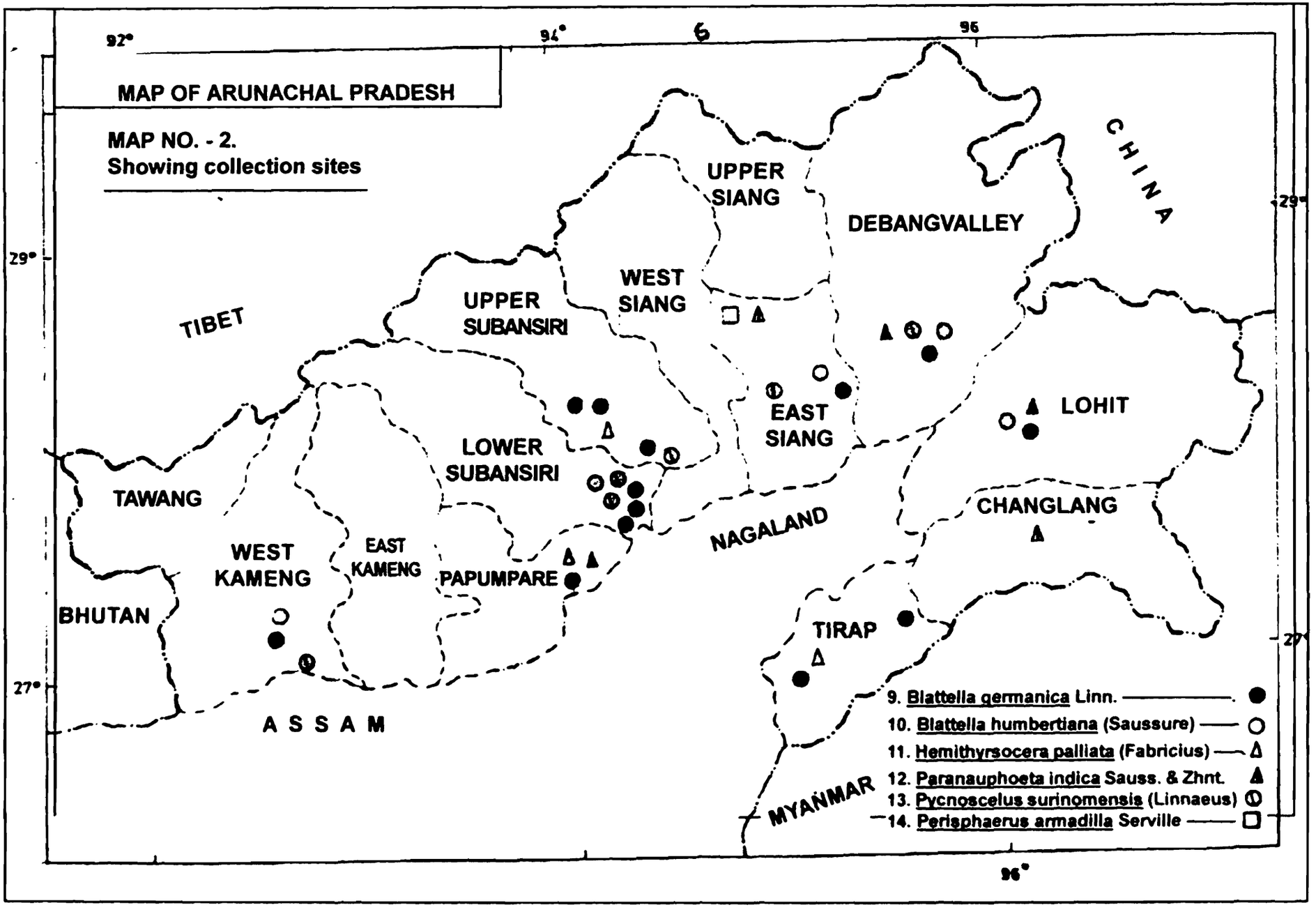
SHELFORD, R. 1910a. Epilamprinae. *Gen. Ins.*, **101** : 1-21.

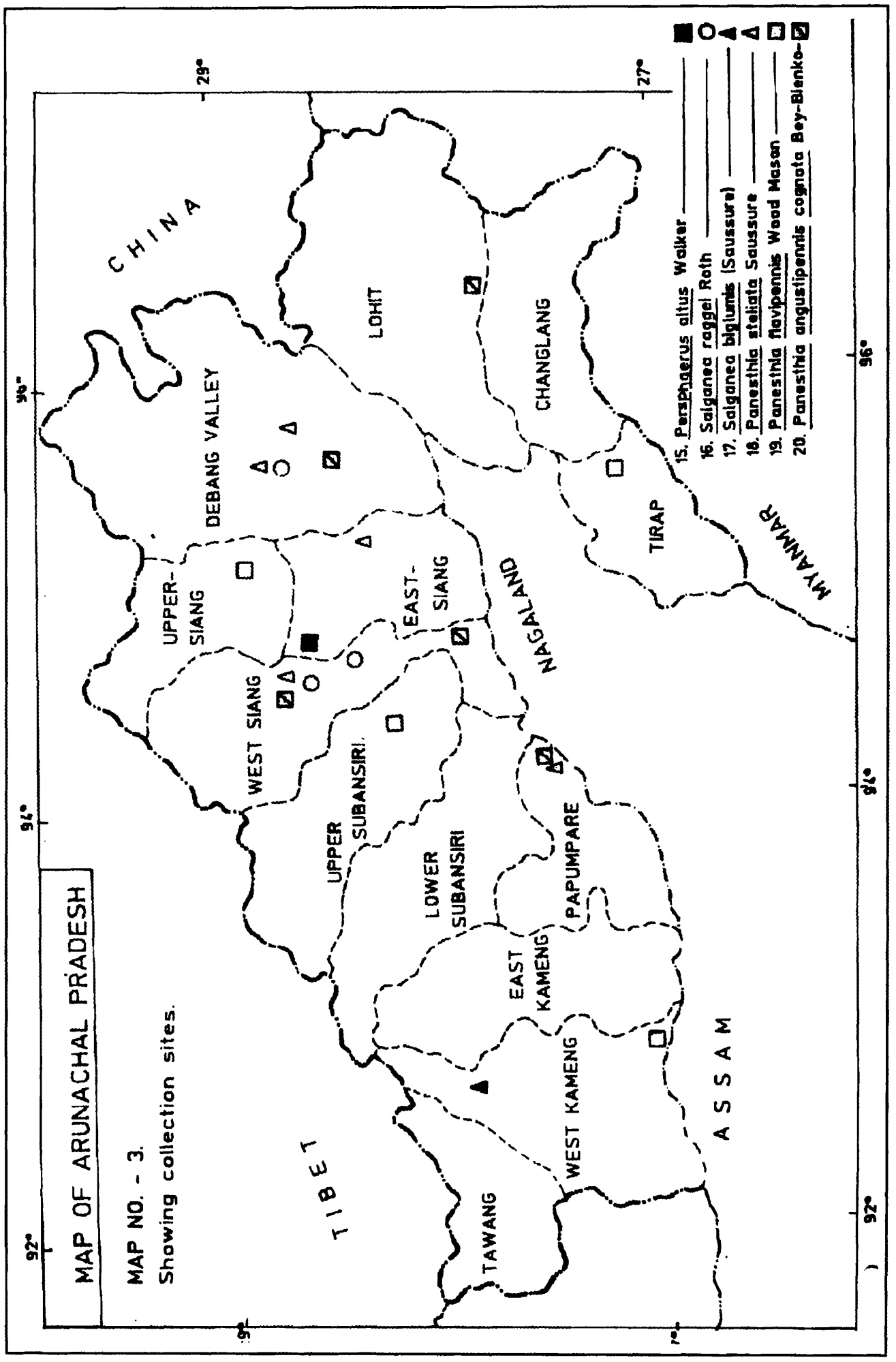
SHELFORD, R. 1910b. Blattinae. *Gen. Ins.*, **109** : 1-27.

Table showing district-wise distribution of Blattaria reported from Arunachal Pradesh

Name of the species	Name of the districts												
Order DICTYOPTERA Suborder BLATTARIA Family BLATTIDAE	Tawang	West Kameng	East Kameng	Papumpare	Lower Subansiri	Upper Subansiri	West Siang	Upper Siang	East Siang	Debang Valley	Lohit	Changlang	Tirap
1. *Periplaneta australasiae*	-	-	-	+	+	-		-	-	-	-	+	+
2. *Periplaneta americana*	-	-	-	+	+	-		-	+	-	-		
3. *Homalosilpha ustulata*	-	+	-			-	+	-	+	+			
4. *Hebardina concina*		+	-	-	+	-	+	-	+		+	+	+
5. *Blatta orientalis*	-	+	-	-	+	-	+		+		+	+	+
Family EPILAMPRIDAE													
6. *Morphna amplipennis*	-		-	+	-	+	+	-					
7. *Rhabdoblatta riddley*	-	-		+		-	-	-	-	-			
8. *Stictolampra plicata*	-	-	-	-	-		-			+	-	+	
Family BLATTELLIDAE													
9. *Blattella germanica*	-	+	-	+	+	+	+	-	+	+	-		+
10. *Blattella humbertiana*	-	+	-	+	+	-		-	+	+	+		
11. *Hemithyrsocera palliata*	-	-	-	+	+	-	-	-	-	-			+
Family BLABERIDAE													
12. *Paranauphoeta indica*	-	-	-	-	-		+						
13. *Pycnoscelus surinamensis*	-	+	-	-	+	-	+	-		+	+		
Family DEROCALYMMIDAE													
14. *Perisphaerus armadillo*		-							+				
15. *Perisphaerus altus*	-	-		-					+				
Family PANESTHIDAE													
16. *Salganea raggei*	-	-			-		+			+			
17. *Salganea biglumis*	-	+	-			-							
18. *Panesthia stellata*	-	-		+			+		+	+			
19. *Panesthia flavipennis*	-	+	-	-		+	+						+
20. *Panesthia angustipennis cognata*	-	-	-	+	-	-	+		-	+	+		


MAP OF ARUNACHAL PRADESH
MAP NO. - 1.
Showing collection sites
92°
94°
96°
29°
27°
TIBET
CHINA
WEST SIANG
UPPER SIANG
DEBANGVALLEY
UPPER SUBANSIRI
EAST SIANG
LOHIT
LOWER SUBANSIRI
EAST KAMENG
TAWANG
CHANGLANG
PAPUMPARE
NAGALAND
WEST KAMENG
BHUTAN
TIRAP
ASSAM
MYANMAR
1. Periplaneta australasiae (Fabricius)
2. Periplaneta americana (Linnaeus)
3. Homalosilpha ustulata (Burmeister)
4. Hebardina concina Dee Haan
5. Blatta orientalis Linnaeuss
6. Morphna amplipennis Walker
7. Rhabdoblatta ridleyi (Kirby)
8. Stictolompra plicata Novas


MAP OF ARUNACHAL PRADESH
MAP NO. - 2.
Showing collection sites
92°
94°
96°
29°
27°
TIBET
UPPER SUBANSIRI
WEST SIANG
UPPER SIANG
DEBANGVALLEY
CHINA
EAST SIANG
LOHIT
LOWER SUBANSIRI
TAWANG
NAGALAND
CHANGLANG
WEST KAMENG
EAST KAMENG
PAPUMPARE
BHUTAN
TIRAP
ASSAM
MYANMAR
9. Blattella germanica Linn.
10. Blattella humbertiana (Saussure)
11. Hemithyrsocera palliata (Fabricius)
12. Paranauphoeta indica Sauss. & Zhnt.
13. Pycnoscelus surinomensis (Linnaeus)
14. Perisphaerus armadilla Serville


MAP OF ARUNACHAL PRADESH
MAP NO. - 3.
Showing collection sites.
15. Perophaerus altus Walker
16. Salganea raggei Roth
17. Salganea bigiumis (Saussure)
18. Panesthia stellata Saussure
19. Panesthia flavipennis Wood Mason
20. Panesthia angustipennis cognata Bey-Bienko
CHINA
LOHIT
CHANGLANG
DEBANG VALLEY
UPPER-SIANG
WEST SIANG
EAST-SIANG
NAGALAND
TIRAP
MYANMAR
UPPER SUBANSIRI
LOWER SUBANSIRI
EAST KAMENG
PAPUMPARE
WEST KAMENG
TAWANG
TIBET
ASSAM
29°
27°
96°
94°
92°

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2) : 191-224, 2006

INSECTA : COLEOPTERA : SCARABAEIDAE : COPRINAE (DUNG BEETLES)

RAM SEWAK
Zoological Survey of India, Desert Regional Station, Jodhpur-342005

INTRODUCTION

Family Scarabaeidae is the largest of the insect's order Coleoptera. They are coprophagus in nature and feed upon the dung of herbivorous mammals, human feacal matter and some of them also feeding upon carrion, decaying fungi and vegetable substances. They are popularly known as "Dung Beetles" and found in every part of the world.

The present study deals with the collection of dung beetles, collected from the twelve districts of Arunachal Pradesh as follows : Tawang, West Kameng, Lower Subansiri, Upper Subansiri, Papumpare, East Siang, West Siang, Upper Siang, Dibang Valley, Lohit, Tirap and Changlang by different parties of Arunachal Pradesh Field Station, Zoological Survey of India, Itanagar from 1984 to 1997. The author also carried out the extensive and intensive survey of Arunachal Pradesh from 1993 to 1997 and collected large number of specimens from dung pad, dung heap, digging of dung burrows and also utilizing the light trap method to collect them from urban and rural localities. Biswas & Chatterjee (1985) reported fifty five species of dung beetles from "Namdapha Wildlife Sanctuary" and Biswas (1978) also described four new species from Arunachal Pradesh and Assam. So far seventy three species belonging to fourteen genera of subfamily Coprinae under the family Scarabaeidae have been identified. Out of seventy three, twenty two species have been recorded for the first time from Arunachal Pradesh. The classified list of these dung beetles provided according to their systematic position under four tribes, *i.e.*, Scarabaeini, Sisyphini, Corprini and Panelini.

SYSTEMATIC ACCOUNT

Class INSECTA
Order COLEOPTERA
Suborder POLYPHAGA
Superfamily SCARABAEOIDEA
Family SCARA BAEIDAE
Subfamily COPRINAE
Tribe I **Scarabaeini**
Genus 1 ***Gymnopleurus*** Illiger

1. *Gymnopleurus sinuatus* Oliver

Tribe II **Sisyphini**
Genus 2 ***Sisyphus*** Latreille

2. *Sisyphus indicus* Hope

Tribe III **Coprini**
Genus 3 ***Synapsis*** Bates

3. *Synapsis birmanicus* Gillet

Genus 4 ***Heliocopris*** Burmeister

4. *Heliocopris dominus* Bates

Genus 5 ***Catharsius*** Hope

5. *Catharsius molossus* Linnaeus
6. *Catharsius pithecius* Fabricius

Genus 6 ***Copris*** Geoffroy

7. *Copris indicus* Gillet
8. *Copris magicus* Harold
9. *Corpis repertus* Walker
10. *Copris corpulentus* Gillet
11. *Copris numa* Lansberge
12. *Copris punctulatus* Weidemann
13. *Copris furciceps* Felsche
14. *Copris siangensis* Biswas

Genus 7 ***Caccobius*** Thomson

15. *Caccobius inermis* Arrow

Genus 8 ***Onthophagus*** Latreille

16. *Onthophagus crassicollis* Boucomont
17. *Onthophagus laevis* Harold
18. *Onthophagus pacificus* Lansberge
19. *Onthophagus rudis* Sharp
20. *Onthophagus jucundus* Arrow
21. *Onthophagus variegatus* Fabricius
22. *Onthophagus orientalis* Harold
23. *Onthophagus ramosellus* Bates
24. *Onthophagus tibetanus* Arrow
25. *Onthophagus rugulosus* Harold
26. *Onthophagus catta* Fabricius
27. *Onthophagus rectecornutus* Lansberge
28. *Onthophagus seniculus* Fabricius
29. *Onthophagus nilgirensis* Gillet
30. *Onthophagus manipurensis* Arrow
31. *Onthophagus rubricollis* Hope
32. *Onthophagus occipitalis* Lansberge
33. *Onthophagus mauritii* Boucomont
34. *Onthophagus furcicollis* Arrow
35. *Onthophagus dama* Fabricius
36. *Onthophagus kuluensis* Bates
37. *Onthophagus armatus* Blanchard
38. *Onthophagus triceratops* Arrow
39. *Onthophagus bison* Boucomont
40. *Onthophagus sagittarius* Fabricius
41. *Onthophagus politus* Fabricius
42. *Onthophagus luridipennis* Boheman
43. *Onthophagus remotus* Harold
44. *Onthophagus porcus* Arrow
45. *Onthophagus deflexicollis* Lansberge
46. *Onthophagus ensifer* Boucomont
47. *Onthophagus phanaeiformis* Boucomont
48. *Onthophagus centricornis* Fabricius
49. *Onthophagus vaulogeri* Boucomont
50. *Onthophagus cervus* Fabricius
51. *Onthophagus duporti* Boucomont
52. *Onthophagus bengali* Gorden & Oppenheimer
53. *Onthophagus tirapensis* Biswas and Chatterjee
54. *Onthophagus arunachalensis* Biswas and Chatterjee
55. *Onthophagus songsokensis* Biswas and Chatterjee
56. *Onthophagus royi* Biswas and Chatterjee

Genus 9 ***Phacosoma*** Boucomont

57. *Phacosoma obscurum* Boucomont

Genus 10 ***Liatongus*** Reitter

58. *Liatongus phanaeoides* Westwood
59. *Liatongus gagatinus* Hope
60. *Liatongus mergacerus* Hope
61. *Liatongus vertagus* Fabricius

Genus 11 ***Oniticellus*** Serville

62. *Oniticellus namdaphaensis* Biswas & Chatterjee
63. *Oniticellus subhendui* Biswas & Chatterjee
64. *Oniticellus gayeni* Biswas & Chatterjee
65. *Oniticellus cinctus* Fabricius

Genus 12 ***Drepanocerus*** Kirby

66. *Drepanocerus falsus* Sharp
67. *Drepanocerus striatulus* Paulian

Genus 13 ***Onitis*** Fabricius

68. *Onitis siva* Gillet
69. *Onitis excavatus* Arrow
70. *Onitis falcatus* Wulfen
71. *Onitis philemon* Fabricius
72. *Onitis castaneus* Redtenbucher

Tribe IV **Panelini**

Genus 14 ***Paraphytus*** Harold

73. *Paraphytus hindu* Arrow

Key to the tribe of Subfamily COPRINAE

1. Middle coxae not widely separated; middle tibia with one terminal spur ..... **Scarabaeini**

- Middle coxae widely separated, middle tibia with two terminal spurs 2

2. Posterior legs extremely long, the tarsi filiform ..... **Sisyphini**

- Basal joint of the hind tarsus much longer than the second 3

3. Posterior legs not extremely long, tarsi more or less flat and tapering ..... **Coprini**

- Basal joint of the hind tarsus not much longer than the second ..... **Panelini**

Tribe 1 **Scarabaeini**

The tribe Scarabaeini consist of two genera *Scarabaeus* and *Gymnopleurus*, but author found only one species of the genus *Gymnopleurus*.

1. Genus ***Gymnopleurus*** Illiger 1803

1803. *Gymnopleurus* Illiger. *Mag. Ins.*, **2** : 199.

1807. *Gymnopleurus* Latreille, *Gen. Crust. Ins.*, **2** : 78.

1856. *Gymnopleurus* Lacordaire, Gen. Col., **3** : 73.

1931. *Gymnopleurus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 46-48.

1963. *Gymnopleurus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 177-182.

Diagnostic Characters : Small broad and depressed. The clypeus completely fused with the ocular lobes and produced into two or four short teeth at front margin. The prothorax large and convex, having several patches dorsally. The fore legs short and stout and front tibia armed with three external teeth. All six tarsi filiform. Scutellum visible. The two sexes are almost alike and ball rollers.

1. ***Gymnopleurus sinuatus*** Oliver

1789. *Scarabaeus* sinuatus Oliver, Entomologiae, **1** (3) : 160, pl. 10, fig. 93, pl. 21., fig. 189.

1886. *Gymnopleurus morosus Fairmaire, Ann. Soc. Ent. France*, **6** (6) : 319.

1890. *Gymnopleurus assamensis Water house, Ann Mag. Nat. Hist.*, **6** (5) : 411.

1891. *Gymnopleurus morosus* Bates, *Entom.*, **24** (suppl.) : 73.

1914. *Gymnopleurus (Progymnopleurus) sinuatus, Garreta, Bull. Soc. Ent. Franc.*, : 52.

1931. *Gymnopleurus sinuatus*, Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 63-64.

1963. *Gymnopleurus (Progymnopleurus) sinuatus*, Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 218-220.

Diagnostic Characters : Broad and flat, with long and slender legs, the tibiae armed with three acute teeth placed close together and front femur with a small tooth placed at three-fourth of its length from the base. The clypeus acutely notched in the middle and having acute or rounded tooth on each side. The prothorax convex and punctured, and lateral margin are angulate in the middle.

Distribution : India : Arunachal Pradesh : Yingkiong (Getha Village, 31.8.1994, R. Sewak), 1 ex., also recorded from Namdapha, Changlang by Biswas and Chatterjee (1981), Karnataka, Maharastra, Nagaland, Sikkim, West Bengal.

Elsewhere : Myanmar and Nepal.

Tribe 2 **Sisyphini**

The tribe Sisyphini consists only one genus *Sisyphus* and author found only single species from Arunachal Pradesh.

2. Genus ***Sisyphus Latreille*** 1807

1807. *Sisyphus* Latreille, *Gen. Crust. et. Ins.*, **2** : 79.

1856. *Sisyphus* Lacordaire, *Gen. Col.*, **3** : 72.

1927. *Sisyphus* Arrow, *Ann. Mag. Nat. Hist.*, **9** (9) 456

1931. *Sisyphus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 67-68.

Diagnostic Characters : Spider like, subglobose, compressed laterally with long posterior legs and clothed with erect setae above and smooth beneath. Head broad and flat. The clypeus having two or four short teeth at front margin. The prothorax completely compressed and the front leg short with massive femur.

2. ***Sisyphus indicus*** Hope

1831. *Sisyphus indicus* Hope, *Gray's Zool.*, 22.

1848. *Sisyphus kaschmirensis* Redtenbucher, *Hugel's Kaschmir*, **4** (2) : 516.

1927. *Sisyphus indicus* Arrow, *Ann. Mag. Nat. Hist.*, **19** (9) : 456-465.

1931. *Sisyphus indicus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 75-76.

Diagnostic Characters : Oval elongated and convex with very long and slender legs. The front tibae are armed with three strong external teeth, occupying half outer edge and remaining half is serrate. The front margin of the clypeus having two widely separated blunt teeth.

Distribution : India : Arunachal Pradesh : Changlang (Miao, 8.2.1995, R. Sewak), 8 exs., also recorded from Changlang by S. Biswas (1981), Assam, Jammu & Kashmir, Himachal Pradesh, Nagaland, Orissa, Punjab and West Bengal.

Elsewhere : Nepal.

Tribe 3 **Coprini**

Tribe Coprini consists large number of genera and species which varies in size and form. The author collected seventy one species belonging to twelve genera.

Key to genera of tribe Coprini

1. Prothorax with two lateral carina ..... ***Synapsis*** Bates
- Prothorax without two lateral carina 2
2. Prothorax with one lateral carina and first joint of antennal club shining ..... ***Heliocopris*** Burmeister.
- First joint of antennal club is not shining ... 3
3. Antennal club entirely pubescent ..... ***Catharsius*** Hope
- Antennal club not entirely pubescent and Prothoracic carina absent 4
4. Prothorax with deep median groove ..... ***Copris*** Geoffroy
- Prothorax without deep median groove 5
5. The terminal margin of the front tibia at right angle to the inner margin and anterior angles of the prothorax hollowed beneath ..... ***Caccobius*** Thomson
- The terminal margin of front tibia not at right angle to the inner margin and anterior angles of prothorax not hollowed 6
6. The middle and hind tibiae not dilated from base to extremity ..... ***Onthophagus*** Latreille
- The middle and hind tibiae dilated from base to extremity 7
7. Broadly oval and rather depressed, lateal margin of the elytra very sharp ..... ***Phacosoma*** Harold
- Not broadly oval and depressed and lateral margin of elytra not sharp 8
8. Scutellum present and elytra not fringed before the hind margin ..... ***Liatongus*** Reitter
- Elytra fringed before the hind margin 9
9. Sides of the abdomen exposed above ..... ***Oniticellus*** Serville
- Sides of the abdomen not exposed 10
10. Clypeus bidentate and scutellum distinct ..... ***Drepanocerus*** Kirby
- Prothorax with two basal impression near the middle and front tarsi absent in both sexes. ..... ***Onitis*** Fabricius

3. Genus ***Synapsis*** Bates 1868

1868. *Synapsis* Bates, *Col. Hefte*, **4** : 89.

1871. *Homalocopris* Solsky, *Hor. Ent. Soc. Ross.*, **8** : 136.

1881. *Homalocopris* Sharp, *C.R. Ent. Soc. Belg.*, **25** : 92.

1931. *Synapsis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 80.

1963. *Synapsis* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 288-291.

Diagnostic Characters : Oval shaped. Head broad. Clypeus acutely notched in the middle. Antennae nine jointed. Prothorax short and having two lateral carina. Scutellum absent. The front tibiae are armed with three strong external teeth,

middle and hind tibiae slendered at the base, Dilating gradually to the extremity.

The author collected single species *Synapsis birmanicus* from Arunachal Pradesh.

3. ***Synapsis birmanicus*** Gillet

1907. *Synapsis birmanicus* Gillet, *Ann. Mus. Civ. Stor. Nat. Genova*, : 600.

1931. *Synapsis birmanicus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 83.

1963. *Synapsis birmanicus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 293.

Diagnostic Characters : Rather narrowly oval and feebly convex. Head is rugose with clypeus cleft and bilobed in front, and frons without a midian tubercle. Prothorax is smooth, sides coriaceously or finely rugose, front angles toothed and hind angles also obsolete, sides angulated in front and rounded behind, base is rounded. Elytra are extremely finely striate, striae with minute punctures, intervals quite flat and very finely coriaceous. Pygidium is finely and not very closely granular. The middle tibiae are very short and nearly straight, with very strong external teeth. Hind tibiae are rather slender and scarcely curved.

Distribution : India : Arunachal Pradesh : Changlang (Miao, 8.2.1995, R. Sewak), 3 exs., also recorded by S. Biswas (1981) form Namdapha, Arunachal Pradesh.

Elsewhere : Myanmar.

4. Genus ***Heliocopris*** Burmeister 1846

1846. *Heliocopris* Burmeister, *Gen. Ins. Col.*, **10** : 27, figs. 1-8.

1856. *Heliocopris* Lacordaire, *Gen. Col.*, 98.

1931. *Heliocopris* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 84-85.

1963. *Heliocopris* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 297-300.

Diagnostic Characters : Body large, broad and massive. Head large with cephalic horn or carina. The clypeus is rounded or slightly excised in the middle. Eyes not very deeply divided and antennae nine jointed. Prothorax with complete basal groove. Front coxae prominent, middle long, nearly parallel and not very widely separated, and hind coxae with stridulatory ridges at the inner end within the coxal cavities. Abdomen completely covered by elytra.

The author collected single species *Heliocopris dominus* from Arunachal Pradesh.

3. ***Heliocopris dominus*** Bates

1868. *Heliocopris dominus* Bates, *Col. Hefte*, **4** : 88.

1878. *Heliocopris* mouhotus Sharp, *Ent. Mon. Mag.*, **15** : 155.

1903. *Heliocopris dominus* Sharp, *Fasc. Malay Zool.*, **1** 285.

1931. *Heliocopris dominus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera Lamellicornia : Coprinae), **3** : 90-92, pl. V, fig. 1.

1963. *Heliocopris dominus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera Lamellicornia), **1** : 302-303, fig. 21.

Diagnostic Characters : Broad and nearly quadrate in shape. The head is rather large and a pair of erect slightly divergent horns arises from the outer margin of the head in male and cephalic carina in female. Prothorax is very rugose or granular, with small smooth area and the anterior part is nearly vertical, divided from the posterior part by a carina which produced in middle in the male while dorsal carina is very slightly, more prominent in the female. The front tibiae are armed with three strong external teeth.

Distribution : India : Arunachal Pradesh : Papumpare (Itanagar, 2.9.1989, T.K. Pal), 2 exs., also recorded from Assam, Manipur, Meghalaya, Rajasthan, Uttar Pradesh.

Elsewhere : Myanmar.

5. Genus ***Catharsius*** Hope 1837

1837. *Catharsius* Hope, *Col. Man.*, **1** : 21.

1846. *Catharsius* Burmeister, *Gen. Ins. Col.*, **10** : 27.

1848. *Catharsius* Erichson., *Ins. Deutschl.*, **3** : 761.

1931. *Catharsius* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 92.

1963. *Catharsius* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 304-305.

Diagnostic Characters : Broad Compact and very convex. Head broad and semicircular. Prothorax completely margined at the base. The middle coxae long, parallel and far apart, four posterior tibiae strongly dilated from base to extremity. The middle tibia with two and hind tibia with one terminal spur. Scutellum wanting. The elytra with seven striae and completely covered the abdomen.

Key to the species of genus *Catharsius*

1. Head with a distinct small smooth area adjoining each eyes and prothorax entirely granulate ... . *molossus* Linnaeus

– Head without a distinct small smooth area and prothorax granulate only at sides .... *pithecius* Fabricius

5. ***Catharsius molossus*** Linnaeus

1758. *Scarabaeus molossus* Linnaeus, *Syst. Nat. ed.*, p. 347.

1789. *Scarabaeus molossus* Oliver *Ent.*, **3** (1) : 100, pl. 19, fig. 25.

1801. *Copris ursus* Fabricius, *Syst. Eleuth.*, **1** : 43.

1931. *Catharsius molossus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 94-95.

1963. *Catharsius* (s. str.) *molossus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 307-309.

Diagnostic Characters : Broadly oval and very convex, partially clothed with reddish hairs beneath. The head is broad with front margin almost imperceptibly excised in the middle. The sides of the prothorax are rounded, the front angles are broadly truncate and the hind angles almost obsolete, and the lateral scars large and deep. The metasternal shield is acutely angular in front and longitudinally grooved in its hinder part. The front tibia is armed with three external teeth, the middle and hind tibiae are broad and crenate at the extremity. The male having conical, median cephalic horn, broad and a little flattened behind at the base, sharp pointed at the tip, the prothorax has a steep declivity in front, the upper edge of which forms a sharp ridge feebly convex in the middle and curved, with its extremities. The head of the female has a short and pointed process and the prothorax with nearly straight ridge.

Distribution : India : Arunachal Pradesh : Dibang Valley (Roing, 20.12.1996, R. Sewak); Changlang (Nampong, 2.5.1987, S. Ghosh); East Siang (Pasighat 7 & 8 August 1997, R. Sewak); Lower Subansiri (2, 4 & 9 August 1987, P.T. Bhutia; 15.9.1989, T.K. Pal); Papumpare (Nirjulee, 15.5.1987, P.T. Bhutia; Itanagar, 18.7.1989, K. Allia); West Kameng (Bombdila, 25.9.1997, R. Sewak); Upper Siang (Yingkiong, 1.9.1994, R. Sewak), 35 exs., also recorded from Namdapha by S. Biswas (1981), Assam, Bihar, Andaman & Nicobar, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharastra, Meghalaya, Orissa, Rajasthan, Sikkim, Tamilnadu, Uttar Pradesh and West Bengal.

Elsewhere : Srilanka.

6. ***Catharsius pithecius*** Fabricius

1775. *Scarabaeus pithecius* Fabricius, *Syst. Ent.*, 21.

1781. *Scarabaeus sabaeus* Fabricius, *Spec. Ins.*, **1** : 23.

1792. *Scarabaeus nanus* Fabricius, *Ent. Syst.*, **1** : 42.

1842. *Copris sinensis* Hope, *Proc. Ent. Soc., London*, 60.

1858. *Copris cribricollis* Walker, *Ann. Mag. Nat. Hist.*, **3** (2) : 208.

1931. *Catharsius pithecius*, Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 100-101, pl VII, fig. 1, 2.

1963. *Catharsius pithecius* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 312-313, pl. XV, fig. 2.

Diagnostic Characters : Shortly oval and very convex. Head is nearly semicircular, clypeus feebly excised in the middle and having nearly

straight, slendered horn arising just in front of the eyes in male and female having slighty acuminate transverse elevation. Prothorax with a slight, sharp, conical protuberance on each side of the median groove in male. The metasternal shield is acutely angular in front, and very smooth and shining along with median groove.

Distribution : India : Arunachal Pradesh : Tawang (Namet village, 23.9.1997; Lumala, 29.9.1997, R. Sewak), 16 exs., also recorded form Bihar, Karnataka, Kerala, Maharastra, Tamilnadu and Uttar Pradesh.

Elsewhere : Sri Lanka.

6. Genus *Copris* Geoffroy 1762

1762. *Copris* Geoffroy, *Ins. Des. Env De Paris*, 87.

1785. *Copris* Fourcroy, *Ent. Paris*, 1 : 13.

1856. *Copris* Lacordaire, *Gen. Col.*, 3 : 96.

1931. *Copris* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), 3 : 102.

1963. *Copris* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), 1 : 317-319.

Diagnostic Characters : Compact, convex or little depressed. Head broad, more or less semicircular and clypeus notched in the middle at front margin. Prothorax broad and transverse, and its front margin furnished with membranous fringe and hind margin with a deep median groove. Middle coxae long and nearly parallel. The tarsi short and basal joint about twice as long as the second. Scutellum wanting. Elytra not very short, having eight striae and single latral carina.

Key to the species of *Copris*

1. Very shining and the front angles of prothorax are very blunt ..... *indicus* Gillet

– Front angles of prothorax are not blunt 2

2. The front angle of prothorax are broadly truncate and the sides of the metasternum closely hairy ..... *magicus* Harold

– The sides of the metasternum are not closely hairy 3

3. The sides of the metasternum closely punctured and sparsely setose. Elytra striate ..... *repertus* Walker

– The front angles of the prothorax are not truncate and metasternum not closely punctured 4

4. The front angles of the prothorax are obtuse and the sides of the metasternum are not very strongly not closely punctured ..... *corpulentus* Gillet

– The front angles of the prothorax are not obtuse and the sides of the metasternum are strongly punctured 5

5. Elytra deeply striate and clypeus feebly notched in the middle at front margin ..... *numa* Lansberge

– The clypeal margin not notched in the middle at front margin 6

6. The clypeal margin strongly reflexed in the middle and elytral intervals flat and strongly punctured ..... *punctulatus* Wiedemann

– Elytra not deeply striate and clypeal margin not reflexed 7

7. Elytra lightly striate, prothorax, elytra and metasternal shield well punctured ..... *furciceps* Felsche

– Elytra strongly striate and intervals little convex and metasternal shield feebly punctured ..... *siangensis* Biswas

7. *Copris indicus* Gillet

1910. *Copris indicus* Gillet, *Notes Leyed Mus*, 32 : 5

1911. *Copris indicus* Gillet, *Ann. Soc Ent Belg*, 5 314.

1931. *Copris indicus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera Lamellicornia : Coprinae), 3 : 106-107, pl. X, fig 4,5.

Diagnostic Characters : Broadly oval and highly convex. The head is semicircular and the front margin feebly bilobed in the middle. The sides of the prothorax are nearly straight in front, strongly rounded behind, the front angles are broadly truncate and hind angles are very obtuse. The front tibia is broad and armed with four blunt

external teeth, and terminal spur has bented tip at right angles. The male with a short erect and flattened median cephalic horn, which is slightly dilated and feebly bicuspid at the extremity, and the prothorax with dorsal straight prominence along with lateral tubercle on each side. The female bears a slight transverse cephalic elevation.

Distribution : India : Arunachal Pradesh : Dibang Valley (Hunli, 14.12.1996, R. Sewak); East Siang (Pasighat, 23.3.1996, P.T Bhutia); Papumpare (Doimukh, 20.2.1996, R. Sewak); Tawang (Lumala, 28.9.1997, R. Sewak); West Siang (Along, 4.4.1996, P.T. Bhutia), 19 exs., also recorded form Gujarat, Karnataka, Kerala, Tamilnadu.

Elsewhere : Sri Lanka.

8. ***Copris magicus*** Harold

1881. *Copris magicus* Harold, *Mitth. Munch. Ent. Ver.*, **5** : 88.

1931. *Copris magicus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 112-113, pl. IX, fig. 11 & 12.

1963. *Copris magicus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 350-351, fig. 127.

Diagnostic Characters : Broadly oval and very convex. The head is semicircular and the front margin sharply notched in the middle. The side of the prothorax straight in front, strongly rounded behind, the front angles broadly truncate and hind angles obsolete. The front tibia is broad and strongly armed with four external teeth, the ternimal spur is feebly curved. The male with slendered, backwardly curved cephalic horn and female having an erect quadrate cephalic carina.

Distribution : India : Arunachal Pradesh : East Siang (Pasighat, 9.9.1994, R. Sewak); Upper Siang (Yingkiong, 27 & 28 February 1989, T.K. Pal; 31.8.1994, 1.9.1994, R. Sewak), 16 exs., also recorded form Assam, Meghalaya, Manipur, Sikkim.

Elsewhere : China, Laos, Siam, Tonkin, Yunnan.

9. ***Copris repertus*** Walker

1858. *Copris repertus* Walker, *Ann. Mag. Nat. Hist.*, **3** (2) : 208.

1877. *Copris claudius* Harold, *Ann. Mus. Civ. Genova*, **10** : 48.

1886. *Copris repertus* Lansberge, Tijds, Ent., **29** : 11.

1931. *Copris repertus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 116-117, pl. IX, figs. 8 & 9.

1963. *Copris repertus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 351-352.

Diagnostic Characters : Broadly oval and highly convex and the clypeus deeply notched in the middle. The prothorax is strongly grooved longitudinally in the middle, the front angles are truncate and the hind angles almost obsolete. The front tibia is broad and armed with four external teeth and nearly straight. The male bears a slendered, slightly compressed, erect cephalic horn, and with a minute tooth near the base on each side and female with short transverse elevated cephalic carina.

Distribution : India : Arunachal Pradesh : Dibang Valley (Roing, 8.9.1991, T.K. Pal), 2 exs., also recorded form Bihar, Gujarat, Karnataka, Maharastra, Madhya Pradesh, Pondicherry, Rajasthan, Tamilnadu and Uttar Pradesh.

Elsewhere : China, Myanmar, Sri Lanka.

10. ***Copris corpulentus*** Gillet

1910. *Copris corpulents* Gillet, *Notes. Leyed. Mus.*, **32** : 118.

1931. *Copris corpulents* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 118-119. pl. X. Figs 12, 13.

1963. *Copris* (s. str.) *corpulentus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 363-364.

Diagnostic Characters : Elongate-oval and moderately convex, covered with reddish bristles beneath. The clypeal margin is notched in the middle and feebly bilobed and there is a sharp

pointed, backwardly curved cephalic horn in the middle. The prothorax with median groove, the front angles are obtuse and the male thoracic prominence are simple, conical and the female thoracic prominence are flattened in front and dilated laterally.

Distribution : India : Arunachal Pradesh : Papumpare (Ganga Lake, 11.8.1994, R. Sewak); East Siang (Pasighat, 17.8.1994, R. Sewak); Upper Siang (Yingkiong, 1.9.1994, R. Sewak); West Siang (Likabali, 23 & 24 August 1994; Along, 27, 28 & 29 August 1994, R. Sewak), 17 exs., also recorded form Namdapha by S. Biswas (1981), Assam, Gujarat, Manipur, Meghalaya, Rajasthan, Uttar Pradesh.

Elsewhere : Laos, Myanmar, Tonkin.

11. *Copris numa* Lansberge

1986. *Copris numa* Lansberge, Tizds *Ent.*, **29** : 19.

1931. *Copris numa* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 121-122.

1963. *Copris numa* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 364-365.

Diagnostic Characters : Narrowly oval and moderately convex, covered with reddish bristles beneath. The clypeus is feebly excised in the middle at front margin and with a very short conical cephalic process just in front of the eyes. The median prothoracic groove is extended from basal groove to in front of the middle, and the front angles are truncate and hind angles obsolete. The middle and hind tibiae are trilobed at the extremity. The front tibial spurs of the male are blunt and slightly spatulate and the female front tibial spurs are pointed.

Distribution : India : Arunachal Pradesh : Tawang (Lumala, 28.9.1987, R. Sewak), 7 exs., also recorded form Assam, Gujarat, Rajasthan, Uttar Pradesh.

Elsewhere : Borneo, Malaya Peninsula, Myanmar, Sumatra, Tenassrim.

12. *Copris punctulatus* Wiedemann

1823. *Copris punctulatus* Weidemann, *Zool. Mag.*, **2** (1) : 11.

1986. *Cpris punctulatus* Lansberge, *Tizds. Ent.*, **29** : 21.

1931. *Copris punctulatus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 126-127, pl.x. figs. 8 & 9.

1963. *Copris punctulatus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 370.

Diagnostic Characters : Oval and not very convex. The anterior margin of clypeus is strongly reflexed in the middle. Prothorax has a broad marginal membrane in the anterior emargination and the front angles formed prominent rounded lobes and hind angles obsolete. The elytral intervals are flat and well punctured. The front tibiae are broad and armed with four external teeth. The metasternal shield is very smooth and bears a narrow median groove.

Distribution : India : Arunachal Pradesh : Tawang (Thanglang, 29.9.1997, R. Sewak), 3 exs., also recorded from Namdapha by S. Biswas (1981), Assam.

Elsewhere : Combodia, Indo-China, Indonesia, Java, Malaya Peninsula, Myanmar, Tonkin.

13. *Copris furciceps* Felsche

1910. *Copris furciceps* Felsche, *Deutsche Ent. Zeitscher.*, : 348.

1931. *Copris furciceps* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera Lamellicornia : Coprinae), **3** : 130-131.

1963. *Copris (Paracopris) furciceps* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera Lamellicornia), **1** : 372.

Diagnostic Characters : Oval and not very convex. The head is very smooth and shining in front, strongly and closely punctured behind. Prothorax densely punctured, the front angles blunt and hind angles obsolete. The elytra are lightly striate and closely punctured. The metasternal

shiled is well punctured except along the middle line of the anterior part. The front tibia armed with four sharp external teeth.

Distribution : India : Arunachal Pradesh : Lohit (Namsai, 2.2.1995, R. Sewak), 5 exs., also recorded form Namdapha by S. Biswas (1981), Gujarat, Meghalaya, Rajasthan, Uttar Pradesh.

Elsewhere : Myanmar.

14. ***Copris siangensis*** Biswas

1979. *Copris* (s. str.) *siangensis* Biswas, *J. Bombay nat. Hist. Soc.*, Bombay, **76** (1) : 339.

Diagnostic Characters : Elongate-oval and highly convex. Head broad, almost semicircular with a long backwardly directed horn. Prothorax highly convex, the upper margin of declivity with three sharp projections, front angles blunt, truncate and hind angles obsolete. Elytra strongly striate and striae closely punctured. Front tibia armed with four external teeth.

Distribution : India : Arunachal Pradesh : Lower Subansiri (Hapoli, 25.3.1994, R. Sewak); East Siang (Basar, 3 & 4 Sept. 1994, R. Sewak); Upper Siang (Yingkiong, 31.8.1994, 1.9.1994, R. Sewak); and West Siang (Pasighat, 8 & 9 Sept. 1994, R. Sewak), 9 exs., also recorded by S. Biswas (1973) from Along.

7. Genus ***Caccobius*** Thomson 1863

1863. *Caccobius* Thomson, *Skand. Col.*, **5** : 34.

1872. *Caccophilus* Jekel, *Rev. Mag. Zool.*, 410.

1872. Cacconemus Jekel, *Op. Cit.*, 418.

1913. *Caccobius* D'orbigny, *Ann. Soc. Ent. France*, 16.

1931. *Caccobius* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 141-142.

1963. *Caccobius* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 113-115.

Diagnostic Characters : Short compact and generally small sized. The front angles of prothorax are a deep hollow beneath, sharply defined. Tibia very short, broad and terminal teeth not placed obliquely. Antennae eight jointed.

The author collected single species *Caccobius inermis* from Arunachal Pradesh.

15. ***Caccobius inermis*** Arrow

1931. *Caccobius inermis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 147.

Diagnostic Characters : Minute, broadly oval and moderately convex. The head is not very broad, the clypeus feebly and bluntly bilobed. The front angles of the prothorax are blunt and the sides nearly straight and base is gently rounded. The intervals of the elytra are flat and sparingly punctured. The metasternum is coarsely and closely pitted at the sides and strongly punctured in the middle, where there is a broad depression.

Distribution : India : Arunachal Pradesh : Tirap (Deomali, 14.2.1994, R. Sewak), 5 exs., also recorded from Namdapha by S. Biswas (1981), Maharastra, Sikkim, Uttranchal, Uttar Pradesh, West Bengal.

Elsewhere : Sri Lanka.

8. Genus ***Onthophagus*** Latreille 1802

1802. *Onthophagus* Latreille, *Hist. Nat. Crust. Et. Ins.*, **3** : 141.

1856. *Onthophagus* Lacordaire, *Gen. Col.*, **3** : 107.

1856. *Onthophagus* D'orbigny, L'Abeille, **29** : 126-132.

1883. *Proagoderus* Lansberge, Notes Leyed. Mus., **5** : 15.

1913. *Proagoderus* D'orbigny, *Ann. Soc. Ent. France*, **132** : 493.

1917. *Proagoderus* Marcus, *Arch. F. Nat. A10*, **133** : 1.

1931. *Onthophagus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 159-162.

1963. *Onthophagus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 153-168.

Diagnostic Characters : Rather short, compact, smooth or clothed with hairs or setae. The clypeus fused with ocular lobes and variable in shape. The prothorax with lateral margin angulate in the middle and rounded at the base. The legs stout, femora thick and front tibia armed with four but occasionally with three external teeth. The middle and hind tibiae dilating greatly from base to extremity. Elytra covering the abdomen and having a single lateral carina and seven striae.

Key to the species of genus *Onthophagus*

1. Hind tarsus is long, 2nd joint long as 1st joint ..... *crassicollis* Boucomont
- Hind tarsus not long 2
2. Hind tibia extremely short, triangular. Prothorax grooved, vertex with median tubercle ..... *laevis* Harold
- Prothorax not grooved, vertex without a median tubercle 3
3. Prothorax suffused with a metallic luster and vertex with straight carina ..... *pacificus* Lansberge
- Vetex without carina 4
4. The clypeus is little produced, blunt and slightly reflexed in the middle ..... *rudis* Sharp
- The clypeus is not little produced 5
5. The clypeus is strongly rounded and reflexed in front and feebly truncate ..... *juncundus* Arrow
- The clypeus is not rounded and truncate 6
6. The clypeus is little produced and notched in the middle and prothorax granulated ..... *variegatus* Fabricius
- The clypeal margin is not notched and prothorax not granulated 7
7. The clypeal margin is strongly rounded. Prothorax deeply and closely punctured and with deep median longitudinal basal groove. ..... *orientalis* Harold
- Prothorax without median longitudinal basal groove 8
8. Prothorax strongly punctured except anterior lateral part, elytra are strongly punctate striate ..... *ramosellus* Bates
- Prothorax not strongly punctured and elytra are not punctate striate 9
9. The punctures of anterior part of prothorax change to granules. The elytra striate, intervals flat, minutely and sparingly granulate ..... *tibetanus* Arrow
- The intervals of elytra not flat and not sparingly granulate 10
10. Prothorax abruptly flattened at the hind angles, elytra asperately punctured ..... *rugulosus* Harold
- Prothorax not abruptly flattened. Elytra not punctured 11
11. Prothorax bears sparse granules in middle and fine scattered punctures behind, front angles not very sharp ..... *catta* Fabricius
- Prothorax not bears granules and front angles are sharp 12
12. Prothorax light brown, strongly and irregularly punctured. Elytral intervals strongly and closely punctured ..... *rectecornutus* Lansberge
- Prothorax not strongly punctured. Elytral intervals are not strongly punctured 13
13. Prothorax sparsely punctured with blunt front angles. Elytra are opaque and intervals flat and minutely punctured ..... *seniculus* Fabricius
- Prothorax not punctured and elytral intervals punctured 14
14. Prothorax is entirely smooth. Elytra not punctured ..... *nilgirensis* Gillet
- Prothorax not entirely smooth 15
15. Prothorax coarsely regulose with smooth basal part and entirely margined ..... *manipurensis* Arrow
- Prothorax without smooth basal area 16
16. Prothorax strongly punctured rugose in front and absent near the base ..... *rubricollis* Hope

– Prothorax not strongly punctured and with light median groove posteriorly 17

17. Prothorax retuse and smooth in front. Pygidium clothed with very short setae .... *occipitalis* Lansberge

– Pygidium not clothed with setae 18

18. Pygidium is shining and smooth. The elytral striae straight and parallel with the 6th stria ..... *mauritii* Boucomont

– Pygidium is not shining and smooth 19

19. Pygidium bears very large annular punctures and elytral stria bearing small non-contiguous circles ..... *furcicollis* Arrow

– Pygidium without very large annular punctrues 20

20. Pygidium opaque and moderately punctured, elytra not very glossy ..... *dama* Fabricius

– Pygidium not moderately punctured and elytra not glossy 21

21. Eyes very small from above .... *kuluensis* Bates

– Eyes not very small 22

22. Eyes larger from above. Pygidium sparsely punctured ..... *armatus* Blanchard

– Pygidium not sparsely punctured. Eyes rather large 23

23. Pygidium irregularly punctured. Very short and metallic ..... *triceratops* Arrow

– Pygidium not irregularly punctured. Not very short 24

24. Pygidium strongly punctured. Black and shining ..... *bison* Boucomont

– Not black and pygidium not strongly punctured 25

25. Yellow and elytra mottled with dark brown above. Pygidium sparsely punctured .... *sagittarius* Fabricius

– Not yellow and elytra not mottled with dark brown above 26

26. Black, smooth and shining. Elytra bright yellow and striae strongly punctured .... *politus* Fabricius

– Not black and shining. Elytral striae not strongly punctured 27

27. Brownish yellow. Elytra very lightly striate and intervals flat, closely punctured .... *luridipennis* Boheman

– Elytra not lightly striate 28

28. Elytra deeply striate ..... *remotus* Harold

– Not brownish yellow. Elytra not deeply striate 29

29. Black and the side of the head feebly rounded. Elytral intervals flat and closely granular .... *porcus* Arrow

– Not black and the side of the head is not rounded. Elytral intervals not granular 30

30. Shining, chocolate brown. Head flat, uniformly sculptured .... *deflexicollis* Lansberge

– Not chocolate brown. Head is not flat 31

31. Uniformly dark above. The front margin of the head is rounded ..... *ensifer* Boucomont

– Not uniformly dark. Head is not rounded 32

32. Dark Chocolate brown, short and broad. The intervals of elytra well punctured .... *phanaeiformis* Boucomont

– Not dark Chocolate brown. Elytral intervals not well punctured 33

33. Black and very small. The seventh stria strongly curved ..... *centricornis* Fabricius

– The seventh stria not strongly curved 34

34. Black and shining. Elytra dark with red shoulder ..... *vaulogeri* Boucomont

– Elytra not dark and shoulder not red 35

35. Greenish black. Prothorax rather less closely punctured ..... *cervus* Fabricius

– Not greenish black. Prothorax not less closely punctured 36

36. Dark brown or black. Prothorax with a sharp anterior prominence ..... *duporti* Boucomont

– Prothorax without prominence 37

37. Shining black with legs and marginal area of the head is reddish brown. Prothorax with a fine complete border .... *bengali* Gordon & Oppenheimer

– Prothorax without complete border 38

38. Head broadly rounded in front and sinuate behind. Prothorax minutely punctured. Elytra strongly striate and sparsely punctured .... *tirapensis* Biswas & Chatterjee

– Head not rounded in front and not sinuate at sides 39

39. Clypeus produced and strongly reflexed anteriorly. Prothorax strongly and moderately punctured. Elytra shallowly striate and minutely punctured ....*arunachalensis* Biswas & Chatterjee

– Clypeus not produced in front and elytra not minutely punctured 40

40. Clypeus very feebly emarginated in the middle. Prothorax strongly punctured. Elytra strongly very feebly emarginated in the middle .... *songsokensis* Biswas & Chatterjee

– Clypeal margin uniformly rounded. Prothorax uniformly, moderately and closely punctured .....*royi* Biswas & Chatterjee

16. *Onthophagus crassicollis* Boucomont

1883. *Onthophagus nanus* Lansberge, (not. Waterhouse), *Notes. Leyd. Mus.*, **5** : 6.

1914. *Onthophagus crassicollis* Boucomont, *Ann. Soc. Ent. France*, **83** : 67.

1931. *Onthophagus crassicollis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 170-171, fig. 15.

1963. *Onthophagus* (Onthophagiellus) *crassicollis* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 320-321.

Diagnostic Characters : Broadly oval. Deeply waisted and highly convex. Clypeus is rounded in front and ocular lobes strongly rounded and fairly, strongly and closely punctured, the basal joint of the hind tarsus is long and second joint not more than a quarter as long as the preceding one. Elytra striate, intervals flat and fairly closely and not very finely punctured. Pygidium strongly punctured.

Distribution : India : Arunachal Pradesh : Lower Subansiri (Zero, 14.12.1996, R. Sewak), 4 exs., also recorded by Biswas (1981) from Changlang (Miao and Namdapha).

Elsewhere : Indonesia, Malaya Peninsula and Myanmar.

17. *Onthophagus laevis* Harold

1880. *Onthophagus laevis* Harold, *Notes. Leyden Mus* P. 194.

1814. *Onthophagus laevis* Boucomont, *Ann. Soc. Ent France*, p 276.

1931. *Onthophagus laevis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 171-172.

1963. *Onthophagus* (s.str.) *laevis* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera Lamellicornia), **2** : 412-413.

Diagnostic Characters : Elongate-oval, convex with stout legs. The clypeal margin is broadly rounded and strongly reflexed. Prothorax narrow and smooth, excavated in front and sharp angulation on each side of the excavation. The elytra deeply striate, intervals rounded and very sparingly and minutley punctured. Pygidium closely punctured.

Distribution : India : Arunachal Pradesh : West Siang (Likabali, 20.2.1996, R. Sewak); Tawang (Thanglang, 29.9.1997, R. Sewak), 5 exs., also recorded from Miao and Namdapha by S. Biswas (1981), Sikkim, Uttar Pradesh and West Bengal.

Elsewhere : Indonesia, Myanmar, West China.

18. *Onthophagus pacificus* Lansberge

1885. *Onthophagus pacificus* Lansberge, *Notes Leyden Mus.*, **7** : 17.

1914. *Onthophagus pacificus* var. *peguanus* Boucomont, *Ann. Mus. Civ. Stor. Nat. Genova*, **46** : 215.

1931. *Onthophagus pacificus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 172-173.

1963. *Onthophagus* (s. str.) *pacificus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 465.

Diagnostic Characters : Oval, compact and convex. The clypeus short, frons is separated from the vertex by straight carina. Prothorax moderately punctured at side, very minutely in the middle. The elytra deeply striate with ill defined punctures in the striae, intervals rounded. Pygidium very strongly punctured. Middle and hind tibiae very broad at the extremity.

Distribution : India : Arunachal Pradesh : East Siang (Pasighat, 9.9.1994, R. Sewak); West Siang (Likabali, 25.8.1995, R. Sewak), 25 exs., also recorded from Namdapha and Zero by S. Biswas (1981), Meghalaya, Nilgiri Hills, Uttranchal.

Elsewhere : Bangladesh, Indonesia, Indo-China, Malaya Peninsula, Myanmar, Thailand.

19. ***Onthophagus rudis*** Sharp

1875. *Onthophagus rudis* Sharp, *Col. Hefte*, **14** : 58.

1877. *Onthophagus foveolatus* Harold, *Ann. Civ. Stor. Nat. Genova*, **10** : 68.

1931. *Onthophagus rudis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 185.

1963. *Onthophagus* (s. str.) *rudis* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 505.

Diagnostic Characters : Oval, not broad, very convex, strongly constructed at the waist. The clypeus is a little produced, blunt and slightly reflexed in the middle. Prothorax higly convex, densely covered with fine oval granules. Elytra are striate with flat intervals and covered with minute elongate granules. Pygidium closely covered with fine granules.

Distribution : India : Arunachal Pradesh : Changlang (Nampong, 2.5.1987, R. Sewak), 2 exs., also recorded from Namdapha and Zero by S. Biswas (1981), Assam, Bihar.

Elsewhere : Indonesia, Borneo, Java, Sumatra.

20. ***Onthophagus jucundus*** Arrow

1931. *Onthophagus jucundus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 188.

1963. *Onthophagus* (s. str.) *jucundus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 398-399.

Diagnostic Characters : Elongate-oval and very convex. The clypeus separated from the frons by a strong curved carina and the posterior margin bears a short erect tubercle in the middle. Prothorax entirely convex and having densely fine granules. The elytra are very finely striate, intervals flat and not very finely punctured. Pygidium is rather coarsely punctured.

Distribution : India : Arunachal Pradesh : Changlang (Nampong, 11.2.1995, R. Sewak); Tirap (Deomali, 13.2.1995, R. Sewak), 7 exs., also recorded from Namdapha by S. Biswas (1981), Manipur.

Elsewhere : Myanmar.

21. ***Onthophagus variegatus*** Fabricius

1798. *Copris variegatus* Fabricius, *Ent. Syst. Suppl.*, 36.

1913. *Onthophagus variegatus* D'orbigny, *Ann. Soc. Ent. France*, **132** : 452.

1931. *Onthophagus variegatus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 204-205, fig. 20.

1963. *Onthophagus variegatus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 575-576.

Diagnostic Characters : Oval and highly convex. The clypeus is a little produced and notched in the middle. Prothorax having rather evenly and not very closely distributed fine granules. The elytra are rather strongly and having slightly convex, intervals which are very sparsely and minutely punctured. Pygidium is fairly strongly and closely punctured.

Distribution : India : Arunachal Pradesh : Papumpare (Doimukh, 20.2.1996, R. Sewak), 4 exs., also recorded from Gujarat and Punjab.

Elsewhere : Arabia, Abyssinia, Angola, Egypt, East Africa, Pakistan, Purtgal, Somalia, Senegal, Sudan, Tanganyika.

22. ***Onthophagus orientalis*** Harold

1968. *Onthophagus orientalis* Harold, *Col. Hefte.*, **4** : 83.

1931. *Onthophagus orientalis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 213-214.

1963. *Onthophagus* (s. str) *orientalis* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 463-464.

Diagnostic Characters : Oval and convex. The clypeal margin is strongly rounded. Prothorax convex, deeply and closely punctured except near the front margin and also with deep median longitudinal groove at the base. The elytra are striate and having a little rounded and irregular intervals. Pygidium is strongly and closely punctured and clothed with moderately long recumbent hairs.

Distribution : India : Arunachal Pradesh : Papumpare (Kimin, 4.9.1994, R. Sewak); Lohit (Namsai, 2.2.1995, R. Sewak), 4 exs., also recorded from Namdapha by S. Biswas (1981), Andaman Island, Assam, Bihar, Manipur, Meghalaya, Sikkim, Uttranchal, Uttar Pradesh.

Elsewhere : Bangladesh, Malay Peninsula, Siam and South China.

23. ***Onthophagus ramosellus*** Bates

1891. *Onthophagus ramosellus* Bates, *Entom. suppl.* **24** : 11.

1831. *Onthophagus capella* Hope, *Gray's Zool. Misc.* : 22.

1931. *Onthophagus ramosellus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 217-218.

1963. *Onthophagus* (s. str) *ramosellus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 277-278.

Diagnostic Characters : Broadly oval, compact and convex, almost covered with hairs or setae above and beneath. The head is semicircular, clypeus and frons closely transversely rugulose and vertex bears a pair of backwardly inclined horns. Prothorax strongly punctured and entirely margined. Elytra are strongly punctate-striate with minutely and sparsely punctured intervals. Pygidium is opaque and punctured.

Distribution : India : Arunachal Pradesh : Lower Subansiri (Yazali, 23.9.1986, R.N. Bhargava), Dibang Valley (Roing, 19.12.1996, R. Sewak), 8 exs., also recorded from Namdapha by S. Biswas (1981), Assam, Bihar, Karnataka, Himachal Pradesh, Madhya Pradesh, Maharastra, Orissa, Uttranchal, Uttar Pradesh, West Bengal.

Elsewhere : Afganistan, Indonesia, Myanmar, Philippine Island, Vietnam.

24. ***Onthophagus tibetanus*** Arrow

1907. *Onthophagus tibetanus* Arrow, *Ann. Mag Nat Hist.*, **19** (7) : 728.

1931. *Onthophagus tibetanus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera Lamellicornia : Coprinae), **3** : 220.

1963. *Onthophagus tibetanus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera Lamellicornia), **2** : 553-554.

Diagnostic Characters : Broadly oval and not very convex. The clypeus is more or less bilobed. Prothorax is very finely, unevenly and not closely asperately punctured, the punctures changing to granules in the anterior part. The seventh stria of elytra strongly curved, intervals are flat, minutely and sparingly granulated. Pygidium opaque and bears a few minute punctures.

Distribution : India : Arunachal Pradesh : Tawang (Pamghar, 25.9.1997, R. Sewak), 3 exs., also recorded from Jammu & Kashmir and Uttranchal.

Elsewhere : Tibet.

25. ***Onthophagus rugulosus*** Harold

1886. *Onthophagus rugulosus* Harold, *Deutsch Ent Zeits* **30** : 289.

1891. *Onthophagus* expansicollis Fairmaire, *C.R. Soc. Ent. Belg.*, **35** : 193.

1931. *Onthophagus rugulosus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 227-228.

1963. *Onthophagus* (s. str.) *rugulosus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 507.

Diagnostic Characters : Oval and not very convex. The head is not very large and not very broad, clypeus is transversely rugose and separated from the frons by curved carina. The prothorax is closely punctured posteriorly and rugose anteriorly. Elytra are deeply striate, intervals feebly convex and fairly, closely and asperately punctured. Pygidium is strongly and closely punctured.

Distribution : India : Arunachal Pradesh : Upper Subansiri (Daporzo, 28.10.1989, P.T. Bhutia); Lower Subansiri (Yazali, 23.9.1986, R. N. Bhargawa), 7 exs., also recorded from Namdapha Wildlife Sanctuary, Tirap by S. Biswas (1981) Meghalaya.

Elsewhere : South China.

26. ***Onthophagus catta*** Fabricius

1787. *Scarabaeus catta* Fabricius, *Mant. Inst.*, **1** : 12.

1787. *Scarabaeus gazella* Fabricius, *Op. Cit.*, **2** : 377.

1798. *Copris metallicus* Fabricius, *Ent. Syst. Suppl.*, 28.

1798. *Copris antilope* Fabricius, *Op. Cit.*, 32.

1931. *Onthophagus catta* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 230-231.

Diagnostic Characters : Broadly oval and convex, smooth and moderately shining. The head is semicircular, clypeus strongly reflexed anteriorly and separated from the frons by a strong, feebly curved carina. Prothorax bears granules in middle part and scattered punctures behind. Elytra striate and with flat intervals. Pygidium bears an angulate basal carina and a few scattered punctures, vertex of male beras a pair of slendered horns and prothorax having two minute prominence which are separated by a slight groove.

Distribution : India : Arunachal Pradesh : East Siang (Pasighat, 9.9.1994, R. Sewak), 4 exs., also recorded from Gujarat, Haryana, Himachal Pradesh, Karnataka, Maharastra, Punjab, Rajasthan, Uttranchal, Uttar Pradesh, Tamil nadu.

Elsewhere : Africa, Arabia, Pakistan, Combodia, Myanmar, Madagascar and Srilanka.

27. ***Onthophagus rectecornutus*** Lansberge

1883. *Onthophagus rectecornutus* Lansberge, *Notes Leyd. Mus.*, **5** : 49.

1907. *Onthophagus rectecornntus* Arrow, *Ann mag. Nat. Hist.*, **19** (7) : 421.

1931. *Onthophagus rectecornutus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 233-234.

1963. *Onthophagus* (Serrophorus) *rectecornutus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 498-499.

Diagnostic Characters : Oval and very convex, body covered with very minute and unconspicuous greyish setae. The clypeus is semicircular, with strongly reflexed front margin. The vertex having a pair of unconnected backwordly sloping horns. The front angles of prothorax are rather sharp and the sides are gently rounded in front and the base is strongly rounded. The front tibia of male is elongate and narrowed and its teeth are separated. In female the front tibia is broad and teeth are stout and close together.

Distribution : India : Arunachal Pradesh : Dibang Valley (Roing, 19.12.1996, R. Sewak), 11 exs., also recorded from Zero (Lower Subansiri) by S. Biswas (1981), Bihar, Gujarat, Karnataka, Kerala, Nagaland, Uttar Pradesh.

28. ***Onthophagus seniculus*** Fabricius

1781. *Scarabaeus seniculus* Fabricius, *Spec. Ins.*, **1** : 23.

1931. *Onthophagus seniculus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 235-236. Pl XIII, figs 3, 4.

Diagnostic Characters : Broadly oval, moderately compact, smooth, not very shining

above. The head having straight carina and the basal joint of the antennae has serrate anterior edge. The prothorax has smooth, shining excavation just behind the front margin and horizontal prominence behind each excavation. The clypeus of the male curves upward a little in front and its sides are nearly straight and the front tibia is little elongate with the teeth rather small. The head of female is almost semicircular in out line and the dorsal prothoracic prominence are slight and rounded.

Distribution : India : Arunachal Pradesh : East Siang (Pasighat, 7.9.1994, R. Sewak); West Siang (Likabali, 25.8.1994; Basar, 5.9.1994, R. Sewak), 13 exs., also recorded from Gujarat, Rajasthan, Uttar Pradesh.

Elsewhere : Malaya Peninsula, Myanmar, China and Indo-China.

29. ***Onthophagus nilgirensis*** Gillet

1922. *Onthophagus nilgirensis* Gillet, *Ann. Soc. Sci. Brux.*, **101** : 128.

1931. *Onthophagus nilgirensis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 242.

Diagnostic Characters : Broadly oval, moderately compact and convex. Clypeus is produced and limited behind by a short straight carina. Prothorax is a little excavated in front and completely margined, front angles are blunt and the base is obtusely angulated in the middle. Elytra are lightly striate except at the base and sides. Pygidium is shining and punctured.

Distribution : India : Arunachal Pradesh : Upper Siang (Yingkiong, 1.9.1994, R. Sewak), 6 exs., also recorded from Nilgiri Hills.

30. ***Onthophagus manipurensis*** Arrow

1907. *Onthophagus manipurensis* Arrow, *Ann. Mag. nat. Hist.*, **19** (7) : 426.

1931. *Onthophagus manipurensis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 242-243, pl. xiii, figs. 7, 8.

1963. *Onthophagus* (Digitonthophagus) *manipurensis* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 431, pl. xiii, fig. 6.

Diagnostic Characters : Very broadly oval, compact and convex. Head transvesely rugulose, clypeus is a little produced in front. Prothorax is coarsely rugulose at sides and punctured in middle. The front angles are rather blunt, lateral margin bisinuate and the base obtusely angulate in the middle. Elytra are striate and with flat intervals. Pygidium closely punctured.

Distribution : India : Arunachal Pradesh : Changlang (Miao, 8.2.1995, R. Sewak); Lohit (Namsai, 1.7.1995, R. Sewak), 5 exs., also recorded from Miao by S. Biswas (1981), Manipur, Meghalaya.

Elsewhere : Myanmar.

31. ***Onthophagus rubricollis*** Hope

1831. *Onthophagus rubricollis* Hope, *Gray's Zool. Misc.* : 22.

1831. *Onthophagus rubricollis* Redterbucher, *Hugel's Kaschmir*, **4** : 351, pl. 24, fig 5.

1931. *Onthophagus rubricollis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera Lamellicornia : Coprinae), **3** : 244-245.

1963. *Onthophagus* (Digitonthophagus) *rubricollis* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 503-504, pl xiv, fig. 4.

Diagnostic Characters : Very broadly oval, compact and convex. The clypeus produced in front, frons bearing a short, straight carina and vertex is smooth, produced backward and recurved. Prothorax strongly punctured, rugose in front and almost absent near the base on each side, and with complete margin. The front angles of the prothorax are blunt and base obtusely angulate in the middle. Elytra strongly striate and rather less finely punctured.

Distribution : India : Arunachal Pradesh : Changlang (Miao, 8.2.1995, R. Sewak); Tirap

(Deomali, 13.2.1995, R. Sewak), 7 exs., also recorded from Namdapha by S. Biswas (1981), Meghalaya, Sikkim and Uttranchal.

Elsewhere : Nepal.

32. ***Onthophagus occipitalis*** Lansberge

1885. *Onthophagus occipitalis* Lansberge, *Ann. Mus. Civ. Genova*, **22** : 379.

1931. *Onthophagus occipitalis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 251-252.

Diagnostic Characters : Oval and very convex. Head is not very wide, clypeus is little produced, sides nearly straight and apex feebly excised. Frons is produced backward as broad plate toothed near eyes, which bifurcate at the end. Prothorax is strongly and not very closely punctured, front angles are little produced and moderately sharp, sides straight in front, sinuate behind and base is rounded. The elytra are strongly striate and with a little convex intervals, and the striae with well marked punctures. Pygidium is moderately punctured.

Distribution : India : Arunachal Pradesh : East Siang (Pasighat, 25.8.1994, R. Sewak), 5 exs.

Elsewhere : Myanmar.

33. ***Onthophagus mauritii*** Boucomont

1891 (1920). *Onthophagus mauritii* Boucomont, *Ann. Soc. Ent. France*, : 311.

1931. *Onthophagus mauritii* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 267-268.

1963. *Onthophagus* (s. str.) *mauritii* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 434.

Diagnostic Characters : Oval, convex and rather deeply waisted. The head is short and broad, clypeus closely rugosely punctured and feebly sinuate anteriorly. Prothorax is evenly fairly, strongly punctured, front angles fairly sharp, sides straight in front and sinuate behind and base is rounded. Elytra are sharply striate, 7th stria straight and parallel with the 6th, intervals slightly convex and punctured. Pygidium is smooth and shining, with rather sparsely, moderately strongly punctured.

Distribution : India : Arunachal Pradesh : Papumpare (Ganga Lake, 2.8.1994, R. Sewak), 3 exs., also recorded from Namdapha by S. Biswas (1981), Bihar, Maharastra, Tamilnadu.

34. ***Onthophagus furcicollis*** Arrow

1931. *Onthophagus furcicollis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 276-277, fig. 32.

1963. *Onthophagus* (s. str.) *furcicollis* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 359.

Diagnostic Characters : Broadly oval, compact and convex. The head bears only a few fine scattered punctures, clypeus bluntly bilobed, frons having a short straight, erect horn between the eyes. Prothorax bears large, close umbilicate punctures and a broad bifurcate horizontal process, projecting over the head, front angles sharply produced and base is strongly rounded. Elytra bears a chians of large number of punctures in place of stria and intervals are asparately punctured. The pygidium having very large annular punctures.

Distribution : India : Arunachal Pradesh : Lower Subansiri (Yazali, 9.11.1989, P. T. Bhutia); Papumpare (Nirjulee, 15.5.1987, P. T. Bhutia), 5 exs., also recorded from Namdapha by S. Biswas (1981), Sikkim, Uttranchal.

35. ***Onthophagus dama*** Fabricius

1798. *Copris dama* Fabricius, *Ent. Syst. Suppl.*, : 32.

1898. *Onthophagus dama* D'orbigny, L, Abeilte, **29** : 217.

1931. *Onthophagus dama* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 280-281.

1963. *Onthophagus* (s. str.) *dama* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 325-326, pl. xii, fig. 6.

Diagnostic Characters : Oval, compact and very convex. The clypeus is semicircularly rounded with the margin a little more strongly raised in the middle, vertex bears a pair of horns arising close to eyes. Prothorax is finely and

sparsely punctured, front angles blunt and base is rounded. The stria of elytra is punctured and with almost flat intervals. The pygidium is opaque and moderately punctured.

Distribution : India : Arunachal Pradesh : Papumpare (Kimin, 2.2.1996, Midpu, 20.2.1996, R. Sewak), 6 exs., also recorded from Miao, Namdapha by S. Biswas (1981), Assam, Bihar, Karnataka, Madhya Pradesh, Maharastra, Sikkim, Tamilnadu and West Bengal.

Elsewhere : Bhutan and Nepal.

36. ***Onthophagus kuluensis*** Bates

1891. *Onthophagus kuluensis* Bates, *Entom. Suppl.*, **24** : 12.

1931. *Onthophagus kuluensis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 292-293.

1963. *Onthophagus kuluensis* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 409-410.

Diagnostic Characters : Oval and moderately convex. The head is broad, the clypeus is nearly straight in front and separated from the frons by a straight carina. The front angles of the prothorax are blunt, lateral margins are feebly curved in front and the base is obtusely angulated in the middle. The male having a pair of nearly parallel horns, connected by a ridge and female with straight carina on vertex.

Distribution : India : Arunachal Pradesh : East Siang (Pasighat, 7.9.1994, R. Sewak); West Siang (Likabali, 28.5.1994, R. Sewak), 3 exs., also recorded from Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Rajasthan, Uttranchal, and Uttar Pradesh.

37. ***Onthophagus armatus*** Blanchard

1853. *Onthophagus armatus*, Blanchard, *Voy. Au. Pole. Sud.*, : 98, pl. vii, figs. 9 & 10.

1883. *Onthophagus* luzonicus Lansberge, *Notes Leyden Mus.*, **5** : 51.

1914. *Onthophagus armatus* Boucomont, *Ann. Soc. Ent. France*, **133** : 305.

1931. *Onthophagus armatus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 293-294.

1963. *Onthophagus* (s. str.) *armatus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 277-278.

Diagnostic Characters : Broadly oval, compact and broad, clypeal margin is straight and feebly excised in the middle. Prothorax not closely punctured, front angles blunt, lateral margin nearly staight in front and very feebly sinuate behind and base is rounded. Elytra are deeply striate, intervals convex, very minutely and sparsely punctured. Pygidium not very closely punctured.

Distribution : India : Arunachal Pradesh : Lohit (Namsai, 1.2.1995; Teju, 5.2.1995, R. Sewak); Changlang (Miao, 8.2.1995, R. Sewak), 7 exs., also recorded from Namdapha by S. Biswas (1981), Assam.

Elsewhere : Indonesia, Myanmar, Philippine Island and Vietnam.

38. ***Onthophagus triceratops*** Arrow

1913. *Onthophagus triceratops* Arrow, *Rec Indian Mus* . **8** : 195.

1931. *Onthophagus triceratops* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 301-302, fig. 36

1963. *Onthophagus* (s. str.) *triceratops* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 559.

Diagnostic Characters : Broadly oval and moderately convex. Head is broad and angularly dilated in front of the eyes, clypeus evenly but not strongly punctured, truncate and strongly reflexed in front. Prothorax is evenly punctured, front angles are pointed but not very sharp, sides nearly straight and base is gently rounded. Elytra are strongly punctured. Pygidium is finely and irregularly punctured.

Distribution : India : Arunachal Pradesh : Lower Subansiri (Hapoli, 25.3.1994, R. Sewak); West Siang (Malinithan forest, Likabali, 16.3.1989, T.K. Pal), 5 exs., also recorded from Zero and Namdapha by S. Biswas (1981), Assam.

39. ***Onthophagus bison*** Boucomont

1919. *Onthophagus bison* Boucomont, *Ann. Soc. Ent. France*, **133** : 309.

1931. *Onthophagus bison* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 302-303.

1963. *Onthophagus bison* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 293-294.

Diagnostic Characters : Rather broadly oval and convex. Head is short and broad, the sides rather strongly dilated and the front margin entire and semicircular. Prothorax fairly, strongly punctured, front angles are blunt, sides feebly rounded in front and sinuate behind and base evenly rounded. Elytra strongly striate, stria closely punctured, and intervals slightly convex, minutely and very sparsely punctured. Pygidium is fairly, strongly punctured. The sides of the metasternum bear a few scattered punctures.

Distribution : India : Arunachal Pradesh : Tawang (Namat village, 23.9.1997, R. Sewak); West Siang (Doli Road, 2.9.1994, R. Sewak), 22 exs., also recorded from Arunachal Pradesh, India.

Elsewhere : Myanmar.

40. ***Onthophagus sagittarius*** Fabricius

1775. *Onthophagus sagittarius* Fabricius, *Syst. Ent.*, 24 p.

1792. *Scarabaeus* oryx Fabricius, *Ent. Syst.*, **1** : 56.

1819. *Copris* erecta Wiedemann, *Zool. Mag.*, **3** (1) : 157.

1819. *Copris* obtusa Wiedeman, *Op. Cit.*, 158 p.

1931. *Onthophagus sagittarius* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 304-306, fig. 37.

Diagnostic Characters : Oval, moderately compact and fairly convex. Head is subcircular with reflexed clypeal margin and bears a pair of horns upon the clypeo–frontal suture. Prothorax is highly convex in front and well punctured behind, front angles are blunt, base is margined and very feebly prominent in the middle. Elytra are strongly striate and with flat intervals and minutely punctured. Pygidium is sparsely punctured.

Distribution : India : Arunachal Pradesh : Papumpare (Doimukh, 19.2.1996, R. Sewak), 9 exs., also recorded from Assam, Madhya Pradesh Uttranchal and West Bengal.

Elsewhere : Java, Malaya Peninsula, South China.

41. ***Onthophagus politus*** Fabricius

1798. *Copris politus* Fabricius, *Ent. Soc. Suppl.*, 35.

1914. *Onthophagus politus* Boucomont, *Ann. Mus. Civ. Genova*, **96** : 309.

1931. *Onthophagus politus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 309-310. fig. 39.

1963. *Onthophagus* (s. str.) *politus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 480-481.

Diagnostic Characters : Minute, broadly oval, compact and convex. The clypeus is feebly, bluntly bilobed in front with a few punctures on each side. Prothorax bears fine scattered punctures, front and hind angles obutse, side gently rounded in front, feebly sinuate behind and the base is strongly rounded. Elytra strongly striate. Striae minutely and sparingly punctured, 7th stria gently curved, intervals very smooth and shining. Pygidium is very smooth and shining with a few scattered punctures.

Distribution : India : Arunachal Pradesh : Papumpare (Khud river, Kimin, 2.2.1996, R. Sewak), 5 exs., also recorded from Bihar, Gujarat, Karnataka and Tamilnadu.

Elsewhere : Sri Lanka.

42. ***Onthophagus luridipennis*** Boheman

1858. *Onthophagus luridipennis* Boheman, *Eagenies Resa*, : 45.

1914. *Onthophagus fuscopunctulatus* Boucomont, *Ann. Soc. Ent. France*, **88** : 292-293.

1931. *Onthophagus luridipennis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 317-318.

1963. *Onthophagus* (s. str.) *luridipennis* Balthasar. *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 424-425.

Diagnostic Characters : Broadly oval and convex. Head is not very broad and closely punctured. The front angles of prothorax are fairly sharp, sides gently rounded in front and feebly sinuate behind, base is rounded and very bluntly angulate in the middle. Elytra are finely striate, intervals flat and closely punctured. Pygidium strongly punctured.

Distribution : India : Arunachal Pradesh : Dibang Valley (Roing, 8.9.1989, T.K. Pal); East Siang (Pasighat, 30.3.1996, P.T. Bhutia), 4 exs., also recorded from Zero, Miao, Namdapha by S. Biswas (1981), Assam, Uttranchal.

Elsewhere : Bangladesh, Indonesia, Myanmar, Philippine Island and South China.

43. ***Onthophagus remotus*** Harold

1879. *Onthophagus remotus* Harold, *Col. Hefte*, **16** : 226.

1924. *Onthophagus remotus* Boucomont, *Bull. Soc. Ent. France*, : 211.

1931. *Onthophagus remotus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 318-319.

1963. *Onthophagus* (s. str.) *remouts* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 500-501.

Diagnostic Characters : Oval and moderately convex. The clypeus is more or less produced and vertex having a pair of unconnected horns. Prothorax has a two blunt tubercles placed close together a little behind the front margin, front angles are acute and the base is obtusely angular in the middle. Elytra are striate, striae closely punctured and intervals finely and not very sparsely punctured. Pygidium closely punctured.

Distribution : India : Arunachal Pradesh : Dibang Valley (Epipani Road, Roing, 19.12.1996, R. Sewak); Changlang (Miao, 8.2.1995, R. Sewak), 8 exs., also recorded from Namdapha by S. Biswas (1981).

Elsewhere : Myanmar.

44. ***Onthophagus porcus*** Arrow

1931. *Onthophagus porcus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 325, fig. 42

1963. *Onthophagus* (s. str.) *porcus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 482.

Diagnostic Characters : Oval, compact and very convex. The head is narrow, front margin rounded, strongly reflexed and side gently curved. Prothorax is evenly and closely punctured, front angles fairly sharp, sides rounded in front and nearly straight behind and base is strongly rounded. Elytra are striate, intervals not quite flat and fairly, closely granulate. Pygidium moderately, finely punctured.

Distribution : India : Arunachal Pradesh : Lohit (Junito village Road, Namsai, 1.7.1995, R. Sewak), 3 exs., also recorded from Nadapha by S. Biswas (1981).

Elsewhere : Bangladesh.

45. ***Onthophagus deflexicollis*** Lansberge

1883. *Onthophagus deflexicollis* Lansberge, *Notes Leyden Mus.*, **5** : 72.

1883. *Onthophagus* mutabilis Lansberge, *Notes Leyden Mus.*, **5** : 72.

1921. *Onthophagus deflexicollis* Boucomont, *France Ent Del' Indochn.*, **4** : 59-60.

1931. *Onthophagus deflexicollis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera Lamellicornia : Coprinae), **3** : 331-332.

1963. *Onthophagus* (s. str.) *deflexicollis* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 327-328.

Diagnostic Characters : Broadly oval, compact and not very convex. Head is broad and not very flat, clypeus is a little produced to a point, ocular lobes angulate externally. Prothorax is fairly, closely and not very finely punctured,

front angles are rather blunt, lateral margins feebly rounded in front, nearly straight behind and the base is broadly rounded. Elytra are finely striate, intervals flat, finely and rather numerously punctured. Pygidium is moderately, finely and closely punctured.

Distribution : India : Arunachal Pradesh : West Siang (Gai river, Likabali, 25.8.1994, R. Sewak); Papumpare (Midpu, Doimukh, 20.2.1996, R. Sewak), 7 exs., also recorded from Zero, Namdapha by S. Biswas (1981), Assam, Meghalaya, Sikkim, Uttranchal and West Bengal.

Elsewhere : Indonesia, Malaya Peninsula, Myanmar and Vietnam.

46. ***Onthophagus ensifer*** Boucomont

1914. *Onthophagus ensifer* Boucomont, *Ann. Mus. Civ. Genova.*, **96** : 220.

1931. *Onthophagus ensifer* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 334-335, fig. 41.

1963. *Onthophagus* (s. str.) *ensifer* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 342.

Diagnostic Characters : Oval and moderately convex. The head is not very broad and the clypeus and the ocular lobes are rounded. The front angles of the prothorax are a little produced and fairly sharp. The lateral margins are straight in front and sinuate behind. The male having very long slendered, slightly flattened, backwardly directed and curved cephalic horn, arises from the middle of the frons and extending upto the middle of the body. The female having a curved carina in place of horn.

Distribution : India : Arunachal Pradesh : East Siang (Pasighat, 7.9.1994, R. Sewak); West Siang (Along, 4.4.1996, P.T. Bhutia); Papumpare (Doimukh, 19.2.1996, R. Sewak), 8 exs., also recorded from Andhra Pradesh, Gujarat, Kerala, Rajasthan and Uttar Pradesh.

47. ***Onthophagus phanaeiformis*** Boucomont

1914. *Onthophagus phanaeiformis* Boucomont, *Ann. Mus. Civ. Stor. Nat. Genova*, **96** : 224.

1931. *Onthophagus phanaeiformis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 335-336.

1963. *Onthophagus* (Paraphanaeomorphus) *phanaeiformis* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 478.

Diagnostic Characters : Rather short, broad and not very convex, moderately shining with a clothing of very fine erect, scattered pale setae and strongly, closely punctured above. The margin is almost semicircular, frons bears a long slendered, curving upward and backwardly directed horn. The base of prothorax feebly rounded and has a sharp longitudinal meidan carina. Elytra are distinctly striate with fine punctures, intervals very slightly convex, strongly and closely punctured. Pygidium is coarsely, fairly and closely punctured.

Distribution : India : Arunachal Pradesh : Tirap (Deomali, 14.2.1995, R. Sewak), 3 exs., also recorded by S. Biswas (1981) from Namdapha Wild Life Sanctuary, Tirap.

48. ***Onthophagus centricornis*** Fabricius

1798. *Copris centricornis* Fabricius, *Ent. Syst. Suppl.*, p. 33.

1823. *Copris* luteipennis Wiedemann, *Zool. Mag.*, **2** (1) : 20.

1858. *Onthophagus* minutus Motschulsky, *Etudes Ent.*, **7** : 54.

1931. *Onthophagus centricornis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 343-344.

1963. *Onthophagus* (s. str.) *centricornis* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 305-306.

Diagnostic Characters : Very small, broadly oval, compact and moderately convex. Head is short and broad, clypeus sparsely punctured and feebly excised in the middle and frons having a short, straight, erect horn just before eyes. Prothorax is gently rounded. Elytra are striate, 7th stria strongly curved, intervals flat with

extremely minute and scanty asperate punctures, with minute setae. Pygidium is finely and not closely punctured.

Distribution : India : Arunachal Pradesh : Changlang (Namdapha Road, Miao, 7.2.1995, R. Sewak), 4 exs., also recorded from Namdapha by S. Biswas (1981), Karnataka, Madhya Pradesh, Maharastra, Meghalaya and Tamil nadu.

Elsewhere : Srilanka.

49. ***Onthophagus vaulogeri*** Boucomont

1923. *Onthophagus vaulogeri* Boucomont, *Bull. Soc. Ent. France*, p. 10.

1931. *Onthophagus vaulogeri* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 244-345.

1963. *Onthophagus* (s. str.) *vaulogeri* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 576-577.

Diagnostic Characters : Oval, compact and convex. Head is very smooth, shining and sparsely punctured, sides are rounded and the clypeus is a little produced to a blunt point in front. Prothorax is rather finely, closely and evenly punctured, front angles are a little produced, sides straight in front and feebly sinuate behind and base is strongly rounded. The front tibiae are elongate and curved. Elytra are striate intervals flat and closely punctured. Pygidium is moderately, finely and closely punctured.

Distribution : India : Arunachal Pradesh : Tawang (Namat village, 23.9.1997, R. Sewak), 3 exs., also recorded from Namdapha by S. Biswas (1981), Meghalaya, Uttranchal.

Elsewhere : Indo-China, Myanmar.

50. ***Onthophagus cervus*** Fabricius

1798. *Copris cervus* Fabricius, *Ent. Syst. Suppl.*, : 31.

1798. *Copris* nuchidens Fabricius, *Ent. Syst. Suppl.*, : 31.

1801. *Copris cervus* Fabricius, *Syst. Eleuth.*, **1** : 46.

1877. *Onthophagus* ceylonicus Harold, *Ann. Mus. Civ. Genova*, **10** : 61.

1931. *Onthophagus cervus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 348-350, fig. 45.

Diagnostic Characters : Oval and moderately convex. Head is not very broad, clypeus is a little produced and the vertex is having a pair of backwardly sloping horns, broad at the base but not united. Prothorax is fairly, strongly, not very closely but evenly punctured with intermixed small punctures, front angles are rather sharp, lateral margin straight in front, sinuate behind and the base is rounded. Elytra are finely striate, intervals slightly convex and rather finely but evenly punctured. Pygidium is punctured with intermix large and small punctures.

Distribution : India : Arunachal Pradesh : West Siang (Along Road, Basar 5.9.1994, Kaying Road, Along, 29.8.1994; Daporzo Road, 4.9.1994; R. Sewak); Upper Siang (Getha Road, Yingkiong, 31.8.1994, R. Sewak); Lohit (Chokhum Road, Namsai, 2.2.1995, R. Sewak); Tirap (Dirok Road, Deomali, 13.2.1995, R. Sewak); Papumpare (Midpu village, Doimukh, 20.2.1996, R. Sewak), 48 exs., also recorded from Andaman and Nicobar Island, Karnataka, Kerala, Madhya Pradesh, Maharastra, Pondicherry, Uttranchal and West Bengal.

Elsewhere : Srilanka.

51. ***Onthophagus duporti*** Boucomont

1914. *Onthophagus duporti* Boucomont, *Ann Mus Civ Stor. Nat. Genova*, **96** : 228.

1931. *Onthophagus duporti* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 353.

1963. *Onthophagus* (s. str.) *duporti* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 337-338.

Diagnostic Characters : Oval, fairly compact, convex, smooth and shining. Head is not very broad, sides are rounded, clypeus feebly produced and separated from the frons by a short transverse carina. The frons bear a short, erect, blunt conical horn. Prothorax is unequally punctured with large and small punctures, front angles are a little produced but not very sharp, lateral margin nearly straight in front and feebly sinuate behind and base is rounded. Elytra are rather deeply striate, intervals slightly convex and not very finely or sparsely punctured, 7th stria is strongly curved.

Pygidium unequally punctured with intermixed large and small punctures.

Distribution : India : Arunachal Pradesh : East Kameng (Dirang, 22.11.1992, T.K. Pal), Dibang Valley (Shantipur, 1.9.1991, T.K. Pal), 4 exs., also recorded from Zero and Namdapha by S. Biswas (1981), Bihar, Karnataka, Nilgiri Hills and West Bengal.

Elsewhere : Myanmar.

52. ***Onthophagus bengali*** Gorden and Oppenheimer

1975. *Onthophagus* (Onthophagus) *bengali* Gorden and Oppenheimer, Orient Insect., **9** (4) : 497-498.

Diagnostic Characters : Small, oval, feebly compact and convex. Head wider than long, flattened, punctured and with clypeal ridges or carina, anterior margin of the clypeus truncate and feebly reflexed, vertex with two distinct basely connected vertical horns. Prothorax with a fine complete border and evenly, entirely punctured, front angles abruptly rounded and hind angles broadly rounded. Elytra are finely striate and punctured, intervals are flat and finely, irregularly punctured. Pygidium slightly convex and slightly altuaceously, coarsely punctured and each puncture bearing a short erect seta.

Distribution : India : Arunachal Pradesh : Changlang (Changland Rd, Miao, 8.2.1995, R. Sewak); Dibang Valley (Epipani Road, Roing, 20.12.1996, R. Sewak), 5 exs., also recorded from Namdapha by S. Biswas (1981), West Bengal.

53. ***Onthophagus tirapensis*** Biswas and Chatterjee

1985. *Onthophagus tirapensis* Biswas and Chatterjee, *Rec. zool. Surv. India*, **82** (1-4) : 160-162, fig. 4.

Diagnostic Characters : Elongate oval, highly convex. Head broadly rounded in front, gently sinuate at sides and straight behind, closely and rugosely punctured, vertex with a strong and broad lamina directed upward and backwardly and splited in the middle into two finger like process behind the eyes. Prothorax highly convex, anterior declivity prominent, minutely and sparsely punctured, front angles bluntly produced, sides almost obsolete and base is a little produced in middle. Elytra are striate, striae minutely and sparsely punctured, intervals microscopically sculptured and minutely punctured. Pygidium sparsely punctured.

Distribution : India : Arunachal Pradesh : Tirap (Namsang Road, Deomali, 14.2.1995, R. Sewak), 3 exs., also recorded from Namdapha Wildlife Sanctuary, Tirap by S. Biswas (1981).

54. ***Onthophagus arunachalensis*** Biswas and Chatterjee

1985. *Onthophagus arunachalensis* Biswas and Chatterjee, *Rec. zool. Surv. India*, **82** (1-4) : 162-164, fig. 5.

Diagnostic Characters : Black and shining and covered with short setae on upper surface. Head narrow in front, clypeus produced and strongly reflexed anteriorly and uniformly punctured. Prothorax is strongly punctured with large central depression which has a strong conical process on upper margin, front angles produced, sides almost straight in front, sinuate behind and base is rounded. Elytra shallowly striate, striae sparsely and minutely punctured. Pygidium uniformly punctured. The hind tibiae produced three lobes at the extremity.

Distribution : India : Arunachal Pradesh : Changlang (Namdapha Road., Miao, 7.2.1995, R. Sewak), 5 exs., also recorded from Zero, Namdapha by S. Biswas & Chatterjee (1981).

55. ***Onthophagus songsokensis*** Biswas and Chatterjee

1985. *Onthophagus songsokensis* Biswas and Chatterjee, *Rec. zool. Surv. India*, **82** (1-4) : 166-167, fig. 6.

Diagnostic Characters : Black and not very shining. Head is rounded, clypeus very feebly emarginate in the middle and sparsely punctured anteriorly, vertex with a strong transverse, abruptly narrow carina, having an angular process on each side near the base and bifurcated at apex. Prothorax strongly umblicately punctured, front angles blunt, hind angles obsolete, lateral margin straight in front and rounded behind. Elytra are fairly strongly striate, striae closely punctured,

intervals convex, shining and asperately punctured. The front tibia short, with four external teeth. Pygidium fairly, strongly punctured.

Distribution : India : Arunachal Pradesh : Upper Subansiri (Daporzo, 28.10.1989, P.T. Bhutia); Lower Subansiri (Yazali, 15.9.1988, T.K. Pal), 4 exs., also recorded and described from Zero, Miao and Namdapha by S. Biswas and Chatterjee (1981).

56. ***Onthophagus royi*** Biswas and Chatterjee

1985. *Onthophagus royi* Biswas and Chatterjee, *Rec. zool. Surv. India*, **82** (1-4) : 172-174, fig. 7.

Diagnostic Characters : Short, not very convex. Head semicircular, clypeal margin uniformly rounded, bear a curved carina and closely punctured by large and meidum sized punctures, frons bounded by a straight carina posteriorly. Prothorax is not very convex, a little depressed longitudinally in the middle, lateral margins rounded in front and sinuate behind. Elytra are strongly striate, striae feebly punctured, intervals covered with numerous setigerous punctures, arranged in two rows. Pygidium not margined at the base, moderately, strongly punctured. The front tibiae are having four external teeth, serrate at the base.

Distribution : India : Arunachal Pradesh : Changlang (Changlang Rd, Miao, 8.2.1995, R. Sewak), 3 exs., also recorded from Namdapha (1981) and Meghalaya (Shillong and Khasi Hills, 1974) by S. Biswas.

9. Genus ***Phacosoma*** Boucomont, 1914

1914. *Phacosoma* Boucomont, *Ann. Soc. Ent. France*, **133** : 249.

1931. *Phacosoma* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 354.

1963. *Phacosoma* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 269-270.

Diagnostic Characters : Broadly oval and rather depressed in shape with rather slender legs, front tibiae armed with three external teeth and minutely serrate between and above them, middle and hind tibiae long and not much dilated at extremity. Head flat, clypeus narrowed and bidentate in front. Prothorax short and broad, lateral margin angulate in front, nearly straight and parallel behind with a short parallel carina at the base and base is gently rounded. The scutellm absent. The elytra flat and striate with six dorsal and very sharply inflexed broad epipluera. Antennae nine jointed.

Author collected single species *Phacosoma obscurum* from Arunachal Pradesh.

57. ***Phacosoma obscurum*** Boucomont

1920. *Phacosoma obscurum* Boucomont, *Ann. Soc Ent France*, **88** : 307.

1931. *Phacosoma obscurum* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 354-355.

1963. *Phacosoma obscurum* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 272-273, fig. 109.

Diagnostic Characters : Black oval and depressed. Head and prothorax densely punctured, punctures are very deep, rather elongate. Elytra finely and shallowly striate, intervals very feebly convex, finely rugose and scarcely perceptibly punctured. Pygidium convex opaque at the base, shining and punctured at the apex. The front and hind femora are broadly triangular, hind tibiae strongly curved.

Distribution : India : Arunachal Pradesh : Tirap (Dirok Rd, 13.2.1995, R. Sewak), 2 exs., also recorded by S. Biswas (1981) from Namdapha.

Elsewhere : Myanmar.

10. Genus ***Liatongus*** Reitter 1893

1893. *Liatongus* Reitter, *Verh. Ver. Brunn*, **31** : 166.

1931. *Liatongus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia Coprinae), **3** : 362.

1963. *Liatongus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 78-79.

Diagnostic Characters : Very small and rather elongate in shape. Scutellum present. Elytra elongate and without posterior fringe of bristles or setae. Pygidium has a sharp ridge parallel to base. Antennae eight jointed. The head of the male generally with horns and oftenly prothorax also.

Key to the species of genus *Liatongus*

1. Oval and flattened. Elytral intervals flat and covered with granules ..... *phanaeoides* Westwood
- Not oval and flattened. Elytral intervals not covered with granules 2
2. Broadly oblong and convex. Elytral intervals convex, microscopically sculptured and sparsely punctured ..... *gagatinus* Hope
- Not oblong and convex. Elytral intervals not convex 3
3. Oval and not very shining. Elytral intervals opaque and minutely punctured ..... *mergacerus* Hope
- Oval, subopaque with head and lower surface shining. Elytral intervals coriaceous and scarcely punctured ..... *vertagus* Fabricius

58. *Liatongus phanaeoides* Westwood

1840. *Onthophagus phanaeoides* Westwood, *Royle's Himalaya, Entomology*, **55**, pl. 9, Fig. 3.

1848. *Onthophagus excavatus* Redtenbuchar, *Hugels Kaschmir*, **4** (2) : 523.

1860. Phanaeus minutus Motschulsky, *Etudes Entom.*, **9** : 13.

1931. *Liatongus phanaeoides* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 364-365.

1963. *Liatongus* (s. str.) *phanaeoides* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 92-93, fig. 45.

Diagnostic Characters : Oval and flattened. Head is finely and closely puctured, front margin reflexed and slightly truncate or feebly excised. Prothorax is coarsely, densely punctured, with a broad shallow depression along the middle, front angles not very sharp and hind angles obsolete and base is obtusely angulate in the middle. Elytra striate with flat intervals, bearing minute scattered granules. Pygidium unpuctured. Metasternal shield closely punctured. The head of the male having strong horn arising between the eyes.

Distribution : India : Arunachal Pradesh : West Siang (Along to Basar Road, 27.8.1994, R. Sewak), 4 exs., also recorded from Zero and Namdapha by S. Biswas (1981), Himachal Pradesh, Uttar Pradesh and West Bengal.

Elsewhere : Indo-China, South-China, Japan, Myanmar and Pakistan.

59. *Liatongus gagatinus* Hope

1831. *Liatongus gagatinus* Hope, *Gray's Zool. Misc.*, 122.

1848. *Onthophagus brama* Redtenbuchar, *Hugel'r Kaschmir*, **4** (2) : 521.

1931. *Liatongus gagatinus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 365-366.

1963. *Liatongus* (s. str.) *gagatinus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 104.

Diagnostic Characters : Broadly oblong, moderately convex and lower surface almost devoid of hairs or setae. The clypeus is finely punctured, front margin reflexed and almost imperceptibly excised in the middle. Prothorax broad in front, longitudinally depressed posteriorly, front angles blunt, sides little contracted behind and obtusely angulate in the middle and punctured. The elytra are short, deeply sulcate with convex intervals and microscopically sculptured, and minutely sparsely punctured. Pygidium is opaque and feebly punctured.

Distribution : India : Arunachal Pradesh : Upper Siang (Getha Road, Yingkiong, 31.8.1994, R. Sewak), 5 exs., also recorded from Namdapha by S. Biswas (1981), Assam, Meghalaya, Nagaland, Sikkim, Uttranchal and West Bengal.

Elsewhere : Myanmar and Nepal.

60. *Liatongus mergacerus* Hope

1831. *Onthophagus mergacerus* Hope, *Cray's Zool. Misc.*, 22.

1874. *Oniticellus mergacerus* Harold, *Col. Hefte*, **12** : 94.

1931. *Liatongus mergacerus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 369-370.

1963. *Liatongus* (s. str.) *mergacerus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 96-97.

Diagnostic Characters : Oval, not very shining except upon the head and anterior part of the prothorax. The clypeus is nearly straight or feebly curved carina and finely punctured. Prothorax is fairly, closely punctured, completely margined and with a short, very deep longitudinal impression at the base, sides strongly bisinuate, front angles blunt and hind angles wanting. Elytra are lightly striate, striae minutely, rather indistinctly punctured and the intervals opaque and very minutely punctured.

Distribution : India : Arunachal Pradesh : Tawang (Kumba village, Lumala, 27.9.1997, R. Sewak), 4 exs., also recorded from Namdapha by S. Biswas (1981), Sikkim, Uttranchal and West Bengal.

Elsewhere : Bhutan and Nepal.

61. *Liatongus vertagus* Fabricius

1798. *Copris vertagus* Fabricius, *Ent. Syst. Suppl*, 30.

1834. *Oniticellus bifurcatus* Erichson, *Nova. Acta. Leop. Carol. Suppl.*, **16** : 235, pl. 37, fig. 4.

1844. *Onthophagus bifurcatus White, Ann. Mag. Nat. Hist.*, **14** : 423.

1858. *Onthophagus dichrous* Boheman, *Eugen. Resa*, 43.

1891. *Oniticellus pictisternum* Fairmaire, *Bull. Soc. Ent. Belg.*, **35** : 193.

1893. *Oniticellus* tonkineus Fairmaire, *Bull. Soc. Ent. Belg.*, **37** : 305.

1908. *Oniticellus vertagus* Arrow, *Ann. Mag. Nat. Hist.*, **8** (1) : 180.

1931. *Liatongus vertagus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 371-373, pl.xii, figs 1, 2, 3.

1963. *Liatongus* (s. str.) *vertagus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 96.

Diagnostic Characters : Oval, subopaque with the head and lower surface shining. The clypeal margin nearly straight or feebly excised in front, convergent at the sides, frons having a strongly recurved horn, broad at the base and strongly bifurcated at the end. Prothorax finely and moderately, closely punctured, front margin smooth with a median longitudinal groove, very deeply impressed behind, front angles are moderately sharp and hind angles obsolete and base is distinctly angulate in the middle. Elytra are lightly striate, striae feebly punctured and intervals coriaceously and scarcely punctured. Pygidium bears a few minute scattered punctures.

Distribution : India : Arunachal Pradesh : Changlang (Namdapha Road, Miao, 7.2.1995; Jairampur Road, 11.2.1995, R. Sewak); Dibang Valley (Roing, 18.12.1996; Corna Village, Roing, 19.12.1996; Epipani Road, Roing, 20.12.1996, R. Sewak); Lohit (Junito village road, Namsai, 1.2.1995; Chokhum Road, Namsai, 2.2.1995; Digaru river, Teju, 5.2.1995, R. Sewak); Lower Subansiri (Yazali, 10.2.1996, R. Sewak); East Siang (Pasighat, 26.2.1989, T.K. Pal; Remi Road, Pasighat, 7.9.1994, R. Sewak); Papumpare (Doimukh 19.2.1996, R. Sewak); Tirap (Dirok Rd, Deomali, 13.12.1996; Namsang Rd, Deomali, R. Sewak); Upper Siang (Yingkiong, 26.2.1989, T.K. Pal; Getha Road Yingkiong, 31.8.1994; Moiring Road Yingkiong, 1.9.1994, R. Sewak); West Siang (Along Rd, Likabali, 24.8.1994; Gai River Likabali, 25.8.1994; Kaying Road, Along, 29.8.1994; Daporjo Road, Basar, 4.9.1994; Along Road, Basar, 5.9.1994, R. Sewak); West Kameng (Dirang, 22.11.1992, T.K. Pal), 150 exs., also recorded from Assam and Manipur.

Elsewhere : Indo-China, South-China, and Myanmar.

11. Genus *Oniticellus* Serville 1825

1825. *Oniticellus* Serville, *Encycl. Meth.*, **10** : 356.

1856. *Oniticellus* Lacordaire, *Gen. Col.*, **3** : 110.

1893. *Oniticellus* Reitter, *Verh. Ver. Brunn*, **31** 165

1901. *Tiniocellus* Peringuey, *Trans. S. Afr Phil Soc.*, **12** 116.

1931. *Oniticellus* Arrow, *Fauna of British India including*

Ceylon and Burma (Coleoptera : Lamellicornia : Coprinae), **3** : 375.

1963. *Oniticellus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 70-71.

Diagnostic Characters : Elongate and scutellum present. Elytra flat and not completely covered the abdomen and having the fringe of stiff hair at the hind margin. Two sexes are alike. The four species of the genus have been found from Arunachal Pradesh.

Key to the species of genus *Oniticellus*

1. Clypeus straight in front. Prothorax with spots and patches. Elytral intervals sculptured .... *namdaphaensis* Biswas & chatterjee

– Clypeus not straight. Prothorax without spots or patches. Elytral intervals not sculptured .. 2

2. Clypeus not uniformly rounded. Prothorax with blunt front angles and obtuse hind angles. Elytral intervals bears minute setigerous punctures... ..... *subhendui* Biswas & Chatterjee

– Prothorax not having blunt front angles and obtuse hind angles. Elytral intervals not bear setigerous punctures 3

3. Clypeus uniformly rounded. Prothorax having rounded front angles and obsolete hind angles. Elytral intervals minutely punctured and tuberculate ..... *gayeni* Biswas & Chatterjee

– Clypeus is gently excised. Prothorax smooth and unpunctured. Elytral intervals minutely and sparingly punctured ..... *cincuts* Fabricius

62. ***Oniticellus namdaphaensis*** Biswas & Chatterjee

1985. *Oniticellus namdaphaensis* Biswas & Chatterjee, *Rec. zool. Surv. India*, **82** (1-4) : 152-154, fig. 1.

Diagnostic Characters : Elongate-oval, covered with uniformely minute pale setae except head and a spear shaped marking on the antero-median region of prothorax, four spots near apex of elytra and two patches on posterior end and metasternum dark. The clypeal margin almost straight in front, little hollowed behind, clypeal disc thick and convex, front depressed and flat, vertex with two strong triangular projections. Prothorax longer than broad, completely margined, bear deep longitudinal median groove in the middle and covered with setigerous asparate punctures. Elytra shallowly striate, intervals very convex and microscopically punctured. Pygidium flat and covered with pale setigerous punctures.

Distribution : India : Arunachal Pradesh : Changlang (Digaru river, Namdapha Rd, Miao, 7.2.1995, R. Sewak), 3 exs., also recorded from Namdapha by S. Biswas (1981).

63. ***Oniticellus subhendui*** Biswas & Chatterjee

1985. *Oniticellus subhendui* Biswas & Chatterjee, *Rec. zool. Surv. India*, **82** (1-4) : 154-156.

Diagnostic Characters : Elongate-oval. Head narrow, clypeus margined, clypeal disc convex, flat and less strongly punctured and separated from the frons by a carina, frons depressed and bear two small pae shaped prominence anteriorly and vertex strongly raised. Prothorax punctured, margined and with a groove in the middle near the base, front angles blunt, hind angles obtuse and lateral margin rounded in front and sinuate behind. Elytra lightly striate and intervals covered with minute setigerous punctures. Pygidium opaque and covered with setigerous punctures.

Distribution : India : Arunachal Pradesh : Tirap (Namdapha Road, Deomali, 14.2.1995, R. Sewak), 2 exs., also recorded by S. Biswas (1981) from Namdapha.

64. ***Oniticellus gayeni*** Biswas & Chatterjee

1985. *Oniticellus gayeni* Biswas & Chatterjee, *Rec. zool. Surv. India*, **82** (1-4) : 156-158, fig. 3.

Diagnostic Characters : Uniformly black with greenish lusture. Head without any armature and covered with strong punctures, clypeus rounded, depressed in the middle anteriorly, clypeal disc, frons and vertex with few strong punctures. Prothorax strongly punctured at sides, imperceptly in the middle with a longitudinal impressed line in the middle, front angles rounded and hind angles obsolete. Elytra deeply striate, stria strongly punctured, intervals feebly convex and minutely

punctured. Pygidium have a broad transverse prominence, covered with pale short setae and rugosely punctured.

Distribution : India : Arunachal Pradesh : Dibang Valley (Carona village Road, Roing, 20.12.1996, R. Sewak), 5 exs., also recorded from Namdapha by S. Biswas (1981).

65. ***Oniticellus cinctus*** Fabricius

1775. *Scarabaeus cinctus* Fabricius, *Syst. Ent.*, 30.

1931. *Oniticellus cinctus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 379-380.

1963. *Oniticellus* (s. str.) *cinctus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 77.

Diagnostic Characters : Smooth, shining black with a slight greenish lusture. Oblong-oval and not very convex. Head without carina or elevations, clypeus short, with a slight depression just behind the middle of the front margin, which is rounded and gently excised in the middle. Prothorax very smooth and unpunctured, with deeply impressed median longitudinal line, sides almost obsolete. Elytra are deeply striate, striae feebly and closely puncutred, intervals convex, very minutely and sparingly punctured. Pygidium is finely rugose and opaque.

Distribution : India : Arunachal Pradesh : Changlang (Namdapha Road, Miao, 7.2.1995; Namsai Road, Miao, 8.2.1995, R. Sewak); Dibang Valley (Shelly lake, Roing, 18.12.1996; Epipani Road, Roing, 20.12.1996, R. Sewak); Lohit (Chokhum Road, Namsai, 2.2.1995; Lohit, 5.2.1995, R. Sewak); Upper Siang (Yingkiong, 28.2.1989, T.K. Pal), 8 exs., also recorded from Namdapha by S. Biswas (1981), Assam, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharastra, Uttranchal, Uttar Pradesh and West Bengal.

Elsewhere : Annam, Bangladesh, Malaya Peninsula, Myanmar, Siam and South China.

12. Genus ***Drepanocerus*** Kirby, 1828

1828. *Drepanocerus* Kirby, *Zool. Journ.*, **3** : 521.

1856. *Drepanocerus* Lacordaire, *Gen. Col.*, **3** : 111.

1881. *Ixodina* Roth, *Arch. Nat.*, **17** (1) : 128.

1931. *Drepanocerus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 380-381.

1963. *Drepanocerus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 61.

Diagnostic Characters : Elongate and flattened and clothed with erect scale like hairs. Clypeus bidentate. Prothorax very uneven and scutellum distinct. Elytra flat, not covered the sides of abdomen. Legs long and slendered. The males generally with horn.

The author founal two speecies from Ariunachal Pradesh.

Key to the species of genus *Drepanocerus*

1. Clypeus not dentate in front. Prothorax with pits or cubitus. Fifth and seventh striae elongate ..... *falsus* Sharp

– Clypeus dentate in front. Prothorax without pits. Elytral intervals flat and punctate .... *striatulus* Paulian

66. ***Drepanocerus falsus*** Sharp

1875. *Oniticellus falsus* Sharp, *Col. Hefte*, **13** : 52.

1875. *Oniticellus exsul* Sharp, *Col. Hefte*, **13** : 53.

1931. *Drepanocerus exsul* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera Lamellicornia : Coprinae), **3** : 385-386.

1963. *Drepanocerus falsus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera Lamellicornia), **2** : 66.

Diagnostic Characters : Head not very broad. Clypeus emarginated in front, longer than broad. Prothorax broad, depressed longitudinally and covered with pits anteriorly which are transeversely united and sides are rounded. Elytra moderately and acutely striate, 5th and 7th stria elongate, intervals sculptured and covered with scales or bristles. Pygidium with two tuberculate carina.

Distribution : India : Arunachal Pradesh : Tawang (Namet village, Tawang, 23.9.1997, R. Sewak), 2 exs., also recorded from Namdapha by S. Biswas (1981), Assam.

Elsewhere : Laos and Thailand.

67. ***Drepanocerus striatulus*** Paulian

1945. *Drepanocerus striatulus* Paulian, *Col. Scarab. Del'Inddochine* (Coleoptera : Lamellicornia : Coprinae), : 140.

1963. *Drepanocerus striatulus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 69.

Diagnostic Characters : Black, smooth and shining. Head short and not very broad. Clypeus deeply emarginated and strongly dentate in front and sparsely, minutely behind. Prothorax not distinctly and densely punctated in upper part. Elytra ringly punctated and striated, suture of elytra very broad, intervals are flat and unpuctate. Pygidium with carina.

Distribution : India : Arunachal Pradesh : East Siang (Panzing Road, Pasighat, 9.9.1994, R. Sewak), 3 exs., also recorded from Namdapha by S. Biswas (1981), Assam, Manipur, Meghalaya.

Elsewhere : China, and North Vietnam.

13. Genus ***Onitis*** Fabricius

1798. *Onitis* Fabricius, *Ent. Syst. Suppl.*, : 2.

1856. *Onitis* Lacordaire, *Gen. Col.*, **3** : 103.

1857. *Onitis* Lansberge, *Ann. Soc. Ent. Belg.*, **18** : 49.

1931. *Onitis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 386-387.

1963. *Onitis* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 26-28.

Diagnostic Characters : Oblong with stout legs and without front tarsi. Head is not broad and the prothorax without process or excavation but minute. The front tibiae armed with four external teeth. Abdomen completely covered by the elytra.

The author found five species from Arunachal Pradesh.

Key to the species of genus *Onitis*

1. Clypeus without a carina and clypeo-frontal carina simple and entire ..... *siva* Gillet
– Clypeus with a carina and clypeo-froantal carina not simple 2
2. Clypeo-frontal carina is widely interrupted. Metasternum transversely excavated in the middle ..... *excavatus* Arrow
– Metasternum not transversely excavated in the middle 3
3. Prothorax sparsely punctured and without a well marked median groove or line .... *falcatus* Wulfen
– Prothorax not sparsely punctured and clypeo-frontal carina not widely interrupted 4
4. Prothorax strongly and closely punctured. The clypeo-frontal carina interruptly curved .... *philemon* Fabricius
– Prothorax unevenly punctured and its basal impression tuberculate. The clypeo-frontal carina strongly elevated, acuminated in the middle ..... *castaneus* Redtenbucher

68. ***Onitis siva*** Gillet

1911. *Onitis siva* Gillet, *Ann. Soc. Ent. Belg.*, **105** : 313.

1931. *Onitis siva* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 388-389.

1963. *Onitis siva* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 53-54.

Diagnostic Characters : Elongate-oval and moderately convex. The clypeal margin is strongly rounded and the clypeus is separated from the frons by a strongly elevated and curved carina. The prothorax having a trace of a longitudinal median groove posteriorly in the middle, uniting with the close and narrow basal fovae, the front angles are acutely rectangular and the hind angles

obsolete. The front legs of the male are elongate, femur having a very strong spine at the middle of the anterior edge, the tibiae are slendered, strongly curved anteriorly, armed with four sharp external teeth. The hind femur is little hollowed on its lower surface and has hooked tooth just beyond the middle on its enterior edge and the female is without teeth.

Distribution : India : Arunachal Pradesh : Changlang (Changlang Road, Miao, 8.2.1995, R. Sewak); Upper Siang (Yingkiong, 27.2.1982, T.K. Pal), 5 exs., also recorded from Gujarat, Kerala, Rajasthan, Tamilnadu and Uttar Pradesh.

69. ***Onitis excavatus*** Arrow

1931. *Onitis excavatus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 391, pl. xii, fig. 19.

1963. *Onitis excavatus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 37-38.

Diagnostic Characters : Rather narrow, oval and moderately convex. The clypeus is shortly elliptical, moderately closely and finely rugulose, clypeo-fronatl carina is widely interrupted in the middle, with a short transverse clypeal carina in front and a small frontal tubercle behind it, vertex is granular. Prothorax very smooth with irregular minute punctures in front and without a longitudinal groove and base is very obtusely granular. Elytra are finely striate, 1st, 3rd, and 5th intervals are a little raised and narrower and other are flat. Pygidium smooth and unpuctured. The front tibiae are elongate, with a serrate carina upon its anterior half beneath, armed with two sharp teeth near the extremity, the trochanters of hind legs are acutely produced.

Distribution : India : Arunachal Pradesh: Lower Subansiri (Sagalee Rd, Zero, 14.2.1996, R. Sewak), 2 exs., also recorded from Miao by S. Biswas (1981), Assam.

Elsewhere : Myanmar and South-China.

70. ***Onitis falcatus*** Wulfen

1786. *Scarabaeus falcatus* Wulfen, *Descr. Cap. Ins.*, : 14, pl. 2, fig. 17.

1875. *Onitis falcatus* Lansberge, *Ann Soc. Ent Belg*. **18** : 126.

1848. *Onitis himaleyicus* Redtenbucher. Hugel's Kaschmir. **4** (2) : 518.

1931. *Onitis falcatus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 392-393, pl. xi, figs. 9, 10.

1963. *Onitis falcatus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 33-34, pl. iv, fig. 1.

Diagnostic Characters : Rather narrowly oval and convex. The clypeus is elliptical and clypeo-frontal carina is widely interrupted in the middle and with a short front tubercele behind it. The prothorax without a well marked median groove and the base is strongly ruonded and has basal foveae. The front tibia of the male is elongate, armed with four short external teeth, two or three minute teeth before the middle of the lower surface and a sharp incurved terminal process and the middle femur has a minute tooth near the end of lower edge. The front tibia of the female is rather uniformly curved and armed at the tip with an articulated spur.

Distribution : India : Arunachal Pradesh : Dibang Valley (Epipani Road, Roing, 19.12.1994, R. Sewak); Lohit (Junito village Road, Namsai, 1.2.1995; Namsai Road, Teju, 4.2.1995, R. Sewak); Lower Subansiri (Yazali, 27.2.1889, P.T. Bhutia); Papumpare (Ganga Lake, Itanager, 2.8.1994, R. Sewak), 92 exs., also recorded from Miao by S. Biswas (1981), Assam, Gujarat, Haryana, Karnataka, Meghalaya, Manipur, Rajasthan, Tamilnadu, Tirpura, Uttranchal, Uttar Pradesh and West Bengal.

Elsewhere : Bangladesh, Malaya Peninsula, Philipine Island and South-China.

71. ***Onitis philemon*** Fabricius

1801. *Onitis philemon* Fabricius, *Syst Eleut*. **1** : 30.

1875. *Onitis distinctus* Lansberge, *Ann Soc Ent Belg*. **18** : 138.

1931. *Onitis philemon* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 393-394, pl. xi, figs. 3, 40

1963. *Onitis philemon* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 41, pl. v, fig. 2.

Diagnostic Characters : Oval, not very elongate and not very convex. The clypeus is parąbolic with an feeble emargination in the middle. The clypeus is separated from the frons by a interrupted carina, with a short transverse carina just before it and a conical tubercle just behind it. The prothorax is without well marked median line and the front angles are rectangular and the hind angles obsolete, the sides are straight in front and strongly rounded in the middle and the base is obtusely angulate in the middle. The middle femur of the male has a sharp tooth near the end of lower edge and the hind trochantre is little toothed beneath. The front tibia of the female is broad, armed with four strong external teeth and an articulated terminal spur.

Distribution : India : Arunachal Pradesh : Dibang Valley (Shalley lake, Roing, 18.2.1996; Epipani Road, Roing, 21.12.1996; Kebali road, Roing, 21 12.1996, R. Sewak); Papumpare (Doimukh, 19.2.1996; Midpu, Doimukh, 20.02.1996, R. Sewak); East Siang (Remi Road, Pasighat, 7.9.1994; Ranaghat, Pasighat, 8.9.1994, R. Sewak); West Siang (Malinithan Forest, Likąbali, 16.3.1989, P.T. Bhutia; Gai river, Likabali, 25.8.1994; Basar Road, Likabali; 27.8.1994; Pasighat Road, Along, 28.8.1994; Kaying Road Along. 28.8.1994; Doli Road Basar, 3.9.1994, R. Sewak); Upper Siang (Moiring Road Yingkiong, 1.9.1994, R. Sewak), 80 exs., also recorded from Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Ma' arastra, Rajasthan, Tamilnadu, Uttranchal, Uttar Prad_sh and West Bengal.

Elsewhere : Srilanka.

72. ***Onitis castaneus*** Redtenbucher

1848. *Onitis castaneus* Redtenbuchre, *Hugel's Kaschmir*, **4** (2) : 517.

1875. *Onitis castaneus* Lansberge, *Ann. Soc. Ent. Belg.*, **38** : 144.

1931. *Onitis castaneus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 398-399, pl. xi, figs. 7, 8.

1963. *Onitis castaneus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **2** : 46.

Diagnostic Characters : Short, compact and convex. The outer margin of the clypeus is strongly reflexed and straight in the middle and has a long transverse arcuate carina and the frons has a strongly elevated entire carina and the vertex is strongly excavated. The front angles of the prothorax are rather blunt, the sides are bisinuate and the base is distinctly lobed in the middle. The front femur of the male has strong oblique spine near the middle of its anterior edge and the middle tibia has two strong process at its outer edge. The front tibia of the female is broad and bears four strong external teeth.

Distribution : India : Arunachal Pradesh : Dibang Valley (Epipani Road,. 20.12.1996, T.K. Pal); Lohit (Chokhum Road, Namsai, 2.2.1995; Digaru river, Namsai, 5.2.1995, R. Sewak), 13 exs., also recorded from Assam, Bihar, Gujarat, Rajasthan, Uttranchal, Uttar Pradesh and West Bengal.

Elsewhere : Pakistan.

Tribe IV **Panelini**

Tribe Panelini consists about six genera, which are differ greatly in the form of legs but they are compact form. The middle coxae far apart and nearly parallel and with simple tarsi, first four joints are nearly equal in size.

Genus 14 ***Paraphytus*** Harold, 1877

1877. *Paraphytus* Harold, *Ann. Mus. civ. Genova*, **10** : 42.

1880. *Xynophron* Harold, *Notes Leyd. Mus.*, **2** : 199.

1895. *Maraxes* Lewis, *Ann. Mag. Nat. Hist.*, **16** (6) : 376.

1909. *Maraxes* Lewis, *Op. Cit.* **4** (8) : 304.

1931. *Paraphytus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 417.

1963. *Paraphytus* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und*

Orientalischen Region (Coleoptera : Lamellicornia), **2** : 279-280.

Diagnostic Characters : Elongated and not very convex. Head is short and broad, ocular lobes completely fused with clypeus, strongly angulated externally, and clypeus armed with four short teeth at the front margin. Prothorax short and broad, sides nearly straight, angles blunt and base is feebly curved. Scutellum wanting. Elytra long, striate (7 Nos.) and well marked epipleurae. Pygidium broad and reflexed ventrally. Abdomen with six visible sternites. Legs short and stout, tibae short and flat, strongly dilating from base to extremity, tarsi short with short basal joint and 5th joint is longer than other.

The author collected single species *Paraphytus hindu* from Arunachal Pradesh.

73. ***Paraphytus hindu*** Arrow

1913. *Paraphytus hindu* Arrow, *Rec. Indian Mus.*, **8** : 193.

1931. *Paraphytus hindu* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae), **3** : 418-419.

1963. *Paraphytus hindu* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), **1** : 283-284, fig. 115.

Diagnostic Characters : Oblong and moderately convex. Head finely and densely punctured and a little depressed along the middle line. Prothorax strongly and very closely punctured at sides and a little more finely and less closely in the middle. Elytra deeply striate, stria rather deeply, closely and regularly punctured, intervals nearly flat and very minutely and sparsely punctured. Pygidium has a deep transverse groove at the base and another at the apex and scarcely or evenly punctured.

Distribution : India : Arunachal Pradesh : Dibang Valley (Shalley Lake, Roing, 18.12.1996, R. Sewak), 2 exs., also recorded from Namdapha by S. Biswas (1981), Meghalaya.

DISCUSSION

All together seventy three species belonging to fourteen genera have been studied from Arunachal Pradesh, were collected from the dung of cow, mithun, goet, horse, yak, deer, pig, elephant and human feacal matters. On the basis of head, prothorax, elytra, legs structure, the dung beetles are divided into four tribes Scarabaeini, Sisyphini, Coprini and Panelini. The clypeus of the genus *Gymnopleurus* having two or four lobe anteriorly in the middle and with all six tarsi and the genus *Sisyphus* is spider like in form by presence fo long legs and clothing of setae. The clypeus of *Synapsis* acutely notched in the middle and elytra with lateral carina. The head of *Heliocopris* having cephalic horn or carina and prothorax with supplementary carina while head of *Catharsius* with a complete margin and elytra with a longitudinal carina. The front tibiae of the genus *Copris* with three or four external teeth and four postreior tibae are strongly dilated from base to extermity and each with two transverse carina at outer edge. The representative of the genus *Caccobius*, *Phacosoma*, *Liatongus*, *Oniticellus*, *Drepanocerus* and *Paraphytus* is very small in size, and having eight jointed antennae except *Paraphytus*. *Liatongus* with cephalic and prothoracic horn and the elytra with posterior fringe or bristles but bristles or scale like hairs are present in *Drepanocerus*. The elytra having well marked epipleurae in *Paraphytus* and clypeus with four short teeth at the front margin. The species of the genus *Onthophagus* usually having stout legs, femora are very thick and tibia armed with four but occasionally three external teeth and also with cephalic horns or carina. The genus *Onitis* is easily recognized by the absent of front tarsi, dilating of posterior tibiae and strong single lateral carina upon the elytra.

SUMMARY

Total seventy three species belonging to fourteen genera of subfamily Coprinae under the family Scarabaeidae were recorded from Arunachal Pradesh. Out of senventy three species namely *Heliocopris dominus*, *Catharsius pithecius*, *Copris indicus*, *Copris magicus*, *Copris repertus*, *Copris numa*, *Onthophagus variegatus*, *Onthophagus tibetanus*, *Onthophagus catta*,

Onthophagus seniculus, Onthophagus nilgirensis, Onthophagus occipitalis, Onthophagus kuluensis, Onthophagus bison, Onthophagus sagittarius, Onthophagus politus, Onitis siva, Onitis philemon, Onitis castaneus have been recorded for the first time from Arunachal Pradesh. All these species are belonging to tribe Scarabaeini, Sisyphini, Corprini and Panelini.

ACKNOWLEDGEMENT

The author is grateful to Dr. J.R.B. Alfred, Director, Zoological Surey of India for encouragement of study and thanks are also due to Shri P.T.Bhutia, Joint Director and Officer-in-Charge, Arunachal Pradesh Field Station, Zoological Survey of India, Itanagar for permitting me to carry the collection of Dung Beetles from Itanagar to Jodhpur for study and also thankful to Dr. Q.H. Baqri, Additional Director & Officer-in-Charge, Desert Regional Station, Zoological Survey Of India, Jodhpur for providing necessary facilitites to carry out the work and for going through the manuscript.

REFERENCES

ARROW, G.J. 1931 *Fauna of British India including Ceylon and Burma* (Coleoptera : Lamellicornia : Coprinae); *Taylor and Francis, London*, **3** : 428.

BALTHASAR, VLADIMIR 1963. *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera : Lamellicornia), *Verlag der Tscheshoslowakischen Akademic der Wissenschften, Prague*, **1** : 1-39, pls. 1-24, figs. 1-137; **2** : 1-627, pls. 1-16, figs. 1-226.

BISWAS, S. 1978. Studies on the Scrab beetles (Coleoptera : Scarabeidae) of North-East India : A new species and notes on other Indian species of subgenus Strandius, genus *Onthophagus*. *J. Bombay nat. Hist. Soc.*, **75**(3) : 911-913.

BISWAS, S. 1978. Studies on the Scrab beetles (Coleoptera : Scarabaeidae) of North-East India. Part II : Three new species and two new record from India, *J.Bombay Nat. Hist. Soc.*, **76** : 339-344.

BISWAS, S. AND CHATTERJEE, S.K. 1985. Insecta : Coleoptera : Scarabaeidae : Coprinae; *Rec. zool. Surv. India*, **82**(1-4) : 147-177.

GORDEN R.D. AND OPPENHEIMER, J.R. 1975. Taxonomy and Ecology of two species of Indian *Onthophagus* (Coleoptera : Scarabaeidae), *Oriental Insect*, **9**(4) : 495-501.

SEWAK, R. 1985. On a collection of Dung beetles (Coleoptera : Scarabaeidae : Coprinae) from Gujarat, India, *Oikoassay*, **2**(2) : 33-35.

SEWAK, R. 1986. On a collection of Dung beetles (Coleoptera : Scarabaeidae : Coprinae) from Rajasthan, India, *Oikoassay*, **3**(1) : 11-15.

SEWAK, R. 1991. Dung beetles (Coleoptera : Scarabaeidae : Coprinae) from five districts of Western Uttar Pradesh, *Oikoassay*, **8**(1 & 2) : 25-27.

SEWAK, R. (2004). Dung beetles (Insecta : Coleoptera : Scarabaeidae : Coprinae) *Rec.* : *Fauna of Gujarat, State Fauna Series*, **8**(Part-2) : 105-125.

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, **13**(Part-2) : 225-255, 2006

INSECTA : DIPTERA : NEMATOCERA

BULGANIN MITRA, A. R. LAHIRI AND M. MUKHERJEE
Zoological Survey of India, M-Block, New Alipore, Kolkata 700053

INTRODUCTION

The state of Arunachal Pradesh physiographically is just not diverse but also unique in the sense that it encompasses not only the flood plains & the foot hills but also the Greater Himalayan ranges. Moreover, the state lies in a transitional ecological province between the India, Indo-Malayan & Sino-Myanmarese biogeographic realms leading to a mingling of biological elements besides its own. The state lies in between 26° 28′ to 29° 30′ N latitudes and 91° 30′ to 97° 31′ E having an area of bout 83,743 sq km.

The history of Arunachal Pradesh goes back many centuries and is interwoven with tradition & myths. As per knowledge goes the history of Arunachal Pradesh is traceable to the 16th century when ahom Kings began to rule Assam. Till 1972, it was known as the 'North East Frontier Agency' (NEFA). It was given the union territory status on January 20, 1972 and renamed as Arunachal Pradesh and declared as a full fledged state on 20th February, 1987.

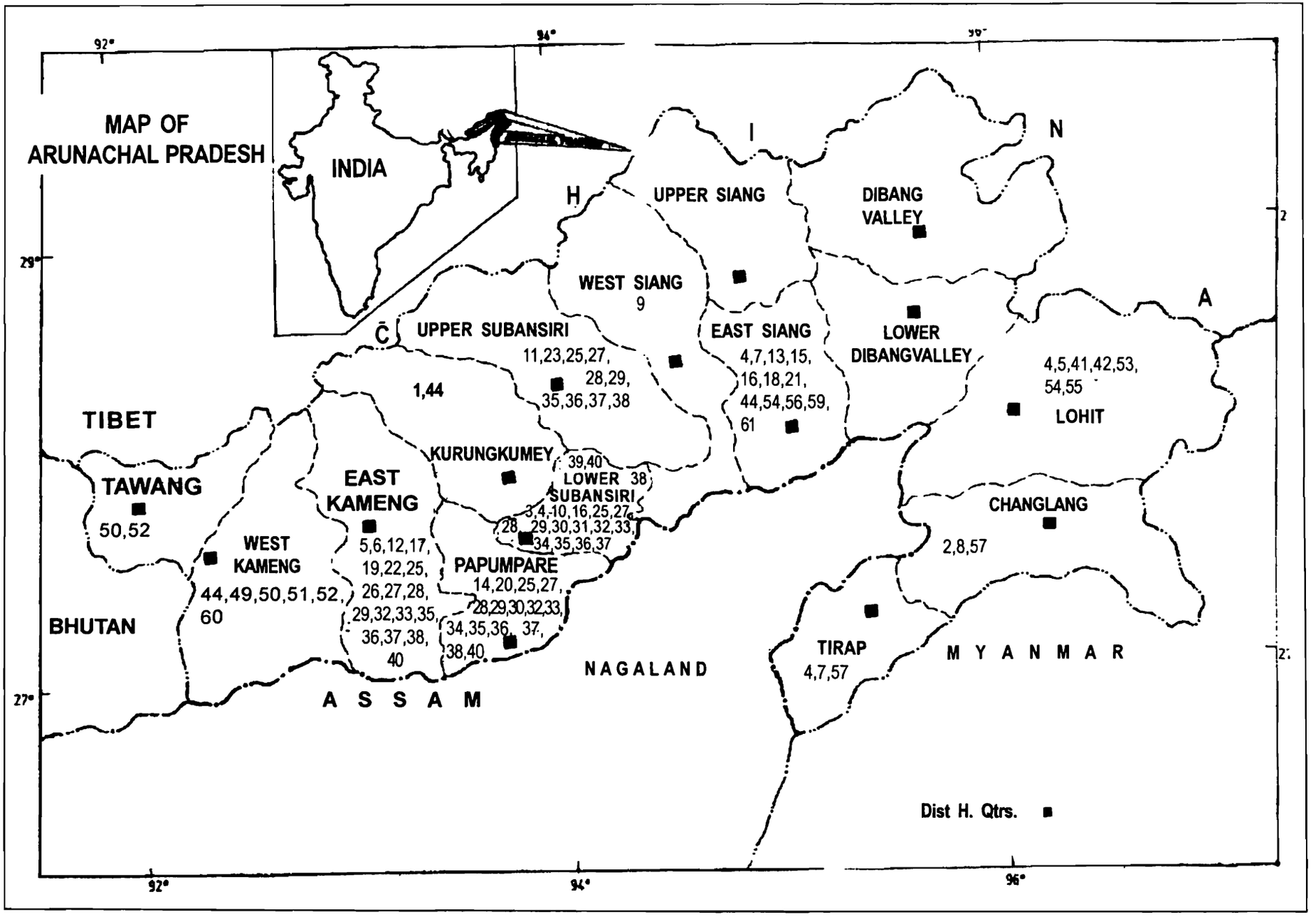
The Diptera or true flies, are the fourth most diverse, and one of the most important and popular insect orders of endopterygote Neoptera. It is estimated that the order contains 200,000 species worldwide, although only just over half of these have been described (Hardy, 1977).

Diptera may be recognized by their single pair of membranous wings. The hind wings of flies have become reduced into small club-shaped structures called halteres. Only the forewings function in flight. All flies have essentially suctorial mouthparts which may commonly be in the form of a thin proboscis, adapted for piercing, or a wide fleshy labellum.

Classification of the modern Diptera continues to posing problems, particularly the rank assignable to different groups. The difficulty arises in part because the order is extreamly old; it contains many extinct groups and others that are decline; and yet there are also groups that are still evolving at a rapid rate. According to the recent classification of Diptera, it divides in two suborders, Nematocera and Brachycera (Mc. Alpine *et al.* 1981-1989). But the classification used here the old one, followed after Oriental catalogue (Delfinado & Hardy, 1973). According to this classification the order Diptera divides into three suborders *viz.* Nematocera, Brachycera and Cyclorrhapha. The present communication is dealt herewith only the Suborder Nematocera.

Nematocera includes the mosquitoes, black flies, midges, gnats and related forms. Many of these are blood suckers and vectors of diseases of man and animals. The families under suborder Nematocera so far recorded from India, are 22 of which only 5 families have been reported to be present in Arunachal Pradesh namely Tipulidae, Culicidae, Simuliidae, Bibionidae and Sciaridae comprising of 61 species under 25 genera, out of 1753 species under 95 genera in India.

A perusal of literature reveals that a good number of publication were made on Diptera fauna as a whole, and a large number of Nematocerans were described from this hotspot of India. The first report of Nematoceran species from this state probably the report of *Erioptera (Symplecta) hybrida* by Meigen (1804). Besides this Joseph & Parui (1973, 1977), Joseph & Rao (1972b), Joseph & Ray (1976), and Datta & Chakraborty (1985) published some valuble works on Diptera of Arunachal Pradesh. The study of the anopheline fauna in Arunachal Pradesh being enriched by Sen *et al.* (1973) and Pal & Dutta (1993).



Map 1 : Showing the distribution of species within the districts of Arunachal Pradesh

Recently some collecting trips were organized by this Institute in all 15 districts of Arunachal Pradesh in order to reveal the fauna of the state as tabulated below.

A. R. Lahiri	Aug-Sept, 1998	Papumpare, West Kamcng, East Kameng, Tawang.
	Sept-Oct-, 2000	Tirap, Changlang, Lower Dibang Valley
Bulganin Mitra	May-June, 2000	Papumpare, Kurungkumcy, Upper Subansiri, West Siang
	Sept-Oct, 2001	West Kameng,. Tawang
M. Sil	Sept-Oct, 2002	East & Upper Siang
R. S. Mridha	Feb-March, 2003	Lohit, Lower Dibang valley, Dibang Valley

This report incorporates the material belonging to the families : Tipulidae (23 spp.), Culicidae (19 spp.), Simuliidae (6 spp.), Bibionidae (8 spp.), and Sciaridae (5 spp.).

MORPHOLOGY AND TERMINOLOGY

The Nematocera are so called because, in the adult stage, they have comparatively long filiform or plumose antennae (Nematocera= "thread horn"). Most Nematoceran (except the larger Tipulidae) are small delicate flies with long legs and long thin wings. The larvae have well developed heads with mandibles that move in a horizontal plane. The pupae are obtect.

The family Tipulidae, commonly known as crane flies, is the largest family in the Diptera, with 14,000 described species in the world. This is one of the very old group of Diptera with many resemblances to the Mecoptera, tipulids have a number of derived characters and perhaps the sister group of all other Diptera. Tipulids are characterized prinicipally by wing venation, presence of a V-shaped mesonotal suture, deciduous legs, absence of ocelli, and, in larvae, a retractile hemicephalous head capsule. They also differ from other Nematocera in several less obvious characters such as the larval peritrophic membrane, sperm structure and cerebral neurosecretory cells.

The members of the family Culicidae are well known as mosquitoes. These are the most important group of flies in this suborder. The word mosquito is Spanish and means 'little fly' Mosquito adults can be recognised because they are the only family of flies which have both the veins of their wings covered in scales (very rare in any flies at all). Usually very slender flies, generally with an elongate piercing proboscis and no ocelli. Legs long antennae densely plumose in the males, pilose in the females.

The family Simuliidae or black flies is one of the most homogeneous families of the superfamily Culicoidea. The family includes small stout flies usually with horn-like, 11-segmented antennae; long mandibles; short legs having elongate basitarsomeres; broad wings having strong costa, subcosta & radius, a submedian fold between veings M_2 & Cu_1; and non-petiolate cubitus; first tergum of abdomen modified as a basal scale fringed with long hairs; males holoptic, females dichoptic, without ocelli.

March Flies (Family Bibionidae) are small, stout-bodied and usally black. Ocelli present. Antennae are short, thick, and beadlike, situated low on the face. The wings bear a characteristic stigma on the costal wing margin (C cell) and have a well-pronounced anal angle with well-developed anterior veins. Tarsal claws rest upon wing pads (pulvilli). Tibiae have apical spurs. Sexes may be highly dimorphic. Typically, males have large, holoptic eyes; female's eyes are small on narrowed heads.

The sciarids or Root Gnats resemble mycetophilids or Fungus gnats in most habits and so were once treated as together. Adults sciaridis (1-11 mm) are slender to moderately robust, long legged, somewhat mosquitolike. Color usually black, brown, or yellowish, wings usually smoke-colored. Head with eyes touching just above antennal bases; ocelli (simple eyes) present. Antenna usually with 16 segments (range 11-17). Wings with front margin (C) thickened to near wing tip; Sciaridae with only 2 branched/forked veins, median (M) usually appearing unattached basally and forking beyond middle of wing and

cubitus (Cu) forking in basal 1/4th of wing. Legs with coxae elongated, tibiae with 1 or 2 apical spurs, pulvilli (pada beneath tarsal claws) absent or narrow to broad but much shorter than claws.

MATERIAL AND METHODS

Datta, Parui and Mukherjee (1997) laid down the general method of collecting dipteran specimens from their habitats and of preserving them in proper manner for taxonomic studies. Therefore, we are stressing upon certain specific requirements relating to some family-group undertaken here rather than detailing on the broad range of procedures once again. In fact, collecting becomes much easier and more ambitious if the collector knows the proper habitat as well as the bionomical aspects of the insect (Datta & Parui, 2000).

Among the families dealt with here the family Tipulidae or crane flies are easy to encounter in the hilly tracts of this state. Their larvae may be aquatic or live in moist soil or decaying vegetation. The larvae may feed on plants, fungi, decaying vegetation or be predatory on small animals. The adults of this family are sometimes called "mosquito hawks" in the mistaken belief that they may attack mosquitoes or other small flies. In fact, they may not feed at all as adults.

Mosquitos are best known for their role in the transmission of diseases, among the more dangerous ones are Malaria, Yellow Fever and Dengue fever; they also carry various encephalitis viruses and filarial worms. Of these Malaria is by far the most important. Mosquitoes are typical holometabolous insects, passing through four life cycle stages : egg; four larval instars; pupa; and adult. Mosquito larvae are all aquatic. The adults tend to hide in dimly-lit refuges with high humidity, such as the secluded corners around buildings, amongst low vegetation, until they ready to feed. The females of most species show at least some degree of preference in oviposition sites which include both permanent and temporary water bodies, and salt water, but especially those rich in organic matter.

The Simuliidae or black flies, comprisea cosmopolitan family of biting flies of great importance in many parts of the world as bloodsuckers and vectors of certain parasitic organisms. The larvae and pupae are aquatic, found in natural or artifical unpolluted water sources of the hilly areas.

March Flies are so named because they are noticed about that time of the year, when they emerge as adults. Some emerge in early summer. Larvae feed on roots or decaying vegetation.

Adults of the family Sciaridae are typically found on or near larval food materials. Larvae feed primarily on fungi growing in the soil and moist decaying organic matter. Sciarid larvae mostly feed on decaying plant material, animal excrement, or fungus, but some feed in rotting wood or under bark of fallen trees. Adlts are usually found in moist areas where larval food is present. During the day, adults of many species congregate in dark moist places. Some species are most active at dusk and less active at dawn. Adults of most species are attarcted to light.

CLASSIFIED LIST OF SPECIES

Family TIPULIDAE

Subfamily TIPULINAE

1. *Ctenophora (Pselliophora) ardens* (Wiedemann)
2. *Holorusia fulvolateralis* (Brunetti)
3. *Nephrotoma concolorithorax* (Brunetti)
4. *Nephrotoma consimilis* (Brunetti)
5. *Nephrotoma delta* (Walker)
6. *Nephrotoma javensis* (Doleschall)
7. *Nephrotoma serricornis* (Brunetti)
8. *Tipula (Acutipula) subvernalis* Alexander
9. *Tipula (Emdotipula) stylostena* Alexander
10. *Tipula (Indotipula) singhalica* Alexander and Alexander
11. *Tipula (Vestiplex) subtincta* Brunetti

Subfamily LIMONIINAE

Tribe **Limoniini**

12. *Antocha (Antocha) indica* Brunetti
13. *Limonia (Euglochina) saltens* (Doleschall)
14. *Limonia (Libnotes) palaeta* Alexander

Tribe **Hexatomini**

15. *Hexatoma (Eriocera) graveleyi* Brunetti
16. *Hexatoma (Eriocera) nepalensis* (Westwood)
17. *Pseudolimnophila (Pseudolimnophila) fusca* (Brunetti)

Tribe **Eriopterini**

18. *Conosia irrorata* (Wiedemann)
19. *Erioptera (Symplecta) hybrida* (Meigen)
20. *Gonomyia (Idiocera) punctipennis* Edwards
21. *Gonomyia (Protogonomyia) nigripes* (Brunetti)
22. *Styringomyia subobscura* Alexander
23. *Teucholabis fenestrata* Osten Sacken

Family CULICIDAE
Subfamily ANOPHELINAE

24. *Anopheles (Anopheles) aitkenii* James
25. *Anopheles (Anopheles) barbirostris* van der Wulp
26. *Anopheles (Anopheles) gigas* Giles
27. *Anopheles (Anopheles) nigerrimus* Giles
28. *Anopheles (Cellia) aconitus* Donitz
29. *Anopheles (Cellia) annularis* van der Wulp
30. *Anopheles (Cellia) balabacensis* Baisas
31. *Anopheles (Cellia) culicifacies* Giles
32. *Anopheles (Cellia) jamesii* Theobald
33. *Anopheles (Cellia) jeyporensis* James
34. *Anopheles (Cellia) karwari* (James)
35. *Anopheles (Cellia) kochi* Donitz
36. *Anopheles (Cellia) maculates* Theobald
37. *Anopheles (Cellia) philippiensis* Ludlow
38. *Anopheles (Cellia) splendidus* Koidzumi
39. *Anopheles (Cellia) subpictus* Grassi
40. *Anopheles (Cellia) vagus* Donitz

Subfamily CULICINAE

41. *Culex (Culex) bitaeniorhynchus* Giles
42. *Mansonia (Mansonioides) indiana* Edwards

Family SIMULIIDAE

43. *Simulium (Eusimulium) aureohirtum* Brunetti
44. *Simulium (Himalayam) indicum* Becher
45. *Simulium (Simulium) himalayense* Puri
46. *Simulium (Simulium) nitidithorax* Puri
47. *Simulium (Simulium) novolineatum* Puri
48. *Simulium (Simulium) rufibasis* Brunetti

Family BIBIONIDAE
Subfamily BIBIONINAE

49. *Bibio fuscitibia* Brunetti
50. *Bibio tenebrosus* Coquillett
51. *Dilophus gratiosus* Bigot

Subfamily PLECIINAE

52. *Penthetria japonica* Wiedemann
53. *Plecia aterrima* Brunetti
54. *Plecia fulvicollis* (Fabricius)
55. *Plecia imposter* Brunetti
56. *Plecia tergorata* Rondani

Family SCIARIDAE

57. *Phorodonta exacta* (Brunetti)
58. *Psilomegalosphys xanthogaster* Enderlein
59. *Sciara indica* Walker
60. *Sciara nigripennis* Brunetti
61. *Trichosia rufithorax* (van der Wulp)

Family TIPULIDAE

Key to the subfamilies

1. Terminal segment of maxillary palpus elongate; nasus usually distinct; wings with Sc_1 usually atrophid; vein Cu slightly constricted at m-cu; body size large (wing commonly over 10.00 mm) ..... TIPULINAE

– Terminal segment of maxillary palpus short; no distinct nasus; wings with Sc_1 present; vein Cu straight, not constricted at m-cu; body size small or medium, rarely large (wing commonly under 10.00 mm) ..... LIMONIINAE

Subfamily TIPULINAE

Key to the genera

1. Antennae in male 13 segmented, the flagellar segments branched, the intermediate ones each with four short branches subequal in length to the segment; in female antennae 11 segmented, the flagellar segments strongly protuberant ... . ***Ctenophora*** Meigen

- Antennal segments unbranched, if protuberent, antennae 13 segmented 2

2. Wings with vein M_4 the most basal branch of M_2 followed by a short element M_{1+2+3}; cell M_1 sessile or very short petiolate ..... ***Nephrotoma*** Meigen

- Wings with M forking into M_{1+2} and M_{3+4}; Cell M_1 with a petiole, commonly equal to or longer than the cell 3

3. Body size large; wings over 25.00 mm; cell R_3 constricted at near mid length, at margin about two and one-half to three times as extensive as cell R_5, antennae with flagellar segments without verticils ..... ***Holorusia*** Loew

- Body size smaller; wings commonly less than 20.00 mm; R_3 not evidently constricted at near mid length, at margin less than twice as extensive as cell R_5; antennae with flagellar segments provided with strong verticils ..... ***Tipula*** Linnaeus

Genus ***Ctenophora*** Meigen

1803. *Ctenophora* Meigen, *Magazin Insektkde*, **2** : 263.

Type species : *Tipula atrata* Linnaeus.

Subgenus ***Pselliophora*** Osten Sacken

1886. *Pselliophora* Osten Sacken, *Berlin. Ent. Z.*, **30** : 165.

Type species : *Tipula laeta* Fabricius.

Diagnosis : The four branches issuing from same antennal joint (in the male) are of the same length and clothed with rather long, soft, not very dense hairs; the 12th joint of the antennae has two pairs of branches. Male genitalia lacking long, protruding adminiculum. In female, 3rd joint of antennae (1 str joint of flagellum) broader from base to tip without any expansion on the underside.

1. ***Ctenophora (Pselliophora) ardens*** Wiedemann

1821. *Ctenophora ardens* Wiedemann, *Dipt. Exot.* **1** : 20.

Material examined : 2♂♂, 3♀♀, Sero forest, 1500m, Kurungkumey dist, 31.v.2000, coll. B. Mitra.

Distribution : India : Arunachal Pradesh (Kurungkumey).

Elsewhere : Ambonia, China, Hainan Island, Java, Sumatra.

Genus ***Holorusia*** Loew

1863. *Holorusia* Loew, *Berl. ent. Z.* **7** : 277.

Type-species : *Holorusia rubiginosa* Loew.

2. ***Holorusia fulvolateralis*** (Brunetti)

1911. *Tipula fulvolateralis* Brunetti, *Rec. Indian Mus.* **6** : 249.

Diagnosis : Large, ground colour of thoracic dorsum brownish grey forming three nearly contiguous stripes, sides of thorax yellowish with a very distinct dark brown lateral stripe from neck to root of wings; wings unicolorous, costal cell brownish yellow; tibiae and tarsi without any whitish rings.

Distribution : India : Arunachal Pradesh (Changlang), Uttaranchal, West Bengal.

Elsewhere : Myanmar, Nepal.

Genus ***Nephrotoma*** Meigen

1803. *Nephrotoma* Meigen, *Magazin Insektkde*, **2** : 262.

Type-species : *Tipula dorsalis* Fabricius.

Key to the species

1. Antennae sub-serrate on underside ..... *serricornis* Brunetti

- Antennae not sub-serrate 2

2. Thorax wholly bright orange-yellow, the usual three dorsal stripes very faintly darker ..... *concolorithorax* Brunetti

- Thorax always with the usual three dorsal black or dark brown stripes very distinct 3

3. Outer thoracic stripes distinctly turned outwards and down words at their tips; femora generally more or less blackish on apical half..... *consimilis* Brunetti

– Outer thoracic stripes abruptly terminated, clear-cut but not curved outwards or down wards; femora generally yellowish with a tolerably distinct apical narrow blackish band 5

4. Bright lemon yellow species (at least the thorax) ..... *javensis* (Doleschall)

– Brownish yellow or ferruginous species .... *delta* (Walker)

3. ***Nephrotoma concolorithorax*** (Brunetti)

1912. *Pachyrhina concolorithorax* Brunetti, *Fauna Brit. India. Diptera, Nematocera* : 346.

Distribution : India : Arunachal Pradesh (Lower Subansiri), Assam, Maghalaya.

Elsewhere : Bangladesh.

4. ***Nephrotoma consimilis*** (Brunetti)

1911. *Pachyrhina consimilis* Brunetti, *Rec. Indian Mus.*, **6** : 266.

Distribution : India : Arunachal Pradesh (East Siang, East Kameng, Lower Subansiri, Tirap, Lohit), Sikkim, Uttaranchal, West Bengal.

Elsewhere : Nepal.

5. ***Nephrotoma delta*** (Walker)

1856. *Tipula delta* Walker, *Insecta Saundersiana*, **1** : 445.

Distribution : India : Arunachal Pradesh (Lohit), Bihar.

Elsewhere : Indochina, Taiwan.

6. ***Nephrotoma javensis*** (Doleschall)

1856. *Tipula javensis* Doleschall, *Nat. Tijd. Ned. Ind.*, **10** : 406.

Distribution : India : Arunachal Pradesh (East Kameng), Uttaranchal.

Elsewhere : Ambonia, Borneo, Jawa, Kotosho Island, Malayasia, Sri Lanka, Sumatera.

7. ***Nephrotoma serricornis*** (Brunetti)

1922. *Pachyrhina serricornis* Brunetti, *Fauna Brit. India, Diptera. Nematocera* : 341.

Distribution : India : Arunachal Pradesh (East Siang, Tirap), West Bengal.

Elsewhere : None.

Genus ***Tipula*** Linnaeus

1758. *Tipula* Linnaeus, *Syst. Nat.*, **10** : 558.

Type-species : *Tipula doracea* Linnaeus.

Key to the subgenera

1. Fore tibia without spur 2

– Fore tjbia with a single spur 3

2. Squama of wing without setae; hypovalve of female genitalia long, slender and smooth margined ..... ***Indotipula*** Edwards

– Squama of wing with long setae; hypovalve of female genitalia short and margin setiferus .. .. ***Emdotipula*** Alexander

3. Ovipositor with hypovalve greatly reduced, cerci large, heavily sclerotized; squama of wing without setae, vein R_5 considerably longer than m-cu ..... ***Vestiplex*** Bezzi

– Ovipositor with hypovalve subequal in length, cerci slender, not heavily sclerotized; squama of wing generally with setae; vein R_5 very short, subequal to m-cu .... ***Acutipula*** Alexander

Subgenus ***Acutipula*** Alexander

1924. *Acutipula* Alexander, *Ark. Zool.*, **16(18)** : 11.

Type-species : *Tipula (Acutipula) gaboonensis* Alexander

8. ***Tipula (Acutipula) subvernalis*** Alexander

1927. *Tipula subvernalis* Alexander, *Rec. Indian Mus.*, **29** : 168.

Diagnosis : Yellowish or yellowidh grey, female more greyish; occiput and frons dull greenish grey; antennae black, but scape and 1st flagellar joint yellowish; median of usual three dorsal stripes of thorax narrowly divided; scutellum more whitish-gery, metanotum dull greenish with whitish grey reflections; 1st segment and from the 5th to the 8th abdominal segments blackish;

2nd, 3rd and 4th yellowish with a median dark stripe and a narrow side stripe; genitalia large, curved brown dorsal plate with a pointed black piece; basal joint of claspers blackish grey, 2nd joint brownish yellow; keel shaped ventral plate; wings brownish; a curved streak from costa just before stigma, over basal half of discal cell, thence along bases of 2nd, 3rd and 4th posterior cells, a 2nd streak embracing 6th vein throughout its length; legs brownish, tibiae darker, tarsi blackish, coxae grey in front, femora with broad apical ring.

Distribution : India : Arunachal Pradesh (Changlang), West Bengal.

Elsewhere : Tibet.

Subgenus ***Emdotipula*** Alexander

Emdotipula Alexander, *Philipp. J. Sci.*, **94** : 244.

Type-species : *Tipula marmoratipennis* Brunetti.

9. ***Tipula (Emdotipula) stylostena*** Alexander

1961. *Tipula (Lunatipula) stylostena*, Alexander, *Philippines J. Sci.*, **90** : 439.

Material examined : 2♂♂, 2♀♀, Angu village, Along, West Siang dist., 7.v.2000, coll. B. Mitra.

Diagnosis : Frontal prolongation including nasus dark brown; antennal scape and pedicel yellow, flagellum usually dark brown; pronotum light grey with three brown areas, mesonotum grey with 4 brownish grey stripes; scutellum light yellow with a brown lateral spot; abdominal tergites 1-5 orange with brown mid dorsal stripe, remaining tergites brown or black; wings yellow; conspicuously patterned with pale brown and dark brown in a zigzag pattern; legs with coxae and trochanters yellow; in males femora black, basally narrow yellow, in female femora uniformly brownish yellow with blackened tip.

Distribution : India : Arunachal Pradesh (West Siang), Uttaranchal.

Elsewhere : Pakistan.

Subgenus ***Indotippula*** Edwards

1931. *Indotipula* Edwards, *Ann. Mag. Nat. Hist.* (10)**8** : 81.

Type-species : *Tipula walkeri* Brunetti.

10. ***Tipula (Indotipula) singhalica*** Alexander and Alexander

1912. *Tipula flavescens* Brunetti, *Fauna Brit. India, Diptera, Nematocera*, : 334.

Diagonosis : Yellowish; head bright yellow, antennal segments pubescent, narrowly black at bases; ovipositor shining reddish brown, the lower valves shorter and set further back than the upper ones; wings very pale grey; costal cell yellowish; stigma very faint, pale blackish; discal cell small, pentagonal, all the sides comparatively short, pedicel of fork of M_1-M_2 about half the length of a nearly parallel veinlets; tips of femora, tibiae and tarsi blackish.

Distribution : India : Arunachal Pradesh (Lower Subansiri).

Elsewhere : Sri Lanka.

Subgenus ***Vestiplex*** Bezzi

1924. *Vestiplex* Bezzi, *Annalis Mus., civ. Stor. Nat Giacomo Doria*, **51** : 230.

Type-species : *Tipula cisalpina* Bezzi.

11. ***Tipula (Vestiplex) subtincta*** Brunetti

1912. *Tipula subtincta* Brunetti, *Fauna Brit. India, Diptera, Nematocera*, : 326.

Diagonosis : Yellowish; head above grey with short stiff yellow hairs near edges; vertex with a narrow brown median line; underside with a round black spot at the lower corner of each eye; antennae with scape, the 1st joint of flagellum and tips of some basal joint yellowish, rest dark brown; thorax with three usual stripes greenish grey, median one broad on anterior margin, narrowing to a point at the suture, side stripes in the shape of oval spots, two similarly coloured spots on each side behind suture, the anterior one round, the hinder subtriangular; scutellum and metanotum each with a narrow indistinct median line; abdomen with a black dorsal stripe in basal half, in apical half wholly blackish; genitalia large and complex, penis long, straight, bulbous at the base; wings pale yellowish grey, costal cell

brownish yellow, stigma brown; rather clear spots beyond and below stigma, in the discal cell, 4th posterior cell, beyond the middle of 2nd basal cell and in anal and axillary cells; coxae and bases of femora yellowish, rest black.

Distribution : India : Arunachal Pradesh (Upper Subansiri), West Bengal.

Elsewhere : None.

Subfamily LIMONIINAE

Key to the tribes

1. Free tips of Sc_2 often present veins R_4 and R_5 fused for their whole length, only two branches of Rs being present ..... **Limoniini**
- Free tips of Sc_2 atrophid; veins R_4 and R_5 separate, Rs commonly with three branches 2
2. Tibial spurs present ..... **Hexatomini**
- Tibial spurs lacking ..... **Eriopterini**

Tribe **Limoniini**

Key to the genera

1. Antennae 14 segemnted .... ***Lomonia*** Meigen
- Antennal 16 segmented ..... ***Antocha*** Osten Sacken

Genus ***Antocha*** Osten Sacken

1859. *Antocha* Osten Sacken, *Proc. Acad. Nat. Sci. Philad.*, : 219.

Type-species : *Antocha saxicola* Osten Sacken.

12. ***Antocha (Antocha) indica*** Brunetti

1912. *Antocha indica* Brunetti, *Fauna Brit. India, Diptera, Nematocera* : 426.

Diagnosis : Yellowish; occiput dark grey, proboscis and palpi brown; antennae blackish, rather thickly pale pubscent, joints oval, 1st scapal joint yellowish; scutellum and metanotum brownish grey, lightly dusted; abdomen brownish yellow with or without a dark line towards each side; genitalia of moderate size; wings colourless, veins yellow, no stigma; marginal cross vein present or absent, anterior cross vein just before middle of discal cell, posterior cross vein just anterior to discal cell; veins in distal part if wing with minute hairs; legs yellow or brownish yellow.

Distribution : India : Arunachal Pradesh (East Kameng), Assam, Himachal Pradesh, Uttar Pradesh, West Bengal.

Elsewhere : China, Malayasia.

Genus ***Limonia*** Meigen

1803. *Limonia* Meigen, *Magazin Insekt kde.* **2** : 262

Type-species : *Tipula tripunctata* Fabricius.

Key to the subgenera

1. Origin of vein R_4 and anterior cross vein normal; the latter and the discoidal cell always situated at a point beyond the middle of wing ..... ***Euglochina*** Alexander
- Origin of vein R_4 and anterior cross vein enestra proximal; the latter and the discoidal cell situated at a point about middle of wing ..... ***Libnotes*** Westwood

13. ***Limonia (Euglochina) saltens*** (Doleschall)

1857. *Limonia saltens* Doleschall, *Nat. Tijd. Ned. Ind.* **14** : 390.

Diagnosis : Brownish yellow; palpi dark; thorax lighter in posterior half including scutellum and metanotum; abdomen may be darker, brown or blackish; wings clear pale yellow, colorless at base, distinctly infuscated at tips; an oval, rather large distinct brown stigma at tip of Rs; Rs originates beyond middle of wing, R_4 begins before middle of Rs-so that the veins appear crowded towards the tip of the wing. Halters with black knob; legs yellowish on coxae and base of femora, basal half of metatarsi black, remainder of tarsi snow-white.

Distribution : India : Arunachal Pradesh (East Siang), Assam, South India.

Elsewhere : Java, Philippines, Sri Lanka, Taiwan.

14. ***Limonia (Libnotes) palaeta*** Alexander

1942. *Libnotes palaeta* Alexander, *Rec. Indian Mus.*, **44** : 30.

Material examined : 3♂♂, 4♀♀, Ganga lake area, 530m, Itanagar, Papumpare dist., 28.v.2000, coll. B. Mitra.

Diagnosis : Eyes nearly contiguous; occiput and very narrow interocular space yellowish grey; antennae black at base, flagellum yellow, joints subglobular near base but much more elongated towards the tip; thorax pale yellowish but metanotum brownish; former with whitish rejlections when viewed from certain directions and four brown stripes of moderate width on the dorsum, of which the median pair are joined for some distance in front and not extending beyond mesonotal suture while the outer ones are abbreviated in front and interrupted at the mesonotal sututre to reappear as a pair of elongated spots behind; sides of thorax marked by a narrow brown stripe along the side of the neck reaching base of wing and a horizontal streak of same colour on pleurae; abdomen and ovipositor yellowish brown with a little pale pubescence, parts of dorsum and sides of segments dark brown; legs brownish yellow, tips of femora, tibiae and tarsi dark brown; wings clear, veins carrying numerous small pale grey spots not sufficiently large to reach from base of prefurca and at tips of R_1, R_{2+3}, M_1, Cu_1f and 2nd A.; femora with few pale yellow hairs.

Distribution : India : Arunachal Pradesh (Papumpare), Assam, West Bengal.

Elsewhere : Espiritu Santo, Java, Malayasia, Philippines, Samoa, Sri Lanka.

Tribe **Hexatomini**

Key to the genera

1. Antenna with no more than 12 segments ..... ***Hexatoma*** Latreille

– Antenna with more than 13 segments..... ***Pseudolimnophila*** Alexander

Genus ***Hexatoma*** Latreille

1809. *Hexatoma* Latreille, *Genera crust et Insect.*, **4** : 260.

Type-species : *Hexatoma nigra* Latreille.

Subgenus ***Eriocera*** Macquart

1838. *Eriocera* Macquart, *Mem. Soc. Sci. Agric., Lille.*, **2** : 78.

Type-species : *Limnobia nigra* Wiedemann.

Diagnosis : Eyes widely separated; proboscis short, palpi long; antennae variable in length, flagella at regular interval beset with bristles, long irregular hairs towards tip of antenae; abdomen in male cylindrical or subclavate, in female widened beyond middle, the tip conical; male genitalia with a pair of fleshy claspers; in female ventral plate narrow, pointed; wings generally brownish or blackish; 2 submarginal, 4 or 5 posterior cells, 1 discal cell; the auxillary vein ending about opposite the beginning of the 2nd marginal cell, the subcostal cross vein near the tip of the auxillary or at a short distance before the tip, marginal cross vein a little before the tip of the 1st longitudinal cross vein; praefurea long, straight arcuate at base only; discal cell approximately square, pentagonal or even six sided.

Key to the species

1. Five posterior cells; legs black or dark brown ..... *graveleyi* Brunetti

– Four posterior cells; legs black .... *nepalensis* Westwood

15. ***Hexatoma (Eriocera) graveleyi*** Brunetti

1918. *Eriocera graveleyi* Brunetti, *Rec. Indian Mus.*, **15** : 337.

Distribution : India : Arunachal Pradesh (East Siang,), Assam, Meghalaya, West Bengal.

Elsewhere : Nepal.

16. ***Hexatoma (Eriocera) nepalensis*** (Westwood)

1835. *Caloptera nepalensis* Westwood, *Ann. Soc. Ent. France*, **4** : 681.

Distribution : India : Arunachal Pradesh (Lower. Subansiri, East. Siang), Assam, Uttaranchal, West Bengal.

Elsewhere : China, Malayasia, Nepal.

Genus ***Pseudolimnophila*** Alexander

1919. *Limnophila subg. Pseudolimnophila* Alexander, *Mem. Cornell Univ. Agric. Exp.* : 849.

Type-species : *Limnophila luteipennis* Osten Sacken.

Subgenus ***Pseudolimnophila*** Alexander

Diagnosis : Antenna usually 16-jointed; pronotum small, the sides produced into small lateral lobes; wing with anterior arcules preserved; radius 4-branched, cell M_1 present, cell 1st M_2 closed, cell R_5 without cross-vein.

17. ***Pseudolimnophila (Pseudolimnophila) fusca*** (Brunetti)

1918. *Limnophila fusca* Brunetti, *Rec. Indian Mus.*, **15** : 326.

Diagnosis : Head dark gray; antennae blackish, basal flagellar joints yellowish; joints elongated with long verticilis; thorax and abdomen dark yellowish brown, a narrow median dark line on former; wings gray, stigmal practically absent; 5 posterior cells, 2nd twice as long as its petiole; legs dull yellowish brown (paler in female).

Distribution : India : Arunachal Pradesh (East Kameng), West Bengal.

Elsewhere : Nepal.

Tribe **Eriopterini**

Key to the genera

1. Five posterior cells ..... ***Conosia*** Wulp
- Four posterior cells 2
2. Two branches of Rs reaches wing margin .3
- Three branches of Rs reaches the wing margin 4
3. Vein Sc present, widing in the costa at about the middle of wing, R_{1+2} end in the costa beyond the middle of the wing .... ***Teucholabis*** Osten Sacken
- Vein Sc absent, R_{1+2} ending in the costa before the middle of wing ..... ***Stringomyia*** Loew
4. Cell R_5 deep, three or more times its petiole 5
- Cell R_5 shallow, not more than twice its petiole ..... ***Gonomyia (Idiocera)*** Dale
5. Vein M_2 forked .... ***Gonomyia (Protogonomyia)*** Alexander
- Vein M_3 forked ..... ***Erioptera*** Meigen

Genus *Conosia* van der Wulp

1880. *Conosia* van der Wulp, *Tijdschr. Ent.*, **23** : 159.

Type-species : *Limnobia irrorata* Wiedemann.

18. ***Conosia irrorata*** (Wiedemann)

1928. *Limonia irrorata* Wiedemann, *Aussereurop zweifl Insekt.*, **1** : 574.

Diagnosis : Eyes well separated above, shortly contiguous below; head bright yellowish grey, proboscis brownish; 1st scapal joint longer than 2nd, flagellar joints shortly eylindrical, the 1st longer than the crest, all with few long hairs, shorter pubescence more marked on basal segments; thorax yellowish grey with a broad brown median line with nine /ten small dark brown spots, a similar median line on scutellum posterior margin of thorax and scutellum with few moderately long golden hairs, a less distinct grey stripe on each of the median one beginning behind shoulder and interrupted at suture behind which it takes the shape of pointed stripe that atains posterior margin; in female a close series of irregularly placed small brown spots on each side of median thoracic stripe; abdomen yellowish with or without a black stripe on each side of dorsum; wings yellowish grey, anterior margin broadly brown; veins in clear part of wing bearing a row of minute dark brown spots; legs yellow, claws black.

Distribution : India : Assam, Arunachal Pradesh (East Siang,), Bihar, Uttar Pradesh, West Bengal.

Elsewhere : Borneo, China, Java, Kotosho Island, Malaya, Nepal, Simeule Island, Sri Lanka, Taiwan, New Guinea, Africa, Australia, Israel, Japan.

Genus ***Erioptera*** Meigen

1803. *Erioptera* Meigen,Magazin Insektkde, **2** : 262.

Type-species : *Erioptera lutea* Meigen.

Subgenus ***Symplecta*** Meigen

1830. *Symplecta* Meigen. *Syst. Beschr. zweifl. Insekt.* **6** : 282.

Type-species : *Limnobia punctipennis* Meigen, by designation of Westwood **1840** : 128, =*hybrida* (Meigen).

Diagnosis : Wings with cell 1st M_2 when present closed, not divided; a supplementary cross vein present at near midlength of cell Rs; vein 2nd A strongly sinuous on outer half.

19. ***Erioptera (Symplecta) hybrida*** (Meigen)

1804. *Limonia hybrida* Meigen. *Klass. Europ. Zweifl. Insekt.* **1** : 57.

Diagnosis : Head blackish, but proboscis yellowish; frons moderately broad; thorax blackish grey with a black dorsal line from anterior margin, disappearing before the suture; sides of dorsum of thorax and a line above the hinder pleurae yellow, also are the scutellum and posterior corners of mesonotum; metanotum blackish, basal corners minutely yellow; abdomen dark blackish grey with a little pale pubescence; posterior margins of segments either sex normally yellowish white; male genitalia with upper and lower plates short, narrowly as broad as the last abdominal segment; ovipositor brownish yellow, of moderate size; wings clear with very small blackish infuscatrions placed (i) just below the base of parefurca; (ii) on R_{1+2}– a little beyond the 1st spot; (iii) at the tip of R_{1+2}; (iv) P at base of wing between Mand Cu; legs blackish, tips of femora slightly but distinctly enlarged.

Distribution : India : Arunachal Pradesh (East Kameng), Himachal Pradesh, West Bengal.

Elsewhere : Europe.

Genus ***Gonomyia*** Meigen

1918. *Gonomyia* Meigen, *Syst. Beschr. europ. zweifl. Insekt.* **1** : 146.

Type-species : *Limnobia tenella* Meigen.

Subgenus ***Idiocera*** Dale

1842. *Limnobia subg. Idiocera* Dale. *Ann. Mag Nat. Hist.*, **8** : 431.

Type-species : *Idiocera sexgutata* Dale.

Diagnosis : Front of head not produced into a rostrum; wing with vein Sc short, Sc1 ending about opposite origin of Rs, veinR_1 (or R_{1+2}) ending at or beyond 2/3rd the wing length, cell M_2 open by atrophy of basal section of M_3, m-cu at least its own length before form of m; middle and hind coxae approximated, reducing the size of meron which is not longer than mid coxa.

20. ***Gonomyia (Idiocera) punctipennis*** Edwards

1926. *Gonomyia punctipennis* Edwards, *Treubia*, **7** : 140.

Material examined : 3♂♂, 1♀, Naharalagun, 500 m, Papumpare dist., 29.v.2000, coll. B. Mitra.

Diagnosis : Head dull yellow; scape of antenna yellow, flagellum brownish, proboscis and palpi black; thorax dark brown, pleura brown above and yellowish below; legs uniformly yellowish; wings hyaline with brown veins, r-m crossvein clouded, vein R_2 ending slightly beyond the tip of R_1; abdomen dark brown, posterior margins of tergites yellowish.

Distribution : India : Arunachal Pradesh (Papumpare).

Elsewhere : Borneo, Buru, Philippines, Sumatera.

Subgenus ***Protogonomyia*** Alexander

1934. *Gonomyia subgenus protogonomyia* Alexander. *Philipp. J. Sci.* **55** : 52.

Type-species : *Gonomyia confluenta* Alexander.

Diagnosis : Characters much as *Progonomyia* Alexander, differing especially with short fleshy

valves of the ovipositor. In all other subgeneric groups of *Gonomyia*, the valves are elongate, with anteriorly pointed cerci. Wings with cell R_3 deep, almost as in the genus *Gonomyia*, the branches enclosing the cell subparallel or but slightly divergent on basal half; cell 1st M_2 open by atrophy of basal section of M_3; m-Cu close to fork of M.

21. ***Gonomyia (Protogonomyia) nigripes*** (Brunetti)

1912. *Mesocyphona nigripes*, Brunetti, *Fauna Brit. India*, Diptera, Nematocera : 458.

Diagnosis : Head grey to dark grey; proboscis brownish yellow, palpi blackish; 1st and 2nd scalpal joints of antennae blackish; frons widening from one third the width of the head a little above antennae to half the width of the head at vertex; stiff black hairs on frons and back of head; antennal joints generally elongated but basal ones of flagella oval; each flagellar joint with verticel of long hairs in addition to short pubescence; thorax markedly arched and black except scutellum that is yellowish; abdomen black, roughened with sparse short pale hairs; wings pale grey, pubesence on the veins distinct; legs black.

Distribution : Arunachal Pradesh (East Siang), Assam, Uttar Pradesh, West Bengal.

Elsewhere : None.

Genus ***Stringomyia*** Loew

1845. *Stringomyia* Loew, *Dipterol. Beitr.* **1845** : 6.

Type-species : *Stringomyia venusta* Loew.

22. ***Stringomyia subobscura*** Alexander

1966. *Stringomyia subobscura* Alexander, *Jt. N. Y. ent. Soc.*, **74** : 182.

Diagnosis : Head black; antenna dark brown; proboscis brownish yellow; thorax black, wing light brown with an infuscation on anterioer cross-vein; legs dark brown with a distinct yellowish ring at base of apical third.

Distribution : India : Arunachal Pradesh (East Kameng).

Elsewhere : None.

Genus ***Teucholabis*** Osten Sacken

1859. *Teucholabis* Osten Sacken, *Proc. Acad. Nat. Sci Philad.*, **1859** : 222.

Type-species : *Teucholabis complexa* Osten Sacken.

23. ***Teucholabis fenestrata*** Osten Sacken

1887. *Teucholabis fenestrata* Osten Sacken, *Berl. Ent Z* **31** : 188.

Diagnosis : Head black, front shining; thorax ferruginous red, shining with a distinct stripe black, with indistinct brown suffusion in parts; wings tinged with brown except a large subhyaline area on the proximal half between R_{1+2} and the hind margin that does not quite reach the central cross vein and touches the hind margin only between root and anal angle; a second ill defined much smaller hyaline spot between R_3 and M covering cross vein at the end of discal cell; discal cell comparatively shorter and much shorter than 2nd posterior cell; the legs are dark brown or black, sometimes dark yellowish brown, coxae occasionally reddish yellow hairy, rather stout.

Distribution : India : Arunachal Pradesh (Upper Subansiri), Assam, Uttaranchal, Meghalaya, Sikkim.

Elsewhere : Sri Lanka, Taiwan.

Family CULICIDAE

Key to the subfamilies

1. Wing usually spotted; palpi long and of about same length as the proboscis in female; palpi with the two apical segments swollen & flattened to be shaped as the head of a golf-club in male ..... ANOPHELINAE

– Wing usually unspotted, palpi shaped otherwise ..... CULICINAE

Subfamily ANOPHELINAE

Tribe **Anophelini**

Genus ***Anopheles*** Meigen

1818. *Anopheles* Meigen, *syst. Beschr. europ. zweifl. Insekt.* 1 : 10.

Type-species : *Anopheles maculipennia* Meigen.

Diagnosis : Palpi of both sexes equal to the length of proboscis, only male with apical two segments club-shaped; posterior edge of scutellum bar-shaped with hairs on it in a continuous series; male with single claw in fore tarsi; in female abdomen with scattered scales on tergites but rare on sternite.

Key to the subgenera

1. Wing wholly dark or with maximum 3 dark infuscations covering both costa and first logitudinal vein; male coxite with 2 parabasal spines and 1 lateral spine ..... ***Anopheles*** Meigen

– Wing with at least 4 infuscated areas on costa and first longirudinal vein; male coxite with 4 or 5 parabasal spines, internal spine absent.. ..... ***Cellia*** Theobald

Subgenus ***Anopheles*** Meigen

1915. *Anopheles* Meigen, *Indian J. Med. Res.*, **3** : 383.

Key to the species

1. Palpi with definite pale marking; fringe spots present on vein 5,2 ..... *nigerrimus* Giles

– Palpi without definite pale marking 2

2. Wing entirely without pale markings; head scales very narrow, rod like .... *aitkeni* James

– Wing with pale markings 3

3. Inner quarter of costa with pale interruption; basal half of vein 6 uniformly dark .... *gigas* Giles

– Inner quarter of costa mainly dark; basal half of vein 6 with scattered black scales .... *barbirostris* Wulp

24. ***Anopheles (Anopheles) aitkenii*** James

1903. *Anopheles aitkenii* James, in Theobald, *Monogr. Cul.*, **3** : 22.

Distribution : India : Andaman Islands, Arunachal Pradesh, Karnataka, Maharashtra.

Elsewhere : China, Indonesia, Malaya, Nepal, New Guinea, Philippines, Sri Lanka, Thailand.

25. ***Anopheles (Anopheles) barbirostris*** van der Wulp

1884. *Anopheles barbirostris* van der Wulp, *Notes Leyden Mus.*, **6** : 248.

Distribution : India : Andhra Pradesh, Assam, Arunachal Pradesh (East Kameng, Lower Subansiri, Papumpare, Upper Subansiri), Bihar, Delhi, Goa, Gujarat, Haryana, J & K, Karnataka, Lakshadweep, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, Nepal, Myanmar, Sri Lanka, Pakistan, Jawa, Kampuchea.

26. ***Anopheles (Anopheles) gigas*** Giles

1901. *Anopheles (Anopheles) gigas* Giles, *Entomologist's mon. Mag.* **37** : 196.

Distribution : India : Assam, Arunachal Pradesh (East Kameng), Gujarat, Haryana, Himachal Pradesh, J & K, Madhya Pradesh, Meghalaya, Punjab, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, Pakistan, Sri Lanka, Sulawesi.

27. ***Anopheles (Anopheles) nigerrimus*** Giles

1900. *Anopheles (anopheles) nigerrimus* Giles, *Handbook Gnats or mosquitoes* ed. **1** : 161.

Distribution : India : Andhra Pradesh, Assam, Arunachal Pradesh (East Kameng, Papumpare, Lower Subansiri, Upper Subansiri), Bihar, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Lakshadweep, Manipur, Maharashtra, Madhya Pradesh, Meghalaya, Nagaland, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, China, Myanmar, Nepal, Pakistan, Sri Lanka, Vietnam, Afganisthan, Iran, Oman.

Subgenus ***Cellia*** Theobald

1902. *Cellia* Theobald, *J. trop. Med;* **5** : 183.

Type-species : *Anopheles pharaensis* Theobald.

Key to the species

1. Tip of hind tarsi (5th trasal segment) white 6
- Tip of hind tarsi (5th tarsal segment) not white 2
2. Apical and subapical pale bands of palpi nearly of euqal length 3
- Pale apical band of palpi always broader than subapical pale band 4
3. Intermediate dark area between apical and subapical pale bands of palpi much broader than either of two bands .... *culicifacies* Giles
- Intermendiate dark area between apical and subapical pale bands of palpi much broader either of two bands ..... *aconitus* Donitz
4. Pale apical band of palpi a little broader than subapical pale band, the intermediate dark area much broader than either of two bands..... ..... *jeoporiensis* James
- Pale apical band of palpi distinctly broader than subpical pale band; the intermediate dark area either of the same size of apical band or smaller than that; tarsi of front legs with broad pale bands 5
5. Dark intermediate area between two pale bands at apex of palpi is almost equal in length of the apical pale band..... *subpictus* Grassi
- Dark intermediate area between two pale bands at apex of palpi markedly narrow and less than 1/3rd of apical pale area..... ..... *vagus* Donitz
6. Hind tarsi with only one segment or less white, commonly with white bands above this 7
- Hind tarsi with a continuous white area on at least two terminal segments 10
7. Femora and tibiae speckled 8
- Femora and tibiae not speckled .... *karwari* (James)
8. Sixth vein (2nd A) of wing with more than three dark spots ..... *balabacensis* Baisas
- Sixth vein (2nd A) of wing with not more than three dark spots 9
9. Half 5th hind tarsal segment of whitish; palpi with four pale bands; prominent black scale tufts on ventral side of each abdominal segment ..... *kochi* Donitz
- Whole of 5th hind and 1/3rd of 4th hind tarsal segments white with a dark band on 4th segment; palpi with three pale bands .... *maculatus* Theobald
10. Femora and tibiae speckled 11
- Femora and tibiae not speckled 12
11. Palpi with 2 broad apical pale bands equal, palpi speckled ..... *splendidus* Koidzumi
- Palpi with 2 apical bands unequal; at least 2 segments of dorsum of abdomen clothed with golden scales ..... *jamesii* Theobald
12. Fifth vein (Cu) of wing mainly dark with a dark spot at its bifurcation .... *annularis* van der Wulp
- Cu continuously pale and no dark spot at its bifurcation ..... *Philippinensis* Ludlow

28. ***Anopheles (Cellia) aconitus*** Donitz

1902. *Anopheles aconitus* Donitz, *Z. Hyg. Insekt Krankh.* **41** : 70.

Distribution : India : Andaman, Assam, Arunachal Pradesh (East Kameng, Papumpare, Lower & Upper Subansiri), Bihar, Karnataka, Kerala, Madhya Pradesh, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, Myanmar, Sri Lanka, Malaysia, Indonesia, Sulawesi.

29. ***Anopheles (Cellia) annularis*** van der Wulp

1844. *Anopheles annularis* van der Wulp, *Leyden Mus.*, **6** : 249.

Distribution : India : Andhra Pradesh, Assam, Arunachal Pradesh (East Kameng, Papumpare, Lower Subansiri, Upper Subansiri), Bihar, Delhi, Goa, Gujarat, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, Myanmar, Sri Lanka, Nepal, Pakistan, China, Taiwan, Malaysia, Indonesia, Philippines, Thailand, Vietnam.

30. ***Anopheles (Cellia) balabacensis*** Baisas

1936. *Anopheles leucosphyrus* var. *balabacensis Baisas, Philipp. J. sci.* **59** : 65.

Distribution : India : Andaman, Assam, Arunachal Pradesh (Lower Subansiri, Papumpare), Karnataka, Kerala, Meghalaya, Punjab, Tamil Nadu, Tripura, West Bengal.

Elsewhere : Bangladesh, China, Indonesia, Kampuchea, Malaysia, Myanmar, Philippines, Taiwan, Thailand.

31. ***Anopheles (Cellia) Culicifacies*** Giles

1911. *Myzomyia culicifacies* var. punjabensis James & Liston, Anopheline mosquitoes of Indian. ed. **2** : 72. Giles

1933. *Anopheles (Myzomyia) culicifacies* : Chrishtophers, *Fauna. Brit. India, Diptera* **4** : 216.

Distribution : India : Andhra Pradesh, Assam, Arunachal Pradesh (Lower Subansiri), Bihar, Delhi, Goa, Gujarat, Haryana, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Afganisthan, Bangladesh, China, Iran, Myanmar, Nepal, Oman, Pakistan, Sri Lanka, Vietnam.

32. ***Anopheles (Cellia) jamesii*** Theobald

1901. *Anopheles jamesii* Theobald, *Monogr. Cul.* **1** : 134.

Distribution : India : Andhra Pradesh, Assam, Arunachal Pradesh (East Kameng, Lower Subansiri, Papumpare), Goa, Karnataka, Kerala, Maharashtra, Meghalaya, Orissa, Tamil Nadu, West Bengal.

Elsewhere : Bangladesh, China, Malayasia, Myanmar, Sri Lanka, Vietnam.

33. ***Anopheles (Cellia) jeyporensis*** James

1902. *Anopheles jeyporensis* James, *Scient. Mem. Offrs. med. sanit. Deps. India* **2** : 32.

Distribution : India : Andhra Pradesh, Assam, Arunachal Pradesh (East Kameng, Lower Subansiri, Papumpare), Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Myanmar, Taiwan, Vietnam.

34. ***Anopheles (Cellia) karwari*** (James)

1903. *Nyssorhynchus karwari* James in Theobald, *Monogr. Cul.* **3** : 102.

Distribution : India : Andhra Pradesh, Assam, Arunachal Pradesh (Lower Subansiri, Papumpare) Bihar, Goa, Karnataka, Kerala, Maharashtra, Meghalaya, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Widespread in Oriental region upto New Guinea.

35. ***Anopheles (Cellia) kochi*** Donitz

1901. *Anopheles kochi* Donitz, *Insektenborse* **18** : 36.

Distribution : India : Andaman, Assam, Arunachal Pradesh (East Kameng, Lower Subansiri, Papumpare, Upper Subansiri), Meghalaya, West Bengal.

Elsewhere : Bangladesh, Indonesia, Malayasia, Moluccus, Myanmar, Philippines.

36. ***Anopheles (Cellia) maculatus*** Theobald

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

Distribution : India : Andhra Pradesh, Assam, Arunachal Pradesh (East Kameng, Lower Subansiri, Papumpare, Upper Subansiri), Bihar, Goa, Haryana, Himachal Pradesh, Jammu &

Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Nagaland, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, China, Lesser Sunda Island, Myanmar, Nepal, Pakistan, Sri Lanka.

37. ***Anopheles (Cellia) philippinensis*** Ludlow

1902. *Anopheles philippinensis* Ludlow, *J. Am. med. Ass.* **39** : 426.

Distribution : India : Assam, Arunachal Pradesh (East Kameng, Lower Subansiri, Papumpare, Upper Subansiri), Bihar, Karnataka, Maharashtra, Manipur, Meghalaya, Orissa, West Bengal.

Elsewhere : Bangladesh, China, Myanmar, Thailand, Vietnam.

38. ***Anopheles (Cellia) splendidus*** Koidzumi

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

Distribution : India : Andhra Pradesh, Arunachal Pradesh (East Kameng, Lower Subansiri, Papumpare, Upper Subansiri), Bihar, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh,l Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : China, Kampuchea, Myanmar, Nepal, Pakistan, Taiwan, Vietnam.

39. ***Anopheles (Cellia) subpictus*** Grassi

1899. *Anopheles subpictus* Grassi, *Rec. R. Acad. Lincei* **8** : 101.

Distribution : India : Andhra Pradesh, Assam, Arunachal Pradesh (Lower Subansiri), Bihar, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : Afganisthan, Bangladesh, Bismarck Island, China, Indonesia, Iran, Maldieves, Myanmar, Nepal, New Guinea, Pakistan, Sri Lanka. Thailand.

40. ***Anopheles (Cellia) vagus*** Donitz

1902. *Anopheles vagus* Donitz., *Z. Hyg. Infektkrankh* **41** : 80.

Distribution : India : Andaman, Andhra Pradesh, Assam, Arunachal Pradesh (East Kameng, Lower Subansiri, Papumpare, Upper Subansiri), Bihar, Goa, Gujarat, Karnataka, Kerala, Lakshadweep, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Pondichery, Tamil Nadu, Tripura, West Bengal.

Elsewhere : Bangladesh, Myanmar, Sri Lanka, Taiwan, and widespread in Oriental region.

Subfamily CULICINAE

Tribe **Culicini**

Diagnosis : Proboscis flexible and of uniformly thick but at times swollen at tip, not hooked; posterior margin of scutellum usually trilobed with 3 distinet group of bristles; clypeus longer than broad; V-shaped thickening absent in hind margin of wing.

Key to the genera

1. Pulvilli well developed; wing scales narrow and uniformly dark ..... ***Culex*** Linnaeus

– Pulvilli absent or rudimentary; wing scales very broad and mixed brown white ..... ***Mansonia*** Blanchard

Genus ***Culex*** Linnaeus

1758. *Culex* Linnaeus, *Syst. Nat., Ed. 10*, **1** : 602.

Type-species : *Culex pipiens* Linnaeus.

Subgenus ***Culex*** Linnaeus

Diagnosis : Head with upright and narrow scales on vertex; palpi of male longer than proboscis with 2 apical segments upcurved and hairy; scale-tufts absent in male antenna; male coxite with a subapical lobe divided into two halves bearing some modified spines and a leaflet; phallosome divided into 2 lateral portions provided with various tooth or lobes.

41. ***Culex (Culex) bitaeniorhynchus*** Giles

1901. *Culex (Culex) bitaeniorhynchus* Giles, *J. Bombay nat. Hist. Soc.*, **13** : 607.

Diagnosis : Head with vertex with golden yellow and numerous upright yellow and brown scales; in female palpi uniformly black, in male with a few pale rings; proboscis black with a creamy band in the middle; scutum covered with narrow golden brown scales up to the level of wing; rest with brownish black scales except a few golden scales in front of scutellum; scutellum with dark brown scales at base of mid lobe, golden scales at its apex and on lateral lobes; legs brownish black with pale scales on femora, tibiae and first tarsal segments; wing with veins clothed with mixed broad, pale yellow and black scales; abdominal tergites with moderately broad apical yellow bands.

Distribution : India : Arunachal Pradesh (Lohit), widely diustributed in India.

Elsewhere : Oriental, Africa, Australia, Japan, Malagasy region, New Caledonia, New Guinea, Korea, Palau Island, Soviet Far East.

Genus ***Mansonia*** Blanchard

1901. *Mansonia* Blanchard, *C. r. Seane. Soc. Biol.*, **53** : 1046.

Type-species : *Culex titillans* Walker.

Subgenus ***Mansonioides*** Theobald

1907. *Mansonioides* Theobald, *Monogr. Cul.*, **4** : 498.

Type-species : *Mansonia (Mansinioides) septemgullata* Theobald.

Diagnosis : Palpi of male longer than proboscis; pleura with well developed bristles, 10-12 postspiracular, 9-15 proepimeron, 12-18 upper meseepimeral, 4-9 at lower part of mesoepimeron, tergite viii of female with a small tooth at apex, paraprocts with a few teeth at crown and with minute hairs.

42. ***Mansonia (Mansonioides) indiana*** Edwards

1930. *Mansonia (Mansonioides) indiana* Edwards, *Bull. Ent. Res.* **21** : 541.

Diagnosis : Head with vertex with yellow decumbent and brown upright scales; flagellum of antenna brown with faint rings; scutum with light brown scales; all femora with 4-5 oblique pale markings; all tibiae with yellowish tinged markings; lateral chitinous hooks on tergite VIII of female widely spacid and curved, lobes of sternite VIII slightly emarginate.

Distribution : India : Arunachal Pradesh (Lohit), Assam, Kerala, Meghalaya, Tamil Nadu, West Bengal.

Elsewhere : Indo–China, Java, Malaya, New Guinea, Sri Lanka, Sumatra and Thailand.

Family SIMULIIDAE

Genus ***Simulium*** Latreille

1802. *Simulium* Latreille, *Hist. nat. gen. part. Crust. Ins.*, **3** : 426.

Type-species : *Rhagio columbaschensis* Fabricius.

Diagnosis : Antenna with scape, pedicel and 9 flagellomeres (very rarely with 8 or 10 flagellomeres); pleural membrane and katepisternum bare or haired; basal cell absent; radial sector unbranched; basal section of radius bare or haired; calcipala and pediculus present.

Key to the subgenera

1. Basal section of vein R bare dorsally (especially males) ..... ***Simulium*** Latreille

– Basal section of vein R haired dorsally 2

2. Claw of female with stout basal tooth; male distimere with one spinule ..... ***Eusimulium*** Roubaud

– Claw of female with small basal tooth; male distimere with an accessory spinule ..... ***Himalayam*** Lewis

Subgenus ***Eusimlium*** Roubaud

1906. *Eusimulium* Roubaud, *Cr. hebd Seanc. Acad. Sci Paris.*, **143** : 521.

Type-species : *Simulium aurea* Fries.

43. ***Simulium (Eusimulium) aureohirtum*** Brunetti

1911. *Simulium aureohirtum* Brumetti *Rec. Indian. Mus,* **4** : 287.

Diagnosis : Large upper facet of eye in male relatively smaller than other species, eyes closely contiguous from vertex to antennae; anteunae dull reddish brown varying to black, palpi blackish to dark brown; thorax blackish; abdomen blackish, golden yellow hairs; fore coxae brownish yellow or pale yellow, posterior coxae black to blackish grey, coxae, femora, outer side of tibiae & under side of hind metatarsus bear golden yellow hair prominently in male, sparsely in female; wings clear.

Distribution : Andhra Pradesh, Arunachal Pradesh Assam, Chandigarh, Haryana, Himachal Pradesh, Karnataka, Maharashtra, Manipur, Meghalaya, Mizoram, Tamil Nadu, West Bengal.

Elsewhere : Borneo, China, Jawa, Malaya, Pakistan, Philippines, Ryukyu Islands, Sri lanka, Sulawesu, Sumatera, Taiwan, Thailand; Japan.

Subgenus ***Himalayam*** Lewis

1973. *Himalayam* Lewis, *Bull. Ent. Res.*, **62** : 460.

Type-species : *Simulium indicum* Becher.

44. ***Simulium (Himalayam) indicum*** Becher

1884. *Simulium indicum* Becher, *J. Asiat. Soc. Bengal,* **53** : 199.

Diagnosis : Scutum without conspicuous pattern in female; fore tarsomere flattened; abdomen thickly covered with scales & with first two segments pale; ovipositor lobes simply bluntly rounded; anal lobes rather large.

Distribution : India : Assam, Arunachal Pradesh (West Kameng, Kurungkumey, East Siang), Himachal Pradesh, J & K, Manipur, Meghalaya, Nagaland, Sikkim, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, Bhutan, China, Myanmar, Nepal, Pakistan, Siam, Thailand.

Subgenus ***Simulium*** Latreille

1802. *Simulium* Latreille, *Hist. Nat. Gen. et Particuliere des Crustaces et Insectes,* **3** : 426.

Type-species : *Rhagio colombaschensis* Fabricius.

Key to the species

1. Claws simple 2
– Claws with subbasal tooth ..... ***himalayense*** Puri
2. Seutum unstriped 3
– Seutum striped ..... ***novolineatum*** Puri
3. Abdominal sternum 7 with a pair of submedian clusters of fairly long & thick hairs ..... ***rufibasis*** Brunetti
– Abdominal sternum 7 without such clusters but with short scattered hairs ..... ***nitidithorax*** Puri

45. ***Simulium (Simulium) himalayense*** Puri

1932. *Simulium (Simulium) himalayense* Puri. *Indian J med Res*, **19** : 885.

Distribution : India : Arunachal Pradesh, Bihar, Himachal Pradesh, Manipur, West Bengal.

Elsewhere : Pakistan.

46. ***Simulium (Simulium) nitidithorax*** Puri

1932. *Simulium (Simulium) nitidithorax* Puri, *Indian J Med Res.*, **19** : 909.

Distribution : India : Arunachal Pradesh, West Bengal.

Elsewhere : Malaysia.

47. ***Simulium (Simulium) novolineatum*** Puri

1933. *Simulium (simulium) novolineatum* Puri, *Indian J med Res.*, **19** : 1125.

Distribution : India : Arunachal Pradesh, Karnataka, Uttar Pradesh, West Bengal.

Elsewhere : None.

48. ***Simulium (Simulium) rufibasis*** Brunetti

1911. *Simulium (Simulium) rufibasis* Brunetti, *Rec. Indian Mus.* **4** : 285.

Distribution : India : Arunachal Pradesh, Himachal Pradesh, Manipur, Meghalaya, Sikkim, West Bengal.

Elsewhere : Pakistan? Japan.

Family BIBIONIDAE

Key to the subfamilies

1. Vein R_4 forked; posterior cross vein distinctly nearer the base than the anterior cross vein ..... PLECIINAE

– Vein R_4 not forked; posterior cross vein distinctly beyond the anterior cross vein ..... BIBIONINAE

Subfamily BIBIONINAE

Key to the genera

1. Fore tibiae in both sexes with a prominent tooth like spine at the tip; dorsum of thorax never with a dentate ridge ..... ***Bibio*** Geoffroy

– Fore tibiae in both sexes with a circlet of spines at the tip instead of the spiny process, also often with spines on the middle of the fore tibiae; dorsum of thorax with two dentate transverse ridges ..... ***Dilophus*** Meigen

Genus ***Bibio*** Geoffroy

1762. *Bibio* Geoffroy, *Hist abreg. Ins. Paris*, **2** : 568.

Type-species : *Tipula hortulaha* Linnaeus.

Key to the species

1. Larger species; basal Part of R_4 usually much longer than the anterior cross vein ..... *tenebrosus* Coquilett

– Smaller species; basal part of R_4 usually (if at al) longer than the anterior cross vein ..... *fuscitibia* Brunetti

49. ***Bibio fuscitibia*** Brunetti

1911. *Bibio fuscitibia* Brunetti, *Rec. Indian. Mus.*, **4** : 279.

Distribution : India : Arunachal Pradesh (West Kameng), Uttar Pradesh, West Bengal.

Elsewhere : None.

50. ***Bibio tenebrosus*** Coquilett

1898. *Bibio tenebtrosus* Coquilett, *Proc. U. S. natn. Mus.*, **21** : 307.

Distribution : India : Arunachal Pradesh (west Kameng, Tawang), Himachal Pradesh, West Bengal.

Elsewhere : China, Japan, Myanmer, Nepal.

Dilophus Meigen

1800. *Philia* Meigen, *Nouv. Class. Mouches* : 20.

Type-species : *Tipula febritis* Linnaeus.

51. ***Dilophus gratiosus*** Bigot

1890. *Dilophus gratiosus* Bigot, *J. Asiatic. Soc. Bengal.* **59** : 265.

Diagnosis : Entire body with short sparse pale hairs, some long whitish hairs below head, yellowish hairs on legs; eyes bright reddish brown; thorax shining in male and bright ferruginous with a thin black dorsal line in female; abdomen roughened; posterior margin of scutellum and a scutellar ridge below it bright brownish yellow; wings nearly clearing male and wings yellowish grey in female legs reddish brown in male and in female legs black.

Distribution : India : Arunachal Pradesh (West Kameng), Punjab, Uttar Pradesh, West Bengal.

Elsewhere : China Myanmer, Nepal, Pakistan.

Subfamily PLECIINAE

Key to the genera

1. Vein R_4 forks just beyond the anterior cross vein, the upper branch almost parallel to the lower one; vein R_5 forks exactly at the anterior cross vein ..... ***Penthetria*** Meigen

– Vein R_4 forks some little distance beyond the anterior cross vein, the upper branch sometimes

approximately parallel to it, sometimes almost erect; Vein R_5 forked some distance beyond the anterior cross vein ..... ***Plecia*** Wiedemann

Genus ***Penthetria*** Meigen

1803. *Penthetria* Meigen, *Magazin Insekt Kde*, **2** : 264.

Type-species : *Penthetria funebris* Meigen.

52. ***Penthetria japonica*** Wiedemann

1830. *Penthetria japonica* Wiedemann, *Aussereurop. Zweifl. Ins.*, **2** : 618.

Diagnosis : Head black, vertex very prominent in male, frons in female one third the width of the head with a median longitudinal ridge; antennae longer in female; thorax, legs and abdomen black; genitalia large, shining black, the 2nd joint of the claspers, incurved, conical; wings blackish or blackish brown darker on basal nad anterior parts.

Distribution : India : Arunachal Pradesh (West Kameng, Tawang).

Elsewhere : China, Jappan, Nepal, Taiwan.

Genus ***Plecia*** Wiedemann

1828. *Plecia* Wiedemann, *Ausserenrop zweiffel. Insekt.*, **1** : 72.

Type-species : *Hirtea fulvicollis* Fabricius.

Key to the species

1. Thorax on dorsum or even entirely reddish yellow 2

– Thorax on dorsum or even entirely black ... 3

2. The whole thorax reddish yellow; antennae 12 jointed ..... *fulvicollis* (Fabricius)

– Only dorsum & scutellum reddish yellow, the sides and metanotum black; antennae 10 jointed ..... *tergorata* Rondani

3. Thorax black, hind part of dorsum ferruginous; antennae 9 jointed; smaller species .... *imposter* Brunetti

Thorax entirely black; antennae 10-12 jointed; larger species ..... *aterrima* Brunetti

53. ***Plecia aterrima*** Brunetti

1925. *Plecia aterrima* Brunetti, *Rec. Indian Mus.*, **27** : 446.

Distribution : India : Arunachal Pradesh (Lohit), West Bengal.

Elsewhere : Vietnam.

54. ***Plecia fulvicollis*** (Fabricius)

1805. *Hirtea fulvicollis* Brunetti, *Syst. Antl.* : 53.

Distribution : India : Arunachal Pradesh (East Siang, Lohit).

Elsewhere : None.

55. ***Plecia imposter*** Brunetti

1912. *Plecia imposter* Brunetti, *Rec. Indian Mus.* **7** : 446.

Distribution : India : Arunachal Pradesh (Lohit), Uttar Pradesh.

Elsewhere : Nepal.

56. ***Plecia tergorata*** Rondani

1895. *Plecia tergorata* Rondani, *Ann. Mus Civ. Genova*, **8** : 462.

Distribution : India : Assam, Arunachal Pradesh (East Siang), Uttar Pradesh, West Bengal, S. India.

Elsewhere : Borneo, Java, Myanmer.

Family SCIARIDAE

Key to the genera

1. Thoracic dorsum all yellowish, without stripes ..... ***Trichosia*** Winnertz

– Thoracic dorsum wholly blackish or dark brown 2

2. Abdomen with red dorsum .... ***Psilomegalosphys*** Enderlin

– Abdomen with black dorsum 3

3. R_1 ends exactly opposite of fork of vein M ..... ***Phorodonta*** Coquilett

– R_1 ends distinctly beyond fork of vein M .... ***Sciara*** Meigen

Genus ***Phorodonta*** Coquilett

1910. *Phorodonta* Coquilett, *Proc. U.S. natn. Mus.*, **37** : 589.

Type-species : *Sciara nigra* Wiedemann.

57. ***Phorodonta exacta*** (Brunetti)

1910. *Sciara exacta* Brunetti, *Fauna Brit. India, Diptera, Nematocera,* : 132.

1973. *Phorodonta exacta* : Steffen, *A Catalog of Diptera of the Oriental Region.* **1** : 466.

Diagnosis : Black; R_1 ending exactly opposite the fork of vein M and practically exactly in the middle of the wing.

Distribution : India : Arunachal Pradesh (Changlang, Tirap), Manipur, Uttaranchal, West Bengal.

Elsewhere : China, Malaya, Sri Lanka, Sumatra.

Genus ***Psilomegalosphys*** Enderlein

1910. *Psilomegalosphys* Enderlin, *Arch. Naturgesch* **77** : 137.

Type-species : *Psilomegalosphys xanthogaster* Enderlin.

Diagnosis : Head and thorax black, mouth parts reddish brown; abdomen and belly orange red but base of first segment above and last segment black; wings pale blackish, 2nd posterior cell four times as long as wide.

58. ***Psilomegalosphys xanthogaster*** Enderlin

1911. *Psilomegalosphys xanthogaster* Enderlein, *Arch. Naturgesch.* **77** : 137.

Distribution : India : Arunachal Pradesh, Manipur.

Elsewhere : Sumatera.

Genus ***Sciara*** Meigen

1803. *Sciara* Meigen, *Magazin Insektkde,* **2** : 263.

Type-species : *Tipula thomae* Linnaeus.

Key to the species

1. Abdomen wholly black .... ***nigripennis*** Brunetti

– Abdomen black marked by a lateral red or reddish yellow stripe ..... ***indica*** Walker

59. ***Sciara indica*** Walker

1856. *Sciara indica* Walker, *Ins. Saund., Dipt.*, pt **5** : 419.

Distribution : India : Arunachal Pradesh, (East Siang), Uttar Pradesh, West Bengal.

Elsewhere : None.

60. ***Sciara nigripennis*** Brunetti

1912. *Sciara nigripennis* Brunetti, *Fauna Brit. India. Diptera, Nematocera* : 131.

Distribution : India : Arunachal Pradesh, (West Kameng), Manipur, Uttaranchal, Sikkim, West Bengal.

Elsewhere : Sri Lanka.

Genus ***Trichosia*** Winnertz

1867. *Trichosia* Winnertz, *Monogr. Sciarinen* : 173.

Type-species : *Trichosia splendens* Winnertz.

61. ***Trichosia rufithorax*** (van der Wulp)

1881. *Sciara rufithorax* Wulp, *Midden Sumatra, Dipt.*, **4** : 6.

1973. *Trichosia rufithorax* Delfinado and Hardy, *A catalogue of the Diptera of the Oriental region* **1** : 476.

Diagnosis : Head black, antennae occasionally brownish; thorax brownish, reddish yellow or ferruginous; abdomen black; male genitalia large and conspicuous, 1st joint brownish yellow, 2nd joint black, both with short, rather thickly set hairs; wings blackish, R_1 ending more or less at middle of wing, either opposite (in male) or some distance beyond the fork (in female) of vein M; 2nd posterior cell about three and a half time as long as broad.

Distribution : India : Assam, Arunachal Pradesh, (East Siang), South India, West Bengal.

Elsewhere : China, Java, Malayasia, Mentawai Island, Myanmer, Sri Lanka, Sumatra, Thailand.

SUMMARY

It may be concluded that Arunachal Pradesh has so far known to harbour 61 species under the families–Tipulidae, Culicidae, Simuliidae, Bibionidae, and Sciaridae of the suborder Nematocera of which 7 species are confined to India, and the majority numbering species (44) spread in the boundary of Oriental region but there are 10 species extends their range of distribution beyond the Oriental region. (Table1.2. 3).

ACKNOWLEDGEMENTS

We express our thanks to Dr. J.R. B. Alfred, Director and Dr. A. K. Hazra, Joint Director, Zoological Survey of India, Kolkata for placing the materials at our disposal for study and their constant encouragement.

REFERENCES

BRUNETTI, E. 1925. Notes on Oriental Bibionidae with descriptions of new species. *Rec. Indian. Mus.* **27** : 443-450.

DATTA, M & CHAKRABORTY, M. 1985. Insecta : Diptera, *Rec. zool. Surv. India*, **82**(1-4) : 231-252.

DATTA, M. PARUI, P and MUKHERJEE, M 1997. Insecta : Diptera. 1-76. *In : Fauna of West Bengal, State Fauna Ser.*, **3**(7). Zoological Survey of India, Kolkata.

DATTA, M & PARUI, P. 2000. Insecta : Diptera *In* : *Fauna of Tripura, State Fauna Ser. 7* : 165-200. Zoological Survey of India, Kolkata.

DELFINADO, M. D. and HARDY, D. E. (1973). (eds.). *A catalog of Diptera of the Oriental Region.* **1** : 1-Univ. of Hawaii Press, Honolulu.

EDWARDS, F. W. 1921. Seven new species of pselliophora (Diptera : Tipulidae). *Ann. Mag. Nat. Hist* (9)**7** : 373-378.

GHOSH, A. K. 1985. Namdapha biosphere reserve- an overview. *Rec. zool Surv. India*, **82**(1-4) : 1-8.

HARDY, 1977. The present & future status of our knowledge of the Diptera faunas of the world. Communicated at 14th Congr. Entomology. Washington, U. S. A.

JOSEPH, A. N. T. and RAO, K. R. 1972b. Diptera from NEFA and Assam foot hills. Kameng frontier division, Subansiri frontier division, North Lakhimpur and Assam foot hills. *Rec. zool. Surv. India*, **66**(1-4) : 103-128.

JOSEPH, A. N. T. and PARUI, P. 1973. Diptera from NEFA and Assam foot hills. Part III. Siang frontier division, and North Lakhimpur. *Rec. zool. Surv. India*, **67** : 325-342.

JOSEPH, A. N. T and RAY, K. K. 1976. Diptera from Arunachal Pradesh & Assam Foot hills, part iv. Lohit Forntier Division, Lakhimpur district & sibsagar district *Rec. zool. Surv. India*, **69** : 275-290.

JOSEPH, A. N. T. and PARUI, P. 1977. Diptera from Arunachal Pradesh and Assam Foot hills, Part V. Tirap division. *Rec. zool. Surv. India*, **72** : 333-339.

JULKA, J. M. 1983. Report on the fauna collected during Subansiri expedition (1974-1975) Arunachal Pradesh. *Misc. Pub. G. S. I.* no **43** : 22-25.

MALHOTRA, P. R., SARKAR, P. K. DAS, N. G. & HAZARIKA, S. 1987. Mosquito survey in Tirap & Subansiri districts of Arunachal Pradesh. *Indian. J. Malar.*, **24**(2) : 151-156.

MCALPINE, J. F & D. M. Wood (eds.) 1989. Mannual of nearctic Diptera vol. 3. Research Branch, Agriculture cenada, Monograph, 32 :

MEIGEN, J. W, 1804, Kdassifikazion und Beschrcibung der curopaischen gweiflugeligen Insecter (Diptra Linn.). *Frster Band.* Abt. I. pp. 1-xxviii + 1-152, pls. 1-8; Abh 11, pp. i-vi + 153-314. pls 9-15 Braunschwing.

PAL, T. K. 1989. On a collection of Bibionidae (Diptera) from India. *Oikoassay,* **6** : 93-98.

PAL. T. K. & DATTA, R. K. 1993. Anophelines (Diptera : Culicidae) of three districts (East kameng, Lower Subansiri & Upper Subansiri) of Arunachal Pradesh & their perspective impact on human & non-human hosts. *Rec. zool. Surv. India,* **91**(2) : 189-202.

SAVCHENKO, E. N. 1966. Phylogeny and systematics of the Tipulidae. *Fauna Ukraini* **14** : 63-88.

SEN, S. K., JOHN, V. M. KRISHNAN, K. S. and Rajagopal, R 1973. Studies on Malaria transmission in Tirap district, Arunachal Pradesh (NEFA). *J. Com. Dist.* **5** : 98-110.

Table 1. Distribution of species in different districts of Arunachal Pradesh. Present : +

	Species	Family	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	*Ctenophora (Pselliophora) ardens* (Wiedemann)	Tipulidae				+											
2	*Holorusia fulvolateralis* (Brunetti)															+	
3	*Nephrotoma concolorithorax* (Brunetti)							+									
4	*Nephrotoma consimilis* (Brunetti)			+				+				+			+		+
5	*Nephrotoma delta* (Walker)														+		
6	*Nephrotoma javensis* (Doleschall)			+													
7	*Nephrotoma serricornis* (Brunetti)											+					+
8	*Tipula (Acutipula) subvernalis* Alexander															+	
9	*Tipula (Emdotipula) stylostena* Alexander									+							
10	*Tipula (Indotipula) singhalica* Alexander and Alexander							+									
11	*Tipula (Vestiplex) subtincta* Brunetti								+								
12	*Antocha (Antocha) indica* Brunetti			+													
13	*Limonia (Euglochina) saltens* (Doleschall)											+					
14	*Limonia (Libnotes) palaeta* Alexander						+										
15	*Hexatoma (Eriocera) graveleyi* Brunetti											+					
16	*Hexatoma (Eriocera) nepalensis* (Westwood)							+				+					
17	*Pseudolimnophila (Pseudolimnophila) fusca* (Brunetti)			+													
18	*Conosia irrorata* (Wiedemann)											+					
19	*Erioptera (Symplecta) hybrida* (Meigen)			+													
20	*Gonomyia (Idiocera) punctipennis* Edwards						+										
21	*Gonomyia (Protogonomyia) nigripes* (Brunetti)											+					
22	*Stringomyia subobscura* Alexander			+													
23	*Teucholabis fenestrata* Osten Sacken								+								
24	*Anopheles (Anopheles) aitkenii* James	Culicidae															
25	*Anopheles (Anopheles) barbirostris* vander Wulp			+			+	+	+								
26	*Anopheles (Anopheles) gigas* Giles			+													
27	*Anopheles (Anopheles) nigerrimus* Giles			+			+	+	+								
28	*Anopheles (Cellia) aconitus* Donitz			+			+	+	+								
29	*Anopheles (Cellia) annularis* vander Wulp			+			+	+	+								
30	*Anopheles (Cellia) balabacensis* Baisas						+	+									
31	*Anopheles (Cellia) culicifacies* Giles							+									
32	*Anopheles (Cellia) jamesii* Theobald			+			+	+									
33	*Anopheles (Cellia) jeyporensis* James			+			+	+									
34	*Anopheles (Cellia) karwari* (James)						+	+									
35	*Anopheles (Cellia) kochi* Donitz			+			+	+	+								
36	*Anopheles (Cellia) maculates* Theobald			+			+	+	+								
37	*Anopheles (Cellia) philippiensis* Ludlow			+			+	+	+								
38	*Anopheles (Cellia) splendidus* Koidzumi			+			+	+	+								
39	*Anopheles (Cellia) subpictus* Grassi							+									
40	*Anopheles (Cellia) vagus* Donitz			+			+	+	+								
41	*Culex (Cules) bitaeniorhynchus* Giles														+		
42	*Mansonia (Mansonioides) indiana* Edwards														+		
43	*Simulium (Eusimulium) aureohirtum* Brunetti	Simulidae															
44	*Simulium (Himalayam) indicum* Becher		+			+						+					

Table Contd.

	Species	Family	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
45	*Simulium (Simulium) himalayense* Puri																
46	*Simulium (Simulium) nitidithorax* Puri																
47	*Simulium (Simulium) novolineatum* Puri																
48	*Simulium (Simulium) rufibasis* Brunetti																
49	*Bibio fuscitibia* Brunetti	Bibionidae	+														
50	*Bibio tenebrosus* Coquilett		+		+												
51	*Dilophus gratiosus* Bigot		+														
52	*Penthetria japonica* Wiedemann		+		+												
53	*Plecia aterrima* Brunetti														+		
54	*Plecia fulvicollis* (Fabricius)											+			+		
55	*Plecia imposter* Brunetti														+		
56	*Plecia tergorata* Rondani											+					
57	*Phorodonta exacta* (Brunetti)	Sciaridae														+	+
58	*Psilomegalosphys xanthogaster* Enderlein											+					
59	*Sciara indica* Walker		+														
60	*Sciara nigripennis* Brunetti											+					
61	*Trichosia rufithorax* (van der Wulp)																

Name of districts as per serial

1. West Kameng, 2. East Kameng, 3. Tawang, 4. Kurungkumey, 5. Papumpare, 6. Lower Subansiri, 7. Upper Subansiri, 8. West Siang, 9. Upper Siang, 10. East Siang, 11. Dibang Valley, 12. Lower Dibang Valley, 13. Lohit, 14. Changlang, 15. Tirap.

Table 2. Distribution of the species (as per serial number) Arunachal & in other parts of India

Species Districts		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1	*Ctenophora (Pselliophora) ardens* (Wiedemann)	+																																
2	*Holorusia fulvolateralis* (Brunetti)	+								+																			+					
3	*Nephrotoma concolorithorax* (Brunetti)	+	+		+																													
4	*Nephrotoma consimilis* (Brunetti)	+							+	+																			+					
5	*Nephrotoma delta* (Walker)	+									+																							
6	*Nephrotoma javensis* (Doleschall)	+																											+					
7	*Nephrotoma serricornis* (Brunetti)	+								+																								
8	*Tipula (Acutipula) subvernalis* Alexander	+								+																								
9	*Tipula (Emdoripula) stylostena* Alexander	+																											+					
10	*Tipula (Indotipula) singhalica* Alexander and Alexander	+																																
11	*Tipula (Vestiplex) subtincta* Brunetti	+								+																								
12	*Antocha (Antocha) indica* Brunetti	+	+							+																	+	+						
13	*Limonia (Euglochina) saltens* (Doleschall)	+	+											+	+	+	+																	
14	*Limonia (Libnotes) palaeta* Alexander	+	+							+																								
15	*Hexatoma (Eriocera) graveleyi* Brunetti	+	+		+					+																								
16	*Hexatoma (Ericera) nepalensis* (Westwood)	+	+							+																			+					
17	*Pseudolimnophila (Pseudolimnophila) fusca* (Brunetti)	+								+																								
18	*Conosia irrorata* (Wiedemann)	+	+							+	+																	+						
19	*Erioptera (Symplecta) hybrida* (Meigen)	+								+																	+							
20	*Gonomyia (Idiocera) unctipennis* Edwards	+																																
21	*Gonomyia (Protogonomyia) nigripes* (Brunetti)	+	+							+																		+						
22	*Stringomyia subobscura* Alexander	+																																
23	*Teucholabis fenestrata* Osten Sacken	+	+		+																								+					
24	*Anopheles (Anopheles) aitkenii* James	+														+				+											+			
25	*Anopheles (Anopheles) barbirostris* vander Wulp	+	+		+					+	+	+		+	+		+	+	+	+		+		+	+	+		+		+		+		

Table Contd.

Species Districts		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
26	*Anopheles (Anopheles) gigas* Giles	+	+		+				+	+					+				+			+		+	+		+	+		+				
27	*Anopheles (Anopheles) nigerrimus* Giles	+	+		+	+		+		+	+	+		+	+	+	+	+	+	+		+		+	+	+	+	+				+		
28	*Anopheles (Cellia) aconitus* Donitz	+	+							+	+				+	+	+					+						+			+			
29	*Anopheles (Cellia) annularis* vander Wulp	+	+							+	+			+	+	+	+	+	+	+		+	+		+	+		+		+				
30	*Anopheles (Cellia) balabacensis* Baisas	+	+	+	+					+					+	+	+								+						+			
31	*Anopheles (Cellia) culicifacies* Giles	+	+		+					+	+	+		+	+	+	+	+	+	+		+	+	+	+	+		+		+				
32	*Anopheles (Cellia) jamesii* Theobald	+	+		+					+		+		+	+	+	+	+		+														
33	*Anopheles (Cellia) jeyporensis* James	+	+		+					+	+	+		+	+	+	+		+	+		+						+						
34	*Anopheles (Cellia) karwari* (James)	+	+		+					+	+	+		+	+	+	+	+		+								+						
35	*Anopheles (Cellia) kochi* Donitz	+	+		+					+																					+			
36	*Anopheles (Cellia) maculates* Theobald	+	+		+			+		+	+	+		+	+	+	+	+		+		+		+	+		+	+		+				
37	*Anopheles (Cellia) philippiensis* Ludlow	+	+		+	+				+	+	+					+			+														
38	*Anopheles (Cellia) splendidus* Koidzumi	+								+	+	+		+	+	+	+	+	+	+		+		+	+	+	+	+		+				
39	*Anopheles (Cellia) subpictus* Grassi	+	+	+	+					+	+	+		+	+	+	+	+	+	+		+	+	+	+		+	+						
40	*Anopheles (Cellia) vagus* Donitz	+	+	+	+	+				+	+	+		+	+	+	+	+	+	+		+									+	+	+	
41	*Culex (Cules) bitaeniorhynchus* Giles	+																																
42	*Mansonia (Mansonioides) indiana* Edwards	+	+		+					+					+	+																		
43	*Simulium (Eusimulium) aureohirtum* Brunetti	+	+		+	+	+			+				+	+		+		+					+			+						+
44	*Simulium (Himalayam) indicum* Becher	+	+		+	+		+	+	+																	+	+		+				
45	*Simulium (Simulium) himalayense* Puri	+				+				+	+																+							
46	*Simulium (Simulium) nitidithorax* Puri	+								+																								
47	*Simulium (Simulium) novolineatum* Puri	+								+							+											+						
48	*Simulium (Simulium) rufibasis* Brunetti	+			+	+			+	+																	+							
49	*Bibio fuscitibia* Brunetti	+								+																		+						
50	*Bibio tenebrosus* Coquilett	+								+																	+							
51	*Dilophus gratiosus* Bigot	+								+															+			+						

Table Contd.

Species Districts		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
52	*Penthetria japonica* Wiedemann	+																																
53	*Plecia aterrima* Brunetti	+								+																								
54	*Plecia fulvicollis* (Fabricius)	+																																
55	*Plecia imposter* Brunetti	+																										+						
56	*Plecia tergorata* Rondani	+	+							+				+	+	+	+											+						
57	*Phorodonta exacta* (Brunetti)	+				+				+																			+					
58	*Psilomegalosphys xanthogaster* Enderlein	+				+																												
59	*Sciara indica* Walker	+								+																		+						
60	*Sciara nigripennis* Brunetti	+				+			+	+																			+					
61	*Trichosia rufithorax* (van der Wulp)	+								+				+	+	+	+																	

Name of states as per serial

1. Arunachal Pradesh, 2. Assam, 3. Tripura, 4. Meghalaya, 5. Manipur, 6. Mizoram, 7. Nagaland, 8. Sikkim, 9. West BEngal, 10. Bihar, 11. Orissa, 12. Jharkhand, 13. Andhra Pradesh, 14. Tamil Nadu, 15. Kerala, 16. Karnataka, 17. Goa, 18. Gujarat, 19. Maharashtra, 20. Chhatishgarh, 21. Madhya Pradesh, 22. Rajasthan, 23. Haryana, 24. Punjab, 25. Delhi, 26. Himachal Pradesh, 27. Uttar Pradesh, 28. Uttaranchal, 29. J & K, 30. A & N Islands, 31. Lakshadweep, 32. Pondichery, 33. Chandigarh.

Table 3. Distribution of species in different Zoogeographical regions of the World. Present : +

	Species	Family	Oriental	Palae arcti	Ethiopian	Austra lian
1	*Ctenophora (Pselliophora) ardens* (Wiedemann)	Tipulidae	+			
2	*Holorusia fulvolateralis* (Brunetti)		+			
3	*Nephrotoma concolorithorax* (Brunetti)		+			
4	*Nephrotoma consimilis* (Brunetti)		+			
5	*Nephrotoma delta* (Walker)		+			
6	*Nephrotoma javensis* (Dóleschall)		+			
7	*Nephrotoma serricornis* (Brunetti)					
8	*Tipula (Acutipula) subvernalis* Alexander		+			
9	*Tipula (Emdoripula) stylostena* Alexander		+			
10	*Tipula (Indotipula) singhalica* Alexander and Alexander		+			
11	*Tipula (Vestiplex) subtincta* Brunetti					
12	*Antocha (Antocha) indica* Brunetti		+			
13	*Limonia (Euglochina) saltens* (Doleschall)		+			
14	*Limonia (Libnotes) palaeta* Alexander		+			
15	*Hexatoma (Eriocera) graveleyi* Brunetti		+			
16	*Hexatoma (Ericera) nepalensis* (Westwood)		+			
17	*Pseudolimnophila (Pseudolimnophila) fusca* (Brunetti)		+			
18	*Conosia irrorata* (Wiedemann)		+	+	+	+
19	*Erioptera (Symplecta) hybrida* (Meigen)		+	+		
20	*Gonomyia (Idiocera) unctipennis* Edwards		+			
21	*Gonomyia (Protogonomyia) nigripes* (Brunetti)					
22	*Stringomyia subobscura* Alexander					
23	*Teucholabis fenestrata* Osten Sacken		+			
24	*Anopheles (Anopheles) aitkenii* James	Culicidae	+			
25	*Anopheles (Anopheles) barbirostris* vander Wulp		+			
26	*Anopheles (Anopheles) gigas* Giles		+			
27	*Anopheles (Anopheles) nigerrimus* Giles		+	+		
28	*Anopheles (Cellia) aconitus* Donitz		+			
29	*Anopheles (Cellia) annularis* vander Wulp		+			
30	*Anopheles (Cellia) balabacensis* Baisas		+			
31	*Anopheles (Cellia) culicifacies* Giles		+	+		
32	*Anopheles (Cellia) jamesii* Theobald		+			
33	*Anopheles (Cellia) jeyporensis* James		+			
34	*Anopheles (Cellia) karwari* (James)		+			
35	*Anopheles (Cellia) kochi* Donitz		+			
36	*Anopheles (Cellia) maculates* Theobald		+			
37	*Anopheles (Cellia) philippiensis* Ludlow		+			
38	*Anopheles (Cellia) splendidus* Koidzumi		+			
39	*Anopheles (Cellia) subpictus* Grassi		+	+		
40	*Anopheles (Cellia) vagus* Donitz		+			
41	*Culex (Cules) bitaeniorhynchus* Giles		+	+	+	+
42	*Mansonia (Mansonioides) indiana* Edwards		+			
43	*Simulium (Eusimulium) aureohirtum* Brunetti	Simulidae	+	+		
44	*Simulium (Himalayam) indicum* Becher		+			

Table Contd.

	Species	Family	Oriental	Palaeo arctic	Ethiopian	Austra lian
45	*Simulium (Simulium) himalayense* Puri		+			
46	*Simulium (Simulium) nitidithorax* Puri		+			
47	*Simulium (Simulium) novolineatum* Puri					
48	*Simulium (Simulium) rufibasis* Brunetti		+	+		
49	*Bibio fuscitibia* Brunetti	Bibionidae	+	+		
50	*Bibio tenebrosus* Coquilett		+			
51	*Dilophus gratiosus* Bigot		+			
52	*Penthetria japonica* Wiedemann		+	+		
53	*Plecia aterrima* Brunetti		+			
54	*Plecia fulvicollis* (Fabricius)					
55	*Plecia imposter* Brunetti		+			
56	*Plecia tergorata* Rondani		+			
57	*Phorodonta exacta* (Brunetti)	Sciaridae	+			
58	*Psilomegalosphys xanthogaster* Enderlein		+			
59	*Sciara indica* Walker					
60	*Sciara nigripennis* Brunetti		+			
61	*Trichosia rufithorax* (van der Wulp)		+			

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2) : 257-281, 2006

INSECTA : DIPTERA : BRACHYCERA

BULGANIN MITRA, P. PARUI AND D. BANERJEE
Zoological Survey of India, M-Block, New Alipore, Kolkata 700053

INTRODUCTION

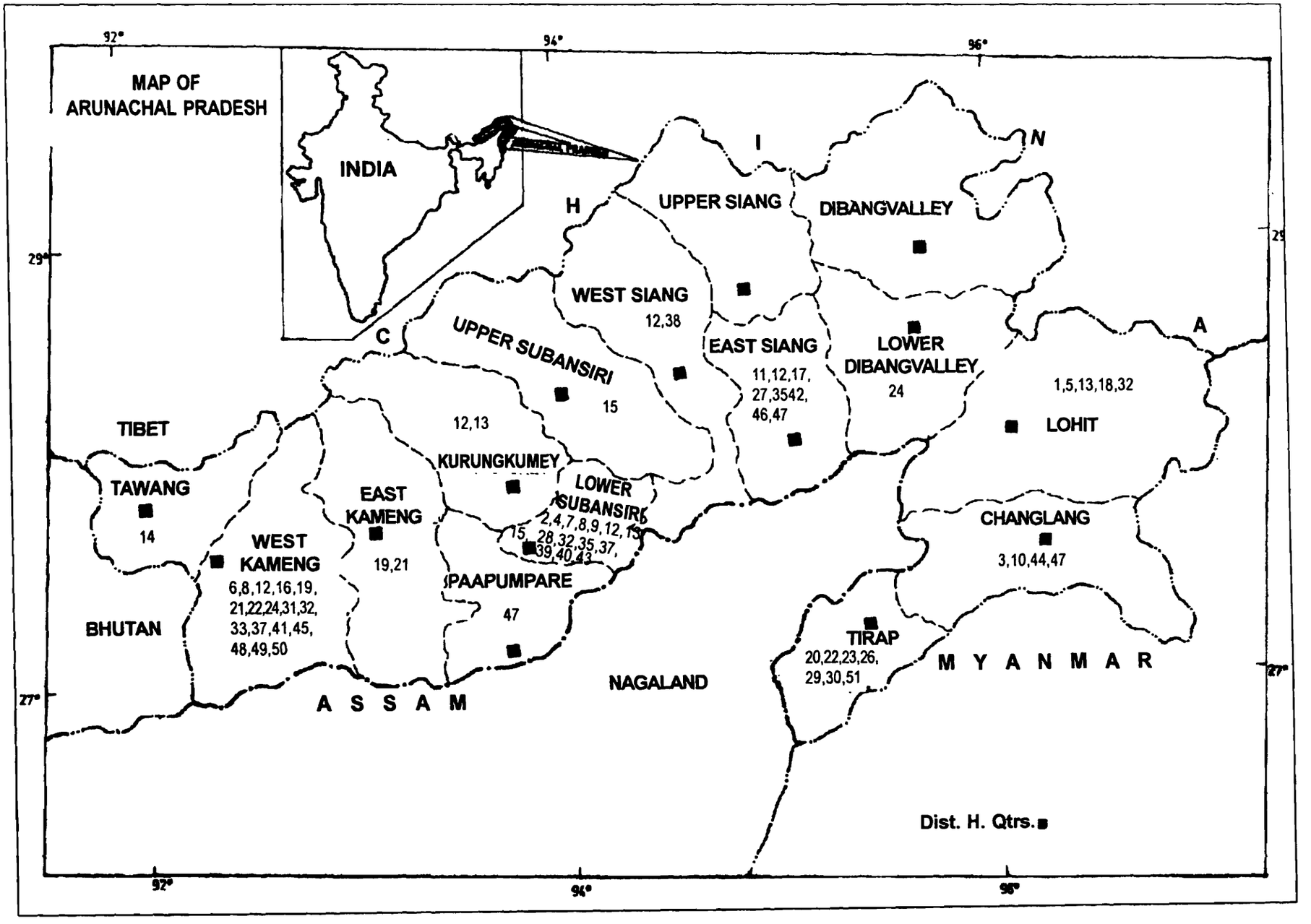
Arunachal Pradesh, a serene land tucked into the north-eastern tip of India, lies between 26° 28′ to 29° 30′ N latitudes & 91° 30′ to 97° 31′ E having an area of about 83,743 sq. km. Area-wise it is the largest in the north-east region and is surrounded by Bhutan, China and Myanmar. It stretches from the snow-capped mountains in the north to the plains of the Bramhaputra valley in the South. The land is mostly mountainous with the Himalayan range along the northern borders criss-crossed with ranges running north-south. These divide the state into 5 river valleys : the Kameng, the Subsansiri, the Siang, the Lohit and the Tirap. All these are fed by snow from the Himalayas and countless rivers and rivulets. The mightiest of these rivers is Siang, which becomes Bramhaputra after the Dibang and the Lohit of the plains of Assam join it. The climate varies from hot and humid to heavy rainfall in the Shiwalik ranges. It becomes progressively cold as one-move northwards to higher altitudes. Trees of great size, plentiful climbers cane and bamboos make Arunachal evergreen.

The Diptera are commonly known as (true) flies and include many familiar insects such as mosquitoes, black flies, midges, horse flies, fruit flies, blowflies and houseflies. Flies are generally common and can be found all over the world, and in a few cases in sub Antarctic also (except Continental Antarctica). Many species are particularly important as vectors of disease in man, other animals, and plants. Flies are holometabolous insects and their life cycle involves a major physical change from a soft-bodied, wingless larval stage to a hardened, winged adult.

The order Diptera is generally divided into three suborders : Nematocera, Brachycera, and Cyclorrhapha on the basis of the antennal characteristics, the shape of the exit hole from the pupal case, the nature of the pupa, and larval morphology. But this type of classification was posing problems to assign the rank of different groups. Therefore, attempts to formulate a monophyletic classification of Diptera have gained pace recently but no definite consensus has been reached to date (Michelsen 1996, Osterbroek and Courtney 1995, Sinclair *et al.* 1994, Cumming *et al.* 1995, Griffiths 1994, 1996). The most comprehensive treatment of dipteran phylogeny and contemporary views on morphological character evidence can be found in Volume 3 of the Manual of Nearctic Diptera (McAlpine and Wood 1989).

According to the new classification the order Diptera is divided into two suborders, the Nematocera and Brachycera. The Brachycera includes robust flies with short antennae. In older classifications two Divisions were recognised in the Brachycera, the Orthorrhapha and Cyclorrhapha. The "Orthorrhapha" includes brachyceran flies with a simple, obtect pupa, such as horse flies and robber flies, and the Cyclorrhapha comprise brachyceran flies with a pupa enclosed in a hardened puparium. The classification followed in this communication is older one, i.e., three suborders of Diptera : Nematocera, Brachycera, and Cyclorrhapha.

The Brachycera includes horseflies, robberflies, dance flies etc. These are the second main stem in the evolution of flies, many of them are stockier and more solid than the Nematocera and some of them are exceptionally good fliers. The families



Map 1 : Showing the distribution of species within the districts of Arunachal Pradesh

under suborder Brachycera so far recorded from India are 15 of which only 6 families have been reported to be present in Arunachal Pradesh namely Stratiomyidae, Tabanidae, Asilidae, Bombyliidae, Empididae, Dolichopodidae (Bombyliidae dealt separately). This present communication is reported 51 species under 30 genera of 5 families.

A perusal of literature reveals that quite a few publications were made on the diptera fauna of Arunachal Pradesh as a whole, and quite a good number of brachyceran species were described from this hotspot of India. Joseph & Parui (1973, 1977), Joseph & Rao (1972b), Joseph & Ray (1976), and Datta & Chakraborty (1985) published recently some valuable works on Diptera of Arunachal Pradesh.

Recently some collecting trips were organized by this Institute in all 15 districts of Arunachal Pradesh in order to reveal the fauna of the state as tabulated below :

A. R. Lahiri	Aug-Sept, 1998	Papumpare, West Kameng, East Kameng, Tawang.
	Sept-Oct., 2000	Tirap, Changlang, Lower Dibang Valley
Bulganin Mitra	May-June, 2000	Papumpare, Kurungkumcy, Upper Subansiri, West Siang
	Sept-Oct, 2001	West Kameng, Tawang
M. Sil	Sept-Oct, 2002	East & Upper Siang
R. S. Mridha	Feb-March, 2003	Lohit, Lower Dibang valley, Dibang Valley

This report incorporates the material belonging to the families : Stratiomyidae (10 spp.), Tabanidae (24 spp.), Asilidae (15 spp.), Empididae (1 sp.), Dolichopodidae (1 sp.).

MORPHOLOGY AND TERMINOLOGY

The major morphological feature which distinguishes flies as a whole from other insects is their reduced hind wings or halteres. The halteres are small, club-like structures that function as balancing organs during flight. Because of the reliance on the forewings for flight, the mesothorax has become enlarged to contain the enormous flight muscles, and the pro–and metathorax are correspondingly reduced. The mouthparts of flies are also characteristically suctorial and many have large fleshy pads with drainage canals termed pseudotracheae for efficient liquid uptake. Some flies have mouthparts modified for stabbing and piercing other insects, such as the predatory robber-flies (Asilidae) and dance flies (Empididae).

Flies in the sub order Brachycera (=short horn) are rather stout flies with antenna having fewer than seven segments and often, an arista. Maxillary palps are usually unsegmented or 2 segmented. Larvae have weakly developed heads, which are generally retractile, and the mandibles move in the vertical plane. With the exception of the family Stratiomyidae, the head of brachyceran larvae is usually retractile within thorax. The pupae may be recognized by their thorny appearance, spines being present on the antennal sheath & other regions of the head & thorax. The abdominal segments are also usually provided with girdles of spines & the terminal somite is armed with a pointed process. The pupae of these flies are exarate. Except Stratiomyidae, the pupa is free and not enclosed in the larval skin, very rarely a cocoon is present (Dolichopodidae).

The Stratiomyidae, commonly known as "Soldier-flies" are often colourful. Two members of the family are small to rather large bristlesless flies, more or less flattened, with diverse forms of antennae having flagellum upto 8-segments; scutellum conspicuously developed, may be with upto 8 spines, longitudinal veins stout and crowded in the fore parts of wing, remaining veins faint and often not reaching wing margin, ambient vein absent; pulvilli and arolium pad like; third antennal segment annulated, usually with white, yellow or green markings.

The tabanids or horse flies of the family Tabanidae are stout, medium to large-sized flies. They are recognized because their antennae have three segments with the distal one bearing annulations but no arista. The large, bean shaped head is much broader than long and the eyes are particularly well developed, as befits predominantly

diurnal creatures. In life many species display colorful eye banding that all disappears on dried specimens. The mouthparts of tabanids are particularly well suited to the mechanical transmission of blood-dwelling pathogens from host to host. The R_4 and R_5 veins of their wings diverge and enclose the wing tip. The discal cell is located more or less in the centre of the wing.

The members of the family Asilidae are small to large-sized flies; head is dichoptic in both sexes; well developed tubercle or gibbosity either on the lower part of the face or frons or all over it, bears stout long bristles called mystax, antennae 3-segmented, majority of genera bears one or two apical microsegments besides the terminal bristles or bristle-like style; thorax stout; mesonotum very large & convex; male terminalia genitalia very complex & highly variable; wing venation much variable.

The Empididae commonly called 'dance flies' with large eyes contiguous or separate in both sexes or only contiguous in males; proboscis moderately developed and adapted for piercing; antennae porrect; flagellum sometimes bear arista; thorax humped; scutellum bears bristles; femora usually incrassated and sometimes spinous below; costa usually ends at wing apex; second to fifth longitudinal veins simple or forked; posterior cross vein always absent, submarginal cells and posterior cells variable in number; abdomen 7 or 8 segmented.

Dolichopodidae or the "long-legged flies" of small size and metallic blue or green in colour; arista or style dorsal or apical; proboscis short and fleshy discal cell united to second basal cell, third longitudinal vein diverges from a swelling form near the base.

MATERIAL AND METHODS

Datta, Parui and Mukherjee (1997) laid down the general method of collecting dipteran specimens from their habitats and of preserving them in proper manner for taxonomic studies. Therefore, we are stressing upon certain specific requirements relating to some family-group undertaken here rather than detailing on the broad range of procedures once again. In fact, collecting becomes much easier and more ambitious if the collector knows the proper habitat as well as the bionomical aspects of the insect (Datta & Parui, 2000).

Larval flies have a variety of common names, such as wriggler and maggot. Fly larvae have an enormous varicty of feeding habits, and individual species often have very precise requirements. Many consume decaying organic matter, or are predacious, and a large proportion is parasitic on other insects and other organisms. Adult flies are almost always free-living and fly during the day. They typically consume liquid food such as nectar and other plant exudates, or often decomposing organic matter.

The cosmopolitan family Stratiomyidae includes a wide range of considerably different forms, the larvae of which live as micropantophages in standing waters, soil, under the bark of trees and in decaying remains of plant and animal origin. These are generally rather pretty flies, which can often be seen sitting on flowers during the summer; the adults are pollen or nectar feeders. The larva, which eats a mixture of rotting vegetable and animal matter, is unusual in having their skin thickened with calcium carbonate.

The members of the family Tabanidae are commonly known as horse-flies, deer-flies, clegs, stouts, breeze-flies, dun-flies, whame-flies and lots of other strange names. There are about 3,500 species of horse-flies in the world of which about 200 species of 12 genera under 3 subfamilies occur in India. Tabanids are mostly sturdy flies and usually strong fliers. The adults of both sexes feed on nectar and pollen of flowers. Females of most species suck blood from warm-blooded vertebrates; a few attack cold-blooded vertebrates; males and non-blood sucking females take nourishment from flowers. Eggs laid by most species in clusters or layers upon vegetation overhanging water, or on nearby rocks; oviposition in some species accomplished only after female has taken a blood meal.

The larva of robber-flies is believed to be mostly herbivorous (vegetarian) but the adult flies are highly active carnivores. They are specialised hunting machines of superb design which live by

chasing down other insects, usually in flight; they have long spiny legs in which they hold their prey as they pierce it with their powerful proboscis in order to suck it dry on the wing.

Dance flies look and act a lot like robber-flies, from which they can be distinguished by their less bulging eyes and the lack of the trough between their eyes, and the fact that their larva, as well as their adults, are carnivorous. They are called Dance flies because members of the genus *Hilara* can often be seen flying low over the water in a twisting spiraling manner that to our eyes looks much like a dance.

Flies of the family Dolichopodidae are often abundant in moist habitats and are frequently found on foliage, tree trunks, mud flats, and river rocks. Adults are predaceous on soft-bodied invertebrates and serve as important general control agents of many pest species. The maggot like larvae is found in such habitats as soil, rotten vegetation, mud, and under barks. Most are predators or scavengers.

LIST OF SPECIES

A. Family STRATIOMYIDAE
Subfamily SARGINAE

1. *Microchrysa flaviventris* (Wiedemann)
2. *Ptecticus aurifer* (Walker)
3. *Sargus metallinus* Fabricius

Subfamily CLITELLARINAE

4. *Nigritomyia maculipennis* (Macquart)

Subfamily HERMETIINAE

5. *Campeprosopa longispina* (Brunetti)
6. *Eudmeta marginata* (Fabricius)

Subfamily PACHYGASTERINAE

7. *Cibitogaster azurea* (Gerstaecker)
8. *Ptilocera fastuosa* (Gerstaecker)
9. *Rosapha bicolor* (Bigot)
10. *Stratiosphecomyia variegata* Brunetti

Family TABANIDAE
Subfamily PANGONIINAE

11. *Philoliche varipes* (Ricardo)

Subfamily CHRYSOPSINAE

12. *Chrysops designatus* Ricardo
13. *Chrysops dispar* (Fabricius)

Subfamily TABANINAE

14. *Hybomitra hirta* (Walker)
15. *Tabanus (Tabanus) auriflamma* Walker
16. *Tabanus (Tabanus) dominus* Datta & Das
17. *Tabanus (Tabanus) fuscomaculatus* Ricardo
18. *Tabanus (Tabanus) jucundus* Walker
19. *Tabanus (Tabanus) kamengensis* Datta & Das
20. *Tabanus (Tabanus) miniatus* Datta & Biswas
21. *Tabanus (Tabanus) minusculus* Datta & Das
22. *Tabanus (Tabanus) monotaeniatus* (Bigot)
23. *Tabanus (Tabanus) namdaphaicus* Datta & Chakraborty
24. *Tabanus (Tabanus) nephodes* Bigot
25. *Tabanus (Tabanus) pullomaculatus* Philip
26. *Tabanus (Tabanus) rubicundus* Macquart
27. *Tabanus (Tabanus) rubidus* Wiedemann
28. *Tabanus (Tabanus) scutellus* Philip
29. *Tabanus (Tabanus) shyamarupi* Datta & Chakraborty
30. *Tabanus (Tabanus) tenuifrons* Datta & Chakraborty
31. *Haematopota annandalei* Ricardo
32. *Haematopota assamensis* Ricardo
33. *Cydistomyia (Cydistomyia) assamensis* Philip
34. *Cydistomyia (Cydistomyia) mouchai* Philip

C. Family ASILIDAE
Subfamily LAPHRIINAE

35. *Laphria alternans* Wiedemann
36. *Maira indiana* Joseph & Parui

Subfamily DASYPOGONINAE

37. *Trigonomima fuscopoda* Joseph & Parui

Subfamily ASILINAE

38. *Cophinopoda chinensis* (Fabricius)
39. *Merodontina robusta* Rao & Parui
40. *Michotamia aurata* (Fabricius)

41. *Astochia hindostani* (Ricardo)
42. *Astochia maculipes* (Walker)
43. *Clephydroneura bengalensis* (Macquart)
44. *Clephydroneura sundaica* (Jaennicke)
45. *Machimus angularis* (Ricardo)
46. *Neomochtherus gnavus* (van der Wulp)
47. *Philodicus femoralis* Ricardo
48. *Promachus leoninus* Loew
49. *Promachus yerburiensis* Ricardo

D. Family EMPIDIDAE
Subfamily TACHYDROMINAE

50. *Drapetis (Elaphropeza) variata* Melandet

E. Family DOLICHOPODIDAE
Subfamily DOLICHOPODINAE

51. *Dolichopus angustinervis* Becker

Key to the families

1. Third antennal segment with rings 2
– Third antennal segment with an elongate style or bristle 3
2. Calypters small or vestigial, discal cells small, as long as wide ..... STRATIOMYIDAE
– Calypters large & distinct, discal cell at least twice as long as wide, biting flies ..... TABANIDAE
3. Top of head distinctly concave & eyes bulging when viewed from front; body elongate, sometimes robust and hairy; face very hairy ..... ASILIDAE
– Top of head not concave; eyes and body variable; face typically not hairy 4
4. R-M cross vein in basal 4th of wing; discal cell & 2nd basal cell united ..... DOLICHOPODIDAE
– R-M cross vein situated beyond basal 4th of wing; discal cell & 2nd basal cell usually separate ..... EMPIDIDAE

Family STRATIOMYIDAE

1. Vein M with only 2 endings ..... PACHYGASTERINAE
– Vein M with 3 endings 2
2. Anterior cross-vein (r-m) joining prefurca to discal cell ..... SARGINAE
– Anterior cross-vein (r-m) joining R to discal cell 4
3. Vein M_4 arises from discal cell; antennal flagellum usually with 6 flagellomeres ..... CLITELLARINAE
– Vein M_4 forming a part of discal cell; antennal flagellum comprising of 8 flagellomeres ..... HERMETIINAE

Subfamily SARGINAE

Key to the genera

1. Antennal segment 2 with a thumb-like expansion over segment 3, latter being short, broad and without annulations ..... ***Ptecticus*** Loew
– Antennal segment 2 without any such expansion 2
2. Abdomen elongate, eyes in ♀ not contiguous; discal veinlets distinct ..... ***Sargus*** Fabricius
– Abdomen short, rounded, eyes in ♂ contiguous, discal veinlets very faint ..... ***Microchrysa*** (Loew)

Genus ***Microchrysa*** Loew

1855. *Microchrysa* Loew, *Verh. zool. bot. Ges. Wien.* **5** : 146.

Type-species : *Musca polita* Linnaeus.

1. ***Microchrysa flaviventris*** (Wiedemann)

1824. *Sargus affinis* Wiedemann, *Analecta Ent.*, : 31.

1920. *Microchrysa flaviventris* (Wiedemann) : Brunetti, *Fauna Brit. India*, Brachycera, **1** : 88.

Diagnosis : Face shining metallic green, bare, proboscis and palpi yellow; thorax brilliantly shining metallic green, dorsum with sparse yellow pubescence, abdomen metallic green; wings colourless.

Distribution : India : Arunachal Pradesh (Lohit), Uttar Pradesh, West Bengal.

Elsewhere : Borneo, Hainan Islands, Jawa, Pakistan, Philippines, Sarawak, Sri Lanka, Sumatera, Thailand; Papua.

Genus ***Ptecticus*** Loew

1855. *Ptectius* Loew *Verh. zool-bot. Ges. Wien.*, **5** : 142.

Type-species : *Sargus testaceus* Fabricius.

2. ***Ptecticus aurifer*** (Walker)

1854. *Sargus aurifer* Walker, *List Dipt. Colln Br. Mus.*, **5** : 96.

Diagnosis : Scutellum and thorax bright orange, pleura covered with yellowish-orange pubescence; abdominal first 4 segments bright orange, covered with golden yellow pubescence, remainder with greyish black pubescence; basal half of wing upto discal cell orange yellow, rest dark brown.

Distribution : India : Arunachal Pradesh (Lower Subansiri), Sikkim, Uttar Pradesh, West Bengal.

Elsewhere : China, East Malaysia, Kalimantan, Malaya, Taiwan.

Genus ***Sargus*** Fabricius

1798. *Sargus* Fabricius, Suppl. *ent. Syst.* : 549, 566.

Type-species : *Musca cupraria* Linneaus.

3. ***Sargus metallinus*** Fabricius

1805. *Sargus metallinus* Fabricius, *Syst. Antliat.* : 258.

Diagnosis : Frons in ♂ extremely narrow, the upper part varying from bronze to bright metallic green, the lower part brownish yellow to brownish, in ♀ frons at its middle distinctly wide, varying from brilliant metallic violet blue to bright green, dorsum and scutellum brilliantly shining metallic green with dense yellow (♂) or whitish (♀) pubescence; legs pale yellow; wings pale yellowish grey or pale brownish; abdomen metallic shining yellowish bronze or cupreous in ♂, violet or blue in ♀

Distribution : India : Andaman Islands, Arunachal Pradesh (Changlang), Bihar, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Meghalaya, Orissa, Uttar Pradesh, West Bengal.

Elsewhere : China, Indonesia, Malaysia, Myanmar, Nepal, Sri Lanka.

Remarks : This species is reported by Joseph & Parui (1977) as *Sargus mactans* Walker.

Subfamily CLITELLARIINAE

Genus ***Nigritomyia*** Bigot

1877. *Nigritomyia* Bigot, *Annls. Soc. ent. Fr.*, (5) 7 (Bull) : lxxiv.

Type-species : *Ephippium maculipenne* Bigot.

4. ***Nigritomyia maculipennis*** (Macquart)

1850. *Ephippium maculipenne* Macquart, *Mem Soc Sci Agric. Lille.* **1849** : 358 (54).

Diagnosis : Palpi brownish, whitish mark above each antenna absent; facial region above the antennal base with two small patches of white hairs; clubs of halteres snow-white.

Distribution : India : Arunachal Pradesh (Lower Subansiri), Tamil Nadu.

Elsewhere : Borneo, Philippines, Sri Lanka, Sumatera.

Remarks : This species is reported by Joseph & Parui (1972) as *Negritomyia maculipennis* (Macquart).

Subfamily HERMETIINAE

Key to the genera

1. Scutellum bears 2 spines; flagellomere 1 filiform ..... ***Campeprosopa*** Macquart

– Scutellum without spines; flagellomere 1 cylindrical ..... ***Eudmeta*** Wiedemann

Genus ***Campeprosopa*** (Macquart)

1850. *Campeprosopa* Macquart, *Mem Soc Sci Agric Lille.* **1849** : 350 (46).

Type-species : *Campeprosopa flavipes* Macquart

5. ***Campeprosopa longispina*** (Brunetti)

1913. *Ampsalis longispina* Brunetti, *Rec. Indian Mus.* **9** 264.

Diagnosis : Antennal scape and pedicel sub equal, flagellum with 8 flagellomeres; leg yellow, except hind tibia wholly, and hind metatarsus two-thirds black; wing yellowish, apical third and hind margin brownish, vein M with 4 terminations.

Distribution : India : Arunachal Pradesh (Lohit), Meghalaya, West Bengal.

Elsewhere : None.

Remarks : This species is reported by Joseph & Roy (1976) as *Ampsalis longispinus* Brunetti.

Genus ***Eudmeta*** (Wiedemann)

1830. *Eudmeta* Wiedemann, *Aussereurop. zweifl. Insekt.*, **2** : 43.

Type-species : *Hermetia marginata* Fabricius.

6. ***Eudmeta marginata*** (Fabricius)

1805. *Hermetia marginata* Fabricius, *Syst. Antliat* : 63.

Diagnosis : Pleura apple green in colour, tips of scutellum green, two narrow tubercles extend from the anterior extremities of scutellum towards the mesonotum.

Distribution : India : Arunachal Pradesh (West Kameng), West Bengal.

Elsewhere : Borneo, Jawa, Myanmar, Malay, Sumatera.

Subfamily PACHYGASTERINAE

Key to the genera

1. Antenna branched, ending in a spray like form ..... ***Ptilocera*** Wiedemann

– Antenna unbranched and of different forms 2

2. Eyes pubescent ..... ***Cibotogaster*** Enderlein

– Eyes bare 3

3. Scutellum 4 spined; antennal segment 3 with long densely pubescent stlye .... ***Rosapha*** Walker

– Scutellum unspined; antennal segment 3 conspicuously long, filiform .... ***Stratiosphecomyia*** Brunetti

Genus ***Cibotogaster*** Enderlein

1914. *Cibotogaster* Enderlein, *Zool. Anz.*, **43** : 305.

Type-species : *Acanthina azurea* Gerstaecker.

7. ***Cibotogaster azurea*** (Gerstaeker)

1857. *Acanthina azurea* Gerstaecker, *Linnaea. ent.*, **11** : 335.

Material examined : 1♂, Tamen, Subansiri dist., 19.v.1966. coll. A. N. T Joseph.

Diagnosis : Antennal scape and pedicel orange, flagellum blackish with 4 flagellomeres and 2 segmented style; thorax and abdomen dark shining blue; leg more or less wholly black; wing dark brown except pale costal cell, discal cell, base of posterior cell 4, anal and axillary cell.

Distribution : India : Arunachal Pradesh (Lower Subansiri), Assam, Karnataka, Meghalaya, Nagaland, Tamil Nadu.

Elsewhere : Andalas, Philippines, Sri Lanka, Sumatera.

Genus ***Ptilocera*** Wiedemann

1820. *Ptilocera* Wiedemann, *Nova Dipt. Gen.* : 7.

Type-species : *Stratiomys quadridentata* Fabricius.

8. ***Ptilocera fastuosa*** Gerstaeker

1857. *Ptilocera fastuosa* Gerstaecker, *Linnaea. ent.*, **11** : 332.

Diagnosis : Antennal scape and pedicel shining black, terminal style yellowish-white, sponge-like; thorax black; leg shining black; base of wing, major portion of anal and axillary cell and alula clear, rest dark brown; abdomen shining blue or violet.

Distribution : India : Arunachal Pradesh (West Kameng, Lower Subansiri), Karnataka, Kerala, Meghalaya, Nicobar Island, Tripura, West Bengal.

Elsewhere : Jawa, Malaysia, Myanmar, Philippines, Sri Lanka, Sulawesi, Thailand.

Genus ***Rosapha*** Walker

1860. *Rosapha* Walker, *J. Linn. Soc. Lon.*, **4** : 100.

Type-species : *Rosapha habilis* Walker.

9. ***Rosapha bicolor*** (Bigot)

1879. *Calcochaetis bicolor* Bigot, *Annls Soc. ent. Fr.*, (5)9 : 189.

Diagnosis : Scutellum unmarked; hind tarsi with first joints white, femora pale yellow to the tips.

Distribution : India : Arunachal Pradesh (Lower Subansiri), Assam, Nagaland, Tamil Nadu.

Elsewhere : Philippines.

Genus ***Stratiosphecomyia*** Brunetti

1913. *Stratiosphecomyia* Brunetti, *Rec. Indian Mus.* **9** : 261.

Type Species : *Stratiosphecomyia variegata* Brunetti.

10. ***Stratiosphecomyia variegata*** Brunetti

1913. *Stratiosphecomyia variegata* Brunetti, *Rec. Indian Mus.* **9** : 262

Diagnosis : Antennal scape twice as long as pedicel, flagellum with 4 flagellomeres; thorax black with some lemon yellow marks; fore femur yellowish, hind one brownish yellow; wing pale grey basally, darker apically.

Distribution : India : Arunachal Pradesh (Changlang), Meghalaya, Sikkim, West Bengal.

Elsewhere : None.

Remarks : This is the only known species under the genus from the Oriental region.

Family TABANIDAE

Key to the Subfamilies

1. Hind tibiae with no spurs, ocelli usually absent ..... TABANINAE

– Hind tibiae with spurs, ocelli usually present 2

2. Third joint of antennae with eight or at least seven divisions; proboscis usually prolonged ..... PANGONIINAE

– Third joint of antennae with five divisions; proboscis short, wings ornamented with dark median crossband ..... CHRYSOPSINAE

Subfamily PANGONIINAE

Genus ***Philoliche*** Wiedemann

1828. *Philoliche* Wiedemann, *Aussereurop. zweifl Insekt.* **1** : 95.

Type-species : *Tabanus rostratus* Linnaeus.

11. ***Philoliche varipes*** (Ricardo)

1911. *Corizoneura longirostris* Fabricius, subsp. *varipes* Ricardo, *Rec. Indian Mus.* **4** : 367

1975. *Philoliche varipes* (Ricardo) : Delfinado and Hardy, *A catalog of Diptera of the Oriental region*, **2** : 44.

Diagnosis : The males with no prolongation on the first two joints of fore tarsi and the females with these joints not at all prolonged, appear cup-like the first two joints being reddish grey with black hairs, by the shining reddish brown face, no grey or yellow tomentum covering it, & by the abdomen being usually more largely reddish yellow, the first three segments wholly so, with only median blackish spots, the remaining segments blackish with reddish segmentation covered with short yellow hairs.

Distribution : Arunachal Pradesh (East Siang), Assam, Kerala, Sikkim, West Bengal.

Elsewhere : Nepal.

Subfamily CHRYSOPSINAE

Genus ***Chrysops*** Meigen

1803. *Chrysops* Meigen, *Magazin Insektkde.* **2** : 267

Type Species : *Tabanus caecutiens* Linnaeus.

Diagnosis : Small, slender & greatly patterned flies with colourful eyes in life; slender antenna much longer than width of head; face highly developed, wing with cross-bands.

Key to the species

1. Abdomen with a short black bifid stripe on the 2nd segment, often extending to the 3rd or 4th segment ..... *dispar* (Fab.)

– Abdomen with a bifid stripe on the 2nd segment and a net work of black markings on the 3rd segment, leaving only three yellow spots free ..... *designatus* Ricardo

12. ***Chrysops designatus*** Ricardo

1911. *Chrysops designata* Ricardo, *Rec. Indian Mus.* **4** : 383.

Distribution : India : Arunachal Pradesh (West Kameng, Lower Subansiri, East & West Siang), J & K. Uttar Pradesh.

Elsewhere : China, Nepal.

13. ***Chrysops dispar*** (Fabricius)

1798. *Tabanus dispar* Fabricius, *Ent. Syst. Suppl.*, : 567.

Material examined : 2♂♂, 3♀♀, Old Zero Kurungkumey dist, 30.v.2000, coll. B. Mitra, 3♂♂, 4♀♀ Parasuram Kunda, Lohit dist., 17.ii.2003, coll. R. S. Mridha.

Distribution : India : Arunachal Pradesh (Lower Subansiri, Kurungkumey, Lohit), West Bengal.

Elsewhere : Borneo, China, Hainan, Laos, Malaya, Myanmar, Nepal, Philippines, Sri Lanka, Sumatera, Taiwan, Thailand, Vietnam.

Subfamily TABANINAE

Key to the genera

1. Eyes bare 2

– Eyes hairy ..... ***Hybomitra*** Enderlein

2. Wings with pale spots, wavy lines or punctuate ..... ***Haematopota*** Meigen

– Wings hyaline 3

3. Antennal style 6-annulate ..... ***Cydistomyia*** Taylor

– Antennal style 4-annulate ..... ***Tabanus*** Linnaeus

Genus ***Hybomitra*** Enderlein

1922. *Hybomitra* Enderlein, *Mitt. Zool Mus. Berl.* **10** : 347.

Type-species : *Hybomitra solox* Enderlein.

14. ***Hybomitra hirta*** (Walker)

1850. *Tabanus hirta* Walker, *Insecta Saundersiana* **1** : 52.

Diagnosis : Hairy eyes, robust species with black abdomen, largely reddish yellow at the sides; fore head almost parallel with the frontal callus, broad continued as a thick spindle shaped line towards the vertex, legs blackish.

Distribution : India : Arunachal Pradesh (Tawang), Uttar Pradesh.

Elsewhere : None.

Remarks : Reported earlier as *Tabanus (Therioplectes) hirtus* Walker by Joseph & Rao (1972).

Genus ***Tabanus*** Linnaeus

1758. *Tabanus* Linnaeus, *Syst. Nat.*, **10** : 601.

Type-species : *Tabanus bovinus* Linnaeus.

Subgenus ***Tabanus*** Linnaeus

Diagnosis : Head hemispherical; vertex smoothly flat or slightly concave; postocular rim present; banding on eyes often present; frons usually much narrow; antennal scape nearly as long as wide, hairy.

Key to the species

1. Frons broad, with two callosities the first one usually transverse, the second one smaller, irregular shaped, separated from each other, smaller in size (9-14mm) ..... *namdaphaicus* Datta & Chakraborty

– Frons with one square, or narrow or oblong callus, always prolonged towards the vertex as more or less narrow line 2

2. Abdomen unicolorus or nearly so, sometimes darker at apex, but with no spots or bands.. 6

– Abdomen with lateral spots & stripes 3

3. Species with lateral spots & bands in abdomen 4

– Species with continuous stripes on abdomen dorsally or ventrally 12

4. Large species; wings distinctly marked with brown or yellow colouring 5

– Medium to small species; wings clear sometimes pale colour 9

5. First posterior cell of wings closed or very narrow ..... *nephodes* Bigot

– First posterior cell of wings open, not very narrow ..... *auriflama* Walker

6. Antennae entriely red brown/red 7

– Scape & pedicel red brown with black hairs ..... *miniatus* Datta & Biswas

7. Thorax black, unstriped 8

– Thorax black with 3 inconspicuous stripe .... *tenuifrons* Datta & Chakraborty

8. Wings with spur-vein ..... *scutellus* Philip

– Spur-vein usually longer than stem, abdominal venter with a long broad, black median stripe extended upto tip .... *minusculus* Datta & Das

9. Medium sized dull black species .... *shyamarupi* Datta & Chakraborty

– Red brown to dark red species 10

10. Antennae uniformly red, sometimes darker apically, tooth not so much extended 11

– Scape & pedicel red, flagellum black, distinct tooth, presumably not spine like .... *fuscomaculatus* Ricardo

11. Thorax indistinctly striped, red-yellow species ..... *rubicundus* Macquart

– Thorax unstriped, red brown species .... *pullomaculatus* Philip

12. Thorax striped 13

– Thorax unstriped .... *kamengensis* Datta & Das

13. Species black with two very distinet lateral grey stripe on thorax ..... *jucundus* wallker

– Red brown species with 3-4 indistinct lateral stripes on thorax 14

14. Abdomen with spots 15

– Abdomen without spots .... *dominus* Datta & Das

15. Abdomen with a median & two lateral tomentose and/or haired equilateral stripes or truncated confluent median triangles and/or lateral spots ..... ***rubidus*** Wiedemann

– Abdomen with a median tomentose and/or haired equilateral stripes or a series of triangles but without any lateral stripes, triangles or spots (excepting occasional dark patches laterally) ..... *monotaeniatus* (Bigot)

15. ***Tabanus (Tabanus) auriflama*** Walker

1848. *Tabanus auriflama* Walker. *List Dipt Colln Br Mus* 1 : 155.

Material examined : 3♂ 2♀, Daporizo guest house, Upper Subansiri dist. 3.vi.2000, coll : B. Mitra.

Distribution : India : Assam, Arunachal Pradesh (Lower & Upper Subansiri), Nagaland.

Elsewhere : Bangladesh.

16. ***Tabanus (Tabanus) dominus*** Datta & Das

1978. *Tabanus dominus* Datta & Das. *Bull zool Surv India.* 1(2) : 181-185.

Distribution : India : Arunachal Pradesh (West Kameng).

Elsewhere : None.

17. ***Tabanus fuscomaculatus*** Ricardo

1911. *Tabanus fuscomaculatus* Ricardo. *Rec. Indian Mus* 4 : 183.

Distribution : India : Arunachal Pradesh (East Siang), Sikkim.

Elsewhere : Myanmar, Sulawesi.

18. ***Tabanus (Tabanus) jucundus*** Walker

1848. *Tabanus jucundus* Walker, *List Dipt. Colln. Br. Mus.*, **1** : 187.

Distribution : India : Arunachal Pradesh (Lohit), Punjab, Uttar Pradesh.

Elsewhere : China, Hongkong, Philippines, Sri Lanka.

19. ***Tabanus (Tabanus) kamengensis*** Datta & Das

1978. *Tabanus dominus* Datta & Das, *Bull. Zool. Surv. India.* **1**(2) 181-185.

Distribution : India : Arunachal Pradesh (East & West Kameng).

Elsewhere : None.

20. ***Tabanus (Tabanus) miniatus*** Datta & Biswas

1977. *Tabanus miniatus* Datta and Biswas, *Proc. Indian Acad. Sci. (B)*, **86** : 130.

Distribution : India : Arunachal Pradesh (Tirap), Meghalaya.

Elsewhere : None.

21. ***Tabanus (Tabanus) minusculus*** Datta & Das

1978. *Tabanus minusculus* Datta & Das, *Bull. Zool. Surv. India.* **1**(2) : 181-185.

Distribution : India : Arunachal Pradesh (East & West Kameng).

Elsewhere : None.

22. ***Tabanus (Tabanus) monotaeniatus*** (Bigot)

1892. *Atylotus monotaeniatus* Bigot, *Mem. Soc. Zool. France*, **5** : 655.

Distribution : India : Assam, Arunachal Pradesh (West Kameng, Lower Subansiri, Tirap), Meghalaya.

Elsewhere : China, Jawa, Myanmar.

23. ***Tabanus (Tabanus) namdaphaicus*** Datta and Chakraborty

1985. *Tabanus (Tabanus) namdaphaicus* Datta and Chakraborty *Rec. zool. Surv. India*, **82** : 233.

Distribution : India : Arunachal Pradesh (Tirap).

Elsewhere : None.

24. ***Tabanus (Tabanus) nephodes*** Bigot

1892. *Tabanus nephodes* Bigot, *Mem. Soc. Zool. France*, **5** : 656.

Material examined : 1♂, 1♀, Bhismarknagar, Lower Dibang valley dist. 21.ii.03, coll. R. S. Mridha.

Distribution : India : Arunachal Pradesh (West Kameng & Lower Dibang Valley), Assam, Nagaland.

Elsewhere : Laos, Malaya, Thailand.

25. ***Tabanus (Tabanus) pullomaculatus*** Philip

1970. *Tabanus pullomaculatus* Philip, *Indian vet. Res. Inst. Izatnagar*, U. P. : 443-452.

Distribution : India : Arunachal Pradesh.

Elsewhere : None.

26. ***Tabanus (Tabanus) rubicundus*** Macquart

1846. *Tabanus rubicundus* Macquart, *Dipt. exot. Suppl.*, **1** : 33 (160).

Distribution : India : Arunachal Pradesh (Tirap), Assam.

Elsewhere : Bangladesh, Jawa, Myanmar.

27. ***Tabanus (Tabanus) rubidus*** Wiedemann

1821. *Tabanus rubidus* Wiedemann, *Dipt. Exot.*, **69** : 14.

Distribution : India : Arunachal Pradesh (East Siang), Assam, Bihar, Delhi, Haryana, J & K, Kerala, Maharashtra, Meghalaya, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : China, Jawa, Malaya, Myanmar, Nepal, Nias Island, Sri Lanka, Sumatera, Thailand, Vietnam.

28. ***Tabanus (Tabanus) scutellus*** Philip

1970. *Tabanus scutellus* Philip, *H. D. Srivastava Commen. Vol. Ind. Vet. Res. Inst. Izatnagar* : 447.

Distribution : India : Arunachal Pradesh.

Elsewhere : None.

29. *Tabanus (Tabanus) shyamarupi* Datta and Chakraborti

1985. *Tabanus (Tabanus) shyamarupi* Datta and Chakraborty, *Rec. zool. Surv. India*, **82** : 235.

Distribution : India : Arunachal Pradesh (Tirap).

Elsewhere : None.

30. *Tabanus (Tabanus) tenuifrons* Datta and Chakraborti

1985. *Tabanus (Tabanus) tenuifrons* Datta and Chakraborty *Rec. zool. Surv. India*, **82** : 237.

Distribution : India : Arunachal Pradesh (Tirap).

Elsewhere : None.

Genus *Haematopota* Meigen

1803. *Haematopota* Meigen. *Magazin Insenktenkde*, **2** : 67.

Type-species : *Tabanus pluvialis* Linnaeus.

Key to the species

1. Frontal callus with nearly straight margins, centrally with a pair of protuberances .... *annandalei* Ricardo

– Frontal callus with upper margin trilobed and lower margin deeply concave .... *assamensis* Ricardo

31. *Haematopota annandalei* Ricardo

1911. *Haematopota annandalei* Ricardo, *Rec. Indian Mus.*, **4** : 335.

Distribution : India : Arunachal Pradesh (West Kameng, Tirap), Maharashtra, Meghalaya.

Elsewhere : China, Myanmar.

32. *Haematopota assamensis* Ricardo

1911. *Haematopota assamensis* Ricardo, *Rec. Indian Mus.*, **4** : 343.

Distribution : India : Arunachal Pradesh (West Kameng, Lower Subansiri, Lohit), Assam, Meghalaya.

Elsewhere : Thailand, Vietnam.

Genus *Cydistomyia* Taylor

1911. *Cydistomyia* Taylor. *Proc. Linn. Soc. N. S W.* **44** : 47.

Type-species : *Cydistomyia dodds* Taylor

33. *Cydistomyia (Cydistomyia) assamensis* Philip

1970. *Cydistomyia assamensis* Philip. *H. D. Srivastava Commen. Vol. Ind. Vet. Res. Inst. Izatnagar* : 444.

Distribution : India : Arunachal Pradesh (West Kameng).

Elsewhere : None.

34. *Cydistomyia (Cydistomyia) mouchai* Philip

Distribution : India : Arunachal Pradesh.

Elsewhere : None.

Family ASILIDAE

Key to the subfamilies

1. Palpus one-segmented, usually robust species marginal cell closed; third antennal segment long and slender with short bristle bearing microsegment ..... ASILINAE

– Palpus two segmented 2

2. Marginal cell open, third antennal segment spindle shaped with apical micro segment, fourth posterior cell generally open or closed in margin; females generally with circlet of spines on acanthophorites .... DASYPOGONINAE

– Marginal cells closed, third antennal segment rod-like or clavate with apical pit, fourth posterior cell generally closed and stalked .... LAPHRIINAE

Subfamily LAPHRIINAE

Tribe Laphriini

Diagnosis : First flagellomere of antenna club-shaped, blunt with a tiny apical style; and

episternum often with bristle before wing base; marginal cell of wing closed, vein M_3 curved.

Key to genera

1. First flagellum without apical spine; scutum and abdomen metallic coloured ..... ***Maira*** Schiner
- First flagellum with an apical spine; scutum not metallic but abdomen partly so ..... ***Laphria*** Meigen

Genus ***Laphria*** Meigen

1803. *Laphria* Meigen, *Magazin Insektkde,* **2** : 270.

Type-species : *Asilus gibbosus* Linnaeus.

35. ***Laphria alternans*** Wiedemann

1828. *Laphria alternans* Wiedemann, *Aussereurop. zweifl. Insekt.* **1** : 511 (♀).

Material examined : 2♂, Angu village, Along, Lower Subansiri dist. 7.vi.2000, coll. B. Mitra.

Diagnosis : Head with golden yellow-mystax; antennal scape and pedicel yellowish brown; thorax black, scutum with faint mediolongitudinal stripe extends up to transverse suture; scutellum bears sparse golden yellow setae, border with 6 golden yellow bristles; femora yellowish brown with black tips, anterodorsally with a black band; wings yellowish-brown with brown markings at the union of Cu_2 and 2nd anal vein, along posterior cross-vein and the furcation of R_4 and R_5; abdomen yellowish brown and black, male genitalia of similar color with pale yellowish setae.

Distribution : India : Assam, Arunachal Pradesh (Lower Subansiri, East Siang), Kerala, Rajasthan.

Elsewhere : Bangladesh, Myanmar, Jawa, Philippines.

Remarks : Reported earlier as *L. (Pagidolaphria) alternans* Wiedemann by Joseph & Parui (1973).

Genus ***Maira*** Schiner

1866. *Maira* Schiner, *Verh. zool.-bot. Ges. Wien,* **16** : 673.

Type-species : *Laphria spectabilis* Guérin-Menéville.

36. ***Maira indiana*** Joseph & Parui

1998. *Maira indiana* Joseph & Parui, *Bull. Zool. Surv. India.* **8**(1-30) : 90.

Diagnosis : Mystax pale yellow with a few black bristles above; antenna black, first flagellomere about one and half times the combined length of scape and pedicel; scutum shining metallic blue; scutellum black setose, hind border with long black and pale yellow setae; femora shining metallic black, tibiae blackish; wing dark brown, slightly lighter basally; abdomen shining metallic blue, male genitalia black and yellowish brown.

Distribution : India : Arunachal Pradesh.

Elsewhere : None.

Subfamily DASYPOGONINAE

Tribe **Damalini**

Genus ***Trigonomima*** Enderlein

1914. *Trigonomima* Enderlein, *Wien. Ent. Ztd.,* **33** : 164.

Type-species : *Trigonomima apipes* Enderlein.

Diagnosis : Head height more than its width; eyes flattened at anterior half, first flagellomere a little more than twice the combined length of scape and pedicel; thorax extremely humpbacked, humeri with long hairs and bristles, pleural region long haired, anterior and middle femora with short hairs, hind femur dorsally on basal half with dense fringe of stiff hairs, hind tibia comparatively thickened with dorsal surface arched bearing a fringe of long bristly hairs; marginal cell open, posterior cell 4 in number, widely open or closed at margin; abdomen broad, widest at second segment, male genitalia short, more prominent ventrally with long and short lateral process.

37. ***Trigonomima fuscopoda*** Joseph & Parui

1981. *Trigonomima fuscopoda* Joseph & Parui, *Bull. Zool. Surv. India.* **4**(2) : 203.

Diagnosis : Mystax golden yellow; antenna black, first flagellomere about twice the combined length of scape and pedicel; mesonotum black

with humeri bright orange marked, posterolateral sides yellowish brown; scutellum with a transverse row of three median bristles on disc; legs dark brown with concolorous and pale hairs, pale hairs usually confined ventrally, wing blackish, lighter distally with 4 posterior cells; abdomen dark brown and black, male genitalia lighter.

Distribution : India : Arunachal Pradesh (West Kameng, Lower Subansiri).

Elsewhere : None.

Subfamily ASILINAE

Key to the tribes

1. Antennal style plumose ..... **Ommatini**
- Antennal style bare ..... **Asilini**

Tribe **Ommatini**

Key to the genera

1. First flagellomere at least four times the combined length of scape and pedicel, style shorter than first flagellomere .... ***Michotamia*** Macquart.
- First flagellomere short, frons slightly longer to shorter than the combined length of scape and pedicel, style long 2
2. Hind femur with a tooth-like projecton at base, brush of setae absent near base of haltere.. ..... ***Merodontina*** Enderlein
- Hind femoral tooth absent; a brush of setae present immediately above base of haltere... ..... ***Cophinopoda*** Hull

Genus ***Cophinopoda*** Hull

1958. *Cophinopoda* Hull, *Proc. Ent. Soc.* Washington, **60** : 251.

Type-species : *Asilus chinensis* Fabricius.

38. ***Cophinopoda chinensis*** (Fabricius)

1974. *Asilus chinensis* Fabricius, *Ent. Syst;* **4** : 383.

Material examined : 1 ♂, Hissar colony, Along, West Siang dist, 11.vi.2000. coll. B. Mitra.

Diagnosis : Mystax yellow, a tuft of yellow setae on fronto-orbital plate along eye margin and an other tuft on either side of antenna; legs black except yellow tibiae; epandrium convex with a long curved ventral process.

Distribution : India : Arunachal Pradesh (W. Siang), Andhra Pradesh, Assam, Bihar, Kerala, Meghalaya, Orissa, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : China, Jawa, Sri Lanka, Sumatera, Japan, Korea.

Remarks : This is the first record of the species from Arunachal Pradesh.

Genus ***Merodontina*** Enderlein

1914. *Merodontina* Enderlein, *Zool. Anz.*, **44** : 262

Type-species : *Merodontina sikkimensis* Enderlein.

39. ***Merodontina robusta*** Rao & Parui

1969. *Merodontina robusta* Ram Chandra Rao & Parui, *Zool. Anz.* **182** : 110.

Diagnosis : Mystax pale yellow; first flagellomere longer than the combined length of scape and pedicel; scutum black with a mediolongitudinal black stripe extends the entire length; scutellum with 4 black bristles on border, disc with sparse black setae; fore and mid femur dorsally anteriorly and apically dark brown, rest black, hind femur black, tibiae yellowish brown, hind tibia with black apex; wing basally hyaline, grayish brown distally; abdomen black, terga 1-3 with narrow yellowish brown border.

Distribution : India : Arunachal Pradesh (Lower Subansiri).

Elsewhere : None.

Genus ***Michotamia*** Macquart

1838. *Michotamia* Macquart, *Dipt. Exot;* **1**(2) : 72

Type-species : *Michotamia analis* Macquart.

40. ***Michotamia aurata*** (Fabricius)

1794. *Asilus aurata* Fabricius, *Ent. Syst;* **4** : 387.

Material examined : 1♂1♀, Hissar colony, Along, West Siang dist, 11.vi.2000. coll. B. Mitra.

Diagnosis : Mystax pale yellow; antennal scape and pedicel orange yellow. First flagellomere black; thorax black with dense grayish-yellow and grey tomentum; scutum with a mediolongitudinal black stripe; legs yellowish brown and pale yellow; basal half of wing pale yellow, rest infuscated; tergites 1-4 and 7 yellowish brown, remaining tergites black; male genitalia dark brown and yellowish brown.

Distribution : India : Arunachal Pradesh (Lower Subansiri), Andhra Pradesh, Bihar, Karnataka, Kerala, Madhya Pradesh, Orissa, Pondicherry, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Myanmar, Pakistan, Sulawesi, Taiwan.

Tribe **Asilini**

Key to the genera

1. Submarginal cells 3 2
- Submarginal cells 2 3
2. Radial fork longer than second posterior cells, apex of marginal cell bulbous; antennae closed together; in female tenth segment with numerous short spines, the apical pair longer, stout ..... ***Philodicus*** Loew
- Radial shorter than second posterior cell, apex of marginal cell not bulbous; antennae wide apart; in female tenth segment without spine ..... ***Promachus*** Loew
3. Fourth posterior cell bulged forward causing discal cell constricted; first longitudinal vein almost fused with costa ..... ***Clephydroneura*** Becker
- Fourth posterior cell not bulged 4
4. Basitarsus of fore leg highly thickened; male genitalia pedunculate; female ovipositor of 5-elongate, slender segments ..... ***Astochia*** Becker
- Basitarsus of fore leg of normal thickness; male and female genitalia of different pattern 5
5. Facial tubercle highly developed with numerous bristles on it ..... ***Machimus*** Loew
- Facial tubercle ill developed with a few bristles on it ..... ***Neomochtherus*** Osten Sacken

Genus ***Astochia*** Becker

1913. *Astochia* Becker, *Ann. Mus. Zool. Acad.* St. Pet. **17** : 538.

Type-species : *Astochia metatarsata* Becker.

Key to the species

1. Femora wholly black; reddish yellow, tuft of hairs continued upto terga 4 ..... ***hindostani*** (Ricardo)
- Femora red, base and apex black; abdominal tergum 1 with reddish yellow tuft of hairs ..... ***maculipes*** (Walker)

41. ***Astochia hindostani*** (Ricardo)

1919. *Neoitamus hindostani* Ricardo, *Ann. Mag. Nat. Hist.* (9)**3** : 62.

Distribution : India : Arunachal Pradesh (West Kameng), Uttar Pradesh, West Bengal.

Elsewhere : Myanmar, Nepal.

42. ***Astochia maculipes*** (Walker)

1855. *Trupania maculipes* Walker, *List. Dipt. Colln. Br. Mus.* 7 suppl. **3** : 605.

Distribution : India : Arunachal Pradesh (East Siang), Assam, West Bengal.

Elsewhere : China, Hainan Islands.

Remarks : Reported earlier as *Astochia maculipes* (Walker), by Joseph & Parui (1973).

Genus ***Clephydroneura*** Becker

1925. *Clephydroneura* Becker, *Ent. Mitt.* **14** : 68.

Type-species : *Asilus xanthopus* Wiedemann, design. by Oldroyd, 1938.

Key to the species

1. Thorax yellow with 2 well separated black

stripes which spread out behind humeri laterally; male hypopygium linear with apex truncate type at dorsal view ..... *sundaica* (Jaennicke)

– Thorax black in ground colour without this type of stripe; male hypopygium bulbous on dorsal view ..... *bengalensis* Macquart

43. *Clephydroneura bengalensis* Macquart

1839. *Asilus bengalensis* Macquart, *Mem. Soc. R. Sci. Lille*, **1838**(3) : 237.

Distribution : India : Arunachal Pradesh (Lower & Upper Subansiri) Tamil Nadu, West Bengal.

Elsewhere : Philippines, Sumatera.

44. *Clephydroneura sundaica* (Jaennicke)

1867. *Asilus sundaica* Jaennicke, *Abh. Senckenb. Netsurf. Ges. Wien* **6** : 363.

Material examined : 1♂, 1♀, Ganga Lake area, Papumpare dist. 28.v.2000. coll. B. Mitra.

Distribution : India : Arunachal Pradesh (Papumpare, Changlang).

Elsewhere : Jawa, Malaya, Thailand.

Remarks : This species is still confined to Arunachal Pradesh in India.

Genus *Machimus* Loew

1849. *Machimus* Loew, *Linn. Ent.*, **4** : 94.

Type-species : *Asilus chrystis* Meigen.

45. *Machimus angularis* (Ricardo)

1922. *Tolmerus angularis* Ricardo, *Ann. Mag. Nat. Hist.* (9)**10** : 614

Diagnosis : Face bronze green; mystax reddish yellow; antennae black; thorax bronze green with 2 indistinct lateral stripes; scutellum with fine long black hairs and a few reddish yellow ones intermixed on disc; border bare of bristles; legs black; wings with grey shading leaving the centre clear; abdomen blackish with long reddish yellow hairs on sides and below, anal genitalia covered with blackish hairs dorsally and reddish yellow ventrally.

Distribution : India : Arunachal Pradesh (West Kameng), Himachal Pradesh, Uttar Pradesh, West Bengal.

Elsewhere : China.

Genus *Neomochtherus* Osten Sacken

1878. *Neomochtherus* Osten Sacken, *Smithson. misc Colln* **16** : 82, 235. (n. name for Mochtherus Loew).

46. *Neomochtherus gnavus* (Van der Wulp)

1872. *Mochtherus gnavas* Van der wulp, *Tijdschr. Ent* **15** 243.

Diagnosis : Mystax yellow; antennae yellowish brown; thorax black, grey tomentose, humeri with pale pile; scutellum black; legs yellowish hind femora and tibiae with a black area at apex; wing infuscated at apex which extends up to fifth posterior cell; abdomen black with lateral pale yellow pile and bristles; male genitalia black, epandrium bifurcated with upper arm small and truncate at apex.

Distribution : India : Arunachal Pradesh (East Siang), Assam, Meghalaya, Sikkim, Tripura, Uttar Pradesh.

Elsewhere : Borneo, Jawa, Sri Lanka, Sulawesi, Thailand.

Remarks : Reported earlier as *Helimmoneura gnava* (Wulp) by Joseph & Parui (1973).

Genus *Philodicus* Loew

1848. *Philodicus* Loew, *Linn. Ent.* **3** : 391.

Type-species : *Asilus javanus* Wiedemann.

47. *Philodicus femoralis* Ricardo

1921. *Philodicus femoralis* Ricardo, *Ann. Mag. Nat. Hist* (9)**8** : 190.

Material examined : 2♂, Ganga Lake area, Papumpare dist. 28.v.2000. coll. B. Mitra.

Diagnosis : Mystax white with a few black bristles near oral opening; thorax dark brown, mesonotum with a mediolongitudinal dark brown stripe; scutellum with the disc bearing sparse black

hairs, hind border with two black bristles; legs dark brown with femora comparatively lighter coloured, fore femora bare, mid and hind femora with two rows of bristles; wings medially hyaline, rest brownish; abdomen dark brown with hind border of tergites grey; male genitalia black with a few pale yellow bristles; in female ninth tergite with a circlet of spines on border and numerous short spines on dorsally.

Distribution : India : Arunachal Pradesh (East Siang, Papumpare, Changlang), Assam, Bihar, Himachal Pradesh, Karnataka, Meghalaya, Orissa, Rajasthan, Uttar Pradesh, West Bengal.

Elsewhere : Myanmar.

Genus ***Promachus*** Loew

1848. *Promachus* Loew, *Linn. Ent;* **3** : 390.

Type-species : *Asilus maculates* Fabricius.

Key to the species

1. Male genitalia with a tuft of white hair; abdomen with long orange red pubescence .. .. *leoninus* Loew

– Male genitalia with two tufts of black hairs, abdomen with dense short pubescence of black and yellowish grey colour .... *yerburiensis* Ricardo

48. ***Promachus leoninus*** Loew

1838. *Promachus leoninus* Loew, *Linn. Ent;* **3** : 404.

Distribution : India : Arunachal Pradesh (West Kameng), Tamil Nadu.

Elsewhere : Jawa, Philippines.

49. ***Promachus yerburiensis*** Ricardo

1920. *Promachus yerburiensis* Ricardo, *Ann Mag. nat. Hist.* (9)**5** : 220.

Material examined : 1♂, 1♀, Sera basti, Bomdila, West Kameng, 3.x.2001, coll. B. Mitra.

Distribution : India : Arunachal Pradesh (West Kameng).

Elsewhere : Sri Lanka.

Family EMPIDIDAE
Subfamily TACHYDROMINAE

Genus ***Drapetis*** Meigen

1822. *Drapetis* Meigen, *Syst. Beschr. Europ. Zweifl. Insekt.*, **3** : 91.

Type-species : *Drapetis exilis* Meigen.

Diagnosis : Eyes microscopically pubescent, dichoptic in both sexes; third antennal segment pointed with long apical arista posessing a microscopic basal joint; thorax square-shaped with round corner bearing fine pubescence and some bristles; scutellum with 2 bristles; fore and hind femora thickened, hind tibia ends in a projecting teeth; auxiliary vein inconspicuous, short, ending free, discal cell absent; abdomen short and robust.

Subgenus ***Elaphropeza*** Macquart

1827. *Elaphropeza* Macquart, *Ins. Dipt. N. Fr.*, **3** : 86.

Type-species : *Tachydromia ephippiata* Fallén.

Diagnosis : Eyes microscopically pubescent, facets uniform, frons narrow or contiguous in both sexes, third antennal segment elongate, conical with apical arista bearing microscopic basal joint; thorax subquadrangular with rounded corners; wing short rounded with well developed anal angle, discal cell absent; legs slender, fore tibia with short spur, abdomen with last two segments hidden under male genitalia.

50. ***Drapetis (Elaphropeza) variata*** Melander

1913. *Elaphropeza variegata* Brunetti, *Rec. Indian. Mus.*, **9** : 42.

Diagnosis : Occiput and frons shining black; anterior half of thorax shining brown with three faint stripes, posterior half blackish, scutellum yellowish with blackish dorsum bearing two long curved apical bristles; legs wholly bright yellow except brown coxae; wing pale yellow, iridescent; abdomen basal third yellowish, middle third blackish and apical third yellowish or brownish.

Distribution : India : Arunachal Pradesh (Kameng) Assam, Bihar, Orissa, W. Bengal.

Elsewhere : Myanmar.

Remarks : This species has been reported earlier as *Elaphropeza variegata* Brunetti by Joseph & Rao (1972).

Family DOLICHOPODIDAE

Genus ***Dolichopus*** Latreille

1976. *Dolichopus* Latreille, *Precis Caract. Gen. Ins.* : 159.

Type-species : *Musca ungulata* Linnaeus.

51. ***Dolichopus angustinervis*** Becker

1922. *Dolichopus angustinervis* Becker, *Capita zool.*, 1(4) : 9.

Diagnosis : Thorax bronze-green, humeral bristles scanty; eyes black; frons grey, face grayish white; antennae reddish yellow, third segment completely black; abdomen metallic green; fore femora yellow, middle and hind femora at tip blackish brown, apex of hind tibia and metatarsum black, hind metatarsus with 2 bristles, middle tibia with 3 and hind tibia with 5 bristles; wing grayish brown.

Distribution : India : Arunachal Pradesh (Tirap) Meghalaya, West Bengal.

Elsewhere : Taiwan.

SUMMARY

It may be concluded that Arunachal Pradesh has so far known to harbour 51 species under the families Stratiomyidae, Tabanidae, Asilidae, Empididae and Dolichopodidae of the suborder Brachycera. Among the 51 species so far reported from Arunachal Pradesh, *Chrysops designatus* Ricardo of the family Tabanidae is very common throughout (5 districts) the state, and the following species like, *Tabanus (Tabanus) rubicundus* Macquart (13 states), *Cophinopoda chinensis* (Fabricius) (11 states), *Michotamia aurata* (Fabricius) & *Sargus metallinus* Fabricius (10 states), *Philodicus femoralis* Ricardo (9 states) are distributed in maximum number of states of India. However, among the 51 species of brachycerans, 13 species (marked with**) are confined to Arunachal Pradesh, 4 species (marked with*) to India, 33 species extend their range upto the boundary of Oriental region and a only a lone species, *Cophinopoda chinensis* (Fabricius) extends its range to Japan and Korea beyond the Oriental region. (Table : 1. 2. 3).

ACKNOWLEDGEMENTS

We express our thanks to Dr. J.R.B. Alfred, Director and Dr. A.K. Hazra, Joint Director, Zoological Survey of India, Kolkata for placing the materials at our disposal for study and their constant encouragement.

REFERENCES

BRUNETTI, E., 1920. The Fauna of British India, including Ceylon & Burma, Diptera, Brachycera, 2. ix. 401 pp. Taylor and Francis, London.

CUMMING, J. M., B. J. SINCLAIR, and D. M. Wood., 1995. Homology and phylogenetic implications of male genitalia in Diptera-Eremoneura. Entomologica Scandinavica **26** : 120-151.

DATTA, M & CHAKRABORTY, M. 1985. Insecta : Diptera, *Rec. zool. Surv. India*, **82**(1-4) : 231-252.

DATTA, M. PARUI, P and MUKHERJEE, M. 1997. Insecta : Diptera. 1-76. *In : Fauna of West Bengal, State Fauna Ser.*, 3(7). Zoological Survey of India, Kolkata.

DATTA, M & PARUI, P. 2000. Insecta : Diptera *In* : *Fauna of Tripura, State Fauna Ser.* 7(Part-3) : 165-200. Zoological Survey of India, Kolkata.

DATTA, M & DAS, B. N. 1978. Three new species of the genus Tabanus (Diptera : Tabanidae) from Arunachal Pradesh, India. *Bull. zool. Surv. India.* 1(2) : 81-185.

DELFINADO, M. D. and HARDY, D. E. (1973). (eds.). *A catalog of Diptera of the Oriental Region.* **2** : 1-Univ. of Hawaii Press, Honolulu.

GHOSH, A. K. 1985. Namdapha Biosphere Reserve-overview. *Rec. zool Surv. India,* **82** (1-4) : 1-8.

GRIFFITHS, G. C. D. 1994. Relationships among the major subgroups of Brachycera (Diptera) : A critical review. *The Canadian Entomologist,* **126** : 861-880.

GRIFFITHS, G. C. D. 1996. Review of papers on the male genitalia of Diptera by D. M. Wood and associates. *Studia Dipterologica,* **3** : 107-123.

JOSEPH, A. N. T. and RAO, K. R. 1972b. Diptera from NEFA and Assam foot hills. Kameng frontier division, Subansiri frontier division, North Lakhimpur and Assam foot hills. *Rec. zool. Surv. India* **66** (1-4) : 130-138.

JOSEPH, A. N. T. and PARUI, P. 1973. Diptera from NEFA and Assam foot hills. Part III. Siang frontier division, and North Lakhimpur. *Rec. zool. Surv. India,* **67** : 325-342.

MICHELSEN, V. 1996. NEODIPTERA : New insights into the adult morphology and higher level phylogeny of Diptera (Insecta). Zoological Journal of the Linnean Society, **117** : 71-102.

MCALPINE, J. F and D. M. Wood (eds.) 1989. Manunal of Nearctic Diptera, Vol. 3. Research Branch, Agriculture Canada, Monograph, 32.

OOSTERBROOK, P. and Courtney. G. 1995. Phylogeny of the nematocerous families of Diptera (Insceta). *Zoological Journal of the Linnean Society* **115** : 267-311.

SINCLAIR, B. J. CUMMING, J. M. and D. M. Wood. 1994. Homology and phylogenetic implications of the male genitalia in Diptera–Lower Brachycera. Entomological Scandinavica **24** : 407-432.

JOSEPH, A.N.T. and RAY, K.K. 1976. Diptera from Arunacal Pradesh & Assam Foot hills, Part IV, Lohit, Fronter division, Lakhimpur district and Sibsagar district, *Rec. zool. Surv. India,* **69** : 275-290.

JOSEPH, A.N.T. and PARUI, P. 1977. Diptera from Arunachal Pradesh and Assam foot hills, Part V. Tirap division. *Rec zool. Surv. India,* **72** : 333-339.

Table 1. Distribution of species (as per serial number) in different districts of Arunachal Pradesh.

Species / Districts	Family	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Stratiomyidae													+		
2							+									
3															+	
4							+									
5														+		
6		+														
7							+									
8		+					+									
9							+									
10															+	
11	Tabanidae										+					
12		+			+		+		+		+					
13					+		+							+		
14				+												
15							+	+								
16		+														
17											+					
18														+		
19		+	+													
20																+
21		+	+													
22		+					+									+
23																+
24													+			
25																
26																+
27											+					
28																
29																+
30																+
31		+														
32		+					+							+		
33		+														
34																
35	Asilidae						+				+					
36																
37		+					+									
38									+							
39							+									
40							+		+							
41		+														
42											+					
43							+									

Table Contd.

Species Districts	Family	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
44															+	
45		+														
46											+					
47						+					+				+	
48		+														
49		+														
50	Empididae	+					+									
51	Dolichopodidae															+

Name of districts as per serial

1. West Kameng, 2. East Kameng, 3. Tawang, 4. Kurungkumey, 5. Papumpare, 6. Lower Subansiri, 7. Upper Subansiri, 8. West Siang, 9. Upper Siang, 10. East Siang, 11. Dibang Valley, 12. Lower Dibang Valley, 13. Lohit, 14. Changlang, 15. Tirap.

Table 2. Distribution of species (as per serial number) in other parts of India

Species States	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1								+																		+						
2							+																			+						
3			+					+	+	+				+	+			+							+	+			+			
4													+																			
5			+					+																								
6								+					+		+																	
7	+		+			+																										
8		+	+					+						+	+														+			
9	+					+							+																			
10			+				+	+																								
11	+						+	+						+																		
12																										+		+				
13								+																								
14	+					+																										
15																																
16							+																									
17																							+			+						
18																																
19			+																													
20																																
21	+		+																													
22																																
23	+					+																										
24																																
25	+																															
26	+		+					+	+	+			+	+				+				+	+	+		+		+				
27																																
28																																
29																																
30																										+						
31	+		+															+														
32	+		+																													
33																																
34																																
35	+													+							+											
36																																
37																																
38	+	+	+				+	+	+	+		+	+	+												+						
39																																
40								+	+	+		+	+	+	+					+						+					+	
41								+																		+						
42	+							+																								
43								+					+																			

Table Contd.

Species States	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
44																																
45								+																	+	+						
46	+	+	+				+																			+						
47	+		+					+	+	+					+						+				+	+						
48													+																			
49										+		+	+	+	+																	
50	+							+	+	+																						
51			+					+																								

Name of states as per serial

1. Assam, 2. Tripura, 3. Meghalaya, 4. Manipur, 5. Mizoram, 6. Nagaland, 7. Sikkim, 8. West Bengal, 9. Bihar, 10. Orissa, 11. Jharkhand, 12. Andhra Pradesh, 13. Tamil Nadu, 14. Kerala, 15. Karnataka, 16. Goa, 17. Gujarat, 18. Maharashtra, 19. Chhatishgarh, 20 Madhya Pradesh, 21. Rajasthan, 22. Haryana, 23. Punjab, 24. Delhi, 25. Himachal Pradesh, 26. Uttar Pradesh, 27. Uttaranchal, 28. J & K, 29. A & N Islands, 30. Lakshadweep, 31. Pondichery, 32. Chandigarh.

Table 3 : Distribution of species in different Zoogeographical regions of the world.

SPECIES	FAMILY	ORIENTAL	PALAEARCTIC	AUSTRALIAN	ETHIOPIAN
1	STRATIOMYIDAE	+			
2		+			
3		+			
4		+			
*5		+			
6		+			
7		+			
8		+			
9		+			
*10		+			
11	TABANIDAE	+			
12		+			
13		+			
*14		+			
15		+			
**16		+			
17		+			
18		+			
**19		+			
*20		+			
**21		+			
22		+			
**23		+			
24		+			
**25		+			
26		+			
27		+			
**28		+			
**29		+			
**30		+			
31		+			
32		+			
**33		+			
**34		+			
35	ASILIDAE	+			
**36		+			
**37		+			
***38		+			
**39		+			
40		+			
41		+			
42		+			
43		+			
44		+			
45		+			
46		+			
47		+			
48		+			
49		+			
50	EMPIDIDAE	+			
51	DOLICHOPODIDAE	+			

* INDIA, ** ARUNACHAL PRADESH, *** JAPAN & KOREA

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2): 283-295, 2006

INSECTA : DIPTERA : BOMBYLIIDAE

D. BANERJEE AND BULGANIN MITRA
Diptera section, Zoological Survey of India, M-Block, New Alipore, Kolkata 700053

INTRODUCTION

The bombyliids or "bee-flies" are a group of moderate to large sized colourful and beautiful flies, of the superfamily Asiloidea under the suborder Brachycera. They constitute one of the largest groups within the orthorraphous Brachycera. With around 4,500 species currently described world over, the family Bomblyiidae is numerically one of the largest families in one of the largest orders (Diptera) in by far the largest class of living things (Yeates, 1994). Of the 212 species reported from the Oriental region (Bowden, 1975), 121 species are reported from India (Pal, 1991) and only 5 species have been reported from Arunachal Pradesh.

The bombyliids though are more frequently found in arid and semi-arid regions of the world, quite a few specialized forms are found in moist tropical climates. Adults range in size from 1 to 21 mm in length and are commonly found on flowers, hovering in bright sunlight, or resting on warm bare ground with wings stretched in bright sunshine. Many, if not all, are pollen and nectar feeders, with some acting as primary pollinators of some species of desert wild flowers (Evenhuis, 1989). While almost all the adult bee flies are fast flying anthophiles their larvae are clandestine and feed on other insect immatures, making a living as predators or parasitoids.

The State of Arunachal Pradesh physiographically is just not diverse but also unique in the sense that it encompasses not only the flood plains and the foot hills but also the Greater Himalayan ranges. Moreover "the state lies in a transitional ecological province between the Indian, Indo-Malayan and Sino-Myanmarese biogeographic realms leading to a mingling of biological elements besides its own." Though not ideally the place for all bombyllids to thrive, the wet forested areas do harbour a small but no doubt a diverse population of bombyliids.

The present knowledge on the bombyliid fauna of Arunachal Pradesh is far from being adequate. Apart from scattered references by Bowden (1975), Brunetti (1920), the few other reports available are that of Joseph and Rao (1972b), Joseph and Parui (1973), Pal (1991), whereby 5 species in all have been reported from Arunachal Pradesh. The reason may be due to lack of intensive faunistic surveys in those areas.

Keeping this in view, an attempt has been made to formulate a comprehensive account of the bee-fly fauna of Arunachal Pradesh, one of the "hot spot" areas of India. The present paper deals with a brief note on general distribution and systematic account coupled with keys to taxa. The present report comprises of 9 species of bombyliids (50 exs.) belonging to 5 genera under 3 tribes of 1 subfamily of which 4 species of 3 genera under the tribe Exoprosopini are recorded for the first time from the State of Arunachal Pradesh.

Classification of the family follows that provided by Yeates (1994), whereby the entire family is divided into 2 sections (a level between family and subfamily). These are namely the Homeopthalmae (taxa with hind margin of the

eye not indented and without a bisecting line) and Tomopthalmae (taxa with hind margin of the eye indented and with a bisecting line). Moreover the subfamilies are now divided into tribes (Yeates 1994) and all the species under discussion now fall under the section Tomophthalmae, under 1 subfamily Anthracinae and 3 tribes Anthracini, Exoprosopini and Villini (Evenhuis, 1991; Yeates, 1994).

GENERAL MORPHOLOGY

The Bombyliidae are separated from other closely related dipterous families by the characteristics found primarily on the head, antennae, and in the wings; additional characters may be found on the abdomen and in the male and female hypopygium.

The head is almost always round or roundish, never flattened. The occiput may be flat or swollen and with or without a central cavity. The vertex is always swollen, never depressed. Antennae composed of three segments with the third segment usually of diagnostic value. The eyes are usually contiguous in males and are widely sepcrated in the female. Proboscis is adapted for sucking or lapping; it may be short or long, when short the labellae are usually thick and fleshy. When the proboscis is long the labellae are thin, narrow, and usually pointed.

The wings represent the most obvious differences that are found between the subfamilies and genera. The wings may consist of one to five submarginal cells. The presence of supernumerary cross veins is not uncommon. The posterior cells number three or four, never five, with the first posterior cell either open or closed at the wing margin or closed before the wing margin and with a petiole. Anal cell likewise may be open or closed in the wing margin or closed before the margin and petiolate. The alula may be vestigeal or strongly developed.

The presence or absence of bristles or hair on the femora and the presence or absence of bristles on the fore tibiae together with the variability found in the pulvilli are about the extent of the morphological charactersistics various authors have used.

Males usually have one more visible segment than females, but the number will usually vary according to the tumidity of the abdomen.

The male hypopygium is usually rotated 180° so that the ninth tergite is located ventrally. The basistylus, or ninth sternite, is divided and bears on its apex two diatistyli or clasping organs, which are usually hooked. The aedeagus may be one piece or bifid and of various shapes. When not bifid the gonopore is almost always apical, and when bifid it is located on the lower piece and is apical. Basal to the aedeagus is the basal keel which is enlarged and belived to be used as an anchoring device or pendulum during copulation. Basally the aedeagus has two arms or ramifications called the lateral wings. The lateral wings are usually hidden within the ninth tergite.

The present communication is based on the collections of the scientists of the Zoological Survey of India, Kolkata as well as the previously available information The collections were made by S. Biswas (1961), A.N.T. Joseph (1966), S.K.Tandon (1973), B. Mitra (2000), B. Mitra, D. Banerjee and M. Sil (2001), M. Sil, K. Bhattacharya (2002).

MATERIAL AND METROD

Insect samples have been collected and preserved for further study following the recommendations of the Zoological Survey of India, Kolkata (Ghosh and Sengupta, 1982).

LIST SYSTEMATIC

Subfamily ANTHRACINAE

Tribe **Anthracini**

1. *Anthrax distigma* (Widemann)

Tribe **Exoprosopini**

* 2. *Exoprosopa* (*Exoprosopa*) *insulata* (Walker)

* 3. *Ligyra aurantiaca* (Guerin-Meneville)

4. *Ligyra oenomaus* (Rondani)

* 5. *Ligyra semifuscata* (Brunetti)

6. *Ligyra tantalus* (Fabricius)
* 7. *Litorhina lar* (Fabricius)

Trie **Villini**

8. *Villa aperta* (Walker)
9. *Villa paniscus* (Rossi)

SYSTEMATIC ACCOUNT

Subfamily ANTHRACINAE

1804. Anthracinae Latreille. : 189 (as Anthracii).

Type genus ***Anthrax*** Scopoli, 1763.

Diagnosis : Flagellum with three, two, or one flagellomere; style present and apical; circlet of hairs around apex of second flagellomere, male eyes dichoptic; face tumid or flat; cibarium elongate; posterior arms straight in lateral view with knees joined medially.

Basicosta produced or spinelike, three branches of R_s; R_{2+3} arises at 90° or distally (in Anthracini, Exoprosopini, & Villini), M_2 present. Pulvilli modified to spine like lobes below tarsal claws, fore tarsal claws small (as in Exoprosopini and Villini).

Male genitalia rotated; male epandrium with posterior margin convex or concave, hypandrium absent. Female epiphallus, a simple blind lobe above aedeagus; brush of long hairs on posterior margin of tergite 8; tergite 9 and 10 separate or fused but line of fusion evident.

Key to the Tribes

1. Apex of antennal flagellum destitute of hairs; basicosta spinelike; laterotergite and mediotergite haired; pulvilli reduced 2
– Apex of antennal flagellum with a circlet of hairs; basicosta produced but not spinelike; laterotergite and mediotergite bare; pulvilli and foretarsal claws not reduced..... **Anthracini**
2. Two antennal flagellomeres with an apical style; pulvilli reduced, conical in shape .... **Exoprosopini**
– One antennal flagellomere wiht an apical style; pulvilli reduced, rounded in shape..... ..... **Villini**

A. Tribe ANTHRACINI Latreille

Genus ***Anthrax*** Scopoli

1763. *Anthrax* Scopoli, *Ent. Carniolica* : 358.

Type-species : *Musca morio* L.

1840. *Spogostylum* Macquart, *Dipt. exot.* 2(1) : 53.

Type-species *Mystaceum* Macquart.

Diagnosis : Body scales usually decumbent, often silvery or shining black; antennal segment 2 usually subspherical, loosely attached to segments 1 & 3, latter not aberrantly enlarged as bulb at base; anal cell usually open in wing margin; spur vein usually present at base of veins R_{2+3} and R_4; female genitalia with distinct ejection apparatus; vaginal apodeme L–shaped.

1. ***Anthrax distigma*** (Wiedemann)

1828. *Anthrax distigma* Wiedemann, *Aussereurop zweifl Insekt.*, 1 : 309.

1857. *Anthrax argyropa* Doleschall, *Natuurk. Tijdschr Ned-indie.*, 14 : 401.

1867. *Anthrax tripunctata* Wulp. *Tijdschr. Ent.* 11 : 109.

1882. *Anthrax tripunctata* : Osten-Sacken, *Ann Mus Genev.* 21 : 433.

1898. *Spogostylum distigma* : Coquillett, *Proc. U.S Natl Mus.* 21 : 318.

1907. *Argyramoeba distigma* : de Meijere, *Tijdschr Ent* 50 : 241.

1988. *Anthrax distigma* : Zaitzev, *Rev. Ent URSS* 66 : 86.

Material examined : 9♂, 10♀, Tamen, Subansiri dist., 305-475m., 20.v.1966, Coll : A.N.T. Joseph & party; 2♀, Elephant flat, W. Kameng dist., 400m., 22.iii.73, Coll. S.K. Tandon & Party.

Diagnosis : Wing nearly clear, with dark brown baso-costal oblique band limited to cross-vein r-m and bases of discal and posterior cell 4 (Cu_1); a distinct round brown spot on fork of vein R_{2+3} reaching upto R_{4+5} and a smaller indistinct spot on posterior cell 2 (M_1) present; anal cell open.

Distribution : India : Arunachal Pradesh : (Subansiri, W. Kameng), Andaman & Nicobar

ls., Bihar, Karnataka, Kerala, Meghalaya, Sikkim, Tamil Nadu, Uttaranchal and West Bengal.

Elsewhere : Bangladesh, Myanmar, Indonesia (Java, Sumatra.), Philippines, Sri Lanka, Sulawesi.

Tribe **Exoprosopini** Becker

Key to the genera

1. Antennal segment 3 with a terminal style bearing a microscopic bristle; submarginal cells in wing 3 ..... 2.

– Antennal segment 3 with terminal style bearing a minute appendage ; submarginal cells in wing 4 ..... ***Ligyra*** (Newman)

2. Projecting proboscis longer than oral cavity ; wings with broad median, transverse banded neuration and pattern ; front tibiae beset with spicules ..... ***Litorhina*** (Bowden)

– Non-projecting proboscis, shorter than oral cavity; wing pattern variable or absent; front tibiae generally smooth ..... ***Exoprosopa*** (Macquart).

Genus ***Exoprosopa*** (Macquart)

1840. *Exoprosopa* Macquart, *Dipt. exot.*, **2**(1) : 35.

Type-species : *Anthrax pandora* Fabricius

* 2. ***Exoprosopa (Exoprosopa) insulata*** (Walker)

1852. *Anthrax insulata* Walker, *Insecta Saundersiana*, **1** : 72.

1908. *Exoprosopa insulata* : Brunetti, *Rec. Ind. Mus.* **2** : 446.

1975. *Exoprosopa (Exoprosopa) insulata* : Bowden, *Catalog Dipt. Orient Reg.*, **2** : 181.

Material examined : 2♀, Elephant flat, W. Kameng dist, 400m., 22.iii.73, Coll. S.K. Tandon & pty.

Diagnosis : Antenna black ; pleuron with dense bristles confined either to lower edge or all over except upper edge; wing mostly clear, with submarginal cells, discal cell typically short and obtuse, upper branch of cubital fork widely divergent; first posterior cell of wing broadly open at margin, dark pattern of wing extending beyond middle of discal and anal cell with several isolated dark spots on clear part, allula well developed; abdomen with scale spots; hind tibia usually covered with dense black bristles.

Distribution : India : Arunachal Pradesh (W. Kameng), Bihar, Himachal Pradesh, Karnataka, Madhya Pradesh, Meghalaya, Tamil Nadu, Uttaranchal, and West Bengal.

Elsewhere : Myanmar, Nepal and Sri Lanka.

Remarks : This species is being reported for the first time from the State of Arunachal Pradesh.

Genus ***Ligyra*** Newman

1841. *Ligyra* Newman, *Entomologist*, **1** : 220.

Type-species : *Anthrax bombyliformis* Macleay.

Key to the species

1. Wing dark blackish brown, without any considerable clear or nearly clear part 2

– Wing with apical part and considerable portion of posterior half practically clear .... *oenomaus* (Rondani)

2. Wing uniformly dark blackish brown, posterior half hardly lighter than apical part; venter with a median stripe of white pubescence ..... *tantalus* (Fabricius)

– Wing dark blackish brown fading to smoky brown towards the hind border, posterior cell 2 distinctly wider at base than tip; venter with uniform silvery white pubescence .... *aurantiaca* (Guérin-Méneville)

– Venter black with yellowish pubescence; wing with posterior cell 2, slightly narrower at base than tip ..... *semifuscata* (Brunetti)

* 3. ***Ligyra aurantiaca*** (Guérin-Méneville)

1844. *Anthrax aurantiaca* Guérin-Méneville, *Icon. du regne anim, Dipt.*, **3** : 539.

1845. *Anthrax pulchra* Walker, *Insecta Saundersiana* 1 : 169.

Material examined : 1♀, Elephant flat, W. Kameng dist., 400m., 22.iii.73, Coll S.K. Tandon & pty., 1♂, Kilor, Upper Siang dist., 399m., 18.xi.2002, Coll. K. Bhattacharya.

Distribution : India : Arunachal Pradesh (W. Kameng, Upper Siang), Bihar and West Bengal.

Remarks : This species is being reported for the first time from Arunachal Pradesh.

4. *Ligyra oenomaus* (Rondani)

1794. *Hyperalonia oenomaus* Rondani *Annali Mus. Civ. Stor. nat. Giacomo Doria*, 7 : 453.

1909. *Hyperalonia oenomaus* : Brunetti, *Rec. Indian. Mus.* 2 : 442.

1975. *Ligyra oenomaus* : Bowden, *Catalog. Dipt. Orient. Reg.* 2 : 184.

Material examined : 1♀, Tipi, W. Kameng dist. 3.v.1966, Coll. A.N.T. Joseph & pty., 2♂, 1♀, Bhalukpong (riverside forest), W. Kameng dist., 200m., 21.ix.2001., Coll. M. Sil; 2, Dirang foothills (millet field), Dirang, W. Kameng dist., 1500m., 7.x.2001., Coll. B. Mitra; 3♂, 2♀, Dirang Basti, Dirang, W. Kameng dist., 1400m., 13.x.2001., Coll. D. Banerjee, M. Sil, B. Mitra; 1♀, Gossang, Upper Siang dist., 398m., 18.ix.2002., Coll. K. Bhattacharya.

Distribution : India : Arunachal Pradesh (W. Kameng), Assam, Sikkim and West Bengal.

Elsewhere : Borneo, Malaya and Philippines.

*5. *Ligyra semifuscata* (Brunetti)

1912. *Hyperalonia semifuscata* Brunetti. *Rec. Indian Mus.*, 7 : 466.

1975. *Ligyra semifuscata* : Bowden, *Catalog. Dipt. Orient Reg.* 2 : 184.

Material examined : 1, Laa, Daporizo, W. Siang dist., 215m., 22.ix.2002., Coll. K. Bhattacharya.

Distribution :.India : Arunachal Pradesh (W. Siang, E. Siang), Maharashtra and West Bengal.

Remarks : This species is also recorded for the first time from Arunachal Pradesh.

6. *Ligyra tantalus* (Fabricius)

1794. *Anthrax tantalus* Fabricius. *Ent. Syst.* 4 : 260.

1828. *Anthrax tantalus* : Wiedemann. *Aussereurop zweifl. Insekt.* 1 : 255.

1840. *Exoprosopa tantalus* : Macquart. *Dipteres exotiques noveaux ou peu connus* 2(1) : 37.

1857. *Anthrax coeruleopenis* Dolescnall. *Natuurk. Tijdschr. Ned Indie* 14 : 400.

1875. *Hyperalonia tantalus* : Rondani, *Annali Mus civ Stor. nat Giacomo Doria* 7 : 453.

1907. *Exoprosopa tantalus* : de Meijere. Tijdschr Ent. 50 : 239.

1909. *Hyperalonia tantalus* : Brunetti, *Rec. Indian Mus* 2 : 438.

1975. *Ligyra tantalus* : Bowden, *Catalog Dipt. Orient. Reg.* 2 : 184.

Material examined : 1♀, Tipi, W. Kameng dist., 3.v.1966. Coll. A.N.T Joseph & pty; 2♂, Bhalukpong (riverside forest), W. Kameng dist., 200m., 21.ix.2001., Coll. M. Sil; 1♀, Dirang foothills (millet field), Dirang, W. Kameng dist., 1500m., 7.x.2001, Coll. B. Mitra; 2♀, Dirang Basti (millet field), Dirang, W. Kameng dist., 1400m., 13.x.2001., Coll D. Banerjee, M. Sil.

Distribution : India : Arunachal Pradseh (W. Kameng), Assam, Uttaranchal and West Bengal.

Elsewhere : China, Malaya, Taiwan, Thailand and Philippines.

Genus *Litorhina* (Bowden)

1840. *Litorhyncus* Macquart, *Dipt. Exot.* 2(1) : 78.

1975. *Litorhina* Bowden, Catalog. Dipt. Australasian Oeceanian Reg. : 314.

Type-species : *Litorhyncus corticeus* Bezzi, 1924, orig des.

* 7. *Litorhina lar* (Fabricius)

1781. *Bibio lar* Fabricius, *Spec Insect* 2 : 414.

1828. *Anthrax lar* : Widemann, *Aussereurop zweifl. Insekt.* **1** : 268.

1840. *Litorhyncus collaris* (nec. Wiedemann) : Macquart. *Dipteres exotiques nouveaux ou peu connus* **2**(1) : 80.

1840. *Litorhyncus lar* : Oldroyd. Ann. Mag. nat Hist. **5**(1) : 202.

1841. *Anthrax rugicollis* Sanders. *Trans. Ent. Soc. Lond.* **3** : 59.

1909. *Exoprosopa collaris* (nec. Wiedemann) : Brunetti. *Rec. Indian Mus.* **2** : 444.

1920. *Exoprosopa lar* : Brunetti, *Fauna Br. India, Dipt.* **2** : 194.

1975. *Litorhyncus lar* : Bowden, *Catalog Dipt. Orient Reg.* **2** : 80.

1989. *Litorhina lar* : Bowden, *Catalog. Dipt. Australasian* Oceanian Reg. : 314.

Material examined : 1♀, Elephant flat, W. Kameng dist., 400m., 22.iii.73, Coll. S.K. Tandon & pty.

Diagnosis : Frons narrower at vertex than above, antennae 3 segmented, segments 1 & 2 ferruginous, 3 black; thorax with sparse black pubescence; abdomen black, sides more or less reddish, dorsum with short depressed black pubescence, venter dark brown; legs reddish brown, metatarsi darker, rest of tarsi black; wings pale gray with basal third dark brown filling the anal and axillary cells except their tips, the colour continued along the costa nearly to the tip of the R_1 and extending hindwards to the upperside of the discal cell, spreading out to the apical third of that cell, the base of the posterior cell 2 and just entering the posterior cell 3, the colour sharply delimited distally by a line drawn from its costal limit to where it ends posteriorly in the posterior cell 3.

Distribution : India : Arunachal Pradesh (W. Kameng), Assam, Bihar, Gujarat, Karnataka, Kerala, Maharshtra, Tamil Nadu and Uttar Pradesh.

Elsewhere : Sri Lanka, Australia.

Remarks : This species is also reported for the first time from Arunachal Pradesh.

Tribe **Villini** Hull

Genus ***Villa*** (Lioy)

1864. *Villa* Lioy, *Atti. Inst, veneto. Sci.*, (3) **9** : 732.

Type-species : *Anthrax concinnus* (Meigen)

Key to the species

1. Pubescence on sides of abdomen wholly snow-white, except for a few bunches of scales on each side near tip .... *aperta* (Walker).

– Pubescence on sides of abdomen usually deep black, except on the segment 7 snow-white, with scales on the middle and hind margin ..... *paniscus* (Rossi).

8. ***Villa aperta*** (Walker)

1852. *Anthrax aperta* Walker, *Insecta Saundersiana*, **1** : 180.

Material examined : 1♂, Dirong Dzong jungle, W. Kameng dist., 1604m., 28.vii.1961, Coll. S. Biswas.

Distribution : India : Arunachal Pradesh (W. Kameng), Himachal Pradesh, Meghalaya and Uttar Pradesh.

Elsewhere : Myanmar.

9. ***Villa paniscus*** (Rossi)

1790. *Bibio paniscus* Rossi, *Fauna Etrusca*, **2** : 256.

1820. *Anthrax cingulatus* Meigen, *Systematische Beschreibung der bekannten europaischen zweifleiigeligen Insektten* **2** : 145.

1824. *Anthrax bimaculatus* Macquart, *Nouvelles suites d Buffon, formant avec les oeuvres de cet auteur, un cours cimplet d'Histoire naturelle* **1** : 403.

1849. *Anthrax hottentottus*, Walker, *List. Dipt. Colln. Br. Mus.* **2** : 29.

1920. *Anthrax paniscus* : Brunetti, *Fauna Br. India Dipt.* **2** : 248.

1975. *Villa paniscus* : Bowden, *Catalog Dipt. Orient Reg.*, **2** : 177.

Material examined : 2♀, Dun Bridge, E. Kameng dist., 1524m., 1.v.1966., Coll A.N.T. Joseph & pty.

Distribution : India : Arunachal Pradesh (E. Kameng), Uttar Pradesh and Tamil Nadu.

Elsewhere : Europe.

DISCUSSION

All the species (9 species) recorded from the state and reported here are essentially Oriental in distribution (4 being recorded for the first time from this state with the exception of 4 species which have spread themselves as far as the Palaearctic region *(V. paniscus)* and the Australian region *(L. lar, A. distigma, Ligyra tantalus)*. However all the species show a distinct Himalayan bias always, occuring in the Himalayan ranges (east, west and central).

Of them the lone species *Anthrax distigma* (tribe Anthacini) is extremely widespread in India, extend to Myanmar and Philippines in the east and to Sri Lanka and Java in the south. *Villa paniscus* and *Villa aperta* and restricted in their distibution in between north-western and north-eastern Himalayan slopes. Among the 6 species of the tribe Exoprosopini, *Litorhina lar* is certainly widespread in the Indian subconitinent, though it exhibits a noticeable discontinuity in the Peninsular India. *Exprosopa insulata* is almost uniform in its distibution all over India, from the Hmalayas to the southern tip and extends its range upto Sri Lanka. Out of three species of the genus *Ligyra*, *L.oenomaus* and *L.tantulus* are restricted in their distibution in the Himalayan region with an exception of *L.tantalus* which is also reported from Assam; whereas *Ligyra aurantiaca* is distibuted in the eastern part of India and found mostly in the high altitude plains and low-altitude foothills. However *L. semifuscata* is wider in its distribution, also being found in Maharastra as well as West Bengal.

Considering the distribution pattern of all the species within the Indian subcontinent it can be inferred that the species of bombyliids discussed so far probably have a prference to the high altitudes of the Himalayas as they are by and far consistently found in the Himalayan ranges and foot hills. The uneven zoogeographical features of the wet and hilly Arunachal Pradesh contribute to a great extent to the diversity of the bombyliid fauna as found in the State.

But this zoogeographical analysis, however remains tentative due to poor collection of bombyliid fauna from this area. So, it may still need a thorough and intensive exploration for a fuller knowledge on the species diversity of the family Bombyliidae.

ACKNOWLEDGEMENTS

We wish to express our thanks to Dr. J.R.B. Alfred, Director, Zoological Survey of India. for the necessary facilities and encouragement. We are very much obliged to Dr. A.K. Hazra, Scientist 'E' for kindly going through the manuscript and making useful suggestions.

REFERENCES

BOWDEN, J., 1975. Family Bombyliidae In M.D. Delfinado, and D.E. Hardy,. (ed). A catalogue of Diptera of the Oriental Region, Brachycera, University of Hawaii Press, Honolulu

BRUNETTI, E., 1920. The Fauna of British India, including Ceylon & Burma, Diptera, Brachycera, **2** : ix-401pp. Taylor and Francis, London.

EVENHUIS, N.L., 1989, Catalog of Diptera of the Australasian and Oceanian Regions : 314.

EVENHUIS, N.L., 1991. World catalog of genus group names of bee-files, (Diptera : Bombyliidae). Bishop Museum Bulletin. In : *Entomology*, **5** : 1-13.

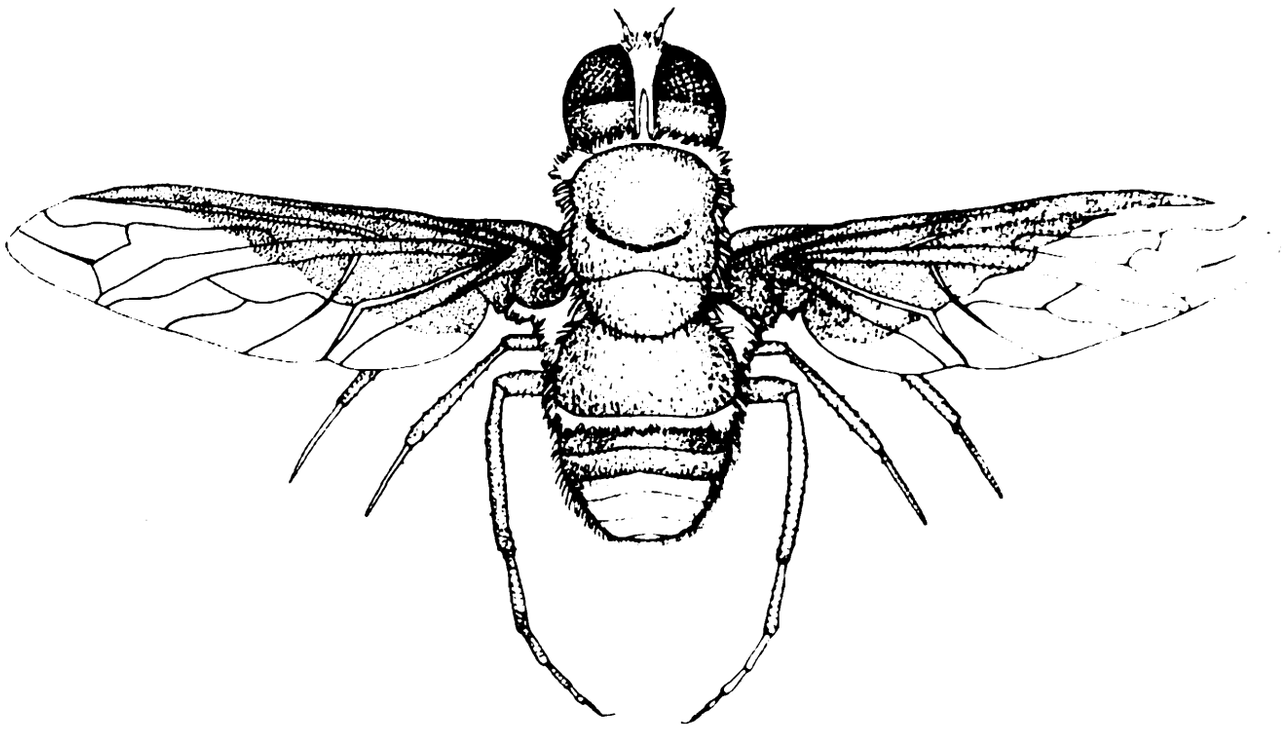
GHOSH & SENGUPTA, 1982. Hand book an insect collection, preservation and standy : 7-65. (ed. Director, ZSI).

JOSEPH, A.N.T. and RAO, K.R. 1972b. Diptera from NEFA and Assam foot hills. Kameng frontier division, Subansiri frontier division, North Lakhimpur and Assam foot hills. *Rec. zool. Surv. India*, **66** (1-4) : 130-138.

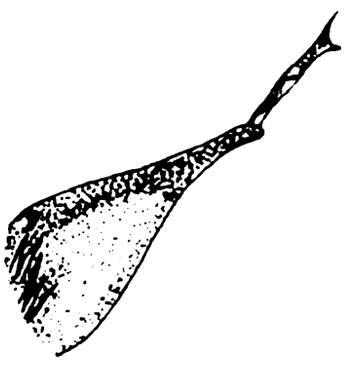
JOSEPH, A.N.T. and PARUI, P., 1973. Diptera from NEFA and Assam foothills. Part iii. Siang frontier div. and north Lankhimpur. *Rec. zool. Surv. India*, **67** : 325-342.

PAL, T.K., 1991. On a collection of Bombyliidae (Diptera) from India and Pakistan, *Rec. zool. Surv. India*, **89** (1-4) : 277-292.

YEATES, DAVID K., 1994. The cladistics and classification of the Bombyliidae (Diptera : Asiloidea), *Bulletin of the American Museum of Natural History* No. **219** : 5-6, 32-33, 84-85, 158-161.



1



2a

2b

2c

2d

Fig. 1. Dorsal view of a bombyliid fly, *Ligyra oenomaus* (Rondani)
Fig. 2.a. Antenna in Exoprosopini, **2b.** Antenna in Anthracini, **2c.** Leg in Exoprosopini (fore pre tarsus)
Fig. 2d. Leg in Exoprosopini (hind pre tarsus, arrow indicates pulvillus).
(All figs. under 2 redrawn from scanning electron micrographs).

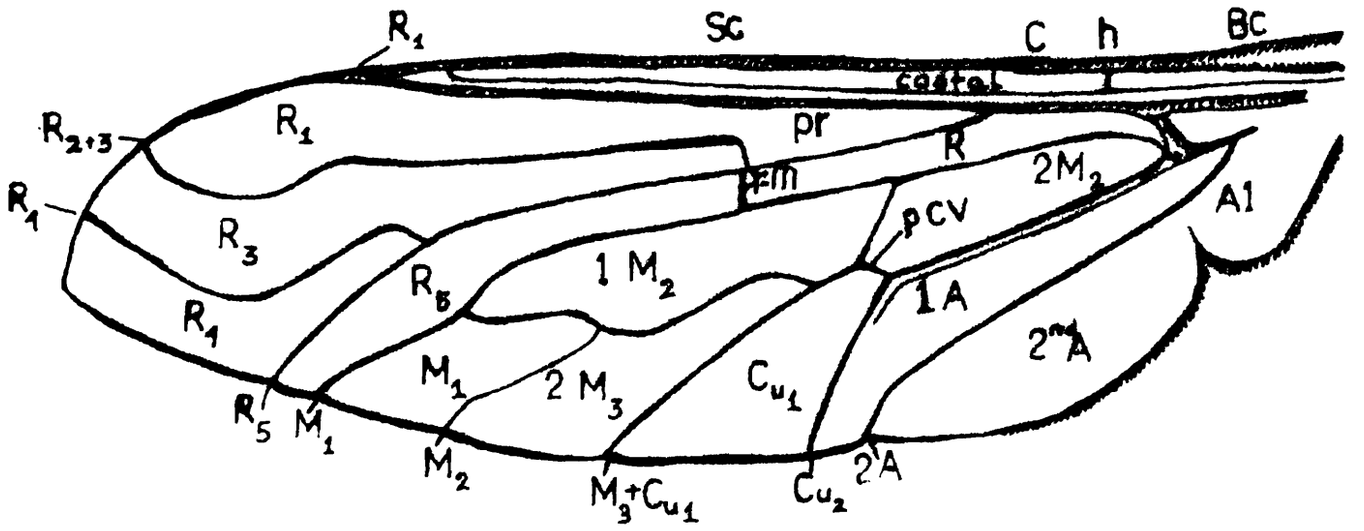


Fig. 3. Generalised wing of a bombyliid fly (Villa sp.) (after Hall, 1980)

Wing Veins.

B C = basicosta
C = costa
Sc = subcosta
R_1 = radius one or first longitudinal vein
R_{2+3} = second longitudinal vein
R_4 = upper branch of third longitudinal vein
R_5 = third longitudinal vein
M_1 = fourth longitudinal vein
$Cu_1 + M_3$ = fifth longitudinal vein
Cu_2 = sixth longitudinal vein
2A = second anal vein
r-m = radial medial crossvein
h = humeral crossvein
pev = posterior or cubital–medial crossvein
pr. = prefurca.

Wing cells :

cc = costal cell
R = 1st basal cell
R_1 = marginal cell
R_3 = first submarginal cell
R_4 = second submarginal cell
R_5 = first posterior cell
$1M_2$ = discal cell
$2M_2$ = second basal cell
M_1 = second posterior cell
$2M_3$ = third posterior cell
Cu_1 = fourth posterior cell
1A = anal cell
2nd A = axillary cell
A1 = alula

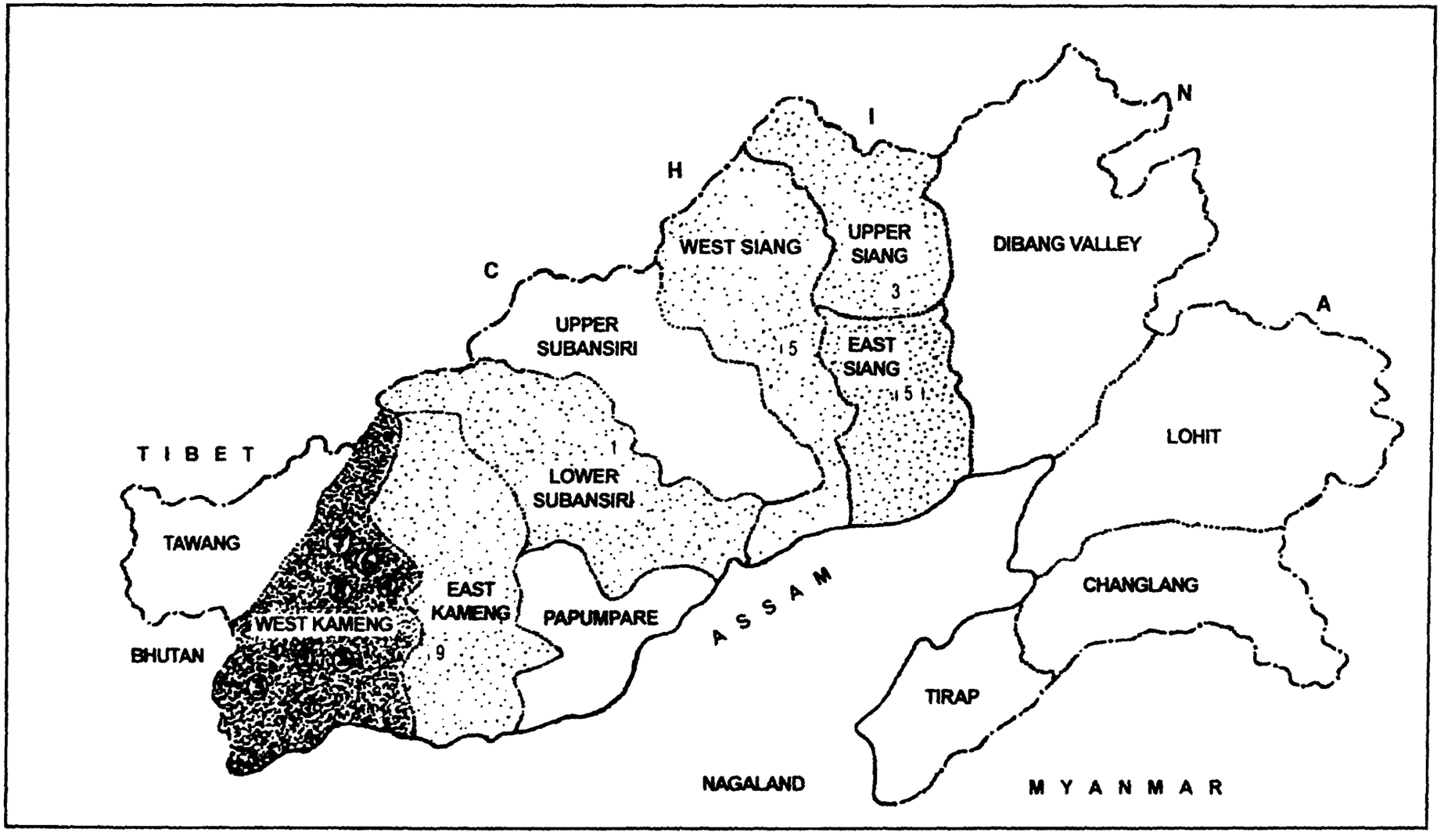


Fig. 4. Map of Arunachal Pradesh showing distribution of the species (dense spots indicates areas of high species diversity).
1 Anthrax distigma 2 Exoprosopa (Exoprosopa) insulata 3 Ligyra aurantiaca 4 Ligyra oenomaus 5 Ligyra semifuscata 6 Ligyra tantalus 7. Litorhina lar 8 Villa aperta. 9. Villa paniscus.

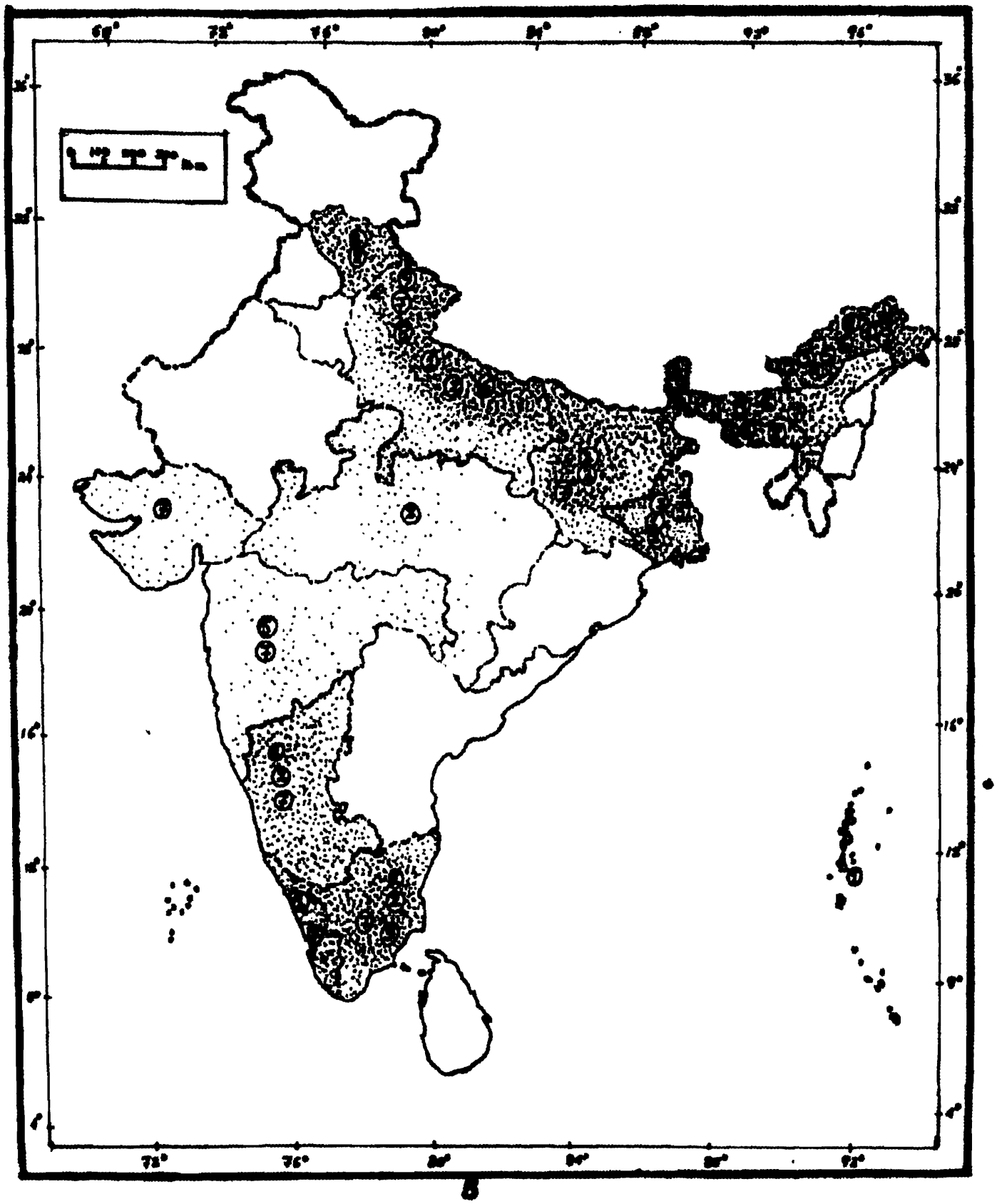


Fig. 5. Map of India showing distribution of the species (dense spots indicates areas of high species diversity).
1. Anthrax distigma. 2. Exoprosopa (Exoprosopa) insulata. 3. Ligyra aurantiaca. 4. Ligyra oenomaus. 5. Ligyra semifuscata. 6. Ligyra tantalus. 7. Litorhina lar. 8. Villa aperta. 9. Villa panisucus.

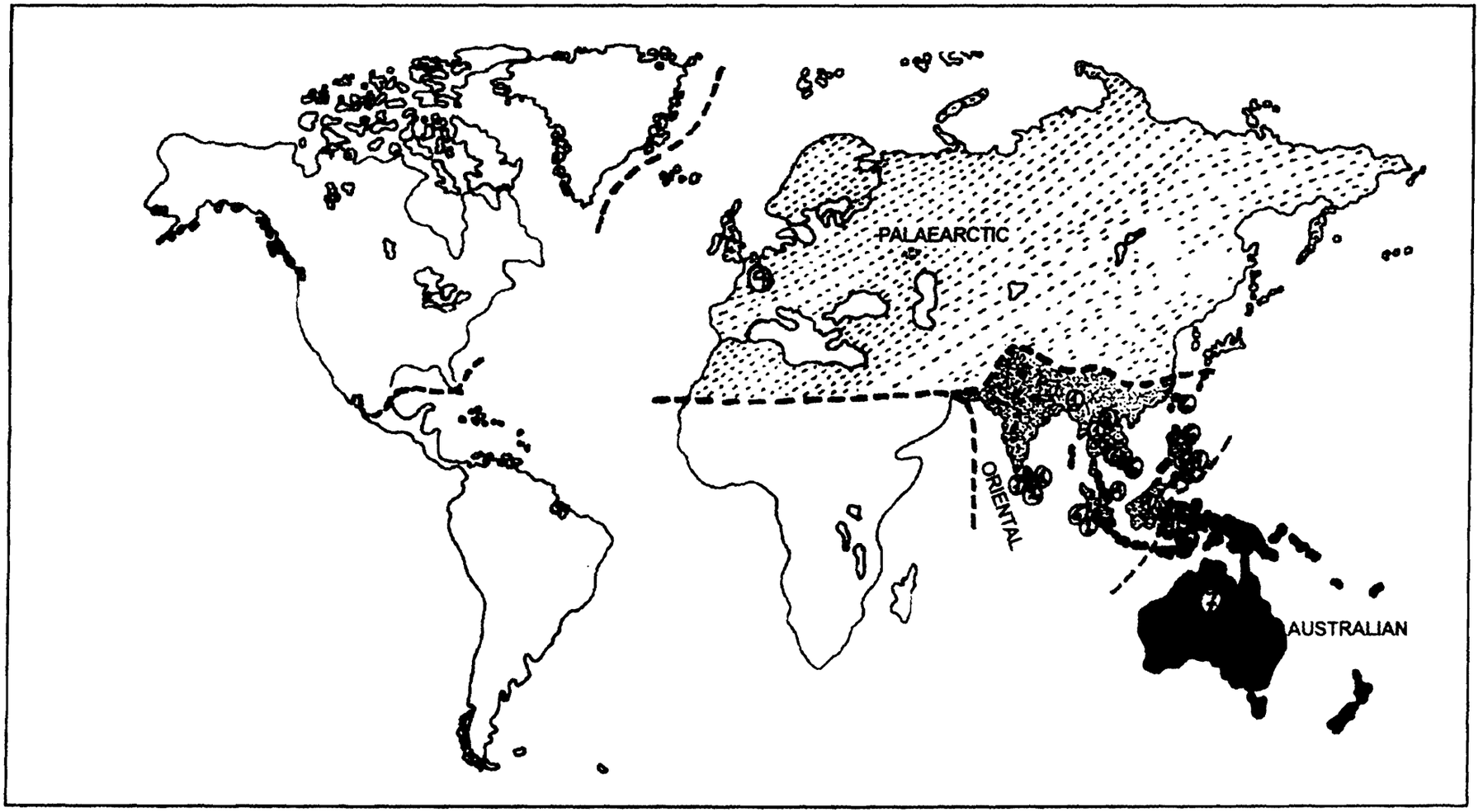


Fig. 6. Worldwide distribution of the species over all the zoo geographic realms (after Wallace, 1876).
1 Anthrax distigma 2 Exoprosopa (Exoprosopa) insulata 3 Ligyra aurantiaca 4 Ligyra oenomaus. 5 Ligyra semifuscata 6 Ligyra tantalus 7 Litorhina lar 8 Villa aperta 9 Villa panisucus

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2) : 297-329, 2006

INSECTA : DIPTERA : CYCLORRHAPHA

BULGANIN MITRA, M. SIL, R. S. MRIDHA & K. BHATTACHARJEE
Zoological Survey of India, M-Block, New Alipore, Kolkata - 700053

INTRODUCTION

The state of Arunachal Pradesh is having a geographical area of about 8.37 million ha, which is 2.54% of the total land area of the country. It is located in the north-east and lies between lat. 26°39' and 29°28' N and long. 91°33' and 97°25' E. Its terrain consists of sub-montane and mountainous ranges, sloping down to the plains of Assam and is divided into valleys by the rivers Kameng, Subansiri, Siang, Lohit and Tirap. About 94% of the land area is covered by forests, thus making forestry as the most important land use.

Climate of the state varies from temperate in the northern part to warm and humid in the southern part of the state. Average annual rainfall ranges between 2,000 mm to 8,000 mm. The temperature in the state varies from below 0° to 31° C. The complex physiography, dense vegetation, altitudes and climatic factors of this state harbour a rich and diverse Diptera fauna.

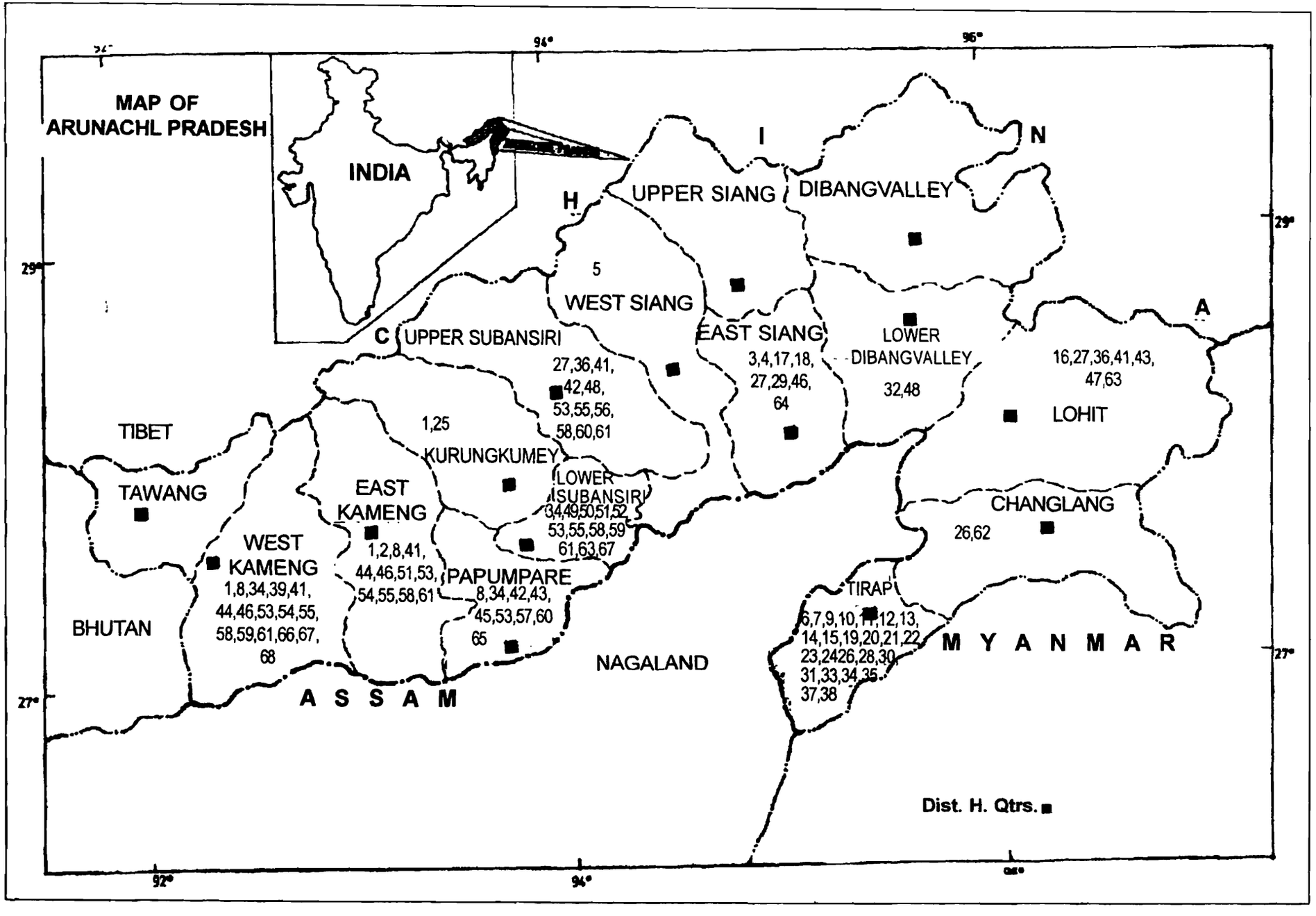
Diptera is the fourth largest order of insects, and its members are found in a wide diversity of habitats. The order Diptera is generally divided into three suborders Nematocera, Brachycera, and Cyclorrhapha. Members of these suborders are separated on the basis of such features as antennal characteristics, the shape of the exit hole from the pupal case, the nature of the pupa, and larval morphology.

The traditional groupings of Diptera have been critically re examined within a cladistic framework in recent decades by a suite of workers, beginning with the great dipterist Willi Hennig. A consensus has emerged that many of the traditional categories such as the Nematocera, Orthorrhapha and Aschiza are not natural groups (they are paraphyletic). In other words these categories consist of a collection of basal lineages from which the other (monophyletic) catergories (Brachycera, Cyclorrhapha and Schizophora, resepectively) arose. Attempts to formulate a monophyletic classification of Diptera have gained pace recently but no overarching consensus has been reached to date (c.g. Michelsen 1996; Sinclair *et al.* 1994; Cumming *et al.* 1995; Griffiths 1994, 1996). The most comprehensive treatment of dipteran phylogeny and contemporary views on morphological character evidence can be found in Volume 3 of the Manual of Nearctic Diptera (McAlpine and Wood 1989). According to the new classification the order Diptera is divided into two suborders, The Nematocera and Brachycera. But we have followed here the older classifiction.

A perusal of literature reveals that a good number of publications were made on Diptera fauna of Arunachal Pradesh as a whole, and quite a good number of cyclorrhaphan species were described from this hotspot of India. Joseph & Parui (1973, 1977), Joseph & Rao (1972), Joseph & Ray (1976), and Datta & Chakraborty (1985) published recently some valuable works on Diptera of Arunachal Pradesh.

Recently some collecting trips were organized by this Institute in all the 15 districts of Arunachal Pradesh in order to reveal the fauna of the state as tabulated below :

A. R. Lahiri	Aug-Sept. 1998	Papumpare, West Kameng, East Kameng, Tawang
	Sept-Oct-. 2000	Tirap, Changlang, Lower Dibang Valley
Bulganin Mitra	May-June. 2000	Papumpare,



Map 1 : Distribution of species (district wise) in Arunachal Pradesh

		Kuruungkumcy, Upper Subansiri, West Siang
	Sept-Oct. 2001	West Kameng,. Tawang
M. Sil	Sept-Oct, 2002	East & Upper Siang
R. S. Mridha	Feb-March, 2003	Lohit, Lower Dibang valley, Dibang Valley

The families under suborder Cyclorrhapha so far recorded from India are 50 of which only 8 families have been reported to be present in Arunachal Pradesh namely Pipunculidae (2 spp.), Conopidae (3 spp.), Tephritidae (26 spp.), Sciomyzidae (1 sp.), Sepsidae (6 sp.), Calliphoridae (15 spp.), Sarcophagidae (15 spp.) (Family Muscidae dealt separately). This present communication reports 68 species under 39 genera of which *Chrysomya defixa* (Walker) of the family Calliphoridae is the first report from this state.

MORPHOLOGY AND TERMINOLOGY

Members of the suborder Cyclorrhapha have coarctate pupae. Cyclorrhapha ("circular scam") refers to the circular shape of the opening through which the adult emerges from the puparium. Near one end of the puparium there is a circular line of weakness along which the cuticle splits at adult emergence, much like a cap popping from a bottle. The split results from pressure being applied by means of an eversible, bladder like structure, the ptilinum, which protrudes from the head after emergence, usually leaving the frontal suture as a remnant. The larvae lack heads and are vermiform (maggots), with mouth hooks that operate in the vertical plane. The adults generally have aristate antennae.

Among the Cyclorrhaphans the Pipunculidae, a very distinct family of small dark flies, many of which pertain to the genus *Pipunculus*. The flies are almost bare with a very large sub hemispherical mobile head formed almost entirely of the eyes; antennae with an usually long dorsal arista; wings much longer than the abdomen, cell R_5 open; tibiae devoid of spurs or with very weak ones; ovipositor horny, exerted. Their most striking feature is the great size and mobility of the head; the third antennal segment is of peculiar shape, being sometimes prolonged into a curious beak-like process.

The superfamily Conopoidea, the most primitive of the Schizophora, contains the single widespread family Conopidae, whose members typically mimic wasps and bees and commonly called as thick-headed flies. A family of more or less clongate, moderate sized flies; proboscis very long and often conspicuously jointed; cell Cu_2 long and reaching the wing margin; thinly pilose or almost bare.

Tephritidae or the fruit flies form an easily recognisable and natural family of almost cosmopolitan distribution. These fruit flies are minute or small and often brightly coloured, with spotted, or banded wings; costa more or less interrupted before end of R_1; male with a long, flexible, coiled aedeagus.

Sciomyzidae is one of the largest cosmopolitan families of the Superfamily Sciomyzoidea. Antennae not received into a scrobal hollow, peristomium not bristly; postvertical bristles divergent, parallel or absent; clypeus hidden; tibiae with preapical bristles.

Scpsidae, a small family under the same superfamily Sciomyzoidea, about 200 species of these small flies with a somewhat ant-like build is known. They usually wave their wings that have a black spot at the tip. Vein R_1 bare above; only front femora with stout bristles or spines beneath and then chiefly in the males.

The Calliphoridae, commonly known as blow flies, blue bottle flies or green bottle flies are distinguished by the weak development of the macrochaetae, which are usually absent from the dorsal surface of the abdomen; the arista is markedly plumose, usually for nearly its whole length.

The family Sarcophagidae comprises a group of medium-sized to fairly large flies that are widely distributed almost all over the world. Flies are generally grayish to black with silvery to golden or yellowish pollen; eyes medium to large mostly without hairs; thorax usually with three dark longitudinal stripes; wings generally hyaline or

infuscated along anterior margin; abdomen with or without silvery-grey pollen forming more or less tessellate pattern.

MATERIAL AND METHODS

Datta, Parui and Mukherjee (1997) laid down the general method of collecting dipteran specimens from their habitats and of preserving them in proper manner for taxonomic studies. Therefore, we are stressing upon certain specific requirements relating to some family-group undertaken here rather than detailing on the broad range of procedures once again. In fact, collecting becomes much easier and more ambitious if the collector knows the proper habitat as well as the bionomical aspects of the insect (Datta & Parui, 2000).

Pipunculidae larvae are endoparasitic of Homoptera. When the Pipunculid larva quits its host, it usually escapes at the junction of the metathorax and abdomen, either above or below, the segments being ruptured at that point. It falls to the ground and buries itself beneath the soil or among rubbish, etc.

The members of the family Conopidae are usually visit flowers. They are slow fliers and their larvae often endoparasites of adult bees and wasps or of Orthoptera. The larvae are parasite of Hymenoptera, cockroaches and calyptrate diptera.

The larvae of the family Tephritidae are phytophagous. When full grown they are rounded or barrel shaped; a pair of rounded anal tubercles is present. The larvae may be grouped under four headings with reference to their habits : (1) Living in fruits, (2) Living in the flower heads of Asteraceae, (3) As leaf or stem miners, (4) As gall formers.

The biology of the Sciomyzidae remained almost completely unknown untill food habits of the larvae were discovered. The larvae of most sciomyzids are observed to attack aquatic snails and kill them quickly, but they may feed on snails in distinctly different ways. Most adult Sciomyzidae tend to stay in the breeding sites of their larvae, where they usually rest on emergent or hygrophilous vegetation, with heads downward. In general, the English vernacular names "marsh flies" and "swale flies" are very appropriate. Flies of this family are not attracted to people, to human foods, or to domestic animals; they rarely enter buildings.

The larvae of the family Scpsidae are saprophagous and have been found in dung. The adults are often very abundant on the larval food and on flowers.

Adults of Calliphoridae often frequent vegetation, flowers, excrement, decaying plant or animal matter. Larvae are scavengers or parasites on insects, earthworms, snails, and other animals. Some species are notorious in causing myiasis in man & animals. The larva of these flies all live in, or feed on carrion (recently dead animals) but only when it contains a high degree of moisture. Blow-Flies got their name from the fact that meat that they had laid their eggs into was called blown as in blown up.

The adults of the family Sarcophagidae or flesh flies are generally found on vegetation, flowers, exerement or decaying plant and animal material. Larvae are saprophagous or coprophagous and live in decaying plant or animal matter or are parasites of insects & other animals.

LIST OF SPECIES

Suborder CYCLORRHAPHA
Family PIPUNCULIDAE
Subfamily PIPUNCULINAE

1. *Pipunculus (Eudorylus) biroi* Kertesz
2. *Pipunculus (Eudorylus) major* Brunetti

Family CONOPIDAE
Subfamily CONOPINAE

3. *Physocephala bicolorata* Brunetti
4. *Physocephala calopa* (Bigot)
5. *Physocephala tenella* (Bigot)

Family TEPHRITIDAE
Subfamily DACINAE

6. *Dacus (Hemigymnodacus) diversus* Coquillett.

7. *Dacus (Zeugodacus) artifacies* (Perkins)
8. *Dacus (Zeugodacus) cucurbitae* Coquillett.
9. *Dacus (Zeugodacus) scutellaris* Bezzi
10. *Dacus (Zeugodacus) tau* (Walker)

Subfamily TRYPETINAE

11. *Acanthonevra dunlopi* (Van der Wulp)
12. *Acanthonevra formosana* Enderlein
13. *Acanthonevra hemileina* Hening
14. *Hexacinia radiosa* (Rondani)
15. *Rioxa parvipunctata* de Meijere
16. *Rioxa sexmaculata* (Van der Wulp)
17. *Sphaeniscus atilius* (Walker)
18. *Ptilona confinis* (Walker)
19. *Acrotaeniostola apiventris* Munro
20. *Anoplomus flexuosus* Bezzi
21. *Chaetellipsis paradoxa* Bezzi
22. *Chaetellipsis atrata* Hardy
23. *Gastrozona balioptera* Hardy
24. *Gastrozona fasciventris* (Macquart)
25. *Xanthorrachis annandalei* Bezzi
26. *Xanthorrachis assamensis* Hardy
27. *Myoleja fossata* (Fabricius)

Subfamily SCHISTOPTERINAE

28. *Rhabdochaeta bakeri* Bezzi

Subfamily TEPHRITINAE

29. *Platensina acrostacta* (Wiedemann)
30. *Spathulina acropeuca* (Schiner)
31. *Dioxyna sororcula* (Wiedemann)

Family SCIOMYZIDAE
Subamily SCIOMYZINAE

32. *Sepedon plumbella* Wiedemann

Family SEPSIDAE
Subfamily SEPSINAE

33. *Dicranosepsis bicolor* (Wiedemann)
34. *Sepsis albopunctata* Lamb
35. *Sepsis himalayensis* Brunetti
36. *Sepsis indica* Wiedemann

Subfamily TOXOPODINAE

37. *Toxopoda adjuncta* Brunetti
38. *Toxopoda viduata* (Thomson)

Family CALLIPHORIDAE
Subfamily CALLIPHORINAE

39. *Calliphora (Calliphora) vicina* Robineau-Desvoidy
40. *Catapicephala splendens* Macquart
41. *Lucilia fumicosta* Malloch
42. *Lucilia papuensis* Macquart
43. *Lucilia porphyrina* (Walker)

Subfamily CHRYSOMINAE

44. *Chrysomya bezziana* Villeneuve
45. *Chrysomya defixa* (Walker)
46. *Chrysomya megacephala* (Fabricius)
47. *Chrysomya pinguis* (Walker)

Subfamily RHINIINAE

48. *Chlororhinia exempta* (Walker)
49. *Cosmina bicolor* (Walker)
50. *Cosmina biplumosa* (Senior-White)
51. *Cosmina simplex* (Walker)
52. *Isomyia delectans* Walker
53. *Stomorhina discolor* (Fabricius)

Family SARCOPHAGIDAE
Subfamily SARCOPHAGINAE

Tribe **Raviniini**

54. *Ravinia pernix* (Harris)

Tribe **Sarcophagini**
Subtribe **Parasarcophagina** Rohdendorf

55. *Burcaea cruentata* (Meigen)
56. *Boettcherisca (s. str.) peregrina* (Robineau-Desvoidy)
57. *Parasarcophaga (Liopygia) ruficornis* (Fabricius)
58. *Parasarcophaga (Liosarcophaga) brevicornis* (Ho)
59. *Parasarcophaga (Liosarcophaga) dux* Thomson
60. *Parasarcophaga (Curranea) scopariformis* (Senior-White)
61. *Parasarcophaga (Parasarcophaga) albiceps* (Meigen)
62. *Parasarcophaga (Parasarcophaga) misera* (Walker)
63. *Parasarcophaga (Parasarcophaga) sericea* (Walker)

64. *Robineaulla (Jantiella) doleschalli* (Johnston & Tiegs)
65. *Sarcorohdendorfia seniorwhitei* (Ho)

Subtribe ***Hapragophallina*** Rohdendorf

66. *Harpagophalla kempi* (Senior-White)
67. *Iranihindia futilis* (Senior-White)

Subtribe ***Seniorwhiteina*** Rohdendorf

68. *Seniorwhitea krameri* (Boettecher)

Key to the families

1. Anal cell longer than 2nd basal cell B_2, with apex typically pointed & closed near wing margin, frontal suture lacking 2

– Anal cell absent or short, closed distant from posterior wing margin, frontal suture present or absent 3

2. Proboscis longer than head, face with distinct grooves below antennae ..... CONOPIDAE

– Proboscis very short, than head, face lacking grooves ..... PIPUNCULIDAE

3. Antennal segment 2 above without distinct external groove; squamma small or vestigeal 4

– Antennal segment 2 above with a distinct external groove; squamma well developed 5

4. Vibrissiae present; paplus reduced .... SEPSIDAE

– Vibrissiae absent; palpus normally developed ..... SCIOMYZIDAE

5. Subcosta ends perpendicularly to costa, wing usually punctured ..... TEPHRITIDAE

– Subcosta ends to costa normally 6

6. Arista plumose upto its middle & bare distally; distal part of abdomen with few macrochatae; non-metallic ..... SARCOPHAGIDAE

– Arista plumose almost upto its apex, abdomen almost without macrochatae; usually metallic blue or green in colour .... CALLIPHORIDAE

Family PIPUNCULIDAE

Subfamily PIPUNCULINAE

Diagnosis : Body usually with sparse hairs; head nearly spherical, with prominent occiput but without occllar bristles.

Genus ***Pipunculus*** Latreille

1802. *Pipunculus* Latreille, *Hist. Nat. Crust. Ins.*, **3** : 463.

Type-species : *Pipunculus campestris* Latreille.

Diagnosis : Wing with costal third section, between apices of veins Sc and R_1 (stigma) brown-coloured and usually equal or longer than fourth section; leg all yellow or slightly brownish before apices of mid and hind femora only.

Subgenus ***Eudorylus*** Aczel

1940. *Eidprylus* Aczel, *Zool. Anz.* **132** : 151.

Type-species : *Pipunculus opacus* Fallen.

Diagnosis : Antenna scute to acuminate, with or without a long bristle-like apex; propleuron without a fan of hairs; wing with vein M_{1+2} lacking an appendix.

Key to the species

1. Tibiae wholly black ..... *biroi* Kertesz

– Tibiae black, except (at most) base and tip.. ..... *major* Brunetti

1. ***Pipunculus (Eudorylus) biroi*** Kertesz

1903. *Pipunculus biroi* Kertesz, *Annls his. nat. Mus. Hung.*, **1** : 466.

Material examined : 2♂♂, 1♀, Old Zero, Kurungkumey dist, 30.v.2000, coll. B. Mitra.

Distribution : India : Arunachal Pradesh (East & West Kameng, Kurungkumey), Assam, Bihar, Orissa, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : Malayasia, Myanmar, Sri Lanka.

2. ***Pipunculus (Eudorylus) major*** Brunetti

1923. *Pipunculus major* Brunetti, *Fauna Brit. India*, Diptera, **3** : 10.

Distribution : India : Arunachal Pradesh (East & West Kameng), Bihar.

Family CONOPIDAE
Subfamily CONOPINAE

Diagnosis : Ocelli absent; 3rd antennal joint terminating in a distinct, two jointed, apical style.

Genus ***Physocephala*** Schiner

1861. *Physocephala* Schiner, *Wien. Ent. Monatschr.* **5** : 137.

Type-species : *Conops rufipes* Fabricius.

Diagnosis : This genus is undoubtedly very close to genus *Conops*, but differ in the shape of femora. In case of *Physocephala*, femora especially hind pair, suddenly incrassated towards basc; tibiae more irregularly thickened; anterior cross-vein situated at about 2/3rd the length of the discal cell; basal scgments of abdomen considerably narrowed.

Key to the species

1. Wing with dark band extending to tip of 3rd vein, even if fainter or nearly absent just before its end ..... *cicolorata* Brunetti

– Wing with dark band ending at tip of 2nd vein or at a short distance beyond it, always at distance from tip of 3rd vein 2

2. 4th & 5th veins not basally infuscated, nor the intervening space ..... *calopa* (Bigot)

– Either 4th or 5th vein infuscated, or both, or the intervening space ..... *tenella* (Bigot)

3. ***Physocephala bicolorata*** Brunetti

1925. *Physocephala bicolorata* Brunetti, *Rec. Indian Mus.* **27** : 79.

Material examined : 2♂♂, Angu village, Along Lower Subansiri dist., 7.vi.2000, coll. B. Mitra.

Distribution : India : Arunachal Pradesh (East Siang, Lower Subansiri), Assam, Meghalaya, Himachal Pradesh, Uttaranchal, West Bengal.

Elsewhere : China, Nepal.

4. ***Physocephala calopa*** (Bigot)

1887. *Physocephala calopa* Bigot, *Annls Soc. ent. Fr.* (6)7 : 33.

Material examined : 2♂, 2♀, Angu village, Along, Lower Subansiri dist., 7.vi.2000, coll. B. Mitra.

Distribution : India : Arunachal Pradesh (East Siang, Lower Subansiri), Pondichery, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : China, Pakistan.

5. ***Physocephala tenella*** (Bigot)

1887. *Physocephala tenella* Bigot, *Annls Soc. ent. Fr* (6)7 : 35.

Material examined : 1♂, Hissar colony, Along, West Siang dist., 11.vi.2000, coll. B. Mitra.

Distribution : India : Arunachal Pradesh (West Siang), Karnataka, Uttar Pradesh.

Elsewhere : Malayasia, Pakistan, Sri Lanka.

Family TEPHRITIDAE
Key to the Subfamilies

1. Chaetotaxy greaty reduced, lacking ocellars, postoellars, dorsocentrals, presuturals, sternopleurals and usually humerals; cell M broad, 2 X wider than cell Cu and usually about 2 X longer than wide. A row of prominent long hairs present on each side of third abdominal tergum of males and a patch of dense microtrichia over the cubital cell and lower margin of cell M4; third antennal segment 3 or more times longer than wide; typically yellow and black flies with wings mostly hyaline except for a brown band and streak through costal margin and cubital area respectively .... DACINAE

– Not as above, chaetotaxy complete or nearly so; with cell M narrow equal in width to Cu and usually over 4 X longer than wide; 3rd antennal segment typically short; wings usually with elaborate markings 2

2. Costa of wing without a deep cleft and a lobe at the end of subcostal vein 3

– Costa of wing with a deep cleft at the apex of sub costal vein and a prominent lobe at apex of 2nd costal; wing with distinctive markings ..... SCHISTOPTERINAE

3. Occipital thin, pointed, black or dark brown; 6th tergum of female generally shorter than 5th; dorsocentral bristles usually behind supraalars; wings variously marked but rarely spoted; mesonotum rarely tomentose, never with scale like, white, recumbent setae ..... TRYPETINAE

– Occipital thick, flat, scale-like, mostly white or yellow white; 6th tergum equal or longer than 5th dorsocentral bristles before or near supraalars; wings typically spotted; mesonotum generally tomentose and covered with scale-like, white, recumbent setae ..... TEPHRITINAE

Subfamily DACINAE

Genus ***Dacus*** Fabricius

1805. *Dacus* Fabricius, *Syst. Antliat.*, : 272.

Type-species : *Dacus armatus* Fabricius.

Diagnosis : Antannae short, nearly equal or less than front; segment 1 about half as long as 2 and less than half as long as face; abdomen not strongly petiolate or arched and without well developed tubercles on tergum 1 literally; suture between terga 3 and 4 or so; ovipositor usually flattened dorsoventrally.

Key to the subgenera

1. Pecten present on third tergum of male ..... ***Zeugodacus*** Hendel

– Pecten absent on third tergum of male ..... ***Hemigymnodacus*** Hardy

Subgenus ***Hemigymnodacus*** Hardy

1973. *Hemigymnodacus* Hardy, *Pacif. Ins. Monogr.*, **31** : 19.

Type-species : *diversus*. Hardy

6. ***Dacus (Hemigymnodacus) diversus*** Coquillett.

1904. *Dacus diversus* Coquillett, *Proc. ent. Soc. Wash.*, **6** : 139.

Diagnosis : Male face entirely pale yellow, female face with a transverse black band over face; mesonotum with three yellow vittae; pecten absent on third tergum of male; prescutellars present; only 2 scutellar bristles present.

Distribution : India : Arunachal Pradesh (Tirap), Karnataka.

Elsewhere : Myanmar, Nepal, Sri Lanka, Thailand.

Subgenus ***Zeugodacus*** Hendel

1927. *Zeugodacus* Hendel, *In Lindner, Fliegen palaearkt. Reg.*, **49** : 26.

Type-species : *Dacus caudatus* Fabricius.

Key to the species

1. With 3 postsutural yellow vittae 2

– With 2 postsutural yellow vittae ..... *atrifacies* (Perkins)

2. Wings spot formed by the expansion of the costal band also by its predominately rufous color ..... *cucurbitae* Coquillett.

– Wings hyaline 3

3. Scutellum with a black spot at apex ..... *scutellaris* (Bezzi)

– Scutellum yellow except for narrow black band at base ..... *tau* (Walker)

7. ***Dacus (Zeugodacus) atrifacies*** (Perkins)

1938. *Zeugodacus atrifacies* Perkins, *Proc. R. Soc. Qd.*, **49**(1) : 140.

Distribution : India : Arunachal Pradesh (Tirap).

Elsewhere : Malayasia.

8. ***Dacus (Zeugodacus) cucurbitae*** Coquillett.

1899. *Dacus cucurbitae* Coquillett, *Ent. News*, **10** : 129.

Material examined : 5♂♂, 3♀♀, Ganga Lake area, Papumpare dist. 28.v.2000, coll. B. Mitra; 2♂♂, 1♀, Sera basti, Bomdila, West Kameng, 3.x.2001, coll. B. Mitra.

Distribution : India : Arunachal Pradesh (East & West Kameng, Papumpare).

Elsewhere : Widespread, Oriental, including China, Ryukyu Islands, Japan, Pacific, New Guinea, Solomon Islands, Bismark Archipelago, Darwin; Australia, Mauritius; Africa.

9. ***Dacus (Zeugodacus) scutellaris*** (Bezzi)

1913. *Bactrocera scutellaris* Bezzi, *Mem. Indian. Mus.*, 3 : 98.

Distribution : India : Arunachal Pradesh (Tirap), Uttar Pradesh, West Bengal.

Elsewhere : Myanmar, Nepal, Thailand.

10. ***Dacus (Zeugodacus) tau*** (Walker)

1849. *Dasyneura tau* Walker, *List Spec. Dipt. colln. Brit. Mus.*, 4 : 1074.

Material examined : 1♂, 1♀♀, Ganga Lake area, Papumpare dist., 28.v.2000, coll. B. Mitra; 1♂, 3♀♀, Sera basti, Bomdila, West Kameng, 3.x.2001, coll. B. Mitra.

Distribution : India : Arunachal Pradesh (Tirap, Papumpare, West Kameng), Bihar, Karnataka, Maharashtra, Meghalaya, Punjab, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Oriental (Widespread).

Fubfamily TRYPETINAE

Key to the genera

1. Pleuroterga with abundant erect fine hairs ... ***Ptilona*** van der Wulp

– Pleuroterga bare, except for microscopic pubescence 2

2. Six or more scutellar bristles present or if secondary scutellars are small, the wings dark brown hyaline wedges on margins and the body not polished black, female usually with three spermathicae 3

– Four (rarely two) scutellar bristles present 5

3. Mesopleuron not with a bristle on lower median portion; wings normal in shape 4

– Mesopleuron with a prominent bristle near lower edge centrally; wings broad about twice longer than wide ..... ***Hexacinia*** Hendel

4. Two or three pairs of inferior fronto orbital bristles ..... ***Rioxa*** Walker

– One pair of inferior fronto-orbitals; subcostal cell as long as 2nd costal; mesonotum sometimes with brownish vittae but not with isolated black spots ..... ***Acanthonevra*** Macquart

5. Arista plumose or pectinate; female usually with two spermathecae 6

– Arista pubescent or bare 10

6. Scutellum convex 7

– Scutellum flat 8

7. Humeral bristle strong ..... ***Xanthorrachis*** Bezzi

– Humeral bristles absent .... ***Anoplomus*** Bezzi

8. Fronto-orbital bristles lacking or represented by only small setae ..... ***Chaetellipsis*** Bezzi

– Fronto-orbitals well developed 9

9. 3rd antennal scgment rounded at apex ..... ***Gastrozona*** Bezzi

– 3rd antennal segment sharp pointed apico-dorsally ..... ***Acrotaeniostola*** Hendel

10. Thorax and abdomen polished black; wings predominantly dark brown, with hyaline wedges on anterior and posterior margins ..... ***Myoleja*** Rondani

Genus ***Acanthonevra*** Macquart

1843. *Acanthonevra* Macquart, *Mem Soc Sci Agric Lille* **1842** : 377.

Type-species : *Acanthonevra fuscipennis* Macquart

Key to the species

1. Wing *Hemilea*-like, anterior 2/3rd predominately dark brown, entire posterior margin broadly hyaline ..... *hemileina* Hening

– Not as above 2

2. Mesonotum with complete, or nearly complete, brown to black median or submedian vittae ..... *sormosana* Enderlein

– Mesonotum yellow medially, lacking complete vittae except along each lateral margin in some species ..... *dunlopi* (Wulp)

11. ***Acanthonevra dunlopi*** (Van der Wulp)

1880. *Ptilona dunlopi* van der Wulp, *Tijdschr. Ent.*, **5** 186.

Distribution : India : Arunachal Pradesh (Tirap), West Bengal.

Elsewhere : Indonesia, Myanmar, Nepal, Pakistan, Thailand.

12. ***Acanthonevra formosana*** Enderlein

1911. *Acanthonevra formosana* Enderlein, *Zool. Jb.* (syst.). **31** : 419.

Distribution : India : Arunachal Pradesh (Tirap).

Elsewhere : China, Taiwan, Laos, Myanmar, Nepal, South Vietnam, Thailand; Japan, Korea.

13. ***Acanthonevra hemileina*** Hering

1939. *Acanthonevra hemileina* Hering, *Verh. VIIth Intern. Kongr. Ent. Berlin*, 1938, **1** : 173.

Distribution : India : Arunachal Pradesh (Tirap), Tamil Nadu.

Elsewhere : Myanmar, Nepal, Thailand, Vietnam.

Genus ***Hexacinia*** Hendel

1914. *Hexacinia* Hendel, *Wien. Ent. Zeit.*, **33** : 82.

Type-species : *Scinia stellata* Macquart.

14. ***Hexacinia radiosa*** (Rondani)

1868. *Acinia radiosa* Rondani, *Ann. Soc. nat. hist. Modena*, **3** : 31.

Diagnosis : Apical half of the antenna brown to black; prominent black spot on each side of posterior margin of mesonotum, immediately in line with posterior margin of mesonotum, immediately in line with dorsocentral bristles; marginal wing spots enlarged, rather quadrate & the spot at apex of cell R_5 not filling the cell.

Distribution : India : Arunachal Pradesh (Tirap).

Elsewhere : Myanmar, Philippines, Sri Lanka, South Vietnam, Sumatera, Thailand.

Genus ***Rioxa*** Walker

1856. *Rioxa* Walker, *J. Proc. Linn. Soc. Lond. Zool.*, **1** : 35.

Type-species : *Rioxa lanceolata* Walker.

Key to the species

1. Four marginal hyaline spots on the wing, 4th. costal section of male very short about 1/2 as long as 5th ..... *parvipunctata* de Meijere

– Five or six marginal hyaline spots on wing; 4th costal section of male almost equal in length to 5th ..... *sexmaculata* (Van der Wulp)

15. ***Rioxa parvipunctata*** de Meijere

1911. *Rioxa sexmaculata* var. *parvipunctata* de Meijere, *Tijdschr. Ent.*, **1** : 381.

Distribution : India : Arunachal Pradesh (Tirap).

Elsewhere : Jawa, Sri Lanka, Thailand, Indonesia.

16. ***Rioxa sexmaculata*** (Van der Wulp)

1880. *Ptilona sexmaculata* Van der Wulp, *Tijdschr. Ent.*, **23** : 185.

Distribution : India : Arunachal Pradesh (Lohit), West Bengal.

Elsewhere : Indonesia, Myanmar, Philippines, Sumatra, Thailand.

Remarks : This species is reported earlier by Joseph & Rao (1976) as *Rioxa quinquemaculata* Bezzi.

Genus ***Sphaeniscus*** Becker

1908. *Sphaeniscus* Becker. *Mitt. Zool. Mus. Berl.*, **4** : 138.

Type-species : *Sphaeniscus brevicauda* Becker.

* 17. ***Sphaeniscus atilius*** (Walker)

1849. *Trypeta atilius* Walker, *List Dipt. Colln. Br. Mus.*, **4** : 1021.

Diagnosis : Wings dark brown with base hyaline, hyaline wedge on anterior margin in middle of wing and four hyaline wedges on posterior margin of wing, vein R_{4+5} bare and r-m crossvein stituated about its own length from m crossvein; surstylus broad, equal in width to epandrium and completely hides 10th sternum, aedeagus expanded at apex, piercer thicker at base, extended ovipositor, spermathecae weakly sclerotized.

Distribution : India : Arunachal Pradesh (East Siang).

Elsewhere : Widespread Oriental; Pacific, Japan, Korea, Moluccas.

Genus ***Ptilona*** Van der Wulp

1880. *Ptilona* van der Wulp, *Tijdschr. Ent.*, **23** : 183.

Type-species : *Ptilona brevicornis* van der Wulp.

18. ***Ptilona confinis*** (Walker)

1856. *Rioxa confinis* Walker, *J. Proc. Linn. Soc. Lond., Zool.*, **1** : 132.

Diagnosis : Thorax yellow, brown tinged with brown-black markings over pleura and metanotum, grey pubescence on mesonotum and scutellum, scutellum yellow; legs yellow with brown on apices on middle and hind femora; abdomen dark black to brown, 1st fergum tinged brown, 2nd tergum yellow, 3rd tergum yellow at base and brownish black over rest of segments, rest of abdomen black, in males 5th sternum narrow, wider than long and concave on hind margin, 6th sternum in females wider than long and covered with setae, three spermathecae present, base of ovipositor short, picrcer short, thick, blunt at apex.

Distribution : India : Arunachal Pradesh (East Siang).

Elsewhere : Widespread Oriental; Moluccas, S. W. Pacific, Asia.

Genus ***Acrotaeniostola*** Hendel

1914. *Acrotaeniostola* Hendel, *Wien. Ent. Zig* **33** : 80, 88.

Type-species : *Acrotaeniostola sexvittata* Hendel.

19. ***Acrotaeniostola apiventris*** Munro

1935. *Acrotaeniostola apiventris* Munro, *Rec Indian Mus* **37**(1) : 19.

Diagnosis : Charecterised by the brown thorax with a yellowish bar from humeri along side of dorsum above wing base to scutellum expanding to pleura including the mesopleura; wing with a series of disconnected brownish transverse bands; 2nd segment of the abdomen greatly developed.

Distribution : India : Arunachal Pradesh (Tirap), West Bengal.

Elsewhere : None.

Genus ***Anoplomus*** Bezzi

1913. *Anoplomus* Bezzi, *Mem Ind Mus*, **3** : 100

Type-species : *Anoplomus flexuosus* Bezzi.

20. ***Anoplomus flexuosus*** Bezzi

1843. *Tephritis fasciventris* Macquart, *Dipt Exot Suppl* **3** : 225(65).

Diagnosis : Wing apex rounded; middle & hind femora broadly brown to black at apices; 2nd costal cell dark brown except for a small hyaline spot towards the basal portion.

Distribution : India : Arunachal Pradesh (Tirap), Sikkim, West Bengal.

Elsewhere : Jawa, Philippines.

Genus ***Chaetellipsis*** Bezzi

1913. *Chaetellipsis* Bezzi, *Mem Ind. Mus.*, **3** 126

Type-species : *Chaetellipsis paradoxa* Bezzi

Key to the species

1. Mesonotum mostly yellow to rufous, lacking a

median vitta; femora yellow to rufous .... *paradoxa* Bezzi

– Mesonotum shining black on sides & posteriorly and with a black, median vitta extending the entrie length; apices of mid & hind femora blackened ..... *atrata* Hardy

21. *Chaetellipsis atrata* Hardy

1973. *Chaetellipsis atrata* Hardy, *Pacif. Ins. Monogr.*, **31** : 179.

Distribution : India : Arunachal Pradesh (Tirap).

Elsewhere : Jawa, Laos, Philippines.

22. *Chaetellipsis paradoxa* Bezzi

1913. *Chaetellipsis paradoxa* Bezzi, *Mem. Indian Mus.*, **3** : 127.

Distribution : India : Arunachal Pradesh (Tirap), common over the Indian subcontinent.

Elsewhere : Myanmar, Pakistan, Thailand.

Genus *Gastrozona* Bezzi

1913. *Gastrozona* Bezzi, *Mem. Indian Mus.*, **3** : 105.

Type-species : *Tephritis fasciventris* Macquart.

Key to the species

1. Wing with at least a prominent brown mark on costa at middle of cell R_1 .... *fasciventris* (Macquart)

– Cell R_1 hyaline except for a brown spot at apex; a brown spot present at apex of vein R_{4+5}, a faint brown preapical streak on vein M_{1+2}, apical pale brown mark over m cross-vein & a faint band across most of hind margin from r-m cross vein ..... *balioptera* Hardy

23. *Gastrozona balioptera* Hardy

1973. *Gastrozona balioptera* Hardy, *Pacif. Ins. Monogr.*, **31** : 188.

Distribution : India : Arunachal Pradesh (Tirap).

Elsewhere : Myanmar, Thailand.

24. *Gastrozona fasciventris* (Macquart)

1843. *Tephritis fasciventris* Macquart, *Dipt. Exot. Suppl.*, 3, 225(65).

Distribution : India : Arunachal Pradesh (Tirap) Assam, Kerala.

Elsewhere : Wide spread from Taiwan through China, Laos & Thailand.

Genus *Xanthorrachis* Bezzi

1913. *Xanthorrachis* Bezzi, *Mem. Indian Mus.*, **3** : 137.

Type-species : *Xanthorrachis annandalei* Bezzi.

Key to the species

1. Ocellar bristles moderately developed; 3 black spots on margin of scutellum; having a black spot on each humerus and 3 black spots on each side of mesonotum .. *assamensis* Hardy

– Ocellar bristles tiny; without black spots as above ..... *annandalei* Bezzi

25. *Xanthorrachis annandalei* Bezzi

1913. *Xanthorrachis annandalei* Bezzi, *Mem. Indian Mus.*, **3** : 138.

Material examined : 2♂♂, 1♀, Old Zero, Kurungkumey dist, 30.v.2000, coll. B. Mitra.

Distribution : India : Arunachal Pradesh (Tirap, Kurungkumey).

Elsewhere : Myanmar, Thailand, Laos, Vietnam.

26. *Xanthorrachis assamensis* Hardy

1973. *Xanthorrachis assamensis* Hardy, *Pacif. Ins. Monogr.* **31** : 283.

Material examined : 3♂, 2♀, Changlang dist. 23.ix.2000, coll. A. R. Lahiri.

Distribution : India : Arunachal Pradesh (Tirap, Changlang), Assam.

Elsewhere : None.

Genus *Myoleja* Rondani

1856. *Myoleja* Rondani, *Dipterol. ital. Prodt.* **1** : 112.

Type-species : *Tephritis lucida* Fallen.

27. ***Myoleja fossata*** (Febricius)

1805. *Tephritis. fossata* Fabricius, *Syst. Antiat.*, : 320.

Material examined : 3♂, 2♀, Daporizo guest house, Upper Subansiri dist. 3.vi.2000, coll. B. Mitra; 3♂♂, 4♀♀, Parasuram Kunda, Lohit dist. 17.ii.2003, coll. R. S. Mridha.

Diagnosis : Small sub shining black species having oblique preapical streak of brown extending from upper apex of cell 2nd M2 to vein R_{4+5} and a narrow hyaline streak through entire length of cell M4; 5th abdominal sternum in males longer than wide, hind margin straight and with about four small bristles on each side, surstyli in male genitalia long and slender, pointed apically and with appendages of apex of 10th sternum; in females abdomen entirely dark black to brown, 6th tergum 1/4 as long as 5th, basal position of ovipositor short and thick, piercer short and thick, tapered to a sharp apex, extended ovipositor.

Distribution : India : Arunachal Pradesh (East Siang, Lobit, Upper Subansiri), Kerala.

Elsewhere : Taiwan, Indonesia, Laos, Myanmar, Pakistan, Philippines, Singapore, Ryukyu Island, Vietnam, Japan, Moluceas, New "Ireland (Widespread oriental).

Subfamily SCHISTOPTERINAE

Genus ***Rhabdochaeta*** de Meijere

1904. *Rhabdochaeta* de Meijere, *Bijdr. Dierk.* **17** : 109.

Type-species : *Rhabdochaeta pulchella* de Meijere.

Diagnosis : 2 to 3 pairs of dc present; 3rd antennal segment elongate & pointed; palpi elongate, fringed with short black setae; some of the frontal bristles usually highly modified; 3rd costal section usually very short; cubital cell pointed at lower apex, not lobate.

28. ***Rhabdochaeta bakeri*** Bezzi

1913. *Rhabdochaeta bakeri* Bezzi, *Philipp. J. Sci* (1)**8** : 328.

Diagnosis : Characterised by a strong carinate projection in middle of face just below antennae & a black median spot below the projection; six scutellar bristles and a pair of prominent apical cruciate setae, sub costal cell with an incomplete brown streak through middle.

Distribution : India : Arunachal Pradesh (Tirap), Pusa.

Elsewhere : Laos, Philippines, Vietnam, Thailand.

Subfamily TEPHRITINAE

Key to the genera

1. Body shining balck, rather lightly grey pollinose, especially on abdomen; wings dark brown with large hyaline edges from anterior & posterior margins but a few hyaline spots in middle of the wings ..... ***Spathulina*** Rondani

– Not as above; abdomen densely pollinose; wings differently marked 2

2. 4 scutellar bristles ..... ***Platensina*** Enderlein

– 2 scutellar bristles ..... ***Dioxyna*** Frey

Genus ***Platensina*** Enderlein

1911. *Platensina* Enderlein, *Zool Jb.*, **31** : 454

Type-species : *Platensina sumbana* Enderlein.

29. ***Platensina acrostacta*** (Wiedemann)

1824. *Platensina acrostacta* Wiedemann. *Analecta Ent.* 54

Diagnosis : Frontal & ocellar bristles brownish yellow; 3rd antennal segment predominately dark brown in ground colour; face black, lower 1/2 densely silver grey pollinose, this pollen also extends as a narrow line along eye margin at each side of face; thorax mostly balck, densely covered with grey pollen; wings lacking a hyaline spot in apical portion of cell R_1 & usually with 2 hyaline spots in first M_2; abdomen mostly black; legs entirely yellow.

Distribution : India : Arunachal Pradesh (East Siang), Bihar, Tamil Nadu, West Bengal.

Elsewhere : Cambodia, Pakistan, Sri Lanka, Thailand.

Genus ***Spathulina*** Rondani

1856. *Spathulina* Rondani, *Dipt. Ital. Prodr.*, **1** : 113.

Type-species : *Spathulina sicula* Rondani.

30. ***Tephritis acroleuca*** (Schiner)

1824. *Tephritis acroleuca* Schiner, *Reise Novara. Dipt.*, : 268.

Diagnosis : A small dark coloured species with largely dark brown to black wings, containing hyaline spots along margin, with the apical portion of wing completely hyaline or with just a tiny dark brown spot at extreme apex of cell R3 and with only 2 or 3 isolated byaline spots in the wing field.

Distribution : India : Arunachal Pradesh (Tirap), West Bengal.

Elsewhere : Wide spread throughout Africa, Asia, Australia, Pacific, Indonesia, Bonin Islands, Japan, Formosa, Ryukyu Islands, Solomon Islands, New Guinca, New Caledonia, Philippines, Fiji, Micronesia, Laos, Thailand, Vietnam.

Genus ***Dioxyna*** Frey

1944. *Dioxyna* Frey, *Comm. Biol. Soc. Fenn.*, **8**(10) : 62.

Type-species : *Trypeta sororcula* Wiedemann.

31. ***Dioxyna sororcula*** (Wiedemann)

1830. *Trypeta sororcula* Wiedemann, *Aussereurop. zweifl. Ins.*, **2** : 509.

Diagnosis : Characterised by having only 2 scutellar bristles and the head longer than high, longest on the lower margin, with the epistoma & sides of face protruded; wings hyaline with numerous somewhat diffused brown spots.

Distribution : India : Arunachal Pradesh (Tirap).

Elsewhere : Wide spread throughout the tropies & subtropics.

Family SCIOMYZIDAE

Subfamily SCIOMYZINAE

Diagnosis : Wing with bare vein R_1; veins R_{4+5} & M_{1+2} parallel or only slightly converging apically, anal cell without triangular extension ventro-apically; mid & hind tibiae without median setae.

Genus ***Sepedon*** Latreille

1804. *Sepedon* Latreille, *Nouv. Dict. Hist. nat.* **24** : 196.

Type-species : *Syrphus sphegeus* Fabricius.

Diagnosis : Slender flies with practically immaculate wings; frons deeply excavated & ridged; ocellar bristles microscopic or absent; lunule prominent; scutellum with only two approximated apical bristles; hind tibiae without preapicals; pleura & abdomen without characteristic bristles; antennal segment 2 elongate.

32. ***Sepedon plumbella*** Wiedemann

1830. *Sepedon plumbella* Wiedemann, *Aussereurop. zweifl. Insekt*, **2** : 577.

Material examined : 1♂, 1♀, Bhismarknagar, Lower Dibang valley dist. 21.ii.03, coll. R. S. Mridha.

Diagnosis : Antennal scape reddish yellow, remainder nearly or quite black; wing with clear basal half & dark apical half or so; hind femur usually reddish on apical half.

Distribution : India : Arunachal Pradesh (Lower Dibang valley), Bihar, Himachal Pradesh, Tripura, West Bengal.

Elsewhere : Throughout Oriental Region; Australia, New Caledonia, New Guinca, Solomon Islands.

Family SEPSIDAE

Key to the subfamily

1. Large size, with dull shining black body; middle femur bent at middle..... TOXOPODINAE
- Medium to small size with reddish to black body; middle femur not bent at middle..... ..... SEPSINAE

Subfamily SEPSINAE

Diagnosis : Medium or small in size, with reddish to black body and at least mesopleuron

glossy; inner vertical bristles present; mid-femur normal and not bent at middle.

Key to the genera

1. Abdomen in both sexes with distinct macrochaetae; epandrial process bifurcate at the tip ..... ***Dicranosepsis*** Duda
- Abdomen in male, often in female also, with distinct macrochaetae, epandrial process not bifurcate at the tip ..... ***Sepsis*** Fallen

Genus ***Dicranosepsis*** Duda

1926. *Dicranosepsis* Duda, *Annln. Naturh. Mus. Wien.*, 39(1925) : 43.

Type-species : *Sepsis bicolor* Wiedemann.

33. ***Dicranosepsis bicolor*** (Wiedemann)

1830. *Sepsis bicolor* Wiedemann, *Aussereurop. zweifl. Insekt.* 2 : 645.

Diagnosis : Sternopleuron shining anteroventrally; fore femur without a postero-ventral seta sub basally, hind tibia without a distinct osmeterium and metatarsus without antero-ventral setae in males.

Distribution : India : Arunachal Pradesh (Tirap), Andhra Pradesh, Assam, Maharashtra, Meghalaya, Sikkim, Tripura, Punjab, Uttar Pradesh, West Bengal.

Elsewhere : Other parts of Oriental region; Japan & Australian Region.

Genus ***Sepsis*** Fallen

1810. *Sepsis* Fallen, *Spec. Ent. Meth. Exh.* : 17.

Type-species : *Sepsis cynipsea* Linnaeus.

Key to the species

1. Wing with a dark spot at the end of vein R_{2+3} 2
- Wing without a dark spot at the end of vein R_{2+3}; thorax with a broad black dorsal stripe ..... *indica* Wiedemann
2. Sternopleuron entirely prunose; wing spot angular ..... *himalayensis* Brunetti
- Sternopleuron mainly shiny; wing spot rounded ..... *albopunctata* Lamb

34. ***Sepsis albopunctata*** Lamb

1914. *Sepsis albopunctata* Lamb, *Trans. Linn. Soc Lond Zool.*, (2)16 : 323.

Material examined : 1♂, 1♀, Ganga lake area, Papumpare dist. 28.v.2000, coll. B. Mitra; 1♂ 1♀, Sera basti, Bomdila, West Kameng, 3.x.2001, coll. B. Mitra.

Distribution : India : Arunachal Pradesh (Tirap, Papumpare, West Kameng), Andhra Pradesh, Assam, Bihar, Meghalaya, Kerala, Sikkim, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : Borneo, Celebes, China, Taiwan, Jawa, Lesser Sunda Islands, Malayasia, Nepal, Philippines, Ryukyu Islands, Singapore, Sri Lanka, Sumatera, Thailand, Vietnam; Australasian; Ethiopian.

35. ***Sepsis himalayensis*** Brunetti

1910. *Sepsis himalayensis* Brunetti, *Rec. Indian Mus.* 3(1909) : 345.

Distribution : India : Arunachal Pradesh (Tirap), Meghalaya, Sikkim, West Bengal.

Elsewhere : Myanmar, Nepal, Pakistan.

36. ***Sepsis indica*** Wiedemann

1824. *Sepsis indica* Wiedemann, *Analecta Ent.*, : 57

Material examined : 3♂ Parasuram Kunda, Lohit dist. 17.ii.2003, coll. R. S. Mridha; 2♀, Daporizo guest house, Upper Subansiri dist. 3.vi.2000, coll. B. Mitra.

Distribution : India : Arunachal Pradesh (Tirap, Lohit, Upper Subansiri), Assam, Bihar, Karnataka, Kerala, Maharashtra, Orissa, Sikkim, Tamil Nadu, West Bengal.

Elsewhere : Bangla Desh, Borneo, Celebes, China, Taiwan, Jawa, Lesser Sunda Islands, Malayasia, Nepal, Philippines, Sri Lanka, Sumatera, Vietnam; Australasian; Palaearctic.

Subfamily TOXOPODINAE

Genus ***Toxopoda*** Macquart

1850. *Toxopoda* Macquart, *Dipt. Exot. Suppl.* **4** : 299.

Type-species : *Toxopoda nitida* Macquart.

Diagnosis : Large size with dull shining black body; mouth opening large; outer vertical bristles present; mesonotum and pleura with short downy hairs; middle femur bent at middle part.

Key to the species

1. Fore femur little swollen beyond middle bearing 5-6 short spines on it and tibia bears a few short spines at base ..... *adjuncta* Brunetti

– Fore femur not swollen, but with a few short bristles in the middle and tibia with a row of short spines all through .... *viduata* (Thomson)

37. ***Toxopoda adjuncta*** Brunetti

1910. *Toxopoda adjuncta* Brunctti, *Rec. Indian Mus.*, **3**(1009) : 361.

Distribution : India : Arunachal Pradesh (Tirap), Kerala.

38. ***Toxopoda viduata*** (Thomson)

1869. *Toxopoda viduata* Thomson, *K. Sevenska. Fregatten Eugene Resa. Zool. Dipt.* : 586.

Distribution : India : Arunachal Pradesh (Tirap).

Elsewhere : China, Taiwan.

Family CALLIPHORIDAE

Key to the subfamilies

1. Stem-vein of wing not setulose on upper side of basal section ..... CALLIPHORINAE

– Stem-vein of wing with distinct setulae on posterior upper side of its basal scetion 2

2. The small rounded protuberance below base of wing (subalar knob) frequently with erect hairs; lower calypter subtruncate at apex, concave on outer margin, haired on part of upper surface ..... CHRYSOMIINAE

– The small rounded protuberance below base of wing (subalar knob) bare or without distinct hairs; lower calypter rather narrowly rounded at apex, straight or nearly so on outer margin, bare or without distinct hairs .... RHINIINAE

Subfamily CALLIPHORINAE

Key to the genera

1. Lower lobe of squama with hairs or with a patch of small setulae towards inner margin ..... ***Calliphora*** Robineau-Desvoidy

– Lower lobe of squama quite bare 2

2. Postsutural dorso-centrals 4; base of third longitudinal vein with a few bristles both above and below ..... ***Catapicephala*** Macquart

– Postsutural dorso-centrals 3; third longitudinal vein bristly both above and below as far as small cross vein ..... ***Lucilia*** R-D

Genus ***Calliphora*** Robineau-Desvoidy

1830. *Calliphora* R & D, *Mem. Pres. div. Sav. Acad. Sci. Inst. Fr.*, : 433.

Type-species : *Musca vamiforia* Linnaeus.

Subgenus ***Calliphora*** Robineau-Desvoidy

Diagnosis : Body bluish black; presutural intra alar bristles present; lower squama entriely with hairs on upper surface.

39. ***Calliphora (Calliphora) vicina*** Robineau Desvoidy

1830. *Calliphora vicina* Robineau-Desvoidy, *Mem. Pres. div. Acad. Sci. Inst. Fr.*, : 435.

Material examined : 3♂♂, 4♀♀, Sera basti, Bimdila, West Kameng, 3. x. 2001, coll. B. Mitra.

Diagnosis : Thorax dull bluish black; abdomen greenish blue partially silver dusted; presutural intraalar bristle present, acrostichals 2-3, dorsocentral 2-3. facialia and jowls reddish, with black hairs; eyes in ♂ separated by a distance equal to $1^1/_2$ times width of 3rd antennal segment.

Distribution : India : Arunachal Pradesh (West Kameng), Himachal Pradesh, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : China, Nepal, Pakistan; U. S. Japan, Australia; New Zealand, Europe; Egypt.

Genus ***Catapicephala*** Macquart

1851. *Catapicephala* Macquart, *Mem. Soc. Sci. Agric Lille.*, : 210.

Type-species : *Catapicephala splendens* Macquart.

40. ***Catapicephala splendens*** Macquart

1851. *Catapicephala splendens* Macquart, *Mem. Soc. Sci. Agric Lille.*, : 210.

Diagnosis : Thorax shining metallic green, lightly pale grey dusted anteriorly and on pleura; three pairs marginal and one pair discal scutellar bristles; abdomen shining metallic green, slightly silver dusted on venter, third and fourth visible segments with a complete row, no discal bristles.

Distribution : India : Arunachal Pradesh (Tirap).

Elsewhere : Borneo, Jawa, Malaya, Myanmar, Singapore.

Genus ***Lucilia*** Robineau-Desvoidy

1830. *Lucilia*R-D, *Mem. Pres. div. Sav. Acad. Sci. Inst. Fr.*, : 452.

Type-species : *Musca caeser* Linnaeus.

Key to the species

1. Costa infuscated; parafacialia with a row of minute hairs ..... *fumicosta* Malloch
- Wings hyaline; parafacialia bare 2
2. Antennae reaching upper margin of epistome; one anterodorsal bristle on middle tibia .... *porphyrina* (Walker)
- Antennae not reaching upper margin of epistome; two anterodorsal bristles on mid tibia ..... *papuensis* Macquart

41. ***Lucilia fumicosta*** Malloch

1926. *Lucilia fumicosta* Malloch, *Ann. Mag. Nat. Hist* (9)17 : 507.

Material examined : 5♂, 4♀, Parasuram Kunda, Lohit dist. 17.ii.2003, coll. R. S. Mridha; 3♂, 2♀, Daporizo guest house, Upper Subansiri dist. 3.vi.2000, coll. B. Mitra.

Diagnosis : Eyes at point of closest approximation separated by a distance equal to half the width of third antennal segment in male, in female distance equal to quarter width of head; thorax shining green, two postsutural acrostichals; abdomen shining green, the posterior margins of the second and third abdominal segments sometimes dark-margined.

Distribution : India : Arunachal Pradesh (East & West Kameng, Lohit, Upper Subansiri).

Elsewhere : Philippine Islands.

42. ***Lucilia papuensis*** Macquart

1842. *Lucilia papuensis* Macquart, *Mem. Soc. Sci Agric Lille.*, : 298.

Material examined : 3♂♂, 3♀♀, Daporizo guest house, Upper Subansiri dist.; 3.vi.2000, coll. B. Mitra; 1♂, 1♀, Ganga Lake area, Papumpare dist., 28.v.2000, coll. B. Mitra.

Diagnosis : Frons obliterated for a short space, parafrontalia much narrowed; thorax shining green to purple, lightly dusted anteriorly; abdomen shining green to purple, the posterior margins of the second and third visible segments sometimes darkened. Antennae not reaching upper margin of epistome; with two anterodorsal bristles on mid-tibia.

Distribution : India : Arunachal Pradesh (Upper Subansiri, Papumpare), Malabar coast.

Elsewhere : Ambina, Borneo, Celebes, Jawa, Lombok, Malay peninsula, New Guinea, Siam; Simbawa Islands, Sri Lanka, S. China, Philippine Islands, Ternate, Japan, Australia.

43. ***Lucilia porphyrina*** (Walker)

1856. *Musca porphyrina* Walker, *Journ Proc Linn Soc Lond.*, 1 : 24.

Material examined : 1♂, 2♀♀, Ganga Lake area, Papumpare dist. 28.v.2000, coll. B. Mitra.

Diagnosis : Eyes more closely approximated than in *Lucilia papuensis* Macquart; the parafrontalia being reduced to a fine line; third segment of antenna five times as long as second, narrower in male than in female, dark brown; parafacialia brown with a silvery sheen; thorax green to purple, very slightly dusted in front, two pairs of postsutural acrostichals which lie in front of the two corresponding pairs of postsutural dorsocentral bristles.

Distribution : India : Arunachal Pradesh (Lohit, Papumpare), Assam, Himachal Pradesh, J & K, Sikkim, West Bengal.

Elsewhere : China, Hong-Kong, Jawa, Philippine Islands, Sri Lanka, Sumatra, Japan, Australia.

Subfamily CHRYSOMINAE

Genus ***Chrysomya*** Robineau-Desviody

1830. *Chrysomya* R-D, *Mem Pres Div Sav Acad Sci. Inst. Fr.*, : 444.

Type-species : *Chrysomya regalis* R-D.

Diagnosis : Generally medium-sized flies of metallic green, blue or purple colour; eyes large and bare, usually holoptic and upper facets enlarged in males but dichoptic and with small uniform facets in females; presutural acrostichal bristle absent; propleuron and prosternum hairy; supra-squamosal ridge usually with anterior parasquamosal tuft; subcostal sclerite hairy; tergum 5 with fine erect bristles on disc.

Key to the species

1. Parafacialia and jowls brilliant orange, the latter clothed with golden hairs 2
- Parafacialia never brilliant orange 3
2. Eye in male sharply demarcated, upper two-thirds with large facets, lower one-third with small facets; squama brown .... *megacephala* (Fabricius)
- Eye facets in male small and uniform; squama more whitish ..... *bezziana* Villeneuve
3. Face covered with grey tomentum; subcostal sclerite with a few fine bristles .... *defixa* (Walker)
- Face dark reddish, jowls grey, black-haired; subcostal sclerite covered with pubescence .. .. *pinguis* (Walker)

44. ***Chrysomya bezziana*** Villeneuve

1914. *Chrysomya bezziana* Villeneuve, *Rev. Zool. Afr.*, Iii, P. 430.

Material examined : 7♂, 2♀, Daporizo guest house, Upper Subansiri dist. 3.vi.2000, coll. B. Mitra.

Distribution : India : Arunachal Pradesh (East & West Kameng), & other's states.

Elsewhere : Philippine Islands, Sri Lanka, Tong-king, Ethiopian.

45. ***Chrysomya defixa*** (Walker)

1856. *Musca defixa* Walker, *Proc. Linn. Soc. Lond.* I, 24.

Material examined : 1♂, 1♀, Ganga Lake area, Papumpare dist. 28.v.2000, coll. B. Mitra, 1♂, 1♀,

Distribution : India : Arunachal Pradesh (Papumpare).

Elsewhere : Philippines, Singapore.

46. ***Chrysomya megacephala*** (Fabricius)

1794. *Musca megacephala* Fabricius, *Syst. Ent.*, **4** : 317.

Distribution : India : Arunachal Pradesh (East & West Kameng), and also in other states in India.

Elsewhere : Oriental region, North China and Japan of the Palaearctic region; Australasian region; Malagasy sub-region of the Ethiopian region.

47. ***Chrysomya pinguis*** (Walker)

1858. *Lucilia pinguis* Walker, *Ent. Soc. Lonmd.* Iv, P. 213.

Distribution : India : Arunachal Pradesh

(Lohit), Andhra Pradesh, Assam. Meghalaya, Himachal Pradesh, Tamil Nadu, West Bengal.

Elsewhere : Bangladesh, China, Hong-Kong, Java, Malaya, Sri Lanka, Thailand, Japan, Korea.

Sunfamily RHINIINAE

Key to the genera

1. Arista pectineted i.e., ciliate on upper side only; hind tibia with a conspicuous row of subequal antero-dorsal setae longer than normal hairs; abdomen usually of dark colour ....*Stomorhina* Rondani

– Arista pubescent or plumose 2

2. Arista pubescent..... *Chlororhinia* Townsend

– Arista plumose, fairly long hairs on both upper and lower surface 3

3. Presutural acrostichal and dorsocentral bristles distinct..... *Cosmina* Robineau-Desvoidy

– Presututal acrostichal and dorsocentral bristles prominent .....*Isomyia* Walker

Genus ***Chlororhinia*** Townsend

1917. *Chlororhinia* Townsed, *Rec. Indian. Mus.*, **13** : 191.

Type-species : *Cholororhinia viridis* Townsend.

48. ***Chlororhinia exempta*** (Walker)

1857. *Idia exempta* Walker *Journ. Linn. Soc. Lond.* **1** : 128.

Material examined : 1♂, 1♀, Bhismarknagar, Lower Dibang Valley dist. 21.ii.2003. coll. B. Mitra.

Diagnosis : Male subholoptic head; Female frontal width about one-quarter of head; frons balck; parafacialia silvery pollinose above, opposite antennal roots, rest of head brilliant metallic-green; antcnnae fulvous, third segment pollinose; palpi blackish; thorax bright metallic-green to blackish-blue, covered with black setifcrous dots; pleural hairs tawny; abdomen bright metallic-green, covered with balck sctiferous spots.

Distribution : India : Arunachal Pradesh (U.Subansiri, Lower Dibang Valley), Assam, Meghalaya, Manipur.

Elsewhere : Borneo, Sarawak, Nepal, Philipine.

Genus ***Cosmina*** Robineau-Desvoidy

1830. *Cosmina* R-D. *Mem. pres. div. Sav. Acad Sci Inst Fr.*, 423.

Type-species : *Cosmina fuscipennis* R-D.

Key to the species

1. Antennae yello-brown ..... *bicolor* (Walker)

– Anteanae black on dark brown .... *biplumosa* (Senior-White)

49. ***Cosmina bicolor*** (Walker)

1856. *Idia bicolor* Walker *J. Linn. Proc Linn. Soc.* **1.** : 23. 77.

Distribution : India : Assam, Arunachal Pradesh (Lower Subansiri), Karnataka, Tamil Nadu and Indo Gangetic Plain.

Elsewhere : Bangaladesh, Borneo, Java, Malaya, Myanmar, Sri Lanka, Thailand.

50. ***Cosmina biplumosa*** (Senior-White)

1924. *Stomorhina biplumosa* Senior-White, *S. Pol., Zeyl* xiii. : 110.

Distribution : India : Assam, Arunachal Pradesh (Lower Subansiri).

Elsewhere : Malaya, Sima, Sumalia, Thailand.

51. ***Cosmina simplex*** (Walker)

1857. *India simplex* Walker, *Trans Ent Soc Lond N S*, iv. : 212.

Distribution : India : Arunachal Pradesh, (East Kameng, Lower Subansiri), Assam, Kerala.

Elsewhere : Bhutan, Borneo, Scycchelles, Islands, Sumatra.

Genus ***Strongyloneura*** Bigot

1886. *Strongyloneura* Bigot, *Bull Soc ent. Fr* **1886** : 15

Type-species : *Strongyloneura prasina* Bigot.

52. ***Strongyloneura delectans*** (Walker)

1860. *Isonyia delectans* Walker *Proc. Linn. Soc. Lond,* Zool, **4** : 134.

Diagnosis : Length 12-15 mm. Head : in male subholoptic, eye-facets not noticeably differing in size. Female frons broad, the brown frontal stripe broader than one of theycllowish to grayish parafrontalia, which show black where rubbed. Parafacialia concolorous. Face yellowish to brown, carina distinct. Antennae testaceous, short, not nearly reaching level of bottom of eye. Thorax : the ususl bright metallic green with some reddish reflections. No traces of vittae. Chactotaxy : acrostichals 3 : 4, the first presutural weakup dorso-centrals 2 : 4. Scutellum brighter coloured than mesonotum, sometimes with cupreous reflections. Mesopleura with soft grey hairs on posterior margin, amaong the usual black bristles, more prominent in female than in male. Postalar declivity weakly pale-haired. Abdomen : green, with red or cupreous reflections. half of first visible segment black.

Distribution : India : Arunachal Pradesh (Lower Subansiri), Assam.

Elsewhere : Celebes, Laos, Myanmar, Philippine, Islands.

Genus ***Stomorhina*** Rondani

1861. *Stomorhina* Rondani, *Dipt. Ital. Prodr.*, **4** : 9.

Type-species : *Musca lunata* Fabricius

53. ***Stomorhina discolor*** (Fabricius)

1794. *Musca discolor* Fabricius, *Ent. Syst.*, **4** : 320.

Naterila examined : 1♂2♀, Daporizo guest house; Upper Subansiri dist., 3.vi.2000, coll. B. Mitra. 4♂, 7♀, Ganga Lake area, Papumpare dist. 28.v.2000. coll. B. Mitra.

Diagnosis : Length 6-7 mm. Antenna and palpus brown; wing with cell R 5 narrowly open; abdomen yellowish, with black bands posteriorly on terga 1 and 2 with a median longitudinal black stripe.

Distribution : India : Arunachal Pradesh (East & West Kameng, Lower & Upper Subansiri Papumpare), Assam, Bihar, Kerala, Manipur, Meghalaya, Tripura, Uttar Pradesh and West Bengal.

Elsewhere : Sri Lanka, Malaya, Java, Borneo, Philippine, Islands, Hong-Kong. Buru Island, North Australia; New Caledonia, Fiji.

Family SARCOPHAGIDAE
Subfamily SARCOPHAGINAE

Diagnosis : Flies are small to large in size & usually grayish to black in colour with three dark longitudinal stripes on thorax & cheekered pattern on abdominal tergites. Arista pubescent to plumose n basal two-thirds; notopleuron with 2 strong primary and 2 smaller sub primary bristles, male sternites 3 to 4 free; hind coax with hairs on posterior surface; stem-vein of wing setulose on posterior upperside of its basal section.

Key to the tribes

1. Phalic tube present; styli of glands absent; division of theca and paraphallus in pems not distiner ..... **Ravinllnl**

– Phallic tube absent; styli of glans generally present or may be absent; division of the ca and paraphalus in penis distinct .... **Sareophaginl**

Tribe Raviniini
Genus ***Ravinia*** Robineau-Desvoidy

1863. *Ravinia* R-D, *list. nat. Dipt. Parts.* **2** : 434.

Type-species : *Sareophaga haemdtodes* Meigen (=*Musca perimxplans*).

Diagnosis : Third antennal segment about twice that of the second and reaching up to about lower margin of eye RI usually bare, rarely setose mid tibia without bristles on ventral surface. first genital segment with several strong marginal bristles; second genital segment reddish-orange, the ca very short and fused with paraphallus.

54. ***Ravinia pernix*** (Harris)

1780. *Musca pernix* Harris, *Exp. Engl, Ins.* : 84.

1937. *Ravinia striata* : Rohdendrof, *Faunna USSR, Dipt.*, **19**(1) : 391.

1987. *Ravinia pernix* : Pape, *Fauna ent. Scand.*, 19 : 42.

Diagnosis : Thorax blackish to brown with three black longitudinal stripes; ac 2+1; de 3+3; in 0+3; upper part of propleura well developed and accompanied with short hairs; wings hyaline with brown veins; RI bare; R4+5 with a row of about 9-11 short setae located dorsally and extending up to more than half from the basal node to r-m and several short setae along ventral surface of basal node of R4+5; legs black; abdomen black with golden checkered pattern; first genital segment reddish or brown with 6 marginal bristles, second reddish orange but without marginal bristles.

Distribution : India : Arunachal Pradesh, Bihar, Himachal Pradesh, J & K, Uttaranchal, West Bengal.

Elsewhere : Bangladesh, Bhutan, Nepal, Palaearctic.

Tribe ***Sarcophagini*** Macquart

Key to subtribes

1. Penis very large, slightly sclerotised and vesiculate; lateral plate of paraphallus ill-developed ..... *Seniorwhiteina* Rohdendoft
- Penis short, heavily sclerotised; lateral plate of paraphallus well-developed 5
2. Apical part of paraphallus always large, clearly demarcated, sclerotised and often bearing many processes or protuberandes; propleura sometimes setiferous; postabdomen sometimes light coloured; lateral plate of paraphallus usually well-developed, often intricately constructed and erect; basal part of styli coiled .... *Parasarcophagina* Rohdendorf
- Apical part of paraphallus with long, slender, more or less cylindrical processes which are more delicate than basal part; propleura bare, postabdomen always black; lateral plate of paraphallus in the form of short hamate processes; basal part of styli straight .... *Hapragophallina* Rohdendorf

Subtribe ***Parasarcophagina*** Rohdendorf

Key to the genera

1. Upper part of propleura covered with balck hairs, often rather densely so 2
- Upper part of propleuron bare 3
2. Presutural ac bristles distrinct; 4th obdominal sternite of male with a dark spots and short black bristles .... ***Sarcorohdendorfia*** Baranov
- Presutural ac bristles distinct; 4th abdominal sternite of male without dark spots .... ***Boettcherisca*** Rohdendorf
3. Paraphallus very large and longer than theca; lateral plate of paraphallus with a pair of very large sharp forward protruding processes, apical part of paraphallus small, but clearly demarcated extending forward but without lateral process ..... ***Bercaea*** Robineau-Desvoidy
- Paraphallus rarely longer than theca; lateral plate of paraphallus varied in structure and not clearly demecared but with long lateral prcess, apical part of paraphallus well demarcated with slender process 4
4. Third abdominal tergite normally without long bristles in the middle of Posterior margin; apical part of Paraphallus aways small .... ***Parasarcophaga*** Johnston & Tiegs
- Third abdominal tergite with long crect bristles in the middle of posterior margin, apical part of paraphalius very large .... ***Robineaulla*** Enderlein

Genus ***Bercaea*** Robineau-Desvoidy

1863. *Bercaea* Robineau-Desvoidy, *Hist. Nat. Dipt. Paris* 2 : 549.

Type-species : *Musca haemorrhoidalis* (Fahen)

55. ***Bercaea cruentata*** (Meigen)

1816. *Musca naemorrhoidalis* Fallen, *K. svenska vetensk. Akad. Handal.*, 237.

1986. *Bercaea cruentata* : Verves, *Cat Palae Dipt.* 12 : 159.

Material examined : 2♂♂,1♀ Upper Subansiri Dist. 22.v.1966. 2♂♂, East Kameng Dist., 1.v.66, coll. A.N.T. Joseph & party, 2 ♂♂, 7♀♀ Bhalukpong riverside forest, Bhalukpong, West Kameng Dist., 25.ix.2000. Alt. 200 mts. Coll. B. Mitra.

Diagnosis : Width of frons about three-fifths that of one eye, frontal vitta black; thorax grey with yellowish pollen and three black longitudinal stripes; propleuron bare; abdominal segment 2 without marginals; no costal bristles; mid-tibia with an inconspicuous apical fringe; hind tibia double fringed; inner forcep is dorsally hollowed and shows a sharp angle on the inner edge and paraphallus with well developed apical plate of paraphallus and ventralia, theca is very short and the paraphallus is very elongated and much sclerotised.

Distribution : India : Widespread in the Himalayas from Himachal Pradesh to Arunachal Pradesh (East & West Kameng, Lower & Upper Subansiri).

Elsewhere : Bhutan, Nepal, Thailand, Palaearctic, Africa; America.

Genus ***Boettcherisca*** Rohdendorf

1937. *Boettcherisca* Rohdendorf, *Fauna USSR, Dipt.* **19**(1) : 270.

56. ***Boettcherisca (s. str.) peregrina*** (Robineau-Desvoidy)

1830. *Myophora peregrina* Robineau-Desvoidy, *Mem. pres. div. Sav. Acad. Sci. Inst. Fr.*, (2) **2** : 356.

Material examined : 3♂, 2♀, Daporizo guest house, Upper Subansiri dist. 3.vi.2000, coll. B. Mitra.

Diagnosis : Width of frons about two-fifths that of one eye, frontal vitta black; antenna blackish brown and reaching up to about 0.8 distance to vibrissae, arista long, plumose along basal 2/3rds; thorax blackish, silver to golden pollen and with three black longitudinal stripes; wings hyaline with brown veins; legs black, fore femur with a pair of rows of bristles along posterodorsal surface and a row of bristles along posterior margin of ventral surface; abdomen black, with silvery checkered pattern; first genital segment black with black hairs, second blackish brown with black hairs but without marginal bristles; inner forceps blunt at apex and with many lateral subpical spines, outer forceps almost triangular, broad at apex and with hairs along distal half, theca shorter than paraphallus, both are sclerotized, lateral plate of paraphallus well developed with a pair of short, two-pointed equal lateral process.

Distribution : India : Arunachal Pradesh, (Upper Subansiri), Anadaman & Nicobar Islands, Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Manipur, Meghalaya, Nagaland, Orissa. Sikkim. Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, Bhutan, Myanmar, Nepal, Sri Lanka, Australia, Palaearctic, Ethiopian.

Genus ***Parasarcophaga*** Johnston & Tiegs

1921. *Parasarcophaga* Johnston & Tiegs, *Proc. R. Soc. Qd.* **33**(4) : 86.

Type-species : *Sarcophaga omega* Johnston and Tiegs. (=*Sareophaga seriea* Walker, 1852).

Key to subgenera

1. Lateral plate of paraphallus in the form of lamellate hook-shaped process 2

– Lateral plate of paraphallus in the form of an unpaired pedunculate process .... ***Parasarcophaga*** Johnston & Tiegs

2. Lateral plate of paraphallus rudimentary, posterior part of penis membranous owing to division along median line of basal part of paraphallus; lateral processes of apical part of paraphallus with sharp teeth extending forward ..... ***Liopygia*** Enderlein

– Lateral plate of paraphallus well developed; posterior part of penis invariably selerotised; lateral processes of apical part of paraphallus without teeth extending forward 3

3. Lateral plate of paraphallus in the form of narrow stout process extending forward, apical part plate-like, narrow in profile and extending forward ..... ***Curranea*** Rohdendorf

– Lateral plate of paraphallus lamellate or slender and sharp, not erect and not stout; apical part extending distal, not pointed and extending forward ..... ***Liosarcophaga*** Enderlein

Subgenus ***Liopygia*** Enderlein

1928. *Liopygia* Enderlein, *Arch. klassif. phylogen,* Ent., 1(1) : 41.

Type-species : *Musca ruficornis* Fabricius

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

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

Material examined : 1♂, 1♀, Ganga Lake area, Papumpare dist. 28.v.2000. coll. B. Mitra.

Diagnosis : Width of frons about two-fifths of eye; frontal vitta black; silvery pollen and with three black longitudinal stripes; wings hyaline with brown veins; legs black; fore femur with a pair of rows of bristles along posterodorsal surface and a row of bristles along posterior margin of ventral surface; abdomen black with silvery checkered pattern; penis with membranous bulbous portion in between theca and paraphallus, apical plate of paraphallus not sclerotised but composed of two plates, one of which with a backwrdly projecting spines.

Distribution : Arunachal Pradesh, (Papumpare), Andhra Pradesh, Bihar, Delhi, Goa, Gujarat, Himachal Pradesh, Haryana, Karnataka, Kerala, Meghalaya, Manipur, Mizoram, Madhya Pradesh, Nagaland, Orissa, Pondicherry, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, Anadaman & Nicobar Islands.

Elsewhere : Bangladesh, Bhutan, Nepal, Pakisthan, Sri Lanka.

Subgenus ***Liosarcophaga*** Enderlein

1928. *Liosarcophaga* Enderlein, *Arch. klassif. phyl,* Ent., 1(1) : 18.

Type-species : *Cynomia maderiensis* Schiner.

Key to the species

1. Hind tibia with a single fringe, apical process of paraphallus finger-like with bifurcated tip, juxtal process short and stout .... *brevicornis* (HO)

– Hind tibia double-fringed; apex of paraphallus pointed with a subapical process having bifurcated tip; juxtal process long and slender ..... *dux* Thomson

58. *Parasarcophaga (Liosarcophaga) brevicornis* (HO)

1934. *Sarcophaga brevicornis* Ho. *Bull. Fan Mem Inst Biol.*, 5 : 23.

Material examined : 1♂ Tamen, Subansiri Dist., Alt. 305 m, 18.v.1966, coll. A.N.T. Joseph and party.

Distribution : India : Arunachal Pradesh, (East & West Kameng, Lower & Upper Subansiri), Assam, Bihar, Gujarat, Himachal Pradesh, Meghalaya, Mizoram, Nagaland, Orissa, Rajasthan, Tamil Nadu, Tripura and West Bengal.

Elsewhere : Huinan Islands, Kalimantan, Malaysia, Ryukyu Islands, South China, Sri lanka, Taiwan and Thailand; Korea, Japan and North China.

59. *Parasarcophaga (Liosarcophaga) dux* Thomson

1868. *Sarcophaga dux* Thomson. K. Svenska Fregatten Engenics Resa. Dipt. 2 : 534.

Distribution : India : Arunachal Pradesh, (West Kameng, Lower Subansiri), Andhra Pradesh, Andaman Islands, Assam, Bihar, Chandigarh, Delhi, Gujarat, Goa, Haryana, Himachal Pradesh, Jammu and Kashmir, Kerala, Maharashtra, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Tamilnadu, Tripura, Uttar Pradesh and West Bengal.

Elsewhere : Bangladesh, China, Huinan Islands.

Subgenus ***Curranea*** Rohdendorf

1937. *Curranea* Rohdendorf, *Fauna USSR, Dipt.* 19(1) : 255.

Type-species : *Sarcophaga beckeri* Villeneuve.

60. *Parasarcophaga (Curranea) scopariiformis* (Senior-White)

1927. *Parasarcophaga dux* Thomson var. *scopariiformis* Senior-White, *Spoin zeylan.* 11 (2) : 82.

Material examined : 1♂ 3♀, Daporizo guest house, Upper Subansiri dist, 3.vi.2000, coll. B. Mitra. 1♂ 1♀, Ganga Lake area, Papumpare dist. 28.v.2000. coll. B. Mitra.

Diagnosis : Width of frons about tow-fifths that of one eye; frontal vitta black; thorax brownish black with three black longitudinal stripes; wings hyaline with brown veins; legs black, fore femur with a pair of rows of long bristles along posterodorsal surface and a row of short bristles along posterior margin of ventral surface; abdomen black with silvery checkered pattern; anterior paramere curved at end but without hairs; posterior paramere thicker, theca shorter than paraphallus, both are sclerotised, ventralia elongated, somewhat membranous with 2 elngated curved process.

Distribution : Arunachal Pradesh, (Upper Subansiri, Papumpare), Assam, Karnataka, Kerala, Manipur, Mizoram, Nagaland, Tamil Nadu, Tripura and West Bengal.

Elsewhere : Pakistan, Nepal, Sri lanka, China, Malaysia, Laos, Singapore, Taiwan, Thailand, Vietnam; Ethiopian.

Subgenus ***Parasarcophaga*** Johnston & Tiegs

1921. *Parasarcophaga* Johnston & Tiegs, *Proc. R. Soc. Qd.*, **33** (4) : 86.

Key to the species

1. Hind tibia with bristles on anteroventral surface in addition to long villosity 2

– Hind tibia without bristles on anteroventral surface in addition to long villosity .... *sericea* (Walker)

2. Apical plate of paraphallus long and sharply pointed at end; inner forceps moderately stout and broad ..... *albiceps* (Meigen)

– Apical palte of paraphallus short and almost blunt at end; inner forceps long and slender. ..... *misera* (Walker)

61. ***Parasarcophaga (Parasarcophaga) albiceps*** (Meigen)

1826. *Sarcophaga albiceps* Meigen, *Syst. Beschr. Europ. Zweifl. Insekl.* **5** : 22

Material examined : 1♂, Tipi, E. Kameng, 213 m, 3.v.1966; 1♀, Pamir, Subansiri, 564 m, 17.v.1966; 2♀, Chukru, Subansiri, 1128 m; 22.v.1966, coll. A.N.T. Joseph, and party.

Distribution : India : Arunachal Pradesh, (Lower & Upper Subansiri, East & West Kameng), Assam, Bihar, Chandigarh, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal.

Elsewhere : China, Kalimantan, Malaysia, Nepal, Philippines, Ryukyu Islands, Hainan Islands, Taiwan and Thailand; Bismarek Archipelago, Europe, Hawai, Israel, Japan, Korea, New Britain; New Guinea, Solomon Island and Turkey.

62. ***Parasarcophaga (Parasarcophaga) misera*** (Walker)

1849. *Sarcophaga misera* Walker, *List. dipt. Br. Mus.*, **1** : 829.

1967. *Parasarcophaga orchidea* : Kano, Field and Shinonaga, *Fauna Japomea, Sarcopmagidae.* 44.

Material examined : 3♂, 2♀, Changlang, 28.ix.2000, coll. A.R. Lahiri.

Distribution : India : Arunachal Pradesh, (Changlang), Assam, Bihar, Chandigarh, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Pondicherry, Punjab, Rajasthan, Sikkim, Tamilnadu, Uttar Pradesh and West Bengal.

Elsewhere : Bangladesh, Bhutan, Myanmar, Nepal, Pakistan, Sri Lanka, Afganistan, Bomeo, Caroune, Island, China, East Indies; Micronesia; Palaearctic; Australia.

63. ***Parasarcophaga (Parasarcophaga) sericea*** (Walker)

1852. *Sarcophaga sericea* Walker, *Ins. Saunders. Dipt.*, **4** : 326.

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

Material examined : 3♂, 2♀, Parasuram Kunda, Lohit dist., 17.ii.2003, coll. R. S. Mridha.

Distribution : India : Arunachal Pradesh, (Lower Subansiri Lohit), Assam, Bihar, Chandigarh, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Pondicherry, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal.

Elsewhere : Bangladesh, Bhutan, Myanmar, Nepal, Pakistan, Sri Lanka, Borneo, Caroline Island, China, East Indies; Micronesia; Palaearctic; Australia.

Genus ***Robineauella*** Enderlein

1828. *Robineauella* Enderlein, *Arich. klassif. phylogen. Ent.*, 1(1) : 23.

Type-species : *Sarcophaga scoparia* Pandelle.

Subgenus ***Jantiella*** Rohdendorf

1937. *Jantiella* Rohdendorf, *Fauna USSR, Dipt.*, 19(1) : 223.

Diagnosis : Apical part of paraphallus strongly sclerotised with bifurcated processes at end; lateral plate of paraphallus short and pointed at end; styli of glans moderately short; ventralia : ill-developed; digit-like process on distal part of eaeh arm of fifth sternite absent.

64. ***Robineauella (Jantiella) doleschalli*** (Johnston & Tiegs)

1921. *Sarcophaga doleschalli* Johnston & Tiegs, *Proc. R. Soc. Qd.*, 33(4) : 73.

1966. *Robineauella (Jantiella) coei* Rohdendorf, *Bull. Br. Mus. nat. Hist. (ent.), B*, 17(10) : 458.

Diagnosis : Width of frons about two-fifths that of one eye; frontal vitta black; thorax brown with three black longitudinal stripes; wings hyaline with brown veins; legs black; abdomen black with silvery checkered pattern; first and second genital segments without marginal bristles; inner forceps slightly curved, apical plate of paraphallus with a prominent triangular median pair of cylindrical lateral processes which are notched anteriorly but without bifurcation; ventralia short, membranous and single.

Distribution : India : Arunachal Pradesh, (E. Siang), Manipur, Mizoram, Nagaland, Sikkim, West Bengal.

Elsewhere : Pakistan, Nepal, China, Indonesia, Malaysia, Moluceas Islands, Thailand, Vietnam.

Genus ***Sarcorohdendorfia*** Baranov

1938. *Sarcorohdendorfia* Baranov, *Zagreb. Tel. Arch.* 8 (4) : 173.

Type-species : *Sarcorohdendorfia adiscalis* Baranov = *Notochaeta indusa* Curran.

65. ***Sarcorohdendorfia seniorwhitei*** (HO)

1938. *Sarcophaga seniorwhitei* Ho, *Ann. trop. Med Parasit.*, 32 (2) : 117.

1924. *Sarcophaga flavinervis* Senior-White, *Rec Indian Mus* 26(3) : 229 (preoccupied, Robineau-Desvondy, 1830)

Material examined : 1♂, 1♀, Ganga Lake area, Papumpare dist., 28.v.2000. coll. B. Mitra.

Diagnosis : Width of frons about half that of one eye, frontal vitta black; thorax yellowish-grey with three black longitudinal stripes and yellow pollen at their sides; base of wings yellowish with yellow veins; legs black, fore femur with a pair rows of bristles along posterodorsal surface and a row of bristles along posterior margin of ventral surface; abdomen grey with silvery checkered pattern, first genital segment reddish-black with long hairs, second somewhat blackish with short hairs but without bristles; male forceps curved, pointed at apex and with short spines at subapical end posteriorly and long hairs distally, outer forceps elongated with short hairs; theca almost equal to paraphallus, both are sclerotised, apical plate of paraphallus not so sclerotised, curved, hook like with wide and blunt lateral processes, lateral plate of paraphallus short, ventralia with chitinous hook and large membranous lobe but non serrate.

Distribution : India : Arunachal Pradesh, (Papumpare), Assam, Bihar, West Bengal.

Elsewhere : Java, Malaysia, Moluceas, Nepal, Australia; China, Indonesia, Japan, Papua New Gumea; South Korea; Taiwan; Thailand.

Sutribe ***Harpagophallina*** Rohdendorf

Key to the genus

1. Paraphallus with very large ventral process forming a large hook; apical plate of paraphallus with a pan of slender processes; lateral plate of paraphallus with the form of a single pair of moderately large and sharp styli of glans short and curved; antennae and palpi black ..... ***Harpa gophallina*** Rohdendorf

– Paraphallus without a large hook; apical plate of paraphallus with a pair of anchor-like transparent and membranous processes; lateral plate of paraphallus with thick, short and sharp hooks; styli of glans extending distally in the form of a large, straight and elaborate processes; antennae and palpi orange yellow ..... ***Iranihindia*** Rohdendorf

Genus ***Harpagophalla*** Rohdendorf

1937. *Harpagophalla* Rohdendorf *Fauna of U.S.S.R., Dept.*, **19** (1) : 276.

Type-species : *Sarcophaga sera* Rohdendorf = *Sarcophaga kempi* Senior-White.

66. ***Harpagophalla kempi*** (Senior-White)

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

Material examined : 3♂, 2♀, Tipi, West Kameng Dist., 3.5.1966, coll. A.N.T. Jscph and party.

Diagnosis : Frons narrow, half an eye-width; antenna black, segment 3 grey pollinose; lateral vertical bristle absent; pre-scutellar acrostichal bristles only; posterior dorso-central bristles 5; segment iii of costa equal to v; mid femur with comb and basal fringe; hind femur with lower hind macrochaetal row and fringe; mid tibia bare; hind tibia double-fringed; accessary forceps in male genitalia with internal apical serrate lobes.

Distribution : India : Arunachal Pradesh, (West Kameng), Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and West Bengal.

Elsewhere : China, Hainan Island, Java, Loas, Myanmer, Sri Lanka and Thailand and New Guinea.

Genus ***Iranihindia*** Rohdendorf

1961. *Iranihindia* Rohdendorf *Stutt. Beitr. Naturk.*, **58** : 2.

Type-species : *Sarcophaga futilis* Senior-Whtte.

67. ***Iranihindia futilis*** (Senior-White)

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

Diagnosis : Width of frons about two-fifths that of one eye; frontal vitta black, thorax black with three black longitudinal stripes; wings hyaline with brown veins; legs black; abdomen black with silvery checkered pattern, apical plate of paraphallus long and wide at end; lateral plate of paraphallus with unequal bifurcation; inner forceps with long hairs on basal part and a row of 4-5 stout comb-like spines on distal part.

Distribution : India : Arunachal Pradesh, (West Kameng & Lower Subansiri), Assam, Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Meghalaya, Mizoram, Orissa, Tamil Nadu, Tripura, Uttar Pradesh, Uttaranchal, West Bengal.

Elsewhere : Myanmer, Pakistan, Sri Lanka.

Subtribe ***Seniorwhiteina*** Rohdendorf

Genus ***Seniorwhitea*** Rohdendorf

1937. *Seniorwhitea* Rohdendorf *Fauna of USSR, Dipt.*, **19** : 297.

Type-species : *Sarcophaga orientaloides* Senior-White = *Sarcophaga krameri* Boetteher = *Sarcophaga reciproca* Walker.

Diagnosis : Antennae long, arista long plumose; inner forceps long and pointed with a preapical tuft of hairs, propleura bare; paraphallus with distinct theca, apical plate of paraphallus extensively membranous, lateral plate of paraphallas ill-developed, ventralia small and chitinous, penis very large.

68. ***Seniorwhitea reciproca*** (Walker)

1856. *Sarcophaga reciproca* Walker, *J. Proc. Lim. Soc. Lond. Zool.*, **1** : 22.

1912. *Sarcophaga krameri* Bocleher. *Ent. Mill.* 1 : 165.

Diagnosis : Lateral vertical bristles weak or absent; antenna black, segment 3 more than thrice as long as 1; abdominal tergie 2 only with marginal bristles; mid-femur with strong comb and basal fringe, hind femur well fringed, mid and hind tibiae fringed.

Distribution : India : Arunachal Pradesh, (West Kameng & Lower Subansiri), and also common in other states of India.

Elsewhere : China, Hanan, Island, Laos, Myanmer, Nepal, Singapore, Sri Lanka, Taiwan and Thailand, Hawai.

SUMMARY

It may be concluded the Arunachal Pradesh has so far known to harbour 68 species under the families Pipunculidae, Conopidae, Tephritidae, Sciomyzidae, Calliphoridae and Sarcophagidae of the suborder Cyclorrhapha. Among the 68 species so far reported from Arunachal Pradesh, maximum number of the species (26) has been reported from the district Tirap. However, the distribution pattern of the 68 species of Cyclorrhaphans of this state is like as follows : 15 species have restricted their distribution within the boundary of the state and 49 species restricted themselves within the Oriental region. Rest of the 19 species distributed in the Palaearctic regions of which 6 species only found in this zone other than Oriental. 15 species extends their range upto Australian region of which only 2 species are only found in this zone other than Oriental. 14 speciesof this state extend their range upto the Ethiopian region of which only 2 species are found in this zone other than Oriental.

ACKNOWLEDGEMENTS

We express our thanks to Dr. J.R.B. Alfred, Director and Dr. A.K. Hazra, Joint Director, Zoological Survey of India, Kolkata, for placing the materials at our disposal for study and their constant encouragement.

REFERENCES

BRUNETTI, E., 1920. The Fauna of British India, including Ceylon & Burma, Diptera, Brachycera, 2.ix.401 pp. Taylor and Francis, London.

COURTNEY, G. W. 1991. Phylogenctic analysis of the Blephariceromorpha, with special reference to mountain midges (Diptera : Deuterophlebiidae). Systematic Entomology **16**(2) : 137-172.

CUMMING, J. M., B. J. SINCLAIR, and D. M. Wood. 1995. Homology and phylogenetic implications of male genitalia in Diptera-Eremoneura. Entomologica Scandinavica **26** : 120-151.

DATTA, M & CHAKRABORTY, M. 1985. Insecta : Diptera, *Rec. zool. Surv. India*, **82**(1-4) : 231-252.

DATTA, M. PARUI, P and MUKHERJEE, M 1997. Insecta : Diptera. 1-76. *In* Fauna of West Bengal. *State fauna Ser.*, 3(7). Zoological Survey of India, Kolkata.

DATTA, M & PARUI, P. 2000. Insceta : Diptera *In* : Fauna of Tripura. *State Fauna Ser.* 165-200. Zoological Survey of India, Kolkata.

DATTA, M & DAS, B. N. 1978. Three new species of the genus Tabanus (Diptera : Tabanidae) from Arunachal Pradesh, *India. Bull. zool. Surv. India.* **1**(2) : 81-185.

DELFINADO, M. D. and HARDY, D. E. 1973. (eds.). *A catalog of Diptera of the Oriental Region.* **2** : 1-Univ. of Hawaii Press, Honolulu.

DELFINADO, M. D. and HARDY, D. E. (1977). (eds.). *A catalog of Diptera of the Oriental Region.* **2** : 1-Univ. of Hawaii Press, Honolulu.

GHOSH, A. K. 1985. Namdapha biosphere reserve- and overview. *Rec. zool Surv. India,* **82**(1-4) : 1-8.

GRIFFITHS, G. C. D. 1994. Relationships among the major subgroups of Brachycera (Diptera) : A critical review. The Canadian Entomologist, **126** : 861-880.

GRIFFITHS, G. C. D. 1996. Review of papers on the male genitalia of Diptera by D. M. Wood and associates. Studia Dipterologica **3** : 107-123.

HARDY, D. E. 1973. The Fruit-flics (Tephritide ; Diptera) of Thailand and bordoring countries. *Pactjic Insects Monogr.* **31** : 1-353.

Joseph, A. N. T. and RAO, K. R. 1972b. Diptera from NEFA and Assam foot hills. Kameng frontier division, Subansiri frontier division, North Lakhimpur and Assam foot hills. *Rec. zool. Surv. India* **66**(1-4) : 130-138.

JOSEPH, A. N. T. and OARUI, P. 1973. Diptera from NEFA and Assam foot hills. Part III. Siang frontier division, and North Lakhimpur. *Rec. zool. Surv. India* **67** : 325-342.

MICHELSEN, V. 1996. Neodiptera : New insights into the abult morphology and higher level phylogeny of Diptera (Insceta). *Zoological Journal of the Linncan Society,* **117** : 71-102.

MCALPINE, J. F and D. M. Wood (eds.) 1989. Manual of Nearctic Diptera, Vol. 3. Research Branch, *Agriculture Canada, Monograph* 32.

NANDI, B. C. 2002. Sarcophagidae, *Fauna of India and adjacent countries.* **10** : 1-608. Zoological Survey of India.

OOSTERBROCK, P. and COURTNEY. 1995. Phylogeny of the nematocerous families of Diptera (Insceta). Zoological Journal of the Linnean Society **115** : 267-311.

RADHAKRISHNAN, C. 1984. Tephritidae (Diptera : Insecta) of Namdapha. *Rec. zool. Surv. India,* **81** (3 & 4) 49-65.

SINCLAIR, B. J. CUMMING, J. M. and D. M. WOOD. 1994. Homology and phylogenetic implications of the male genitalia in Diptera-Lower Brachycera. *Entomological Scandinavica* **24** : 407-432.

WOOD, D. M. and A. BORKENT 1989. Phylogeny and classification of the Nematocera. In : McAlpine J. F., Wood, D. M. (eds.) Manual of nearctie Diptera 3. Recsarch Branch, *Agriculture Canada, Monograph* **32** : 1333-1370.

Table 1. Distribution of species (as per serial number) in different districts of Arunachal Pradesh.

Sl. No	Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	*Pipunculus (Eudorylus) biroi* Kertesz	+	+		+											
2	*Pipunculus (Eudorylus) major* Brunetti	+	+													
3	*Physocephala bicolorata* Brunetti						+				+					
4	*Physocephala calopa* (Bigot)						+				+					
5	*Physocephala tenella* (Bigot)								+							
6	*Dacus (Hemigymnodacus) diversus* Coquillett.															+
7	*Dacus (Zeugodacus) artifacies* (Perkins)															+
8	*Dacus (Zeugodacus) cucurbitae* Coquillett.	+	+			+										
9	*Dacus (Zeugodacus) scutellaris* Bezzi															+
10	*Dacus (Zeugodacus) tau* (Walker)															+
11	*Acanthonevra dunlopi* (Van der Wulp)															+
12	*Acanthonevra formosana* Enderlein															+
13	*Acanthonevra hemileina* Hening															+
14	*Hexacinia radiosa* (Rondani)															+
15	*Rioxa parvipunctata* de Meijere															+
16	*Rioxa sexmaculata* (Van der Wulp)													+		
17	*Sphaeniscus atilius* (Walker)										+					
18	*Ptilona confinis* (Walker)										+					
19	*Acrotaeniostola apiventris* Munro															+
20	*Anoplomus flexuosus* Bezzi															+
21	*Chaetellipsis paradoxa* Bezzi															+
22	*Chaetellipsis atrata* Hardy															+
23	*Gastrozona balioptera* Hardy															+
24	*Gastrozona fasciventris* (Macquart)															+
25	*Xanthorrachis annandalei* Bezzi				+										+	+
26	*Xanthorrachis assamensis* Hardy															+
27	*Myoleja fossata* (Fabricius)							+			+			+		
28	*Rhabdochaeta bakeri* Bezzi															+
29	*Platensina acrostacta* (Wiedemann)										+					
30	*Spathulina acropeuca* (Schiner)															+
31	*Dioxyna sororcula* (Wiedemann)															+
32	*Sepedon plumbella* Wiedemann												+			
33	*Dicranosepsis bicolor* (Wiedemann)															+
34	*Sepsis albopunctata* Lamb	+				+										+
35	*Sepsis himalayensis* Brunetti															+
36	*Sepsis indica* Wiedemann							+						+		+
37	*Toxopoda adjuncta* Brunetti															+
38	*Toxopoda viduata* (Thomson)															+
39	*Calliphora (Calliphora) vicina* Robineau-Desvoidy	+														
40	*Catapicephala splendens* Macquart															
41	*Lucilia fumicosta* Malloch	+	+					+						+		
42	*Lucilia papuensis* Macquart					+		+								
43	*Lucilia porphyrina* (Walker)					+								+		
44	*Chrysomya bezziana* Villeneuve	+	+													

Table Contd.

Sl. No	Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
45	*Chrysomya defixa* (Walker)					+										
46	*Chrysomya megacephala* (Fabricius)	+	+								+					
47	*Chrysomya pinguis* (Walker)													+		
48	*Chlororhinia exempta* (Walker)							+					+			
49	*Cosmina bicolor* (Walker)						+									
50	*Cosmina biplumosa* (Serior-White)						+									
51	*Cosmina simplex* (Walker)		+				+									
52	*Isomyia delectans* Walker						+									
53	*Stomorhina discolor* (Fabricius)	+	+			+	+	+								
54	*Ravinia pernix* (Harris)	+	+													
55	*Bercala cruentata* (Meigen)	+	+				+	+								
56	*Boettcherisca (s. str.) peregrina* (Robineau-Desvoidy)							+								
57	*Parasarcophaga (Liopygia) ruficornis* (Fabricius)					+										
58	*Parasarcophaga (Liosarcophaga) brevicornis* (HO)	+	+				+	+								
59	*Parasarcophaga (Liosarcophaga) dux* Thomson	+					+									
60	*Parasarcophaga (Curranea) scopariformis* (Senior-White)					+		+								
61	*Parasarcophaga (Parasarcophaga) albiceps* (Mcigen)	+	+				+	+								
62	*Parasarcophaga (Parasarcophaga) misera* (Walker)														+	
63	*Parasarcophaga (Parasarcophaga) sericea* (Walker)						+							+		
64	*Robineaulla (Jantiella) doleschalli* (Johnston & Tiegs)										+					
65	*Sarcorohdendorfia seniorwhitei* (Ho)					+										
66	*Harpagophalla kempi* (Senior-White)	+														
67	*Iranihindia futilis* (Senior-White)	+					+									
68	*Seniorwhitea krameri* (Bocttecher)	+					+									

Name of districts as per serial

1. West Kameng, 2. East Kameng, 3. Tawang, 4. Kurungkumey, 5. Papumpare, 6. Lower Subansiri, 7. Upper Subansiri, 8. West Siang, 9. Upper Siang, 10. East Siang, 11. Dibang Valley, 12. Lower Dibang Valley, 13. Lohit, 14. Changlang, 15. Tirap.

Table 2. Distribution of the species (as per serial number) in other parts of India

SPECIES STATES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	+	+						+	+	+															+							
2									+																							
3			+					+																	+		+					
4								+					+													+					+	
5															+											+						
6															+																	
7*																																
8	+							+																					+			
9	+							+																		+						
10			+				+	+	+				+		+			+					+			+						
11	+							+																								
12*																																
13													+																			
14*																																
15*																																
16								+																								
17*																																
18*																																
19								+																								
20							+	+																								
21*																																
22																																
23*																																
24	+													+																		
25*																																
26	+		+																													
27														+																		
28									+																							
29								+	+				+																			
30									+																							
31*																																
32		+						+	+																+							
33	+	+	+				+	+										+					+			+						
34								+	+																	+						
35			+				+	+							+																	
36							+	+	+	+			+	+	+			+														
37														+																		
38*																																
39							+	+					+												+	+						
40*																																
41*																																
42															+	+		+														
43	+							+																	+			+				

Table Contd.

SPECIES STATES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
44																																
45*																																
46																																
47			+					+					+												+							
48	+		+	+																												
49			+										+		+																	
50*																																
51	+													+																		
52	+																															
53		+	+	+				+	+					+												+						
54								+	+																+		+	+				
55																																
56	+	+	+	+		+	+	+	+				+	+	+			+							+	+			+			
57			+	+	+	+		+	+	+		+	+	+	+	+	+				+	+	+	+	+	+			+		+	
58	+	+	+		+	+		+	+	+							+				+	+			+							
59	+	+	+		+	+		+	+	+		+	+	+		+	+	+			+	+	+	+	+	+		+	+			+
60	+	+		+	+	+		+					+	+	+																	
61	+		+		+	+	+	+	+	+		+	+	+	+	+	+	+		+	+	+	+	+	+	+			+			+
62	+		+	+	+	+	+	+	+	+		+	+	+	+	+	+	+		+	+	+	+	+	+	+			+		+	+
63	+		+	+	+	+	+	+	+	+		+	+	+	+	+	+			+	+	+	+	+	+	+			+		+	+
64				+	+	+	+	+																								
65	+							+	+																							
66	+	+	+	+	+	+	+	+	+					+	+										+							
67	+	+			+			+	+	+			+	+	+		+	+		+						+	+					
68																																

Name of states as per serial

1. Assam, 2. Tripura, 3. Meghalaya, 4. Manipur, 5. Mizoram, 6. Nagaland, 7. Sikkim, 8. West BEngal, 9. Bihar, 10. Orissa, 11. Jharkhand, 12. Andhra Pradesh, 13. Tamil Nadu, 14. Kerala, 15. Karnataka, 16. Goa, 17. Gujarat, 18. Maharashtra, 19. Chhatishgarh, 20 Madhya Pradesh, 21. Rajasthan, 22. Haryana, 23. Punjab, 24. Delhi, 25. Himachal Pradesh, 26. Uttar Pradesh, 27. Uttaranchal, 28. J & K, 29. A & N Islands, 30. Lakshadweep, 31. Pondichery, 32. Chandigarh.

Table 3 : Distribtion of species in different Zoogeographical regions of the World.

SPECIES	FAMILY	ORIENTAL	PALAEARCTIC	AUSTRALIAN	ETHIOPIAN
1	STRATIOMYIDAE	+			
2		+			
3	CONOPIDAE	+			
4		+			
5		+			
6	TEPHRITIDAE	+			
7		+			
8		+	+	+	+
9		+			
10		+			
11		+			
12		+	+		
13		+			
14		+			
15		+			
16		+	+		
17		+	+		
18		+			
19		+			
20		+			
21		+			
22		+			
23		+			
24		+			
25		+			
26		+			
27		+	+		
28		+			
29		+			
30		+	+	+	+
31		+			
32	SCIOMYZIDAE	+		+	
33		+			
34		+		+	
35		+			
36		+	+	+	
37		+			
38		+			
39	CALLIPHORIDAE	+	+	+	+
40		+			
41		+			
42		+	+	+	
43		+	+	+	
44		+			+
45		+	+	+	+
46		+			
47		+			
48		+			
49		+			
50		+			
51		+			+
52		+			
53		+		+	+
54	SARCOPHAGIDAE	+	+		
55		+	+	+	+
56		+	+	+	+
57		+			
58		+	+		
59		+			
60		+			+
61		+	+		+
62		+	+	+	+
63		+	+	+	
64		+			+
65		+	+	+	+
66		+			
67		+			
68		+			

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2) : 331-354, 2006

INSECTA : DIPTERA : SYRPHIDAE

M. MUKHERJEE, P. PARUI and BULGANIN MITRA
Zoological Survey of India, M-Block, New Alipore, Kolkata 700053

INTRODUCTION

Syrphidae or 'hover flies or flower flies' under the superfamily Syrphoidea of the Infraorder Cyclorrhapha in the section Aschiza, are one of the largest and easily recognized groups of Diptera. They are generally brightly colored, often striped, and many mimic bees or wasps. In contrast to the rather uniform, nectar-feeding habits of adult hover flies, those of larvae are extremely varied, phytophagous, zoophagous, and saprophagous species being known. They are nearly cosmopolitan in distribution and 256 species of 5 sub species under 62 genera in 2 subfamilies are so far known from India. There are some scattered references by Knutson *et al.* (1975), Joseph & Rao (1972 a & b), Joseph & Parui (1973, 1977) and Datta & Chakraborty (1985) on the syrphid of this state.

Recently several collecting trips were organized by the scientists of Zoological Survey of India in all seven districts (Kameng, Subansiri, Tawang, Siang, Lohit, Tirap, and Chang lang) of Arunachal Pradesh (considering the old divisions of districts) for the purpose of addition and revaluation of the faunal components in aid of our comphrensive knowledge. These trips that brought materials for this study, were led by B. Mitra (2000-2001), M. Sil (2002), and R.S. Mridha (2003).

The present communication reports 50 species under 28 genera of which 8 species (marked with asterisk) are recorded for the first time from this state. One unidentified species of the genus *Citrogramma* is reported in "Fauna of Namdhapa" (Datta & Chakraborty, 1985) not incorporated in this communication. Material & Methods and Morphology have been dealt in earlier commounication (Datta, 1998); (Datta, Parui & Mukherjee, 1997)

LIST OF SPECIES

Subfamily SYRPHINAE

Tribe A. **Syrphini**

1. *Allograpta javana* Wiedemann
2. *Allograpta maculipleura* (Brunetti)
3. *Asarkina (Asarkina) ericetorum* (Fabricius)
4. *Betasyrphus serarius* (Wiedemann)
5. *Dideopsis aegrotus* (Fabricius)
6. *Episyrphus balteatus* (De Geer)
7. *Ischiodon scutellaris* (Fabricius)
8. *Metasyrphus (Metasyrphus) confrater* (Wiedemann)
9. *Metasyrphs (Metasyrphus) corollae* (Fabricius)
*10. *Metasyrphus (Metasyrphus) latifasciatus* (Macquart)
11. *Scaeva selenitica* (Meigen)
12. *Sphaerophoria assamensis* Joseph
13. *Sphaerophoria indiana* Bigot
14. *Sphaerophoria vockerothi* Joseph
15. *Syrphus aeneifrons* Brunetti
16. *Syrphus fulvifacies* Brunetti
17. *Syrphus isaaci* Bhatia
*18. *Syrphus vitripennis* Meigen
*19. *Syrphus remotus* Brunetti

Tribe B. **Bacchini**

20. *Baccha (Allobaccha) amphithoe* Walker
21. *Baccha (Allobaccha) dispar* Walker
22. *Baccha (Baccha) maculata* Walker

Tribe C. **Melanostomatini**

23. *Melanostoma orientale* (Wiedemann)
24. *Melanostoma univittata* (Wiedemann)

Tribe D. **Chrysotoxini**

25. *Chrysotoxum baphyrus* Walker

Tribe E. **Paragini**

26. *Paragus (Paragus) serratus* (Fabricius)
27. *Paragus (Pandasyophthalmus) rufiventris* (Brunetti)
28. *Paragus (Pandasyophthalmus) tibialis* (Fallén)

Subfamily MILESIINAE

Tribe F. **Cheilosini**

29. *Cheilosia apicalis* Brunetti

Tribe G. **Volucellini**

*30. *Graptomyza brevirostris* Wiedemann
*31. *Graptomyza ventralis* Wiedemann
32. *Volucella trifasciata* Wiedemann

Tribe H. **Chrysogasterini**

*33. *Sphegina (Asiosphegina) javana* de Meijere
34. *Sphegina (Asiosphegina) tristriata* Brunetti

Tribe I. **Spheginobacchini**

35. *Spheginobaccha macropoda* (Bigot)

Tribe J. **Sericomyini**

36. *Sericomyia eristaloides* Brunetti

Tribe K. **Eumerini**

37. *Azpeytia bifascia* Brunetti

Tribe L. **Cerioidini**

38. *Monoceromyia javana* (Wiedemann)

Tribe M. **Eristalini**

39. *Catacores cyanea* (Brunetti)
40. *Eristalinus (Eristalinus) arvorum* (Fabricius)
41. *Eristalinus (Eristalinus) quinquestriatus* (Fabricius)
42. *Eristalinus (Eristalodes) paria* (Bigot)
43. *Eristalinus (Eristalodes) taeniops* (Wiedemann)
44. *Eristalis (Eristalis) tenax* (Linnaeus)
45. *Eristalis (Eoseristalis) arbustorum* (Linnaeus)
46. *Eristalis (Eoseristalis) cerealis* Fabricius
47. *Eristalis (Eoseristalis) himalayensis* Brunetti
48. *Mesembrius insignis* Walker
49. *Phytomia (Phytomia) errans* (Fabricius)
50. *Phytomia (Phytomia) zonata* (Fabricius)

SYSTEMATIC ACCOUNT

Family SYRPHIDAE

Key to the subfamilies

1. Pronotum bare (excepting a few long hairs occasionally in Baccha); abdomen in males with 5 pregenital segments ..... SYRPHINAE.

   Pronotum pilose; abdomen in male with 4 pregenital segments ..... MILESINAE.

Subfamily SYRPHINAE

Key to the tribes

(Modified after Vockeroth, 1969)

1. Tergite 1 well developed and distinctly extended well beyond scutellum; scutellum at its posterior margin inconspicuously or strongly denticulate; abdomen robust and usually oval .... **Paragini.**

– Tergite 1 small and practically covered by scutellum (excepting some Bacchini with petiolate abdomen); scutellum posteriorly smooth and not denticulate; abdomen usually slender 2

2. Antenna porrect, elongate and occasionally longer than head; abdomen very strongly convex dorsally ..... **Chrysotoxini**

– Antenna drooping and usually short, abdomen searcely convex 3

3. Abdomen distinctly petiolate; anterior flat portion of mesopleuron at its postero-dorsal corner with a few distinct, erect and coarse hairs; metasternum bare; face usually flat and with very weak tubercle ..... **Bacchini**

   Abdomen usually equilateral or oval; mesopleural hairing, if present, different or disposed otherwise; metasternum bare or haired; face neither distinctly produced nor narrowed below but usually with well-developed tubercle 4

4. Face and scutellum entirely black; anterior flat portion of mesopleuron with only microscopic pubescence; aedeagus undivied, strongly swollen basally and slender tube-like apically ..... **Melanostomatini**

   Face and scutellum usually yellow or yellowish brown; mesopleural hairing variable; aedaegus nearly always 2 segmented, with complex associated structures ..... **Syrphini**

Tribe Syrphini

Key to the genera

(Modified after Vockeroth, 1969)

1. Mesopleuron at its anterior flat portion with long, fine, erect or suberect hairs at least posterodorsally; male terminalia with broad and somewhat flat surstylus, superior lobe with a short tooth apically ..... ***Episyrphus*** Matsumura & Adachi.

– Mesopleuron at its anterior flat portion with only microscopic pubescence or pollinose 2

2. Metasternum haired 3

– Metasternum bare 7

3. Face produced rather strongly forward below and oral opening more than 3-4 times as long as broad; hair tuft present in front of and just below ventral end of metathoracic spiracle (on mesokatepimeron) and a second tuft of lower end of spiracle postero-ventrally (on metaepimeron) ..... ***Asarkina*** Macquart

– Face usual or moderately produced forward below and oral opening usually below 3 times as long as broad; hypopleuron bare below metathoracic spiracle and infront of its lower end 4

4. Eye densely haired; hind coxa with tuft of hairs at postero median apical angle ..... ***Dideopsis*** Brunetti

– Eye entirely or predominantly bare or with short sparse hairs; hind coxa without tuft of hairs at posteromedian apical angle 5

5. Abdomen strongly margined from middle of tergite 2 to end of tergite 5, male terminalia small but never inconspicuous, retracted under apex of abdomen ..... ***Metasyrphus*** Matsumura

– Abdomen unmargined, male terminalia shaped otherwise 6

6. Sub-scutellar fringe complete and moderately dense; male terminalia inconspicuous; cerci set in a deep U-shaped notch of tergite 9; tergite 9 much narrower than pre-abdomen ..... ***Allograpta*** Osten Sacken

– Sub-scutellar fringe absent or nearly so on at least median third and sparse laterally; male terminalia greatly enlarged, globose; cerci almost always entirely surrounded by tergite 9; tergite 9 as broad as pre-abdomen ..... ***Sphaerophoria*** Lep. & Serv.

7. Eye with long dense hairs, at least as much as anterior half 8

– Eye bare or with very short hairs (as in some syrphus) 9

8. Wing membrane almost densely and uniformly trichose at least beyond level of end of spurious vein; male eye without distinctly demarked area of larger facets above ..... ***Betasyrphus*** Matsumura

– Wing membrane with very sparse microtrichia scattered over entire surface; male eye with distinctly demarked area of larger facets above ..... ***Scaeva*** Fabricius

9. Antennal segment 3 twice as long as broad, sub acute apically; sternopleuron at its upper

margin with distinct yellow spot; with vein R_{4+5} ending well before wing apex, lower lobe of squama with only microscopic pile; hind trochanter in males with spine-like process ventrally ..... ***Ischiodon*** Sack

– Antennal segment 3 short, oval and broadly rounded apically; sternopleuron without any yellow spot at its upper margin; wing with vein R_{4+5} ending at wing apex; lower lobe of squama with abundant coarse, long, erect yellow hairs above; hind trochanter unarmed ..... ***Syrphus*** Fabricius

Tribe **Syrphini**

Genus ***Allograpta*** Osten Sacken

1875. *Allograpta* Osten Sacken, *Bull. Buffalo Soc. nat. Sci.* **3** : 49.

Type-species : *Scaeva obliqua* Say.

Key to the species

1. Hind femora black except a little yellow at base ..... *maculipleura* (Brunetti)

– Hind femora yellow except black apical third ..... *javana* (Wiedemann)

1. ***Allograpta javana*** (Wiedemann)

1824. *Syrphus javanus* Wiedemann, *Analecta Ent* : 34.

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Assam, Delhi, Karnataka, Manipur Meghalaya, Mizoram, Sikkim, Tamil Nadu, Tripura and West Bengal.

Elsewhere : China, Malaysia, Jawa, Kalimantan, Philippines, Sri Lanka, Sumatera, Taiwan and Thailand; Australia, Fiji, Guadalcanal, Hawaii, Japan, Korea and New Guinea.

2. ***Allograpta maculipleura*** (Brunetti)

1913. *Syrphus maculipleura* Brunetti, *Rec. Indian Mus.*, **8** : 162.

Distribution : India : Arunachal Pradesh, Assam.

Genus ***Asarkina*** Macquart

1842. *Asarkina* Macquart, *Dipt. Exot.* **2** (2) : 77 (137).

Type-species : *Scaeva rostrata* Wiedemann.

Sub genus ***Asarkina*** Macquart

Diagnosis : Mesonotum with dense anterior collar of long erect hairs; vien R_{4+5} distinctly dipped into cell R_{4+5}; surstylus strongly convergent and nearly transverse in position.

3. ***Asarkina (Asarkina) ericetorum*** (Fabricius)

1781. *Syrphus ericetorum* Fabricius, *Spec. Insekt;* **2** : 425.

Material examined : 1♀, Zemithang, Tawang, 11.x. 2001, coll. B. Mitra; 1♀, Ganga lake, Itanagar, 29. V. 2000, coll. B. Mitra.

Diagnosis : Male frons bright sulphur yellow with long blackish pubescence, a semicircular shining blackish brown spot on upper side of small antennal prominence; female frons at vertex about one-ninth of head rather rapidly widening to double that width at level of antennae; surstylus broad basaly, only slightly narrowed to subtruncate apex.

Distribution : India : Arunachal Pradesh, Assam, Gujarat, Jammu & Kashmir, Manipur, Meghalaya, Sikkim, Tamil Nadu and West Bengal.

Elsewhere : Oriental Region; Africa, Australia, Fiji, Molluccas, New Guinea and samoa.

Genus ***Betasyrphus*** Matsumura

1917. *Betasyrphus* Matsumura, *Ent. Mag. Kyota.* **2** : 143.

Type-species : *Syrphus serarius* Wiedemann.

4. ***Betasyrphus serarius*** (Wiedemann)

1830. *Syrphus serarius* Wiedemann, *Aussereurop. Zweifl. Insekt;* **2** : 128.

Diagnosis : Eye densely haired; face orange with blackish tinge; antenna black, base of antennal segment 3, dull orange; mesonotum shining black, yellow haired auteriorly and black haired posteriorly at wing-base along lateral margin; scutellum dull yellow with yellow hairs basally and rest black; lower lobe of squama with few erect fine, white hairs above; greyish-pollinose abdominal markings; aedeagus in male terminalia tubular, not produced apically and not with setulae anteriorly; aedeagae base with 2 long distinct tooth-like processes on each side antero-ventrally.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Karnataka, Meghalaya, Uttar Pradesh and West Bengal.

Elsewhere : Other parts of the SE Asia; Australia, Japan, Korea and New Guinea.

Genus ***Dideopsis*** Matsumura

1917. *Dideopsis* Matsumura, *Ent. Mag. Kyota.* **2** : 142.

Type-species : *Eristalis aegrotus* Fabricius.

5. ***Dideopsis aegrotus*** (Fabricius)

1805. *Eristalis aegrotus* Fabricius, *Syst. antliat* : 243.

Diagnosis : Eye bare; frons black with black hairs; face black with yellow hairs; a black stripe extending from base of antennae to central bump; mesonotum black with brownish hairs except yellowish humerus with yellow hairs mesonotum with anterior collar of long erect hairs; vein R_{4+5} indistinctly dipped into cell R_{4+5} upper and lower sternopleural hair patches widely separated throughout; postero-median apical angle of hind coxa with a strong tuft of hairs; abdomen oval with broad yellow bands; sternite 9 in male terminalia with short but distinct setae laterally; distal portion of aedaegus with broad flattened apically rounded postero-dorsal process.

Distribution : India : Arunachal Pradesh, Assam, Kerala, Meghalaya, and West Bengal.

Elsewhere : Nepal and other parts of the SE Asia; Australia, Molluccas and New Guinea.

Genus ***Episyrphus*** Matsumura & Adachi

1917. *Episyrphus* Matsumura & Adachi, *Ent. Mag. Kyota.* **2** : 134.

Type-species : *Musca balteata* De Geer.

6. ***Episyrphus balteatus*** (De Geer)

1776. *Musca balteata* De Geer, *Mem pour Serv. Hist. Ins.* **6** : 116.

Material examined : 1♂, 4♀♀, Pine Bihar, Ziro, lower Subansiri Dist., 1.VI.2000, coll. B. Mitra; 2♀♀, Hapoli, lower Subansiri Dist., 31.V.2000, coll. K. Bhattacharya; 1♀, Salari, W. Kameng, 8.X.2001, coll. T.K. Mondal; 1♂, 1♀, Ghumin Basti, Along, E. Siang Dist., 8.VI.2000, coll. B. Mitra; 1♀, Salari, W. Kameng, 8.X.2001, coll T.K. Mondal.

Diagnosis : Eye bare; face orange with orange hairs; base of antenna with a black dot above; mesonotum black with a narrow median and 2 lateral groyish stripes; posterior margin of wing with a series of sclerotized dots; abdomen linear, orange, tergites 3 and 4 mostly yellow with narrow sub-basal and broad apical black bands; surstylus in male terminalia straight not more than twice as long as broad; superior lobe stout, with ventrolaterally directed tooth apically; distal portion of aedeagus not expanded apically.

Distribution : India : Arunachal Pradesh, Assam, Jammu & Kashmir, Kerala, Meghalaya, Mizoram, Orissa, Sikkim, Tripura and West Bengal.

Elsewhere : China, Malaya and other parts of the Oriental Region; Australia, Bonin Islands and Palaearctic region.

Genus ***Ischiodon*** Sack

1913. *Ischiodon* Sack, *Ent. Mitt.*, **2** : 5.

Type-species : *Ischiodon trochanterica Sack* (*Scaeva scutellaris* Fabricius).

7. ***Ischiodon scutellaris*** (Fabricius)

1805. *Scaeva scutellaris* Fabricius, *Syst Antliat* : 252

Diagnosis : Eye bare; wing with vein R_{4+5} up curved apically and ending well before wing-apex; hind femur with a sub-apical black ring; surstylus in male terminalia elongate, broadened beyond base, dorsally curved and serrate ventrally straight and smooth; aedeagal base, very large and strongly sclerotized.

Distribution : India : Arunachal Pradesh, Gujarat, Jammu & Kashmir, Manipur, Meghalaya, Karnataka, Orissa, Sikkim, Tamil Nadu and West Bengal.

Elsewhere : Java, Philippines, Taiwan and other parts of the SE Asia; Australia, Hawaii, Japan and Micronesia.

Genus ***Metasyrphus*** Matsumura

1917. *Metasyrphus* Matsumura, *Ent. Mag. Kyoto*, **2** : 147.

Type-species : *Scaeva corollae* F.

Sub genus ***Metasyrphus*** Matsumura

Diagnosis : Wing with vein R_{4+5} straight or nearly so; sternite 9 in male terminalia without lateral and dorsolateral grooves.

Key to the species

1. Abdomen with 3 pairs of spots passing over lateral margins; surstylus in male terminalia slender and curved sharply forward near apex with distinct anterior flange .... *corollae* (Fabricius).

   Abdomen with 2-3 pairs of complete bands lying across middle of segments 2

2. Scutellum yellow haired; hind femora partly in male at base, entirely orange in female, hind tibia mainly orange; second abdominal segment with a pair of triangular spot but not widely separated..... *latifasciatus* (Macquart)

3. Scutellum black haired with a narrow band of yellow hairs on anterior margin, basal half of hind femora brownish and apical half of hind tibiae brownish; second abdominal segment with a pair of oval or diamond shaped spots..... .....*confrater* (Wiedemann)

8. ***Metasyrphus (Metasyrphus) confrater*** (Wiedemann)

1830. *Syrphus confrater* Wiedemann, *Ausseurop Zweifl. Insekt.* : **2** : 120.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Meghalaya, Uttar Pradesh and West Bengal.

Elsewhere : China and other parts of the Oriental region; Japan and New Guinea.

9. ***Metasyrphus (Metasyrphus) corollae*** (Fabricius)

1794. *Scaeva corollae* Fabricius, *Ent. Syst.*, **4** : 306.

Distribution : India : Arunachal Pradesh, Meghalaya and West Bengal.

Elsewhere : Other Asian Countries including Taiwan, N. Africa and Palaearctic region.

*10. ***Metasyrphus (Metasyrphus) latifasciatus*** (Macquart)

1829. *Syrphus latifasciatus* Macquart, *Ins. Dipt. N. Fr.*, **4** : 94 (242).

Material examined : 1♀, Salari, W. Kameng, 8.X. 2001, coll T.K. Mondal.

Distribution : India : Arunachal Pradesh (West Kameng District), Himachal Pradesh and Simla.

Elsewhere : Europe and extends to N. America.

Genus ***Scaeva*** Fabricius

1805. *Scaeva* Fabricius, *Syst. Antliat.* : 248.

Type-species : *Musca pyrastri* Linnaeus.

11. ***Scaeva selenitica*** (Meigen)

1822. *Syrphus seleniticus* Meigen, *Beschr. Europ. Zweifl. Insekt*, **3** : 304.

Diagnosis : Eye densely haired, sparser posteriorly; antenna black except yellowish segment 1 and base of 3; mesonotum shining black, with dense yellowish brown hairs; wing clear; leg predominantly bright-yellow; hind tibia with a dark brown ring; abdomen black, tergites 2-4 each with a pair of bright yellow spots being lunulate on 3-4.

Distribution : India : Arunachal Pradesh, Himachal Pradesh, Meghalaya, and Uttar Pradesh.

Elsewhere : Cambodia, China, Laos and Vietnam; Europe.

Genus ***Sphaerophoria*** Lepeletier & Serville

1828. *Sphaerophoria* Lepeletier & Serville, *Encycl. meth. (Ins)*, **10** (2) : 513.

Type-species : *Musca scripta* Linnaeus.

Key to the species

1. Face unstriped; scutellum pale yellow with concolourous pubescence ..... *indiana* Bigot

– Face striped or spotted; scutellum with black and yellow hairs 2

2. Tergite 5 with usual row of black hairs, superior lobe with sternal cornua .... *Vockerothi* Joseph

– Terite 5 with a conspicuous cluster of black hairs at middle, superior lobe without sternal cornua ..... *assamensis* Joseph

12. *Sphaerophoria assamensis* Joseph

1970. *Sphaerophoria assamensis* Joseph, *Eos Madr.* **45** : 168.

Distribution : India : Arunachal Pradesh.

13. *Sphaerophoria indiana* Bigot

1884. *Sphaerophoria indiana* Bigot, *Annls Soc. ent. Fr.*, (6) **4** : 99.

1915. *Sphaerophoria nigritarsis* Brunetti, *Rec. Indian Mus.*, **11** : 216. (As form)

Material examined : 1♂, 1♀, Zemithang, Tawang District, 11.X.2001, coll B. Mitra.

Distribution : India : Arunachal Pradesh (Tawang), Bihar, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Meghalaya, Sikkim, Uttar Pradesh & West Bengal.

Elsewhere : China, Sri Lanka, Korea & Eastern part of the erstwhile U.S.S.R.

14. *Sphaerophoria vockerothi* Joseph

1970. *Sphaerophoria vockerothi* Joseph, *Eos Madr.* **45** : 165.

Distribution : India : Arunachal Pradesh.

Elsewhere : Taiwan.

Genus *Syrphus* Fabricius

1775. *Syrphus* Fabric3ius. *Syst. Ent.* : 762.

Type-species : *Musca ribesii* Linnaeus.

Key to the species

1. Hind femur with basal half black and rest yellow; abdomen with 3 pairs of spots .... *aeneifrons* Brunetti.

– Hind femur wholly black except yellow at tip 2

2. Hind tibiae wholly yellow .... *vitripennis* Meigen

Hind tibiae not wholly yellow 3

3. Mid femur wholly orange .... *remotus* Brunetti

– Mid femur bicoloured 4

4. Outer side of mid femur blackish, rest yellowish brown ..... *isaaci* Bhatia

– Mid femur black on basal half, rest yellow... ..... *fulvifacies* Brunetti

15. *Syrphus aeneifrons* Brunetti

1913. *Syrphus aeneifrons* Brunetti, *Rec. Indian Mus.* **8** : 159.

Distribution : India : Arunachal Pradesh.

16. *Syrphus fulvifacies* Brunetti

1913. *Syrphus fulvifacies* Brunetti, *Rec Indian Mus.* **8** 161.

Distribution : India : Arunachal Pradesh, Assam.

Elsewhere : China, Java, Laos, Nepal and Philippines.

17. *Syrphus isaaci* Bhatia

1933. *Syrphus isaaci* Bhatia, *Indian J. agric. Sci.* **2** 566

Distribution : India : Arunachal Pradesh, Assam, Bihar, Uttar Pradesh.

Elsewhere : Nepal.

*18. *Syrphus vitripennis* Meigen

1822. *Syrphus vitripennis* Meigen, *Syst. Beschr Zweifl Insekt.*, **3** : 308.

Material examined : 1♂, 1♀, Zemithang, Tawang, 11.X. 2001, coll B. Mitra.

Distribution : India : Arunachal Pradesh.

Elsewhere : Taiwan; Europe.

*19. ***Syrphus remotus*** Brunetti

1923. *Syrphus remotus* Brunetti, *Fauna. Br. India, Dipt.*, **3** : 78.

Material examined : 1♂, Zemithang, Tawang, 11.X.2001, coll. B. Mitra.

Distribution : India : Arunachal Pradesh (Tawang District) and Kufri, Simla Hills.

Tribe **Bacchini**

Genus ***Baccha*** Fabricius

1805. *Baccha* Fabricius, *Syst. Antliat.* : 199.

Type-species : *Syrphus elongatus* Fabricius.

Diagnosis : Flies with head broader than thorax and more than hemispherical, hollowed behind; eye practically bare; frons slightly prominent; antenna short, with bare dorsal arista; wing with rudimentary or atmost no alula; squama inconspicuous; leg long and thin, hind femur much longer than others and slender; abdomen very much longer than thorax, segment 2 and 3 very long and narrow, succeeding segments widening gradually before tip.

Key to the subgenera

1. Humerus with a row of hairs behind or almost half hairy ..... ***Allobaccha*** Curran.
- Humerus bare entirely ..... ***Baccha*** Fabricius

Sub genus ***Allobaccha*** Curran

1928. *Allobaccha* Curran, *J. fed. Malay St. Mus.* : **14** : 251 (as subgenus of Baccha F.).

Type-species : *Baccha rubella* Van der Wulp.

Key to the species

1. Wing clear; 3rd and 4th abdominal segments with a black band ..... *amphithoe* Walker
- Wing with a conspicuous transverse dark band across middle; 3rd and 4th segment of abdomen with a pair of yellowish spot .... *dispar* Walker

20. ***Baccha (Allobaccha)amphithoe*** Walker

1849. *Baccha amphithoe* Walker, *List. Dipt. Br. Mus.*, **3** : 549.

1913. *Baccha flavopunctata* Brunetti, *Rec. Indian. Mus.*, **8** : 165.

Distribution : India : Arunachal Pradesh, Assam, Meghalaya, Sikkim and West Bengal.

Elsewhere : Sri Lanka, Taiwan South to Flores Is (Indonesia).

21. ***Baccha (Allobaccha)dispar*** Walker

1860. *Baccha dispar* Walker, *J. Linn. Soc. Lond.*, **4** : 121.

Distribution : India : Arunachal Pradesh.

Elsewhere : Celebes; Malay.

Sub genus ***Baccha*** Fabricius

22. ***Baccha (Baccha) maculata*** Walker

1852. *Baccha maculata* Walker, *Insecta Saundersiana.*, **1** : 223.

Diagnosis : Antenna right yellow, antennal process shining black in males, bluish black in females; humerus, a longitudinal stripe on mesopleura in front of wing base cupreous in males, yellowish in females; leg predominantly yellowish, hind femur with a subapical browinsh ring and hind tibia with an indistinct dark median band; abdomen mainly shining brown, sometimes with pale spots.

Distribution : India : Arunachal Pradesh, Himachal Pradesh, Meghalaya, Uttar Pradesh and West Bengal.

Elsewhere : Andalas, Java, Kalimantan, Malaya, E. Malaysia, Nepal, Philippines and Taiwan; Japan and Korea.

Tribe **Melanostomatini**

Genus ***Melanostoma*** Schiner

1800. *Melanostoma* Schiner, *Wien ent. Mschr.*, **4** : 213.

Type-species : *Musca mellina* L.

Diagnosis : Syrphines with elongate oblong

abdomen and intermediate tergites usually with pairs of bright yellow spots; male fore tarsus normal and not dilated; surstylus in male terminalia usually not bifid; superior lobe normally triangular.

Key to the species

1. Face with 2 distinct small bumps .... *orientale* (Wiedemann)
- Face nearly flat forming a single angle only on lower end .....*univittata* (Wiedemann)

23. ***Melanostoma orientale*** (Wiedemann)

1824. *Syrphus orientalis* Wiedemann, *Analecta Ent.*, : 36.

Distribution : India : Arunachal Pradesh, Assam, Himachal Pradesh, Jammu & Kashmir, Karnataka, Meghalaya, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

Elsewhere : Bhutan, Nepal, Pakistan, Sri Lanka, and other parts of the Oriental region; Palaearctic region.

24. ***Melanostoma univittata*** (Wiedemann)

1824. *Syrphus univittatus* Wiedemann, *Analecta Ent.*, : 36.

Distribution : India : Arunachal Pradesh, and Assam.

Tribe **Chrysotoxini**

Genus ***Chrysotoxum*** Meigen

1803. *Chrysotoxum* Meigen, *Magazin Insecktkde.*, **2** : 275.

Type-species : *Musca bicincta* L.

Diagnosis : Rather large flies with semicircular head as broad as thorax; eye haired; frons and face, prominent; long antennae placed in between produced frons and face, arista sub-basal, bare, mesonotum finely punctate, with a pair of faint greyish stripes anteriorly in addition to yellowish lateral lines; leg predominantly yellowish; wing yellowish anteriorly; abdomen mainly ovate, finely punctate and usually with a pair of curved yellow spots on tergite 2-5.

25. ***Chrysotoxum baphyrus*** Walker

1849. *Chrysotoxum baphyrus* Walker, *List Dipt. Colln Br. Mus.*, **3** : 542.

Diagnosis : Face lemon yellow with a moderately wide black median stripe which is sometimes narrowly orange on each side; eyes with blackish brown pubescence; antennal prominence brown, arista orange brown; thorax with two yellowish-grey median stripes on upper part, side margins broadly yellowish; scutellum lemon-yellow to rather brownish with pale yellow to brownish pubescence; legs mainly yellow; wings pale gray, a little yellowish anteriorly; abdomen yellowish, 2nd segment with a median transverse black line and a short vertical stripe above it joined to a narrowly black anterior margin, 3rd and 4th segments yellow, a pair of elongate, black, diagonally placed stripes their inner ends pointed, a large orange triangular space on hind margin, 5th segment black with a pair of comparatively large yellow elongate spots diagonally and a single apically.

Distribution : India : Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir, Meghalaya, Tamil Nadu, Uttar Pradesh and West Bengal.

Elsewhere : Cambodia, Jawa, Laos, Nepal, Sri Lanka and Vietnam.

Tribe **Paragini**

Genus ***Paragus*** Latreille

1804. *Paragus* latreille, *Nouv. Dict. Hist. Nat.*, **24** : 94
Type-species : *Syrphus bicolor* Fabricius.

Diagnosis : Head slightly flattened and broader than thorax; eye pilose; face produced to a large central bump; antennal arista bare; thorax quadrate and arched; mesonotum striped; wing with veins M_{1+2} and $M_3 + Cu_1$ undulating apically and cross vein r-m distinctly before middle of discal cell; abdomen as wide as thorax nearly parallel-sided; aedeagus in male terminalia undivided, simple and tubular medially with a complex lateral lobe at base on either side.

Key to the subgenera

1. Eye with bicolourous pile, with alternating vittae of pale and dark hairs; spurious vein shorter, not extending beyond discal (r-m) cross vein ..... ***Paragus*** Latreille

– Eye with unicolorous pile; spurious vein long, extending beyond discal (r-m) cross-vein ....***Pandasyophthalmus*** Stuckenberg

26. ***Paragus (Paragus) serratus*** (Fabricius)

1805. *Mulio serratus* Fabricius, *Syst Antliat.*, : 186.

Diagnosis : Eye with 3 vittae of white hairs; scutellum black with yellow margin, strongly denticulate posteriorly; abdomen yellow with brown markings; punctate; tergites 3 and 4 each with a whitish band on each side anteriorly, broken in mid-line; tergite 5 with a similar but continuous band placed diagonally.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Goa, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharastra, Meghalaya, Orissa, Punjab, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

Elsewhere : Jakarta, Jawa & Malaysia, Nepal, Pakistan and Sri Lanka; Africa, and Papua.

Sub genus ***Pandasyophthalmus*** Stuckenberg

1954. *Pandasyophthalmus* Stuckenberg, Revue *Zool Bot. afr.*, **49** : 100. Type-species : *Paragus longiventris* Loew.

Key to the Species

1. Abdomen entirely shining black; male terminalia with short and broad surstylus, even broader apically; superior lobe short, slightly longer than surstylus ..... *tibialis* (Fallén)

– Abdomen bluish black anteriorly; and bright reddish posteriorly; male terminalia with long and slender surstylus gradually tapering apically; superior lobe robust; even longer than tergite 9 and surstylus together ....*rufiventris* Brunetti

27. ***Paragus (Pandasyophthalmus) rufiventris*** Brunetti

1913. *Paragus rufiventris* Brunetti, *Rec. Indian Mus.*, **8** : 157.

1975. *Paragus (Pandasyophthalmus) tibialis rufiventris* Brunetti, Knutson Thompson and Vockeroth, *A Catalog of Diptera of the Oriental Region*, **2** : 328.

1983. *Paragus (Pandasyophthalmus) rufiventris* Brunetti, Datta & Chakraborti, *Rec. zool. Surv. India*, **81** : 245.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Jammu & Kashmir, Sikkim, Tripura, Uttar Pradesh and West Bengal.

Elsewhere : Bhutan, Nepal, Pakistan and Sri Lanka.

28. ***Paragus (Pandasyophthalmus) tibialis*** (Fallen)

1817. *Pipiza tibialis* Fallen, *Syrphici Sveciae* : 60.

1983. *Paragus (Pandasyophthalmus) tibialis* (Fallen) Datta & Chakraborti, *Rec. zool. Surv. India*, **81** : 244.

Distribution : India : Arunachal Pradesh, Bihar, Himachal Pradesh, Jammu & Kashmir, Kerala, Meghalaya, Tripura, Uttar Pradesh and West Bengal.

Elsewhere : Nepal and other parts of the Oriental Region, Palaearetic Region.

Sub family MILESIINAE

[Modified after Thompson 1972]

Tribe **Cheilosiini**

Genus ***Cheilosia*** Meigen

1822. *Cheilosia* Meigen, *Syst. Beschr. Europ. zweifl. Insekt.* **3** : 296. Type-species : *Eristalis scutellaris* Fallen.

Diagnosis : Eye hairy, always more hairy in male than female; frons in female usually with 3 longitudinal channels and with distinct transverse depression just above the antenna; face excavated below antenna and then produced into a distinct central bump; antenna with 3rd joint ovate, arista dorsal, bare or slightly pubescent, nearly basal; thorax pubescent, bristly towards sides; legs simple, sometimes with specific characters; wing with squamae long fringed; abdomen oblong or elongate oval.

29. ***Cheilosia apicalis*** Brunetti

1913. *Cheiolsia apicalis* Brunetti, *Rec. Indian Mus.*, **8** : 158.

Diagnosis : Head with greyish reflections, vertex and frons with black hairs and the transverse calosity just above the antenna; antenna reddish brown, upper side and apex of 3rd joint

blackish; thorax blackish with a very slight bronze-green tint and with short black and yellow hairs; scutellum concolours; femora black except yellowish at tip, tibiae orange, hind tibiae with broad complete black band, tarsi orange; wings clear, stigma brownish yellow; 1st abdominal tergite brownish, remaining dark black with yellowish hairs thicker at base and sides.

Distribution : India : Arunachal Pradesh and Assam.

Tribe **Volucellini**

Key to the genera

1. Wing without spurious vein between R and M; marginal cell (R_1) open; apex of vein M_{1+2} strongly divergent from wing margin ..... ***Graptomyza*** Wiedemann
- Wing with spurious vein between R and M; marginal cell (R_1) closed; vein M_{1+2} strongly recurrent at tip ..... ***Volucella*** Geoffroy

Genus ***Graptomyza*** Wiedemann

1820. *Graptomyza* Wiedemann, *Nova Dipt. Gen.*, **16**. Type-species : *Graptomyza longirostris* Wiedemann.

Key to the Species

1. 2nd abdominal segment with a broad black band on hind margin in the shape of three blunt triangles ..... *brevirostris* Wiedemann
- 2nd abdominal segment with a large transverse spot on hind margin not reaching side and extends forward beyond middle .... *ventralis* Wiedemann

*30. ***Graptomyza brevirostris*** Wiedemann

1820. *Graptomyza brevirostris* Wiedemann, *Nova Dipt Gen.*, 17.

Material examined : 1♂, Salari, W. Kameng, 8.X. 2001, coll T. Mondal.

Distribution : India : Arunachal Pradesh, Tamil Nadu.

Elsewhere : Borneo, Jawa, Malaya, Mayanmar, Napal, Phillipines and Srilanka.

*31. ***Graptomyza ventralis*** Wiedemann

1830. *Graptomyza ventralis* Wiedemann, *Aussereurop. Zweifl. Insekt.*, **2** : 207.

Material examined : 1♂, 3♀, Rama Camp, W. Kameng, 7.8.2001, coll M. Sil.

Distribution : India : Arunachal Pradesh.

Elsewhere : Jawa, Malay.

Genus ***Volucella*** Geoffroy

1762. *Volucella* Geoffroy, *Hist Insect Paris.* **2** : 540. Type-species : *Musca pellucens* Linnaeus.

32. ***Volucella trifasciata*** Wiedemann

1830. *Volucella trifasciata* Wiedemann, *Aussereurop. Zweifl. Insekt.* **2** : 196.

Diagnosis : Head yellowish orange to dull yellow, frons in male small, projecting, dull yellowish with yellow pubescence face deeply cut away; below antennae where it is pale yellowish; antennae orange with black hairs on arista; thorax orange with yellow pubescence and a row of yellow bristles on hind margin; humeri with at least spines; scutellum orange; legs orange, hind femora may be with a broad sub basal or median black band; wing yellowish gray, a small brown narrow infuscation in middle from anterior margin, at cross veins, fades away towards anal cell; abdomen black, base of first segment yellow, two narrow linear band, first being wider than second lying over the margins of 2nd and 3rd and of 3rd and 4th segments.

Distribution : India : Arunachal Pradesh, Maghalaya and Sikkim.

Elsewhere : Cambodia, China, Jawa, Kalimantan, Malaya, E. Malaysia, Myanmar, Philippines, Sulawesi, Taiwan, Thailand and Vietnam.

Tribe **Chrysogasterini**

Genus ***Sphegina*** Meigen

1822. *Sphegina* Meigen, *Syst. Beschr. europ zweifl. Insekt* **3** : 193. Type-species : *Milesia clunipes* Fallén

Diagnosis : Eyes bare, distinctly separated in both sexes, face below antenna with no central

bump but upper mouth edge much enlarged; 3rd antennal joint ovate, arista slightly pubescent dorsally; thorax sub-quadrate with short pubescence; scutellum bare with a pair of subapical bristles; hind femora very much thickened with spines below, hind tibiae curved, hind basitarsus dialated; 4th and 5th longitudinal vein turned sharply upward with as rectangular bend; squamae with characteristic fringes peculier to this genus; abdomen more or less clubshaped.

Sub genus ***Asiosphegina*** Stackelberg

1953. *Asiosphegina* Stackelberg, *Trudy. Zool. Inst. Akd. Nauk. SSSR.*, **13** : 376. Type-species : *Sphegina sibirica* Stackelberg.

Key to the Species

1. Wing with small brownish infuscation; hind femora with distinct pale transverse streak below ..... *tristriata* P ··netti
– Wing entirely clear; hind femora yellow on basal half, apical half, black .... *javana* de Meijere

*33. ***Sphegina (Asiosphegina) javana*** de Meijere

1814. *Sphegina (Asiosphegina) javana* de Meijere. *Tijdschr. Ent.*, **57** : 166.

Material examined : 1♂, Zemithang, Tawang, 11.viii.2001, coll B. Mitra.

Distribution : India : Arunachal Pradesh and West Bengal.

Elsewhere : Jawa.

34. ***Sphegina (Asiosphegina) tristriata*** Brunetti

1913. *Sphegina (Asiosphegina) tristriata* Brunetti. *Rec. Indian Mus.*, **8** : 165.

Distribution : India : Arunachal Pradesh and Assam.

Tribe **Spheginobacchini**

Genus ***Spheginobaccha*** de Meijere

1908. *Spheginobaccha* de Meijere, *Tijdschr. Ent.*, **51** : 327. Type-species : *Sphegina macropoda* Bigot.

Diagnosis : Eye pilose or bare; face with weak tubercle; occiput produced on upper half, with a deep crease on upper two-thirds; antennal arista bare; scutellum without a rim and hairfringe, mesopleuron at its anterior portion bare; metathoracic spiracular hair-patch absent; metasternum pilose; wing with vein R_{4+5} straight, apical cross-vein directed outward, a distinct spur on vein M_{1+2} and marginal cell open at margin; hind femur with ventral spines.

35. ***Spheginobaccha macropoda*** (Bigot)

1883. *Spheginobaccha macropoda* (Bigot), *Annls Soc. Ent Fr.*, (6) **3** : 331.

Diagnosis : Eye pilose, anterior ocellus not sunken into a cleft and divided; wing with basal cell 2 microtrichose on apical third; abdominal pattern always with more extensive dark areas except 2 pairs of yellow lateral spots on tergites 2 and 3, and 1 pair of silvery spots on 4; sternite 9 in male genitalia pilose on dorso-lateral surface posteriorly; superior lobe apically like a hook.

Distribution : India : Arunachal Pradesh, Meghalaya, Sikkim and West Bengal.

Elsewhere : Anambas Is., China, Hainan Is., Jawa, Kalimantan, Laos, Malaya, E. Malaysia, Myanmar, Thailand and Vietnam.

Tribe **Sericomyini**

Genus ***Sericomyia*** Meigen

1803. *Sericomyia* Meigen, *Magazin Insekt de.* **2** : 274. Type-species : *Musca lappona* Linnaeus.

Diagnosis : Eyes bare, face slightly hollowed below antennal prominence, with moderate sized snout; third antennal joint rounded or subquadrate, arista sub basal very plumose; thorax subquadrate moderately pubescent; hind femora thickened, hind tibiae slightly bent; marginal cell widely open, anterior cross vein at middle of discal cell, oblique, 1st posterior cell closed before border of vein; abdomen generally blackish with transverse yellow spots.

36. ***Sericomyia eristaloides*** Brunetti

1913. *Sericomyia eristaloides* Brunetti, *Rec. Indian Mus.*, **8** : 167.

Diagnosis : Face moderately swollen, snout elongate, central knob not conspicuous, frons with long soft black hairs, central bump with black hairs towards sides; antenna without any protuberance; thorax dull brownish, thickly covered with yellowhis brown hairs; scutellum brownish yellow, paler on hind margin, dorsum with brown hairs at base and yellow and longer towards tip; fore femora black with a yellow streak posteriorly, middle femora yellow with wide black streak in front, hind femora basal half brownish yellow, apical half black, hind femora with a number of stiff black bristles of various length on apical half below, hind tibiae wholly black, rest tibiae bi-colour; wing with a small brownish infuscation in middle extending from the costa and the brown stigma to the fourth logitudinal vein; abdomen with 1st segment whitish yellow remainder blackish, 2nd, 3rd and 4th segments with an uniterrupted narrow yellowish band just before the middle and reaching the lateral margins, 5th segment entirely black.

Distribution : India : Arunachal Pradesh and Assam.

Tribe **Eumerini**

Genus *Azpeytia* Walker

1865. *Azpeytia* Walker, *J. Linn. Soc. Lond.*, **8** : 113. Type-species : *Azpeytia scutellaris* Walker.

Diagnosis : Head as broad as thorax, frons prominent, eyes pubescent; antennae short, third segment elongate-conical, arista bare; thoracic suture distinct, hind corners with a distinct ridge, scutellum with a ridged margin; legs robust; marginal cell widely open; third vein curved downwards into first posterior cell, but not so deeply like *Eristalis*, fourth longitudinal vein bisunuate at apical section, antrior cross vein much beyond middle of discal cell; abdomen longer than thorax.

37. *Azpeytia bifascia* Brunetti

1907. *Azpeytia bifascia* Brunetti, *Rec. Indian Mus.*, **1** : pl. xiii, figs 1-5; 1908.

1908. *Rec. Indian Mus.*, **8** : 84 (♂).

Diagnosis : Head black, frons, vertex and lower part of face with strong black hairs; antenna dark brown, base of arista very distinctly thicker and reddish; outer ocular orbit-with a fringe of short yellow hairs; thorax shining black covered with thick short bright yellow hairs; scutellum reddish, darker at base and covered with thick yellow hairs; legs wholly brown, hind femora with a fringe of brown hairs on apical half below and yellow hairs on outer side, all tibiae and coxae with yellow hairs on outer side, wings yellow, stigma reddish brown; abdomen black, shining covered with thick black hairs, second segment with a large reddish brown triangular spot on each side covered with yellowish gray hairs, extreme edge of abdomen before tips with a fringe of short bright yellow hairs.

Distribution : India : Arunachal Pradesh and Assam.

Tribe **Cerioidini**

Genus *Monoceromyia* Shannon

1922. *Monoceromyia* Shannon, *Bull. Brocklyn ent Soc.*, **17** : 32 (as subgenus of *Cerioides* Rondani). Type-species : *Ceria tricolor* Loew.

Diagnosis : Eye bare; frons at its lower part slightly produced; antenna porrect; placed on an elongate peduncle; segment 3 as long as or longer than segment 2, with a narrow terminal style instead of arista; scutellum without a ventral pile fringe and without distinct apical rim; metathoracic spiracular pile patch absent; anterior portion of mesopleuron pilose only on upper half; metasternum always with a few short distinct hairs; wing long, narrowed apically and broadly darkened all along anterior margin; marginal cell broadly open; apical cell closed at wing margin; vein R_{4+5} with a pointed loop downwards into apical cell; anterior cross-vein always beyond middle, usually at outer third of discal cell; hind fermur slightly swollen and with ventral spines.

38. *Monoceromyia javana* (Wiedemann)

1824. *Ceria javana* Wiedemann, *Analecta Ent.*, : 32.

Diagnosis : Face pale yellow, cheeks wholly black; antenna black; thorax black with a trace of yellowish tomentose median stripe reaching hind margin, humeri with bright orange yellow calli;

scutellum yellow with central black spot, with brown pubescence; legs black, fore femora with bright yellow distinct streak on lower surface and on middle femora the streak is on hind surface, hind femora the steaks are inner and outer upto basal half; wing gray, 5th vein narrowly suffused with brown up to base of discal cell; abdomen slightly shining black, 1st segment with two large yellow spots on each side at base; 2nd segment four times longer than 1st; 2nd, 3rd and 4th segment with thick pale yellow to brownish orange hind margins, pubescence of abdomen yellowish brown.

Distribution : India : Arunachal Pradesh, Assam, Karnataka and West Bengal.

Elsewhere : Borneo, Jawa, Malaya, Nepal, Sumatra.

Tribe **Eristalini**

Key to the genera

1. Wing with marginal cell (R_1) open 2
- Wing with marginal cell (R_1) closed 3
2. Brillantly metallic species, body subfusiform, hind femur without process ..... ***Catacores*** Hull
- Non-metallic, body not subfusiform hind femur with a process on underside ..... ***Mesembrius*** Rondani
3. Eye bare; wing with normal submarginal cell (R_3) due to normal length of anterior cross-vein (r-m); metathoracic spiracular pile-patch present ..... ***Phytomia*** Guerin-Meneville
- Eye at least partially pilose; if bare, then submarginal cell narrowed basally due to longer anterior cross-vein; metathoracic spiracular pile patch usually absent 4
4. Antennal arista practically bare; if with microscopic pubescence at base, then abdominal tergites with transversely located spots ..... ***Eristalinus*** Rondani
- Antennal arista plumosa at least on basal half; if bare, then eye invariably with 2 distinct bands of dense, dark-coloured piles ..... ***Eristalis*** Latreille

Genus ***Catacores*** Hull

1944. *Catacores* Hull, *Ent. News*, **55** : 205. Type-species : *Axona cyanea* Brunetti.

39. ***Catacores cyanea*** (Brunetti)

1913. *Axona cyanea* Brunetti, *Rec. Indian Mus.*, **9** : 272.

Diagnosis : A violet blue species with head, thorax and abdomen approximated; antennal segment 3 rounded, with arista beset with a few hairs at base; wing with marginal cell very narrowly open;anterior cross-vein just beyond mid-point of discal cell; anal vein running nearly to wing-margin; hind femur without spines or bristles; hind tibia barely curved and slightly thickened in middle.

Distribution : India : Arunachal Pradesh, Meghalaya, Sikkim and West Bengal.

Genus ***Eristalinus*** Rondani

1845. *Eristalinus* Rondani, *Nuovi Annali Sci. Nal. Bologna,*, **2** (2) : 453. Type-species : *Musca sepulchralis* L.

Key to the Subgenera

1. Eye with brown or black spots or with dark irregular markings; metathoracic spiracle at its front without any patch of hairs ..... ***Eristalinus*** Rondani
- Eye with distinct stripes; metathoracic spiracle at its front with a distinct patch of hairs ..... ***Eristalodes*** Mik

Subgenus ***Eristalinus*** Rondani

Key to the Species

1. Femur normally orange or brownish orange, tarsi of similar colour, at most a little darker apically ..... *arvorum* (Fabricius)
- Femur black, tarsi yellowish white nearly to tips ..... *quinquestriatus* (Fabricius)

40. ***Erstalinus (Eristalinus) arvorum*** (Fabricius)

1787. *Syrphus arvorum* Fabricius, *Mantissa Insect.*, **2** : 335.

Distribution : India : Arunachal Pradesh,

Jammu & Kashmir, Meghalaya, Orissa, Sikkim and West Bengal.

Elsewhere : China and other parts of the SE Asia; Australia, Hawaii, Japan and Micronesia.

41. ***Erstalinus (Eristalinus) quinquestriatus*** (Fabricius)

1794. *Syrphus quinquestriatus* Fabricius, *Ent. Syst.*, **4** : 289.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Karnataka, Kerala, Madhya Pradesh, Meghalaya, Orissa, Uttar Pradesh and West Bengal.

Elsewhere : China and other parts of the Oriental region; Japan.

Subgenus ***Eristalodes*** Mik

1897. *Eristalodes* Mik, *Wien. ent. ztg.*, **16** : 144. Type-species : *Eristalis taeniops* Wiedemann.

Key to the Species

1. Thorax yellowish with 4 distinct black stripes; abdominal segment 3 mainly or entirely black ..... *paria* (Bigot)

– Thorax dull yellowish gray, with 4 but indistinct black stripes; abdominal segment 3 predominently bright yellow .... *taeniops* (Wiedemann)

42. ***Erstalinus (Eristalodes) paria*** (Bigot)

1880. *Eristalomyia paria* Bigot, *Annls Soc. ent. Fr.* (5) **10** : 218.

1923. *Eristalis quinquelineatus* var. *orientalis* Brunetti, *Fauna Br. India, Dipt.*, **3** : 183.

Material examined : 1♀, Rama Camp, (W. Kameng District), 7.X.2001, coll M. Sil.

Distribution : India : Arunachal Pradesh (West Kameng District), Sikkim, Himachal Pradesh, Jammu & Kashmir, Karnataka, Manipur, Meghalaya, Mizoram, Tamil Nadu, Uttar Pradesh and West Bengal.

Elsewhere : Jawa, Laos, Malay, Nepal, Sri Lanka and Taiwan; Japan & Maluccas.

43. ***Erstalinus (Eristalodes) taeniops*** (Wiedemann)

1818. *Erstalis taeniops* Wiedemann, *Zool. Mag.*, **2** : 42.

Distribution : India : Arunachal Pradesh, Himachal Pradesh, Sikkim, Meghalaya and West Bengal.

Elsewhere : Nepal and Pakistan; Ethiopian and Palaearctic region.

Genus ***Eristalis*** Latreille

1804. *Eristalis* Latreille, *Nouv. Dict. Hist. Nat.*, **24** : 194. Type-species : *Musca tenax* L.

Key to the Subgenera

1. Upper edge of meropleuron (barrette) pilose ..... ***Eristalis*** Latreille

– Upper edge of meropleuron bare .... ***Eoseristalis*** Kanervo

Subgenus ***Eristalodes*** Latreille

44. ***Eristalis (Eristalis) tenax*** (Linnaeus)

1758. *Musca tenax* Linnaeus, *Syst. Nat. Ed.*, **10** : 591.

Diagnosis : Eye brown-haired with 2 longitudinal bands of dense hairs; antenna usually brownish black, arista bare; mesonotum shining brownish black; scutellum brownish yellow; subscutellar fringe absent; abdominal coloration bright reddish yellow to black.

Material examined : 4♂♂, 1♀; Zemithang, Tawang, 11.X.2001, coll B. Mitra.

Distribution : India : Arunachal Pradesh (Tawang District), Meghalaya nearly cosmopolitan.

Subgenus ***Eoseristalis*** Kanervo

1938. *Eoseristalis* Kanervo, *Annls Univ. Jenn. abo.* (A) **6** : 12. Type-species : *Eristalis cerealis* F.

Key to the Species

1. Wing with a large brown suffusion filling about middle third of anterior half .... ***himalayensis*** Brunetti

- Wing nearly clear excepting suffused stigma and at most, costal area but never extensive as above 2

2. Mesonotum without any transverse stripe; abdominal tergite 3 with a black spot filling half of anterior margin, tergite 4 shining black like 5 ..... *arbustorum* (L.)

- Mesonotum with a transverse stripe of greyish pubescence along suture; abdominal tergite 3 in males with a triangular or oblong spot on anterior margin, reaching laterally, in females spots smaller and narrower but always on anterior margin .... *cerealis* Fabricius

*45. *Eristalis (Eoseristalis) arbustorum* (Linnaeus)

1758. *Musca arbustorum* Linnaeus, *Syst. Nat. Ed.*, **10** : 591.

Material examined : 1♂, Rama Camp, (West Kameng District), 7.X.2001, coll M. Sil.

Distribution : India : Arunachal Pradesh (West Kameng District), Sikkim, Jammu & Kashmir, Meghalaya, and West Bengal.

Elsewhere : Holarctic.

46. *Eristalis (Eoseristalis) cerealis* Fabricius

1805. *Eristalis cerealis* Fabricius, *Syst. antliat.* : 232.

1849. *Eristalis solitus* Walker, *List Dipt. Colln. Br. Mus.*, **3** : 619.

Material examined : 1♂, Zemithang, Tawang, 11.X.2001, coll B. Mitra.

Distribution : India : Arunachal Pradesh (Tawang District), Assam, Himachal Pradesh, Jammu & Kashmir, Manipur, Meghalaya, Mizoram, Sikkim, and West Bengal.

Elsewhere : China, Myanmar and other parts of the Oriental region; Japan, Korea and Sakhalin.

47. *Eristalis (Eoseristalis) himalayensis* Brunetti

1880. *Eristalis ursinus* Bigot, *Annls Soc. Ent. Fr.* (5) **10** : 215 (Pre-occupied, Jaennicke 1867).

1908. *Eristalis himalayensis* Brunetti, *Rec. Indian Mus.*, **2** : 70 (Nov. nom.).

Distribution : India : Arunachal Pradesh, Himachal Pradesh, Kashmir, Sikkim, Uttar Pradesh and West Bengal.

Elsewhere : China, Myanmar and Nepal.

Genus *Mesembrius* Rondani

1857. *Mesembrius* Rondani, *Dipterol ital. prodr.*, **2** : 50. Type-species : *Helophilus peregrinus* Loew.

*48. *Mesembrius insignis* (Walker)

1855. *Helophilus Insignis* Walker, *J. Linn. Soc. Lond.* **1** : 17.

Material examined : 1♂, 1♀, Salari, W. Kameng, 8.8.2001, coll T.K. Mondal.

Diagnosis : Frons and face yellow dusted and with long soft pale yellow pubescence; antennal prominence distinct, shining black with stiff black hairs, tip brownish orange, basal two antennal joints brownish orange to black; thorax yellow with three longitudinal black stripes; dorsum with short yellow pubescence behind a bunch of long yellow pubescence, humer extending downwards to mesopleura; scutellum orange yellow with dense yellow pubescence; legs shining black, tips of femora narrowly brownish orange, all tibia brownish orange, more or less on basal half; squamae of wing fringed; 1st abdominal segment black with orange yellow sides, 2nd segment with a pair of large oblong orange yellow spots above centre, 3rd segment with a broad basal yellow band occupying about half the segment which may vary in colour, 4th segment moderately shining black.

Distribution : India : Arunachal Pradesh.

Elsewhere : Borneo, Jawa, Malaya and Mayanmar.

Genus *Phytomia* Guerin-Meneville

1834. *Phytomia* Guerin-Meneville, *in Belanger, Voyage Ind.-orient.*, **7** : 509. Type-species : *Eristalis chrysopygus* Wiedemann.

Sub genus ***Phytomia*** Guerin-Meneville

Diagnosis : Scutellum devoid of apical rim; hind femur unarmed in that sub-apical tooth on front side lacking.

Key to the Species

1. Antennal arista bare; hind femur without any stiff bristly hairs; wing pale gray, brown at base and pale yellowish brown on about basal half or two-thirds anteriorly .... *errans* (Fabricius)

– Antennal arista plumose on basal half; hind femur with short stiff bristly hairs; wing yellowish gray, with dark brown suffusion anteriorly, extending to apex of basal cell 1 and base of submarginal cell (R_3) .... *zonata* (Fabricius)

49. ***Phytomia (Phytomia) errans*** (Fabricius)

1787. *Syrphus errans* Fabricius, *Mantissa Insect.* **2** : 337.

1923. *megaspis errans* Fabricius, Brunetti; *Fauna Br. India Dipt,* **3** : 199.

Material examined : 1♂, Circuit house, Daporijo, (Upper Subansiri District), 4.VI.2000, coll R.S. Mridha.

Distribution : India : Arunachal Pradesh (Upper Subansiri District), Assam, Bihar, Karnataka, Mizoram, Jammu & Kashmir, Kerala, Manipur, Tamil Nadu, Tripura and West Bengal.

Elsewhere : Other parts of the SE Asia; Japan.

50. ***Phytomia (Phytomia) zonata*** (Fabricius)

1787. *Syrphus zonatus* Fabricius, *Mantissa Insect.* **2** : 337.

1923. *Megaspis zonatus* Fabricius : Brunetti, *Fauna Br. India, Dipt.,* **3** : 203.

Distribution : India : Arunachal Pradesh, Assam, Karnataka, Kerala, Meghalaya, Sikkim, Tamil Nadu, Tripura and West Bengal.

Elsewhere : Bangladesh, China, Philippines, and other parts of the SE Asia; Japan, Korea and Manchuria.

GENERAL REMARKS

The fauna of Arunachal Pradesh comprises of 50 species under 28 genera, viz., *Allograpta* Osten Sacken (2spp.), *Asarkina* Macquart (1sp.), *Betasyrphus* Matsumura (1sp.), *Dideopsis* Matsumura (1sp.), *Episyrphus* Matsumura & Adachi (1sp.), *Ischiodon* Sack (1sp.), *Metasyrphus* Matsumura (3spp.), *Scaeva* Fabricius (1sp.), *Sphaerophoria* Lepeletier & Serville (3spp.), *Syrphus* Fabricius (5spp.), *Baccha* Fabricius (3spp.), *Melanostoma* Schiner (2spp.), *Chrysotoxum* Meigen (1sp.), *Paragus* Latreille (3spp.), *Cheilosia* Meigen (1sp.), *Graptomyza* Wiedemann (2spp.), *Volucella* Geoffroy (1sp.), *Sphegina* Meigen (2spp.), *Spheginobaccha* de Meijere (1sp.), *Sericomyia* Meigen (1sp.), *Azpeytia* Walker (1sp.), *Monoceromyia* Shanon (1sp.), *Catacores* Hull (1sp.), *Eristalinus* Rondani (4spp.), *Eristalis* Latreille (4spp.), *Messembrius* Rondani (1sp.), *Phytomia* Guerin-Meneville (2spp.). Among the fifty speceis so far reported from Arunachal Pradesh, the three species namely, *Sphaerophoria assamensis* Joseph, *Sphaerophoria vockerothi* Joseph and *Syrphus aeneifrons* Brunetti are confined only to this state.

Interesting to note that, a few speceis are reported in India only from this state, but also distributed in other countries. The species are *Syrphus vitripennis* (Taiwan & Europe), *Baccha (Allobaccha) dispar* (Celebes & Malaya), *Graptomyza ventralis* (Jawa & Malaya), & *Mesembrius insignis* (Borneo, Jawa, Malaya, Myanmar).

However, the faunal analysis shows that, 74% syrphid fauna of this state occur in the other north-east Indian states, 66% in the eastern India, 34% in South India, 46% in northern India and only 10% in western India (Table : 2)

In addition to this, among the 50 species reported from Arunachal Pradesh, only 16% species are confined to India, 20% species confined to Oriental Region, 32% species extends their range up to Palaearcitc Region beyound the Oriental, 10% species extends their distribtion their distribution up to the Australian Region beyond the Oriental & Palaearctic Regions, and 10% specees also up to the Ethiopian Region. A single species, *Eristalis (Eristalis) tenax* (Linnaeus) is cosmopolitan in distribution (Table : 3)

ACKNOWLEDGEMENT

We are very much thankful to Dr. J.R.B. Alfred, Director, and Dr. A.K. Hazra, Scientist E and in charge of Entomology Division A & B of the Zoological Survey of India, Kolkata, for placing the materials at our disposal for study and also their constant encouragement.

REFERENCES

BRUNETTI, E., 1923., *The Fauna of British India including Ceylon and Burma.* Diptara : Pipunculidae, Syrphidae, Conopidae and Oestridae, **3** : xi + 424 pp. Taylor and Francis, London.

DATTA, M. 1998. Diptera : Syrphidae *In : Fauna of Meghalaya, State Fauna Ser,* **4**(Part-6): 113-176. Zoological Survey of India, Calcutta.

DATTA, M., PARUI P., and MUKHERJEE, M., 2000. Diptera : Syrphidae *In : Fauna of Tripura. State Fauna Ser.* **7**(Part-3) : 241-259. Zoological Survey of India, Calcutta.

DATTA, M., PARUI, P. and MUKHERJEE, M. 1997. Insecta : Diptera In : *Fauna of West Bengal. State Fauna Ser.* **3**(Part-7) : 1-76. Zoological Survey of India, Calcutta.

DATTA. M. CHAKRABORTY, M. 1985. Insecta : Diptera : In fauna of Namdapha : Arunachal Pradesh; *Rec. zool. Surv. India*, **82**(1-4) : 231-252.

JOSEPH, A.N.T. 1967. On the 'FORMS' of *sphaerophoria* st Fargeau and Seruille (Diptera : Syuphidae) described by Brunetti from India, *Oriental Insects,* **1** (3-4) : 243-248.

JOSEPH, A.N.T. and P. PARUI, 1973. Diptera from NEFA and Assam Foot Hills, Part III, Siang Frontier Division and North Lakhimpur. *Rec. zool. Surv. India*, **67** : 325-342.

JOSEPH, A.N.T. and P. PARUI, 1977. Diptera from Arunachal Pradesh and Assam Foot Hills, Part V, TIRAP Division. *Rec. zool. Surv. India*, **72** : 333-339.

JOSEPH, A.N.T. and RAO, K.R. 1972a. Diptera from NEFA and Assam Foot Hills, Part I, Kameng Frontier Division and Assam Foot Hills. *Rec. zool. Surv. India*, **66** : 63-74.

JOSEPH, A.N.T. and K.R. RAO, 1972b. Diptera from NEFA and Assam Footh Hills, Part II, Kameng Frontier Division, Subansiri Frontier Division, North Lakhimpur and Assam Foot Hills. *Rec. zool. Surv. India*, **66** : 103-128.

JOSEPH, A.N.T. and RAY, K.K. 1976. Diptera from Arunachal Pradesh and Assam Foot Hills, Part IV, Lohit Frontier Division, Lakhimpur District and Sibsagar District. *Rec. zool. Surv. India*, **69** : 275-290.

KNUTSON, L. V., THOMPSON, F. C. and VOCKEROTH, J. R. 1975. *A Catalog of the Diptera of the Oriental Region*, **2** : 307-374. Univ. Hawaii press, Honolulu.

THOMPSON, F.C. 19972. A Contribution to a generic revision of the Neotropical Milesinae (Diptera : Syrphidae). *Arq. zool., Sao Paulo,* **23** : 73-215.

VOCKEROTH, J.R. 1969. A revision of the genera of the syrphini (Diptera : Syrphidae), *Mem. ent. Soc. can.,* **62** : 1-176.

Table : 1 Distribution of the speceis in the different districts of Arunachal Pradesh
Present : + Reported as N.E.F.A. : ●

Sl. No.	SPECIES	Kameng	Subansiri	Tawang	Siang	Lohit	Triap	Chang Lang
1.	*Allograpta Javana* Wiedemann							+
●2.	*A. maculipleura* (Brunetti)							
3.	*Asarkina (A) ericetorum* (Fab.)		+		+	+	+	+
4.	*Betasyrphus serarius* (Wied.)	+			+	+		
5.	*Dideopsis aegrotus* (Fab.)	+	+		+	+		
6.	*Episyrphus balteatus* (De Geer)	+	+		+	+		+
7.	*Ischiodon scutellaris* (Fab.)	+	+					
8.	*Metasyrphus (M) confrater* (Wied.)	+						+
9.	*M (M) corollae* (Fabricius)	+	+					
●10.	*M (M) latifasciatus* (Macq.)							
11.	*Scaeva selenitica* (Meigen)	+						
12.	*Sphaerophoria assamensis* Joseph	+						
13.	*S. indiana* Bigot	+	+			+		+
14.	*S. vockerothi* Joseph					+		
●15.	*Syrphus aenifrons* Brunetti							
●16.	*S. fulvifocies* Brunetti							
17.	*S. isaaci* Bhatia							
18.	*S. vitripennis* Meigen							
19.	*S. remotus* Brunetti							
20.	*Baccha (Allobaccha) amphithoe* Walk		+			+		
21.	*B. (A) dispar* Walker		+					
22.	*B. (A) maculata* Walker				+			
23.	*Melanosloma orientale* (Wiede.)	+	+		+	+	+	
24.	*M. univittata* (Wiedemann)	+	+			+		
25.	*Chrysotoxum baphurus* Walker		+		+	+		+
26.	*Paragus (P) serratus* (Fabricius)		+				+	
27.	*P (P) rafiventrls* (Bruneui)				+		+	
28.	*P. (P) tibialis* (Fallen)	+			+			
●29.	*Cheilosia apicalis* Brunetti							
30.	*Groptomyza brevirostris* Wiede.							
31.	*G. ventralis* Wiedemann							
32.	*Volucella trifasciata* Wiedemann							
33.	*Sphegina (Asiophegina) javana* de Meijre							
●34.	*S. (A) tristriata* Brunetti							
35.	*Speginobaccha macropoda* (Bigot)							
●36.	*Sericomyia eristaloides* Brunetti							
37.	*Azpeytia bifascia* Brunetti							
38.	*Monoceromyia javana* (Wiedemann)		+		+			

Table Contd.

Sl. No.	SPECIES	Kameng	Subansiri	Tawang	Siang	Lohit	Triap	Chang Lang
39.	*Catacores cyaneys* (Brunetti)							+
40.	*Eristalinus (E) arvorum* (Fab.)	+	+					+
41.	*E. (E) quinquestriatus* (Fabricius)	+	+					
42.	*E. (Eristalodes) paria* (Bigot)	+	+					
43.	*E. (E) taeniops* (Wiedemann)	+						
44.	*E (E) tenax* (Linnaeus)	+	+					
45.	*E. (Eoseristalis) arbutorum* (L)					+		
46.	*E (E) cerealis* Fabricius					+		
47.	*E (E) himalyensis* Brunetti	+						
48.	*Messembrius insignis* (Walker)							
49.	*Phytomia (P) errans* (Fabricius)		+		+			
50.	*P (P) zonata* (Fabricius)				+	+		+

Table : 2 Distribution of the speceis in the different zones of India
Present : ●

Sl. No.	SPECIES	N.E. India	Eastern India	South India	North India	Western India
1.	*Allograpta javana* Wiedemann	●	●	●		
2.	*A. maculipleura* (Brunetti)	●				
3.	*Asarkina (A) ericetorum* (Fab.)	●	●	●	●	●
4.	*Betasyrphus serarius* (Wied.)	●	●	●	●	
5.	*Dideopsis aegrotus* (Fab.)	●	●	●		
6.	*Episyrphus balteatus* (De Geer)	●	●		●	
7.	*Ischiodon scutellaris* (Fab.)		●	●		●
8.	*Metasyrphus (M) confrater* (Wied.)	●	●		●	
9.	*M (M) corollae* (Fabricius)	●	●			
10.	*M (M) latifasciatus* (Macq.)				●	
11.	*Scaeva selenitica* (Meigen)	●			●	
12.	*Sphaerophoria assamensis* Joseph					
13.	*S. indiana* Bigot	●	●	●	●	●
14.	*S. vockerothi* Joseph					
15.	*Syrphus aenifrons* Brunetti					
16.	*S. fulvifocies* Brunetti	●				
17.	*S. isaaci* Bhatia	●	●		●	
18.	*S. vitripennis* Meigen					
19.	*S. remotus* Brunetti				●	
20.	*Baccha (Allobaccha) amphithoe* Walk	●				
21.	*B. (A) dispar* Walker					
22.	*B. (A) maculata* Walker	●	●		●	
23.	*Melanosloma orientale* (Wiede.)	●	●	●	●	
24.	*M. univittata* (Wiedemann)	●		●		●
25.	*Chrysotoxum baphurus* Walker	●	●	●	●	
26.	*Paragus (P) serratus* (Fabricius)	●	●	●	●	●
27.	*P (Pandasyophthalmus) rafiventrls* (Bruneui)	●	●		●	
28.	*P. (P) tibialis* (Fallen)	●	●	●	●	
29.	*Cheilosia apicalis* Brunetti	●				
30.	*Groptomyza brevirostris* Wiede.			●		
31.	*G. ventralis* Wiedemann					
32.	*Volucella trifasciata* Wiedemann	●	●			
33.	*Sphegina (Asiophegina) javana* de Meijre		●			
34.	*S. (A) tristriata* Brunetti	●				
35.	*Speginobaccha macropoda* (Bigot)	●	●			
36.	*Sericomyia eristaloides* Brunetti	●				
37.	*Azpeytia bifascia* Brunetti	●				
38.	*Monoceromyia javana* (Wiedemann)	●	●	●		
39.	*Catacores cyaneys* (Brunetti)	●	●			

Table Contd.

Sl. No.	SPECIES	N.E. India	Eastern India	South India	North India	Western India
40.	*Eristalinus (E) arvorum* (Fab.)	●	●		●	
41.	*E. (E) quinquestriatus* (Fabricius)	●	●	●	●	
42.	*E. (Eristalodes) paria* (Bigot)	●	●	●	●	
43.	*E. (E) taeniops* (Wiedemann)	●	●		●	
44.	*E (E) tenax* (Linnaeus)	●				
45.	*E. (Eoseristalis) arbutorum* (Linnaeus)	●	●		●	
46.	*E (E) cerealis* Fabricius	●	●		●	
47.	*E (E) himalyensis* Brunetti		●		●	
48.	*Messembrius insignis* (Walker)					
49.	*Phytomia (P) errans* (Fabricius)	●	●	●	●	
50.	*P (P) zonata* (Fabricius)	●	●	●		

Table : 3 Distribution of speceis in different zoogeographical regions of the World. Present : ■ * Distributed/Confined onlly in India.

Sl. No.	SPECIES	Orien Tal	Palaearctic	Australian	Ethiopian
1.	*Allograpta javana* Wiedemann	■	■	■	
*2.	*A. maculipleura* (Brunetti)				
3.	*Asarkina (A) ericetorum* (Fab.)	■	■	■	■
4.	*Betasyrphus serarius* (Wied.)	■	■	■	
5.	*Dideopsis aegrotus* (Fab.)	■	■	■	
6.	*Episyrphus balteatus* (De Geer)	■	■	■	
7.	*Ischiodon scutellaris* (Fab.)	■	■	■	
8.	*Metasyrphus (M) confrater* (Wied.)	■	■	■	
9.	*M (M) corollae* (Fabricius)	■	■		■
10.	*M (M) latifasciatus* (Macq.)	■	■		
11.	*Scaeva selenitica* (Meigen)	■	■		
*12.	*Sphaerophoria assamensis* Joseph				
13.	*S. indiana* Bigot	■	■		
14.	*S. vockerothi* Joseph				
*15.	*Syrphus aenifrons* Brunetti				
16.	*S. fulvifocies* Brunetti	■	■		
17.	*S. isaaci* Bhatia	■	■		
18.	*S. vitripennis* Meigen	■	■		
*19.	*S. remotus* Brunetti				
20.	*Baccha (Allobaccha) amphithoe* Walk	■			
21.	*B. (A) dispar* Walker	■			
22.	*B. (A) maculata* Walker	■	■		
23.	*Melanosloma orientale* (Wiede.)	■	■		
24.	*M. univittata* (Wiedemann)	■	■		
25.	*Chrysotoxum baphurus* Walker	■			
26.	*Paragus (P) serratus* (Fabricius)	■		■	■
27.	*P (Pandasyophthalmus) rafiventrls* (Bruneui)	■			
28.	*P. (P) tibialis* (Fallen)	■	■		
*29.	*Cheilosia apicalis* Brunetti				
30.	*Groptomyza brevirostris* Wiede.	■	■		
31.	*G. ventralis* Wiedemann	■			
32.	*Volucella trifasciata* Wiedemann	■			
33.	*Sphegina (Asiophegina) javana* de Meijre	■			
*34.	*S. (A) tristriata* Brunetti				
35.	*Speginobaccha macropoda* (Bigot)	■			
*36.	*Sericomyia eristaloides* Brunetti				
*37.	*Azpeytia bifascia* Brunetti				
38.	*Monoceromyia javana* (Wiedemann)	■	■		
*39.	*Catacores cyaneys* (Brunetti)				

Table Contd.

Sl. No.	SPECIES	Orien Tal	Palaearctic	Australian	Ethiopian
40.	*Eristalinus (E) arvorum* (Fab.)	■			■
41.	*E. (E) quinquestriatus* (Fabricius)	■	■		
42.	*E. (Eristalodes) paria* (Bigot)	■			
43.	*E. (E) taeniops* (Wiedemann)	■	■		■
44.	*E (E) tenax* (Linnaeus)				
45.	*E. (Eoseristalis) arbutorum* (Linnaeus)	■	■		
46.	*E (E) cerealis* Fabricius	■	■		
47.	*E (E) himalyensis* Brunetti	■	■		
*48.	*Messembrius insignis* (Walker)				
49.	*Phytomia (P) errans* (Fabricius)	■			
50.	*P (P) zonata* (Fabricius)		■		

Zool. Surv. India
Fauna of Arunachal Pradesh, State fauna Series, 13(Part-2) : 355-367, 2006

INSECTA : DIPTERA : MUSCIDAE

BULGANIN MITRA
Zoological Survey of India, M-Block, New Alipore, Kolkata-700053

INTRODUCTION

The muscids, or common true flies are a group of small to medium sized flies, usually black or green but some of them resemble to calliphorids or blue-bottle flies. The representatives of this family are closely associated with decaying organic matter, especially dung and also responsible for spreading several diseases of man and animals.

The muscid fauna of Arunachal Pradesh is still far from being well known. Though 89 species belonging to 28 genera are reported from north-east India, only 25 species under 7 genera are reported by Joseph and Parui (1973, 1977), Joseph & Rao, (1972), Joseph & Ray (1976), and Datta & Chakraborti (1985) from the NEFA (old name of Arunachal Pradesh).

However, the present paper is based on the recent survey in Arunachal Pradesh by B. Mitra (2001) as well as the previously available information.

The present paper reports 32 species belonging to 11 genera under 4 subfamilies, of which 6 species are new records from this state. The taxonomical keys of subfamilies, genera, etc. have been followed after Vockeroth (1972), Shinonaga and Singh (1994). General morphology, materials & methods have been dealt in the "Fauna of Tripura" by the author (2000).

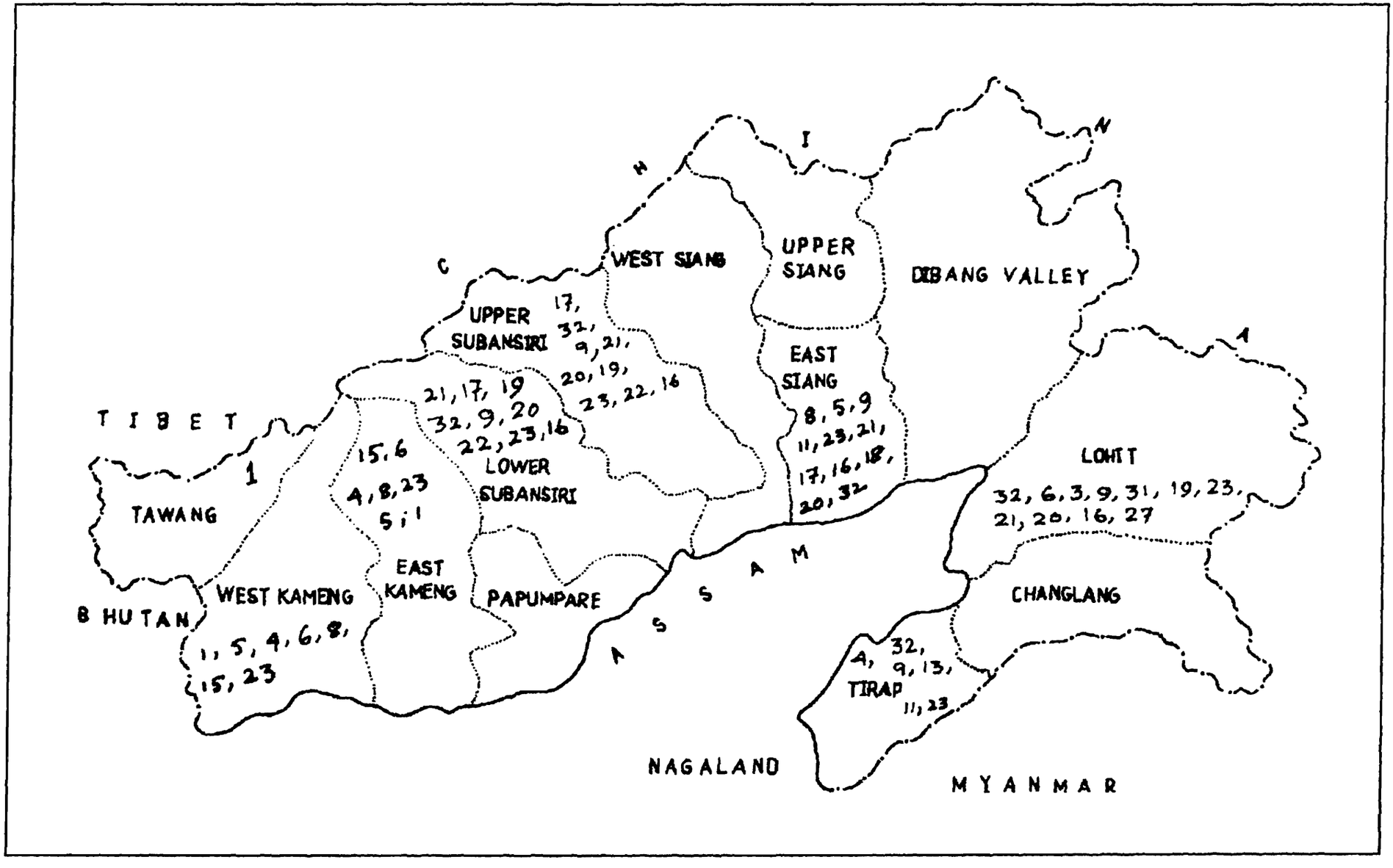
LIST OF SPECIES

A. Subfamily MUSCINAE

1. *Dasyphora kempi* Emden
*2. *Morellia hortensia* (Wiedemann)
3. *Musca (Byomya) conducens* Walker
4. *Musca (Byomya) pattoni* Austen
5. *Musca (Byomya) sorbens* Wiedemann
6. *Musca (Byomya) ventrosa* Wiedemann
7. *Musca (Eumusca) lusoria* Wiedemann
8. *Musca (Musca) domestica* Linnaeus
9. *Musca (Philaematomyia) crassirostris* Stein
10. *Musca (Pseudostimusca) santoshi* Joseph and Parui
11. *Musca (Ptilolepis) inferior* Stein
12. *Musca (Setimusca) malaisei* Emden
13. *Musca (Viviparomusca) bezzii* Patton and Cragg
14. *Musca (Viviparomusca) convexifrons* Thomson
15. *Musca (Viviparomusca) illingworthi* Patton
16. *Orthellia claripennis* Malloch
17. *Orthellia coeruleifrons* (Macquart)
18. *Orthellia diffidens* (Walker)
19. *Orthellia fletcheri* Emden
20. *Orthellia gavisa* (Walker)
21. *Orthellia indica* (Robineau-Desvoidy)
22. *Orthellia lauta* (Wiedemann)
23. *Orthellia timorensis* (Robineau-Desvoidy)
*24. *Muscina pascuorum* (Meigen)

B. Subfamily PHAONIINAE

*25. *Dichaetomyia bibax* (Wiedemann)
*26. *Dichaetomyia quadrata* (Wiedemann)
27. *Atherigona (Atherigona) pulla* (Wiedemann)



Map 1 : Showing the distribution of species in the districts of Arunachal Pradesh.

*28. *Atherigona (Atherigona) simplex* (Thomson)

C. Subfamily LIMNOPHORINAE

29. *Limnophora conica* Stein

*30. *Lispe orientalis* Wiedemann

D. Subfamily STOMOXYINAE

31. *Haematobosca sanguinolenta* (Austen)

32. *Stomoxys calcitrans* (Linnaeus)

SYSTEMATIC ACCOUNT

Key to the subfamilies

1. Probosis elongate, strongly sclerotized, adapted for piercing, tapering from a broad base to a slender apex and with atrophied labella, propleuron haired, vein M_{1+2} gradually curved forward apically from about middle of last section ..... STOMOXYINAE

– Probosis moderately weakly sclerotized not distinctly tapering to apex and with well developed and often fleshy labella, pteropleuron haired or bare, vein M_{1+2} variable, often straight or sharply curved forward near middle of last section 2

2. Pteropleuron at least with a few fine hairs 3

– Pteropleuron bare .... PHAONIINAE (*Atherigona* Rondani)

3. Pteropleuron with strong hairs along upper mergin below base of wing, often with distinct hairs on lower half also, parafacial bare 4

– Pteropleuron with only a row or tuft of a few fine rather short hairs on posterior part of the lower half above posterior sterno-pleural bristle, parafacial usually with fine short hairs throughout its length .... LIMNOPHORINAE

4. Vein M_{1+2} with apical portion curved strongly forward at about middle of the length, body colour grey to black and often metallic .... MUSCINAE

– Vein M_{1+2} straight with curved only slightly forward, body non-metallic in colour .... PHAONIINAE (*Dichaetomyia* Malloch)

A. Subfamily MUSCINAE

Key to the genera

1. Mid tibia without or with pv seta beyond middle, in later case in some *Musca* with an av 2

– Mid tibia with a strong pv seta beyond middle 3

2. Bend of m subangular, outline of aristal plumosity forming a convex curve to tip, ovate 4

– Bend of m broadly rounded, outline of aristal plumosity forming a very sharp angle at tip, lancet shaped .... ***Morellia*** Robineau-Desvoidy

3. Suprasquamal ridge hairy; prosternum hairy, with one ia .... ***Orthellia*** Robineau-Desvoidy

– Suprasquamal ridge bare; prosternum bare, with 1 or 2 ia .... ***Dasyphora*** Robineau-Desvoidy

4. Mid tibia with pv seta; vein M_{1+2} sharply bending anteriorly ..... ***Musca*** Linnaeus

– Mid tibia without pv seta; hypopleuron setulose just above coxa & vein M_{1+2} broadly divided ..... ***Muscina*** Robineau-Desvoidy

Genus ***Dasyphora*** Robineau-Desvoidy

1830. *Dasyphora* Robineau-Desvoidy, *Mem. pres div Sav. Acad. Sci. Inst. Fr.* **2** : 409.

Type-species : *Musca agilis* Robineau-Desvoidy.

1. ***Dasyphora kempi*** Emden

1965. *Dasyphora cyanicolor kempi* Emden, *Fauna Brit India.*, **1** : 144.

Diagnosis : Eyes approximated in male, widely separated in female; arista long, plumose; thorax rather stout, 0-2+1 acr, 2(3)+4dc, 0+2 ia, pra about as long as second npl; propleural & prostigmal present; anteric mesopleural distinct; suprasqumal ridge & infra-alar bulla not setulose; pteroplerura setulose; abdomen with somewhat longer hairs only on hind margins of segments, wings with evenly haired membrane

and broadly rounded bend of m; mid tibia with a strong pv seta, hind tibia with a pd seta at about apical fourth.

Distribution : India : Arunachal Pradesh, Assam, Himachal Pradesh, Kashmir, West Bengal.

Elsewhere : Nepal, Tibet.

Genus ***Morellia*** Robineau-Desvoidy

1830. *Morellia* Robineau-Desvoidy, *Mem. pres. div. Sav. Acad. Sci. Inst. Fr.*, **2** : 405.

Type-species : *Morelia agilis* Robineau-Desvoidy (= *hortorum* Fallén).

*2. ***Morellia hortensia*** (Wiedemann)

1824. *Musca hortensia* Wiedemann, *Analecta. Ent.*. : 49.

Material examined : 2♂♂, Bhalukpong Riverside forest, West Kameng district, 3.x.2003, coll. B. Mitra.

Diagnosis : Whitish species, body densely covered with greyish pollen; eyes separated at vertex, parafrontalia fuscous and slightly silvery dusted on central vitta and laterally, with a large black vitta on each dorsocentral lines and not divided; wings membrane might be wholly haired or basal third of discl cell bare; mid tibia with a short av row on basal half, a strong pd and pv between apical third and fourth; abdomen with 3 dark longitudinal vittae and silvery patches; scutellum with dark longitudinal stripe on the middle; post dc 4-5, anterior 2 or 3 much shorter than posterior one.

Distribution : India : Arunachal Pradesh, Andhra Pradesh, Assam, Himachal Pradesh, Kerala, Madhya Pradesh, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Borneo, China, Formosa, Jawa, Malaya, Nepal, Philippines, Ryukyu Island, Sri Lanka, Sumatera, Sumbawa, Papuan subregions.

Genus ***Musca*** Linnaeus

1758. *Musca* Linnaeus, *Syst. Nat. Ed.*, **10** : 589.

Type-sepecies : *Musca domestica* Linnaeus.

Key to the subgenera

1. Propleural depression hairy ..... ***Musca*** Linnaeus
– Propleural depression bare 2
2. Suprasquamal ridge bare 3
– Suprasquamal ridge setulose 4
3. Mid tibia with an av seta ..... ***Philaematomyia*** Austen
– Mid tibia without an av seta, stpl present .. ***Byomya*** Robineau-Desvoidy
4. Suprasquamal ridge setulose all over ..... ***Ptilolepis*** Bezzi
– Suprasquamal ridge setulose either anteriorly or posteriorly 5
5. Suprasquamal ridge setulose only anteriorly 6
– Suprasquamal ridge setulose only posteriorly 7
6. Lower calyptra bare on dorsal surface ..... ***Eumusca*** Townsend
– Lower calyptra densely setulose on dorsal surface ..... ***Setimusca*** Emden
7. Parfacialia bare ..... ***Viviparomusca*** Townsend
– Parfacialia setulose ..... ***Pseudosetimusca*** Joseph & Parui

Subgenus ***Byomya*** Robineau-Desvoidy

1830. *Byomya* Robineau-Desvoidy, *Mem. pres. div. Sav. Acad. Sci. Inst. Fr.* **2** : 392.

Type-species : *Byomya violacea* Robineau-Desvoidy.

Key to the species

1. Fore tibia with posteroventral bristle ..... *conducens* Walker
– Fore tibia without posteroventral bristles 2
2. Abdomen entriely orange without any vittae in both sexes ..... *ventrosa* Wiedemann
– Abdomen pale yellow to black or brown median vitta or tessellated pattern 3

3. Thorax with 2 conspicuous vittae .... *sorbens* Wiedemann

– Thorax with 4 conspiuous vittae; 2nd tergite pale yellow with a conspicuous median vitta; stem vein with 1 hair on upper posterior side ..... *pattoni* Austen

3. *Musca (Byomya) conducens* Walker

1859. *Musca conducens* Walker, *J. Proc. Linn., Zool.* **4** : 138.

Distribution : India : Andaman Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Madhya Pradesh, Nagaland, Orissa, Punjab, Uttar Pradesh, West Bengal.

Elsewhere : China, Flores Island, Jawa, Lombok, Malaya, Myanmar, Napal, Philippines, Ryukyu Island, Sabah, Sarawak, SriLanka, Sumatera, Sumbawa, Thailand; Ethiopian; New Guinea; Palaearctic.

4. *Musca (Byomya) pattoni* Austen

1910. *Musca pattoni* Austen, *Ann. Mag. nat. Hist.*, (8) : 114.

Distribution : India : Andhra Pradesh, Assam, Arunachal Pradesh, Chandigarh, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, China, Nepal, Sri Lanka.

5. *Musca (Byomya) sorbens* Wiedemann

1830. *Musca sorbens* Wiedemann *Aussereurop. zweifl. Insekt.*, **2** : 418.

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Mizoram, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : China, Christmas Island, Cocos Island, Flores Island, Jawa, Lombok, Malaya, Maldive Islands, Myanmar, Nepal, Pakistan, Peloe Endeh, Philippines, Ryukyu Island, Sri Lanka, Taiwan, Thaliand; Ethiopian; Hawaii; Micronesia; South Palaearctic.

6. *Musca (Byomya) ventrosa* Wiedemann

1830. *Musca (Byomya) ventrosa* Wiedemann *Aussereurop. Zweifl. Insekt.* **2** : 656.

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Tamil Nadu, Uttar Pradesh.

Elsewhere : Borneo, Celebes, China, Jawa, Krakatau, Malaya, Myanmar, Nepal, Philippines, Ryukyu Island, Sri Lanka, Sumatera, Sumbawa, Thailand; Australasian; Ethiopian.

Subgenus *Eumusca* Townsend

1911. *Eumusca* Townsend, Proc. ent. Soc. Wash., 13 : 170.

Type-species : *Eumusca corvina* Fabricius.

7. *Musca (Eumusca) lusoria* Wiedemann

1824. *Musca (Eumusca) lusoria* Wiedemann *Analecta Ent.* : 47.

Diagnosis : Eyes bare, separated in male by up to width of third antennal segment or contiguous; thorax rather densely dusted whitish or yellowish grey, with four rather broad, in female narrow, undusted black vittae, the disc in male often with some greyish brown dust between the vittae; 1 acr, 2+4 strong dc; anterior end of suprasquamal ridge with some erect black setulae; abdomen of male largely pale orange, first segment piceous black with the later part of the hind margin somewhat invaded by the pale colouration, a moderately broad median vitta on the second and a rather narrow one on the third segment also dark, disc of fourth segment and narrow hind margin of third usually darkened; wings with light brown veins and entirely hairy membrane; fore tibia with out a pv seta; mid tibia without an av or ad seta.

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Madhya Pradesh, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Myanmar, Nepal, Sri Lanka; Ethiopian.

Subgenus *Musca Linnaeus*

1915. *Promusca* Townsend, *J wash. Acad Sci*., 5 434

Type-species : *Musca domestica* Linnaeus.

8. *Musca (Musca) domestica* Linnaeus

1758. *Musca domestica* Linnaeus, *Syst. Nat. Ed.* 10, **1** : 596.

Material examined : 5♂♂, 4♀♀, Lohu Basti, Tawang district, 10.x. 2001, coll. B. Mitra.

Diagnosis : Four black vittae on thorax, inner pair terminating towards posterior end, propleural depression with fine setulose hair; suprasquamal ridge without black setulae, all post dc strong; mid tibia without av and ad seta.

Distribution : India : Andaman Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Goa, Himachal Pradesh, Karnataka, Kashmir, Maharashtra, Nagaland, Punjab, Sikkim,Tripura & other parts of India.

Elsewhere : Cosmopolitan.

Subgenus ***Philaematomyia*** Austen

1909. *Philaematomyia* Austen, *Ann. Mag. na* '. (8) **3** : 295.

Type-species : *Philaematomyia insignis* Austen.

9. *Musca (Philaematomyia) crassirostris* Stein

1903. *Musca crassirostris* Stein, *Mitt. zool. Mus. Berl.* **2**(3) : 99.

Diagnosis : Wholly fuscous-black with pale orange palpi; densely dusted cinereous-grey; eyes bare; frons of male almost as wide as third antennal segment; interfrontalia piceous black, very narrow, parafacialia densely dusted pale grey, proboscis short and stout; thorax with four narrow well separated black vittae; scutellum with a basal dark spot on lateral surface; 1 acr, 2+2 dc, the anterior post dc being indistinct; abdomen densely dusted pale grey, sometimes with slight shifting spots and dots; wings with light brown veins and wholly hairy membrane; fore tibia without a pv seta, mid tibia with an av seta at apical third.

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Kerala, Madhya Pradesh, Tamil Nadu, Punjab, Uttar Pradesh, West Bengal.

Elsewhere : Borneo, China, Formosa, Jawa, Lombok, Malay, Myanmar, Nepal, Philippines, Sri Lanka, Sumatera, Thailand; Ethiopian; South Palaearctic.

Subgenus ***Pseudosetimusca*** Joseph & Parui

1972. *Pseudosetimusca* Joseph & Parui, *Zool. Anz.* 189 : 180.

Type-species : *Pseudosetimusca santoshi* Joseph & Parui.

10. *Musca (Pseudosetimusca) santoshi* Joseph and Parui

1972. *Pseudosetimusca santoshi* Joseph & Parui, *Zool. Anz.* **189** : 180.

Diagnosis : Head with densely haired eyes, thorax moderately, thickly dusted silver white with four broad black vittace; acr, 2+4 dc, the last pair of dc strong, suprasquamal ridge with setulae at posterior side; abdomen rather short; wings with brown veins and wholly haired membrane; lower calyptra whitish grey, seldom with brownish tinge; fore tibiae without a pv seta, mid tibia without an av or ad seta.

Distribution : India : Arunachal Pradesh

Elsewhere : None.

Subgenus ***Ptilolepis*** Bezzi

1921. *Ptilolepis* Bezzi, *Ann. Trop. Med. Parasit.* **14** : 335.

Type-species : *Ptilolepis inferior* Stein.

11. *Musca (Ptilolepis) inferior* Stein

1909. *Musca inferior* Stein. *Tijdschr. Ent.* **52** : 213.

Diagnosis : Eyes bare, in male separated by a tenth head width, proboscis stout, mentum about two and half times width of third antennal segment, palpi dull brownish orange with darker tip in male, orange in female; thorax rather thickly dusted whitish grey with four rather broad black vittae, which are thinly dusted dark brown; abdomen fuscous, in male suffusedly dull light brown on lateral anterior part of intermediate segments, intermediate segments each with two pair of very large silver of pale golden grey dusted spots, seconed with a narrow,

third with a very narrow, fourth with or without a linear black median vitta, fourth segment otherwise wholly dusted, with three to four shifting dark vittae; wings with brown veins & wholly hairy membrane; fore tibia without a pv seta, mid tibia without ad seta.

Distribution : India : Andaman Island, Andhra Pradesh, Arunachal Pradesh, Assam, Tamil Nadu, West Bengal.

Elsewhere : Borneo, Celebes, China, Flores Island, Formosa, Jawa, Lombok, Malaya, Myanmar, Nepal, Philippines, Simeule Island, Sri Lanka, Sumbawa, Sumatera, Thailand, Vietnam, New Guinea.

Subgenus *Setimusca* Emden

1965. *Setimusca* Emden, *Funa. Brit. India* Muscidae **1** : 91.

Type-species : *Musca malaisei* Emden.

12. *Musca (Setimusca) malaisei* Emden

1965. *Musca (Setimusca) malaisei* Emden, Fauna. Brit. India., Muscidae **1** : 91.

Diagnosis : Eyes densely long haired; parafacialia densely setulose; thorax moderately, thickly dusted silver-white with four rather broad black vittae; 1 acr, 2+4 strong dc; abdomen rather short & broad, fuscous-black; suprasquamal ridge with a tuft of black setulae at anterior end, lower calyptra with black setulae; fore tibia without pv seta, mid tibia without an av or ad seta.

Distribution : India : Arunachal Pradesh.

Elsewhere : Myanmar.

Subgenus *Viviparomusca* Townsend

1915. *Viviparomusca* Townsend, *J. Wash. Acad. Sci.* **5** : 435.

Type-species : *Musca bezzi* Patton & Cragg

Key to the species

1. Eyes distinctly hairy 2

- Eyes virtually bare..... *illingworthi* Patton

2. Abdomen in male yellowish orange, median vitta on 3rd more than twice as long as wide .....*convexifrons* Thomson

In male first segment of the abdomen piceous-black with a narrow pale orange hind margin on each side, 3rd segment with a moderately narow parallel sided median vitta..... ..... *bezii* Patton & Cragg

13. *Musca (Viviparomusca) bezzi* Patton & Cragg

1913. *Musca bezzii* Patton & Cragg, *Indian J. med. Res* **1** : 19.

Distribution : India : Arunachal Pradesh, Assam, Chandigarh, Himachal Pradesh, Kashmir, Meghalaya. Tamil Nadu, Punjab, Sikkim, Uttar Pradesh.

Elsewhere : Malaya, Myanmar, Nepal; East Palaearctic.

14. *Musca (Viviparomusca) convexifrons* Thomson

1869. *Musca convexifrons* Thomson, *K sevenska Fregatten Eugenies Resa, zool., Dipt.* : 547.

Distribution : India : Arunachal Pradesh, Assam.

Elsewhere : China, Formosa, Jawa, Malaya, Philippines, Vietnam.

15. *Musca (Viviparomusca) illingworthi* Patton

1923. *Musca illingworthi* Patton, *Philipp. J Sci* **23** : 323

Distributiob : India : Arunachal Pradesh, Assam.

Elsewhere : China, Formosa, Jawa, Malaya, Philippines, Vietnam.

Genus *Orthellia* Robineau-Desvoidy

1863. *Orthellia* Robineau-Desvoidy, *Hist. nat Dipt env* Paris **2** : 837.

Type-species : *Lucilia rectinervis* Robineau-Desvoidy

Key to the species

1. Thorax without prst dc, anterior mesopleural

absent; prst acr absent; parafrontalia polished; interfrontalia narower than parafrontalia in female 2

– Thorax with two pairs of conspicuous prst dc, anterior mesopleural distinct; one pair of strong prst acr present or interfrontalia wider than one parafrontalia in female 5

2. Palpi and antennae brownish orange, bend of m vein subangular; discal cell without hairs m-m closer to bend than r-m, base of wings yelowish, frons wider than an eye .... *lauta* (Wiedemann)

– Palpi and antenna fuscous, bend of m vein very broadly and evenly rounded, discal cell more or less extensively haired, at least apical third largely hairy, frons much narrower than an eye 3

3. m-m closer to bend than r-m, very oblique and somewhat sigmoid; calyptrae dark brown, especially the lower one 4

– m-m at middle between bend and r-m, rather straight and steep, calyptrae lightly infuscate, prsc acr and ia distinct, sc densely covered with hairs, more than half of discal cell covered with hair, anterior and basal third to half of wing yellowish tinged ..... *diffidens* (Walker)

4. prsc acr absent or indistinct, sections of costa between r4+5 and m one sixth to one-fifth length of preeceding section, post ia almost always absent, body less robust, the hairs of the wings occupy a large part, especially more or less all of anterir of sc. .... *claripennis* (Malloch)

– prsc acr absent or indistinct, sections of costa between r4+5 and m $^1/_4$ to $^1/_3{}^{rd}$ length of preeceding section, post ia almost always present, body stout, the hairs on the wing occupy a smaller part of apex of discal cell, Sc with only a few hairs ..... *gavisa* (Walker)

5. Vibrissiae inserted above mouth margins by half length of 3rd antennal segment; calyptrae and halteres dark brown, m without a distinct dip behind bend; discal cell bare on a a strip close to 5th vein, large flies .... *fletcheri* Emden

– Vibrissae inserted close to or just above mouth margins, from which they are separated by up to about width of third antennal segment 6

6. Discal cell wholly hairy; m usually without a dip behind, mesonotum either conspicuously dusted in front, or with only three post dc, the anterior two of which are sub equal; mid tibia without an ad seta .... *timorensis* (Robineau-Desvoidy)

– Discal cell with a bare strip; m with a distinct bend, mesonotum not markedly dusted infront and with more than 3 post dc, the anterior 2-4 of which are inconspicuous, palpi slender 7

7. Mid tibia with an ad seta between apical fifth and fourth, second segment of antenna ferruginous, third and palpi infuscate ferruginous, nearly basal half of discal cell bare, the bare area extended towards apex along 4th, facets on inner part of eyes strongly enlarged ..... *indica* (Robineau-Desvoidy)

– Mid tibia without an ad seta, second antennal segment strongly infuscate, third narrowly reddish at base, otherwise like palpi fuscous, discal cell hairy except on a longitudinal strip close to 5th vein; facets on inner part of eyes only slightly enlarged .... *coerulifrons* (Macquart)

16. ***Orthellia claripennis*** Malloch

1923. *Othellia claripennis* Malloch, *Ann. Mag. nat. Hist* (9) **12** : 515.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Karnataka, Kerala, Tamil Nadu, Sikkim, West Bengal.

Elsewhere : Borneo, China, Flores Island, Formosa, Jawa, Lombok, Malaya, Myanmar, Nepal, Philippines, Sri Lanka, Sumatera, Sumbawa.

17. ***Orthellia coerulifrons*** (Macquart)

1851. *Lucillia coerulifrons* Macaquart *Mem. Soc. Sci. Agric. Lille.*, 248.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Kerala, Uttar Pradesh.

Elsewhere : Borneo, Myanmar, Sri Lanka,

Flores Island, Formosa, Jawa, Laos, Lombok, Malaya, Nepal, Philppines, Ryukyu Islands, Sumatera, Thailand, Japan.

18. ***Orthellia diffidens*** (Walker)

1856. *Musca diffidens* Walker, *J. Proc. Linn. Soc. Lond. zool.* **1** : 26.

Distribution : India : Arunachal Pradesh, Assam, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Borneo, Celebes, China, Jawa, Malaya, Myanmar, Philippines, Sri Lanka, Sumatera, Thailand, Vietnam.

19. ***Orthellia fletcheri*** Emden

1965. *Orthellia fletcheri* Emden, *Fauna. Brit. India. Muscidae.* **1** : 122.

Distribution : India : Arunachal Pradesh, Assam, Himachal Pradesh, Jammu & Kashmir, Punjab, Sikkim, Uttar Pradesh, West Bengal.

Elsewhere : Myanmar, Nepal, Sri Lanka, Thailand, VietNam.

20. ***Orthellia gavisa*** (Walker)

1859. *Musca (Neomyia) gavisa* Walker, *J. Proc. Linn. Soc. Lond. Zool.* **4** : 138.

Distribution : India : Arunachal Pradesh, Assam, Himachal Pradesh, Jammu & Kashmir, Punjab, Sikkim, Uttar Pradesh, West Bengal.

Elsewhere : Jawa, Nepal, Pakistan, Simeule Island, Sumatera, Tamaon Island.

21. ***Orthellia indica*** (Robineau-Desvoidy)

1830. *Lucilia Indica* Robineau-Desvoidy, *Mém. Prés. div. Sav. Acad. Sci. Inst. Fr.*, **2** : 453.

Distribution : India : A & N Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Goa, Kerala, Maharashtra, Madhya Pradesh, Mizoram, Nagaland, Orissa, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : Bali, Bangladesh, Malaya, Myanmar, China, Formosa, Jawa, Nepal, Pakistan, Philippines, Simeule Islands, Sumatera, Sumbawa, Thailand, Vietnam cosmopolitan.

22. ***Orthellia lauta*** (Wiedemann)

1830. *Musca lauta* Wiedemann, *Aussereurop. Zweifl Insekt*, **2** : 410.

Distribution : India : Andaman Islands, Andhra Pradesh, Assam, Bihar, Chandigarh Karnataka, Manipur, Madhya Pradesh, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : China, East Malaysis, Flores Island, Jawa, Kalimantan, Laos, Lombok, Malay, Myanmar, Nepal, Pakistan, Philippines, Ryukyu Islands, Sumatera, Sumbawa, Sri Lanka, Taiwan, Thailand; Australia.

23. ***Orthellia timorensis*** (Robineau-Desvoidy)

1830. *Lucilia timorensis* Robineau-Desvoidy, *Mém Prés div. Sav. Acad. Sci Inst. Fr.*, **2** : 460.

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Kerala, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, China, Dammar Islands, Flores Island, Jawa, Malaya, Myanmar, Nepal, Philippines, Ryukyu Islands, Simeulae Island, Sulawesi, Sumatera, Taiwan, Thailand, Viet Nam; Japan; Papuan Subregions.

Genus ***Muscina*** Robineau-Desvoidy

1830. *Muscina* Robineau-Desvoidy, *Mem pres Div Sav Acad. Sci. Inst. F.*, **2** : 406.

Type-species : *Musca stabulans* Fallen

*24. ***Muscina pascuorum*** (Meigen)

1826. *Musca pascuorum* Meigen, *Syst Beschr europ zweifl. insekt.*, **5** : 74.

Material examined : 3♂♂, Bustang, W.Kameng district, 6.x. 2001, coll. B.Mitra.

Diagnosis : Fuscous black with apical part of scutellum and in males lateral parts of abdomen dull rufous translucent, thorax with 3+2 acr, 2-3+4 dc, 2 ia, 2 ia, 3 humerals.

Distribution : India : Arunachal Pradesh, Assam, Sikkim, West Bengal.

Elsewhere : Pakistan Taiwan; Holarctic.

Subfamily PHAONINAE

Key to the genera

1. Metathoracic spiracles with strong bristle on anterior margin ..... ***Dichaetomyia*** Malloch
- Metathoracic spiracles without strong bristles ..... ***Atherigona*** Rondani

Genus ***Dichaetomyia*** Malloch

1921. *Dichaetomyia* Malloch, *Ann. mag. nat. Hist.* (9) 7 : 163.

Type-species : *Dichaetomyia polita* Malloch.

Key to the species

1. Ventral surface of scutellum without fine pale golden hairs ..... *quadrata* (Wiedemann)
- Ventral surface of scutellum with fine pale golden hairs ..... *bibax* (Wiedemann)

* 25. ***Dichaetomyia bibax*** (Wiedemann)

1830. *Anthomyia bibax* Wiedemann, *Aussereurop, zweifl. Insekt.*, **2** : 431.

Material examined : 3♀♀, Sangti, W.Kameng district, 12.x.2001, coll. B. Mitra.

Distribution : India : Arunachal Pradesh, Assam, Himachal Pradesh, Sikkim, Uttar Pradesh, West Bengal.

Elsewhere : Borneo, China, Formosa, Jawa, Malaya, Myanmar, Philippines, Ryukyu Islands, Sumatera, Japan.

* 26. ***Dichaetomyia quadrata*** (Wiedemann)

1824. *Anthomyia quadrata* Wiedemann, *Analecta Ent.*, : 52.

Material examined : 2♂♂, Bhalukpong, W. Kameng district, 1.x.2001, coll. B. Mitra; 1♂, Bustang, W. Kameng district, 6.x.2001, coll. B. Mitra.

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

Elsewhere : Borneo, Cina, Flores Island, Formosa, Jawa, Lombok, Malaya, Myanmar, Philippines, Ryukyu Islands, Simeulue Island, Sumatera; Melanesia.

Genus ***Atherigona*** Rondani

1865. *Atherigona* Rondani, *Dipterol. ital. Prodr.* **1** : 97.

Type-species : *Anthomyia varia* Meigen

Key to the species

1. Vibirissiae, usually together with an adjacent seta and a few ground-setulae, clear yellow ..... *pulla* (Wiedemann)
- Vibrissae and all setae and ground-setulae at vibrissal angle black ..... *simplex* (Thomson)

27. ***Atherigona (Atherigona) pulla*** (Wiedemann)

1830. *Coenosia pulla* Wiedeman, *Aussereurop. Zweifl. Insekt.* **2** : 441.

Distribution : India : Arunachal Pradesh, Bihar, Tamil Nadu, Karnataka.

*28. ***Atherigona (Atherigona) simplex*** (Thomson)

1869. *Coenosis simplex* Thomson, K. *sevenska. Fregatten Eugenies Resa, zool., Dipt.* : 560.

Material examined : 2♂♂, Bhalukpong, W. Kameng district, 1.x.2001, coll. B. Mitra.

Distribution : India : Assam, Bihar, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : China, Flores Island, Formosa, Jawa, Lombok, Malaya, Myanmar, Nepal, Philippines, Sri Lnaka, Sumatera, Sumbawa, Austrlasian.

Subfamiy LIMNOPHORINAE

Genus ***Limnophora*** Robineau-Desvoidy

1830. *Limnophora* R-D, *Mem. pres. Div. Sav. Acad. Sci. Inst. Fr.*

Type-sepcies : *Limnophora palustris* (Robineau-Desvoidy).

Key to the genera

1. Eyes holoptic or dichoptic in male, usually dichoptic in female, arista bare to short plumose, prosternum hairy ..... ***Limnophora*** Robineau-Desvoidy

– Eyes dichoptic in bothdsexes, palpi strongly dilated at apex, somewhat spoon-shaped, arista long plumose on basal half but sometimens reaching at apex, prosternum bare ..... ***Lispe*** Latreille

29. *Limnophora conica* Stein

1915. *Limnophora conica* Stein, *Suppttaent.* **4** : 30.

Diagnosis : Fuscous black with rather dense whitish-grey or yellowish-grey dust & fuscous, brown dusted paterns, scutellum usually with some greyish-brown or grey dust at tip, abdomen with the first segment wholly dark dorsally except for a linear pale dusted hind margin and a narrow or vestigeal median vitta; thorax anteriorly with 2, towards centre with 3-4 longitudinal rows of prst acr, the outer ones less widely separated from each other tthan from the dc; abdomen short ovate with pointed apex in male; wings greyish, sudhyaline, m-somewhat upcurved at apex; legs without submedian setae on anterior tibiae, except for the p seta of the mid tibia.

Distribution : India : Arunachal Pradesh, Assam.

Elsewhere : China, Formosa, Jawa, Malaya, Myanmar, Sumatera, Thailand.

Genus *Lispe* Latreille

1796. *Lispe* Latreille, *Precis caract Gen Ins* : 169

Type-species : *Musca tentaculata* (De Geer)

30. *Lispe orientalis* Wiedemann

1824. *Lispe orientalis* Wiedemann, *Analecta Ent* . . 51.

Material examined : 2♂♂, Dirang Basti, W. Kameng district, 13.x.2001, coll. B. Mitra; 4♂♂, Bhalukpong, W. Kameng district, 1.x. 2001, coll. B. Mitra.

Diagnosis : Legs entirely black, femora with long bristle like hairs on av and pv surfaces, hind tibia without av and pv seta.

Distribution : India : Arunchal Pradesh, Assam, Kerala, Maharashtra, Uttar Pradesh, West Bengal.

Elsewhere : China, Flores Inland, Formosa, Malaysia, Myanmar, Pakistan, Sri Lanka, Sumatera; Japan.

Subfamily STOMOXYINAE

Key to the genera

1. Palpi short, shorter than proboscis, stemopleural bristles 0+1; arista longfeathered ..... ***Stomoxys*** Geffroy

– Palpi long, about as long as proboscis; stemopleural bristles 1+1 ..... ***Haematobosca*** Bezzi.

Genus *Haematobosca* Bezzi

1907 *Haematobosca* Bezzi, *Z Syst Hymenopt Dipterol* **7** 414

Type-species *Haematobosca atripalpss* Bezzi

31. *Haematobosca sanguinolenta* (Austen)

1909 *Bdellolarvn sanguinolenta* Austen, *Ann Mag Nat Hist* (8) **3** 290.

Diagnosis : Fuscous with grey or brownish-grey dust; head with more silver or pale golden (some males) dust; antennal segments infuscate with orange edges; papi pale orange-yeelow, slendes at base, apical two-fifth conspicuously clubbed; probosis brownish-orange, the apical part chestnut brown; thorax densely dusted with the inner vittae almost linear and separated by a third width of thorax; abdomensubcircular, densely dusted grey; wings wholly haired, slightly brownish, with light brown veins, m not markedly sinuous at apex, only moderately upcurved, legs piceous brown, with the tibiae and the tip of the femora, all tibiae without sub median setae.

Distribution : India : Arunachal Pradesh, Assam, Kerala, Maharashtra, Uttaranchal, Uttar Pradesh, West Bengal.

Elsewhere : Borneo, Cambodia, China, Formosa, Laos, Lombok, Myanmar, Nepal, Philippines. Ryukyu Isalands, Sri Lanka, Sumatera, Thailand, Vietnam, E. Palaearctic, Micronesia.

Genus ***Stomoxys*** Geffroy

1762. *Stomoxys* Geffroy, *Hist. Ins.*, **3** : 538.

Type-species : *Conops calcitrans*.

32. ***Stomoxys calcitrans*** (Linnaeus)

1758. *Conops calcitrans* Linnaeus, *Syst. Nat. Ed.*, 10, **1** : 604.

Diagnosis : Fuscous black with whitish-grey or cinereous-grey pollinocity and some brown dust on the dark thoracic vittae and forming spots on abdomen; eyes in male separated by a quarter head-width or somewhat more, frons very slightly narrowed from vertex to middle, moderately dilated from there to lunula, interfrontalia parallel-sided; in female frons well over a third head-width at vertex; antennae fuscous-brown, apex of second and base of third segment, not reaching fore margin of mouth; thorax with four fuscous vittae, which are somewhat brown-dusted; abdomen with a moderately broad less densely dusted and darker median vitta and similar fore and hind margins; wings with the setulae on r4+5 not nearly reaching r-m, m strongly upcurved and distinctly sinuous near apex; legs fuscous with pale testaceous knees; base of hind femur with only one long hair, which seldom reaches with pale testaceous knees; base of hind femur with only one long hair, which seldom reaches length of femoral diameter, often with 2-3 shorter hairs following upon the long hair, hairs of the av row somewhat stronger and more erect.

Distribution : India : Andaman & Nicobar Island, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Kerala, Maharastra, Goa, Orissa, Sikkim,Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Cosmopolitan.

SUMMARY

A comphrensive account of the Muscid fauna of Arunachal Pradesh is given in the paper. 32 species under 11 genera of 4 subfamilies are reported from this State; of which 6 species are recorded for the first time. Keys and diagnostic characters to the identification of families, genera and species are reported here. Among the 32 species are reported here, only a lone species *Musca (Pseudosetimusca) santoshi* Joseph and Parui confined to India, 12 species spread only in the boundary of Oriental region, 5 species upto Palaearctic region, 14 species extends their range of distribution beyond the Oriental and Palaearctic (4 species Australian, 6 species Ethiopian, 3 species Cosmopolitan and only one species Holarctic in distribution).

ACKNOWLEDGEMENTS

I wish to express my thanks to Dr. J.R.B. Alfred, Director, Zoological Survey of India. for the necessary facilities and encouragement. Thancks are also due to Dr. A.K. Hazra, Scientist 'E' for kindly going through the manuscript and making useful suggestion.

REFERENCES

DATTA, M and CHAKRABORTI, M. 1985. DIPTERA : Fauna of Namdhapha, *Rec. zool. Surv. India*, **82**(1-4) : 231-252.

EMDEN, F.I.VAN, 1965. The Fauna of India and the adjacent countries, Diptera, Muscidae, **7**(1) : (1-1) 647 : Govt. of India, New Delhi.

JOSEPH, A.N.T & RAO, K.R. 1972, Diptera from NEFA and Assam foot hills. *Rec. zool. Surv. India*, **66** (1-4) : 63-74, Part II. : 103-128.

JOSEPH, A.N.T & PARUI, P. 1973. Diptera from NEFA and Assam foot hills, Part III. Siang frontier Division and North Lakhimpur, *Rec. zool. Surv. India*, **67** : 325-342.

JOSHEPH, A.N.T & RAY, K.K. 1976. Diptera from Arunachal Pradesh and Assam foot hills, Part IV, Lohit disttrict, Lakhimpu district and Sibsagar district. *Rec. zool. Surv. India*, **69** : 275-290.

JOSEPH, A.N.T & PARUI, P 1977. Diptera from Arunachal Pradesh and Assam foot hills, Part V, Tirap division, *Rec. zool. Surv. India*, **72** : 333-339.

MITRA, BULGANIN. 2000. DIPTERA : Muscidae, *In : Fauna of Tripura. State Fauna Ser.*, **7**(Part-3). : 261-269. Zoological Survey of India, Kolkata.

MITRA, BULGANIN. 2003. Diptera : Muscidae, *In : Fauna of Sikkim. State Fauna Ser.* **9**(Part-3) : 401-411. Zoological Survey of India, Kolkata.

MITRA, BULGANIN. 2004. Diptera : Muscidae, *In : Fauna of Manipur. State Fauna Ser.*, **10** (2) : 503-508 Zoological Survey of India, Kolkata.

PONT, A.C. 1977. Family Muscidae. *In* M.D. Delfinado and D. E. Hardy (eds). *A Catalogue of Diptera of the Oriental region* **3** : 451-523. Univ. Hawaii Press, Honolulu.

SHINONAGA, S and SINGH, M.M. 1994. Muscidae of Nepal (Diptera), I. Muscina, Stomoxyinae and Phaoniinae. *Jpn. J. Sanit. Zool.* **45**(supp.) : 99-177.

VOCKEROTH, J.R. 1972. A review of the World genera of Mydaeinae, with a revision of the species of New Guinea and Oceania (Diptera : Muscidae), *Pacif. Insects. Monogr.*, **29** : 1-34.

Zoolo. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2) : 369-398, 2006

INSECTA : HYMENOPTERA : FORMICIDAE

S. N. GHOSH, S. SHEELA, B. G. KUNDU, S. ROYCHOWDHURY AND R. N. TIWARI
Zoological Survey of India, M-Block, New Alipore, Kolkata - 700053

INTRODUCTION

Ants (family Formicidae), the most successful social insects, are found everywhere. They can survive in almost all kinds of ecological niches, living in colony. The colony consists of different castes–male, female, worker and soldier–which have specific and specialised duty to perform for the survival of the colony. This synchronised group activities and the great degree of adaptability are the key factors for their survival since Mesozoic period.

Ants have both the deleterious and beneficial effects. Some ants are considered as pests (house hold as well as garden); some give protection (even nurture in their colony) to the other plant pests, like plant-lice, mealy bugs, tree hoppers, etc.; some are notorious for their stinging and biting habits. On the other hand some ants have also been utilised as an agent of biological control; formic acid of ants has the value in pharmacology; some tribal people consume ants (*Oecophylla* sp.) as a source of high protein; and even efforts are there to establish ants as index organism of environmental pollution.

Considering the immense importance of these tiny creatures, exploration of ants is very much in need. Workers like Jerdon (1851, 1854 a, b), Forel (1900 a, b), Bingham (1903), Wheeler (1928), Smith (1948), Chapman and Capco (1951), Wilson (1964), Bolton (1977), Mathew (1980), Tiwari and Jonathan (1986 a, b), Tiwari (1994), Dutta and Raychaudhuri (1983), Sheela and Narendran (1997, 1998) have made valuable contributions to the Indian fauna of ants. But except some stray reports, no effort was there to consolidate the ant fauna of Arunachal Pradesh.

This taxonomic work of Ants of Arunachal Pradesh under the *State Fauna Series* is based on the collections done by the authors (twice in the year 2001) and other survey parties of this department. Beside that, the National Zoological Collection lying in Z.S.I has also been studied and incorporated. The entire materials have been deposited in the collection of Z.S.I., Kolkata and its Field Station of Arunachal Pradesh.

TOPOGRAPHY

Arunachal Pradesh, lying on the lap of eastern Himalaya, is situated in between 91° 31′ to 97° 30′ E longitude and 26° 28′ to 29° 30′ N latitude. This north-eastern state of India, covering an area of 83,743 sq. km, consists of 13 districts with the capital as Itanagar. It has long international boundary with China in the north and north-east, Bhutan in the west and Myanmar in the east. It is a land of thick forests, deep river valleys, beautiful plateaus and ice-capped mountains. Some peaks of Greater Himalayas are with permanent ice cover and some are seasonal. The snow of these peaks along with heavy rain fall are the source of countless rivers and rivulets criss-crossed through valleys of this area.

The state has nearly 61.5% forest area which is gradually coming down by human interference. The forest area is mainly dominated by tropical rain forest. Other types–tropical moist deciduous forest, temperate forest and alpine forest—are also seen here.

This rich floral wealth makes this state an abode of large number of species of all the groups.

MATERIALS AND METHODS

Ants were collected from the field mostly by hand picking with the help of brush soaked in alcohol (70%) and forceps of different sizes. Some were collected by sweeping also. Sometimes baits like sugar, jaggery and other eatables were used to attract the ants. The collected specimens were kept in 70% alcohol, as well as the specimens of bigger sizes were kept in insect packet with dry preservatives after killing those with ethyle acetate/benzene vapour. The collected specimens were brought to the laboratory and were set, pinned and labeled for study.

SYSTEMATIC ACCOUNT

The ants are classified as a single family Formicidae under order Hymenoptera and are widely distributed throughout the world. Nearly 9538 species of ants under 296 genera and 16 subfamilies have been in record presently from world over. Of these 771 species under 101 genera are from Oriental region (Bolton, 1995a). From Indian subregion nearly 550 species are so far recorded.

Report, specifically from Arunachal Pradesh, is very rare and scanty. Tiwary and Maiti (1976) and Tewary *et al.*(1977) recorded 12 species from Arunachal Pradesh. Earlier the other eminent naturalists might have explored this region. But locality was not mentioned as 'Arunachal Pradesh' by them as this has been designated as a new state of India in 1987. Present work deals with 63 species of ants under 30 genera and 7 subfamilies. Keys of the subfamilies, genera and species have also been incorporated here. A few undetermined species are recorded here which are not included in the keys. Species represented singly of a genus is with its brief diagnostic characters.

Abbreviation : The abbreviations used in the text are M = Male, F = Female, W = Worker and S = soldier.

Distinguishing features : Ants are distinguished at a glance from other aculeate hymenoptera by the presence of petiole and post petiole which is/are the modification of one or two segments of abdomen immediately following the propodeum. Presence of elbowed antennae is also unique.

LIST OF TAXA

Family FORMICIDAE

Subfamily DORYLINAE Forel

Genus ***Dorylus*** Fabricius

1. *Dorylus labiatus* Shuckard
2. *Dorylus laevigatus* Smith

Subfamily PONERINAE Lepeletier

Genus ***Diacamma*** Mayr

3. *Diacamma assamense* Forel
4. *Diacamma rugosum sculptum* (Jerdon)

Genus ***Gnamptogenys*** Roger

5. *Gnamptogenys bicolor* (Emery)

Genus ***Hypoponera*** Santschi

6. *Hypoponera truncata* (Smith)

Genus ***Myopopone*** Roger

7. *Myopopone castanea* (Smith)

Genus ***Odontomachus*** Latreille

8. *Odontomachus monticola* (Emery)

Genus ***Odontoponera*** Mayr

9. *Odontoponera transversa* (Smith)

Genus ***Pachycondyla*** Smith

10. *Pachycondyla astuta* Smith
11. *Pachycondyla javana* (Mayr)
12. *Pachycondyla leeuwenhoeki* (Forel)
13. *Pachycondyla luteipes* (Mayr)
14. *Pachycondyla rufipes* (Jerdon)

Subfamily CERAPACHYINAE Forel

Genus ***Cerapachys*** Smith

15. *Cerapachys sulcinodis* Emery

Subfamily FORMICINAE Lepeletier

Genus ***Camponotus*** Mayr

16. *Camponotus confucii* Forel
17. *Camponotus compressus* (Fabricius)
18. *Camponotus invidus* Forel
19. *Camponotus irritans* (Smith)

20. *Camponotus nicobarensis* Mayr
21. *Camponotus* sp.

Genus ***Cataglyphis*** Foerster

22. *Cataglyphis setipes* (Forel)

Genus ***Oecophylla*** Smith

23. *Oecophylla smaragdina* (Fabricius)

Genus ***Paratrechina*** Motschoulsky

24. *Paratrechina bourbonica* (Forel)
25. *Paratrechina indica* Forel
26. *Paratrechina* sp.

Genus ***Polyrhachis*** Smith

27. *Polyrhachis armata* (Le Guillou)
28. *Polyrhachis bicolor* Smith
29. *Polyrhachis convexa* Roger
30. *Polyrhachis dives* Smith
31. *Polyrhachis hippomanes ceylonensis* Emery
32. *Polyrhachis illaudata* Walker
33. *Polyrhachis laevissima* Smith
34. *Polyrhachis tibialis* Smith

Genus ***Pseudolasius***

35. *Pseudolasius familiaris* (Smith)

Subfamily DOLICHODERINAE Forel

Genus ***Dolichoderus*** Lund

36. *Dolichoderus* sp.

Genus ***Tapinoma*** Foerster

37. *Tapinoma melanocephalum* (Fabricius)

Genus ***Liometopum*** Mayr

38. *Liometopum lindgreeni* Forel

Genus ***Technomyrmex*** Mayr

39. *Technomyrmex albipes* (Smith)

Subfamily PSEUDOMYRMECINAE Emery

Genus ***Tetraponera*** Smith

40. *Tetraponera rufonigra* (Jerdon)

Subfamily MYRMICINAE Lepeletier

Genus ***Aphaenogaster*** Mayr

41. *Aphaenogaster smythiesii* Forel

Genus ***Cardiocondyla*** Emery

42. *Cardiocondyla nuda* (Mayr)
43. *Cardiocondyla shuckardi* Forel
44. *Cardiocondyla* sp.

Genus ***Crematogaster*** Lund

45. *Crematogaster aberrans* Forel
46. *Crematogaster biroi* Mayr
47. *Crematogaster politula* Forel
48. *Crematogaster walshi* Forel
49. *Crematogaster* sp.

Genus ***Meranoplus*** Smith

50. *Meranoplus bicolor* (Guer.)
51. *Meranoplus rothneyi* Forel

Genus ***Monomorium*** Mayr

52. *Monomorium aberrans* Forel

Genus ***Myrmica*** Latreille

53. *Myrmica rugosa* Mayr

Genus ***Solenopsis*** Westwood

54. *Solenopsis geminata* (Fabricius)

Genus ***Tetramorium*** Mayr

55. *Tetramorium lanuginosum* Mayr
56. *Tetramorium* sp.

Genus ***Pheidologeton*** Mayr

57. *Pheidologeton affinis* (Jerdon)
58. *Pheidologeton diversus* (Jerdon)
59. *Pheidologeton nanus* Roger
60. *Pheidologeton* sp.

Genus ***Pheidole*** Westwood

61. *Pheidole parva* Mayr
62. *Pheidole watsoni* Forel
63. *Pheidole* sp.

Key to the subfamilies of FORMICIDAE

1. Pedicel of abdomen with one node 2

– Pedicel of abdomen with two nodes 6

2. A more or less marked constriction between basal two segments of abdomen 3

– No constriction between basal two segments of abdomen 4

3. Elongate, slender; scape usually short and stout, antennal fossa more or less encircled by a

lateral carina on the cheek (rarely obsolete); posterior surface of head usually with distinct carina running ventrally from each dorso-lateral corner; dorsal surface of thorax with sutures indistinct or absent; pygidium margined laterally and posteriorly with a row of large or small (always distinct) spines ..... CERAPACHYINAE

– Without these combinations of characters..... PONERINAE

4. Opening at posterior end of gaster (acidopore) terminal, circular and usually surrounded by a fringe of hairs ..... FORMICINAE

– Opening at posterior end of gaster (acidopore) transverse, slit-like 5

5. Eyes never present, blind ..... DORYLINAE

– Eyes always present .. DOLICHODERINAE

6. Elongate, often very slender; eyes very large and elongate; clypeus with a rounded upper margin, not prolonged between frontal carinae; frontal carinae usually narrow and not expanded laterally to cover the antennal insertions; antennae short ..... PSEUDOMYRMECINAE

– Without these combinations of characters; frontal carinae usually large, nearly always covering the antennal insertions ..... MYRMICINAE

Subfamily DORYLINAE Forel

Genus ***Dorylus*** Fabricius

1793. *Dorylus* Fabricius, *Ent. Syst.*, **2** : 365, M.

Type species : *Vespa helvola* Linnaeus, 1764

Key to the species

1. Mandibles without teeth on the masticatory margin,apex acutely pointed ..... *laevigatus*

– Mandibles with 2 teeth on the masticatory margin, apex broader ..... *labiatus*

1. ***Dorylus labiatus*** Shuckard

1840. *Dorylus labiatus* Shuckard, *Ann. Mag. Nat. Hist.*, **5** : 319, M.

2000. *Dorylus (Typhlopone) labiatus*, Tiwari *et al.*, *Zool. Surv. India, State Fauna Series 3: Fauna of West Bengal*, **8** : 232.

Material examined : India : Arunachal Pradesh : 1 M, Kameng Division, Elephant Flat, Bhalukpong (700 m), 23, xii 1965, coll. S.K. Bhattacharya and A.N.T. Joseph; 26 M, Lohit Division, Kangu, Roing (300m), 7.iii. 1969, coll. S.K. Tandon and party; 7 M, Lohit Division, Sadiya Road (300m), 8.iii 1969, coll. S.K. Tandon and party; 12W, Chowkhan Road, Namsni (100m), 16.iii.1969, S.K. Tandon and party; 25 W, Papumpare, Naharlagun, 19.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, Sikkim and whole continent of India, particularly from West Bengal, Uttar Pradesh, Manipur, Orissa, Himachal Pradesh, Maharashtra, Gujarat and Delhi.

2. ***Dorylus laevigatus*** Smith

1857. *Typhlopone laevigatus* Smith, *J. Proc. Linn. Soc. London Zool.*, **2** : 70.

1951. *Dorylus (Dichthadia) laevigatus*, Chapman and Capco, *Monogr. Inst. Sci. Tech. Manila* (Check List Ants Asia), **1** : 9.

Material examined : India : Arunachal Pradesh : 2 F, Lohit Dist., Namsai, Papagan River, 31.i.1994, coll. G. Tirumalai and party.

Distribution : India : Arunachal Pradesh.

Elsewhere : Borneo, Myanmar, Java, Sumatra.

Subfamily PONERINAE Lepeletier

Key to the genera

1. Pedicel not free; a strong constriction, but no flexible joint between pedicel and abdomen.. ..... ***Myopopone***

– Pedicel free, with a flexible joint between pedicel and abdomen 2

2. Mandibles articulated close together in middle of front margin of head..... ***Odontomachus***

– Mandibles articulated wide apart at lateral angles of front margin of head 3

3. Pronotum with teeth or spines ..... ***Odontoponera***
- Pronotum without teeth or spines 4
4. Node of pedicel bispinous posteriorly ..... ***Diacamma***
- Node of pedicel not bispinous, sometimes denticulate posteriorly 5
5. Posterior coxae armed with a spine ..... ***Gnamptogenys***
- Posterior coxae unarmed 6
6. Ventral apex of hind tibia, when viewed from in front with femur at right angle to the body, with a single large pectinate spur; without a second simple spur in front of the pectinate main spur in the direction of observer ..... ***Hypoponera***
- Ventral apex of hind tibia, when viewed from in front with femur at right angle to the body, with two spurs–a large pectinate spur and a second simple spur, which is in front of the pectinate main spur in the direction of observer ..... ***Pachycondyla***

2. Genus *Diacamma* Mayr

1862. *Diacamma* Mayr, *Verh. Zool.-Bot. Ges. Wien*, **12** : 718, W.

Type species : *Ponera rugosa* Le Guillou, 1842.

Key to the species

1. Pronotum longitudinally striate ..... *assamense*
- Pronotum with transversely arched striae, which are more or less concentric anteriorly ..... *rugosum sculptum.*

3. *Diacamma assamense* Forel

1897 *Diacamma tritschleri* Forel, race *assamensis* Forel, in *Emery, Rend. Accad. Sci. Bologna* (N.S.), **1** : 151.

1900b *Diacamma assamense* Forel, *J. Bombay nat. Hist. Soc.*, **13** : 318, 319.

1995. *Diacamma assamense*, Bolton, *New Genl. Cat. Ants World* : 169.

Material examined : India : Arunachal Pradesh : Kameng : 3W, Tini (213m), 3.v.1966, coll. A.N.T. Joseph & Party; 2W, Pinjuli (244 m), 4.v.1966, coll. A.N.T. Joseph & party; 1W, Boindila (2621 m), 22.iv.1966, coll. A.N.T. Joseph & Party.

Distribution : India : Arunachal Pradesh, Sikkim and Assam.

Elsewhere : Myanmar.

4. *Diacamma rugosum sculptum* (Jerdon)

1851. *Ponera sculpta* Jerdon, *Madras J. Lit. Sci.*, **17** : 117, W.

1863. *Diacamma sculptum*, Mayr, *Verh. Zool.- Bot Ges Wien*, **13** : 407.

2003. *Diacamma rugosum sculptum*, Tiwari *et al.*, *Zool Surv. India, Fauna of Sikkim, State Fauna Series* **9** (Part-4) : 576.

Material examined : India : Arunachal Pradesh: 2W, Papumpare, Itanagar, Ganga Lake, 15.v.1991, coll. D. B. Bastawade & party; 22W, Papumpare, Lobi, 25.vii.1991, coll. T.K. Pal & party.

Distribution : India : Arunachal Pradesh, Karnataka, Kerala, Maharashtra, Tamil Nadu, Sikkim, West Bengal, Andaman & Nicobar Islands.

Elsewhere : Borneo, Philippines, Singapore, Sri Lanka, Taiwan.

3. Genus *Gnamptogenys* Roger

1864. Gnamptogenys Roger, *Berl. Ent. Zeitschr.*, **7** : 174.

Type species : *Ponera tornata* Emery, 1911.

5. *Gnamptogenys bicolor* (Emery)

1889. *Ectatomma (Stictoponera) bicolor* Emery, *Ann. Mus Civ. Stor. Nat. Gen.*, **27** : 493, W.

1958. *Gnamptogenys bicolor*, Brown, *Bull Mus Comp Zool. Harvard*, **118** : 227.

1995b. *Gnamptogenys bicolor*, Bolton, *New Genl Cat Ants World* : 208.

Diagnostic characters : W. TL 6-6.5 mm.

Dark ferruginous brown; head, thorax, pedicel and base and sides of the first abdominal segment coarsely punctured, cribrate. Head oval; mandibles triangular, not dentate; clypeus obtuse. Prothorax angular anteriorly, forming distinct tooth on either side; metanotum with two distinct teeth situated mid-apical position. Laminated angular projection beneath the pedicel. Second abdominal segment shining and smooth.

Material examined : India : Arunachal Pradesh : 13 W, Lower Subansiri, Yazli, 15.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, Assam.

Elsewhere : Myanmar, Malay Peninsula.

4. Genus ***Hypoponera*** Santschi

1938. *Ponera (Hypoponera)* Santschi, *Bull. Soc. Ent. Franc.*, **43** : 79.

1967. *Hypoponera*, Taylor, *Pacific Ins. Monogr.*, **13** : 9.

Type species : *Ponera abeillei Andre*, 1881.

6. ***Hypoponera truncata*** (Smith)

1860a. *Ponera truncata* Smith, *J. Proc. Linn. Soc. London Zool.* **5** : 72, W.

1995b. *Hypoponera truncata*, Bolton, *New Genl. Cat. Ants World* : 216.

Diagnostic characters : W. TL 3-3.5 mm. Castaneous brown; mandibles, antennae, legs paler, punctate and pubescent. Head without mandibles broadly oval; mandibles with extremely broad masticatory margin; clypeus carinate. Thorax above distinctly flat and depressed. Node of pedicel flat, much broader than long, distinctly thick and rounded above. Constriction between basal two segments of abdomen well marked, sting exerted.

Material examined : India : Arunachal Pradesh : 1W, Tawang (320m), 27.iv.1966, col. A.N.T. Joseph and party; 35W, Lower Subansiri, Ziro 13.v.1966, coll. A.N.T. Joseph and party; several W, Dibang Valley, Riong, Salley Lake, 7.iv.1993, coll. P.T. Bhutia and party.

Distribution : India : Arunachal Pradesh, Sikkim, Tamil Nadu, West Bengal.

Elsewhere : Myanmar, Celebes, Java, Borneo, Sulawesi, Taiwan.

5. Genus ***Myopopone*** Roger

1861. *Myopopone* Roger, *Berl. Ent. Zeitschr.*, **5** : 49, W.

Type species : *Myopopone maculata* Roger, 1861.

7. ***Myopopone castanea*** (Smith)

1860b. *Amblyopone castaneus* Smith, *J. Proc. Linn. Soc. London Zool.*, **5** : 105. W.

1903. *Myopopone castanea*, Bingham, *Fauna Brit. India, Hym.*, **2** : 33.

1995b. *Myopopone castanea*, Bolton, *New Genl. Cat. Ants World* : 270

Diagnostic characters : W. TL 16 mm. Jet Black, shining; legs and apical segment of abdomen light yellowish brown; pilosity long and fairly dense, more towards apex of abdomen. Head, without mandibles, square; mandibles as broad at apex as at base, the apex and inner margin strongly dentate, puncture run into longitudinal striae; antennae 12-segmented, short thick; eyes minute. Thorax almost flat above, compressed laterally; pronotum broader than long, transverse posteriorly; mesonotum transverse, highly polished and smooth. Pedicel almost square, anteriorly truncate, posteriorly attached to abdomen by its whole posterior face; abdomen tapering gradually to apex, constriction between basal two segments well marked; sting long exerted.

Material examined : India : Arunachal Pradesh : 1W, Santipur (100m), 2.iii.1969, coll. S.K. Tandon and party; 2W, Digaru Road (150m), 11.iii.1969, coll. S.K. Tandon and party; 1W, Dibang Valley, Roing, 8.ix.1991, coll. T.K. Pal and party; 8W, Kameng, Ankaling (2800m), 10.iii.1961, coll. K.C. Jayrama Krishna and party; 1W, Subansiri, Kimin (180 m), 9.v.1966, coll. A.N.T. Joseph and party.

Distribution : India : Arunachal Pradesh, Sikkim, Andaman and Nicobor Islands.

Elsewhere : Myanmar, Indonesia, Malayan Sub-region.

6. Genus *Odontomachus* Latreille

1804. *Odontomachus* Latreille, *Hist. Nat. Crust. Ins.*, **13** : 257.

Type species : *Formica haematoda* Linnaeus, 1758.

8. *Odontomachus monticola* Emery

1892. *Odontomachus monticola* Emery, *Ann. Soc., Ent. Fr.*, 60 : 560, W.

1900b. *Odontomachus monticola*, race *punctulatus* Forel, *J. Bombay nat. Hist. Soc.* **13** : 58, W.

1995b. *Odontomachus monticola*, Bolton, *New Genl. Cat. Ants World* : 296.

Diagnostic characters : W. TL 11–13 mm. Dark castaneous; mandibles, antennae, legs reddish yellow. Pilosity almost wanting, pubescence sparse and short. Head broader in front; the side hollows deep and well marked; mandibles robust with 8 small but distinct teeth; apical one large, innermost one as broad as long; striae on the front coarse, divergent, spread out in fan-shape; emarginate occiput smooth. Thorax with concentric striae on pronotum; meso-and metanotum transversely striate. Node of pedicel smooth, very convex in front, the spine at apex above thick at base; abdomen large.

Material examined : India : Arunachal Pradesh : 2W, Lower Subansiri, 12 km. North of Ziro, 29.iii.1992, coll. D.B. Bastawade and party.

Distribution : India : Arunachal Pradesh, Assam, Andaman and Nicobar Islands, Meghalaya, Sikkim, West Bengal.

Elsewhere : China, Myanmar, Indonesia.

7. Genus *Odontoponera* Mayr

1862. *Odontoponera* Mayr, *Verh. Zool.-Bot. Ges. Wien*, **12** : 717, W.

Types species : *Ponera transversa* Smith, 1857.

9. *Odontoponera transversa* (Smith)

1857. *Ponera transversa* Smith, *J. Proc. Linn. Soc. London Zool.*, **2** : 68, W.

1903. *Odontoponera transversa*, Bingham, *Fauna Brit India, Hym.*, **2** : 73, W F.

1995b. *Odontoponera transversa*, Bolton, *New Genl. Cat. Ants World* : 298

Diagnostic characters : W. TL 9-12 mm. Black; mandibles, antennae, legs castaneous; head almost square, striate, striae outwardly divergent from medial longitudinal lines; mandible subtriangular, strongly dentate; clypeus narrow, anteriorly transverse; mandible and clypeus finely longitudinally striate, antennae 12-segmented. Thorax massive, transversely striate; pronotum convex, anterior lateral angles dentate; suture distinct; apical portion of metanotum flat with a denticulate ridge on each side, basal portion with gradual slope. Pedicel cuneiform, transversely striate. Abdomen comparatively short, smooth.

Material examined : India : Arunachal Pradesh : 2 W, Subansiri Division, Pamir (564 m) / Tamen (457 m), 18.v.1966, coll. A. N. T. Joseph and party; 1 W, Siang Division, Likhaboli (140 m), 6.x.1966, coll. S. K. Tandon and G. S. Arora; 2 W, Tirap, Changlong (500 m), 30.x–1.xi.1971, coll. G. S. Arora and party.

Distribution : India : Arunachal Pradesh, Sikkim, Meghalaya, Andaman and Nicobar Islands and almost throughout India.

Elsewhere : Myanmar, China, Java, Borneo, Sumatra, Malayan region, Philippines, Singapore.

8. Genus *Pachycondyla* Smith

1858. *Pachycondyla* Smith, *Cat. Hym. Brit. Mus.* **6** : 105

Type species : *Formica crassinoda* Latreille, 1802.

Key to the species

1. Episternum of mesothorax separated from sternum by a suture 2

– Episternum of mesothorax not separated from sternum 4

2. Node of pedicel convex in front, upper portion of the posterior face bevelled off towards front 3

– Node of pedicel not bevelled, flat and truncate anteriorly and posteriorly ..... *leeuwenhoeki*

3. Abdomen finely and closely punctured, opaque, not shining ..... *astuta*

– Abdomen smooth, highly polished and shining ..... *javana*

4. Meso-metanotal suture obsolete ..... *rufipes*

- Meso-metanotal suture well-marked .... *luteipes*

10. ***Pachycondyla astuta*** Smith

1858. *Pachycondyla astuta* Smith, *Cat. Hym. Brit. Mus.*, **6** : 107, W.

1903. *Ectomomyrmex astutus*, Bingham, *Fauna Brit. India, Hym.*, **2** : 86.

1995b. *Pachycondyla astuta*, Bolton, *New Genl. Cat. Ants World* : 303.

Material examined : India : Arunachal Pradesh: 1W, Papumpare, Itanagar, Ganga Lake, 15.v.1991, coll. D.B. Bastawade and party; 9W, Debang Valley, 3 km. From Roing, 8.ix.1991, coll. T.K. Pal and party.

Distribution : India : Arunachal Pradesh, Assam, Meghalaya, Sikkim.

Elsewhere : Myanmar, China, Malaya, Java, Sumatra.

11. ***Pachycondyla javana*** (Mayr)

1867. *Ectomomyrmex javanus* Mayr, *Tijds. V. Ent.*, **10** : 84.

1903. *Ectomomyrmex javanus*, Bingham, *Fauna Brit. India, Hym.*, **2** : 86.

1995b. *Pachycondyla javana*, Bolton, *New Genl. Cat. Ants World* : 306.

Material examined : India : Arunachal Pradesh : 1W, Tirap, Pangsam Pass (1265 m.), 28.x.1971, coll. G.S. Arora and party.

Distribution : India : Arunachal Pradesh, Assam, Sikkim, West Bengal.

Elsewhere : Myanmar, China, Indonesia. (Java, Sumatra).

12. ***Pachycondyla leeuwenhoeki*** (Forel)

1886. *Ponera leeuwenhoeki Forel, J. Asiat. Soc. Bengal*, **55** : 244, W.

1900b. *Ectomomyrmex leeuwenhoeki, Forel, J. Bombay Nat. Hist. Soc.*, **13** : 321, W.

1995b. *Pachycondyla leeuwenhoeki*, Bolton, *New Genl. Cat. Ants World* : 306.

Material examined : India : Arunachal Pradesh : 9W, Upper Subansiri, Ziro, 29.iii.1992, coll. D.B. Bastawade and party; 2W, East Siang, Pasighat, Ranaghat, 29.iii.1996, P.T. Bhutia and party; 1W, Papumpare, Itanagar, Ganga lake, 10.iv.2001, Sheela and party.

Distribution : India : Arunachal Pradesh, Assam, Kerala, Meghalaya, Sikkim.

Elsewhere : Myanmar, Singapore.

13. ***Pachycondyla luteipes*** (Mayr)

1862. *Ponera luteipes* Mayr, *Verh. Zool.-Bot. Ges. Wien*, **12** : 722, W.

1903. *Brachyponera luteipes*, Bingham, *Fauna Brit. India, Hym.*, **2** : 101,W M.

Material examined : India : Arunachal Pradesh : 6W, Dirang (800 m), 11–12. iii.1969, coll. S.K. Tandon and party; 3W, Bomdila (2480m), 6.iii.1973, coll. S.K. Tandon and party; 4W, Sapper (1800m), 13.iii.1973, coll. S.K. Tandon and party.

Distribution : India : Arunachal Pradesh, Kerala, West Bengal and mostly throughout India.

Elsewhere : Myanmar, Sri Lanka, Indonesia (Java, Sumatra), Philippines, Malay Peninsula.

14. ***Pachycondyla rufipes*** (Jerdon)

1851. *Ponera rufipes* Jerdon, *Madras J. Lit. Sci.*, **17** : 119, W.

1903. *Bothroponera rufipes*, Bingham, *Fauna Brit. India, Hym.*, **2** : 96, W.

1995. *Pachycondyla rufipes*, Bolton, *New Genl. Cat. Ants World* : 309.

1999. *Bothroponera rufipes*, Tiwari, *Memoirs Zool. Surv. India*, **18**(4) : 28, syns.

Material examined : India : Arunachal Pradesh : 1W, Kameng Division, Dirang, 24.vii.1961, coll. S. Biswas and party; 1W, Siang Division, Saitan Bridge (1524 m), 23.iv.1966, coll. A.N.T. Joseph and party; 2W, Kameng Division,

Pinjuli (244m), 21.v.1966, coll. A.N.T. Joseph and party; 1W, Siang Division, Dali Vill. (200m), 10.x.1966, S.K. Tandon and G.S. Arora; 1W, Siang Division, Kambang (200m), 14.x.1966, S.K. Tandon and G.S. Arora; 1W, Daphabum Expedition, Chowkham (250m), 24.ii.1969, coll. J.M. Julka and party; 1W, Tirap, Changlong (600m), 6.x.1966, coll. A.N.T. Joseph and party; 1W, Lower Subansiri, Yazli, Pitapol, 19.ix.1983, coll. T.K. Pal and party, 1W West Siang, Kabu (600m), 2.iv.1966, coll. Bhutia and party.

Distribution : India : Arunachal Pradesh, Meghalaya, Karnataka, Kerala, Orissa, Sikkim, West Bengal, Andaman & Nicobar Islands, Himalayas from Siwalik to Assam.

Elsewere : Sri Lanka.

III. Subfamily CERAPACHYINAE Forel

9. Genus *Cerapachys* Smith

1857. *Cerapachys* Smith, *J. Proc. Linn. Soc. London. Zool.*, **2** : 74, W.

Type species : *C. antennatus* Smith, 1857.

15. *Cerapachys sulcinodis* Emery

1889. *Cerapachys sulcinodis* Emery, *Ann. Mus. Civ. Stor. Nat. Genova*, **27** : 493, W.

1951. *Cerapachys (Cerapachys) sulcinodis*, Chapman and Capco, *Monogr. Inst. Sci. Tech.*, Manila (Check List Ants Asia), **1** : 20.

1995b. *Cerapachys sulcinodis*, Bolton, *New Genl. Cat. Ants World* : 145.

Diagnostic characters : W. TL 5.5-6.5 mm. Black; mandibles, antennae and legs brownish yellow; abundant fine erect yellowish hairs along the whole body. Head convex in front, posterior lateral angles acute; mandibles triangular, obsoletely dentate; antennae 12-segmented, apical joint of flagellum distinctly much longer than preceding three joints, basal joint very short. Thorax strongly rounded and convex above, posterior face of metanotum flat; legs cylindrical, densely pubescent. Node of pedicel longer than broad, convex above, densely punctured and longitudinally coarsely furrowed or wrinkled; abdomen elongate, constriction between basal two segments broad and well marked, apex acute.

Material examined : India : Arunachal Pradesh, 5W, Lower Subansiri, Yazli, Lichi, 19.ix.1988, coll. T.K. Pal and party.

Distribution : India : Arunachal Pradesh, Meghalaya, Sikkim.

Elsewhere : China, Hong Kong, Myanmar, Malaya Peninsula.

IV. Subfamily FORMICINAE Lepeletier

Key to the genera

1. Antennal sockets situated close to the posterior clypeal margin, and metapleuron with a distinct metapleural gland orifice, the orifice situated above the hind coxa and below the level of propodeal spiracle 2

– Either antennal sockets situated far behind the posterior clypeal margin, or the metapleuron lacking a metapleural gland orifice in the location described above 4

2. Maxillary palp with 2-4 segments ..... ***Pseudolasius***

– Maxillary palp with 6 segments 3

3. With alitrunk in absolute profile, the propodeal spiracle well in front of the point where the propodeal side rounds into the declivity ..... ***Cataglyphis***

– With alitrunk in absolute profile, the propodeal spiracle bordering or actually on the curvature where the propodeal side rounds in the declivity ..... ***Paratrechina***

4. Mandibles with 10 or more teeth or denticles in total. Apical tooth disproportionately large. Petiole reduced to an elongate low node, which allows gaster to be bent forward over alitrunk. Maxillary palpi 5-jointed ..... ***Oecophylla***

– Mandibles usually with 5-7 teeth. Apical tooth not as above. Petiole an erect node or scale, gaster not capable of being bent forward. Maxillary palpi 6-jointed 5

5. Targite of first gastral segment large,

accounting for at least half the length of gaster in dorsal view in profile. Spines or teeth present on pronotum, propodeum, or on both ..... ***Polyrhachis***

– Targite of first gastral segment shorter, accounting for distinctly less than half the length of gaster in dorsal view in profile. Spines or teeth usually absent from pronotum, propodeum and petiole ..... ***Camponotus***

10. Genus *Camponotus* Mayr

1861. *Camponotus* Mayr, *Europ. Formicid* : 35.

Type species : *Formica ligniperda* Latreille, 1802.

Key to the species

1. Thorax viewed from side forming a regular arch 2

– Regular arch of the thorax interrupted by the metanotum being raised, rounded above and gibbous ..... *confucii*

2. Head, thorax and abdomen either entirely black or pale yellow 3

– Head, thorax and abdomen never all black or all yellow 4

3. Head, thorax and abdomen black .... *compressus*

– Head, thorax and abdomen pale yellow .... *invidus*

4. Head and abdomen black or dark castaneous red, thorax yellow; tibiae spined beneath .... *irritans*

– Head, thorax and base of abdomen reddish yellow, apex of abdomen darker; tibiae without spines beneath ..... *nicobarensis*

16. *Camponotus confucii* Forel

1894. *Camponotus confucii* Forel, *J. Bombay Nat. Hist. Soc.*, **8** : 396, W.

1999. *Camponotus confucii*, Tiwari, *Memoirs zool. Surv. India*, **18**(1) : 73.

Material examined : India : Arunachal Pradesh : 26W, Tirap, Deomali Forest (250 m), 9.xi.1971, coll. G.S. Arora and party.

Distribution : India : Arunachal Pradesh, Karnataka, Western India.

Elsewhere : Upper Myanmar.

17. *Camponotus compressus* (Fabricius)

1787. *Formica compressa* Fabricius, *Mant. Insect.*, **1** : 307, W.

1999. *Camponotus compressus*, Tiwari, *Memoris zool. Surv. India*, **18**(1) : 69.

Material examined : India : Arunachal Pradesh : 1W, Debang Valley, Roing, Abango Vill., 5.iv.1993, coll. P.T. Bhutia and party; 5W, Papumpare, Nirjuli, 20.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, Assam, Tamil Nadu, West Bengal and almost throughout India.

Elsewhere : Arabia, Africa, Borneo, Myanmar, Nepal, Philippines, Russia, Sri Lanka.

18. *Camponotus invidus* Forel

1892a. *Camponotus invidus* Forel, J. *Bombay Nat. Hist. Soc.*, **7** : 225 and 234, W.

1995b. *Camponotus (Tanaemyrmex) invidus*, Bolton, *New Genl. Cat. Ants World* : 105.

Material examined : India : Arunachal Pradesh, 15W, Papumpare, Itanagar, Ganga Lake, 15.v.1991, coll. D.B. Bastawade and party; 7W, Changlong, Tengmo, 17 km from Nampong, ix.1991, coll. T.K. Pal and party.

Distribution : India : Arunachal Pradesh, Orissa, Sikkim, West Bengal, Andaman and Nicobar Islands.

19. *Camponotus irritans* (Smith)

1857. *Formica irritans* Smith, *J. Proc. Linn. Soc. London Zool.*, **2** : 55.

1995b. *Camponotus (Tanaemyrmex) irritans*, Bolton, *New Genl. Cat. Ants World* : 105.

Material examined : India : Arunachal Pradesh, 3W, Lohit, Khupa, Nara, 26.ii.1990, coll. T.K. Pal and party.

Distribution : India ; Arunachal Pradesh, West Bengal.

Elsewhere : Indonesia, Indo-China, Sri Lanka.

20. *Camponotus nicobarensis* Mayr

1865. *Camponotus nicobarensis* Mayr, *Reise der Nov. Zoologischer Wien* : 31, W.

1995b. *Camponotus (Tanaemyrmex) nicobarensis*, Bolton, *New Genl. Cat. Ants World* : 113.

Material examined : India : Arunachal Pradesh : 1W, West Kameng, Rupa Camp, 20.xii.1965, coll. S.K. Bhattacharyya and A.N.T. Joseph.

Distribution : India : Arunachal Pradesh, Andaman and Nicobar Islands.

Elsewhere : China, Java, Nias Islands.

Camponotus sp.

Material examined : India : Arunachal Pradesh : 4W, Upper Subansiri, Ziro, 29.iii.1992, coll. D.B. Bastawade and party; 2W, E. Siang, Pasighat, Regin, 5.ix.1992, coll. P.T. Bhutia and party; 8W, Debang Valley, Roing, Salley Lake, 7.iv.1993, coll. P.T. Bhutia and party; 6W, West Kameng, Tippi, 12.x.1993, coll. P.T. Bhutia and party.

11. Genus *Cataglyphis* Foerster

1850. *Cataglyphis* Foerster, *Verh. Nat. Ver. Pre. Rhein. West.* 7 : 493.

Type species : *Formica bicolor* Fabricius 1793 (=*Cataglyphis fairmairei* Foerster 1850).

22. *Cataglyphis setipes* (Forel)

1894. *Myrmecosystus viaticus* race, *setipes* Forel, *J. Bombay Nat. Hist. Soc.*, 8 : 401, W.

1922. *Cataglyphis setipes*, Wheeler, *Bull. Amer. Mus. Nat. Hist.*, 45 : 945.

1995b. *Cataglyphis setipes*, Bolton, *New Genl. Cat. Ants World* : 137.

Diagnostic characters : W. TL 10 mm. Head, thorax, pedicel dark red, abdomen black, legs almost black; densely setose and spinose. Head without mandibles quadrangular, sides straight; mandibles large, strongly dentate, apical tooth remarkably long, curved and acute: clypeus convex; frontal area triangular; antennae 12-segmented, filiform; eyes placed well above the middle line of head; ocelli present. Thorax viewed from side constricted, saddle-shaped, sutures well marked; pronotum convex; mesonotum long, narrow, rounded above; metanotum short, gibbous. Node of pedicel rounded; abdomen comparatively short, oval.

Material examined : India : Arunachal Pradesh : 1W, Subansiri, Pamir (564m), 17.v.1966, coll. A.N.T. Joseph and party; 1W, Siang, Tappi (600m), 23.x.1966, coll. S.K. Tandon and G.S. Arora.

Distribution : India : Arunachal Pradesh, Meghalaya, Punjab, Sikkim, Tamil Nadu, West Bengal, Central India.

Elsewhere : Persia.

12. Genus *Oecophylla* Smith

1857. *Oecophylla* Smith., *J. Proc. Linn. Soc. London Zool.* 5 : 101, W F.

Type species : *Formica smaragdina* Fabricius, 1775 (= *Formica virescens* Fabricius, 1775).

23. *Oecophylla smaragdina* (Fabricius)

1775. *Formica smaragdina* Fabricius, *Syst. Ent.* : 828, W, pl., figs.

1999. *Oecophylla smaragdina*, Tiwari, *Memoirs Zool. Surv India*, 18 (4) : 66.

Diagnostic characters : W. TL 8-10 mm. Yellowish red. Head quadrangular without mandibles, posteriorly transverse; mandibles long, dentate, apical tooth acute and curved; clypeus strongly convex; antennae 12- segmented, filiform; eyes large. Thorax elongate; pronotum convex, anteriorly narrowed into a collar; mesonotum saddle-shaped; metanotum rounded above, sutures distinct. Pedicel elongate, scarcely nodiform; abdomen short, oval.

Material examined : India : Arunachal Pradesh : 2W, Siang, Siji Vill. (200m), 8.x.1966, coll. S.K. Tandon and G.S. Arora; 32W, Papumpare, Itanagar, Ganga Lake, 10.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, Manipur, Meghalaya, Karnataka, Kerala, Orissa, Sikkim, Tamil Nadu, West Bengal, Andaman and Nicobar Islands, and mostly the whole India except desert and treeless areas.

Elsewhere : Australia, China, Java, Myanmar, New Guinea, Sri Lanka.

13. Genus ***Paratrechina*** Motschoulsky

1863. *Paratrechina* Motschoulsky, *Bull. Soc. Nat. Moscou.*, **36** : 13.

Type species : *Formica longicornis* Latreille, 1802 (= *P. currens* Motschoulsky, 1863).

Key to the species

1. Head highly polished, smooth and shining, not pilose; only a few scattered hairs on clypeus and mandibles ..... *bourbonica*
- Head not polished, only slightly shining, pilose or pubescent ..... *indica*

24. ***Paratrechina bourbonica*** (Forel)

1886. *Prenolepis nodifera bourbonica* Forel, *Ann. Soc. Ent. Belg.*, **30** : 210, W F M.

1999. *Paratrechina bourbonica*, Tiwari, *Memoirs Zool. Surv. India*, **18** (4) : 80.

Material examined : India : Arunachal Pradesh : 8W, Lower Subansiri, Yazli, 16.v.1989, coll. P.T. Bhutia and party.

Distribution : India : Arunachal Pradesh, Tamil Nadu, West Bengal.

Elsewhere : Myanmar, Seychelles, Pemba Islands, Oceania.

25. ***Paratrechina indica*** Forel

1894. *Prenolepis indica* Forel, *J. Bombay Nat. Hist. Soc.*, **8** : 409, W F M.

1995b. *Paratrechina indica*, Bolton, *New Genl. Cat. Ants World* : 314.

Material examined : India : Arunachal Pradesh : 6W, Lower Subansiri, Hapoli, 16.iv.2001, coll. Sheela and party; 3W, Upper Subansiri, Daporizo, 18.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, Maharashtra, West Bengal.

26. ***Paratrechina*** sp.

Material examined : India : Arunachal Pradesh, 2 W, Lower Subansiri, Hapoli, 16.iv.2001, coll. Sheela and party.

14. Genus ***Polyrhachis*** Smith

1857. *Polyrhachis* Smith, *J. Proc. Linn. Soc. London Zool.*, **2** : 58.

Type species : *Formica bihamata* Drury, 1773.

Key to the species

1. Thorax more or less rounded above, the sides not margined along their whole length 2
- Thorax more or less flat above, the sides margined along their whole length 7
2. Metanotum unarmed ..... *laevissima*
- Metanotum with a spine on each side 3
3. Pronotum with a short spine .... *hippomanes ceylonensis*
- Pronotum with a spine on each side 4
4. Pubescence sparse, almost entirely wanting ..... *armata*
- Pubescence dense, silky and recumbent 5
5. Abdomen red ..... *bicolor*
- Abdomen black 6
6. Pubescence bronzy yellow or golden ... *dives*
- Pubescence silvery ..... *tibialis*
7. Node of pedicel with 2 long spines on upper angles and 2 short teeth on sides ... *illaudata*
- Node of pedicel armed with 4 short sub equal spines ..... *convexa*

27. ***Polyrhachis armata*** (Le Guillou)

1842. *Formica armata* Le Guillou, *Ann. Soc. Ent. France*, **10** : 313, F.

1863a. *Polyrhachis armata*, Roger, *Berl. Ent. Zeitsch.*, **7** : 9.

1995b. *Polyrhachis (Myrmhopla) armata*, Bolton, *New Genl. Cat. Ants World* : 343.

Material examined : India : Arunachal Pradesh : 1W, Lohit, Kariranga (100m), 25.ii.1969, coll. S.K. Tandon and party.

Distribution : India : Arunachal Pradesh, Assam.

Elsewhere : Indonesia (Java), Myanmar, Philippines.

28. ***Polyrhachis bicolor*** Smith

1858. *Polyrhachis bicolor* Smith, *Cat. Hym. Brit. Mus.*, **6** : 65, F.

1995b. *Polyrhachis (Myrmhopla) bicolor*, Bolton, *New Genl. Cat. Ants World* : 344.

Material examined : India : Arunachal Pradesh : 2W, Lower Subansiri, Yazli, 16.v.1989, coll. P.T. Bhutia and party.

Distribution : India : Arunachal Pradesh, West Bengal.

Elsewhere : Myanmar, Philippines.

29. ***Polyrhachis convexa*** Roger

1863a. *Polyrhachis convexa* Roger, *Berl. Ent. Zeitschr.*, **7** : 153, W.

1995b. *Polyrhachis (Myrma) convexa*, Bolton, *New Genl. Cat. Ants World* : 346.

Material examined : India : Arunachal Pradesh, 1W, Kameng, Loo Dohung (1524m.), 23.iv.1966, coll. A.N.T. Joseph and party.

Distribution : India : Arunachal Pradesh.

Elsewhere : Sri Lanka.

30. ***Polyrhachis dives*** Smith

1857. *Polyrhachis dives* Smith, *J. Proc. Linn. Soc. London Zool.*, **2** : 64. W.

1999. *Polyrhachis dives*. Tiwari, *Memoirs Zool Surv. India* **18**(4) : 75.

Material examined : India : Arunachal Pradesh : 33W, Kameng, Rupa Camp, 20.xii.1965, coll S.K. Bhattacharyya and A.N.T. Joseph; 16W, Siang, Kambang (200m.) and Old Jining (500m.), 16.x.-20.x.1966, coll. S.K. Tandon and G.S. Arora; 14W, Tawang, Lumla, 9.iv.1991, coll. P.T. Bhutia and party; 40W, Lohit, Namsai, 31.i.1994, coll. G. Thirumalai and party; 27W, Debang Valley, Roing, Abango vill., 5.iv.1993, coll. P.T. Bhutia and party; 4W, Papumpare, Naharlagun, 19.iv.2001, coll. Sheela and party; 7W, West Kameng, Bhalukpong, Sessa, 22.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, Sikkim, Tamil Nadu, Eastern Himalayas.

Elsewhere : China, Indonesia, Myanmar, Philippines, Singapore, Sri Lanka, Thailand.

31. ***Polyrhachis hippomanes ceylonensis*** Emery

1893. *Polyrhachis hippomanes ceylonensis* Emery, *Ann Soc. Ent. France*, **62** : 254.

1995b. *Polyrhachis hippomanes ceylonensis*, Bolton, *New Genl. Cat. Ants World* : 345.

Material examined : India : Arunachal Pradesh : 21W, Kameng, Rupa Camp, 20.xii.1965, coll. S.K. Bhattacharyya and A.N.T. Joseph.

Distribution : India : Arunachal Pradesh.

Elsewhere : Singapore, Sri Lanka.

32. ***Polyrhachis illaudata*** Walker

1859. *Polyrhachis illaudata* Walker, *Ann Mag. Nat Hist.* (3) **4** : 373, W.

1995b. *Polyrhachis (Myrma) illaudata*, Bolton, *New Genl Cat. Ants World* : 350.

Material examined : India : Arunachal Pradesh : 1W, Kameng, Rupa Camp, 20.xii.1965, coll. S.K. Bhattacharyya and A.N.T. Joseph; 2 W, Kameng, Dunn Bridge (1524m.) and Shaitan Bridge (1524m.), 21-23.iv.1966, coll. A.N.T. Joseph and party; 3W, Subansiri, Kimin (198m) and Pamir (564m.), 17.v.1966, coll. A.N.T. Joseph

and party; 2W, Tirap, Changlong (600m.), 30.x.1971, coll. G.S. Arora and party.

Distribution : India : Arunachal Pradesh, Assam, Andaman & Nicobar Islands, Karnataka, Kerala, Mehgalaya, Sikkim, Tamil Nadu, West Bengal.

Elsewhere : China, Indonesia, Myanmar, Philippines, Sri Lanka.

33. ***Polyrhachis laevissima*** Smith

1858. *Polyrhachis laevissimus* Smith, *Cat. Hym. Brit. Mus.*, **6** : 64, W.

1995b. *Polyrhachis (Cyrtomyrma) laevissima*, Bolton, *New Genl. Cat. Ants World* : 351

Material examined : India : Arunachal Pradesh : 2W, Lower Subansiri, Yazli, 16.v.1989, coll. P.T. Bhutia and party.

Distribution : India : Arunachal Pradesh, West Bengal.

Elsewhere : Indonesia, Myanmar, Singapore.

34. ***Polyrhachis tibialis*** Smith

1858. *Polyrhachis tibialis* Smith, *Cat. Hym. Brit. Mus.*, **6** : 63, W.

1995b. *Polyrhachis (Myrmhopla) tibialis*, Bolton, *New Genl. Cat. Ants World* : 358

1999. *Polyrhachis tibialis*, Tiwari, *Memoirs Zool. Surv. India*, **18**(4) : 78.

Material examined : India : Arunachal Pradesh : 6W, Lower Subansiri, Yazli, 16.v.1989, coll. P.T. Bhutia and party.

Distribution : India : Arunachal Pradesh, Karnataka, Kerala, West Bengal.

Elsewhere : Indonesia, Myanmar.

15. Genus ***Pseudolasius*** Emery

1887. *Pseudolasius* Emery, *Ann. Mus. Civ. Stor. Nat. Genova*, **4**(24) : 244.

Type spaces : *Formica familiaris* Smith, 1860.

35. ***Pseudolasius familiaris*** (Smith)

1860a. *Formica familiaris* Smith, *J. Proc. Linn. Soc. London Zool.* **5**(suppl. to 4) : 68, W.

1903. *Pseudolasius familiaris*, Bingham, *Fauna Brit. India, Hym.*, **2** : 338.

1995b. *Pseudolasius familiaris*, Bolton, *New Genl. Cat. Ants World* : 370

Diagnostic characters : W. TL(maj.) 6-7 mm.,(min.) 3.5 mm. Reddish yellow to creamy buff, abdomen almost reddish brown; very minutely but closely reticulate-punctate; hairs fairly long, erect; pubescence fine, short and silky, dense on abdomen. Head nearly square without mandibles, broader posteriorly; powerful mandibles with four teeth, innermost broad, others acute; clypeus convex in the middle; depressed at the sides; 12-segmented antennae somewhat short, scape stout; eyes small. Thorax short, narrower than head; pronotum rounded, convex; viewed from above mesonotum circular; basal portion of metanotum much shorter than oblique apical portion; sutures distinct. Node of pedicel quadrangular, posteriorly fitted into a hollow in abdomen; abdomen short, broad and convex.

Material examined : India : Arunachal Pradesh : 3W, Lower Subansiri, Bismile, 14.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, Meghalaya, Sikkim.

Elsewhere : Celebes, Java, Myanmar.

V. Subfamily DOLICHODERINAE Forel

Key to the genera

1. Petiole in profile usually a simple transversely flattened strip, sometimes slightly swollen anterodorsally but never equipped with a standing scale. Petiole overhung by first gastral segment and usually not visible in dorsal view when alitrunk and gaster are in same plane 2

– Petiole in profile surmounted by a node or scale, which somewhat inclined, forward, but node always present and conspicuous. Petiole not overhung by first gastral segment, usually visible in dorsal view when alitrunk and gaster are in same plane 3

2. In dorsal view 5 gastral tergites visible, the

fifth one small but continuing the line of gaster and not bent forward, anal orifice situated apically ..... ***Technomyrmex***

– In dorsal view only 4 gastral tergites visible; the fifth one bent forward and the anal orifice situated ventrally ..... ***Tapinoma***

3. Clypeus with oval side-processes overlapping the base of the mandibles on each side .... ***Liometopum***

– Clypeus without such side-processes .... ***Dolichoderus***

16. Genus *Dolichoderus* Lund

1831. *Dolichoderus* Lund, *Ann. Sci. Nat.*, **23** : 130.

Type species : *Formica attelaboides* Fabricius, 1775.

36. *Dolichoderus* sp.

Material examined : India : Arunachal Pradesh, 2W, Lohit, Yalong, 25.ii.1990, coll. T.K. Pal and party.

17. Genus *Tapinoma* Foerster

1850. *Tapinoma* Foerster, *Hym., Stud.*, **1** : 43, W F.

Type species : *Tapinoma collina* Foerster, 1850 (= *Tapinoma erraticum* Latreille, 1798)

37. *Tapinoma melanocephalum* (Fabricius)

1793. *Formica melanocephala* Fabricius, *Ent. Syst.*, **2** : 353, W.

1999. *Tapinoma melanocephalum*, Tiwari, *Memoirs zool. Surv. India*, **18**(4) :83.

Diagnostic characters : W. TL 1.5-2 mm. Head, sometimes thorax also dark brown; thorax and abdomen or abdomen alone yellowish white. Head longer than broad, oval, rounded posteriorly; mandibles triangular, broad, masticatory margin armed with numerous minute teeth; antennae long, scape extending beyond the top of the head; eyes comparatively large. Thorax viewed from side not emarginate; pro-meso and meso-metanotal sutures distinct; basal portion of metanotum very short, passing into much longer obliquely slopping portion by an obtuse angle. Pedicel very short; abdomen elongate, oval.

Material examined : India : Arunachal Pradesh, 35W, Lower Subansiri, Bismile, 11.iv.2001, coll. Sheela and party; 4W, Upper Subansiri, Daporizo, 18.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, Karnataka, Tamil Nadu, West Bengal and almost throughout the country.

Elsewhere : Oceania, South America and spreaded through the tropics of both hemispheres.

18. Genus *Liometopum* Mayr

1861. *Liometopum* Mayr, *Europ. Formicid.* : 38.

Type species : *Formica microcephala* Panz., 1798.

38. *Liometopum lindgreeni* Forel

1902a. *Liometopum lindgreeni* Forel, *Ann Soc Ent Belg.*, **46** : 293.

1995b. *Liometopum lindgreeni*, Bolton, *New Genl. Cat Ants World* : 247.

Diagnostic characters : W. TL 4.5-5 mm. Head, thorax, legs, nodes of pedicel and base of abdomen reddish brown; rest of abdomen dark brown. Pubescence pale, very dense and decumbent, giving with the fine, close, minute reticulate punctate sculpture. Head with the mandibles triangular, broader posteriorly than in front; broad mandibles with 8-10 teeth; clypeus triangular, rounded posteriorly with oval side-processes overlapping the base of mandibles on each side; 12-segmented antennae stout, planted immediately behind the posterior margin of clypeus. Pro-meso, and meso-metanotal sutures well-marked; thorax in-total forming a slight curve to the apex of metanotum, which is oblique but not truncate. Node of pedicel oval, not inclined, erect; abdomen broadly oval, not gibbous.

Material examined : India : Arunachal Pradesh, 36W, Papumpare, Itanagar, Ganga lake, 10.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, Assam.

Elsewhere : Myanmar.

19. Genus *Technomyrmex* Mayr

1872. *Technomyrmex* Mayr, *Ann. Mus. Civ. Stor. Nat. Genova*, **2** : 147, W F.

Type species : *Technomyrmex strenua* Mayr, 1872.

39. *Technomyrmex albipes* (Smith)

1861. *Tapinoma albipes* Smith, *J. Proc. Linn. Soc. London. Zool.*, **6** : 38, W.

1895. *Technomyrmex albipes*, Forel, *J. Bombay Nat. Hist. Soc.*, **9** : 466.

2003. *Technomyrmex albipes*, Tiwari *et al.*, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series* **9** (Part-4) : 494.

Diagnostic characters : W. TL 2.5-3 mm. Black, mandibles reddish brown, tarsi white; head, thorax and abdomen very finely and closely reticulate-punctate, covered with thin short silky-white pubescence. Head longer than broad, widely emarginate posteriorly; broad, triangular mandibles armed with numerous small teeth on its masticatory margin; clypeus with a deep crescentic emargination medially on anterior margin; scape of antennae scarcely extending beyond top of head. Thorax somewhat broad, viewed in profile widely emarginate at meso-metanotal suture; mesonotum convex, slightly raised above pronotum; apical portion of metanotum much longer with backward slope. Pedicel without a proper elevated node, simply with an oval flat thickening in the middle; gibbous abdomen produced at base, overhanging the pedicel, posteriorly conical.

Material examined : India : Arunachal Pradesh: 26W, West Kameng, Tippi, 28.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh and almost all other states.

Elsewhere : Java, New Guinea, Oceania.

VI. Subfamily PSEUDOMYRMECINAE Emery

20. Genus *Tetraponera* Smith

1852. *Tetraponera* Smith, *Ann. Mag. Nat. Hist.*, (2) **9** : 44.

Type species : *Eciton nigrum* Jerdon, 1851 (= *Tetraponera arata* Smith, 1852).

40. *Tetraponera rufonigra* (Jerdon)

1851. *Eciton rufonigrum* Jerdon, *Madras J. Lit. Sci.*, **17** : 111,W.

1999. *Tetraponera (Tetraponera) rufonigra*, Tiwari, *Memoirs zool. Surv. India*, **18**(4) : 35.

Diagnostic characters : W. TL 10-13 mm. Head, second joint of pedicel and abdomen black; mandibles, antennae, thorax and first joint of pedicel light to deep brick-red; pilosity and pubescence sparse. Shining, minutely and closely punctured. Head little longer than broad; occiput transverse; cheeks straight; broadly linear mandibles with 5 to 6 teeth on masticatory margin; ocelli present. Thorax elongate; broad pronotum with dentate anterior lateral angles; pro-mesonotal suture arched to the front; meso-metanotal suture deeply emarginate; metanotum longer than pro- and mesonotum together. Pedicel elongate; abdomen oval, acute at apex; sting exerted.

Material examined : India : Arunachal Pradesh : 17W, Lower Subansiri, Yazli, 16.v.1989, coll. P.T. Bhutia; 21W, Papumpare Itanagar, Ganga lake, 10.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, Karnataka, Kerala, West Bengal and mostly widely distributed species in India.

Elsewhere : China, Indonesia, Myanmar, Singapore, Sri Lanka.

VII. Subfamily MYRMICINAE Lepeletier

Key to the genera

1. Postpetiole articulated on dorsal surface of first gastral segment; the gaster in dorsal view roughly heart-shaped and capable of being bent forward over the alitrunk. Petiole dorsoventrally flattened and without a node ..... ***Crematogaster***

– Postpetiole articulated on anterior surface of first gastral segment; gaster in dorsal view not heart-shaped and not capable of being bent forward. Petiole not dorsoventrally flattened,

possessing a node of some form 2

2. Apical and preapical antennal segments much larger than preceding funicular segments and forming a conspicuous 2-segmented club 3

– Apical plus 2 preapical funicular segments of antennae enlarged and forming a conspicuous 3-segmented club 4

3. Antenna with 10-segments; anterior clypeal margin with a single long, anteriorly projecting, unpaired median seta at the midpoint of the margin ..... ***Solenopsis***

– Antenna with 11-segments; anterior clypeal margin lacking a single median unpaired seta, instead usually with a pair of setae that straddle the midpoint ..... ***Pheidologeton***

4. Antenna with 9-segments ..... ***Meranoplus***

– Antenna with 11-12 segments 5

5. Antenna with 11-segments; sting with a lamellate appendage, which projects dorsally, close to the sting apex but at an angle to the shaft ..... ***Tetramorium***

– Antenna with 12-segments; sting without a lamellate appendage 6

6. Palp formula 6, 4. Spurs on posterior tibiae usually pectinate ..... ***Myrmica***

7. Palp formula less than 6,4. Spurs on posterior tibiae usually simple or absent 8

8. Masticatory margin of mandibles with 3-6 teeth which are decreasing in size from the apical to the basal most. Club of flagellum distinct 9

– Masticatory margin of mandibles with 7 or more teeth or denticles. Club of flagellum not distinct ..... ***Aphaenogaster***

9. Midpoint of anterior clypeal margin without a long unpaired median seta. Median portion of clypeus not longitudinally bicarinate and lateral portion not flattened and prominent .... ***Pheidole***

– Midpoint of anterior clypeal margin with a long unpaired median seta, which projects forward over the mandibles. Median portion of clypeus longitudinally bicarinate, or lateral portions of clypeus flattened and strongly prominent 10

10. Propodeum unarmed and rounded. Clypeus bicarinate medially ..... ***Monomorium***

– Propodeum armed with a pair of spines. Clypeus not bicarinate medially; but lateral portions of clypeus dorsoventrally flattened and thin, strongly prominent over the mandibles .. .. ***Cardiocondyla***

21. Genus *Aphaenogaster* Mayr

1853. *Aphaenogaster* Mayr. *Verh. Zool.-Bot. Ver Wien.* **3** : 107.

Type species : *Aphaenogaster sardous* Mayr. 1853

41. *Aphaenogaster smythiesii* Forel

1902b. *Stenamma (Aphaenogaster) smythiesi* Forel. *Rev Suisse Zool.*, **10** : 222. W. F. M.

2003. *Aphaenogaster smythiesii*, Tiwari *et al*. *Zool Surv India, Fauna of Sikkim, State Fauna Series* **9** (Part-4) : 482.

Diagnostic characters : W. TL.4.5-5.5 mm. Dark castaneous brown; smooth, polished and shining; pilosity white and obtuse, most plentiful on abdomen. Head without mandibles rectangular, posterior lateral angles rounded; triangular mandibles striate at base. Thorax narrow; pronotum convex, pro-mesonotal suture distinct; mesonotum obliquely slopping back; meso-metanotal suture emarginate, deeply marked; metanotum rounded from side to side; short and acute metanotal spines broad at base. First node of pedicel obliquely sloped posteriorly, rounded above; second node longer than broad; abdomen a little broader posteriorly than at base, rounded in front at apex.

Material examined : India : Arunachal Pradesh, 6W, Lower Subansiri, Bismile, 14.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, Meghalaya, Sikkim, West Bengal, North-West Himalayas.

22. Genus *Cardiocondyla* Emery

1869. *Cardiocondyla* Emery, *Ann. Acc. Asp. Nat. Naples, Era* 2, **2** : 20.

Type species : *Cardiocondyla elegans* Emery, 1869.

Key to the species

1. Anterior angles of propodeum rounded ..... *nuda*
- Anterior angles of propodeum bidenticulate .. .. *shuckardi*

42. *Cardiocondyla nuda* (Mayr)

1866. *Leptothorax nuda* Mayr, *Sitz. Akad. Wiss. Wien.*, **53** : 508, W.

2003. *Cardiocondyla nuda*, Tiwari *et al., Zool. Surv. India, Fauna of Sikkim, State Fauna Series* **9** (Part-4) : 492.

Material examined : Arunachal Pradesh : 1W, Debang Valley, Roing, Abango vill., 5.iv.1993, coll. P.T. Bhutia and party.

Distribution : India : Arunachal Pradesh, Andaman and Nicobar Islands, Meghalaya, Sikkim, West Bengal.

Elsewhere : Malaysia, Sri Lanka, Oceania.

43. *Cardiocondyla shuckardi* Forel

1891. *Cardiocondyla shuckardi* Forel, *Hist. Phy. Nat. Pol. Madagascar*, **20** : 161.

1995. *Cardiocondyla shuckardi*, Bolton, *New Genl. Cat. Ants World* : 133.

Material examined : India : Arunachal Pradesh : 1W, West Kameng : Bhalukpong, 22.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh.

44. *Cardiocondyla* sp.

Material examined : India : Arunachal Pradesh. 15 W, Papumpare, Nirjuli, 20.iv.2001, coll. Sheela and party.

23. Genus *Crematogaster* Lund

1831. *Crematogaster* Lund, *Ann. Sci. Nat.*, **23** : 132.

Type species : *Formica scutellaris* Oliv., 1792.

Key to the species

1. Club of flagellum of antennae 3-jointed 2
- Club of flagellum of antennae 2-jointed .... *biroi*
2. Pronotum sculptured ..... *Crematogaster sp.*
- Pronotum not sculptured, smooth 3
3. Basal level portion of metanotum sculptured ..... *walshi*
- Basal level portion of metanotum not sculptured, smooth 4
4. Head, viewed from the front, anteriorly truncate, raised into a high convex cone above ..... *aberrans*
- Head, viewed from the front, anteriorly not truncate, not cone-shaped above ..... *politula*

45. *Crematogaster aberrans* Forel

1892b. *Crematogaster aberrans* Forel, *Ann. Soc. Ent. Belg.*, **36** : 531, W.

1995. *Crematogaster aberrans*, Bolton, *New Genl. Cat.Ants World* : 146.

Material examined : India : Arunachal Pradesh : 33 W, Lohit, Teju (150 m.),10.iii.1969, coll. S. K. Tandon and party.

Distribution : India : Arunachal Pradesh, Karnataka, Maharashtra.

46. *Crematogaster biroi* Mayr

1897. *Crematogaster biroi* Mayr, Term. *Fuzetek*, **20** : 428, W.

2003. *Crematogaster biroi*, Tiwari *et al., Zool. Surv. India, Fauna of Sikkim, State Fauna Series* **9** (Part-4) : 487.

Material examined : India : Arunachal Pradesh : 2 W, Lower Subansiri, Bismile, 14.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, Meghalaya, Karnataka, Sikkim, Uttar Pradesh.

Elsewhere : Sri Lanka.

47. *Crematogaster politula* Forel

1902b. *Crematogaster subnuda* Mayr, race *politula Forel, Rev. Suisse Zool.*, **10** : 207, W.

2003. *Crematogaster politula*, Tiwari *et al., Zool. Surv. India, Fauna of Sikkim, State Fauna Series* **9** (Part - 4) : 488.

Material examined : India : Arunachal Pradesh : 6W, Lohit, Teju (150m.), 10.iii.1965, coll. S.K. Tandon and party.

Distribution : India : Arunachal Pradesh : Assam, Meghalaya, Sikkim.

48. *Crematogaster walshi* Forel

1902b. *Crematogaster walshi* Forel, *Rev. Suisse Zool.*, **10** : 205, W.

2003. *Crematogaster walshi*, Tiwari *et al. Zool. Surv. India, Fauna of Sikkim, State Fauna Series* **9** (Part-4) : 488.

Material examined : India : Arunachal Pradesh : 26W, East Kameng, Golosa, 4.iv.1998, coll. P.T. Bhutia and party.

Distribution : India : Arunachal Pradesh, Meghalaya, Orissa, Sikkim, West Bengal.

49. **Crematogaster** sp.

Material examined : India : Arunachal Pradesh : 13W, Lohit, Teju, Lohitpur Road (500m), 13.iii.1969, coll. S.K. Tandon and party.

24. Genus *Meranoplus* Smith

1854. *Meranoplus* Smith, *Trans. Ent. Soc. London* (2), **2** : 224.

Type species : *Cryptocerus bicolor* Guer., 1844.

Key to the species

1. Mesonotum armed posteriorly with two long acute spines; pronotum dentate ..... *bicolor*

– Mesonotum armed posteriorly with only comparatively short teeth; pronotum subdentate ..... *rothneyi*

50. *Meranoplus bicolor* (Guer.)

1844. *Cryptocerus bicolor* Guer., *Cuv. Iconogr. Regn Anim. Ins.* **3** : 425.

1903. *Meranoplus bicolor*, Bingham, *Fauna Brit India, Hym.*, **2** : 168.

1995. *Meranoplus bicolor*, Bolton, *New Genl. Cat Ants World* : 250.

Material examined : India : Arunachal Pradesh : 32W, Papumpare, Itanagar, Ganga Lake, 10.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh and nearly throughout the country excepting hot, dry places.

Elsewhere : Myanmar to Malayan sub-region.

51. *Meranoplus rothneyi* Forel

1902b. *Meranoplus rothneyi* Forel, *Rev. Suisse Zool.*, **10** 241, W.

1995. *Meranoplus rothneyi*, Bolton, *New Genl Cat Ants World* : 251.

Material examined : India : Arunachal Pradesh : 22W, Papumpare, Itanagar, Ganga Lake, 10.iv.2001, coll. Sheela and party; 5W, Papumpare, Itanagar, Gohpur, 11.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, Kerala.

25. Genus *Monomorium* Mayr

1855. *Monomorium* Mayr, *Verh Zool-Bot Ges Wien*, **5** 452.

Type species : *Monomorium minutum* Mayr, 1855.

52. *Monomorium aberrans* Forel

1902b. *Monomorium aberrans* Forel, *Rev Suisse Zool.*, **10** : 209.

1995. *Monomorium aberrans*, Bolton, *New Genl Cat Ants World* : 258.

Diagnostic characters : W. TL 3.5 mm. Reddish yellow, abdomen dark brown with bluish reflections; head, thorax and abdomen smooth and shining, metanotum above transversely striate.

Head quadrate, as broad as long, posteriorly emarginate; clypeus short; scape of antennae reaching beyond the top of head; eyes lateral, closer to the anterior than to posterior margin of head. Thorax anteriorly very rounded and convex; pro-mesonotal suture obsolete; meso-metanotal suture deep, wide and in profile emarginate. Anteriorly petiolate first node of pedicel high, rounded and obtuse above; second node lower, longer than broad, rounded above; abdomen somewhat elongate, oval.

Material examined : India : Arunachal Pradesh : 1W, Kameng, Tenga, 19.xii.1965, coll. S.K. Bhattacharya and A.N.T. Joseph.

Distribution : India : Arunachal Pradesh, Madhya Pradesh.

26. Genus ***Myrmica*** Latreille

1804. *Myrmica* Latreille, *Nouv. Dict. d'Hist. Nat.*, **24** : 179

Type species : *Formica rubra* Linnaeus, 1758.

53. ***Myrmica rugosa*** Mayr

1865. *Myrmica rugosa* Mayr, *Novara Reise. Zool. Formicid* : **19**, W.

2003. *Myrmica rugosa*, Tiwari *et al.*, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series* **9** (Part-4) : 485.

Diagnostic characters : W. TL.5.5–6 mm. Black, mandibles, antennae and legs dark castaneous; head, thorax and pedicel striate, rugose; abdomen highly polished, smooth and shining; plenty of pale, long pilosity on head, thorax and abdomen. Head convex with distinct posterior margin; finely longitudinally striate mandibles with denticulate masticatory margin and very acute apical teeth; medial portion of clypeus produced anteriorly, apex obtuse, rounded posterior margin produced between bases of antennae; antennae without distinct club. Thorax elongate, impressed at meso-metanotal suture; metanotal spines as long as the basal face of metanotum which is rectangular above. First node of pedicel longer than broad with a short petiole anteriorly, second node as broad as long, convex above; abdomen oval.

Material examined : India : Arunachal Pradesh : 11W, West Kameng, Bomdila, 24.iv.2001, coll. Sheela and party; 16W, West Kameng, Tenga, 24.iv.2001, coll. Sheela and party; 33W, Tawang, 26.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, Sikkim and along Himalayan ranges and above 4000 ft.

27. Genus ***Solenopsis*** Westwood

1840. *Solenopsis* Westwood, *Ann. Mag. Nat. Hist.*, **6** : 86.

Type species : *Atta geminata* Fabricius, 1804 (= *Solenopsis mandibularis* Westwood, 1841.)

54. ***Solenopsis geminata*** (Fabricius)

1804. *Atta geminata* Fabricius, *Syst. Piez.* : 423.

1863. *Solenopsis geminata*, Mayr, *Verh. Zool.-Bot. Ges. Wien*, **12** : 453.

2003. *Solenopsis geminata*, Tiwari *et al.*, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series* **9** (Part-4) : 491.

Diagnostic characters : W. TL. 3-4.5 mm. Pale yellow to reddish yellow; smooth, shining and polished. Head more or less square; mandibles short, stout, 4-dentate; clypeus in the middle produced back between antennal carinae, apices of each side projected as small teeth beyond the anterior margin; antennae 10-segmented. Thorax narrow, pronotum rounded anteriorly; pro-mesonotal suture obsolete; mesonotum convex. First node of pedicel squamiform; petiolate anteriorly; second node oval, broader; abdomen oval.

Material examined : India : Arunachal Pradesh : 3W, Siang Div., Tarak vill. (200m.), 18.x.1966, coll. S.K. Tandon and G.S. Arora; 1W, Tirap, Changlong (540m.), 30.x.1971, coll. G.S. Arora and party; 1W, Tirap, Khonsa (825m.) 4.xi.1971, coll. G.S. Arora and party.

Distribution : India : Arunachal Pradesh and almost all other states.

Elsewhere : Spread pretty nearly over the tropics of the two hemispheres (Bingham 1903.).

28. Genus ***Tetramorium*** Mayr

1855. *Tetramorium* Mayr, *Verh. Zool.-Bot. Ges. Wien*, **5** : 423.

Type species : *Formica caespitum* Linnaeus, 1758.

55. *Tetramorium lanuginosum* Mayr

1870. *Tetramorium lanuginosum* Mayr, *Verh. Zool.-Bot. Ges. Wien*, **20** : 976.

1995. *Tetramorium lanuginosum*, Bolton, *New Genl. Cat. Ants World* : 410.

Diagnostic characters : W. TL. 2.5-3 mm. Head, thorax and pedicel light orange-brown, abdomen bright brown; head, thorax and pedicel densely, rather coarsely punctured, rugose and opaque; abdomen polished. Head, thorax and abdomen covered with uneven long soft dense whitish pilosity. Head convex, broader posteriorly than in front; sides convex; mandibles finely, regularly, rather closely longitudinally striate; clypeus broad, somewhat rounded; antennae thick, scape not reaching the top of head; antennal carinae wide apart, long and divergent. Thorax broad, rounded in front; metanotal spines long and slender; metasternal teeth very small. Pedicel short; anteriorly shortly petiolate first node little longer than broad; smooth and shining second node smaller and lower; abdomen very broadly oval.

Material examined : India : Arunachal Pradesh : 5W, Lower Subansiri, Yazli, 15.iv.2001, coll. Sheela and party; 4W, Lower Subansiri, Hapoli, 16.iv.2001, coll. Sheela and party; 2W, Upper Subansiri, Daporizo, 18.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, Gujarat, Sikkim.

Elsewhere : Myanmar, Sri Lanka.

56. *Tetramorium* sp.

Material examined : India : Arunachal Pradesh : 1W, Lohit, Sunpura area, 28.ix.1991, coll. T.K. Pal and party.

29. Genus *Pheidologeton* Mayr

1862. *Pheidologeton* Mayr, *Verh. Zool.-Bot. Ges. Wien*, **12** : 750.

Type species : *Oecodoma diversa* Jerdon, 1851.

Key to the species (based on soldier caste)

1. Length 4.5–13 mm.; dark chestnut brown in colour; head posteriorly widely emarginate; pedicel short, thick in profile, upper margin of first node transverse 2

– Length under 4.5 mm.; dull yellow in colour; head posteriorly slightly emarginate; pedicel somewhat elongate, first node conical..... ..... *nanus*

2. Front of the head bearing a single ocellus in the middle ..... *diversus*

– Front without any ocellus ..... *affinis*

57. *Pheidologeton affinis* (Jerdon)

1851. *Oecodoma affinis* Jerdon, *Madras J Lit Sci.* **17** : 110, S W.

1863a. *Pheidologeton affinis*, Roger, *Berl. Ent. Zeits.*, **7** : 30

1995. *Pheidologeton affinis*, Bolton, *New Genl. Cat Ants World* : 333.

Material examined : India : Arunachal pradesh : 1W, Lohit, Kandu (300m.), 7.iii.1969, coll. S.K. Tandon and party, 32W, Tirap, Changlong (500m.), 31.x.1971, coll. G.S. Arora and party.

Distribution : India : Arunachal Pradesh, Assam, Maharashtra, Karnataka, West Bengal.

Elsewhere : Myanmar, Sri Lanka.

58. *Pheidologeton diversus* (Jerdon)

1851. *Oecodoma diversa* Jerdon, *Madras J Lit Sci.* **17** 109, S W.

1863a. *Pheidologeton diversus*, Roger, *Berl Ent Zeits.* **7** : 30.

2003. *Pheidologeton diversus*, Tiwari *et al.*, *Zool Surv India, Fauna of Sikkim State Fauna Series* **9** (Part-4) : 486.

Material examined : India : Arunachal Pradesh : 3W, Siang, Kambang (200m.), 16.x.1966, coll. S.K. Tandon and G.S. Arora.

Distribution : India : Arunachal Pradesh, Karnataka, Kerala, Maharashtra, Sikkim, West Bengal.

Elsewhere : Myanmar, Malaysia.

59. *Pheidologeton nanus* Roger

1863b. *Pheidologeton nanus* Roger, *Berl. Ent. Zeits.* **7** 191.

1995. *Pheidologeton nanus*, Bolton, *New Genl Cat Ants World* : 333.

Material examined : India : Arunachal Pradesh

: 1W, Siang, Perying vill. (200m.), 15.x.1966, coll. S.K. Tandon and G.S. Arora.

Distribution : India : Arunachal Pradesh.

Elsewhere : Sri Lanka.

60. ***Pheidologeton*** sp.

Material examined : India : Arunachal Pradesh, 10W, Upper Subansiri, Daporizo, 18.iv.2001, coll. Sheela and party.

30. Genus ***Pheidole*** Westwood

1839. *Pheidole* Westwood, *Ann. Mag. Nat. Hist.*, **6** : 87.

Type species : *Atta providens* Sykes, 1835.

Key to the species (based on soldier caste)

1. Head anteriorly beneath bidentate ....*watsoni*

– Head anteriorly beneath not dentate ...*parva*

61. ***Pheidole parva*** Mayr

1865. *Pheidole parva* Mayr, *Nov. Reise, Formicid.*, **98**, W S.

1995. *Pheidole parva*, Bolton, *New Genl. Cat. Ants World* :327.

Material examined : India : Arunachal Pradesh : 1S, Siang, Perying vill. (200 m.), 15.x.1966, coll. S.K. Tandon and G.S. Arora.

Distribution : India : Arunachal Pradesh, Western India.

Elsewhere : Myanmar, Sri Lanka.

61. ***Pheidole watsoni*** Forel

1902b. *Pheidole watsoni* Forel, *Rev. Suisse Zool.*, **10** : 171 & 189, S W.

1995. *Pheidole watsoni*, Bolton, *New Genl. Cat. Ants World* : 332.

Material examined : India, Arunachal Pradesh : 4S, Lower Subansiri, Hapoli, 16.iv.2001, coll. Sheela and party; 35S, Papumpare, Itanagar, Nirjuli, 20.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh, West Bengal.

Elsewhere : Myanmar, Sri Lanka.

62. ***Pheidole*** sp.

Material examined : India : Arunachal Pradesh : 50 S, Papumpare, Itanagar, Nirjuli, 20.iv.2001, coll. Sheela and party.

SUMMARY

The paper deals with the ants collected from different parts of Arunachal Pradesh by the authors in 2001 and other collections made by various survey parties of Zoological Survey of India.

This is the first consolidated report of the ants of Arunachal Pradesh. Altogether 63 species of ants under 30 genera and 7 subfamilies have been incorporated here including the earlier record of 12 species of ants from this state by Tiwari and Maiti (1976) and Tiwari, Guha and Maity (1977).

Key to the subfamilies, genera and species of the recorded taxa are provided here.

ACKNOWLEDGEMENT

The authors extend their gratefulness to Dr. J.R.B. Alfred, Director, Zoological Survey of India, for providing necessary facilities to undertake this project. Thanks are due to Dr. A.K. Hazra, Scientist-F and Divisional-in-Charge and Dr. B.C. Das, Scientist-D and Officer-in-Charge of Hymenoptera section for their inspiration and co-operation to complete this work. Our appreciation is due to Dr. P.T. Bhutia, Officer-in-charge and other Staff of Arunachal Pradesh Field Station of Zoological Survey of India for extending their helping hands during our visit to that state. Thanks are extended to Mr. P.N. Ray, Mr. P. Mishra, Mr. B. Chakraborty, Mr. P.G. Majumdar and Mr. S.K. Pandit for their timely help for the completion of this project. The authors are also thankful to Mr. Rati Ram. P.P.O, Zoological Survey of India for helping in publication of this report.

District wise distribution of the species

No	Name of the species	Papumpare	E. Kameng	W. Kameng	L. Subansiri	U. Subansiri	E. Siang	W. Siang	Dibang Valley	Lohit	Tirap
1	*Dorylus labiatus* Shuckard	+		✓						+	
2	*D. laevigatus* Smith									+	
3	*Diacamma assamense* Forel	+									
4	*D. rugosum sculptum* (Jerdon)	+									
5	*Gnamptogenys bicolor* (Emery)				+						
6	*Hypoponera truncata* (Smith)			+	+				+		
7	*M. castanea* (Smith)			✓		✓			+		
8	*Odontomachus monticola* (Emery)				+						
9	*O. transversa* (Smith)					✓		✓			
10	*Pachycondyla astuta* (Smith)	+							+		
11	*P. javana* (Mayr)										+
12	*P. leeuwenhoeki* (Forel)	+			+		+				
13	*P. luteipes* (Mayr)			+							
14	*P. rufipes* (Jerdon)			+	+		+				+
15	*Camponotus sulcinodis* Emery						+				
16	*C. confucii* (Forel)										+
17	*C. compressus* (Fabricius)	+							+		
18	*C. invidus* Forel)	+									+
19	*C. irritans* (Smith)	+								+	
20	*C. nicobarensis* Mayr			+							
21	*Camponotus* sp			+		+	+		+		
22	*Cataglyphis setipes* (Forel)					✓		✓			
23	*Oecophylla smaragdina* Fabricius	+						✓			
24	*Paratrechina bourbonica* (Forel)				+						
25	*P indica* Forel				+	+					
26	*Paratrechina* sp.				+						
27	*Polyrhachis armata* (Le Guillou)									+	
28	*P bicolor* Smith				+						

No	Name of the species	Papumpare	E. Kameng	W. Kameng	L. Subansiri	U. Subansiri	E. Siang	W. Siang	Dibang Valley	Lohit	Tirap
29	*P. convexa* Roger		✓								
30	*P. dives* Smith	+		+				✓	+	+	
31	*P. hippomanes ceylonensis* Emery			+							
32	*P. illaudata* Walker										+
33	*P. laevissima* Smith				+						
34	*P. tibialis* Smith				+						
35	*Pseudolasius familiaris* (Smith)				+						
36	*Dolichoderus* sp.									+	
37	*Tapinoma melanocephalum* (Fab.)				+	+					
38	*Liometopum lindgreeni* Forel	+									
39	*Technomyrmex albipes* (Smith)			+							
40	*Tetraponera rufonigra* (Jerdon)	+			+						
41	*Aphaenogaster smythiesi* Forel				+						
42	*Cardiocondyla nuda* (Mayr)			+					+		
43	*C. shuckardi* Forel			+							
44	*Cardiocondyla* sp.	+									
45	*Crematogaster aberrans* Forel									+	
46	*C. biroi* Mayr				+						
47	*C. politula* Forel									+	
48	*C. walshi* Forel		+								
49	*Crematogaster* sp.									+	
50	*Meranoplus bicolor* (Guer.)	+									
51	*M. rothneyi* Forel	+									
52	*Monomorium aberrans* Forel			+							
53	*Myrmica rugosa* Mayr			+							
54	*Solenopsis geminata* (Fabricius)						+				
55	*Tetramorium lanuginosum* Mayr				+	+					
56	*Tetramorium* sp.									+	
57	*Pheidologeton affinis* (Jerdon)									+	+

No	Name of the species	Papumpare	E. Kameng	W. Kameng	L. Subansiri	U. Subansiri	E. Siang	W. Siang	Dibang Valley	Lohit	Tirap
58	*P. diversus* (Jerdon)						✓				
59	*P.nanus* Roger						✓				
60	*Pheidologeton* sp.					+					
61	*Pheidole parva* Mayr						✓				
62	*P. watsoni* Forel	+			+						
63	*Pheidole* sp.	+									

+ indicates the presence in the species in particular district

✓ indicates also the presence of the species. but here in 'material examined' data division of district is not clearly mentioned

REFERENCES

ANDRE, E. 1881. Untitled contribution in "séance du 13 avril 1881" introduced by "M. Ernest Andre, de Gray, addresse les descriptions de trois nouvelles especes de fourmis" *Bull. Soc. Ent. France*, **7** : 60-62.

BINGHAM, C. T. 1903. *The Fauna of British India, including Ceylon and Burma* (Hymenoptera : Formicidae). **2** : 1-414.

BOLTON, B. 1977. The Tetramorini (Hymenoptera : Formicidae). The genus *Tetramorium* Mayr in the Oriental and Indo-australian regions and Australia. *Bull. Br. Mus. Nat. Hist.(ent.)*, **36**(2) : 67-151, illustr.

BOLTON, B. 1995a. A taxonomic and Zoogeographical census of the extant ant taxa (Hymenoptera : Formicidae). *J. Nat. Hist.*, **29** : 1037-1056.

BOLTON, B. 1995b. A New General Catalogue of Ants of the World. Harvard Univ. Press, Cambridge. 1-504.

BROWN, W. L. Jr. 1958. Contributions toward a reclassification of the Formicidae. II. Tribe Ectatommini. *Bull. Mus. Comp. Zool.*, Harvard, **118** : 175-362.

CHAPMAN, J. W. and CAPCO, S. R. 1951. Check List of the Ants (Hymenoptera : Formicidae) of Asia. *Monogr. Inst. Sci. Tech. Manila*, **1** : 1-327, 1 map.

DATTA, S. K. and RAYCHAUDHURI, D. 1983. Taxonomy of the aphidocolous Ants (Hymenoptera : Formicidae) of Sikkim and hilly areas of West Bengal (1) : Myrmicinae. *AKITU N. Ser.*, **56** : 1-14.

DONISTHORPE, H. 1942. Ants from the Columbo Museum Expedition to Southern India, Sept.-Oct., 1938, *Ann. Mag. Nat. Hist.*, (11) **9** : 449-561.

DRURY, D. 1773. *Illus. Nat. Hist.* Wherein are exhibited upwards of two hundred and twenty figures of exotic insects. **3** : 1-76 London.

EMERY, C. 1869. Enumerazione dei Formicidi che rinvengonsi nei contornidi Napoli. *Ann. Accad. Asp. Natur.*(2), **2** : 1-26.

– 1886. Alcune formiche africane. *Bull. Soc. Ent. Ital.*, **18** : 356-366.

– 1889. Viggio di Leonardo Fea in Birmania e regioni vicine. 20 formiche di Birmania e del Tenasserim raccolte da Leonardo Fea (1885-87) *Ann. Mus. Civ. Stor. Nat. Gen.* (2), **7** : 485-520.

– 1892. Voyage de M. Ch. Alluaud dans le territoire d'Assinie (Afrique occidentale) en juillet et aout 1886. Formicides. *Ann. Soc. Ent. France*, **60** : 553-574.

– 1893. Voyage de M. E. Simon a l ile de Ceylan (janvier-fevrier 1892). Formicides. *Ann. Soc. Ent. France*, **62** : 259-270.

– 1897. Revisione del genere *Diacamma* Mayr. *Rend. Accad. Sci. Bologna (N.S.)*, **1** : 147-167.

– 1911. Hymenoptera, Fam. Formicidae, Subfam. Ponerinae. *Genera insect.*, **118** : 1-125, 3 pls.

FABRICIUS, J.C. 1775. *Systema Entomologiae*, sistens insectorum classes, ordines, genera, species, adiectics synonymis, locis, descriptionibus, observationibus : 1-832.

– 1787. *Mantissa Insectorum*, **1** : 1-348 Hafniae.

– 1793. *Entomologia systematica* emendata et aucta. Secundum classes, ordines, genera, species adjectis synonimis, locis, observationibus, descriptionibus **2** : 1-519.

– 1804. *Systema Piezatorum* : 439 Brunsvigae.

FOERSTER, A. 1850. Eine Centurie neuer Hymenopteren. Zweite Dekade. *Ver. Nat. Ver. Pre. Rhein und West.*, **7** : 485-500.

FOREL, A. 1886, Indian ants of the Indian Museum, Calcutta. No.2. *J. Asiat. Soc. Bengal* (2), **55** : 239-249.

– 1891. In Grandidier, *Hist. Phy. Nt. Pol. Madagascar*, **20** : Histoire naturelle des Hymenopteres. **2.** Les formicides : 1-231.

– 1892a. Les formicides de l'empire des Indes et de Ceylan. Part 1. *J. Bombay nat. Hist. Soc.*, **7** : 219-245.

FOREL, A. 1892b. Nouvelles especes de formicides de Madagascar. *Ann. Soc. Ent. Belg.*, **36** : 516-535.

– 1894. Les formicides de l'Empire des Indes et de Ceylan. Part 4. Adjonction aux genres *Camponotus* Mayr, et *Polyrhachis* Shuck. *J. Bombay nat. Hist. Soc.*, **8** : 396-420.

– 1900a. Les Formicides de l'Empire des Indes et de Ceylon, part VI, *J. Bombay nat.* Hist. *Soc.*, **13** : 52-65.

– 1900b. Les formicides de l'Empire des Indes et de Ceylon, Part 7. *J. Bombay nat. Hist. Soc.*, **13** : 303-332.

– 1902a. Varietes myrmecologique. *Ann. Soc. Ent. Belg.*, **46** : 284-296.

FOREL, A. 1902b. Myrmicinae nouveaux de l'Inde et de Ceylan. *Rev. Suisse Zool.*, **10** : 165-249.

GUERIN-MENEVILLE, F. E. 1844. *Icono. Du regne animal de G. Cuvier*, ou representation d'apres nature de l'une des especes les plus remarquables et souvent non figurees de chaque genre d'animanx. Insects (1829-1838) : 576 Paris.

JERDON, T. C. 1851. A catalogue of the species of ants found in Southern India, *Madras J. Lit. Sci.*, **17** : 103-127.

JERDON, T. C. 1854a. A catalogue of the species of ants found in Southern India (Part). *Ann. Mag. Nat. Hist.*, (2) **13** : 45-46.

JERDON, T. C. 1854b. A catalogue of the species of ants found in Southern India (Concl.). *Ann. Mag. Nat. Hist.* (2) **13** : 100-110.

LATREILLE, P.A. 1802. *Hist. Nat. Fourmis*, et recueil de memoirs et de'observations sur les abeilles, les fanchers, et autres insectes : 1-445 Paris.

LATREILLE, P.A. 1804. Tableau methodique des insectes. Class huitieme. Insectes, Insecta. *Nouv. Dic. Hist. Nat.*, **24** : 129-200.

LE GUILLOU, E.J.F. 1842. Catalogue raisonne des insectes hymenopteres recueillis dan le voyage de circumnavigation des corvettes l'Astrolabe et La Zelle. *Ann. Soc. Ent. France*, **10** (1841) : 311-324.

LINNAEUS, C. 1758. *Systema Naturae* per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Editio 10, **1** : 1-823 Holmiae.

– 1764. Museum S : ae Rae Mtis Ludo. Ulri. Regi. Suec., Goth., Van. In. quo animalia rariora, exotica, imprimis. Insecta & Conchilia describuntur & determinantur. Prodromi instar : 1- 719 Holmiae.

LUND, P. W. 1831. Lettre sur les habitudes de quelques fourmis du Bresil, adressee a M. Audouin. *Ann. Sci. Nat.*, **23** : 113-138.

MATHEW, R. 1980. Description of new species of ants (Hymenoptera : Formicidae) from Khasi Hills, Mehgalaya. *Oriental Ins.*, **14** (4) : 425-427.

MAYR, G. 1853. Beitrage zur Kenntniss der Ameisen. *Ver. Zool.-Bot. Ver. Wien*, **3** : 101-114.

– 1855. Formicina austriaca. Beschreibung der bisher im Osterreichischen Kaiserstaate anfgefundenen Ameisen nebst Hinzufugung jener in Deutschland, in der Schweiz und in Italien vorkommenden Ameisen. *Ver. Zool.-Bot. Ver. Wien*, **5** : 273-478.

MAYR, G. 1861. Die Europaischen Formiciden (Ameisen.) : 1-80 Wien.

– 1862. Myrmecologische Studien. *Ver. Zool.-Bot. Ges. Wien*, **12** : 649-776.

– 1863. Formicidarum index syonoymicus. *Ver. Zool.-Bot. Ges. Wien*, **13** : 385-460.

– 1865. *Reise der Osterreichischen Fregatte Novara um die Erde in den Jahren 1857, 1858, 1859, unter den befehlen des Commodore B. Von Wullerstorf-Urbair.* Zoologischer Theil. Formicidae : 1-119 Wien.

– 1866. Myrmecologische Beitrage. *Sitzu. Akad. Wiss. Math.-Nat. Classe*, **53** : 484-517.

– 1872. Formicidae Borneenses collectae a J. Doria et O. Beccari in territorio Sarawak annis 1865-1867. *Ann. Mus. Civ. Stor. Nat. Genova*, **2** : 133-155.

– 1897. Formiciden ans Ceylon und Singapur. *Term. Fuzetek*, **20** : 420-436.

MOTSCHOULSKY, V. de. 1863. Essai d'um catalogue des insectes de l'ile Ceylon. *Bull. Soc. Imp. Nat. Moscou*, **36** 1-153.

OLIVIER, G.A. 1792. *Encyclo. Methodique. Hist. Nat. Insects*, **6** (Part 2) : 369-704. Paris.

PANZER, G.W.F. 1798. *Faunae Insect. Ger. Initia*; order Dentschlands Insecten gesammelt und herausgegeban von D. G. W. F. Panzer, **54** Heft : Nos. 1651-1652. Nurnberg.

ROGER, J. 1861. Die Ponera-artigen ameisen. *Berl. Ent. Zeitschr.*, **5** : 1-54.

– 1863a. Verzeichniss der Formiciden-Gattungen und Arten. *Berl. Ent. Zeitschr.*, **7** : 1-65.

– 1863b. Die neu aufgefuhrten Gattungen und Arten meines Formiciden-Verzeichnisses, nebst eganzung einiger fruher gegeben Beschreibungen. *Berl. Ent. Zeitschr.*, **7** : 131-214.

SANTSCHI, F. 1938. Notes sur quelques *Ponera*. *Bull. Soc. Ent. France*, **43** : 78-80.

SHEELA, S. and NARENDRAN, T.C. 1997. A new genus and a new species of Myrmicinae (Hymenoptera : Formicidae) from India. *J. Ecobiol.* **9**(2) : 87-91.

– 1998. On Five New species of *Tetramorium* (Hymenoptera : Formicidae : Myrmicinae) from India. *Entomon*, **23**(1) : 37-44.

SHUCKARD, W.E. 1840. Monograph of the Dorylidae, a family of the Hymenoptera Heterogyna. *Ann. Mag. Nat. Hist.*, **5** : 315-328.

SMITH, F. 1852. Descriptions of some hymenopterous insects captured in India, with notes on their economy, by Ezra T. Downes, Esq.,who presented them to the Honourable East India Company. *Ann. Mag. Nat. Hist.* (2), **9** : 44-50.

– 1854. Monograph of the genus Cryptocerus, belonging to the group Cryptoceridae–family Myrmicidae–division Hymenoptera Heterogyna. *Trans. Ent. Soc. London* (2), **2** : 213-228.

– 1857. Catalogue of the hymenopterous insects collected at Sarawak, Borneo; Mount Ophir, Malacca; and at Singapore, by A. R. Wallace. *J. Proc. Linn. Soc. London, Zool.*, **2** : 42-88.

– 1860a. Descriptions of new species of hymenopterous insects collected by Mr. A. R. Wallace at Celebes. *J. Proc. Linn. Soc. London, Zool.*, **5** (suppl to 4) : 57-93.

– 1860b. Catalogue of hymenopterous insects collected by Mr. A. R. Wallace in the Islands of Bachian, Kaisaa, Amboyna, gilolo, and at Dory in New Guinea. *J. Proc. Linn. Soc. London, Zool.*, **5** (suppl. To 4) : 93-143.

SMITH, M.R. 1948. A new genus and species of ant from India. *N.Y. Ent. Socl. Jour.*, **56** : 205-208.

TAYLOR, R.W. 1967. A monographic revision of the ant genus *Ponera* Latreille. *Pacific Ins. Monogr.*, **13** : 1-112.

TEWARI, R.N. & MAITY, P.K. 1976. Some New Records of Ants from Arunachal Pradesh (Hymenoptera : Formicidae). *Newsl. zool. Surv. India*, **2**(2) : 49-50.

TIWARI, R.N.; GUHA, D.K. & MAITY, P.K. 1977. New Records of Ponerine Ants from Arunachal Pradesh (Hymenoptera : Formicidae). *Newsl. zool. Surv. India*, **3**(3) : 132-133.

TIWARI, R.N. & JONATHAN, J.K. 1986a. A new spepcies of *Liomyrmex* Mayr from Andaman Islands (Hymenoptera : Formicidae). *Rec. zool. Surv. India*, **83**(1 & 2) : 87-90.

TIWARI, R.N. & JONATHAN, J.K. 1986b. A new spepcies of *Metapone* Forel from Nicobar Islands (Hymenoptera : Formicidae). *Rec. zool. Surv. India*, **83**(1 & 2) : 149-153.

TIWARI, R.N. 1994. Two new species of a little known genus *Myrmecina* Curtis (Insceta : Hymenoptera : Formicidae) from Kerala, India. *Rec. zool. Surv. India*, **94**(2-4) : 151-158.

TIWARI, R.N. 1999. Taxonomic Studies of Ants of Southern India (Insecta : Hymenoptera : Formicidae). *Memoirs zool. Surv. India*, **18**(4) : 1-96.

TIWARI, R.N.; KUNDU, B.G.; ROYCHOWDHURY, S and GHOSH, S.N. 2000. Insecta : Hymenoptera : Formicidae. *Fauna of West Bengal, State Fauna Series*, **3**(Part-8) : 209-288.

TIWARI, R.N.; KUNDU, B.G.; ROYCHOWDHURY, S and GHOSH, S.N. 2003. Insecta : hymenoptera : Formicidae. *Zool. Surv. India. Fauna of Sikkim, State Fauna Series*, **9**(Part-4) : 467-506.

WALKER, F. 1859. Characters of some apparently undescribed Ceylon insects. *Ann. Mag. Nat. Hist.*, (3) **4** : 370-376.

WESTWOOD, J.O. 1839. Observations on the genus *Typhlopone*, with descriptions of several exotic species of ants. *Ann. Mag. Nat. Hist.*, **6** : 81-89.

WHEELER, W.M. 1922. The ants of the Belgian Congo. *Bull. Ann. Mus. Nat. Hist.*, **45** : 1-1139.

WHEELER, W.M. 1928. *Zatapinoma*, a new genus of Ants from India. *Proc. New. Engl. Zool. Cl. Cambridge*, **10** : 19-23., 3 figs.

WILSON, E.O. 1964. The true Army ants of the Indo-Australian area (Hymenoptera : Formicidae : Dorylinae). *Pacific Ins.*, **6**(3) : 427-483.

Zool. Surv. India,
Fauna of Arunachal Pradesh, State Fauna Series, **13** (Part-2) : 399-426, 2006

INSECTA : HYMENOPTERA : ACULEATA : SPHECIDAE

B. G. KUNDU, S. N. GHOSH and R. N. TIWARI*
Zoological Survey of India, M-Block, New Alipore, Kolkata 700053

INTRODUCTION

The present paper deals with taxonomic account of different species and subspecies of sphecid wasps which belong to the family Sphecidae from the state of Arunachal Pradesh. According to Bohart and Menke (1976), the family Sphecidae belongs to superfamily Sphecoidea. But later on, Goulet and Huber (1993) placed this family under the superfamily Apoidea.

The members of the family Sphecidae are commonly known as blue mud-dauber, black and yellow mud-dauber, digger or sand or hunting wasps. They show complexities in their behaviour and are always being subject to biological studies. These sphecid wasps are mainly beneficial to man and they are sufficiently advanced group of insects in Aculeate Hymenoptera.

The majority of these sphecids are predatory on a great variety of terrestrial insects; but some are cleptoparasitic, i.e., their larvae develop on the provision in the nest of some other wasps. Because of their predatory and cleptoparasitic habits, it may be possible to exploit them for the control of insect pests (Bohart and Menke, 1976).

Bingham (1897) published his valuable work *"The Fauna of British India including Ceylon and Burma"* on wasps and bees, but he did not record any species/subspecies from Arunachal Pradesh. Besides this, Cameron (1899-1902), Turner (1912), Hingston (1925-1926), van der Vecht (1949-1973), Tsuneki (1951-1973), van Lith (1959-1972), Krombein (1981-1987), Roy and Kundu (1985), Sudheendrakumar and Narendran (1989), Jonathan *et al.* (2000, 2003) and Madhavikutty (2004) have made their valuable contributions on Indian and Oriental Sphecidae, but no one other than Roy and Kundu (1985), has exclusively studied on this group of insects from the state of Arunachal Pradesh.

Bohart and Menke (1976) Published a voluminous work on generic classification of the world Sphecidae. Very recent, Goulet and Huber (1993) have also published another classification of Sphecidae and gave the family status to most of the subfamilies. Prior to this, Krombein *et al.* (1979) also restored the subfamilies recognised by Bohart and Menke (1976), to family rank. However, the classification is followed here after Bohart and Menke (1976) as it is considered an authenticated document on Sphecidae tilldate throughout the World.

North-eastern part of India, specially the state of Arunachal Pradesh, is very important from the view point of faunal diversity. An attempt has been made here to provide a consolidated account on the fauna of Sphecidae from the state of Arunachal Pradesh, India. So 33 species/ subspecies under 20 genera are recorded here from this state.

TOPOGRAPHY

Arunachal Pradesh is one of the beautiful and hilly states of India. It is situated in the north east border of India. In the year 1948, it was called as North East Frontier Agency (NEFA). It's name has been changed as "Arunachal" in the year

* 5A, Parkside Road, Kolkata-26.

1972. 'Arun' means sun and 'Achal' means sun-ray. The sun rises first at that area early in the morning. Arunachal Pradesh has been recognised as 24th state of India on 20th February in 1987.

Arunachal Pradesh is a beautiful and romantic state. It is known as the land of Don-lit mountains. It's latitude is 26°28′ to 29°30′ N and longitude is 91°31 to 97°30′ E. The state occupies an area of 84,000 sq. km (approx.), which is divided into 10 districts. Itanagar is the capital of this state which is situated is the district of Papumpare. It is bounded by Myanmar in the east, by Bhutan in the west, by Assam and Nagaland in the south and by China in the north, east and west. Since British Raj, at every border of this state the inner line permit system is still existing to enter into the state from other states or countries.

There are five rivers, viz., Kameng, Subansiri, Siang, Lohit and Tirap present in this state. Most of the districts are named according to the name of the rivers. It's altitude is varying from 150 m to 5000 m (approx.) above the sea level. The maximum temperature is recorded in the district of Lohit is 38°C (approx.) and the maximum rainfall is recorded in the same district is about 3000 mm (approx). The temperature falls below the freezing point in the district of East Kameng in the month December-March in every year.

In summar, more than 500 types of Orchids are found in this state. Different type of birds are also observed in summar which are migrated from different parts of the country. The forest coverage of the state is approximately 62% of the total area of the state. At prevent, due to indiscriminate felling of trees and burning of forests, the crown density of forests are declining gradually. The majority of people are tribal. The most deciduous forests in Indo-Burma border areas in Arunachal Pradesh sustain a variety of rare flora. The economy of the state is mainly based on agriculture, cottage industry, tourism and forest.

MATERIAL AND METHOD

Mostly the sphecid wasps occur in the agriculture fields, various vegetables and flower gardens, and crop fields etc. So they are being collected by sweeping with the help of insect nets. The collected material are killed in a killing jan usuing benzene. After ward, they are kept in the insect envelops with proper lebels mentioning locality, altitude, date and name of collector etc. Then all the collection are preserved dry with paradichlorobenzene and nephthalene adding carbolic acid as antifungal agent in a box properly in the field.

In the laboratory of the department, the specimens are set, pinned and mounted to display properly for easy handling under binocular microscope during the process of identification. Then the identified specimens are kept in insect boxes or cabinets with proper lebels. Smaller specimens are generally preserved in alcohol permanently with proper lebels after study. For detailed specific identification, the genital structures, mandibles and other mouth-parts are also dissected out and mounted on slides.

This taxonomic work of sphecid wasps of Arunachal Pradesh is based on the collection made by the authors and various scientists of the department from this state time to time. Besides this, the specimens lying in the National Zoological Collection of this department have also been incorporated. The entire material studied under this project, have heen deposited in the collection of Zoological Survey of India, Kolkata.

SYSTEMATICS

The family Sphecidae is a moderately large family which is represented by nine subfamilies from the world. More than 1500 species of Sphecidae are known from the world. Of these, more than 450 species are known to occur in India. The present paper represents 33 species/ subspecies belonging to 20 genera and 7 subgenera under 8 subfamilies from the state of Arunachal Pradesh.

Out of 33 species/subspecies, 21 species and 2 subspecies marked with single asterisk (*) in the systematic account have been recorded here for the first time from the state of Arunachal

Pradesh. The genus *Carinostigmus* is recorded here for the first time from India. 2 species under the genera, *Trypoxylon* and *Crabro* are identified upto generic level, due to lack of sufficient number of examples as well as insufficient literature.

The keys to the subfamilies, tribes, genera, subgenera, species and subspecies are provided here for the identification of various taxa of this region, which is mainly basad on the works of Bingham (1897) and Bohart and Menke (1976). The diagnostic characters of family, subfamilies are also incorporated. The diagnostic characters of the species and subspecies are provided here, where the genus is represented by a single species or subspecies. The species/subspecies, not available in the collection but known from Arunachal Pradesh, have been reviewed from literature and also incorporated here in the systematic account.

TAXONOMIC TERMINOLOGY

The terms of morphological characters used in the text are mainly based on the works of Bingham (1897), Bohart and Menke (1976) and Krombein (1981-1987). The abbreviation used in the text are : M = Male; F = Female; coll. = The name(s) of the collector(s); m. = Metre; ex. = Number of specimens/example(s); mm. = Millimetre; des. = The species is described or there is a descriptive note; syn. = The synonymy or taxonomic position of the species; key = A key is provided in the publication to identify the species.

SYSTEMATIC ACCOUNT

Family SPHECIDAE

1. Subfamily AMPULICINAE

1. Tribe **Ampulicini**

1. Genus ***Ampulex*** Jurine, 1807

1. *compressa* (Fabricius, 1793)

2. Subfamily SPHECINAE

2. Tribe **Sceliphronini**

2. Genus ***Chlorion*** Latreille, 1802

2. *lobatum* (Fabricius, 1775)

3. Genus ***Sceliphron*** Klug, 1801

1. Subgenus ***Sceliphron (Sceliphron)*** s. str.

3. *madraspatanum* (Fabricius, 1793)

*4. *javanum* (Lepeletier, 1845)

2. Subgenus ***Sceliphron (Prosceliphron)*** van der Vecht, 1968

5. *formosum* (Smith, 1865)

3. Tribe **Sphecini**

4. Genus ***Sphex*** Linnaeus, 1758

3. Subgenus ***Sphex (Sphex)*** s. str.

*6. *argentatus* Fabricius, 1793

*7. *praedator luteipennis* Mocsáry, 1883

*8. *subtruncatus* Dahlbom, 1843

4. Tribe **Ammophilini**

5. Genus ***Ammophila*** Kirby, 1798

*9. *atripes* Smith, 1852

*10. *basalis* Smith, 1856

11. *laevigata* Smith, 1856

3. Subfamily PEMPHREDONINAE

5. Tribe **Psenini**

6. Genus ***Psen*** Latreille, 1796

*12. *orientalis* Cameron, 1890

13. *rufiventris* Cameron, 1890

6. Tribe **Pemphredonini**

7. Genus ***Carinostigmus*** Tsuneki, 1954

*14. *congruus* (Walker, 1860)

4. Subfamily ASTATINAE

7. Tribe **Astatini**

8. Genus ***Astata*** Latreille, 1796

*15. *nigricans* Cameron, 1889

9. Genus ***Dryudella*** Spinola, 1843

*16. *orientalis* (Smith, 1856)
*17. *maculifrons* (Cameron, 1889)

5. Subfamily LARRINAE

8. Tribe **Larrini**

10. Genus ***Larra*** Fabricius, 1793

4. Subgenus ***Larra (Cratolarra)*** Cameron, 1900

*18. *maura* (Fabricius, 1793)

11. Genus ***Liris*** Fabricius, 1804

5. Subgenus ***Liris (Liris)*** s. str.

*19. *ducalis* (Smith, 1860)

6. Subgenus ***Liris (Leptolarra)*** Cameron, 1900

20. *jaculator* (Smith, 1856)
*21. *laboriosa* (Smith, 1856)
*22. *subtessellata* (Smith, 1856)

12. Genus ***Tachytes*** Panzer, 1806

*23. *sinensis* Smith, 1856

13. Genus ***Tachysphex*** Kohl, 1883

*24. *bengalensis* Cameron, 1889

9. Tribe **Miscophini**

14. Genus ***Lyroda*** Say, 1837

*25. *formosa* (Smith, 1859)

10. Tribe **Trypoxylonini**

15. Genus ***Trypoxylon*** Latreille, 1796

7. Subgenus ***Trypoxylon (Trypoxylon)*** s. str.

26. sp.

6. Subfamily CRABRONINAE

11. Tribe **Crabronini**

16. Genus ***Ectemnius*** Dahlbom, 1845

27. *chrysites* (Kohl, 1892)

17. Genus ***Crabro*** Fabricius, 1775

28. sp.

7. Subfamily NYSSONINAE

12. Tribe **Bembicini**

18. Genus ***Bembix*** Fabricius, 1775

*29. *westoni* Bingham, 1893

8. Subfamily PHILANTHINAE

13. Tribe **Philanthini**

19. Genus ***Philanthus*** Fabricius, 1793

*30. *notatulus concinnus* Bingham, 1896

14. Tribe **Cercerini**

20. Genus ***Cerceris*** Latreille, 1805

*31. *instabilis* Smith, 1856
*32. *pentadonta* Cameron, 1890
*33. *unifasciata* Smith, 1856

Family SPHECIDAE

The family Sphecidae is recognised by the following characters : Pronotum essentially fixed with the mesothorax; its posterior margin in dorsal view nearly straight and usually separated from the scutum by a constriction that contributes to the formation of a raised collar; pronotal lobe well-separated from the tegula, so that the mesoscutum and mesopleuron are in contact with each other, but in some cases the pronotal lobe is very close to tegula or in narrow contact. Hind leg with a cleaning pecten or brush in a basal depression on the inner side of the basitarsus; this apparatus is opposed by the pectinate inner tibial spur. The setae simple and unbranched. Inner eye margin not notched or emarginate, except for Trypoxylonini and Philanthini. Cerci on tenth tergum of male absent in most higher sphecids, but are present in Dolichurini, some Sphecini, most Sceliphronini and Astatinae. The thorax with episternal sulcus on the mesopleuron.

Key to the subfamilies of family Sphecidae
(After Bohart and Menke, 1976)

1. Gaster with cylindrical petiole composed of sternum only, except in *Ammophila* with two sections; jugal lobe of hind wing large, with an anal vein ..... SPHECINAE

– Gaster variable, if petiolate and petiole composed of sternum only, then jugal lobe of hind wing very small 2

2. Middle tibia with two apical spurs or none 3

– Middle tibia with only one apical spur 5

3. Claws with one inner tooth; notauli usually present and very long..... AMPULICINAE

– Claws simple 4

4. Hind wing with jugal lobe less than half the length of anal area; mandible not notched nor strongly angulate externo-ventrally ..... NYSSONINAE

– Hind wing with jugal lobe usually much more than half the length of anal area, but if not, then mandible notched externo-ventrally ..... ASTATINAE

5. Middle coxae contiguous; jugal lobe of hind wing subequal to the length of anal area, and ocelli normal. (Not recorded from Arunachal Pradesh)..... LAPHYRAGOGINAE

– Middle coxae variable but if contiguous, then hind wing jugal lobe one-half or less as long as anal area, or hind ocelli deformed..... 6

6. Gaster with petiole composed of sternum only ..... PEMPHREDONINAE (in part)

– Gaster sessile or with petiole composed of both tergum and sternum 7

7. Gaster sessile, fore wing with two or few submarginal cells and either (a) stigma as large as single discoidal cell; or (b) stigma nearly equal in area to first discoidal cell, two submarginal cells present; mandible simple; inner eye margin not angulate and median vein in hind wing at or before *Cu-a*..... ..... PEMPHREDONINAE (in part)

– Gaster variable, but if sessile, fore wing with three submarginal cells or if less, then stigma much smaller than first discoidal cell; or not agreeing as above 8

8. Hind ocelli deformed or greatly reduced 9

– Hind ocelli normal 10

9. Jugal lobe of hind wing subequal to length of anal area, rarely two-third as long as anal area ..... LARRINAE (Tribe Larrini)

– Jugal lobe of hind wing at most a little more than half the length of anal area .... NYSSONINAE (in part)

10. Scutal carina present, oblique; episternal-scrobal sulcus often present; metapleuron broad below, not tapering. .... NYSSONINAE (Tribe Stizini)

– Scutal carina absent..... 11

11. Antennal sockets above fronto-clypeal suture by at least one-third of a socket diameter, fore wing with three submarginal cells; mandibular socket closed by a forward extension of the hypostoma..... ..... PHILANTHINAE

– Antennal sockets contiguous with fronto-clypeal suture, or if not contiguous, fore wing with fewer than three submarginal cells; mandibular socket usually open..... 12

12. Middle coxae with a dorso-lateral carina or crest-like elevation. Fore wing usually with three submarginal cells, or with one cell which is not confluent with first discoidal, or with none ..... LARRINAE

– Middle coxae without a dorso-lateral carina; fore wing with one submarginal cell or this cell is fused with first discoidal cell .... CRABRONINAE

1. Subfamily AMPULICINAE

The subfamily Ampulicinae is mostly primitive group of insects in the family Sphecidae. These beautiful insects prey upon cockroaches. So the members of this subfamily are commonly known as "Cockroach wasps." They occur in the tropic of Old and New World.

Diagnostic characters : Inner orbits entire; ocelli normal antennae inserted low on face, sockets contiguous with fronto-clypeal suture, male

with 13 and female with 12 segments. Clypeus transverse or strongly nasiform; mandible without a notch on externo-ventral margin; mandibular socket open execpt in *Ampulex*. Pronotal lobe close to or touching tegula. Notauli long and deep. Propodeum moderately long with U-shaped to nearly triangular enclosure. Middle tibia with two apical spurs. Claws with a single tooth or bifid. Fore wing with two or three submarginal cells and two recurrent veins, first recurrent received by submarginal I or II, second recurrent recived by submarginal II or III. Gaster sessile or with a petiole, composed of sternum and tergum; no pygidial plate. Male genitalia : Volsella with movable digitus and cuspis; aedeagus with teeth on ventral edge; creci present, except in Ampulicini.

This subfamily is represented by two tribes, viz., Ampulicini and Dolichurini in India. Only the tribe Ampulicini is reported here from the state of Arunachal Pradesh. A key to both Indian tribes is given below for ready reference.

Key to the tribes of Ampulicinae

1. Antennal sockets with an over hanging frontal lobe; metasternum Y-shaped. Gastral petiole inserted between and on same level as hind coxae ..... **Ampulicini**

– Antennal sockets not covered or both over laid by a single median platform-like lobe; metasternum not Y-shaped. Gastral petiole inserted above and somewhat after hind coxae. (not recorded from Arunachal Pradesh)..... **Dolichurini**

1. Tribe **Ampulicini**

The tribe Ampulicini represents majority of the species under the subfamily Ampulicinae. All of them belong to the genus *Ampulex* Jurine, 1807 under this tribe. The members of this tribe are small to large in size. They are mettalic green to blue in colour. The genus *Ampulex* has been reported here from Arunachal Pradesh.

1. Genus ***Ampulex*** Jurine

1807. *Ampulex* Jurine, *Nouv. Méth. Class. Hym. Dipt.*, Geneva, **1** : 132.

Type-species : *Sphex compressa* Fabricius. 1793.

This is a moderately large genus comprising most of the species of the subfamily Ampulicinae. This genus is represented by about 22 species and subspecies in India. Of these, only the type-species *Ampulex compressa* (Fabricius, 1793) is the sole representative in the state of Arunachal Pradesh, which is detailed below.

1. ***Ampulex compressa*** (Fabricius)

1793. *Sphex compressa* Fabricius, *Ent. Syst.*, **2** : 206.

1807. *Ampulex compressa* (Fabricius) : Jurine, *Nouv. Méth. Class. Hym. Dipt., Geneva* : **1** : 134.

2003. *Ampulex compressa* (Fabricius) : Jonathan and Kundu, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series*, **9** (Part 4) : 423.

Diagnostic characters : *Female* : Length 15-20 mm. Head in front coarsely punctured; pronotum tuberculate at back; the sides of the thorax closely and finely punctured; antennae filiform, long; median segment narrowed posteriorly and truncate; fore wing with three submarginal cells, I and II cell subequal; abdomen short, broad; legs stout, hind tibiae sparsely punctate. Body brilliant metallic blue, sometimes green.

Material examined : India : Arunachal Pradesh : Siang Div. : Tappi, 2 exs., 22.x.1966, coll. S.K. Tandon and G. S. Arora; Kameng Div. : Tanga Valley, 1 ex., 15.x.2001, coll. R.N. Tiwari and party.

Distribution : India : Arunachal Pradesh, Sikkim, Meghalaya, Assam, West Bengal, Orissa, Bihar, Maharashtra, Andaman and Nicobar Is. and throughout India.

Elsewhere : Myanmar, Sri Lanka, China, Africa, Australia, Chagos Archipelago, East Indies, Hawaii, Mauritius, New Caledonia, Reunion, St. Helena, Seychelles.

Remarks : This spectes is readily distinguished by having all femora red; fore wing with three submarginal cells; head and thorax deep metallic

green and abdomen metallic blue with bright purple effulgence.

2. Subfamily SPHECINAE

The members of this subfamily are conmonly called as "Digger wasps" or "Sand wasps" They are generally found in fields, forests and also in human habitats.

Diagnostic characters : Inner orbits entire, converging, diverging, or parallel; ocelli normal. Antennae in male 13 and in female 12-segmented. Mandible without notch on externo-ventral margin. Pronotal lobe broadly separated from tegula. Middle tibia usually with two apical spurs; middle coxal cavities and coxae usually approximate, middle coxae without dorso-lateral carinae; precoxal lobe present; hind femur simple apically; claws with one to five teeth, or simple; aroleum usually large. Propodeum usually long with or without U-shaped enclosure. Fore wing with three submarginal cells except in *Ammophila.* Gaster with cylindrical petiole composed of sternum only unless it has two sections. Jugal lobe of hind wing large containing an anal vein.

This subfamily is subdivided into three tribes. A key to the tribes is given below.

Key to the tribes of Sphecinae

1. Tarsi with plentulae and or claws of some legs with one basal tooth on inner margin.. ..... **Sceliphronini**

– Trasi without plentulae; claw simple or with one or more basal teeth on inner margin 2

2. Claw with two or more teeth; second recurrent vein usually received by submarginal cell III, but if not then claw with at least three teeth or apico-ventral setae of hind tarsomere V very broad, separated at base by not more than one and half times of setal widths; tarsi without plantulae .... **Sphecini**

– Claw usually simple or with one tooth, if with two teeth then apico-ventral setae of hind tarsomere V narrow, separated by three or more times of setal widths; second recurrent vein usually received by submarginal cell II; tarsi some times with plentulae .... **Ammophilini**

2. Tribe **Sceliphronini**

This tribe is represented by three genera in India. Of these, two are found in the state of Arunachal Pradesh. A key to the genera is given below.

Key to the genera of Sceliphronini

1. Both recurrent veins received by second submarginal cell; spiracular groove absent; body usually with yellow areas; female without fore tarsal rake .... ***Sceliphron*** Klug

– Second recurrent vein received by the third submarginal cell or interstitial between II and III; spiracular groove present; body often with metallic blue or green; antennal sockets contiguous with fronto-clypeal suture in female, separated by less than the diameter of a socket in male ..... ***Chlorion*** Latreille

2. Genus ***Chlorion*** Latreille

1802. *Chlorion* Latreille, *Hist Nat Crust. Ins.* **5** 333

Type-species : *Sphex lobatus* Fabricius, 1775.

This is a widely distributed genus, found in most of the regions of the world. Only one species has been reported here under this genus from the state of Arunachal Pradesh.

2. ***Chlorion lobatum*** (Fabricius)

1775. *Sphex lobatus* Fabricius, *Syst Ent* : 348

1976. *Chlorion lobatum* (Fabricius) : Bohart and Menke, *Univ. Calif. Press* : 90, syns.

2003. *Chlorion lobatum* (Fabricius) : Jonathan and Kundu, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series*, **9** (Part 4) : 426.

Diagnostic characters : *Female* : 24-32 mm

long. Body large, smooth and shining. Head and thorax with fine scattered punctures. Clypeus transverse, convex in the middle; apical margin anteriorly curved and emarginate. Propodeum long, cylindrical transversely striated. Legs long, slender, spinous. Abdomen petiolate. Body brilliantly blue-green but the antennae, the tibiae below and the tarsi dark black and face with silvery pubescence.

Male : Body length 15-26 mm., slightly smaller in size, but more or less similar with female; clypeus triangular; tagulae purple-blue.

Material examined : India : Arunachal Pradesh : Kameng div. : Bairab Kunda, 1 ex., 25.v.1961, coll. K.C. Jayaram; Tipi, 3 exs., 3-9.V.1966, coll. A.N.T. Joseph; Bomdila, Selari, 1 ex., 14.x.2001, coll. R.N. Tiwari and party.

Distribution : India : Arunachal Pradesh, Meghalaya, Sikkim, West Bengal, Madhya Pradesh, Karnataka and throughout India.

Elsewhere : Africa, Myanmar, China, Sri Lanka, Malaysia.

3. Genus ***Sceliphron*** Klug

The members of the genus *Sceliphron* are small to large in size, varying 11-36 mm in length. They are mostly black in colour with conspicuous yellow marked legs. They are usually found in allmost all temparate and tropical areas. This genus has been divided into two subgenera, viz. *Sceliphron* s. str. and *Prosceliphron* van der Vecht. These can be distinguished by the following key.

Key to the subgenera of *Sceliphron*

1. 8th tergite without cerci in male; hypostomal carina long, ending near the base of mandible ..... ***Sceliphron*** Klug

– 8th tergite with cerci in male; hypostomal carina evanescent, extending about half the length to the base of mandible ..... ***Prosceliphron*** van der Vecht

1. Subgenus ***Sceliphron (Sceliphron)*** s. str.

1801. *Sceliphron* Klug, *Neue Schrift. Ges. Naturf. Freunde Berlin*, **3** : 561.

Type-species : *Sphex spirifex* Linnaeus, 1758.

1976. *Sceliphron (Sceliphron)* Klug : Bohart and Menke, *Univ. Calif. Press* : 39, 105.

About five species/subspecies under this subgenus are known to occur in India. Of these, only two species, viz., *madraspatanum* (Fabricius, 1793) and *javanum* (Lepeletier, 1845) are recorded here from the state of Arunachal Pradesh. A key to the species is given below.

Key to the species of *Sceliphron (Sceliphron)*

1. Mesonotum striate .... *madraspatanum* (Fabricius)

– Mesonotum punctured, not striate .... *javanum* (Lepeletier)

3. ***Sceliphron (Sceliphron) madraspatanum*** (Fabricius)

1793. *Sphex madraspatanus* Fabricius, *Ent. Syst.*, **2** : 204.

1897. *Sceliphron madraspatanum* (Fabricius) : Bingham, *Fauna Brit. India, Hym.*, **1** : 237, F., M., des., syns.

1976. *Sceliphron (Sceliphron) madraspatanum* (Fabricius) : Bohart and Menke, *Univ. Calif. Press* : 106, syns.

2003. *Sceliphron (Sceliphron) madraspatanum* (Fabricius) : Jonathan and Kundu, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series* **9** (Part 4) : 425.

Material examined : India : Arunachal Pradesh : Subansiri Div. : Tamen, 2 exs., 19.v.1966, coll. A.N.J. Joseph; Daporizo, 3 exs., 27.x.1966, coll. S.K. Tandon and G.S. Arora; Siang Div. : Kambang, 200 m., 3 exs., 14.x.1966, coll. S.K. Tandon and G. S. Arora; Tappi, 1 ex., 22.x.1966, coll. S.K. Tandon and G.S. Arora; Bame, 1 ex., 30.x.1966, coll. S.K. Tandon and G.S. Arora; Basar, 1 ex., 31.x.1966, coll. S.K. Tandon and G.S. Arora; Daporizo, 1 ex., 18.iv.2001, coll. S. Sheela and party.

Distribution : India : Arunachal Pradesh, Sikkim, Meghalaya, West Bengal, Bihar, Orissa, Himachal Pradesh, Uttar Pradesh, Gujarat, Maharashtra, Madhya Pradesh and throughout India.

Elsewhere : Sri Lanka, Myanmar, Maldives, Malaysia, Indonesia, Vietnam.

Remarks : This is one of the common and widely distributed species in India and adjoining countries. This species is readily distinguished by having yellow bands on legs.

4. *Sceliphron (Sceliphron) javanum (Lepeletier)

1845. *Pelopaeus javanus* Lepeletier, *Hist. Nat. Ins., Hym.*, 3 : 309, F.

1897. *Sceliphron javanum* (Lepeletier) : Bingham, *Fauna Brit. India, Hym.*, 1 : 239, F., M.

1976. *Sceliphron (Sceliphron) javanum* (Lepeletier) : Bohart and Menke, *Univ. Calif. Press* : 105.

Material examined : India : Arunachal Pradesh : Tirap District : Jairampur Unit Garden, 1 ex., 27.x.1971, coll. G.S. Arora and party.

Distribution : India : Arunachal Pradesh, Sikkim.

Elsewhere : Sri Lanka, Myanmar, Indonesia (Java).

Remarks : This species is recorded here for the first time from the state of Arunachal Pradesh.

2. Subgenus *Sceliphron (Prosceliphron)* van der Vecht

1968. *Sceliphron (Prosceliphron)* van der Vecht, *Tijdschr. Ent.*, 111 : 192.

Type-species : *Sceliphron coromandelicum* (Lepeletier), 1845 [= *Pelopaeus coromandalicus* Lepeletier, 1845].

This subgenus is represented by single species, *S. (P.) formosum* (Smith) from the state of Arunachal Pradesh.

5. *Sceliphron (Prosceliphron) formosum* (Smith)

1856. *Pelopoeus formosum* Smith, *Cat. Hym. Brit. Mus.*, 4 : 230, F.

1897. *Sceliphron formosum* (Smith) : Bingham, *Fauna Brit. India, Hym.*, 1 : 239, F.

1976. *Sceliphron (Prosceliphron) formosum* (Smith) : Bohart and Menke, *Univ. Calif. Press* : 106.

1985. *Sceliphron (Prosceliphron) formosum* (Smith) : Roy and Kundu, *Rec. zool. Surv. India*, 82 (1-4) : 224.

Diagnostic characters : *Female* : Body 18-21 mm long. Head punctured on the front and vertex; pronotum smooth in front, its posterior margin notched; mesonotum and median segment finely transversely striate; scutellum and postscutellum smooth; abdomen smooth, apical margin of 4-6 abdominal segments yellow; legs reddish chestnut; wings light flavo-hyaline, the apex of the wings fuscescent.

Material examined : India : Arunachal Pradesh : Kameng Div. : Tipi, 213 m., 1 ex., 3.v.1966, coll. A N. T. Joseph; Namdhapa : Deban, 1 ex., 27.iv.1981, coll. S. Biswas and party.

Distribution : India : Arunachal Pradesh, Meghalaya, Sikkim, Uttar Pradesh, Himachal Pradesh.

Elsewhere : Myanmar, China, Australia, New Guinea, Indonesia (Cerum, Ternata).

3. Tribe Sphecini

This tribe is represented by three genera, viz. *Sphex* Linnaeus, 1758; *Isodontia* Patton, 1881 and *Prionyx* van der Linden, 1827 from India. Of these, here only the genus *Sphex (Sphex)* Linnaeus has been recorded from Arunachal Pradesh.

4. Genus *Sphex* Linnaeus

The genus *Sphex* is divided into two subgenera, viz., *Sphex* s. str. and *Fernaldina* Bohart and Menke, 1976. All species and subspecies reported from India, are represented under the subgenus *Sphex (Sphex)*. But the *Sphex (Fernaldina)* has been reported from Holactic region.

3. Subgenus *Sphex (Sphex)* s. str.

1758. *Sphex* Linnaeus, *Syst Nat* (10th *ed*.), 1 : 569

Type-species : *Sphex flavipennis* Fabricius, 1793

1976. *Sphex (Sphex)* Linnaeus : Bohart and Menke, *Univ. Calif. Press* : 39, 114.

Eight species/subspecies, viz., *argentatus* Fabricius, 1793; *diabolicus* Smith, 1858; *obscurus* (Fabricius, 1804); *Fumicatus* Christ, 1791; *Praedator luteipennis* Mocsáry, 1883; *Praedator melanopoda* Strand, 1915; *sericeus fabricii* Dahlbom, 1843 and *subtruncatus* Dahlbom, 1843 are the representatives of this subgenus from India. Of these, three are recorded here from the state of Arunachal Pradesh. These can be distinguished by the following key.

Key to the species/subspecies of *Sphex (Sphex)*

1. Postscutellum longitudinally notched 2

– Postscutellum not longitudinally notched. (Pubescence on head and median segment black; legs black; fore and middle femora and tibiae, red) ..... *subtruncatus* Dahlbom

2. Head and thorax in front very finely and closely punctured, median segment transversely finely striate, clypeus slightly convex, wings clear hyaline .... *argentatus* Fabricius

– Head and thorax in front finely sparsely punctured, median segment transversely finely rugulose, clypeus cone-shaped, wings flavo-hyaline .... *Praedator luteipennis* Mocsáry

*6. ***Sphex (Sphex) argentatus*** Fabricius

1793. *Sphex argentata* Fabricius, *Ent. Syst.*, **2** : 200.

1897. *Sphex umbrosus* Christ : Bingham, *Fauna Brit. India, Hym.*, **1** : 250, syns.

1976. *Sphex (Sphex) argentatus* Fabricius : Bohart and Menke, *Univ. Calif. Press* : 114.

2003. *Sphex (Sphex) argentatus* Fabricius : Jonathan and Kundu, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series*, **9** (Part 4) : 427.

Material examined : India : Arunachal Pradesh : Siang Div. : Kambang, 200 m., 1 ex., 14.x.1966, coll. S.K. Tandon and G.S. Arora; New Jining, 200 m., 2 exs., 19.x.1966, coll. S. K. Tandon and G. S. Arora; Papumpare : Itanagar, Ganga Lake, 1 ex., 10.x.2001, coll. R.N. Tiwari and party.

Distribution : India : Arunachal Pradesh, Meghalaya, Assam, Sikkim, Orissa, Bihar, Uttar Pradesh, Kerala and throughout India.

Elsewhere : Sri Lanka, Myanmar, China, Japan, Bangladesh, Pakistan, Australia, Malaysia, Congo, Senegal, Gambia, Sierra Leone, New Guinea, Arabia.

Remarks : This species is readily distinguished by having postscutellum bituberculate, body largely black with silvery white hairs and the pubescence on the thorax and petiole soft, thin and hoary white.

This is the first record of this species from the state of Arunachal Pradesh.

*7. ***Sphex (Sphex) praedator luteipennis*** Mocsáry

1883. *Sphex luteipennis* Mocsáry, *Magyar Akad. Ert. Term. Kör.*, (13) **11** : 33, F.

1897. *Sphex luteipennis* Mocsáry : Bingham, *Fauna Brit. India, Hym.*, **1** : 247, F., M.

1976. *Sphex (Sphex) praedator luteipennis* Mocsáry : Bohart and Menke, *Univ. Calif. Press* : 116.

Material examined : India : Arunachal Pradesh : Subansiri Div. : Kimin, 198 m., 1 ex., 11.v.1966, coll. A. N. T. Joseph; Siang Div. : New Jining, 200 m., 1 ex., 18.x.1966, coll. S. K. Tandon and G. S. Arora.

Distribution : India : Arunachal Pradesh, Sikkim, Assam, West Bengal.

Elsewhere : Sri Lanka, Myanmar, Indonesia, S. Moluccas, Amban, Buru, Egypt, Zanzibar.

Remarks : This subspecies is recorded here for the first time from Arunachal Pradesh.

*8. ***Sphex (Sphex) subtruncatus*** Dahlbom

1843. *Sphex subtruncatus* Dahlbom, *Hymn. Europaea*, **1** : 28, F.

1897. *Sphex nigripes* Smith : Bingham, *Fauna Brit. India, Hym.*, **1** : 248, F., M.

1976. *Sphex (Sphex) subtruncatus* Dahlbom : Bohart and Menke, *Univ. Calif. Press* : 116.

2003. *Sphex (Sphex) subtruncatus* Dahlbom : Jonathan and Kundu, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series*, 9 (Part 4) : 427.

Material examined : India : Arunachal Pradesh : Siang Div. : New Jining, 100 m., 1 ex., 20.x.1966, coll. S. K. Tandon and G. S. Arora.

Distribution : India : Arunachal Pradesh, Meghalaya, Sikkim, Tripura, Uttar Pradesh, West Bengal, Kerala, Western Ghats.

Elsewhere : Sri Lanka, Myanmar, China, Indonesia, Africa.

Remarks : This species is reported here first time from the state of Arunachal Pradesh.

4. Tribe **Ammophilini**

Three genera, viz., *Ammophila* Kirby, 1798, *Parapsammophila* Taschenberg, 1869 and *Podalonia* Fernald, 1927 are the main representatives of the tribe Ammophilini. Of these, only the genus *Ammophila* has been reported here from the state of Arunachal Pradesh.

5. Genus *Ammophila* Kirby

1798. *Ammophila* Kirby, *Trans. Linn. Soc. London*, 4 : 199.

Type-species : *Sphex sabulosa* Linnaeus, 1758.

This genus is represented by eight species/ subspecies in India. Of these, three species, viz., *atripes* Smith, 1852, *basalis* Smith, 1856 and *laevigata* Smith, 1856 have been recorded from Arunachal Pradesh. These can be distinguished by the following key.

Key to the species of *Ammophila*

1. Pronotum, mesonotum and propodeum striate; propodeum dorsally along the middle line sometimes reticulate 2

– Pronotum and mesonotum punctate, propodeum striate at side, punctate along the middle line. Legs red in females, except coxae, trochanter and femora above, tibiae at apex and tarsi of hind legs, black. Length 20 mm; male unknown ..... *laevigata* Smith

2. Propodeum dorsally and laterally transversely striate. Abdomen largely bluish-black. Body large, female 18-30 mm; male 23-27 mm .. .. *atripes* Smith

– Propodeum dorsally reticulate and striate along the sides. Abdomen largely red. Body short, female 20-22 mm, male 16-18 mm .... *basalis* Smith

*9. ***Ammophila atripes*** Smith

1852. *Ammophila atripes* Smith, *Ann. Mag. Nat. Hist.* (2) 9 : 46.

2003. *Ammophila atripes* Smith : Jonathan and Kundu, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series*, 9 (Part 4) : 429.

Material examined : India : Arunachal Pradesh : Kameng Div. : Bomdila, 2621 m., 1 ex., 22.iv.1966, coll. A. N. T. Joseph; Dunnbridge, 1524 m., 2 exs., 1.v.1966, coll. A. N. T. Joseph; Subansiri Div. : Dejoo, 183 m., 1 ex., 10.v.1966; coll. A. N. T. Joseph; Kimin, 198 m., 1 ex., 11.v.1966, coll. A. N. T. Joseph; Bismile, 1 ex., 11.iv.2001, coll. S. Sheela and party.

Distribution : India : Arunachal Pradesh, Sikkim, Assam, Tripura, Meghalaya, Orissa, Uttar Pradesh, West Bengal, Madhya Pradesh, Himachal Pradesh, Karnataka.

Elsewhere : Sri Lanka, Myanmar, China.

Remarks : This is the first record of this species from the state of Arunachal Pradesh.

*10. ***Ammophila basalis*** Smith

1856. *Ammophila basalis* Smith, *Cat. Hym. Brit. Mus.*, 4 : 214, F.

1897. *Ammophila nigripes* Smith : Bingham, *Fauna Brit. India, Hym.*, 1 : 231, M.

2003. *Ammophila basalis* Smith : Jonathan and Kundu, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series*, 9 (Part 4) : 429.

Material examined : India : Arunachal Pradesh : Kameng Div. : Dunnbridge, 1524 m., 1 ex., 1.v.1966, coll. A.N.T. Joseph; Dirang, Runkhum

(Apple Nursery), 1 ex., 12.x.2001, coll. R.N. Tiwari and party; Subansiri Div. : Dejoo, 183 m., 1 ex., 10.v. 1966, coll. A.N.T. Joseph; Siang Div. : Kambang, 200 m., 1 ex., 16.x.1966, coll. S.K. Tandon and G.S. Arora; New Jining, 200 m., 1 ex., 19.x.1966, coll. S.K. Tandon and G.S. Arora.

Distribution : India : Arunachal Pradesh, Sikkim, Meghalaya, Assam, Uttar Pradesh, West Bengal, Punjab, Orissa, Maharashtra, Madhya Pradesh, Tamil Nadu, Karnataka.

Elsewhere : Pakistan.

Remarks : This species is recorded here for the first time from the state of Arunachal Pradesh.

11. ***Ammophila laevigata*** Smith

1856. *Ammophila laevigata* Smith, *Cat. Hym. Brit. Mus.*, **4** : 215, F.

2003. *Ammophila laevigata* Smith : Jonathan and Kundu, *Zool. Surv. India, Fauna of Sikkim, State Fauna series* **9** (Part 4) : 430.

Distribution : India : Arunachal Pradesh, Sikkim, Meghalaya, Orissa, Bihar, West Bengal, Himachal Pradesh, Uttar Pradesh, Gujarat, Karnataka, Tamil Nadu.

Elsewhere : Sri Lanka, Vietnam, Thailand.

Remarks : Jonathan *et al.* (2000) mentioned 'Arunachal Pradesh' as one of its localities.

3. Subfamily PEMPHREDONINAE

Most of the species/subspecies of this subfamily are to very small, the smallest being 2 mm in size. They prey on Homoptera, Thysanoptera or Collembola. They usually nest in ground or use pre-existing cavities in the twigs, galls etc.

Diagnostic characters : Inner orbits essentially parallel, converging, usually widely separated; ocelli normal. Antennal sockets contiguous with or well separated from fronto-clypeal suture; male with 13 and female with 12-antennal segments. Mandible without notch, apex sometimes bi- to pentadentate. Pronotal lobe and tegula well separated, but sometimes very close to each other. Middle tibiae with one apical spur; claws simple. Propodeum short to moderately long. Fore wing with three, two, one, or no submarginal cell and one or two recurrent veins. Jugal lobe of hind wing small without an anal vein. Gaster sessile or petiolate, the petiole usually composed of sternum I only. Volsella with digitus and cuspis, cerci absent.

This subfamily is represented by two tribes in India. Both of them have also been reported from Arunachal Pradesh. A key to the tribes is given below.

Key to the tribes of Pemphredoninae

1. Fore wing with three submarginal cells; antennal sockets placed well above clypeal margin, usually near middle of face .... **Psenini**

– Fore wing with not more than two submarginal cells; antennal sockets usually placed just above clypeal margin ..... **Pemphredonini**

5. Tribe **Psenini**

This tribe contains three genera, viz., *Psenulus* Kohl, 1896; *Mimumesa* Melloch, 1933 and *Psen* Latreille, 1796 in India. Of these, only *Psen* has been reported from Arunachal Pradesh.

6. Genus ***Psen*** Latreille

1796. *Psen* Latreille, *Précis Caract. Gen. Ins.* : 122.

Type-species : *Sphex atra* Fabricius, 1793.

This is a large genus, represented by 14 species/subspecies in India. Of these, two species, viz., *orientalis* Cameron, 1890 and *rufiventris* Cameron, 1890 have been reported from this state. These can be distinguished by the following key.

Key to the species of *Psen*

1. Clypeus large and more convex; subtriangular space at base of the median segment small, not depressed; abdomen black .... *orientalis* Cameron

– Clypeus small, but convex; subtriangular space

at base of median segment large, depressed; abdomen more or less red .... *rufiventris* Cameron

*12. ***Psen orientalis*** Cameron

1890. *Psen orientalis* Cameron, *Mem. Manch. L. Ph. Soc.*, (4) 3 : 269, F.

1976. *Psen orientalis* Cameron : Bohart and Menke, *Univ. Calif. Press* : 166.

Material examined : India : Arunachal Pradesh : Siang Div. : New Jining, 200 m., 1 ex., 18.x.1966, coll. S.K. Tandon and G.S. Arora.

Distribution : India : Arunachal Pradesh, Uttar Pradesh, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Tamil Nadu.

Elsewhere : Sri Lanka.

Remarks : This species is recorded here for the first time from Arunachal Pradesh.

13. ***Psen rufiventris*** Cameron

1890. *Psen rufiventris* Cameron, *Mem. Manch. L. Ph. Soc.*, (4) 3 : 267, F.

1985. *Psen rufiventris* Cameron : Roy and Kundu, *Rec. zool. Surv. India.*, 82 (1-4) : 224.

Material examined : India : Arunachal Pradesh : Namdhapa : Deban, 1 ex. 6.iv.1981, coll. S. Biswas and party.

Distribution : India : Arunachal Pradesh, Karnataka, Andhra Pradesh, Kerala, Tamil Nadu.

6. Tribe **Pemphredonini**

This tribe represents eighteen genera from India. Of these only a single genus, *Carinostigmus* Tsuneki, 1954 is the sole representative from the state of Arunachal Pradesh.

7. Genus ***Carinostigmus*** Tsuneki

1954. *Carinostigmus* Tsuneki, *Mem. Fac. Lib. Arts, Fukai Univ.*, (2, *Nat. Sci.*) (3) : 3.

Type-species : *Stigmus congruus* Walker, 1860.

Two species, viz., *aterrimus* Turner, 1917 and *congruus* (Walker, 1860) under this genus are known to occur in India. Only the latter species, *congruus* (Walker, 1860) is reported here from this state.

*14. ***Carinostigmus congruus*** (Walker)

1860. *Stigmus congruus* Walker, *Ann. Mag. Nat. Hist.*, (3) 5 : 304, F.

1863. *Stigmus niger* Motsch., *Bull. Soc. Nat. Mosc.* : 23.

1976. *Carinostigmus congruus* (Walker) : Bohart and Menke, *Univ. Calif. Press* : 190.

Diagnostic characters : *Female* : body 7-8 mm long. Head, thorax and abdomen smooth, polished and shining; clypeus subtriangular, slightly convex, apical margin widely arched; front slightly hollowed; median segment coarsely reticulate; Body black, specially the mandible except its apex, the scape, the tegulae of the wings, and the legs testaceous; wings hyaline.

Material examined : India : Arunachal Pradesh : Kameng Div. : Bomdila, 2621 m., 2 exs., 22.iv.1966, coll. A.N.T. Joseph.

Distribution : India : Arunachal Pradesh, Sikkim, Himachal Pradesh.

Elsewhere : Sri Lanka, Myanmar.

Remarks : This species is recorded here for the first time from the state of Arunachal Pradesh.

4. Subfamily ASTATINAE

The subfamily Astatinae is a small group, ranging 4-16 mm in size. It contains some specialized characters. The males of some members of this subfamily have developed holoptic eyes. Most of the species make nests in the soil and provision them exclusively with Hemiptera (Bohart and Menke, 1976).

Diagnostic characters : Inner orbits entire, converging above; ocelli normal. Antennae low on face, sockets contiguous with fronto-clypeal suture; male with 13 and female with 12-segmented antennae. Mandible without notch on externo-ventral margin. Clypeus transverse.

Pronotal lobe separated from tegula. Mesopleuron usually with episternal sulcus. Middle tibia generally with two apical spurs. Propodeum moderately long with U-shaped dorsal enclosure. Fore wing with two or three submarginal cells. Jugal lobe of hind wing subequal to length of anal area. Gaster sessile. Pygidial plate present. Male genitalia with volsella differentiated into digitus and cuspis. Cerci present.

This subfamily is subdivided by two tribes, viz., Astatini and Dinetini. Both the tribes are known to occur in India. But only the tribe Astatini is represented in the state of Arunachal Pradesh. A key to both Indian tribes is given below for ready reference.

Key to the tribes of Astatinae

1. Fore wing with two submarginal cells; anal vein (A_2) of hind wing absent; jugal lobe of hind wing moderate, length not more than three-fourths of anal area. (Not recorded from Arunachal Pradesh) ..... **Dinetini**

– Fore wing with three submarginal cells; anal vein (A_2) of hind wing present; jugal lobe of hind wing large, nearly as long as anal area ..... **Astatini**

7. Tribe **Astatini**

This tribe Astatini is representated by two genera, viz., *Astata* Latreille, 1796 and *Dryudella* Spinola, 1843 in India. Both of them are known to occur in Arunachal Pradesh. These can be distinguished by the following key.

Key to the genera of Astatini

1. Malar space short, base of mandible nearly touching lower eye margin; submarginal cell II as long as or often longer than submarginal cell I in fore wing; pygidial plate bordered with stout, recurved spines ..... ***Astata*** Latreille

– Malar space longer than midocellus diameter; submarginal cell II shorter than submarginal cell I in fore wing; pygidial plate not bordered by stout spines ..... ***Dryudella*** Spinola

8. Genus ***Astata*** Latreille

1796. *Astatus* Latreille, *Précis Caract. Gen. Ins.* : 114.

1802. *Astata* Latreille, *Hist. Nat. Crust. et Ins.*, **3** : 336.

Type-species : *Tiphia abdominalis* Panzer, 1798 [= *Sphex boops* Schrank, 1781].

About 8 species are referable to this genus from India. Of these, only one species, *Astata nigricans* Cameron is the sole representative from the state of Arunachal Pradesh, which is detailed below.

*15. ***Astata nigricans*** Cameron

1889. *Astata nigricans* Cameron, *Mem. Manch. L. Ph. Soc*, (4) **2** : 151, M.

1976. *Astata nigricans* Cameron : Bohart and Menke, *Univ. Calif. Press* : 213.

Diagnostic characters : *Male* : Body 8-9 mm long. Head, thorax and and abdomen not densely pubescent; eyes strongly convergent and meeting on the vertex; the front convex, punctured; pronotum, mesonotum, scutellum and post-scutellum closely punctured; median segment long, slightly narrowed; abdomen shining, slightly punctured. Body usually black, but the pubescence hoary white; the tarsi and posterior margins of basal five segments bronzy testaceous; wings hyaline and iridescent; tegulae black.

Material examined : India : Arunachal Pradesh : Kameng Div. : Jawang Camp, 1 ex., 12.xii.1965, coll. S.K. Bhattacharya and A.N.T. Joseph.

Distribution : India : Arunachal Pradesh, Gujarat, Maharashtra.

Remarks : This is the first record of the species from Arunachal Pradesh.

9. Genus ***Dryudella*** Spinola

1843. *Dryudella* Spinola, *Ann. Soc. Ent. Fr.*, **1** : 135.

Type-species : *Dryudella ghilianii* Spinola, 1843 [= *Astata tricolor* van der Linden, 1829].

The genus *Dryudella* is represented by 2 species, viz., *D. maculifrons* (Cameron, 1889)

and *D. orientalis* (Smith, 1856) in India. Both the species are also known to occur in the state of Arunachal Pradesh. A key to both Indian species of this genus is given below :

Key to the species of *Dryudella*

1. Comparatively body large size, ranging 10-13 mm in length; mesonotum anteriorly carinated and furrowed. (Median segment above coarsely reticulated) .... *orientalis* (Smith)

– Body smaller size, ranging 7-10 mm in length; mesonotum simple. (Median segment above enclosed by lateral convergent furrows) .... *maculifrons* (Cameron)

*16. ***Dryudella orientalis*** (Smith)

1856. *Astata orientalis* Smith, *Cat. Hym. Brit. Mus.*, **4** : 310.

1976. *Dryudella orientalis* (Smith) : Bohart and Menke, *Univ. Calif. Press* : 215.

Material examined : India : Arunachal Pradesh : Kameng Div. : Jawang Camp, 1 ex., 12.xii.1965, coll. S.K. Bhattacharya and A.N.T. Joseph.

Distribution : India : Arunachal Pradesh, West Bengal.

Elsewhere : Myanmar.

Remarks : This species is reported here first time from Arunachal Pradesh.

*17. ***Dryudella maculifrons*** (Cameron)

1889. *Astata maculifrons* Cameron, *Mem. Manch. L. Ph. Soc.*, (4) **2** : 149, M.

1976. *Dryudella maculifrons* (Cameron) : Bohart and Menke, *Univ. Calif. Press* : 214.

Material examined : India : Arunachal Pradesh : Kameng Div. : Jawang Camp, 1 ex., 12.xii.1965, coll. S.K. Bhattacharya and A.N.T. Joseph.

Distribution : India : Arunachal Pradesh, Uttaranchal.

Remarks : This species is recorded here for the first time from the state of Arunachal Pradesh.

5. Subfamily LARRINAE

The members of the subfamily Larrinae are mostly fossorial and commonly known as "digger wasps." They are very small to large (2-30 mm.) in size, often dark in colour. They prey upon the adults of spiders, Coleoptera, Diptera, Hemiptera, Hymenoptera, Orthoptera and also larvae of Lepidoptera.

Diagnostic characters : Inner orbits usually converging above, parallel, rarely converging below; posterior ocelli usually normal. Antenna inserted low on face except near middle in some genera, sockets contiguous with fronto-clypeal suture or separated. Female with 12 and male with 13 antennal segments. Clypeus transverse except about as high as broad in some genera. Palpal formula 6-4 except 5-3 in some *Tachytes*. Pronotal lobe separated from tegula. Mesopleuron usually with an episternal sulcus. Metapleuron consisting only of upper area, definitive pleuron tapering ventrad. Middle tibia with one apical spur; middle coxae usually separated, each with a dorso-lateral carina or crest-like elevation; claws simple except toothed in some females of Larrini. Propodeum short to long, dorsal enclosure present or absent. Fore wing usually with 3 submarginal cells but sometimes none. Hind wing with jugal lobe varying from a long as anal area to very small or absent. Gaster usually sessile, but sometimes pedunculate or petiolate; tergum I and occasionally II with lateral carina; male with 7 visible terga; pygidial plate present or absent. Volsella in male simple without digitus, rarely absent; cerci absent.

This subfamily is represented by four tribes, viz., Larrini, Palarini, Miscophini and Trypoxylonini in India. Only three tribes are represented in the state of Arunachal Pradesh. A key to the tribes is given below.

Key to the tribes of Larrinae

1. Hind ocelli reduced to flat, opaque scars of various shapes; jugal lobe of hind wing large, nearly as long as anal area ..... **Larrini**

– Hind ocellus with a convex or somewhat flattened, complete, transparent lens; jugal lobe

of hind wing small or absent, never more than one-half length of anal area 2

2. Inner orbits emarginate ..... **Trypoxylonini**

– Inner orbits straight, bowed or sinuate but not emarginate 3

3. Clypeus divided into three parts by two vertical suture-like lines; antennal sockets separated from fronto-clypeal suture by one-third or more of a socket diameter; hind ocelli usually flattened and elliptical. (Not recorded from Arunachal Pradesh) ..... **Palarini**

– Clypeus not divided into three parts; antennal sockets essentially contiguous with fronto-clypeal suture; hind ocelli round and convex. (Hind femoral apex simple, femur thickest near middle, gradually tapering toward apex; inner orbits parallel or converging above) ... . **Miscophini**

8. Tribe **Larrini**

In India, the tribe Larrini is represented by nine genera. Of these, 4 genera, viz., *Larra* Fabricius, 1793; *Liris* Fabricius, 1804; *Tachytes* Panzer, 1806 and *Tachysphex* Kohl, 1883 are recorded from Arunachal Pradesh. These can be distinguished by the following key.

Key to the genera of Larrini

1. Frons below median ocellus with a transverse swelling extending between the eyes and joining a linear swelling along inner orbit to form a M or inverted U-shaped swelling 2

– Frons variable and without swelling as above 3

2. *Female* : last tarsomere evenly arcuate in lateral view, sides diverging most of way to apex, ventral surface without hairmat; claws without an inner tooth; pronotal collar flat or slightly arcuate in front view; pygidial plate glabrous and shiny, no transverse row of setae apically. *Male* : propodeum densely punctate; apical half of outer surface of fore tibia usually with one or more erect bristles .... ***Larra*** Fabricius

– *Female* : last tarsomere angled in lateral view, sides parallel on apical half; ventral surface usually with dense hair; claw prehensile, sometimes with an inner tooth; pronotal collar wedge-shaped in front veiw; pygidial plate extensively setose and usually with a transverse row of apical setae. *Male* : propodeum dull and impunctate or if shiny, then at most with sparse minute punctures; outer surface of fore tibia without bristles ..... ***Liris*** Fabricius

3. Ocellar scars very long, distance between middle ocellus and end of tail less than the length of scar; pygidial plate covered with dense setae which obscure integument .... ***Tachytes*** Panzer

– Ocellar scars oval or oblong; distance between middle ocellus and lower end of scar equal to or greater than length of scar; pygidial plate usually present in female, absent in male. Gastral tergum II without a lateral carina, male fore femur with a baso-lateral notch or depression ..... ***Tachysphex*** Kohl

10. Genus ***Larra*** Fabricius

The genus *larra* is represented by more than 10 species/subspecies in India. It is divided into two subgenera, viz., *Larra* s. str. and *Cratolarra* Cameron, 1900. Both the subgenera are represented in India. Only the subgenus *Cratolarra* is found in Arunachal Pradesh.

Key to the subgenera of *Larra*

1. Outer face of fore tibia with one or two spine rows, or with at least one subapical spine. [not recorded from Arunachal Pradesh] .... ***Larra*** Fabricius

– Outer face of fore tibia without spines .... ***Cratolarra*** Cameron

4. Subgenus ***Larra (Cratolarra)*** Cameron

1900. *Cratolarra* Cameron, *Ann. Mag. Nat. Hist.* (7) **4** : 34.

Type-species : *Cratolarra femorata* Cameron, 1900.

1976. *Larra (Cratolarra)* Cameron : Bohart and Menke, *Univ. Calif. Press* : 237.

3 species and one subspecies are reported from India under this subgenus. This subgenus is recorded here from the state of Arunachal Pradesh, which represents only a single species, *maura* (Fabricius, 1793).

*18. *Larra (Cratolarra) maura* (Fabricius)

1793. *Sphex maura* Fabricius, *Ent. Syst.*, **2** : 212.

1897. *Larra maura* (Fabricius) : Bingham, *Fauna Brit. India, Hym.*, **1** : 199, F., syns.

1976. *Larra (Cratolarra) maura* (Fabricius) : Bohart and Menke, *Univ. Calif. Press* : 238.

Diagnostic characters : *Female* : Body 14-15 mm long. Head and thorax minutely and closely punctured; head shining, not densely pubescent; clypeus broader than long, apical margin widely arched; median segment truncate, coarsely punctured; abdomen smooth and shining. Body black, but the pubescence and pile silvery white, hind femora bright red; wings very light fusco-hyaline.

Material examined : India : Arunachal Pradesh : Kameng Div. : Tipi, 213 m., 1 ex., 6.v.1966, coll. A.N.T. Joseph; Siang Div. : Basar, 550 m., 1 ex., coll. S.K. Tandon and G.S. Arora.

Distribution : India : Arunachal Pradesh and mostly in Northern India.

Elsewhere : China, Thailand.

Remarks : This is the first record of this species from the state of Arunachal Pradesh.

11. Genus *Liris* Fabricius

Liris is fairly large cosmopolitan genus. It is subdivided into three subgenera, viz., *Liris* Fabricius, 1804, *Leptolarra* Cameron, 1900 and *Motes* Kohl, 1892. The former two subgenera are reported here from Arunachal Pradesh. A key to subgenera is given below.

Key to the subgenera of *Liris*

1. Mandible entire or with a small V-shaped notch on externo-ventral margin .... ***Liris*** Fabricius

– Mandible with a broad, deep, emargination on externo-ventral margin 2

2. Apex of female pygidial plate with transverse rows of stout setae, surface usually at least partially covered with appressed setae or hairs; female with one or two mandibular teeth on inner margin near base; female tarsal claw usually simple but when toothed within, the pygidial plate is not completely glabrous; hind tibia often with a sharp polished carina .... ***Leptolarra*** Cameron

– Apex of female pygidial plate without transverse row of stout setae, surface glabrous or at most with a fine dust-like bloom; mandible of both sexes without inner teeth; inner margin of female tarsal claw with 2 teeth set side by side; hind tibia without a sharp, polished carina. (Not reported from Arunachal Pradesh) ..... ***Motes*** Kohl

5. Subgenus *Liris (Liris)* s. str.

1804. *Liris* Fabricius, *Syst. Piez.* : 227.

1976. *Liris (Liris)* Fabricius : Bohart and Menke, *Univ. Calif. Press* : 43, 243.

Type-species : *Sphex auratus* Fabricius, 1787

More than 47 species under this subgenus *Liris (Liris)* Fabricius, 1804 are known to occur in India. This is a large genus. Only a single species, *L. (L.) ducalis* (Smith, 1860) is recorded here from this state.

*19. *Liris (Liris) ducalis* (Smith)

1860. *Larrada ducalis* Smith, *J. Proc. Linn. Soc. London.* : 84, F.

1897. *Liris ducalis* (Smith) : Bingham, *Fauna Brit. India. Hym.*, **1** : 207, F.

1976. *Liris (Liris) ducalis* (Smith) : Bohart and Menke, *Univ. Calif. Press* : 245, syn.

1976. *Liris (Liris) nigripennis* Cameron, 1889 : Bohart and Menke, *Univ. Calif. Press* : 245.

2003. *Liris (Liris) ducalis* (Smith) : Jonathan and Kundu, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series* **9** (Part 4) : 432.

Diagnostic characters : *Female* : Body 24-30 mm long. Head dull and opaque on the vertex; thorax smooth and shining; clypeus densely pruinose; median segment long, narrowed posteriorly but truncate anteriorly; abdomen smooth, not shining; legs short and stout. Body jet black with brilliant shining golden pile; wings dark brown, with purple effulgence.

Material examined : India : Arunachal Pradesh : Siang Div. : Peyring vill., 200 m., 4 exs., 15.x.1966, coll. S.K. Tandon and G.S. Arora; Kambang, 200 m., 1 ex., 15.x.1966, coll. S.K. Tandon and G.S. Arora; Subansiri Div. : Daporizo, 150 m., 1 ex., 27.x.1966, coll. S.K. Tandon and G.S. Arora.

Distribution : India : Arunachal Pradesh, Sikkim, Karnataka, Maharashtra.

Elsewhere : Sri Lanka, Myanmar, Indonesia (Celebes).

Remarks : This species is recorded here for the first time from the state of Arunachal Pradesh.

6. Subgenus ***Liris (Leptolarra)*** Cameron

1900. *Leptolarra* Cameron, *Ann. Mag. Nat. Hist.*, (7) **5** : 29.

1976. *Liris (Leptolarra)* Cameron : Bohart and Menke, *Univ. Calif. Press* : 43, syn.

Type-species : *Leptolarra reticulata* Cameron, 1900.

Bohart and Menke (1976 : 243) mentioned that about 35 species/subspecies under this subgenus are known to occur in India. Out of these only three species, viz., *jaculator* (Smith, 1856), *laboriosa* (Smith, 1856) and *subtessellata* (Smith, 1856) are the representatives of this subgenus from the state of Arunachal Pradesh. These can be distinguished by the following key.

Key to the species of *Liris (Leptolarra)*

1. Legs more or less red. (Posterior femora only red; pile on the head, thorax and abdomen silvery) ..... *subtessellata* (Smith)

– Legs entirely black 2

2. Wings light fusco-hyaline, with no tinge of yellow; sides of median segment obliquely striate ..... *laboriosa* (Smith)

– Wings hyaline, with a decided tinge of yellow; sides of median segment transversely striate ..... *jaculator* (Smith)

20. ***Liris (Leptolarra) jaculator*** (Smith)

1856. *Larrada jaculator* Smith, *Cat. Hym. Brit. Mus.*, **4** : 279, F.

1889. *Notogonia jaculator* (Smith) : Cameron, *Mem. Manch. L. Ph. Soc.* (4) **2** : 129.

1897. *Notogonia jaculatrix* : Bingham, *Fauna Brit. India, Hym.*, **1** : 203, F.

1976. *Liris (Leptolarra) jaculator* (Smith) : Bohart and Menke, *Univ. Calif. Press* : 246.

1985. *Liris (Leptolarra) jaculator* (Smith) : Roy and Kundu, *Rec. zool. Surv. India*, **82** (1-4) : 224.

Material examined : India : Arunachal Pradesh : Namdhapa, Deban, 2 exs., 27.iv.1981, coll. S. Biswas and party; Subansiri Div. : Hapoli, 1 ex., 16.iv.2001, coll. S. Sheela and party.

Distribution : India : Arunachal Pradesh, Sikkim, Himachal Pradesh, Uttaranchal, Maharashtra, Tamil Nadu, West Bengal.

Elsewhere : Myanmar.

*21. ***Liris (Leptolarra) laboriosa*** (Smith)

1856. *Larrada laboriosa* Smith, *Cat. Hym. Brit. Mus.*, **4** : 278, F.

1897. *Notogonia laboriosa* : Bingham, *Fauna Brit. India, Hym.*, **1** : 204, F.

1976. *Liris (Leptolarra) laboriosa* (Smith) : Bohart and Menke, *Univ. Calif. Press* : 246.

2000. *Liris (Leptolarra) laboriosa* (Smith) : Jonathan *et al.*, *Zool. Surv. India, State Fauna Series* 4 : *Fauna of Meghalaya* (Part 7) : 194.

Material examined : India : Arunachal Pradesh : Siang Div. : Tippi, 600 m., 1 ex., 23.x.1966, coll.

S.K. Tandon and G.S. Arora; Daphabum Expedition : Tezu, 1 ex., 20.i.1970, coll. J.M. Julka.

Distribution : India : Arunachal Pradesh, Meghalaya, West Bengal.

Elsewhere : Myanmar, Philippines, Hawaii, Marianas, Taiwan.

Remarks : This species is recorded here for the first time from Arunachal Pradesh.

*22. *Liris (Leptolarra) subtessellata* (Smith)

1856. *Larrada subtessellata* Smith, *Cat. Hym. Brit. Mus.*, 4 : 277, F.

1889. *Notogonia subtessellata* (Smith) : Cameron, *Mem. Manch. L. Ph. Soc.*, (4) 2 : 130.

1976. *Liris (Leptolarra) subtessellata* (Smith) : Bohart and Menke, *Univ. Calif. Press* : 246.

Material examined : India : Arunachal Pradesh : Kameng Div. : Rupa, 1 ex., 20.xii.1965, coll. S.K. Bhattacharya and A.N.T. Joseph; Tipi, 213 m., 1 ex., 3.v.1966, coll. A.N.T. Joseph; Digaru Road, 150 m., 1 ex., 11.iii.1969, coll. S.K. Tandon.

Distribution : India : Arunachal Pradesh, Sikkim, Assam, West Bengal, Orissa, Tamil Nadu, Karnataka, Maharashtra and Northern India.

Elsewhere : Myanmar, Sri Lanka, Ryukyus, Marshalls, Hawaii, Fiji, Mediterranean region, Oriental region and S-W Asia.

Remarks : This is first record of this species from the state of Arunachal Pradesh.

12. Genus *Tachytes* Panzer

1806. *Tachytes* Panzer, *Krit. Rev. Insektenf. Deutsch.*, 2 : 129.

Type-species : *Sphex tricolor* Fabricius, 1798.

Tachytes is a large genus. More than 23 species/ subspecies under this genus are known to occur in India. Only a single species, *T. sinensis* Smith, 1856 is the sole representative of this genus from the state of Arunachal Pradesh.

*23. *Tachytes sinensis* Smith

1856. *Tachytes sinensis* Smith, *Cat. Hym. Brit. Mus.*, 4 : 299, F.

1976. *Tachytes sinensis* Smith : Bohart and Menke, *Univ. Calif. Press* : 267.

Diagnostic characters : *Female* : Body 17-19 mm long. Head and thorax closely and finely punctured with dense pubescent; clypeus, the face in front with long, silky pubescent; median segment short, rounded posteriorly; abdomen smooth and shining with transverse pilose bands; pygidial plate large, densely pubescent. Body black, but the pubescence on the head and thorax golden yellow; wings flavo-hyaline; tegulae rufo-testaceous.

Material examined : India : Arunachal Pradesh : Subansiri Div. : Tamen, 305 m., 1 ex., 19.v.1966, coll. A.N.T. Joseph.

Distribution : India : Arunachal Pradesh, Sikkim, West Bengal.

Elsewhere : China, Japan, Korea, Thailand.

Remarks : This is the first report of this species from the state of Arunachal Pradesh.

13. Genus *Tachysphex* Kohl

1883. *Tachysphex* Kohl, *Deut. Ent Ztschr.*, 27 : 166.

Type-species : *Tachysphex filicornis* Kohl, 1883

This is moderately large genus. In India, this genus is represented by more than 20 species/ subspecies. The genus *Tachysphex* is represented here by a single species, *T. bengalensis* Cameron, 1889 from this state, which is detailed below.

*24. *Tachysphex bengalensis* Cameron

1889. *Tachysphex bengalensis* Cameron, *Mem. Manch. Lit Ph. Soc.*, 2 (4) : 144, F.

2003. *Tachysphex bengalensis* Cameron : Jonathan and Kundu, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series*, 9 (Part 4) : 435, F.

Diagnostic characters : Female : Body 8-10 mm long. Head, thorax closely punctured, abdomen smooth, opaque; front, clypeus and cheeks densely pilose; a Λ shaped groove behind the ocelli; first to fifth abdominal segments with broad apical silky pile. Body black with pubescence white, the dense pile on the front and cheeks. Wings hyaline, the apical margin narrowly pubescent.

Material examined : India : Arunachal Pradesh : Siang Div. : Periang vill., 200 m., 2 exs., 15.x.1966, coll. S.K. Tandon and G.S. Arora; New Jining, 1 ex., 18.x.1966, coll. S.K. Tandon and G.S. Arora.

Distribution : India : Arunachal Pradesh, Sikkim, West Bengal.

Elsewhere : Sri Lanka, Myanmar, Thailand, Philippines, Marianas, Carolinas, Hawaii.

Remarks : This species is recorded here for the first time from the state of Arunachal Pradesh.

9. Tribe **Miscophini**

4 genera, viz., *Miscophus* Turine, 1807; *Nitela* Latreille, 1809; *Lyroda* Say, 1837 and *Paranysson* Guérin, 1844 are known to occur in India. Of these, only the genus *Lyroda* is reported here from Arunachal Pradesh.

14. Genus ***Lyroda*** Say

1837. *Lyrops (Lyroda)* Say, *Boston Jour. Nat. Hist.*, **1** : 372.

1979. *Lyroda* Say : Krombein *et al.*, *Cat. Hym. America, North of Maxico, Washington*, **2** : 1633.

Type-species : *Lyrops (Lyroda) subita* Say, 1837.

The genus *Lyroda* is represented by five species, viz., *formosa* (Smith, 1859); *argenteofacialis* (Cameron, 1889); *venusta* Bingham, 1897; *nigra* (Cameron, 1904) and *salai* Giner Mari, 1945 in India. Only the species, *formosa* has been reported from the state of Arunachal Pradesh.

*25. ***Lyroda formosa*** (Smith)

1859. *Morphota formosa* Smith, *J. Proc. Linn. Soc. London*, : 17.

1976. *Lyroda formosa* (Smith) : Bohart and Menke, *Univ. Calif. Press* : 299.

2003. *Lyroda formosa* (Smith) : Jonathan and Kundu, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series* **9** (Part 4) : 435.

Diagnostic characters : Body 9-11 mm long. Front with median impressed line from the anterior ocellus to base of antennae; mesoscutum anteriorly with a median depression; propodeum weakly rugose, with a median longitudinal carina.

Head and thorax densely pruinose. Abdominal tergites 1-4 also apically with pruinose bands. Body in general black, basal two abdominal segments, red. Clypeus, front, malar space, pronotum, mesoscutum at sides and propodeum densely silvery hairs, with a golden-yellow tint. Abdominal apical bands pure silvery. Wings hyaline, iridescent.

Material examined : India : Arunachal Pradesh : Subansiri Div. : Kimin, 198 m., 1 ex., 11.v.1966, coll. A.N.T. Joseph; Siang Div. : Kambang, 200 m., 1 ex., 14.x.1966, coll. S.K. Tandon and G.S. Arora; Daphabum Expedition : Tezu, 1 ex., 20.i.1970, coll. J.M. Julka; Tirap Dist. : Jairampur Unit Garden, 1 ex., 27.x.1971, coll. G.S. Arora and party.

Distribution : India : Arunachal Pradesh, Meghalaya, Sikkim, West Bengal.

Elsewhere : Myanmar, Philippines, Soloman Is., Indonesia (Celebes).

Remarks : This is the first record of this species from the state of Arunachal Pradesh.

10. Tribe **Trypoxylonini**

This tribe is represented by two genera, viz., *Pison* Jurine, 1808 and *Trypoxylon* Latreille, 1796. Of these, only *Trypoxylon* has been reported from the state of Arunachal Pradesh. However, a key to both the Indian genera is given below for ready reference.

Key to the genera of Trypoxylonini

1. Fore wing with one submarginal cell; antennal sockets not contiguous with fronto-clypeal suture ..... ***Trypoxylon*** Latreille

– Fore wing with two or three submarginal cells; antennal sockets contiguous with fronto-clypeal suture ..... ***Pison*** Jurine

15. Genus ***Trypoxylon*** Latreille

7. Subgenus ***Trypoxylon (Trypoxylon)*** s. str.

1796. *Trypoxylon* Latreille, *Précis Caract. Gen. Ins.* : 121.

1976. *Trypoxylon (Trypoxylon)* Latreille : Bohart and Menke, *Univ. Calif. Press*, : 45, 339, syn, des.

Type-species : *Shpex figulus* Linnaeus, 1758.

This is a moderately large genus, represented in India by 20 species/subspecies. The species, only one recorded from this state, is identified upto generic level.

26. *Trypoxylon (Trypoxylon)* sp.

Material examined : India : Arunachal Pradesh : Kameng Div. : Bhalukpong, Elephant Camp, 1 ex., 20.x.2001, coll. R.N. Tiwari and party.

Distribution : India : Arunachal Pradesh.

6. Subfamily CRABRONINAE

This subfamily includes a great variety of forms. They are commonly known as Silver mouth or mustache wasps, due to presence of a tansverse silvery clypeus, which together with the vertical pale stripes on the scapes, forms an inverted pi-mark (ɹ). They prey upon the most orders of insects, but Dipterans are favourite.

Diagnostic characters : Eyes moderately separated, converging below, ocelli normal. Antennal sockets close to fronto-clypeal suture; male with 11-13 and female with 12 antennal segments. Mandible with externo-ventral notch. Pronotal lobe and Tegula separated. Notauli short and indistinct. Middle tibia with one apical spur, sometimes none in male, rearely none in females; middle coxae slightly to broadly separated, without dorso-lateral carina; hind femoral apex sometimes thickened and truncate; claws simple; fore tarsus with or without a rake. Propodeum short, dorsal enclosure sometimes present; propodeal sternite absent. Fore wing usually with one submarginal cell, which may be fused with first discoidal cell, third discoidal cell absent. Jugal lobe of hind wing small, shorter to longer than submedian cell, media diverging beyond cu-a; second anal vein and subcosta absent. Gaster sessile or pedunculate, tergite I with lateral carina; male with 7 visible tergites; pygidial plate always present in females and in some males. Volsella simple and cerci absent.

This subfamily is represented by two tribes, viz., Oxybelini and Crabronini in India. Only the tribe Crabronini is known to occur in the state of Arunachal Pradesh. However a key to the tribes is given below.

Key to the tribes of Crabroninae

1. Submarginal and discoidal cells fused. (Not recorded from Arunachal Pradesh) .... **Oxybelini**

– Submarginal and discoidal cells separate, not fused ..... **Crabronini**

11. Tribe **Crabronini**

This tribe is represented by 12 genera in India. Of these, only two genera, viz., *Crabro* Fabricius, 1775 and *Ectemnius* Dahlbom, 1845 have been reported from the state of Arunachal Pradesh. A key to the species is given below.

Key to genera of Crabronini

1. Female pygidial plate always flat, absent in male; verticulus absent but sometimes replaced by an angle or sharp tooth; male antennae with 12 segments; (mandible usually bidentate apically) ..... ***Crabro*** Fabricius

– Female pygidial plate more commonly gutter-like; verticulus well-developed, L-shaped; male antennae with 12 or rarely 13 segments ..... ***Ectemnius*** Dahlbom

16. Genus ***Ectemnius*** Dahlbom

1845. *Crabro (Ectemnius)* Dahlbom, *Hym Europaea*, I . 389.

1976. *Ectemnius* Dahlbom : Bohart and Menke, *Univ Calif Press* : 49, 424.

Type-species : *Crabro guttatus* Dahlbom, 1845.

Most of the species/subspecies of *Crabro* from India belong to the genus *Ectemnius*. About 17 species under this genus are known to occur in India. Only one species has been recorded here from the state of Arunachal Pradesh, which is mentioned below.

27. *Ectemnius chrysites* (Kohl)

1892. *Crabro chrysites* Kohl, *Ann. Naturhist. Hofmus. Wien,* **8** : 197.

1897. *Crabro auricomus* Bingham, *Fauna Brit. India, Hym.,* **1** : 327, F.

1976. *Ectemnius chrysites* (Kohl) : Bohart and Menke, *Univ Calif. Press* : 424.

2000. *Ectemnius chrysites* (Kohl) : Jonathan *et al., Zool. Surv. India, State Fauna Series* 4, *Fauna of Meghalaya* (Part 7) : 205.

Diagnostic characters : *Female* : Body 13-14 mm long. Head broad, quadrate, finely punctured; clypeus, front and behind the eyes densely hairy; mesonotum anteriorly transversely, posteriorly obliquely striate; scutellum and postscutellum smooth, slightly punctured; median segment pubescent at the sides and finely transversely striate; legs smooth with very few spines; abdomen smooth and shining. Body black, but the base of the mandible, the antennal segments, the scutellum, the legs, yellow; wings hyaline and tegulae testaceous yellow.

Material examined : India : Arunachal Pradesh : Namdhapa : Deban, 1 ex., 6.iv.1981, coll. S. Biswas and party.

Distribution : India : Arunachal Pradesh, Meghalaya, Assam.

Elsewhere : Japan, Korea, Thailand, Taiwan, Philippines, Ryukyus, U.S.S.R.

Remarks : Roy and Kundu (1985) first recorded this species from this state under the genus *Ectemnius (Metacrabro).*

17. Genus *Crabro* Fabricius

1775. *Crabro* Fabricius, *Syst. Ent.* : 373.

Type-species : *Vespa cribraria* Linnaeus, 1758.

Bingham (1897) recorded 18 species in his "Fauna of British India" Most of these species are known to occur in India. Subsequently, Bohart and Menke (1976) transferred all these species from *Crabro* to another different genera. But they (*op. cit.*) recorded another four species from India which were described by different scientists after Bingham's (1897) publication. Here the material received from Arunachal Pradesh is identified upto generic level.

28. *Crabro* sp.

Material examined : India : Arunachal Pradesh : Kameng Div. : Dunnbridge, 1524 m., 1 ex., 21.iv.1966, coll. A.N.T. Joseph.

Distribution : India : Arunachal Pradesh.

Remarks : Due to less number of example as well as lack of literature, the specimen was identified upto generic level.

7. Subfamily NYSSONINAE

This is moderately a large subfamily of this family. More than 1400 species are known to occur under this subfamily. They are commonly known as "sand wasps." Most of the species/ subspecies nest in the ground and prefer sandy habitat. They prey upon variety of other insects, from grasshoppers to flies.

Diagnostic characters : Eyes parallel or converging below, rarely above. Mandible not notched nor toothed. Scutellum without complete notauli. Middle tibia with two apical spurs; claws simple. Propodeal sternite absent. Fore wing with two or three submarginal cells, of which second cell usually receives at least one recurrent vein; three discoidal cells present. Jugal lobe of hind wing usually small, rarely absent, at most half as long as anal area. Gaster usually sessile, when pedunculate, made up of both tergite and sternite. Male genitalia usually with volsella differentiated into cuspis and digitus.

This subfamily is represented by 5 tribes, viz., Alyssonini, Nyssonini, Gorytini, Stizini and Bombicini in India. The state of Arunachal Pradesh is represented by a single tribe Bombicini, which is mentioned below.

12. Tribe **Bembicini**

This tribe is represented by a single genus, viz., *Bembix* Fabricius, 1775 from India. Arunachal Pradesh also represents the same genus, which is detailed below :

18. Genus ***Bembix*** Fabricius

1775. *Bembix* Fabricius. *Syst. Ent.* : 23.

1976. *Ectemnius* Dahlbom : Bohart and Menke. *Univ. Calif. Press* : 49. 424.

Type-species : *Bembix rosrata* Fabricius. 1775.

More than 25 species/subspecies are known to occur in India under this genus. Of these, only one species, *B. westoni* Bingham, 1893 has been recorded here from the state of Arunachal Pradesh.

*29. ***Bembix westoni*** Bingham

1893. *Bembex westonii* Bingham. *J. Bombay Nat. Hist. Soc.*, 8 : 380. F.

1976. *Bembix westoni* Bingham : Bohart and Menke, *Univ Calif. Press* : 549.

Diagnostic characters : *Female* : Body 21-22 mm long. Head, thorax and abdomen finely and closely punctured; clypeus smooth, convex, widely emarginate anteriorly; median segment with a broadly triangular space at base. Body black, but the mandibles at base, the clypeus, the pronotum, the legs, yellow; the middle of the pronotum, coxae, femora, hind tibiae, black; wings hyaline; tegulae dark brown.

Male : More or less similar with female, but slightly differs by having a black spot above the clypeus between the bases of antennae, a yellow mark on the 4th and a yellow spot on each side of the 6th abdominal segments.

Material examined : India : Arunachal Pradesh : Tirap District : Jairampur Unit Garden, 1 ex., 27.x.1971, coll. G.S. Arora and party.

Distribution : India : Arunachal Pradesh.

Elsewhere : Myanmar.

Remarks : This species is recorded here for the first time from Arunachal Pradesh.

8. Subfamily PHILANTHINAE

This is one of the largest subfamilies of Sphecidae. Most of the wasps of this subfamily are generally medium in size. They are colourfully ornamented with yellow or red bands or spots. They are commonly found on flowers and a considerable amount of pollen is found on their body. Almost all the species are ground nesting, and the provisions are Hymenoptera or Coleoptera. (Bohart and Menke, 1976).

Diagnostic characters : Eyes widely separated, inner orbit emarginate or entire, converging above. Antennal sockets separated from fronto-clypeal suture; male with 13 and female with 12 antennal segments. Mandible without externo-ventral notch. Notauli usually distinct; omaulus, sternaulus and acetabular carina absent. Middle tibia with one apical spur; claws simple. Propodeum short to moderately long; dorsal enclosure present, without propodeal sternite. Fore wing with three submarginal cells, II and III each usually receiving one recurrent vein; jugal lobe of hind wing small to large; media in hind wing diverging before, at or after cu-a; second anal vein and subcosta absent. Gaster sessile, pedunculate, or occasionlly petiolate, petiole clearly composed of tergite and sternite; male with 7 exposed terga; pygidial plate usually present. Volsella simple or with digitus and cuspis; cerci usually absent.

This subfamily is subdivided into five tribes. Of these two tribes, viz., Philanthini and Cercerini are known to occur in India. Arunachal Pradesh also represents both the tribes. These can be distiuguished by the following key :

Key to the tribes of Philanthinae

1. Apex of hind femur simple; episternal sulcus present and usually reaching ventral area of mesopleuron; volsella with a digitus and cuspis. (Inner orbit of eye sharply angled or notched, but sometimes weak in some male of genus *Philanthus* whose eyes converge strongly towards vertex) ..... **Philanthini**

– Apex of hind femur somewhat truncate, flattened area sometimes kidney-shaped or forming an apico-ventral process; episternal sulcus absent or very short; volsella simple or divided into a digitus and cuspis.

(Mesopleuron with a broad, deep scrobal sulcus; media of hind wing diverging well beyond cu-a) ..... **Cercerini**

13. Tribe **Philanthini**

This tribe Philanthini represents only one genus *Philanthus* Fabricius from India. This genus is also found in the state of Arunachal Pradesh, which is mentioned below.

19. Genus ***Philanthus*** Fabricius

1793. *Philanthus* Fabricius, *Ent. Syst.*, **2** : 288.

Type-species : *Philanthus coronatus* Fabricius, 1793.

About 11 species/subspecies have been reported under the genus *Philanthus* Fabricius from India. Of these, only one subspecies is recorded here from Arunachal Pradesh.

*30. ***Philanthus notatulus concinnus*** Bingham

1896. *Philanthus concinnus* Bingham, *J. Proc. Linn. Soc.* : 442.

1976. *Philanthus notatulus concinnus* Bingham : Bohart and Menke, *Univ. Calif. Press* : 565.

Diagnostic characters : *Female* : Body 11-12 mm in length. Head, thorax finely and closely punctured, head slightly broader than thorax; clypeus carinate in the middle anteriorly; mesonotum broad, convex; median segment rounded; legs stout, postesiorly spinose; abdomen smooth, but not shining; Body black, but the base of the mandible, the clypeus, a narrow line behind the eyes, an irregular waved subapical line on the dorsal and ventral sides of 2nd to 4th abdominal segments, yellow and a narrow line in the middle of the 2nd abdominal segment, red; wings light fusco-hyaline.

Material examined : India : Arunachal Pradesh : Kameng Div. : Tipi, 213 m., 1 ex., 13.v.1966, coll. A.N.T. Joseph.

Distribution : India : Arunachal Pradesh.

Elsewhere : Myanmar, Vietnam, Philippines, Malaya, Indonesia (Sumatra).

Remarks : This subspecies is recorded here for the first time from the state of Arunachal Pradesh.

14. Tribe **Cercerini**

The tribe Cercerini is represented by two genera, viz., *Cerceris* Latreille, 1805 and *Eucerceris* Cresson, 1856 in world fauna. Only the genus *Cerceris* Latreille is known to occur in India as well as in Arunachal Pradesh.

20. Genus ***Cerceris*** Latreille

1805. *Cerceris* Latreille, *Hist. Nat. Crust. Ins.*, **13** : 315.

Type-species : *Philanthus ornatus* Fabricius, 1793.

This is a largest sphecid genus which contains a huge number of species/subspecies in relation to other genera. More than 47 species under this genus have been reported from India. Of these only three species, viz., *instabilis* Smith, 1856; *pentadonta* Cameron, 1890 and *unifasciata* Smith, 1856 are referable to this genus from the state of Arunachal Pradesh. These can be distinguished by the following key.

Key to the species of *Cerceris*

1. Enclosed triangular or cordate space at base of median segment obliquely striate. (Mesosternum not dentate; clypeus subporrect, slightly incised apically, with five teeth) ..... *pentadonta* Cameron

– Enclosed triangular or cordate space at base of median segment longitudinally striate 2

2. Median segment posteriorly red, marked with yellow, the enclosed space black. (In male, enclosed space punctured; clypeus broad, more or less emarginate apically, with an obtuse tooth on each side) .... *instabilis* Smith

– Median segment black immaculate. (Clypeus convex, its anterior margin rounded; in female, 2nd abdominal tergite with two yellow spots at its base) ..... *unifasciata* Smith

*31. *Cerceris instabilis* Smith

1856. *Cerceris instabilis* Smith, *Cat. Hym. Brit. Mus.*, **4** : 452, F.

2003. *Cerceris instabilis* Smith : Jonathan and Kundu, *Zool. Surv. India, State Fauna Series* 9 : *Fauna of Sikkim* (Part 4) : 443.

Material examined : India : Arunachal Pradesh : Subansiri Div. : Daporizo, 150 m., 1 ex., 26.x.1966, coll. S.K. Tandon and G.S. Arora; Papumpare : Naharlagun, 1 ex., 19.iv.2001, coll. S. Sheela and party.

Distribution : India : Arunachal Pradesh, Sikkim, Meghalaya, Tripura, Maharashtra, Goa, Karnataka, Tamil Nadu, West Bengal.

Elsewhere : Myanmar, Sri Lanka.

Remarks : This species is recorded here for the first time from Arunachal Pradesh.

*32. *Cerceris pentadonta* Cameron

1890. *Cerceris pentadonta* Cameron, *Mem. Manch. L. Ph. Soc.*, (4) **3** : 250 & 262, pl. 10, fig. 13.

1976. *Cerceris pentadonta* Cameron : Bohart and Menke, *Univ. Calif. Press* : 585.

Material examined : India : Arunachal Pradesh : Tirap Dist. : Jairampur Unit Garden, 1 ex., 27.x.1971, coll. G.S. Arora and party.

Distribution : India : Arunachal Pradesh, West Bengal.

Remarks : This is new record of this species from Arunachal Pradesh.

*33. *Cerceris unifasciata* Smith

1856. *Cerceris unifasciata* Smith, *Cat. Hym. Brit. Mus.*, **4** : 456.

2000. *Cerceris unifasciata* Smith : Jonathan *et al.*, *Zool. Surv. India, State Fauna Series* 4 : *Fauna of Meghalaya* (Part 7) : 212.

Material examined : India : Arunachal Pradesh : Siang Div. : Basar, 550 m., 1 ex., 31.x.1966, coll. S.K. Tandon and G.S. Arora; Kameng Div. : Rupa, 1 ex., 16.x.2001, coll. R.N. Tiwari and party.

Distribution : India : Arunachal Pradesh, Meghalaya, Assam, Sikkim, Uttar Pradesh, West Bengal.

Elsewhere : Myanmar, China.

Remarks : This is first record of this species from the state of Arunachal Pradesh.

SUMMARY

The present paper deals with the Sphecidae fauna of the state Arunachal Pradesh, India. The members of the family Sphecidae are commonly known as blue mud-dauber, black and yellow mud-dauber, digger or sand or hunting wasps. They are mainly beneficial to man.

The majority of the members of this subfamily are predatory on a great variety of terrestrial insects, but some are cleptoparasitic. They show complexities in their behaviour and are always being subject to biological studies.

The family is represented by more than 450 species/subspecies in India. Here only 33 species/subspecies belonging to 20 genera under 8 subfamilies have been reported from the state of Arunachal Pradesh. Of these, 23 species/subspecies are recorded here for the first time from this state, which are marked with single asterisk (*) in the systematic account.

The keys to the subfamilies, tribes, genera, subgenera, species and subspecies are provided for the identification of various taxa of the family Sphecidae.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. J.R.B. Alfred, Director, Zoological Survey of India for providing necessary facilities to carry out this research work. The authors are also thankful to Dr. J.K. Jonathan, ex-Addl. Director, Dr. A.K. Hazra, Scientist-E & Divisional-in-Charge (Entomology) and Dr. S.I. Kazmi, Scientist-B & Officer-in-charge, Hymenoptera section, Zoological Survey of India for their inspiration and keen interest for completion of this research work. Thanks are also due to shri Rati Ram, P.P.O., Publication section and all sectional staffs, Hymenoptera section, Zoological Survey of India, Kolkata for helping us in various ways.

REFERENCES

BINGHAM, C.T. 1897. Wasps and Bees. *The Fauna of British India. Hymenoptera,* **1** : 1-579 and i-xxix. Taylor and Francis, London.

BOHART, R.M. and MENKE A.S. 1976. Sphecid wasps of the World (A generic revision). *University of California Press, California* : 1-695.

BROTHERS, D.J. 1975 Phylogeny and classification of the Aculeate Hymenoptera with special reference to Mutillidae. *Kansas Univ. Sci. Bull.,* **50** (11) : 483-648.

CAMERON, P. 1888-1890. Insecta, Hymenoptera, vol. 2 (Fossores), xi + 413 pp. In : F.D. Godman and D. Salvin, Biologia Centrali-Americana, Taylor and Francis, London (pp. 1-32 = 1888, 33-46=1889, 65-128=1890, 129-176=1891, Sphecidae = pp. 1-158).

CAMERON, P. 1899. Description of a new genus and some new species of fossorial Hymenoptera from the Oriental Zoological Region. *Ann. Mag. Nat. Hist.,* (7) **4** : 52-69.

CAMERON, P. 1900. Descriptions of new genera and species of Aculeate Hymenoptera from the Oriental Zoological Region. *Ann. Mag. Nat. Hist.,* (7) **5** : 17-41.

CAMERON, P. 1901. Descriptions of three new genera and seven new species of Hymenoptera from eastern Asia and Australia. *Ann. Mag. Nat. Hist.,* (7) **8** : 116-122.

CAMERON, P. 1902. Descriptions of new genera and species of Hymenoptera collected by Major C.S. Nurse at Deesa, Simla and Ferozepore. *J. Bombay nat. Hist. Soc.,* **14** : 267-293.

GOULET, HENRI and JOHN HUBER. 1993. Hymenoptera of the world, An indentification guide to families. Centre for Land and Biological Resources Research, Ottawa, Ontario.

HINGSTON, R.W.G. 1925-1926. An Oriental hunting wasp *Sphex lobatus. J. Bombay nat. Hist. Soc.,* **30** : 735-743, **31** : 147-157.

JONATHAN, J.K., RAY, K.K. and KUNDU, B.G. 2000. Insecta : Hymenoptera : Sphecidae. *Zool. Surv. India, Fauna of Meghalaya, State Fauna Series,* **4**(Part-7) : 161-222.

JONATHAN, J.K. and KUNDU, B.G. 2003. Insecta : Hymenoptera : Sphecidae. *Zool. Surv. India., Fauna of Sikkim, State Fanua Series,* **9**(Part-4) : 417-446.

KIRBY, W. 1798. *Ammophila,* a new genus of insects in the class Hymenoptera, including the *Sphex sabulosa* of Linnaeus. *Trans. Linn. Soc. London,* **4** : 195-212.

KOHL, F.F. 1892. Neue Hymenopterenformen. *Ann. Naturhist. Hofmus. Wien,* **7** : 197-234.

KOHL, F.F. 1893. Uber *Ampulex* Jur. (s.l.) und die damit enger verwandten Hymenopteren Gattungen. *Ann. Naturhist. Hofmus. Wien,* **8** : 455-516.

KROMBEIN, K.V. 1936. Biological notes on some solitary wasps. *Ent. News,* **47** : 93-99.

KROMBEIN, K.V. 1981. Biosystematic studies of Ceylonese wasps, VIII : A monograph of the Philanthidae (Hymenoptera : Sphecoidea). *Smithsonian Institution Press, Washington D.C.,* No. **343** : 1-75.

KROMBEIN, K.V. 1984a. Biosystematic studies of Ceylonese wasps, XII : Behavioral and life history notes on some Sphecidae (Hymenoptera : Sphecoidea). *Smithsonian Institution Press, Washington D.C.,* No. **387** : 1-29.

KROMBEIN, K.V. 1984b. Biosystematic studies of Ceylonese wasps, XIII : A monograph of the Stizinae (Hymenoptera : Sphecoidea : Nyssonidae). *Smithsonian Institution Press, Washington D.C.*, No. **388** : 1-37.

KROMBEIN, K.V. 1984c. Biosystematic studies of Ceylonese wasps, XIV : A revision of *Carinostigmus* Tsuneki (Hymenoptera : Sphecoidea : Pemphredonidae). *Smithsonian Institution Press, Washington D.C.*, No. **396** : 1-37.

KROMBEIN, K.V. and GINGRAS, S.S. 1984. Revision of North American *Liris* Fabricius (Hymenoptera : Sphecoidea : Larridae). *Smithsonian Institution Press, Washington D.C.*, No. **404** : 1-95, pls., fig.

KROMBEIN, K.V., HUD, P.D., SMITH, D.R. and BURK, B.D. 1979. Catalogue of Hymenoptera in America North of Maxico. *Smithsonian Institution Press, Washington D.C.*, **2** : 1195-2209.

KROMBEIN, K.V. and PULAWASKI, W.J. 1986. Biosystematic studies of Ceylonese wasps, XVI : A revision of *Gastrosericus* Spinola (Hymenoptera : Sphecoidae : Larridae). *Smithsonian Institution Press, Washington D.C.*, No. **436** : 1-19.

KROMBEIN, K.V. and VAN DER VECHT, J. 1987. Biosystematic studies of Ceylonese wasps, XVII : A revision of Sri Lankan and South Indian *Bembix* Fabricius (Hymenoptera : Sphecoidea : Nyssonidae). *Smithsonian Institution Press, Washington D.C.*, No. **451** : 1-30.

MADHAVIKUTTY, M. 2004 Description of a new species of the genus *Trirogma* Westwood (Hymenoptera : Spheciformes) from India. *Perspectives on* Biosystematics and Biodiversity T.C.N. Com. Vol. March 2004 : 593-596.

ROY, S.B. and KUNDU, B.G. 1985. Fauna of Namdhapa, Arunachal Pradesh (Insecta : Hymenoptera). *Rec. zool. Surv. India*, **82**(1-4) : 221-229.

SMITH, F. 1856. Catalogue of Hymenopterous insects in the collection of the British Museum, part IV. Sphecidae, Larridae and Crabronidae. : 207-497. London.

SUDHEENDRAKUMAR, V.V. and NARENDRAN, T.C. 1989. Sphecoid wasps of Kerala, India. *Sphecos*. **18** : 11-12.

TURNER, R.E. 1911. Notes on fossorial Hymenoptera. IV. *Ann. Mag. Nat. Hist.*, (8) **7** : 479-485.

TURNER, R.E. 1912a. A monograph of the wasps of the genus *Cerceris* inhabiting British India. *J Bombay Nat. Hist. Soc.*, **21** : 476-516.

TURNER, R.E. 1912b. Notes on fossorial Hymenoptera, IX. *Ann. Mag. Nat. Hist.*, (8) **10** : 48-63.

TURNER, R.E. 1916. Notes on the wasps of the genus *Pison* and some allied genera. *Proc. Zool Soc London* : 591-629.

TSUNEKI, K. 1951. The genus *Pemphredon* Latreille of Japan and the adjacent regions. *J. Fac. Sci. Hokkaido Univ.*, (6) **10** : 163-208.

TSUNEKI, K. 1954a. The genus *stigmus* Panzer of Europe and Asia with descriptions of eight new species. *Mem. Fac. Lib. Arts, Fukui, Univ.* (2, *Nat. Sci.*) (3) : 1-38.

TSUNEKI, K. 1954b. Descriptions and records of wasps of the families Chrysididae and Sphecidae of Japan. *Mem. Fac. Lib. Arts, Fukui Univ.* (2, *Nat. Sci.*) (4) : 37-54.

TSUNEKI, K. 1959a. Notes on some synonymy of the Japanese Crabroninae, with the erection of a new subgenus of *Ectemnius*. *Akitu*, **8** : 7-8.

TSUNEKI, K. 1959b. Une nouvelle espéce du Crabronien du Japon. *Akitu*, **8** : 83-84.

TSUNEKI, K. 1961. Studies on *Cerceris* of north eastern Asia. *Mem. Fac. Lib. Arts, Fukui Univ.* (2, *Nat. Sci.*) (11) : 1-72.

TSUNEKI, K. 1962. Taxonomic notes on *Ammophila* Kirby of Japan and Korea. *Life Study (Fukui)*, **6** : 24-29.

TSUNEKI, K. 1964. The genus *Tachytes* Panzer of Japan and Korea. *Etizenia* (5) : 1-11.

TSUNEKI, K. 1968. *Cerceris* from the western Pacific areas. *Etizenia* (29) : 1-36.

TSUNEKI, K. 1972a. On some species of the Japanese Sphecidae, notes and descriptions. *Etizenia* (59) : 1-20.

TSUNEKI, K. 1972b. Studies on the Formosan Sphecidae (XIV). Notes on some specimens newly examined, with a description of a related Japanese subspecies. *Etizenia* (60) : 1-13.

TSUNEKI, K. 1973. New and first recorded species and subspecies of Sphecidae and Mutillidae from Japan, with taxonomic notes on some species. *Etizenia* (65) : 1-28.

VAN DER VECHT, J. 1949. On Indo-Australian *Bembecinus*, with special reference to the species occurring in Java. *Treubia*, **20** : 289-307.

VAN DER VECHT, J. 1966. Notes on some Oriental *Philanthus* species. *Proc. Kon. Nederl. Akad. Wetenschappen*, (c), **69** : 420-431.

VAN DER VECHT, J. 1973. Contribution to the taxonomy of the Oriental and Australian Sphecini. *Proc. Kon. Nederl. Akad. Wetenschappen*, (c), **75** : 341-353.

VAN LITH, J.P. 1959. Contribution to the knowledge of the Indo-Australian Pseninae. *Zool. Verh.*, (39) : 1-69.

VAN LITH, J.P. 1962. Contribution to the knowledge of the Indo-Australian Pseninae. Part II. *Psenulus* Kohl, 1896. *Zool. Verh.*, (52) : 1-118.

VAN LITH, J.P. 1965. Contribution to the knowledge of the Indo-Australian Psenini. Part III. *Zool. Verh.*, (73) : 1-80.

VAN LITH, J.P. 1972. Contribution to the knowledge of Oriental *Psenulus*. *Tijdschr. Ent.*, **115** : 153-203.

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2) : 427-448, 2006

INSECTA : HYMENOPTERA : ACULEATA (VESPIDAE AND APIDAE)

B. G. KUNDU, S. N. GHOSH and S. ROYCHOWDHURY
Zoological Survey of India, M-Block, New Alipore, Kolkata - 700053

INTRODUCTION

The present paper includes the systematic account of families Vespidae and Apidae from the state of Arunachal Pradesh. The family Vespidae belongs to superfamily Vespoidea which represents true or yellow wasps. The family Apidae belongs to superfamily Apoidea which represents the bees.

Both the superfamilies Vespoidea and Apoidea, belonging to Aculeate Hymenoptera, are mostly fascinating groups of insects. Mentally they are considered most highly developed among all insects. They are characterised by having two pairs of membranous wings, the hind pair smaller than fore pair; their mouth-parts with biting mandibles and labium adapted for licking juice of flowers. They are minute to large in size.

The important work available on Indian wasps and bees is by Bingham (1897). He *(op. cit.)* published a valuable work "*The Fauna of British India including Ceylon and Burma*" on wasps and bees, but did not record any species/subspecies from the state of Arunachal Pradesh. Subsequently, Das and Gupta (1983, 1989) made valuable contributions on Vespidae from India and its adjacent countries and have recorded 3 species and one subspecies from this state.

Besides the above publications, there are some important contributions on wasps and bees from India and its adjacent countries made by Smith (1871, 1875), Bingham (1888, 1908), Cockerell (1907) Schulthess (1914) Aiyar (1916-1917), Dover and Rao (1922), Bequaert (1936, 1939, 1940), Maa (1937), Schwarz (1939), Kellogg (1941), van der Vecht (1941, 1957, 1959, 1962, 1966, 1979, 1981), Dixit (1956), Yamane (1974), Chhotani and Ray (1975), Gupta and Das (1977), Day (1979), Yamane and Yamane (1979), Archer (1980, 1981, 1987), Williams (1983, 1988), Gadagkar and Joshi (1984), Roy and Kundu (1985), Jacobson (1986), Petersen (1987), Reyes (1991), Jonathan *et al.* (1999, 2000), Lambert and Narendran (2002), Ray (2003), Jonathan and Kundu (2003), Michener *et al.* (2003), Lambert (2004) and Jobiraj (2004).

North-Eastern part of India, specially the state of Arunachal Pradesh, is very important from the view point of faunal diversity. An attempt has been made here to provide a consolidated account on the fauna of families Vespidae and Apidae from the state of Arunachal Pradesh. The classification of Vespidae is followed here after Das and Gupta (1989) and Apidae after Michener (1965).

TOPOGRAPHY

Arunachal Pradesh is situated in the north-east part of India. It has been recognised as the 24th state by Government of India on 20th February, 1987. Previously it was known as NEFA (North East Frontier Agency). It lies in between 91°31′ to 97° 30′ E longitude and 26° 28′ to 29° 30′ N latitude. It has long international border with China in the north and north-east, Bhutan in the west and Myanmar in the east. It is also bounded by Assam and Nagaland in the south.

The state covers approximately 84,000 sq. km areas. Mostly 62% of total area is covered by the forests. It is a land of thick forests, deep river valleys and beautiful plateaus. It has its own attraction for natural beauty. There are five main rivers Siang, Kameng, Subansiri, Lohit and Tirap, of which Siang is the mightiest. The economy of the state is mainly based on agriculture, cottage industry, tourism and forest.

The climate of this state varies with the topography and altitude. It's altitute is varying from 150 m to 5000 m (approx.) above the sea level. The maximum temperature is observed upto 38° C in the mouth of May with frequent rain. Monsoon starts at the end of May or from first week of June and is active upto september. The average rainfall is more than 3000 mm. In winter, the temperature drops below freezing point above 3000 m hight with frequent snowfall.

The people of Arunachal Pradesh are mostly tribal. They proudly adore a thick green vegetation. A rich diversity of flora with the variation is found in the altitude. Orchids enrich the flora with rare as well as endangered groups. The different colours of Rhododendrons in the high altitude add its unique splendor to this heavenly land. The faunal wealth of this state is also richly diversified. Elephant, Tiger, Leopard, Jungle cat, Yak etc are the common animals. The white winged wood Duck, an endangered species, is seen in Namdhapa area.

MATERIAL AND METHOD

These groups of insects (wasps and bees) mostly occur in the agriculture fields, various vegetables and flower gardens, and crop fields etc. So they are being collected by sweeping with the help of insect nets. The collected material are killed in a killing jar usuing benzene. Afterward, they are kept in the insect envelops with proper lebels mentioning locality, altitude, date and name of the collector etc. Then all the collection are preserved dry with paradichlorobenzene and nephthalene adding carbolic acid as antifungal agent in a box properly in the field.

In the laboratory of the department, the specimens are set, pinned and mounted to display properly for easy handling under binocular microscope during the process of identification. Then the identified specimens are kept in insect boxes or cabinets with proper lebels. Smaller species are generally preserved in alcohol permarently with proper lebels after study. For detailed specific identification, the genital structures, mandibles and other mounth-parts are also dissected out and mounted on slides.

This taxonomic work of these groups of insects (wasps and bees) of Arunachal Pradesh is based on the collection made by the authors and various scientists of the department from this state time to time. Besides this, the specimens lying in the National Zoological Collection of this department have also been incorporated. The entire material studied under this project have heen deposited in the collection of Zoological Survey of India, Kolkata.

SYSTEMATICS

The present taxonomic paper incorporates 15 species/subspecies belonging to 5 genera and 3 subgenera and 2 subfamilies under the family Vespidae and 7 species belonging to 4 genera under the family Apidae from the state of Arunachal Pradesh. Out of 15 species/subspecies above under the family Vespidae, 3 species/ subspecies are new record from this state which are marked with single asterisk (*) in the systematic account.

The keys to the families, subfamilies, tribes, genera, subgenera, species and subspecies are provided here for the identification of various taxa of this region, which are mainly based on the works of Bingham (1897), van der Vecht (1957, 1959), Michener (1965), Das and Gupta (1989) and Goulet and Huber (1993). The diagnostic characters of families, subfamilies are also incorporated. The diagnostic characters of the species are provided, where the genus is represented by a single species or subspecies. The species/subspecies, not available in the collection but known from Arunachal Pradesh,

have been reviewed from literature and also incorporated here in the systematic account.

TAXONOMIC TERMINOLOGY

The terms of morphological characters used in the text are mainly based on the works of Bingham (1897), Richards (1956, 1973), Michener (1965), Das and Gupta (1989) and Goulet and Huber (1993). The abbreviation used in the text are : cat. = The reference itself is a catalogue; key = A key is provided in the publication to identify the species; syn. = The synonymy or taxonomic position of the species; sex = M, F, W are used to cite male, female and worker sex of the taxa described; distr. = The place from where the species/subspecis was recorded is given; m. = Metre, indicating here the total elevation from the sea-level; mm. = Millimetre, indicating here the total amount of rainfall in a particular area; ex. = Number of specimens/example(s); des. = The species is described or there is a descriptive note; fig. = The species is illustrated in whole or in part; coll. = The name of collector who collects the specimen(s) from a particular region.

SYSTEMATIC ACCOUNT

A. Family VESPIDAE

1. Subfamily POLISTINAE

1. Tribe **Polistini**

1. Genus ***Polistes*** Latreille, 1802

1. Subgenus ***Polistes (Nygmopolistes)*** Richards, 1973

1. *tenebricosus sulcatus* Smith, 1852

2. Subgenus ***Polistes (Megapolistes)*** van der Vecht, 1968

2. *olivaceus* (De Geer, 1773)

2. Tribe **Ropalidiini**

2. Genus ***Ropalidia*** Guérin, 1838

3. Subgenus ***Ropalidia (Anthreneida)*** White, 1841

3. *santoshae* Das and Gupta, 1989

4. *fasciata* (Fabricius, 1804)

5. *cyathiformis* (Fabricius, 1804)

3. Tribe **Polybiini**

3. Genus ***Parapolybia*** Saussure, 1853

6. *varia* (Fabricius, 1787)

7. *indica tinctipennis* (Cameron, 1900)

2. Subfamily VESPINAE

4. Genus ***Vespa*** Linnaeus, 1758

8. *basalis* Smith, 1852

*9. *bicolor* Fabricius, 1787

10. *mandarinia magnifica* Smith, 1852

11. *tropica tropica* (Linnaeus, 1758)

*12. *tropica ducalis* Smith, 1852

13. *tropica leefmansi* van der Vecht, 1957

*14. *velutina auraria* Smith, 1852

5. Genus ***Provespa*** Ashmead, 1903

15. *anomala* (Saussure, 1853)

B. Family APIDAE

1. Subfamily APINAE

1. Tribe **Apini**

1. Genus ***Apis*** Linnaeus, 1758

1. *indica* Fabricius, 1798

2. *(Megapis) dorsata* Fabricius, 1793

3. *(Micrapis) florea* Fabricius, 1787

2. Tribe **Meliponini**

2. Genus ***Trigona*** Jurine, 1807

4. *laeviceps* Smith, 1858

5. *ventralis* Smith, 1858

2. Subfamily BOMBINAE

3. Tribe **Bombini**

3. Genus ***Bombus*** Latreille, 1802

6. *orientalis* Smith, 1854

Key to the families

1. Tegula touching pronotum when wings are folded so that mesonotum separated from mesopleuron by tegula; body hairs thin and smooth ..... VESPIDAE

– Tegula separated from pronotum so that mesoscutum touches mesopleuron; body hairs with short to long branches, especially on

propodeum, near bases of wings, around coxae, or on margins of terga .....APIDAE

A. Family VESPIDAE

The Vespidae is a cosmopolitan, but predominantly tropical family. The members of this family, commonly known as paper wasps, hornets or yellow jackets, are chiefly predators of many insect larvae. Some of the species are also used as bio-control agent of agriculture (Insect) pests. Their painful sting may, sometimes, prove fatal yet their venom has its utilization in immunisation.

The family Vespidae is recognised by the following characters : Antennae 13-segmented in male and 12-segmented in female; eyes emarginate; pronotum extending back to tegula, and mesopleurum without any oblique suture; wings longitudinally folded in repose (except in Masarinae and Stenogastrinae); fore wing with first discoidal cell elongate and longer than submedian cell, hind wing with an anal cell and enclosed cells; trochanters not divided and trochantellus absent, middle tibiae with one or two apical spurs, tarsal claws toothed, bifid or simple; thorax and gaster joined together by a long and slender or short petiole; gaster with spiracles on 1-7 segments and a sting without sheaths; male genitalia with characteristic spiniform parameres.

Key to the subfamilies of Vespidae

1. Wings not folded longitudinally when at rest. Tarsal claws with one tooth. Mandible elongate. Occipital carina either joining with or almost reaching near to hypostomal carina. Antennal sockets far apart, separated from the basal margin of clypeus by a long supraclypeal area. In male clypeus and mandible produced like a beak. Nervulus distinct. Second cubital cell rectangular. Thorax short, globular; first gastral segment petiolate, longer than rest of the gaster. (Not recorded from Arunachal Pradesh) ....STENOGASTRINAE

– Wings folded longitudinally when at rest. Tarsal claw simple, without tooth. Mandibles of normal shape. Occipital carina joining with or running towards the base of mandible. Antennal sockets not very far apart and separated from the basal margin of clypeus by short supraclypeal area. In male clypeus and mandible normal, not beak shaped. Nervulus short. First cubital cell larger than second cubital cell. Thorax normal. First gastral segment petiolate or subpetiolate or sessile, not much longer than the rest of the gaster 2

2. Hind wing usually with an anal lobe. Hind coxa without a dorsal carina. Mesepimeron not completely or not at all separated from the mesepisternum. Dorsal episternal groove and epicnemial carina present or absent. Gaster petiolate or subpetiolate; 1st tergite gradually curving from base to apex. Occipital carina always present. Apical margin of clypeus in female gradually tapering into a sharp or blunt tooth. Apical margin of postscutellum not at all or weakly produced in the middle of propodeum at base. Propodeum transversely rugose and curved at sides, its apical orifice elongate. Mandibles smaller, not expanded apically. Male antenna with a hook-like bend at apex. Smaller, more slender species with nest consisting of a single horizontal or vertical naked comb that is not enclosed by papery envelopes (*Ropalidia* has species which may build an envelope round the comb; some species have more than one comb) ..... POLISTINAE

– Hind wing without an anal lobe. Hind coxa with a dorsal carina on posterior surface. Mesepimeron completely separated from mesepisternum. Dorsal episternal groove and epicnemial carina always absent. Gaster sessile; 1st tergite anteriorly truncate with an anterior vertical face and a posterior horizontal face, the two making a right angle. Occipital carina absent dorsally, usually present laterally but may or may not reach base of mandible. Apical margin of clypeus broadly truncate or emarginate medially forming two lateral sharp or blunt lobes. Apical margin of postscutellum

produced in the middle forming a long triangular lobe in the basal part of propodeum. Propodeum almost vertical and without rugosities, with a circular apical orifice. Mandibles large with an expanded apical margin. Male antenna straight apically, without a hook-like bend. Larger, stouter species with nest consisting of several combs on a horizontal plane and wrapped by a papery envelope ..... VESPINAE

1. Subfamily POLISTINAE

The members of this subfamily are commonly called paper wasps. The nests consist of a single comb which is not enclosed in a paper envelope. In most of the Temperate zone species the nests are annual each being founded by one or more overwintering females. One of the females becomes dominant and is the only one to lay eggs.

Diagnostic characters : Body usually elongate; apical margin of clypeus tapering into a sharp or blunt tooth. Occipital carina always present; apical margin of postscutellum truncate to weakly produced in the middle at the base of propodeum; mesepimeron not completely or not at all separated from mesepisternum. Hind wing usually with an anal lobe; 1st gastral segment petiolate or subpetiolate.

The subfamily Polistinae is subdivided into 3 tribes, *viz.*, Polistini, Ropalidiini and Polybiini. They are known to occur in India and they have also been reported from the state of Arunachal pradesh. These can be distinguished by the following key.

Key to the tribes of Polistinae

1. First gastral segment always petiolate and usually strongly swollen apically; pronotal lobe apcially in front of tegula without a carina; dorsal episternal groove always absent; subtegular area basally in front of pronotal lobe not margined with a carina; second gastral tergite and sternite usually fused..... ..... **Ropalidiini**

– First gastral segment either petiolate or subpetiolate; pronotal lobe apically in front of tegula with a distinct carina; dorsal episternal groove either present or absent; subtegular area basally in front of pronotal lobe margined with distinct carina; second gastral tergite and sternite never fused 2

2. First gastral segment subpetiolate, shorter than second segment; muscle slit of propodeum long and narrow; subdiscoideus joins postnervulus at or close to middle; mesepisternum with or without epicnemial carina; apical margin of postscutellum usually almost truncate ..... **Polistini**

– First gastral segment petiolate, not shorter than second segment; muscle slit of propodeum short and wider; subdiscoideus joins postnervulus below middle; mesepisternum without epicnemial carina; apical margin of postscutellum weakly produced in the middle just at the base of propodeum ..... **Polybiini**

1. Tribe **Polistini**

This tribe is represented by a single genus in Indian subregion.

1. Genus ***Polistes*** Latreille

This Genus is subdivided into eleven subgenera (Richards, 1973). Of these, six, viz., *Polistes (Polistes)* Latreille, 1802; *P. (Gyrostoma)* Kirby and Spence, 1826; *P. (Nygmopolistes)* Richards, 1973; *P. (Megapolistes)* van der Vecht, 1968; *P. (Stenopolistes)* van der Vecht, 1972 and *P. (Polistella)* Ashmead, 1904 are represented in Indian subregion. In Aruncahl Pradesh, two subgenera have been reported. These can be recognised by the following key.

Key to the subgenera of *Polistes*

1. Mesepisternum without epicnemial carina. Subgenital plate, in males, not squarish, narrow at apex, without apophyses; digitus long and narrow .... ***Nygmopolistes*** Richards

– Mesepisternum with distinct epicnemial carina. Subgenital plate, in males, squarish, with a

pair of apophyses; digitus basally wide .....
..... ***Megapolistes*** van der Vecht

1. Subgenus ***Polistes (Nygmopolistes)*** Richards

1973. *Polistes (Nygmopolistes)* Richards, *Rev. Bras. Ent.*, **17**(13) : 91, 93, 98, 99.

Types-species : *Polistes sulcatus* Smith, 1852 (= *Polistes rugifrons* Cameron, 1900).

This is a small subgenus, represented by a single species, viz., *P. (N.) tenebricosus* Lepeletier, 1886 in Oriental region. Two subspecies, viz., *tenebricosus tenebricosus* Lapeletier, 1886 and *tenebricosus sulcatus* Smith, 1852 are known from Oriental region. Of these, only one subspecies *tenebricosus sulcatus* is reported here from the state of Arunachal Pradesh.

1. *Polistes (Nygmopolistes) tenebricosus sulcatus* Smith

1852. *Polistes sulcatus* Smith, *Trans. Ent. Soc. London*, (2) **2** : 38, M, F, des.

1989. *Polistes (Nygmopolistes) tenebricosus sulcatus* Smith : Das and Gupta, *Oriental Ins. Monogr.*, **11** : 49.

2003. *Polistes (Nygmopolistes) tenebricosus sulcatus* Smith : Jonathan and Kundu, *Zool Surv. India, Fauna of Sikkim, State Fauna Series*, **9** (Part 4) : 378.

Diagnostic characters : Female : Body 18-20 mm in length. Antennae black, its first, second and third segments apically reddish. Head reddish, with a black mark on frons and vertex. Pronotum reddish with a black mark below. Gaster reddish, its basal half of first tergite, second tergite at base, first, second and third sternites (except for two reddish marks on both sides), black. Legs in general black, except apical half of fore femur, fore tibia, middle and hind tibiae apically, all tarsi, reddish. Wings wholly yellowsh.

Male : Similar to the female, but antenna blackish above and reddish below; pronotum black except for the narrow reddish margin; gastral sternite entirely black, tergites partly black and partly reddish.

Material examined : India : Arunachal Pradesh : Namdhapa, Deban, 1 ex., 2.iv.1981, coll. S. Biswas and party; Kameng Division : Bomdila, Selari, 1 ex., 14.10.2001, coll. R.N. Tiwari and party.

Distribution : India : Arunachal Pradesh, Meghalaya, Assam, Uttaranchal, Jammu and Kashmir, Sikkim, West Bengal.

Elsewhere : China, Japan, Nepal, Indonesia.

Remarks : This species resembles with *P. (Polistella) sagittarius* Saussure, 1853, but can be differentiated by the presence of pronotal fovae. This subspecies is mainly found in the hilly area.

2. Subgenus ***Polistes (Megapolistes)*** van der Vecht

1968. *Polistes (Megapolistes)* van der Vecht, *Bijdr. Dierk.*, **38** : 97.

Type-species : *Vespa olivacea* (De Geer, 1773).

This is a moderate size subgenus and widely distributed in Oriental region. Three species, viz., *olivaceus* (De Geer, 1773); *wattii* Cameron, 1900 and *rothneyi* Cameron, 1900 known from Indian region. Of these, only *olivaceus* is recorded here from the state of Arunachal Pradesh.

2. *Polistes (Megapolistes) olivaceus* (De Geer)

1773. *Vespa olivacea* De Geer, *Mem. Hist. Insect.*, **3** : 582, fig.

1787. *Vespa hebraea* Fabricius, *Mant. Ins.*, **1** : 292.

1897. *Polistes hebraeus* : Bingham, *Fauna British India, Hym.*, **1** : 398, F, W, des, fig., syn.

1989. *Polistes (Megapolistes) olivaceus* (De Geer) : Das and Gupta, *Oriental Ins. Monogr.*, **11** : 52.

2003. *Polistes (Megapolistes) olivaceus* (De Geer) : Jonathan and Kundu, *Zool Surv. India, Fauna of Sikkim, State Fauna Series*, **9** (Part 4) : 379.

Diagnostic characters : Female : Body 20-24 mm in length. Head wider than high. Clypeus as wide as long, densely finely punctate. Mandible with a few scattered large punctures. Malar space with moderately larger and close punctures.

Occipital carina incomplete. Propodeum with distinct striations which do not reach the inner margin on side. Pronotum sparsely finely punctures. Gaster almost impunctate, covered with short velvety pubescence; first gastral tergite wider than long; first gastral sternite finely striate.

Body colour yellow with variable black markings and with few reddish marking.

Male : Similar to the female, but clypeus not touching the eye; apical gastral sternite with blunty projecting tubercle on each side; apophyses long, narrow and flattened at apex.

Material examined : India : Arunachal Pradesh : Subansiri Division : Dejoo, 2 exs., 10.v.1966, coll. A.N.T. Joseph; Kameng Division : Sonai Rupai Forest, 1 ex., 28.v.1966. coll. A.N.T. Joseph; Bhalukpong, Kameng River side, 2 ex., 18.x.2001, coll. R.N. Tiwari and party; Namdhapa : Deban, 1 ex., 2.iv.1981, coll. S. Biswas and party.

Distribution : India : Arunachal Pradesh, Assam, Meghalaya, Manipur, Sikkim, Tripura, Jammu and Kashmir, Himachal Pradesh, Uttaranchal, West Bengal, Madhya Pradesh, Karnataka.

Elsewhere : Nepal, Myanmar, Sri Lanka, South China, Taiwan, Japan, Iran, Philippines, Thailand, Vietnam, Malaysia, North and East Africa, Fiji, Thliti, Seychelles, Madagascar, Mauritius, Tanzania (Zanzibar Is.); widely distributed in the Oriental region and Oceanic Islands and also found in Australia and New Zealand.

2. Tribe **Ropalidiini**

This tribe is represented by a single genus, *Ropalidia* Guérin, 1838 (= *Icaria* Saussure, 1853), which is widely distributed in the tropical parts of the old world, including Africa, Indian subcontinent, south-east Asia, Australia, Philippines, Ryukyus etc. (Das and Gupta, 1989).

3. Genus ***Ropalidia*** Guérin

This genus is subdivided into five subgenera, viz., *Ropalidia (Anthreneida)* White, 1841; R. *(Icarielia)* Dalla Torre, 1904; *R. (Paraicaria)* Gribodo, 1892; *R (Polistratus)* Cameron, 1900 and *R. (Ropalidia)* Guérin, 1838. Of these, first three subgenera occur in Indian subregion. Only one subgenus, *R. (Anthreneida)* has been reported from Arunachal Pradesh.

1841. *Anthreneida* White, *Ann. Mag. Nat. Hist.*, (1) 7 : 321.

Type-species : *Vespa sumatrae* Weber, 1801 (= *Anthreneida coronata* White, 1841).

1983. *Ropalidia (Anthreneida)* white : Das and Gupta *Oriental Ins.*, 17 : 415, cat., syn., ref., distri.

This is a large subgenus, widely distributed in the Oriental, Wallacea and Australian regions. Das and Gupta (1989) reported 22 species from Indian subregion. From the state of Arunachal Pradesh, three species have been recorded here and these can be distinguished by the following key.

Key to the species of *Ropalidia (Anthreneida)*

1. Second gastral tergite and sternite not fused ..... *santoshae* Das and Gupta

– Second gastral tergite and sternite fused 2

2. Gastral petiole 2-2.2x as long as wide, swollen toward apex and narrowed apically; propodeum with a narrow and uniform median groove; second gastral tergite petiolate basally and obliquely cut off apically .... *fasciata* (Fabricius)

– Gastral petiole 1.5x as long as wide, gradually swollen apically and not narrowed apically; median groove of propodeum wider; second gastral tergite not petiolate basally and vertically cut of apically .... *cyathiformis* (Fabricius)

3. ***Ropalidia (Anthreneida) santoshae*** Das and Gupta

1989. *Ropalidia (Anthreneida) santoshae* Das and Gupta, *Oriental Ins. Monogr.*, 11 : 123, M. F. des

2003. *Ropalidia (Anthreneida) santoshae* Das and Gupta Jonathan and Kundu, *Zool Surv India, Fauna of Sikkim, State Fauna Series*, 9 (Part 4) : 382

Material examined : India : Arunachal Pradesh : Kameng Division : Bokhar, 699-761 m., 1 female, 28.v.1961, coll. F. Schmid (Gupta collection).

Distribution : India : Arunachal Pradesh, Meghalaya, Sikkim, West Bengal.

Remarks : This is a district species by having strong reticulate punctures on head and thorax and almost complete median groove of propodeum (Das and Gupta, 1989).

4. ***Ropalidia (Anthreneida) fasciata*** (Fabricius)

1804. *Eumenes fasciata* Fabricius, *Syst. Piez.* : 290, des.

1989. *Ropalidia (Anthreneida) fasciata* (Fabricius) : Das and Gupta, *Oriental Ins. Monogr.*, **11** : 140.

2003. *Ropalidia (Anthreneida) fasciata* (Fabricius) : Jonathan and Kundu, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series*, **9** (Part 4) : 383.

Material examined : India : Arunachal Pradesh : Rotung, 1 male, 25.x.1911, coll. S.W. kemp (Z.S.I. Collection).

Distribution : India : Arunachal Pradesh, Sikkim, Meghalaya, Assam, Tripura, Uttaranchal, West Bengal, Maharastra.

Elsewhere : Myanmar, Nepal, South China, Ryukyus, Malaysia (Sarawak), Indonesia (Sumatra, Bali, Flores), Philippines.

Remarks : This species resembles superficially *R.(A.) variegata variegata* (Smith, 1852) in general colour, but can be distinguished by having its greater size and shape of gastral petiole and second gastral tergite. It is also differentiated from *R. (A.) colorata colorata* van der vecht, 1941 by its petiole being strongly swollen apically and then narrowed again at apex, and second gastral tergite being petiolate at base (Das and Gupta, 1989).

5. ***Ropalidia (Anthreneida) cyathiformis*** (Fabricius)

1804. *Eumenes cyathiformis* Fabricius, *Syst. Piez.* : 289, F, des.

1989. *Ropalidia (Anthreneida) cyathiformis* (Fabricius) : Das and Gupta, *Oriental Ins. Monogr.*, **17** : 143, *cat., syn., ref., distr.*

Distribution : India : Arunachal Pradesh, Assam, Uttaranchal, Bihar, Madhya Pradesh, Maharastra, Karnataka.

Elsewhere : Sri Lanka, Nepal, Malaysia, Indonesia, (Sulawesi, Sumba).

Remarks : Das and Gupta (1989) gave detailed account of this species and mentioned "Arunachal Pradesh" as one of its localities in distribution.

3. Tribe **Polybiini**

In India the tribe Polybiini is represented by three genera, viz., *Belonogaster* Saussure, 1853, *Parapolybia* saussure, 1853 and *Polybioides* Buysson, 1913. Only the genus *Parapolybia* is the sole representative from the state of Arunachal Pradesh.

4. Genus ***Parapolybia*** Saussure

1853. *Polybia (Parapolybia)* Saussure, *Étude Famille Vespides*, **2** : 207.

1989. *Parapolybia* Saussure : Das and Gupta : *Oriental Ins., Monogr.*, **11** : 176.

Type-species : *Polybia (Parapolybia) indica* Saussure, 1853.

The genus *Parapolybia* is represented by three species, viz., *varia* (Fabricius, 1787), *indica* (Saussure, 1853) and *nodosa* van der Vecht, 1966 in India. Of these, only two species, *varia* and *indica* have been reported from Arunachal Pradesh, which can be distinguished by the following key.

Key to the species of *Parapolybia*

1. Occipital carina incomplete; interocular distance at clypeus about as long as or shorter than at vertex level; gastral petiole shorter than head width 2

– Occipital carina complete, interocular distance more at clypeus than at vertex level; gastral petiole 1.3x as long as head width .... *indica* (Saussure)

2. Median groove of propodeum shallow; second gastral tergite with yellow marked at base.

..... *varia* (Fabricius)

– Median groove of propodeum wide; second gastral tergite without yellow marked at base (not recorded from Arunachal Pradesh)..... .....*nodosa* van der vecht

6. *Parapolybia varia* (Fabricius)

1787. *Vaspa varia* Fabricius, *Mant. Insect.*, 1 : 293, des.

1983. *Parapolybia varia* (Fabricius) : Das and Gupta. *Oriental Ins.*, 17 : 430, cat., syn.

2003. *Parapolybia varia* (Fabricius) : Jonathan and Kundu, *Zool Surv. India, Fauna of Sikkim, State Fauna Series*, 9 (Part 4) : 383.

Distribution : India : Arunachal Pradesh, Sikkim, Assam, Meghalaya, Manipur, Himachal Pradesh, Punjab, Uttar Pradesh, Uttarachal, Delhi, West Bengal.

Elsewhere : Nepal, Myanmar, Philippines, Malaysia (Malay, Sarawak), China, Japan, Indonesia (Sulawesi, Sumbawa, Sumba).

Remarks : Das and Gupta (1989) mentioned that *Parapolybia varia* is a highly variable species and they *(op. cit.)* identified and described several colour varients from various localities. Jonathan *et al.* (2000) noted "Arunachal Pradesh" as one of its localities.

Parapolybia indica (Saussure)

This species is represented by three subspecies, viz., *indica indica* (Saussure, 1853), *indica fulvinerva* (Cameron, 1900) and *indica tinctipennis* (Cameron, 1900) in India. Of these, only *indica tinctipennis* is recorded here from the state of Arunachal Pradesh.

7. *Parapolybia indica tinctipennis* (Cameron)

1900. *Icaria tinctipennis* Cameron, *Ann. Mag. Nat. Hist.*, (7) 6 : 503, F, des.

1989. *Parapolybia indica tinctipennis* (Cameron) : Das and Gupta. *Oriental Ins. Monogr.*, 11 : 179.

Material examined : India : Arunachal Pradesh : Upper Rotung, 2 females, i.1912, coll. S.W. Kemp (Z.S.I. Collection).

Distribution : India : Arunachal Pradesh, Meghalaya, Assam.

Remarks : This subspecies is distinguished from *P. indica indica* (Saussure, 1853) by having gastral petiole 2.8x as long as head width (Das and Gupta, 1989).

3. Subfamily VESPINAE

This is morphologically the most specialized subfamily of the social wasps. Component species are commonly called hornets (those nesting above ground) and yellow jackets (those nesting usually subterraneously). The nests consist of several to many combs of hexagonal cells composed of paper; cells constructed early in the year may be used for several larvae in succession. The combs are usually enclosed in a paper envelope. The nests are annual, new queens and males being produced late in the summer or early in the rain; the newly fertilized queens overwinter and begin new nests in the spring. There are relatively a few precise records of the nests used to feed vespine larvae; appearently dismembered and masticated adult Diptera and honeybees are commonly used; the wasps may also obtain bits of flesh from fresh and decaying carcasses. Adult vespines feed on liquid foods, primarily nectar or honey; some species are known to prey upon adult honey-bees, which they kill and extract nectar from the crop.

Diagnostic characters : Apical margin of clypeus broadly truncate or concave medially and emarginate laterally, ending in two rounded lateral lobes; mandibles short and wide; maxillary palps 6-segmented; labial palps 4-segmented; antenna 12-segmented in female and worker and 13-segmented in male; mesepimeron separated from mesepisternum by a suture; hind margin of postscutellum produced in the middle forming a long, triangular lobe wedged in the upper part of the propodeum; gaster subsessile, first tergite with a distinect edge or rounded angle between the anterior vertical and the posterior borizontal face.

This subfamily is represented by four genera, viz., *Vespa* Linnaeus, 1758; *Provespa* Ashmead, 1903; *Vespula* Thomson, 1869 and

Dolichovespula Rohwer, 1916 from Indian subregion. Of these, the first two genera have been reported from Arunachal Pradesh. These can be distinguished by the follwing key.

Key to the genera of Vespinae

1. Head small, with short vertex and narrow temples; ocelli very large, posterior ocelli much closer to the eyes than to each other, about as far from the occiput as from the eyes; carina on hind coxa incomplete, absent ventrally from posterior surface; fore wing with large stigma, basal vein joining subcosta close to stigma; first cubital cell very long, as long as the distance of its apex to the tip of the wing; first gastral segment cup-shaped, the tergite convex anteriorly. Coloration uniformly brown, clypeus sometimes brownish. Nocturnal in habits. Colonies founded by swarming ..... ***Provespa*** Ashmead

– Head large, with long vertex and broad temples. Ocelli normal (except in *Vespa binghami);* interocellar distance shorter than ocellocular distance; hind coxa with a carina on its posterior surface; fore wing with short to inconsplcuous stigma, basal vein joining subcosta at a distance of 1.0-3.0x the length of stigma; first cubital cell shorter than the distance between its apex and the tip of fore wing; first gastral segment transverse, the tergite truncate and abruptly sloping anteriorly. Coloration predominantly yellow, brown and/ or black. Large size; length varying from 14-40 mm. Diurnal in habits. Colonies founded by female only ..... ***Vespa*** Linnaeus

5. Genus *Vespa* Linnaeus

1758. *Vespa* Linnaeus, *Systema Naturae,* (10th Ed.), **1** : 343.

Type-species : *Vespa crabro* Linnaeus, 1758.

1983. *Vespa (Vespa)* Linnaeus : Das and Gupta, *Oriental Ins.,* **17** : 435.

1987. *Vespa* Linnaeus : Carpenter, *Syst. Ent.,* **12** : 426.

1989. *Vespa* Linnaeus : Das and Gupta : *Oriental Ins., Monogr.,* **11** : 199.

2003. *Vespa (Vespa)* Linnaeus : Jonathan and Kundu, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series* **9** (Part 4) : 385.

The genus *Vespa* is represented by more than 20 species/subspecies from Indian subregion. Of these, seven species/subspecies, viz., ***biolor*** Fabricius, 1787; *basalis* Smith, 1852; *mandarinia magnifica* Smith, 1852; *tropica tropica* (Linnaeus, 1758); *tropica ducalis* Smith, 1852; *tropica leefmansi* van der Vecht, 1957 and *velutina auraria* Smith, 1852 have been recorded here from the state of Arunachal Pradesh. These can be recognised by the following key.

Key to the species and subspecies of *Vespa*

(Female and worker : antenna 12-segmented, gaster 6-segmented)

(After van der Vecht, 1957, 1959)

1. Head strongly widened and produced behind the eyes; temple in profile view more than 2x as wide as eye. Clypeus coarsely punctate, strongly emarginate apically; temple and mesopleuron finely and sparsely punctate in lower half ..... *mandarinia magnifica* Smith

– Head normal; temple almost 1.5x as wide as eye 2

2. Clypeus coarsely punctate or lower vertical area of pronotum with distinct transverse striation; thora black and head blac to red, not marked with yellow; gaster brown with tergite 2 yellow ..... *tropica* (Linnaeus)

– Clypeus subpolished, with scattered punctures; lwer vertical area of pronotum without distinct transverse ridges; head, thorax and gaster black to brown, with reddish or yellow areas 3

3. Gaster largely black; apical half of clypeus impunctate, its apical emargination shallow and without lateral lobes, middle tibia with long hairs, hairs longer than the width of tibia;

postscutellum brown. Body hairs yellowish-brown ..... *basalis* Smith

– Gaster black or yellow; apical 0.33 of clypeus with more crowded punctures, its apical margin clearly emarginate forming lateral lobes; middle tibiae with a few long hairs. Body hairs black 4

4. Gaster largely yellow, frons, vertex and mesoscutum sparsely hairy; gaster covered with dense erect hairs; hairs on second tergite about as long as the width of hind basitarsus; body largely yellow with mesoscutum black ..... *bicolor* Fabricius

– Gaster largely black; frons, vertex and mesoscutum with dense long hairs; gaster with short, less conspicuous hairs; on second tergite shorter than the width of hind basitarsus; body extensively black, or the mesoscutum partly orange-yellow ..... *velutina*

– Head, thorax and gaster smooth with a fine silky appearance, hairs scattered and erect; mesoscutum dark-brown with a U-shaped mark. Wings brownish-hyaline .... *velutina auraria* Smith

(Male : antenna 13-segmented, gaster 7-segmented)

1. Head large and swollen (as in the worker) (Maler space comparatively longer, tyloids present on segments 4-13, apical margin of 6th and 7th tergites shallowly emarginate... ..... *mandarinia magnificia* Smith

– Head normal 2

2. Sides of clypeus not touching the eyes, seperated from them by narrow extensions of inner orbits 3

– Sides of clypeus touching the eyes .... *basalis* Smith

3. Emargination of 6th gastral sternite broad and semi-elliptical, its sides curving gradually towards sides of hind margin; fourth antennal segment with only the basal tyloid; clypeus rather coarsely punctate .... *tropica* (Linnaeus)

– Emargination of 6th gastral sternite as wide as deep, with angular edges : fourth antennal segment with 2 tyloids; clypeus finely pundtate 4

4. Body yellow, vertex and mesoscutum black; junction of postscutellum and propodeum with a Y-shaped black mark .... *bicolor* Fabricius

– Body more extensively black, or mesoscutum partly orange, yellow ..... *Velutina*

– Fore femur basally in front, fore coxa posteriorly and middle and hind coxae and femora black; middle tibia except at apex and hind tibia in front and a spot at apex, black ..... *velutina auraria* Smith

8. *Vespa basalis* Smith

1852. *Vaspa basalis* Smith, *Trans Ent. Soc. London* (N S 0. 2 (2) : 46. des.

1983. *Vaspa (Vespa) basalis* Smith : Das and Gupta, *Oriental Ins.*, 17 : 438. syn., ref.

1989. *Vespa basalis* Smith : Das and Gupta, *Oriental Ins Monogr.*, 11 209.

2003. *Vespa (Vespa) basalis* Smith : Jonathan and Kundu, *Zool Surv. India, Fauna of Sikkim. State Fauna Series.* 9 (Part 4) : 387.

Material examined : India : Arunachal Pradesh : Kameng Division : Assoni, Sonai Rupai Forest, 12 exs., 2.xii.1965, coll. S.K. Bhattacharya and A.N.T. Joseph; Siang Division : Likhabali River Bank, 2 exs., 6.x.1966, coll. S.K. Tandon and G.S. Arora; Siji villa, 1 ex., 8.x.1966, coll. S.K. Tandon and G.S. Arora; Dali vill, 2 exs., 10.x.1966, coll. S.K. Tandon and G.S. Arora; Peyniny vill., 1 ex., 15.x.1966, coll. S.K. Tandon and G.S. Arora, New Jining, 1 ex., 18.x.1966, coll. S.K. Tandon and G.S. Arora; Old Jining, 1 ex., 20.x.1966, coll. S.K. Tandon and G.S. Arora; Namdhapa : Deban, 1 ex., 28.iv.1981, coll. S. Biswas and Party, Gibbon land, 1 ex., 2.v.1981, coll. S. Biswas and Party; Parum Pare : Ganga Lake, 1 ex., 10.10.2001, coll. R.N. Tiwari and Party.

Distribution : India : Arunachal Pradesh, Meghalaya, Assam, Sikkim, West Bengal.

Elsewhere : Sri Lanka, Nepal, Myanmar, Thailand, China, Indochina, Taiwan, Japan, Indonesia (Sumatoca).

Remarks : This species is different from auother species, *v. mocsaryana* Buysson, 1903 by having antenna long and slender, fourth segment 2x as long as wide, without tyloids; clypeus sparsely and shallowly puctate; middle and hind tiiae lensely covered with long hairs.

*9. ***Vespa bicolor*** Fabricius

1787. *Vespa bicolor* Fabricius, *Mant. Inectorum*, **1** : 288, des.

1983. *Vaspa (Vespa) bicolor* Fabricius : Das and Gupta, *Oriental Ins.*, **17** : 439, cat., syn., distr.

1989. *Vespa bicolor* Fabricius : Das and Gupta, *Oriental Ins. Monogr.*, **11** 209.

2003. *Vespa (Vespa) bicolor* Fabricius : Jonathan and Kundu, *Zool Surv. India, Fauna of Sikkim, State Fauna Series*, **9** (Part 4) : 387.

Material examined : India : Arunachal Pradesh : Siang Division : likhabali River Bank, 2 exs., 6.x.1966, coll. S.K. Tandon and G.S. Arora; Dali camp, 1 ex., 12.x.1966, coll. S.K. Tandon and G.S. Arora; Kamang, 5 exs., 15.x.1966, coll. S.K. Tandon and G.S. Arora; New Jining, 2 exs., 18.x.1966, coll. S.K. Tandon and G.S. Arora; Old Jining, 4 exs., 20.x.1966, coll. S.K. Tandon and G.S. Arora, Tappi, 1 ex., 23.x.1966, coll. S.K. Tandon and G.S. Arora; Subansiri Division : Daprijo, 4 exs., 27.x.1966, coll. S.K. Tandon and G.S. Arora; Kameng Division : Rupa, 1 ex., 16.iv.2001, coll. R.N. Tiwari and Party.

Distribution : India : Arunachal Pradesh, Assam, Meghalaya, Sikkim, Uttaranchal, West Bengal.

Elsewhere : Myanmar, Bhutan, China, Indochina, Japan.

Remarks : This is the first record of this species from the state of Arunachal Pradesh.

10. ***Vespa mandarinia magnifica*** Smith

1852. *Vespa magnifica* Smith, *Trans. Ent. Soc. Lond.* (N.S.), **2** (2) : 45, des.

1959. *Vaspa (Vespa) mandarinia magnifica* Smith : Van der Vecht, *Zool. Meded.*, **36** (13) : 220.

1989. *Vespa mandarinia magnifica* Smith : Das and Gupta, *Oriental Ins. Monogr.*, **11** 212.

2003. *Vespa (Vespa) mandarinia magnifica* Smith : Jonathan and Kundu, *Zool Surv. India, Fauna of Sikkim, State Fauna Series*, **9** (Part 4) : 387.

Material examined : India : Arunachal Pradesh : Kameng Division : Khelong, 1 ex., 19.ix.1961, coll. S. Biswas; Tanga Reserve Forest, 2 exs., 19.xii.1965, coll. S. Biswas; Dirang, Munna, 1 ex., 13.10.2001, coll. R.N. Tiwari and Party; Subansiri Division : Chukru, 1 ex., 22.v.1966, coll. A.N.T. Joseph; Siang Division : Dalo vill, 1 ex., 10.x.1966, coll. S.K. Tandor and G.S. Arora; Tappi, 1 ex., 22.x.1966, coll. S.K. Tandon and G.S. Arora; Bame, 1 ex., 30.x.1966, coll. S.K. Tandon and G.S. Arora.

Distribution : India : Arunachal Pradesh, Sikkim, Assam, Meghalaya, Himachal Pradesh, West Bengal, Uttaranchal.

Elsewhere : Nepal, Sri Lanka, Myanmar, Bhutan, China, Indochina, Malaysia, Taiwan, Thailand.

Remarks : This is a distirct subspecies having the head orange-red, thorax black and gaster reddish-brown with narrow apical bands on first to fifth tergites the tip of gaster yellowish-brown.

Vespa tropica (Linnaeus)

Das and Gupta (1989) reporte five subspecies, *Viz., tropica tropica* (Linnaeus, 1758); *tropica ducalis* Smith, 1852; *tropica eulemoides* Buysson, 1905; *tropica haematodes* Bequaert, 1936 and *tropica leefmansi* van der Vecht, 1957 from India. Of these, three subspecies are known from Arunachal Pradesh. These can be distingished by the following key.

Key to the subspecies of *tropica*

1. First gastral tergite extensively merked with organge-yellow; second gastral tergite bicolored, mostly reddish-brown with a broad apical yellow band, rarely with a black line in-between; third gastral tergite and sternite narrowly margined with yellow; wings uniformly yellowish-brown, darker basally and along costa ..... *tropica ducalis* Smith

– First gastral tergite black, rarely with a small yellowish spots; second gastral tergite and sternite mostly orange or orange-yellow; wings darker 2

2. Orange band on second sternite deeply emarginate basally, the dark basal area extending to or beyond the middle of the sternite; infuscated area at base of wing relatively small; fist discoidal cell almost entirely yellowish ..... *tropica tropica* (Linnaeus)

– Second sternite more extensikely orange, the dark area at base not reaching the middle of the segment; wings more extensively infuscated; first discoidal cell almost entirely infuscated ..... *tropica leefmansi* van der Vecht

11. *Vespa tropica tropica* (Linnaeus)

1758. *Sphex tropica* Linnaeus, *Systema Naturae*, (10th Ed.), 1 : 571, F, des.

1797. *Vespa cincta* Fabricius, 1775 : Bingham, *Fauna British India, Hymenoptera*, 1 : 420, F, W, des., fig.

1936, *Vespa tropica tropica* (Linnaeus) : Bequaert, *Treubia*, 15 : 328, key, des., fig.

1983. *Vespa (vespa) tropica tropica* (Linnaeus) : Das and Gupta, *Oriental Ins.*, 17 : 444, cat., syn., ref., distr.

1989. *Vespa tropica tropica* (Linnaeus) : Das and Gupta, *Oriental Ins. Monogr.*, 11 : 218, syn., des., distr.

2000. *Vespa (Vespa) tropica tropica* (Linnaeus) : Jonathan *et al.*, *Zool Surv. India, State Fauna Series* 4 : *Fauna of Meghalaya* (Part 7) : 149.

Material examined : India : Arunachal Pradesh : Kameng Division : Rangapara, 2 exs., 1.ix.1965, coll. S.K. Bhattacharya; Bomdila, Tanga Valey, 1 ex., 15.10.2001, coll. R.N. Tiwari and Party; Subansiri Division : Dejoo, 1 ex., 10.v.1966, coll. A.N.T. Joseph; Daparijo, 1 ex., 7.x.2000; coll. S. Sheela and party; Namdhapa : Deban more, 1 ex., 28.iv.1981, coll. S. Biswas and party.

Distribution : India : Arunachal Pradesh, Meghalaya, West Bengal.

Elsewhere : Bhutan, Myanmar, Hong-Kong, Indochina, Malaysia, Indonesia, Wallacea, central Asia, South America, Australia and Palaearctic regions.

Remarks : This is one of the most common hornet of the Orisental region. They are large black or reddish-brown wasps with first and second or only second gastral segment partly or wholly orange or orange-brown.

*12. *Vespa tropica ducalis* Smith

1852. *Vespa ducalis* Smith, *Trans Ent. Soc London*, 2 (2) : 39, M, F, W, des.

1936. *Vespa tropica ducalis* Smith : Bequaert, *Treubia*, 15 : 342, key, des.

1983. *Vespa (vespa) tropica ducalis* Smith : Das and Gupta, *Oriental Ins.*, 17 : 444, cat., distr.

1989. *Vespa tropica ducalis* Smith : Das and Gupta, *Oriental Ins. Monogr.*, 11 : 220, des., distr.

2003. *Vespa (Vespa) tropica ducalis* Smith : Jonathan and Kundu, *Zool Surv. India, Fauna of Sikkim. State Fauna Series*, 9 (Part 4) : 388.

Material examined : India : Arunachal Pradesh : Siang Division : Riwi Bridge, 1 ex., 11.x.1966; Kambang, 4 exs., 14.x.1966, coll. S.K. Tandon and G.S. Arora; New Timing, 1 ex., coll. S.K. Tandon and G.S. Arora; Tappi, 1 ex., 22.x.1966, coll. S.K. Tandon and G.S. Arora; Kameng Division : Bhalukpong : sessa, 1 ex., 20.x.2001, coll. R.N. Tiwari and party; Subansiri Division : Daporizo, 1 ex., 28.x.1966, coll. S.k. Tandon and G.S. Arora; zero, 1 ex., 10.x.2000, coll. S. Sheela and Party.

Remarks : This subspecies is recorded here for the first time from the state of Arunachal Pradesh.

13. ***Vespa tropica leefmansi*** van der Vecht

1957. *Vespa tropica leefmansi* van der Vecht, *Zool. Verh.*, **34** : 19, M, F, key., des.

1983. *Vespa (vespa) tropica leefmarsi* van der Vecht : Das and Gupta, *Oriental Ins.*, **17** : 445, cat., syn.

1989. *Vespa tropica leefmansi* van der Vecht : Das and Gupta, *Oriental Ins. Monogr.*, **11** : 219.

1999. *Vespa (Vespa) tropica leefmansi* van der Vecht : Jonathan *et al.*, *Zool Surv. India, Fauna of West Bengal, State Fauna Series*, **3** (Part 8) : 175.

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

Elsewhere : Myanmar, Thailand, Indochina, Malaysia.

Remarks : While reporting this subspecies from West Bengal, Jonathan *et al.* (1999) mentimed "Arunachal Pradesh" as one of its localities in distribution.

*14. ***Vespa velutina auraria*** Smith

1852. *Vespa auraria* Smith, *Trans. Ent. Soc. London*, (N.S.), **2** : 46, F. des., fig.

1957. *Vespa velutina auraria* Smith : *Zool. Verh.*, **34** : 34.

1983. *Vespa (vespa) velutina auraria* Smith : Das and Gupta, *Oriental Ins.*, **17** : 446, cat., syn., ref., distr.

1989. *Vespa veltina auraria* Smith : Das and Gupta, *Oriental Ins. Monogr.*, **11** : 223, des., distr.

2003. *Vespa (Vespa) velutina auraria* Smith : Jonathan *et al.*, *Zool Surv. India, Fauna of Meghalaya, State Fauna Series*, **4** (Part 7) : 149.

Material examined : India : Arunachal Pradesh : Namdhapa, 2 exs., 11.iii.1969, coll. S.k. Tandon; Parum Pare : Bander dewa, 1 ex., 10.x.2001, coll. R.N. Tiwari and Party.

Distribution : India : Arunachal Pradesh, Meghalaya, Assam, Jammu and Kashmir, Uttaranchal, Himachal Pradesh.

Elsewhere : Nepal, Myanmer.

Remarks : This is the first record of this subspecies from the state of Arunachal Pradesh.

6. Genus ***Provespa*** Ashmead

1903. *Provespa* Ashmead, *Ent. News*, **14** : 182.

Type-species : *Vespa anomala* Saussure, 1853 (= *V. dorylloides* Saussure, 1853).

Provespa is known by three species : *P. anomala* (Saussure, 1853); *P. barthelemyi* (Buysson, 1905) and *P. nocturna* van der Vecht, 1936. Das and Gupta (1989) reported first two species, *anomala* and *barthelemyi* from Indian subregion. Of these, only *P. anomala* is recorded here from the state of Arunachal Pradesh, which is detailed below :

15. ***Provespa anomala*** (Saussure)

1853. *Vespa anomala* Saussure, *Étude Famille Vespides*, **2** : 112, F, des., fig.

1853. *Vespa dorylloides* Saussure, *Étude Famille Vespides*, **2** : 256.

1989. *Provespa anomala* (Saussure) : Das and Gupta, *Oriental Ins. Monogr.*, **11** : 227.

2003. *Provespa anomala* (Saussure) : Jonathan and Kundu. *Zool Surv. India, Fauna of Sikkim, State Fauna Series*, **9** (Part 4) : 389.

Diagnostic characters : *Female* : Body 14-15 mm in length. : Head, thorax and gaster impunctate, largely smooth and shiny; head and thorax somewhat densely and gaster sparsely pubescent. Head as broad as thorax; clypeus slightly longer than wide; vertex narrow; eyes touching the base of mandible and on vertex almost close to lateral ocelli. scutellum and metascutellum raised; gaster long and narrow.

Body colour brownish-yellow (honey colour). Inner emarginate area of eye, area arround ocellar triangle, apical tarsal segment, hind margin of first two-third gastral tergites, yellowish-brown. Wings clear hyaline, colour largely variable.

Worker : Body 10-12 mm in length. Similar to the female, but body slightly smaller.

Material examined : India : Arunachal Pradesh : Tirap Dist. : Mao, 1 ex., 26.i.1962, coll. C.B. Srivastava; Daphabum Expedition : 2 exs., 3.xii.1969, coll. J.M. Julka; Namdhapa : 1 ex., 11.iii.1969, coll. S.K. Tandon; 1 ex., 18.iv.1981, coll. S. Biswas and party; Gibbonland, 2 exs., 2.v.1981, coll. S. Biswas and party; Miao, 1 ex., 5.v.1981, coll. S. Biswas and party.

Distribution : India : Arunachal Pradesh, Meghalaya, Sikkim, West Bengal, Uttar Pradesh.

Elsewhere : Myanmer, Malaysia, Indonesia.

B. Family APIDAE

The family Apidae contains the highly social insects – honey-bees, stingless honey-bees and bumble-bees. Most of the bees are Polylectic, *i.e.* they gather pollen or nectar from wide variety of flowers, and some are Oligolectic, which gather pollen from only a few species of related flowers (Michener, 1965). They collect nectar for honey which is widely used for medical purpose. They also help in polination while moving from flower to flower. The sting of bees is fierce and painful, when it bites someone.

The family Apidae is recognised by the following characters : Labrum wider than long; subantennal suture or groove usually directed toward inner margin of antennal socket; eye small; labial palpus with segments 1 and 2 long, flattened and sheathlike; glossa or tongue elongated and pointed (long tongued bees); fore wing generally with three submarginal cells (except in *Trigona*) ; hind tibial spurs absent (except in *Bombus*); inner apical margin of hind tibia (except in some queens) provided with comb of stiff setae; scopa of female (absent in most queens) consists of fringe of long hairs surrounding large smooth shining area, thus forming a corbicula on outer surface of hind tibia; pygidial plate completely absent (Michener, 1965; Goulet and Huber, 1993).

Key to the subfamilies of Apidae

1. Hind tibial spurs absent; small and moderate-sized bees ..... APINAE

– Hind tibial spurs present; large, robust bees ..... BOMBINAE

1. Subfamily APINAE

The subfamily Apinae contains the true honey-bees and the stingless honey-bees. They are mostly common in south-east Asia. Queens and workers differ greatly in morphology. The colonies are perennial, which contain thousands of individuals (Goulet and Huber, 1993).

Two tribes, viz., Apini and Meliponini, under this subfamily are known from the state of Arunachal Pradesh. These can be recognised by the following key.

Key to the tribes of APINAE

1. Apex of marginal cell closed; veins forming submarginal cells strong; sting of females functional ..... **Apini**

– Apex of marginal cell open; veins forming submarginal cells weak or absent; sting not functional, nver exserted ..... **Meliponini**

1. Tribe Apini

The tribe Apini includes here the true honey-bees *(Apis)* from the state of Arunachal Pradesh, which is detailed below :

1. Genus *Apis* Linnaeus

1758. *Apis* Linnaeus, *Systema naturae* : 343, 574

Type-species : *Apis mellifera* Linnaeus, 1758 (= *Apis mellifica* Linnaeus, 1761).

The genus *Apis*, specially its type-species, *Apis mellifera* Linnaeus, 1758, is familiar and distributed throughout the world. Some other species are also found in both south and east Asia. Three species, viz., *indica* Fabricius, *dorsata* Fabricius and *florea* Fabricius under the genus *Apis* are known to occur in the state of Arunachal Pradesh, India. Of these, the *dorsata* is the largest species which belongs to subgenus *Apis (Megapis)* and the *florea* is the smallest species which belongs to

subgenus *Apis (Micrapis)*, but here *indica* does not belong to any subgenus. The above two subgenera are restricted to Oriental region, specially in Southern Asia, the Philippine Islands, and Indonesia, which was noted by Michener (1965). Prior to this, Maa (1953) characterized these subgenera and reported *A. (Megapis) dorsata* Fabricius from Kai Island. A key is given below to distinguish the above three reported species from Arunachal Pradesh.

Key to the species of *Apis*

1. Body large size, worker 16-18 mm in length ..... *(Megapis) dorsata* Fabricius
- Body small in size 2
2. Body smaller, length of worker 11-12 mm. ..... *indica* Fabricius
- Body very small in size, length of worker 8 mm. ..... *(Micrapis) florea* Fabricius

1. *Apis indica* Fabricius

1798. *Apis indica* Fabricius : *Ent. Syst. Suppl.* (1798) : 274.

2003. *Apis indica* Fabricius : Ray, *Zool. Surv. India, Fauna of Sikkim, State Fauna Series*, **9** (Part-4) : 510.

Material examined : India : Arunachal Pradesh : Kameng Division : Assomi Sonai Rupai, 1 ex., 2.xii.1965, coll. S.K. Bhattacharya and A.N.T. Joseph; Dhukampani, 10 exs., 5-6.xii.1965, coll. S.K. Bhattacharya and A.N.T. Joseph; Tenga 'R', 3 exs., 18-19.xii.1965, coll. S.K. Bhattacharya and A.N.T. Joseph; Bolepara, 1 ex., 29.xii.1965, coll. S.K. Bhattacharya and A.N.T. Joseph; Pinjuli, 16 exs., 4.v.1966, coll. A.N.T. Joseph and party; Dengling forest, 6 exs., 5.v.1966, coll. A.N.T. Joseph; Tipi, 2 exs., 6.v.1966, coll. A.N.T. Joseph and party; Bomdila, 4 exs., 22.v.1966, coll. A.N.T. Joseph and party; Subansiri Division : Tamen, 4 exs., 19-20.v.1966, coll. A.N.T. Joseph and party; Papumpare : Naharlagun, 3 exs., 19.iv.2001, coll. Sheela and party; Banderdewa, 2 exs., 10.x.2001, coll. R.N. Tiwari and party.

Distribution : India : Arunachal Pradesh, Sikkim and almost throughout the country.

Elsewhere : Myanmar, Sri Lanka, Malaysia, Madagascar.

2. *Apis (Megapis) dorsata* Fabricius

1793. *Apis dorsata* Fabricius : *Ent. Syst.* **2** : 328.

1904. *Apis (Megapis) dorsata* Fabricius : Ashmead, *Proc. Ent. Soc. Wash.*, **6** : 120.

1985. *Apis (Megapis) dorsata* Fabricius : Roy and Kundu, *Rec. zool. Surv. India*, **82** (1-4) : 221.

Material examined : India : Arunachal Pradesh : Kameng Division : Sonai Rupai forest Missawari, 4 exs., 30.xi.1965, coll. S.K. Bhattacharya and A.N.T. Joseph; Bhalukpong, 4 exs., 25.xii.1965, coll. S.K. Bhattacharya and A.N.T. Joseph; Pinjuli, 4 exs., 4.v.1966, coll. A.N.T. Joseph and party; Denling forest, 10 exs., 5.v.1966, coll. A.N.T. Joseph and party; Subansiri Division : Kimin, 1 ex., 9.v.1966, coll. A.N.T. Joseph and party; Pamir, 3 exs., 17.v.1966, coll. A.N.T. Joseph and party; Siang Divison : Dali vill, 11 exs., 10.x.1966, coll. S.K. Tandon and G.S. Arora; West Kameng Dist. : Tippi, 5 exs., 28.iv.2001, coll. Sheela and party; Papumpare : Itanagar, Ganga Lake, 6 exs., 10.x.2001, coll. R.N. Tiwari and party.

Distribution : India : Arunachal Pradesh and almost throughout the country.

Elsewhere : Myanmar, Sri Lanka, China, Indonesia, Malaysia.

3. *Apis (Micrapis) florea* Fabricius

1787. *Apis florea* Fabricius : *Mant. Insect.*, **1** : 305.

1904. *Apis (Micrapis) florea* Fabricius : Ashmead, *Proc. Ent. Soc. Wash.*, **6** : 122.

1985. *Apis (Micrapis) florea* Fabricius : Roy and Kundu, *Rec. zool. Surv. India*, **82** (1-4) : 222.

Material examined : India : Arunachal Pradesh : Namdhapa, Deban, 7 exs., 27.iv.1981, coll. S. Biswas and party; Lower Subansiri : Yazli, 5 exs., 15.iv.2001, coll. Sheela and party; West Kameng : Bomdila, 5 exs., 14.x.2001, coll. R.N. Tiwari and party.

Distribution : India : Arunachal Pradesha, Assam, Karnataka, Kerala, Sikkim, Tamilnadu, Uttaranchal, West Bengal and almost throughout the country.

Elsewhere : Malaysia, Myanmar, Indonesia, (Java), Sri Lanka, and also in Europe.

2. Tribe **Meliponini**

The tribe Meliponini is represented here only by the single genus *Trigona* Jurine, 1807, the stingless honey-bee.

2. Genus ***Trigona*** Jurine

1807. *Trigona* Jurine, *Nouv. Méth. class. Hym.* : 245.

Type-species : *Apis amalthea* Olivier, 1789.

The genus *Trigona* consists of small, dark, stingless honeybees which live in large colonies; only the workers are commonly seen on flowers. The reduced wing venation is very distinctive (Michener, 1965).

2 species, viz., *laeviceps* Smith, 1858 and *ventralis* Smith, 1858 under the genus *Trigona* have been reported here from Arunachal Pradesh. These can be distinguished by the following key.

Key to the species of *Trigona*

1. Basal abdominal segment and abdomen beneath markedly white or testaceous white ..... *ventralis* Smith

– Basal abdominal segment not differing markedly in colour from remaining segments ..... *laeviceps* Smith

4. ***Trigona laeviceps*** Smith

1858. *Trigona laeviceps* Smith, *J. Proc. Linn. Soc. Zool.*, 2 : 51, W.

1897. *Melipona laeviceps* : Bingham, *Fauna Brit. India, Hym.*, 1 : 563, W.

1965. *Trigona (Tetragona) laeviceps* Smith : Michener, *Bull. Amer. Mus. Nat. Hist.*, 130 : 231.

Material examined : India : Arunachal Pradesh : Siang Division : Old Jining, 2 exs., 20.x.1966, coll. S.K. Tandon and G.S. Arora; Namdhapa : Digane Road, 1 ex., 11.iii.1969, coll. S.K. Tandon; Namdhapa, 6 exs., 1986-'87, coll. S. Biswas and party; West Kameng : Bhalukpong, Kameng river side, 2 exs., 18.x.2001, coll. R.N. Tiwari and party.

Distribution : India : Arunachal Pradesha.

Elsewhere : Myanmar, Singapore, New Guinea, Australia.

Remarks : *Trigona laeviceps* is a common species. It builds its nest often in crevices in the brickwork of the walls of houses (Bingham, 1897).

5. ***Trigona ventralis*** Smith

1858. *Trigona ventralis* Smith, *J. Proc. Linn. Soc. Zool.*, 2 : 50, W.

1897. *Melipona ventralis* : Bingham, *Fauna Brit. India, Hym.*, 1 : 562, W.

1985. *Trigona ventralis* Smith : Roy and Kundu, *Rec. zool. Surv. India*, 82(1-4) : 223.

Material examined : India : Arunachal Pradesh : Namdhapa, Digane Road, 7 exs., 11.iii.1969, coll. S.K. Tandon and party; Namdhapa, 1 ex., 22.iv.1981, coll. S. Biswas and party; Lower Subansiri : Hapoli, 4 exs., 16.iv.2001, coll. Sheela and party.

Distribution : India : Arunachal Pradesh and almost throughout the country.

Elsewhere : Myanmar, Indonesia, Malacca.

2. Subfamily BOMBINAE

The subfamily Bombinae is primarily Holarctic and abundant in cool temperate regions, but it ranges south to southern corner of South America and in the Orient, to Java (Indonesia). Colonies are annual. Each colony consists of a large queen and a few hundreds of morphologically similar but smaller workers (Goulet and Huber, 1993).

This subfamily is represented by two tribes, viz., Bombini and Neotropical Euglossini. The tribe Bombini is being reported here from Arunachal Pradesh.

3. Tribe **Bombini**

The members of the tribe Bombini are known as bumble-bees. This tribe includes here only the genus *Bombus* from this state, which is detailed below :

3. Genus ***Bombus*** Latreille

1802. *Bombus* Latreille, *Hist. Nat. Ins.* : 437.

Type-species : *Apis terrestris* Linnaeus, 1758.

The genus *Bombus* contains the large, robust, hairy, black-and-red, black-and-white or black-and-yellow bumble bees. Females can be easily recognized by the combination of corbiculae on the hind tibiae and hind tibial spurs (Michener, 1965).

This genus is represented here by a single species, viz., *B. orientalis* Smith, 1854.

6. ***Bombus orientalis*** Smith

1854. *Bombus orientalis* Smith, *Cat. Hym. Brit. Mus.*, **2** : 402, W.

1985. *Bombus orientalis*, Smith : Roy and Kundu, *Rec. zool Surv. India*, **82**(1-4) : 222.

Diagnostic characters : *Female* : Body 20-24 mm in length. Head and face elongate and slightly pubescent. Clypeus convex, slightly punctured and shining. Thorax and abdomen densely pubescent. Anal segment concave, and bearing two parallel, short, broad, medial longitudinal carinae. Head, thorax, and the 3rd abdominal segement black; the basal two abdominal segments pale yellow. Wings dark fuscous with purple effulgence.

Worker : Body 15-18 mm in length. Similar to the female, with brighter yellow pubescence on the basal two abdominal segments.

Material examined : India : Arunachal Pradesh : Subansiri Division : Ziro, 3 exs., 14.v.1966, coll. A.N.T. Joseph and party; Tamen, 7 exs., 19.v.1966, coll. A.N.T. Joseph and party; Daporizo, 10 exs., 27.x.1966, coll S.K. Tandon and G.S. Arora; Siang Division : Dali, 5 exs., 10.x.1966, coll. S.K. Tandon and G.S. Arora; Kambang, 10 exs., 14.x.1966, coll. S.K. Tandon and G.S. Arora; New Jining, 3 exs., 17.x.1966, coll. S.K. Tandon and G.S. Arora; Tappi, 2 exs., 22.x.1966, coll. S.K. Tandon and G.S. Arora; West Kameng : Bhalukpong, 3 exs., 22.iv.2001, coll. Sheela and party; Rupa, 4 exs., 16.x.2001, coll. R.N. Tiwari and party.

Distribution : India : Arunachal Pradesh and almost throughout the country except in the hot, dry areas.

SUMMARY

The present paper deals with the fauna of Vespidae and Apidae, two families of Aculeate Hymenoptera, of Arunachal Pradesh, India. It incorporates 15 species/subspecies belonging to 5 genera, 3 subgenera and 2 subfamilies under the family Vespidae and 6 species belonging to 3 genera under the family Apidae. Out of these, 3 species/subspecies of Vespidae are newly recorded here from this state. The keys to the families, subfamilies, tribes, genera, species and subspecies are also provided.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. J.R.B. Alfred, Director, Zoological Survey of India, for providing necessary facilities to carry out this research work. The authors are also thankful to Dr. J.K. Jonathan, ex-Addl. Director, Dr. A.K. Hazra, Scientist-E & Division-in-charge (Entomology) and Dr. S.I. Kazmi, Scientist-B & Officer-in-charge, Hymenoptera Section, Zoological survey of India for showing their keen interest in completion of this work. Thanks are also due to Shri Rati Ram, P.P.O., Publication Scetion and all sectional staff, Hymenoptera section, Zoologcal Survey of India, Kolkata for helping in various ways.

REFERENCES

AIYAR, T.V. RAMKRISHNA. 1916-17. A catalogue of wasps and bees (Fossores, Diploptera and Anthophila) described from Indian region since 1897. *J. Bombay nat. Hist. Soc.*, **24** : 539-560, 711-721; **25** (1917) : 92-103.

ARCHER, M.E. 1980. A new species of *Dolichovespula* and subspecies of D. *pacifica* (Hymenoptera : Vespidae) from China. *Entomon*, **5** (4) : 341-344.

ARCHER, M.E. 1981. The Euro-Asian species of the *Vespula rufa* group (Hymenoptera, Vespidae), with descriptions of two new species and one new subspecies. *Kontyu*, **49** : 54-64.

ARCHER, M.E. 1987. Three new species of *Dolichovespula* (Hym., Vespidae) from China. *Ent. Monthly Mag.*, **123** : 27-31.

ASHMEAD, W.H. 1902. Classification of the fossorial, predaceous and parasitic wasps, or the superfamily Vespoidea, parts 6-8. *Canad. Ent.*, **34** : 163-166, 203-210, 219-221.

ASHMEAD, W.H. 1904. Remarks on Honey bees (Hymenoptera). *Proc. Ent. Soc. Washington*, **6** : 120-123.

BEQUAERT, J.C. 1930. On the generic and subgeneric divisions of the Vespinae (Hymenoptera). *Bull Brooklyn Ent. Soc.*, **25** : 59-70.

BEQUAERT, J.C. 1936. The common Oriental hornets, *Vespa tropica* and *Vespa affinis*, and their color forms. *Treubia*, **15** : 329-351.

BEQUAERT, J.C. 1939. The Oriental *Vespa analis* and its color froms, etc. *Trans. Amer. Ent. Soc.*, **65** : 37-42.

BEQUAERT, J.C. 1940. Notes on Oriental *Polistes* wasps (Hymenoptera : Vespidae). *Trans. Amer. Ent. Soc.*, **66** : 265-272.

BINGHAM, C.T. 1888. Notes on some bees and wasps from Burma. *J. Bombay Nat. Hist. Soc.*, **3** : 183-187.

BINGHAM, C.T. 1897. *Fauna of British India, including Ceylon and Burma, Hymenoptera*, 1. Wasps and Bees. : 579 + i-xxix. Taylor and Francis, London.

BINGHAM, C.T. 1908, Notes on Aculeate Hymenoptera in the Indian museum. *Rec Indian Mus.*, **2** 347-368 (Vespidae : 359-360).

BUYSSON, R. du. 1903. Monographie des guepes ou *Vespa*. *Ann. Soc. Ent. France*, **72** : 260-288.

BUYSSON, R. du. 1905. Monographie des guepes ou *Vespa*. *Ann. Soc. Ent. France*, **73** : 485-556, 565-634.

CAMERON, P. 1900. Description of new genera and species of Hymenoptera : *Ann. Mag. Nat. Hist.*, (7) **6** : 410-419, 495-506.

CARPENTER, J.M. 1982. The phylogenetic relationships and natural classification of the Vespoidea (Hymenoptera). *Syst. Ent.*, **7** : 11-38.

CARPENTER, J.M. 1987. Phylogenetic relationships and classification of the Vespinae (Hymenoptera : Vespidae). *Syst. Ent.*, **12** : 413-431.

CHHOTANI, O.B. and RAY, K.K. 1975. Fauna of Rajasthan, India (Hymenoptera). *Rec. zool. Surv. India,* **71** : 13-49.

COCKERELL, T.D.A. 1907. On a collection of Australian and Asiatic bees. *Bull. Amer. Mus. Nat. Hist.,* **23** : 221-236.

DALLA TORRE, K.W. von 1894. Catalogus Hymenopterorum 9, Vespidae (Diploptera) : 1-81. Leipzig.

DALLA TORRE, K.W. von 1904. Hymenoptera, Family Vespidae. In : P. Wytsman (Ed.). *Genera Insectorum,* **19** : 1-108.

DAS, B.P. and GUPTA, V.K. 1983. A catalogue of the families Stenogastridae and Vespidae from the Indian Subregion (Hymenoptera : Vespoidea). *Oriental Ins.,* **17** : 395-464.

DAS, B.P. and GUPTA, V.K. 1989. The social wasps of India and the Adjacent Countries (Hymenoptera : Vespidae). *Oriental Ins. Monogr.,* **11** : 1-292.

DAY, M.C. 1979. The species of Hymenoptera described by Linnaeus in the Genera *Sphex, Chrysis, Vespa, Apis and Mutilla. Biol. J. Linn. Soc.,* **12** : 45-84.

DIXIT, K.K. 1965. Differential response to form and pattern in two species of Indian honey bees. *J. Bombay Nat. Hist. Soc.,* **54** : 107.

DOVER, C. and RAO, H.S. 1922. A note on the diploterous wasps in the collection of the Indian museum. *J. Proc. Asiat. Soc. Bengal* (N.S.), **18** : 235-249.

EVANS, H.E. and EBERHARD, M.J.W. 1970. The wasps. : 265 + i-vi. David & Charles, Newton Abbot.

GADAGKAR, R. and JOSHI, N.V. 1984. Social organization in the Indian wasp *Ropalidia cyathiformis* (Febr.) (Hymenoptera : Vespidae). *Zeitschr. Tierpsychol.,* **64** : 15-32.

GOULET HENRI and HUBER JOHN, 1993. Hymenoptera of the world, An identification guide to families. Centre for Land and Biological Resources Research, Ottawa, Ontario.

GUPTA, V.K. and DAS, B.P. 1977. Distributional patterns of Indian Vespidae (Hymenoptera) with reference to altitude. *Entomon,* **2** (2) : 209-213.

JACOBSON, R.E. 1986. A field key to the hornets *(Vespa)* of India. *Ann. Ent.,* **4** (1) : 51-52.

JOBIRAJ, T. 2004. A new species, a new subspecies and a new record of *Braunsapis* Michener (Hymenoptera : Apidae) from India. *Perspectives on Biosystematics and Biodiversity T.C.N. com. Vol.* March 2004 : 527-538.

JONATHAN, J.K., ROY, S.B. and KUNDU, B.G. 1999. Insecta : Hymenoptera : Vespidae. *Zool. Surv. India, Fauna of West Bengal, State Fauna Series,* **3**(Part-8) : 149-182.

JONATHAN, J.K., ROY, S.B. and KUNDU, B.G. 2000. Insecta : Hymenoptera : Vespidae. *Zool. Surv. India, Fauna of Meghalaya, State Fauna Series,* **4**(Part-7) : 117-160.

JONATHAN, J.K. and KUNDU, B.G. 2003. Insecta : Hymenoptera : Vespidae. *Zool Surv. India, Fauna of Sikkim, State Fauna Series,* **9**(Part-4) : 369-392.

KELLOGG, C.R. 1941. Some characteristics of the Oriental honeybee, *Apis indica* Fabr. in China. *J. econ Entom.,* **34** : 717.

LAMBERT, K. and NARENDRAN, T.C. 2002. A new species of *Antepipona* Saussure (Hymenoptera : Vespidae) from India. *J. Zool. Soc. Kerala,* **10** (1&2) : 2-4.

LAMBERT, K. 2004. Two new species and a new subspecies of *Antepipona* Saussure (Hymenoptera : Vespidae) from India with a key to species. *Perspectives on Biosystematics and Biodiversity* T.C.N. *Com. Vol.* March 2004 : 553-566.

MAA, T.C. 1937. On some Vespa and Vespula species of China. *Ent. & Phytopath.*, **5** : 29-34.

MAA, T.C. 1953. An inquiry into the systematics of the Tribus Apidini or honeybees (Hym.). *Treubia,* **21**(3) : 525-640.

MICHENER, C.D. 1944. Comparative external morphology, phylogeny and a classification of the bees (Hymenoptera). *Bull. Amer. Mus. Nat. Hist.*, **82**(6) : 151-326.

MICHENER, C.D. 1965. A classification of the bees of the Australian and south Pacific regions. *Bull. Amer. Mus. Nat. Hist.* **130** : 1-362, 15 pls.

MICHENER, C.D. 1986. Family group name among bees. *J. Kansas Ent. Soc.*, **59** (2) : 219-234.

MICHENER, C.D. 1990. Classification of the Apidae. *University of Kansas Science Bulletin,* **54** : 75-164.

MICHENER, C.D. 2000. The bees of the world. *The Johns Hopkins University Press, Baltimore, London* : 1-913.

MICHENER, C.D., RENEE M. BORGES, MERRY ZACHARIAS and MEGHA SHENOY. 2003. A new Parasitic Bee of the Genus *Braunsapis* from India (Hymenoptera : Apidae : Allodapini). *J. Kansas Ent. Soc.*, **76**(3) : 518-522.

NURSE, C.G. 1914. Zoological results of the Abor Expedition 1911-1912, Hymenoptera 5 : Fossores, Diploptera, Chrysididae. *Rec. Indian Mus.*, **8**(34) : 443-447 (446-447 list of 12 Vespidae).

PETERSEN, B. 1987. Subspecies of the Indo-Australian *Polistes stigma* (Fabricius) (Hymenoptera : Vespidae). *Ent. Scandinavica,* **18** : 227-259.

RAY, K.K. 2003. Insecta : Hymenoptera : Aculeata. *Zool. Surv. India, Fauna of Sikkim, State Fauna Series,* **9**(Part 4) : 507-517.

REYES, S.G., 1991. Revision of the bee genus *Braunsapis* in the Oriental region. *Univ. Kansas Sci. Bull.*, **54** : 179-207.

RICHARDS, O.W. 1956. Hymenoptera. Introduction and keys to families. Handbooks for the identification of British insects. *Roy. Ent. Soc. London,* **6**(1) : 1-94.

RICHARDS, O.W. 1968. The subgeneric divisions of the genus *Bombus* Latrielle (Hymenoptera : Apidae). *Bull. Brit. Mus. Nat. Hist. (Ent.),* **22**(5) : 209-276.

RICHARDS, O.W. 1973. The subgenera of *Polistes* Latreille (Hymenoptera : Vespidae). *Rev. Bras. Ent.*, **17**(13) : 85-104.

ROY, S.B. and KUNDU, B.G. 1985. Fauna of Namdhapa, Arunachal Pradesh, India (Insecta : Hymenoptera). *Rec. zool. Surv. India,* **82**(1-4) : 221-229.

SCHULTHESS, R. von. 1913. *Parapolybia* Saussure, Vespidae sociales. *Mett. Schweiz. Eng. Ges.*, **12** : 152-164.

SCHULTHESS, R. von. 1914. Vespidae aus eylon, Malacca, Java, and Sumatra. *Zool. Jahrb. Syst.*, **37** : 253-266.

SCHWARZ, H.F. 1939. The Indo-Malayan species of *Trigona, Bull. Amer. Mus. Nat. Hist.*, **76** : 83-141.

SMITH, F. 1871. A catalogue of the Aculeate Hymenoptera and Ichneumonidae of India and Eastern Archipelago, with introductory remarks by A.R. Wallace. *J. Proc. Linn. Soc. Zool.*, **11** : 285-415.

SMITH, F. 1875. Descriptions of new species of Indian Aculeate Hymenoptera, collected by Mr. G.R. James Rothney, Member of the Entomological Society. *Trans. Ent. Soc. London* : 33-50, pl. 1.

VAN DER VECHT, J. 1941. The Indo-Australian species of the Genus *Ropalidia* (=*Icaria*) (Hymenoptera : Vespoidea) (First Part). *Treubia*, **18**(1) : 103-190.

VAN DER VECHT, J. 1957. The Vespinae of the Indo-Malayan and Papuan areas (Hymenoptera : Vespidae). *Zool. Verh.*, **34** : 1-83.

VAN DER VECHT, J. 1959a. Notes on Oriental Vespinae, including some species from China and Japan (Hymenoptera : Vespidae) *Zool. Meded.*, **36**(13) : 205-232.

VAN DER VECHT, J. 1959b. On some Fabricius types of Indo-Australian Vespidae (Hymenoptera). *Arch. Néerl. Zool.*, **13**(1 suppl. 1858) : 23-247.

VAN DER VECHT, J. 1962. The Indo-Australian species of the genus *Ropalidia* (=*Icaria*) (Hymenoptera : Vespidae) (Second Part). *Zool. Verh.*, **57** : 1-72.

VAN DER VECHT, J. 1966. The East Asiatic and Indo-Australian species of *Polybioides* Buysson and *Parapolybia* Saussure (Hymenoptera : Vespidae). *Zool. Verh.*, **82** : 1-42.

VAN DER VECHT, J. 1979. Notes on Vespoidea from Nepal. *Entomol. Ber. (Amst.)*, **39**(2) : 27-30.

VAN DER VECHT, J. 1981. Studies in Indo-Australian Solitary wasps. *Proc. Icon.* Ic. *Ned. Akad. Wetensch.*, 5, 84, 4 : 443.

WILLIAMS, P.H. 1983. Social wasps (Hym., Vespidae) from North West India. *Ent. Monthly Mag.*, **119** : 193-197.

WILLIAMS, P.H. 1988. Social Wasps (Hym. Vespidae) from the Kashmir Himalaya. *Ent. Monthly Mag.*, **124** : 149-152.

YAMANE, SK. 1974. On the genus *Vespa* (Hymenoptera, Vespidae) from Nepal. *Kontyu*, **42** : 29-39.

YAMANE, SK. 1976. Morphological and taxonomic studies on Vespinae larvae, with reference to the phylogeny of the subfamily Vespinae (Hymenoptera : Vespidae). *Insecta Mats.* (N.S.), **8** : 1-15.

YAMANE, SK. and YAMANE, SO. 1979. Polistine wasps from Nepal (Hymenoptera : Vespidae). *Insecta Mats.* (N.S.), **15** : 1-37.

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2) : 449-465, 2006

ARACHNIDA : SCORPIONIDA, UROPYGI, SCHIZOMIDA AND ONCOPODID OPILIONES (CHELICERATA)

D. B. BASTAWADE
Zoological Survey of India, Western Regional Station, Pune-411044

INTRODUCTION

Arachnids except the Araneae (Spiders) though not very rare in their occurrences need special efforts to locate and collect. This is because most of them are truly nocturnal in their habit which limit their studies. The studies of the Arachnid fauna of North Eastern parts of India are still fragmentary and no consolidated account has so far been attempted.Valuable information is available through literature such as Abor Expedation by Kemp (1871 – 1911) but the phyla-wise reports are meagre and also scarce.

Pocock (1900), the pioneer of Indian Arachnids, appears to be limited to then Assam Frontier and his reports were mainly restricted to Garro and Khasi Hills (now in Meghalaya) and to Dubri, Cachar and Sadiya in Assam. Gravely (1911-25) contributed to North Eastern Arachnid fauna by describing a new species *Tritheryus sijuensis* from Siju cave in Garro Hills (Meghalaya) as Tartarides (now the Order Schizomida). Roewer (1910-1959), the pioneer explorer of Indian Opiliones (Phalangida) added many new genera and species to the knowledge of Indian Opiliones. To then Scientists and naturalists have added and published various information on North East fauna. However, the contributions have mainly been attributed by Zoological Survey of India being the only Govt. agency carrying out exploratory work on faunal resources of India.

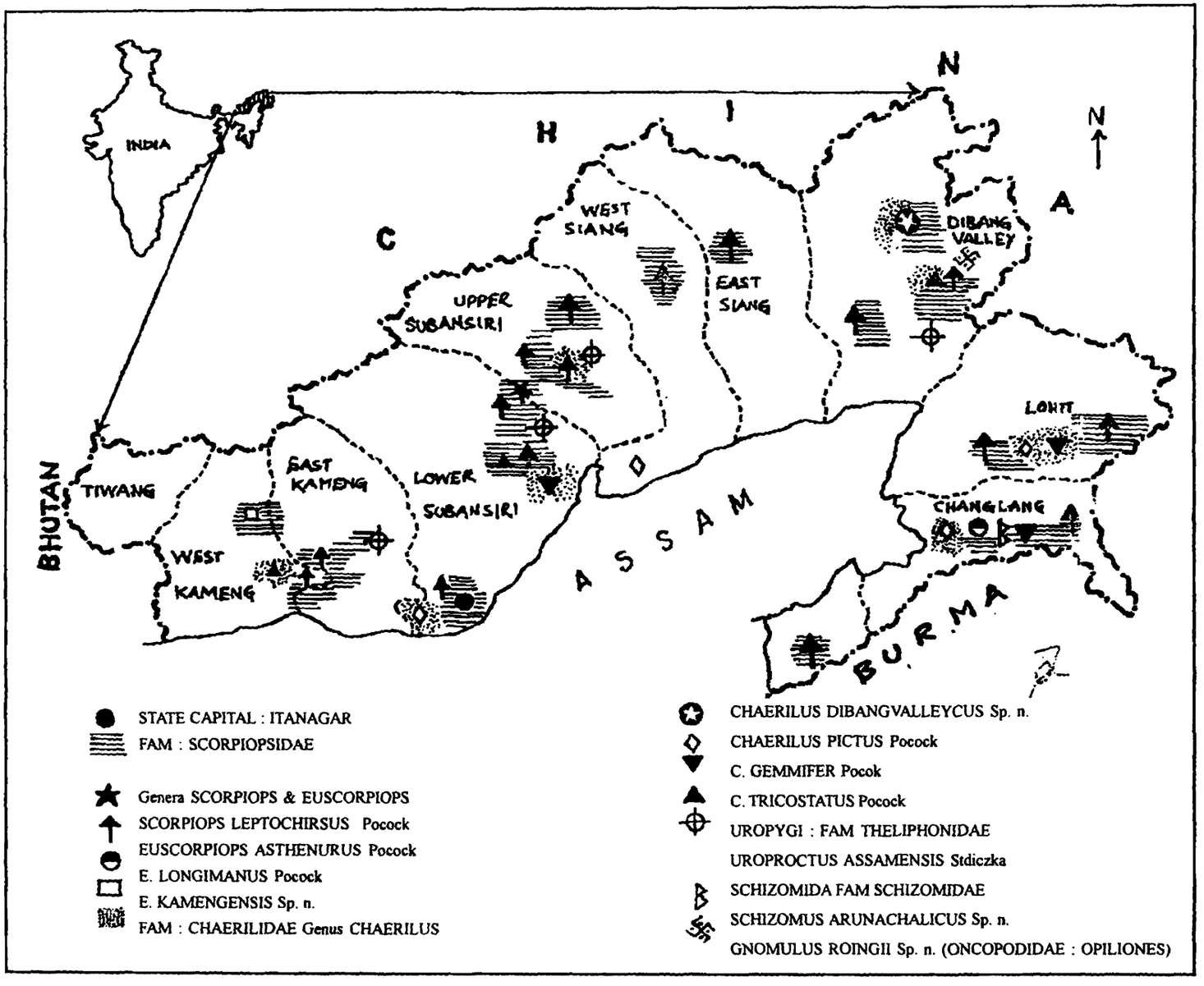
The Fauna of India series on various groups of animals are now available with Zoological Survey of India, which also include lots of information on North East Indian fauna. Tikader (1959-86) has put on tremendous work on Spider fauna of Assam, Meghalaya and Sikkim states. Tikader and Bastawade (1983) have described a new species *Eusorpiops bhutanensis* from Gomchu, Bhutan (Family Scorpiopsidae : Scorpionida). Bastawade (1985) has reported three species of Scorpions belonging to two families Chaerilidae and Scorpiopsidae from Namdapha Tiger Reserve, Changlang Dist., Arunachal Pradesh. Bastawade and Pal (1991) and Bastawade (1992) have reported the order Schizomida and sub order Cyphophthalmi for the first time from Arunachal Pradesh. The present communication deals with the report on the Arachnid orders Scorpionida, Uropygi, Schizomida and Opilonid Laniatore family Oncopodidae from Arunachal Pradesh, India.

Order SCORPIONIDA

The Scorpio-fauna of Arunachal Pradesh is known to constitute only two families namely Chaerilidae and Scorpiopsidae (=Vaejovidae) (Bastawade, 1985) The occurrence of these families ranges from foothills of 600 to 2500 Mts. Elevation. The species of these two families generally seen to inhabit through thinner crevices of outcrops along the road sides, underneath of old fallen wooden logs, bellow stones and rarely under barks. The specimens of these two families are very much similar in body size and coloration which make difficult to recognize them in the fields while collections.

Family CHAERILIDAE

This family of Scorpions is known by the only genus *Chaerilus* Simon (monotypic) under which so far about 10 species have been nominated, out of which only three species are known from Arunachal Pradesh namely *Chaerilus tricostatus* Pocock, *Chaerilus gemmifer* Pocock and *Chaerilus pictus* Pocock. These three species



MAP 1 : Showing distribution of arachnid orders scorpionida, uropygi and schizomida for respective families, genera and species from Arunachal Pradesh, India

normally occur through lower foothills of the state (Pl. see map). The fourth species being described as new to the Indian Scorpiology, which inhabits through high altitude ranges of Dibangvalley of the state.

1. ***Chaerilus dibangvalleycus*** sp. n.
(Figs. 1-16)

General : Body size medium, dark brownish in color but appears redish while alive, male generally more reddish, body surface entirely sparsely granular above, last sternite with two pairs of granular carinae. Chelicera paler but darker on fingers, legs pale brown and yellowish on distal digits. Pectines weakly developed with only 4/4 teeth in male and 5/5 in females. Telson reddish brown, smooth and darker on aculeus. Males slender and thinner than females.

Measurements (in mm) : Holotype 1♂, Total length 41.50; Carapace 6.00; Mesosoma 13.50; Metasoma 22.00. *Paratype* 1♀ Total length 36.75; Carapace 5.00; Mesosoma 12.25; Metasoma 19.50.

Carapace : Almost as long as wide, entire surface coarsely but sparsely granular, interocular area more granular on anterior portion, middle area flat above and marginated with granular lateral carinae (Fig. 1), lateral ocular tubercles granular, not much raised and provided with a pair of lateral eyes and an amber color spot bellow (Figs. 1 & 2), median eyes situated anteriorly on a prominent ocular tubercle in the ratio 1 : 1.5 (Fig. 1), anterior margin truncated, granular and armed with few setae, lateral and posterior margins also granular.

Appendages : *Chelicera* smooth on basal segment, variegated with dark reticulations on dorsal portion, fingers short with regular dentitions except four and eigth to nine minute teeth on inner ventral margins of movable and immovable fingers respectively (Figs. 3 & 4); *Pedipalp* not much strong, carinated on all digits, femur shorter than carapace, dorsal carinae granular, inferior carinae almost obsolete, inter carinal space sparsely granular on dorsal surface, patella as long as femur, carinated, carinae granular on dorsal portion while weakly granular and crenulate on inferior, inner surface bear few granules on proximal portion, manus flat on dorsal portion with four carinae, interior carinae sparsely granular and crenulate and other carinae granular but granules irregularly arranged, intercarinal space finely granular and granules arranged in mosiac fashion, length of underhand shorter than carapace but longer than either femur or patella, immovable finger shorter than femur, patella or underhand, carinated but carinae smooth and obsolete, provided bellow with double row of minute dentition; movable finger longer than femur, patella or underhand, granular and provided with double row of minute dentition (Fig. 5), trochobothrial orthotaxi on femur, patella, manus and immovable finger of Type B (Figs. 9-16); *Legs I-IV* smooth on all segments except exterior carinae on femur, tarsomere I provided with a pair of pedal spur each, tarsomere II provided bellow with a row of paired long lateral bristles and a median row of minute spines. *Genital operculum* always wider than long, operculae smooth, covered with few bristles, separated on middle exposing a pair of minute genital papillae (Fig. 6), *pectines* poorly developed, basal piece almost rectangular less sclerotised and covered with two pairs of reddish bristles, anterior margin straight with a median notch, middle lamellae completely fused, teeth stumpy and 4/4 in male and 5/5 in female.

Mesosoma : All tergites granular (more granular in female), tergite I without carinae, tergites II-IV without carinae but provided with prominent granules at respective places of median and lateral carinae, lateral and posterior margins granular, tergite VII more granular, granules coarse on lateral portions and provided with two pairs of lateral granular carinae, lateral and posterior margins granular, pretergal portion of each tergite smooth but finely granular on posterior margin; Sternites III-VI entirely smooth except weakly granular exterior lateral portions, each provided with a pair of circular stigmata for booklungs, presternal portion entirely smooth, sternite VII granular with two pairs of granular carinae, only on posterior portion, posterior and lateral margins finely granular (Fig.7).

Metasoma : Slightly less than four times as long as carapace, basal segment always wider than long, carinated and all carinae strongly crenulate, segments II-IV also carinated and all carinae except laterals well developed and crenulate, laterals present on posterior portion with

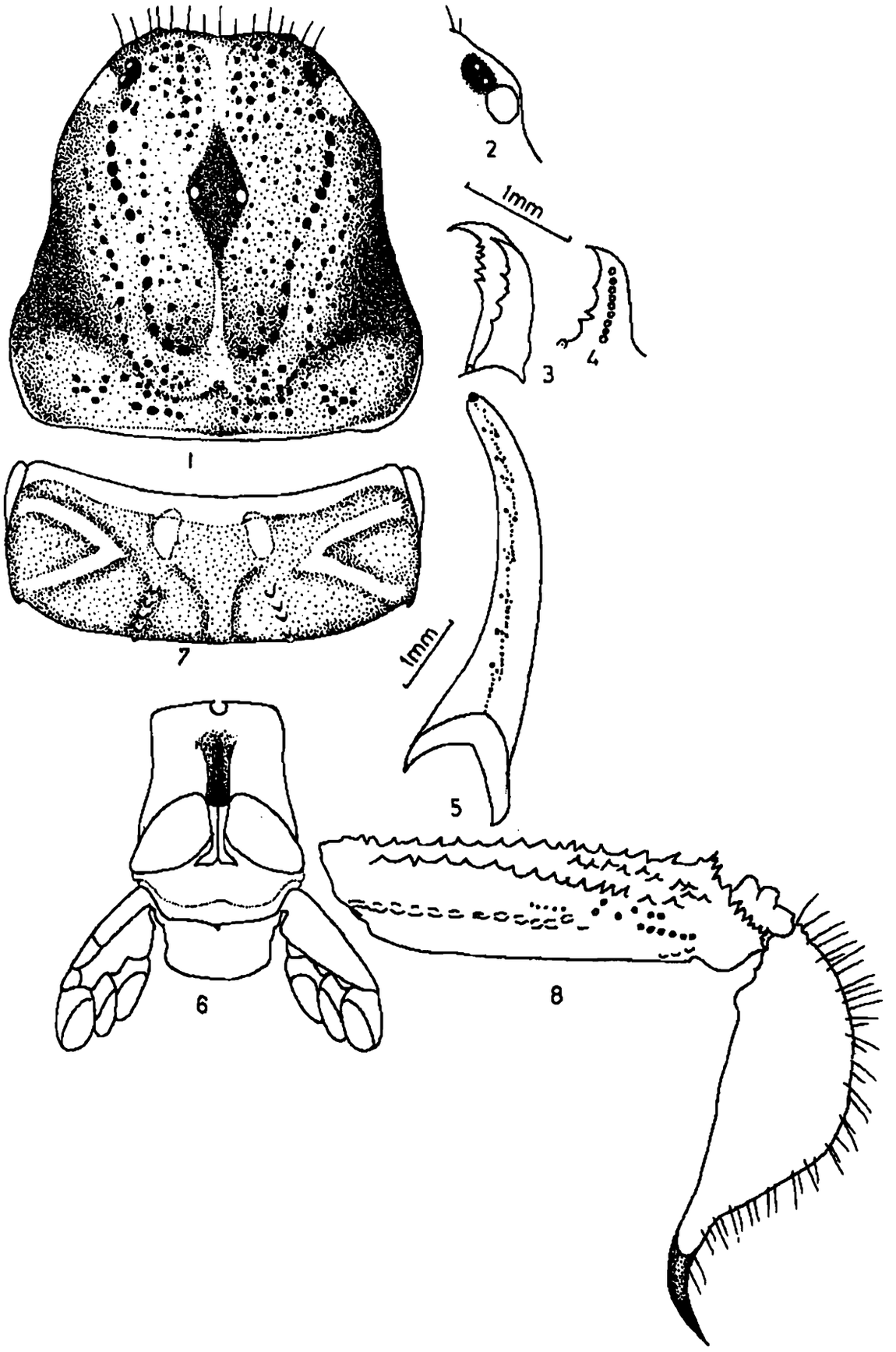


Fig. 1-8

1. Carapace, dorsal aspects., 2. Anterior lateral portion of carapace, lateral aspects., 3. Movable finger of Chelicera showing teeth arrangements on inner margins of dorsal and inner fangs, interior aspects., 4. Immovable finger of Chelicera showing teeth arrangements on dorsal margin and ventral surface, ventral aspects., 5. Movable finger of Pedipalp showing arrangements of dentition, dorsal aspects., 6. Cephalothoracic sternum, pectines and genital operculum, ventral aspects., 7. Tergite, dorsal aspects., 8. Metasomal segment V and vesicle, lateral aspects.

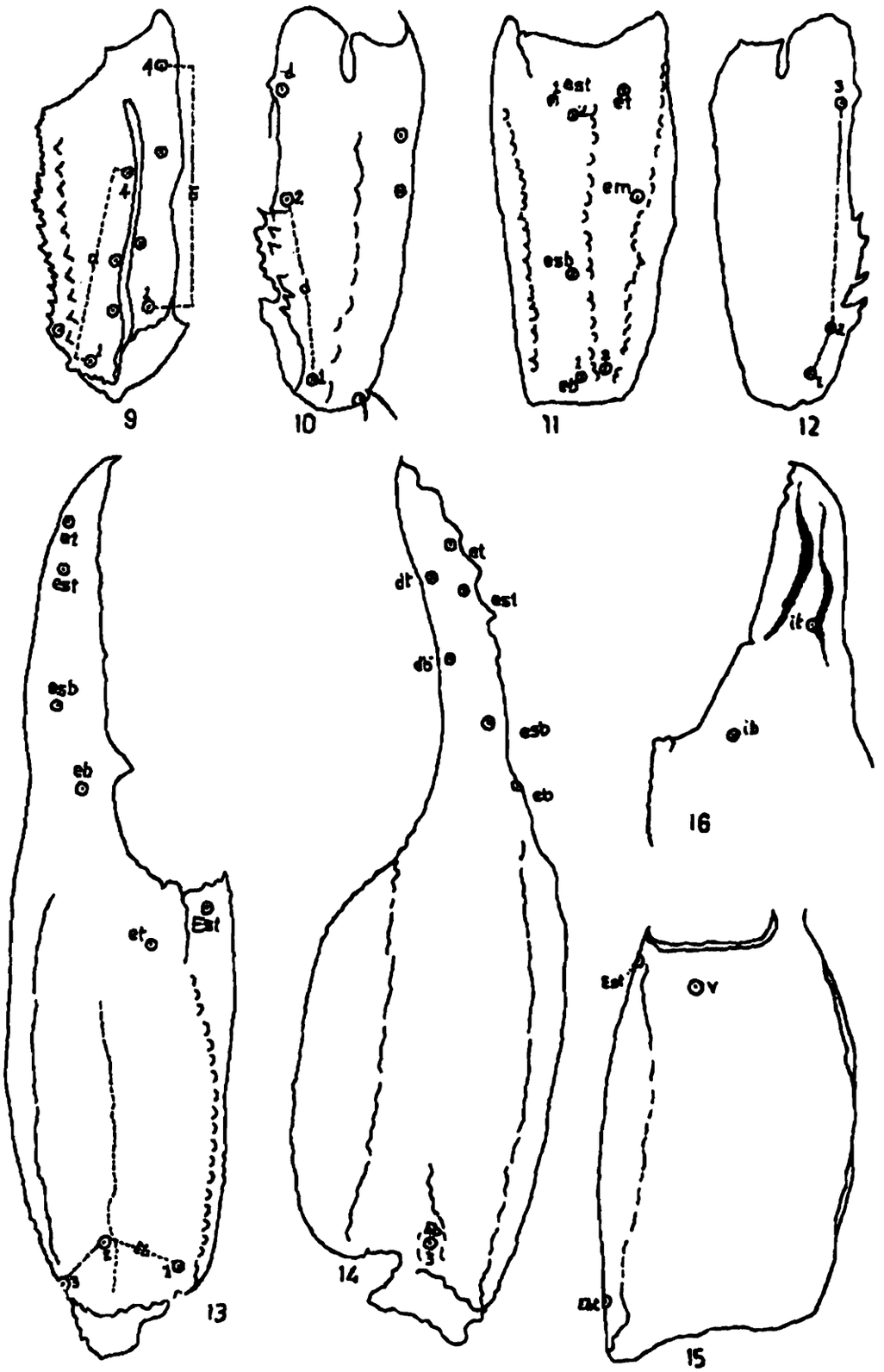


Fig. 9-16.

9. Femur of Pedipalp showing Trochobothridial arrangements, dorsal aspects., 10-12. Patella of Pedipalp showing Trichobothridial arrangements, dorsal, exterior and ventral aspects respectively., 13-14. Manus and Immovable finger of Pedipalp showing Trichobothridial arrangements, exterior and dorsal aspects., 15. Manus of Pedipalp showing Trichobothridia, vental aspects., 16. Manus and Immovable finger distal portions of Pedipalp showing Trichobothridial arrangements, interior aspects.

few granules only, intercarinal space sparsely but coarsely granular, segment V shorter than carapace but longer than femur or patella, carinated, inferior laterals and inferior carinae strongly crenulate, intercarinal space more granular than preceding segments, anal rim of this segment crenulate (Fig. 8); Telson slightly more than as long as carapace, finely granular on vesicle shorter than but more than as wide and deep as segment V, sparsely setose and certain setae at fixed places (Fig.8), aculeus strong, almost half the length of vesicle or as long as segment I or II, less curved and sharply pointed (Fig. 8).

Type-Data : *Holotype* 1♂, *Paratypes* 5♀♀, 5♂♂ and 2 young ones all in spirit, will be deposited in National Collections, Zoological Survey of India, Kolkata.

Type-locality : Mayodia, 1800 Mts, elevation, Dibangvalley District, Arunachal Pradesh, INDIA; Coll. D.B. Bastawade, dt. 15.ix.1991, 3♂♂, 4♀♀; Coll. K. Alia, dt. 16.ix.1991, 1♂, and Coll. D. B. Bastawade, dt. 17.ix.1991, 2♂♂, 1♀ and 2 young ones.

Etymology : This species is named after the district name 'Dibangvalley' adding *cus* as *dibangvalleycus*, and the gender masculine.

Discussions : this species resembles with *Chaerilus tricostatus* Pocock but can be separated as follows 1. A pair of median eyes situated anteriorly in the ratio 1 : 1.5 where as in *tricostatus* the ratio is 1 : 1.9 to 2.0. 2. The lateral ocular tubercles continue posteriorly in broader granules where as the ocular tubercles continue posteriorly in even coarse granules. 3. Immovable finger of chelicerae provided with 10 minute teeth on inner margin where as only 7-8 teeth present in *tricostatus*. 4. Ventral fang of movable finger of chelicerae armed with only five minute teeth where as 8-9 teeth present in *tricostatus*. 5. Tergites II-IV provided with with a prominent granule indicating lateral carinae where as short and prominent granular carinae present in *tricostatus*. 6. Movable finger of pedipalp armed with 7-8 slightly overlapping sequences of minute dentitions where as 10-11 such sequences present in *tricostatus*. 7. Inferior lateral carinae on metasomal segment V more prominent and serrated than in *tricostatus*. 8. The trichobothrial pattern on pedipalp also differ in respective positions of selga in both species.

Family SCORPIOPSIDAE (=Vaejovidae)

This family of Scorpions shows a wide range of distribution throughout the state Arunachal Pradesh and seems to be restricted to somewhat higher altitudes but certainly not so strictly. This family is represented by two genera namely *Scorpiops* Peters and *Euscorpiops* Vachon from North East India, amongst these the genus *Scorpiops* occurs rarely and is being reported by only species *Scorpiops leptochirus* Pocock (Pl. see map). Where as the other genus *Euscorpiops* Vachon occurs much more commonly and shows a wide range of distribution from Western to Eastern parts of the state. This genus has been reported from all the districts of the state except Tawang, where surveys were not conducted by the specialists. Even though four species have been reported from NE India, Bhutan and Myanmar (Burma) (Tikader and Bastawade, 1983), only two species have been reported from Arunachal Pradesh. The species *Euscorpiops asthenurus* Pocock has been reported from all the surveyed districts showing a wide range of distribution (pl. see map). The species *E. longimanus* Pocock has only been reported from Namdapha, Changlang district. The collections made from high altitude place Bomdilla, West Kameng district appears to be interesting and described as a new species namely *Euscorpiops kamengensis*.

2. ***Euscorpiops kamengensis*** sp. n.
(Figs. 17-26)

General : Body size medium, coarsely granular but weakly on carapace and poorly on tergites, appears dull brownish on body but paler on appendages and telson, chelicerae normal with 4-6 minute teeth on ventral interior margin of movable finger, pedipalp narrow on manus and the last abdominal sternite smooth with obsolete carinae.

Measurements (in mm) : *Holotype* 1♀, Total length 42.75; Carapace 6.75, Mesosoma 15.75, Metasoma 20.25.

Carapace : Entire surface granular but more coarser on anterior and lateral portions, weakly granular on middle, lateral ocular tubercles prominent and granular, continued postrio-laterally and provided with three contiguous eyes (Fig. 18),

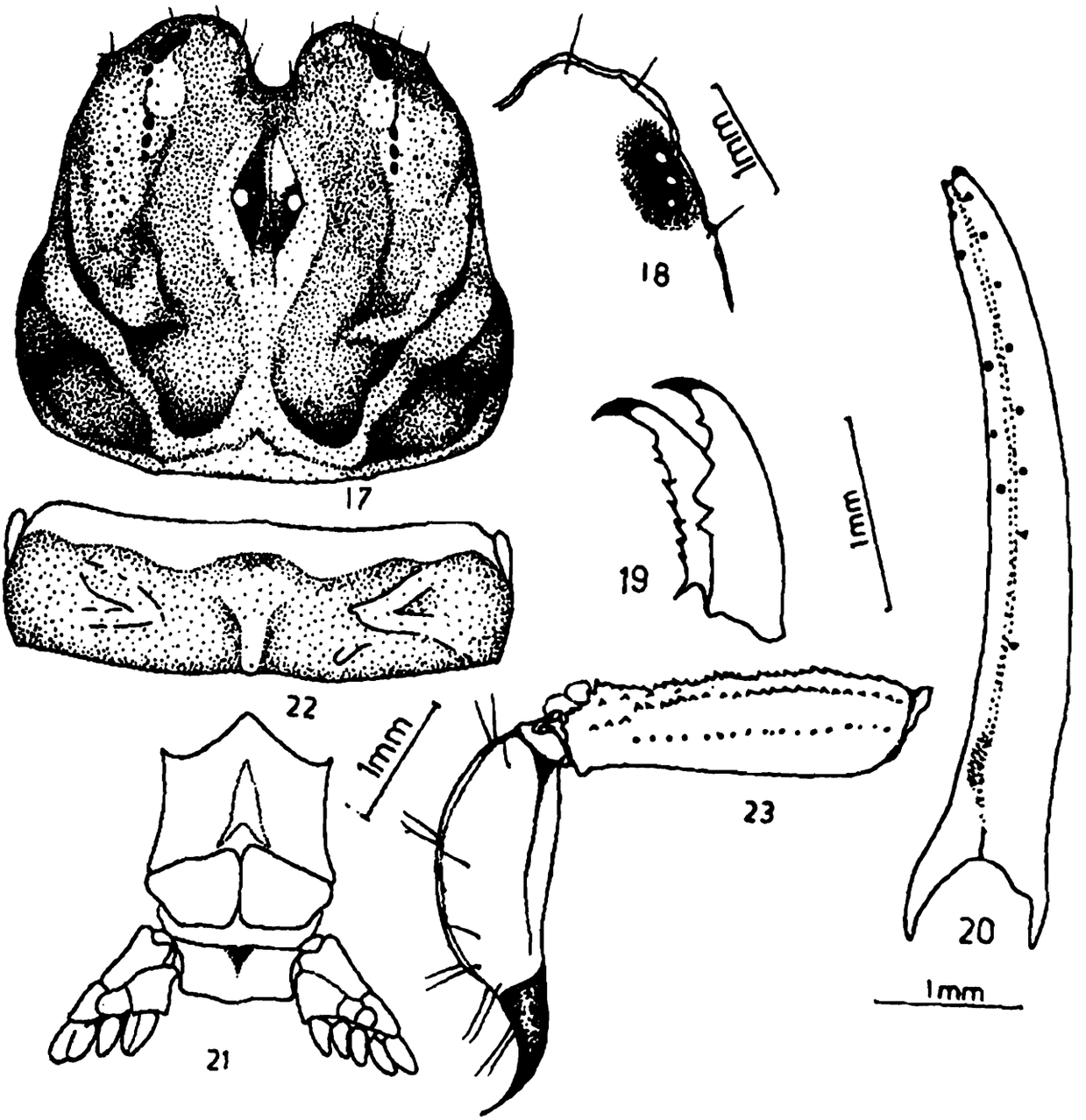


Fig. 17-23.

17. Carapace, dorsal aspects., 18. Carapace anterior lateral portion showing lateral eyes, lateral aspects., 19. Movable finger of Chelicera showing arrangements and number of teeth on dorsal and ventral fangs, interior aspects., 20. Movable finger of Pedipalp showing arrangements of dentition, dorsal aspects., 21. Cephalothoracic sternum, pectines and genital operculum, ventral aspects., 22. Tergite, dorsal aspects., 23. Metasomal segment V and vesicle, lateral aspects

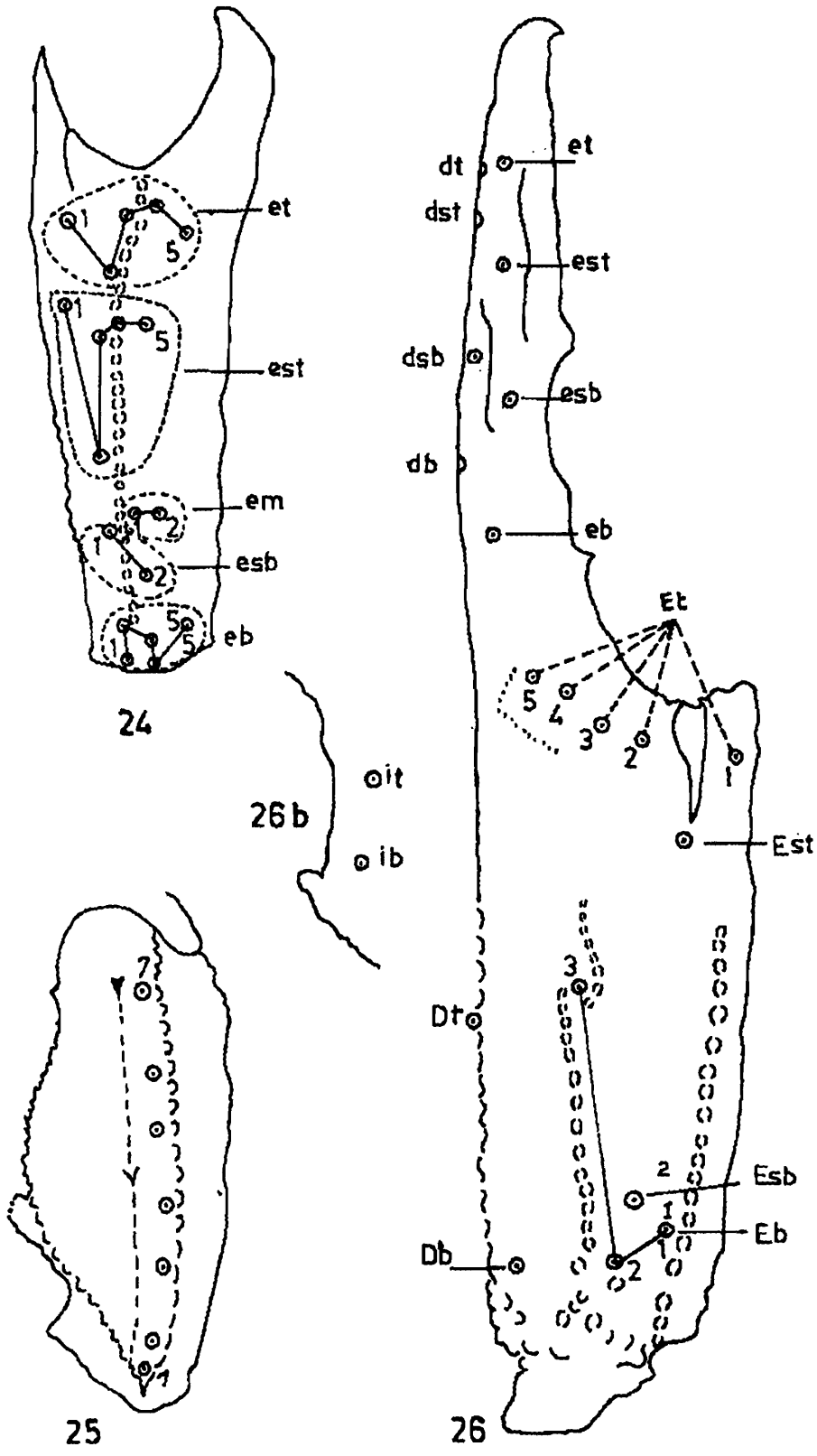


Fig. 24-26.

24. Patella of Pedipalp showing arrangements of Trichobothridial arrangements, exterior aspects., 25. Patella of Pedipalp showing ventral Trichobothridial numbers, ventral aspects., 26. Manus and Immovable fingeer of Pedipalp showing arrangements of Trichobothridia, exterior aspects. 26b. Part of manus showing interior trichobothridia, interior aspect.

median ocular tubercles not much raised, granular on anterior and posterior portions, smoother in middle, provided with a pair of median eyes situated anteriorly in the ratio 1 : 2.6 (Fig. 17), anterior margin smooth, deeply notched in the middle and provided with 8-9 setae, lateral and posterior margins also smooth, posterior median furrow continues anteriorly around median eyes up to anterior median notch.

Appendages : *Chelicera* smooth and pale on basal segment, fingers with normal dentitions but ventral fang of movable finger armed with 6 minute teeth on inner margin (Fig. 19), dorsal fang shorter than ventral; *Pedipalp* much slender and elongated as compared to body, flat on femur and patella, carinated , carinae crenulate and more prominent on exterior surface of femur, while evenly on patella, femur longer than carapace but patella shorter than femur or carapace intercarinal space weakly granular on patella, exterior surface provided with a crenulate carina and 3-4 subdenticulate granules, patella with few pointed spines on proximal portion, the upper being shorter and smaller, manus more than as wide as femur or patella, weakly carinated, coarse granules scattered on inner margin indicating as carinae, exterior carinae more regular and even, intercarinal space coarsely granular on exterior surface, irregularly granular on femur or patella and also more than twice as wide; immovable finger as long as patella, smooth, carinated on exterior margin but carinae smooth and obsolete; movable finger longer than carapace or patella, but as long as femur, smooth, provided with a median row of minute paired teeth and 7-8 outer and 6 inner smooth scars with an apical, pointed tooth (Fig. 20); trichothrial patterns on patella, manus and immovable finger as in Figs, 24-26, patella with *4est*, *5et* and *7V* neobothriotaxi. *Legs I-IV* finely granular on femur and patella but more closely granular on femur only, carinated and carinae crenulate only on femur while smooth on exterior surface of patella; tibiae and tarsomere I & II smooth, each tarsomere I provided with a pair of pedal spur, tarsomere II each with a row of paired, small and delicate spines bellow and the spine formula as 6/6, 7/7, 8/8 and 9/9. *Genital operculum* always wider than long, operculi closed, sparsely clothed with few, short and red setae, basal piece notched in middle of anterior margin, *pectines* weak, stumpy, almost twice as wide, middle lamellae broad, united and clothed with few, short, red setae, fulcra triangular, clearly noticeable, teeth not much elongated but broader and 4/5 in number (Figs.3.4 & 21), cephalothoracic sternum pentagonal, almost as long as wide, deeply furrowed on middle posterior portion.

Type-Data : *Holotype* 1♀, *Praratype* 1♀ immature (right pedipalp damaged), in spirit, will be deposited in National Collections, Zoological survey of India, Kolkata

Type-locality : Sara village, 7 Kms. West of Bomdilla, about 2500 mts. Elevation, Dist. West Kameng, Arunachal Pradesh, Coll. D. B, Bastawade, dt. 18.ix. 1991

Etymology : This species is named after the district name 'Kameng' adding *ensis* as suffix '*kamengensis*' being the locality of first collection and the gender masculine.

Distribution : Known only from type-locality.

Discussions : This species resembles with *Euscorpiops asthenurus* and *E. bhutanensis* but differs from these as follows, 1. Manus of pedipalp slightly longer than twice the width where as it is two and half times in *asthenurus* and more than thrice in *bhutanensis*. 2. The spine formula on legs I-IV 6/6,7/7, 8/8 & 9/9 where as it is 8/8, 8/8, 10/10 & 10/10 in *asthenurus* and 6/6, 6/6, 8/8 & 8/8 in *bhutanensis*. 3.The trichobothrial configurations on patella, manus and immovable finger considerably differ from known species.

Order UROPYGI

The Uropygid Archnids are readily be recognized from others and specially from Scorpions in having a pair of robust, semichelate pedipalps, cephalothorax distinctly separated from abdomen by well defined constriction and the abdomen continues posteriorly in to a long thin, thread like whip so as to commonly termed as whip-scorpion. Apart from this they have pentagonal cephalothorax narrowed anteriorly and provided with four pairs of eyes, three pairs situated laterally in triad and a pair of median eyes almost on anterior margin. Tarsi of first pair of legs sib-divided in to 9 digits. Uropygids are devoid of pectines and a poison glad at the tip of tail (whip).

Distribution : their distribution is known in Oriental region from India to Fiji Islands extending Northwards to China and Southern Japan; In Neotropical region from Brazil Northwards to the Southern states of North America.

Family THALYPHONIDAE

The Indian Uropygid fauna known to constitute two families, four genera and only six nominated species, out of which only two species have so far been reported from Northeastern India. The family Thelyphonidae is represented by *Uropoctus assamensis* Stoliczka and *Hypoctonus oatesii* Pocock (Pocock,1900), the reference further quotes that " the distribution of this species form broad area of Northeastern India but except Khasi Hills (Meghalaya), Sadiya and Cachar in Assam remains unconfirmed. "The present reports of *Uropoctus assamensis* Stoliczka from Arunachal Pradesh are the first authentic reports for this species and is being reported from West and East Kameng, Lower and Upper Subansiri and the Dibangvalley Districts of the state. The species presently been reported by 18♀♀, 3♂♂ and 15 young ones (pl. see map). These all collections have been deposited in Arunachal Pradesh Field Station, Zoological Survey of India, Itanagar.

Order SCHIZOMIDA

The Schizomids are uncommon and rarely known Arachnids, which are also termed as Micro -whip- Scorpions as these resemble with Uropygids in their general appearance but now treated under a separate order as Schizomida. These animals are so far known by the only family Schizomidae representing the genus *Schizomus (=Trithyerius)* Cook, consisting of only four species from India (Pocock 1900, Bastawade 1985, Cockendolpher and others 1988 and Bastawade 1991). They go unnoticed and remain unknown most of the parts of the world even today, due to their very small body size and secretive life habits and selected habitats. Two specimens were hand picked from under the unknown tree bark at 650 mts. Elevation near Miao, Tirap District (now Changlang), Arunachal Pradesh and are being described as new species.

Distribution : Tropical West-Africa, India, Sri-Lanka, Burma, Java, Sumatra and Borneo; Hawai, California and Texas in U.S.A.; introduced in many parts of Europe including England with numerous exotic plants (Cockendolpher, 1985).

Family SCHIZOMIDAE

The Indian Schizomids are known by only four species namely 1. *Schizomus (=Trithyreus) sijuensis* Gravely, 2. *S.* (=*T.*) *kharakpurensis* gravely. 3. *S.* (= *T.*) *lunatus* Gravely and 4. *S.* (=*T.*) *tikaderi* Cockendolpher & others. Amongst only *sijuensis* is the species known to occur in Northeast Indian state Meghalaya. The specimens (1♀, 1♂) collected from Miao, are being described as *Schizomus arunachalicus* sp.n.

3. ***Schizomus Arunachalicus*** sp. n.
(Figs. 27-35)

General : ♂ Length from distal edge of propeltidium to the base of flagellum 4.721 mm. long, entire body smooth and orange brown but light pinkish when alive.

Cephalothorax : Propeltidium 1.28 mm long and 0.67 mm wide with one pair of anteriorly directed setae followed by three dorsal sub-lateral and three lateral pairs, apical margin narrowed in front and sharply bent downwards and smooth on entire surface, finely punctate and raised on middle portion; eyes or oceli totally absent; mesopeltidium divided and separated posteriorly by about half the width of one segment; metapeltidium much narrowed and distinctly divided on posterior portion (Fig. 27); Anterior sternum with a pair of long sternapophysial setae and covered with 8-9 pairs of setae, where as the posterior sternum narrow and covered with only 3 pairs of short setae.

Appendages : *Chelicera* with basal segment laterally compressed, provided with setal types as Type 1 : 3, Type 2 :-, Type 3 : 4, Type 4 : 2, Type 5 : 6 & Type 6 : 1 (Fig. 28), movable finger with no serrula on inner margin but a row of pilose setae (Fig. 28), immovable finger with four sharp but minute teeth between two larger teeth (Fig. 28); Pedipalp much slender, elongated and 9.21 mm long, showing sexual diamorphism, trochanter with a spur on mesal margin, patella with 10-11 spines on exterior margin, tibia with 3-5 pair of spines on interior margin, basi-tarsus-tarsus comparatively shorter, claw longer than basitarsus-tarsus (Fig, 31) : Legs I-IV : Leg I Antenniform, longer than others (broken in type),

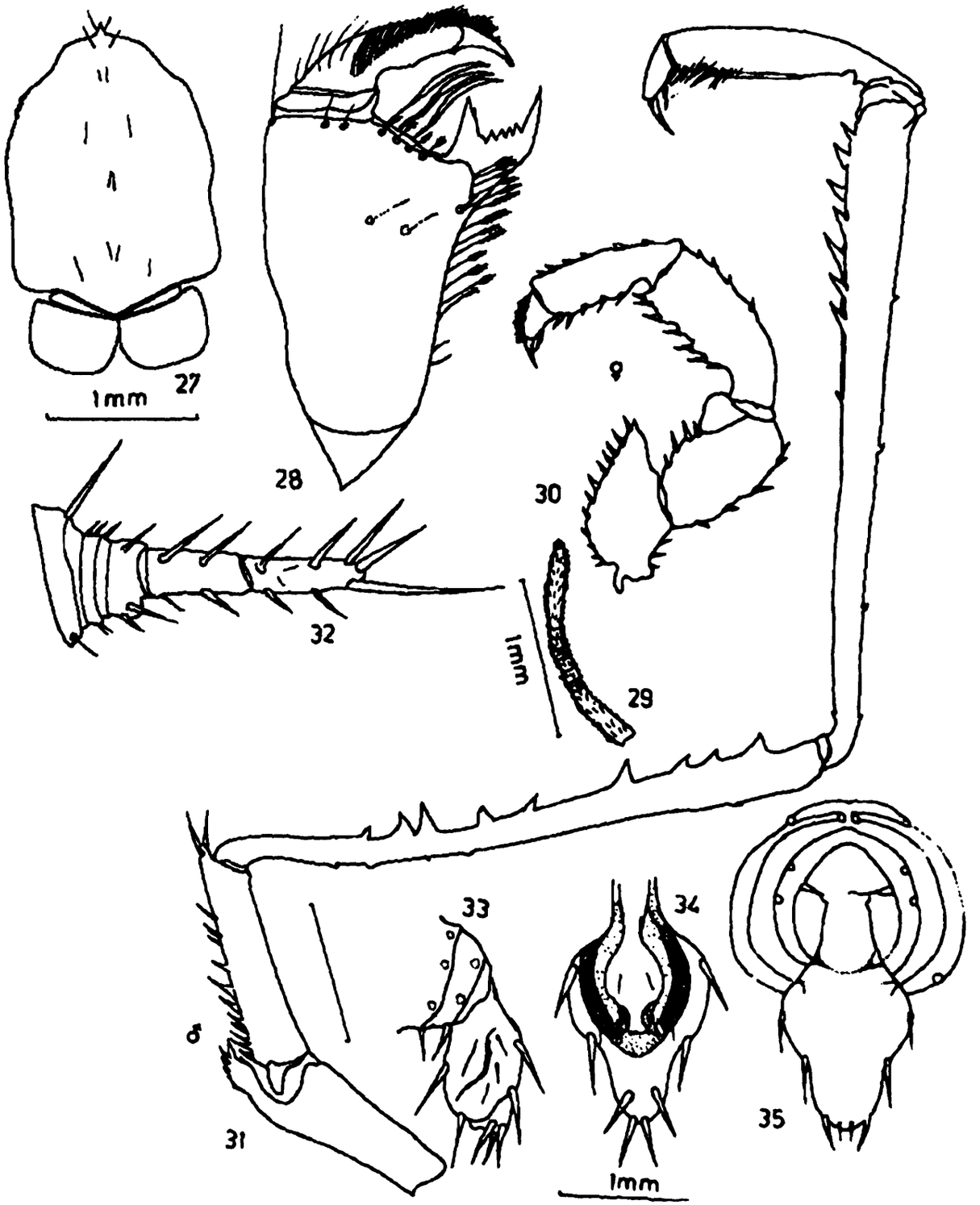


Fig. 27-35.

27. Pro,meso and metapeltidium, dorsal aspects., 28. Chelicera showing dentition on fingers and types of setae, ventral aspects., 29. Distal portion of tarsomere of Leg I, dorsal aspects., 30. Female Pedipalp, interior/mesal aspects., 31. Male Pedipalp, interior/mesal, aspects., 32. Female flagellum, lateral aspects., 33 - 35. Male flagellum, lateral, dorsal and ventral aspects.

measurements as in Table I, femur IV almost 2.75 times longer than wide.

Abdomen : Tergites I-IX each with only one pair of dorsal setae on posterior margin, segments X-XII telescoped, X with one pair of dorsal, one pair of laterals and 7-9 ventral setae; Flagellum 0.65 mm long and 0.38 mm wide , dorsal and ventral setations as Fig. 33-35.

Paratype : ♀ Total length 4.76 mm, tergal and sternal setation almost as in male except few setae, abdominal segments X-XII with more setae than in ♂, flagellum of two annuli and setation as Fig, 32; Chelicera as in male; Pedipalp different as that of ♂ unlike palp short and stout and 2.88 mm long indicating sexual diamorphism, trochanter produced on mesal margin, flat, pointed anteriorly and with 11-12 strong spinose setae, femur short, robust and armed with 1-2 spinose setae on inner margin, patella longer than femur with 3-5 spinose setae on inner surface where as 9-11 on outer margin, basitarsus-tarsus short, less than half the tibia, bearing a pair of spur, half as long as basitarsus-tarsus (Fig. 30); Legs I-IV as in Table 2, Femur IV 2.75 times as wide; Spermathecae not clearly observed as sternite V partially torn during collection and preservation.

Type-Data : *Holotype* ♂, *Paratype* ♀ (some legs broken, flagellum detached, sternite V partially torned, dissected and kept in micro-vial separately in spirit) , will be deposited in National collection, Zoological Survey of India, Kolkata.

Table No. 1. showing measurements in mm for ♂ *Schizomus arunachalicus* sp. n.

	Pedipalp	Legs I	II	III	IV
Trochanter	1.176	1.148	0.28	0.252	0.672
Femur	3.080	0.532	1.176	1.176	1.484
Patella	3.136	2.492	0.616	0.924	0.560
Tibia	1.176	—	0.952	—	1.036
Basitarsus	0.308	—	0.392	—	1.204
Tarsus	—	—	0.420	—	0.560
Total	**9.216**	—	**3.837**	—	**5.516**

Table No. 2. showing measurements in mm for ♀ *Schizomus arunachalicus* sp. n.

	Pedipap	Legs I	II	III	IV
Trochanter	0.560	0.560	0.196	0.280	0.168
Femur	0.672	0.532	1.008	0.952	1.484
Patella	0.840	1.512	0.504	0.336	0.196
Tibia	0.644	2.012	0.798	0.448	0.896
Basitarsus	0.112	1.092	0.392	0.476	0.532
Tarsus	—	1.092	0.392	0.476	0.532
Total	**2.828**	**7.584**	**3.402**	**3.080**	**4.144**

Type-Locality : Miao, 650 Mts. Elevation, from under undisturbed log of wild tree (partially rotten), Changlang District, (previously Tirap), Arunachal Pradesh.

Distribution : Known only from type locality.

Etymology : This species is named after the name of state 'Arunachal' as locality of first report adding *cus* as suffix *arunachalicus* and the gender masculine.

Natural History : Unlike to the only species known from Siju caves in Meghalaya, North East India, which inhabits in the crevices of Lime stone caves and occasionally collected from under stones near Siju caves (Gravely 1912), on the contrary the new species *S. arunachalicus* inhabits the decaying logs in semi-forested areas of Arunachal Pradesh.

Discussions : *S. arunachalicus* Sp.n. closely resembles with the only known species from North East India *S.* (*T.*) *sijuensis* Gravely but it differs in 1. Trochanter much more pointed on anterior mesal portion and also armed with a pointed spinulate spine where as in *S.*(*T.*) *sijuensis* Gravely trochanter longer than wide and almost flat on anterior mesal portion with weak tuberculate spine. 2. ♂ and ♀ pedipalps exhibit sexual diamorphism where as *S.*(*T.*) *sijuensis* Gravely so far no sexual diamorphism noticed, pedipalps almost same in both the sexes. 3.♀ flagellum bear 2 annuli where as ♀ flagellum bears only one annulus in *S.* (*T.*) *sijuensis* Gravely. 4. Inner surface of Chelicera without a denticulate spine where as chelicera armed with a denticulate spine in *S.* (*T.*) *sijuensis* Gravely.

Order OPILIONES
Sub-order LANIATORES
Family ONCOPODIDAE

A rarely occurring Opilionid Laniatore family Oncopodidae was reported by Thorell (1876-91) by three genera namely *Oncopus* Thorell (Type), *Gnomulus* Thorell and *Pelitnus* Thorell. Roewer (1913) described *Pelitnus aborensis* on the basis of 2♀♀ collected in the famous Abor Hill expedationby Kemp (1911) from Upper Rotung (2000' elev.) and proper Rotung (1300') both under stones. The species description was without much description and total lack of illustrations but compared with *P. annulipes* Pocock, (Loc. Borneo). Martens (1977) during his extensive works on Nepal Himalayan Opilionid fauna, while describing *P. hyatti* Martens quotes "The only Oncopodidae species represented extends the area of the family far to the Northwest but confirms its restriction to the Oriental region." Martens further states that "Oncopodidae : SE Asian distribution of 3 genera : *Oncopus* Thorell, (*O. doriae* Thorell. Loc. Borneo), *Gnomulus* Thorell (*G. rostratus* Thorell, Loc. Pingang). and *Pelitnus* Thorell (*P. armillatus* Thorell), 2 of which reaching Himalayas : *Pelitnus* in Darjeeling Dist., West Bengal and Pokhara in Nepal; *Gnomulus* in Abor Hills, Arunachal Pradesh. Thorell has described some more species vize *Oncopus fea* Thorell, Loc. Pingang; *O. truncates* Thorell, Loc. Singapore; *Gnomulus sumatranus* Thorell, Loc, Singalang. Some other known species are *Pelitnus imadatii* Suzuki, *P. goodnighti* Suzuki, *P. palawanensis* Suzuki all from Loc. Philippines and *P. drescoi* Silhavy and *P. segnipes* Loman, Loc. Sumatra. Pocock described 2 species as *O. alticeps*, Loc. Bankok and *O. hosei*, Loc. Borneo.

4. ***Gnomulus roingii*** sp. n.
(Figs. 36-42)

General : Body colour yellowish to light brown, with fine blackish reticulations, entirely smooth, anterior margin of cephalothorax not straight, palpal trochanter bear an acutely pointed tubercle, femur without spine; Tergites I-VII with a mid-dorsal longitudinal suture, sternites II-V also with a mid-ventral longitudinal fine suture.

Measurements(in mm) : ♀ : Total length 3.60; Cephalothorax 1.10 long, 1.90 wide; Abdomen 2.50 long, 2.40 wide; Palp 1.886 in total length.

Cephalothorax : Smooth, deeply furrowed on posterior lateral portions, middle portion raised, provided with a pair of median eyes, situated anteriorly in the ratio1 : 1.50, and separated from each other by 0.5mm, anterior margin not straight, but provided with a median and 2 lateral minute spines (Fig. 36), lateral margins short, narrowed and curved (Fig. 37). Chelicerae three segmented, Ist segments widened distally and unarmed on dorsal portions, 2 short and pointed spines lon

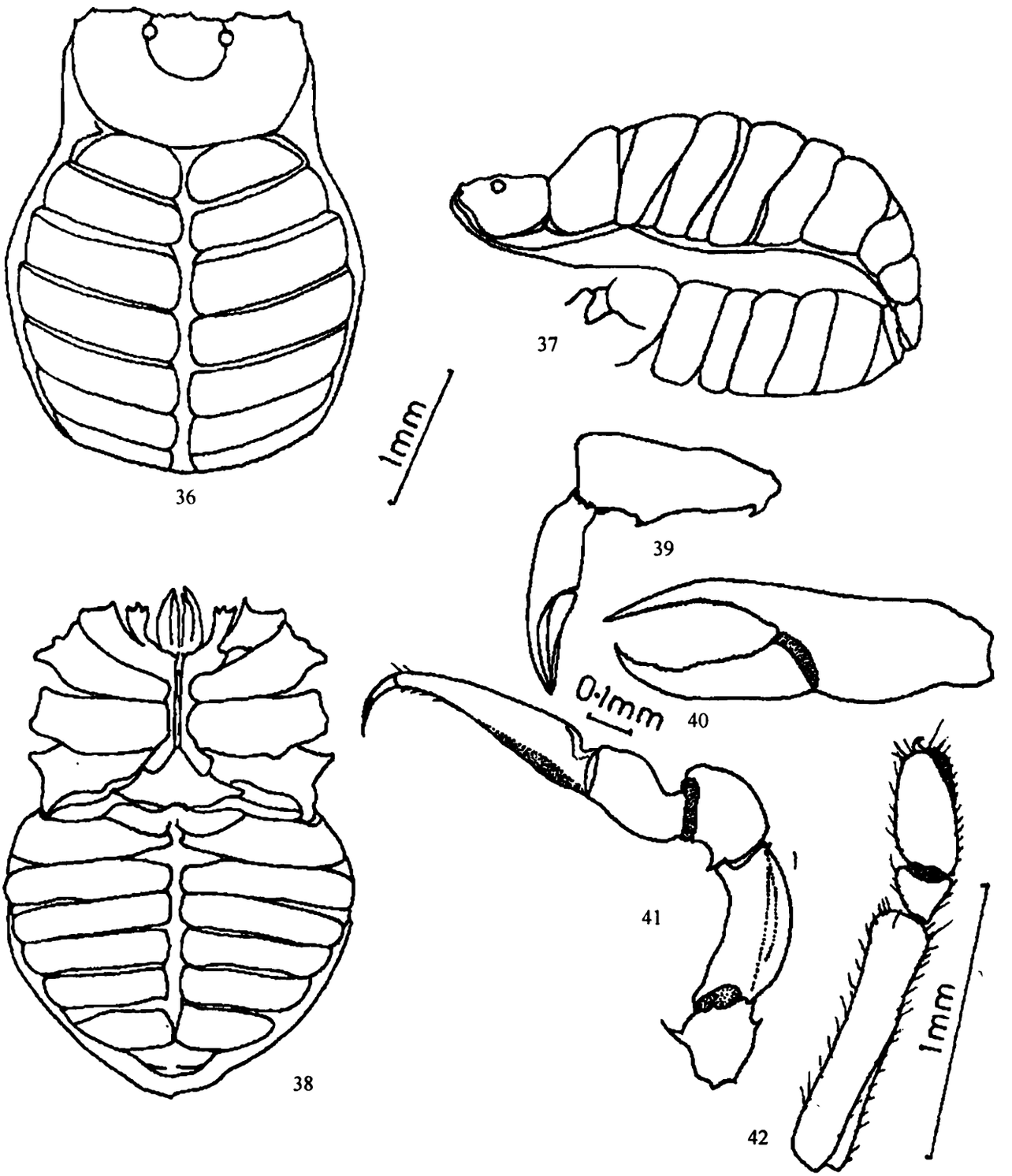


Fig. 36-42.

36. Female, legs omitted, dorsal aspects., 37. Female, legs omitted, lateral aspects., 38. Female, legs omitted, ventral aspects., 39. Chelicera with basal segment, lateral aspects., 40. Chelicera entire, exterior aspects., 41. Palp(left), interior aspects., 42. Distal portion of leg II, lateral aspects.

Table No. 3 showing measurements (in mm) for ♀ of *Gnomulus roingii* sp. n.

	Trochanter	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
Palp	0.276	0.391	0.230	0.253	—	0.736	**1.886**
Legs I	0.161	0.598	0.207	0.345	0.506	0.345	**2.162**
II	0.230	0.920	0.368	0.591	0.874	0.483	**3.466**
III	0.161	0.575	0.276	0.391	0.713	0.276	**2.392**
IV	0.230	0.713	0.368	0.529	1.035	0.345	**3.220**

ventro-proximal and 1on ventro-distal portions (Fig. 39), 2nd segment smooth, without any setation, movable and immovable fingers armed with minute sharp series of dentitions and acutely pointed and cross each other on distal ends when closed (Fig. 40); Palps comparatively short and stout, coxae with one delicate spine each ventrally, trochanters armed bellow with an acutely pointed short spines, femur elongated, almost cylindrical, smooth, without any spine slightly bent downwards, patellae slightly shorter than half the femur, smooth thickened and bent downwards, tibiae less than as long as patellae, and also more than as deep and wide, smooth, with out spines, tarsi cylindrical narrowed on distal portions towards tips, with out spines, twice as long as tibiae, tarsal claw 1/3rd of tarsus, acutely pointed and bent inwardly (Fig. 41). Legs relatively shorter and less stouter, unarmed, coxae I-IV distally produced into anterior and posterior blunt tubercles each and coxae IV with a pair of additional dorsal tubercles, femur I-IV straight bearing yellow band on distal portions, II longest, patellae shorter and stouter, tibiae I-IV each with distal yellow bands, tarsi I-IV each with central yellow band, IV longest, metatarsi I two segmented (Fig. 42), entirely yellow, delicate fringed bellow with minute, dark brownish, sharply pointed row of short but stout spinules, claws I & II very small, dark brown with out claw clefts where as III & IV placed in claw clefts. Legs formula 2431. Sternum elongated slightly widened on posterior portion; genital operculum short, capped, widened posteriorly and smooth; sternites except I & last each with mid-ventral longitudinal suture, entirely light in colour and with few delicate setae on lateral portions; Tergite VII initiates lateral rim on lateral sides and continues anteriorly ending anteriorly into triangular portions befitting between cephalothorax and tergite (Fig. 36). Abdomen dissected for genitalia, found ovipositor fully filled with numerous eggs, unable to draw.

Type-Data : *Holotype* 1 ♀, in spirit, palp and legs removed from one side for measurements and kept separately in spirit micro-vial, will be deposited in Zoological Survey of India, Kolkata.

Type-Locality : 27 Kms. of Roing, Mehao wildlife sanctuary, Dibanvally District, Arunachal Pradesh, Date 10.ix.1991, coll. Dr. D.B. Bastawade.

Distribution : Known only from Dibangvalley District, Arunachal Pradesh, India.

Etymology : The species is named after the name of District head quarter Roing as *roingii*, from where it was collected and the gender neutral.

ACKONWLEDGEMENTS

I am indebtedly thankful to J.R.B. Alfred, Director, Zoological Survey of India, Kolkata for their constant encouragements and numerous facilities to under take and complete this work. I am very much thankful to Dr. P.T. Bhutia, Scientist-SE, Officer-in-Charge, ZSI, APFS., Itanagar, Arunachal Pradesh for facilities to under take the faunistic surveys in Changlang, Kameng and Dibanvalley Districts of the state along with Dr. T.K. Pal, Scientist-SE as a party leader. My special thanks will always be due to Dr. T.K. Pal, Scientist-SE for his kind cooperation and valuable helps he extended to me during the surveys and stay at Arunachal Pradesh and most creditable scientific discussions while carrying out the job

entrusted to us. My thanks are certainly due to Dr. Rama Rao, ex-Joint-Director, ZSI, FBS, Hyderabad and Dr. M. S. Pradhan, Scientist-SE, ZSI, WRS, Pune for their facilities and help during the work of preparation of manuscript and illustrations. I am also thankful to Dr. H.V. Ghate, Head of Zoology, Modern College, Pune for his keen interest in the subject, discussions and suggestions. I may not forget to heart feeling thanks to Shri P.W. Garde, Artist Gr. I and Shri D.J. Kamble, Artist Gr. II for their painstaking efforts in making the inclined illustrations. I too thank to Mrs. Bharati, my wife for her help and sparing me with time to complete the work.

REFERENCES

BASTAWADE, D.B. 1985. Scorpion fauna of Namdapha Bio-sphere Reserve, Arunachal Pradesh, *Rec. zool. Surv. India,* **82**(1-4) : 259-262.

BASTAWADE D.B. 1992. A first record of the genus *Scorpiops* Peters (Vaejovidae (?) Scorpionida) from Mahadeo Hills, M. P., India with description of new species *Scorpiops* (*Scorpiops*) *pachmarhicus, J. Bombay natural History Society,* **89**(1) : 99-103.

BASTAWADE, D.B. and T.K. PAL 1992. first record of the Arachnid order Schizomida from Arunachal Pradesh, *J. Bombay natural History Society,* **94**(1) : 137.

BASTAWADE, D.B. 1997. Distribution of *Neoscorpiops* scorpions in Western Ghats of Maharashtra and Gujarat and possible Trichobothridial variations among isolated populations, *j. Bombay natural History Society,* **99**(1) : 104-114.

COKENDOLPHER, J.C., W.D. SISSOM, and D.B. BASTAWADE. 1988. A new *Schizomus* from the Indian state of Maharashtra, with additional comments o eyed Schizomids (Arachnida : Schizomidae) *Insecta Mundi,* **2** (2) : 90-96.

FRANCKE, O.F. 1976. Redescription of *Parascorpiops montana* Banks (Scorpionida : Vaejovidae) *Ent. News,* **87**(374) : 75-85.

GRAVELY, F.H. 1911. Notes on Pedipalpi in the collection of the Indian Museum I. New Pedipalpi from Calcutta, *Rec. Indian Mus.,* **6** : 33-38.

GRAVELY, F.H. 1912. Notes on Pedipalpi in the collection of the Indian Museum IV. New Oriental Tartarides, *Rec. Indian Mus.,* **7** : 107-110.

GRAVELY, F.H. 1925 Tartarides from Siju Caves, Garo Hills, Assam, *Rec. Indian Mus.,* **26** : 61-62.

KOVARIK, F. 1993. Two new species of the genus *Scorpiops* (Arachnida : Scorpiones : Vaejovidae) from south-east Asia, *Acta Soc. Zoo. Bohem.,* **57** : 109-115.

KOVARIK, F. 1994. *Scorpiops iranae* Sp. n. from Nepal and *Scorpiops hardwickei jendeki Ssp. n.* from Yunnan China (Arachnida : Scorpionida : Vaejovidae) *Acta Soc. Zoo. Bohem,* **58** : 61-66.

LOURENCO, W.R. 1998. designation of the Scorpion sub-family Scorpiopsinae Kraepelin 1905 as family Scorpiopsidae Kraepeli 1905 (stat Nov) : its generic composition and a description of a new species of *Scorpiops* from Pakistan (Scorpiones : Scorpiopsidae), *Entomol. Mitt. Zool. Mus. Hamburg,* **12**(157) : 245-254.

MARTENS, J. 1977. Opiliones aus dem Nepal-Himalaya. III Onchopodidae, Phalangodidae. Assamidàe (Arachnida), *Senckenbergiana boil.,* **57**(4-6) : 295-340.

MARTENS, J. and P.Schewendinger 1998. A taxonomic revision of the family Onchopodidae I. New genera and new species of *Gnomulus* Thorell (Opliliones, Laniatore), *Rev. suis. De Zoologie.* **105**(5) : 499-555.

REDDELL, J.R., and J.C. COKENDOLPHER 1985. Redescription f *Trithyreus Grassii* (Arachnia : Schizomida : Schizomidae) *Oriental Insects,* **18** : 43-52.

REDDELL, J.R. and J.C. COKENDOLPHER 1995 catalogue, Bibliography and Generic Revision of the order Schizomida (Arachnida) *Texas Memorial Mus. spelelogical Monographs* No. **4** : 1-170

ROEWER, F.C. 1913. Arachnida II : Opilione in Zool, Res. Abor Expedition, 1911-12, *Rec. Indian Mus.,* **8** : 203-207.

SCHEWENDINGER, P. and J. MARTENS, 1999. A taxonomic revision of the family Onchopodidae II. The genus *Gnomulus* Thorell (Opiliones, Lanitore). *Rev. suis, De Zoologie,* **106**(4) : 945-982.

TIKADER, B.K. and D.B. BASTAWADE, 1983. *Fauna of India : Scorpions (Arachnida)* **3** : 1-672.

VACHON, M. 1973. Study of characteristics used to classify families and genera of Scorpionida (Arachnida) : 1 Trichobothriotaxi in Arachnology : Trichobothridial sigla and types of Trichobothriotaxi in Scorpionida, *Bull. Mus. Natn. Hist. Nat. Paris, Ser. Zool.,* **104**(140) : 857-958.

Zool. Surv. India
Fauna of Arunachal Pradesh, State fauna Series, 13(Part-2) : 467-478, 2006

ORIBATID MITES (ACARI : ORIBATEI)

A. K. SANYAL, B. J. SARKAR AND M. N. MOITRA
Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053

INTRODUCTION

Oribatid or cryptostigmatid mites form a complex group under the subclass Acarina and are numerically the most abundant soil fauna among the microarthropods inhabiting soil. These mites are commenly known as "beetle" or "moss" mites due to its shape and preference in living in moss. These mites are very common inhabitants of almost all possible habitats in all the continents of the world.

Oribatids are of great economic importance due to its role in promoting soil fertility through humification of organic matter and as biological control agent for pests. There are a few oribatid species which feed on higher plants and transmit fungal spores. They are also responsible for transmitting various helminth diseases to domestic animals. Some of the species of oribatid mites help in regulating soil nematode population. Many oribatid species living in house dust cause respiratory allergy in human beings.

Before the present author initiated the study of oribatid mites of Arunachal Pradesh, no attempt to study the group of tiny mite was done by any acarologist. The present work is based on collection of oribatei from the state done by the author and his associates during the years 1997 and 1999. All the taxa reported here for the first time from Arunachal Pradesh.

MATERIAL AND METHODS

For collection of oribatid mites, litter, soil and humus from all possible habitats in different localities in Arunachal Pradesh were collected by the auther and his associates mainly by hand sorting and extraction methods. The samples were taken from upper 0-10 cm of soil profile with the help of a shovel and kept in polythene bags with proper label. The samples were subjected to the process of extraction by using modified Tullgren funnel extractors and the collected specimens were preserved in 70% alcohol. For desclerotization, preparation of slides and identification of mite specimens Balogh (1972) and Balogh and Balogh (1992) have been followed.

The specimens, after identification, were kept in 70% alcohol with proper label and deposited in the National Zoological collection, Zoological Survey of India, Kolkata.

GENERAL MORPHOLOGY AND TERMINOLOGY

For details of morphological features and terminology discussed in the paper Sanyal (2000) may be consulted.

List of Oribatid Taxa known from Arunachal Pradesh

Family 1. HAPLOCHTHONIIDAE

1. Genus ***Haplochthonius*** Willmann

1. *H. clavatus* (Hammer)

Family 2. PHTHIRACARIDAE

2. Genus ***Atropacarus*** Ewing

2. *A. (Hoplophorella) scapellatus* (Aoki)

3. Family EUPHTHIRACARIDAE

3. Genus ***Rhysotritia*** Markel and Meyer

4. *R. ardua ardua* (Koch)

4. Genus ***Euphthiracarus*** Ewing

5. *E. meghalayensis* Sanyal

Family 4. LOHMANIIDAE

5. Genus ***Javacarus*** Balogh

6. *J. kuhnelti* Balogh

Family 5. EPILOHMANNIIDAE

6. Genus ***Epilohmannia*** Berlese

7. *E. cylindrica* (Berlese)

Family 6. NOTHRIDAE

7. Genus ***Nothrus*** Koch

8. *N. gracilis* Hammer

Family 7. TRHYPOCHTHONIIDAE

8. Genus ***Allonothrus*** Hammen

9. *A. monodactylus* Wallwork

9. Genus ***Archegozetes*** Grandjean

10. *A. longisetosus* Aoki

Family 8. NANHERMANNIIDAE

10. Genus ***Cyrthermannia*** Balogh

11. *C. quadricornuta* chakrabarti and Bhaduri

Family 9. EREMULIDAE

11. Genus ***Eremulus*** Berlese

12. *E. avenifer* Berlese

Family 10. EREMOBELBIDAE

12. Genus ***Eremobelba*** Berlese

13. *Eremobelba* sp.

Family 11. ZETORCHESTIDAE

13. Genus ***Zetorchestes*** Berlese

14. *Z. saltator* Oudemans

Family 12. TECTOCEPHEIDAE

14. Genus ***Tectocepheus*** Berlese

15. *T. velatus* (Michael)

Family 13. OTOCEPHEIDAE

15. Genus ***Dolicheremaeus*** Jacot

16. *D. geminus* Mondal and Kundu

Family 14. OPPIIDAE

16. Genus ***Arcoppia*** Hammer

17. *A. bidentata* Hammer

17. Genus ***Brachioppiella*** Hammer

18. *Brachioppiella* sp.

18. Genus ***Multioppia*** Hammer

19. *M. radiata* Hammer

19. Genus ***Oppia*** Koch

20. *O. yodai* Aoki

Family 15. SUCTOBELBIDAE

20. Genus ***Suctobelba*** Paoli

21. *S. elegantula* Hammer

Family 16. XYLOBATIDAE

21. Genus ***Xylobates*** Jacot

22. *X. seminudus* Hammer

Family 17. CERATOZETIDAE

22. Genus ***Ceratozetes*** Berlese

23. *C. gracilis* Michael

Family 18. HAPLOZETIDAE

23. Genus ***Haplozetes*** Willmann

24. *Haptozetes* sp.

24. Genus ***Rostrozetes*** Sellnick

25. *R. foveolatus* Sellnick

Family 19. SCHELORIBATIDAE

25. Genus ***Rhabdoribates*** Aoki

26. *R. siamensis* Aoki

26. Genus ***Scheloribates*** Berlese

27. *S. albialatus* Hammer

28. *S. natalensis* Pletzen
29. *S. parvus* Pletzen
30. *S. thermophilus* Hammer

Family 20. AUSTRACHIPTERIIDAE

27. Genus ***Hypozetes*** Balogh

31. *H. laysanensis* Aoki

28. Genus ***Lamellobates*** Hammer

32. *L. palustris* Hammer

29. Genus ***Paralamellobates*** Bhaduri and Raychaudhuri

33. *P. bengalensis* Bhaduri and Raychaudhuri

Family 21. GALUMNIDAE

30. Genus ***Galumna*** Von Heyden

34. *G. crenata* Deb and Raychaudhuri
35. *G. flabellifera* Hammer
36. *Galumna* sp.

SYSTEMATIC ACCOUNT

Key to the families and genera of ORIBATID MITES from Arunachal Pradesh

1. Ptychoid body, propodosoma can be shut back against hysterosoma and ventral region like blade of penknife, generally laterally compressed body 2

– Body not ptychoid, propodosoma can not be shut back like blade of penknife; body not laterally compressed 3

2. Anogenital region narrow, 'V'-shaped; body considerably compressed laterally ..... EUPHTHIRACARIDAE Jacot

– Anogenital region wide, almost 'V'–shaped; body only slightly compressed laterally ..... PHTHIRACARIDAE Perty–(ii).

(i) Two interlocking triangles present in middle of anogenital region; notogaster sculptured. ..... ***Euphthiracarus*** Ewing.

– One interlocking triangle present in middle of anogenital region; notogaster not sculptured ..... ***Rhysotritia*** Markel and Meyer.

(ii) Genital setae forming a row or almost a row, located near the proximal margin, distance between g_6 and g_5 reater than that between g_5 and g_4 ....***Atropacarus (Hoplophorella)*** Niedbala.

3. Anogenital region of macropyline type 4

– Anogenital region of brachypyline type 8

4. Notogaster with 3 transverse sutures; all notogastral setae almost similar in length, not rigid, arising on the shields .... HAPLOCHTHONIIDAE–(iii).

(iii) Notogaster with three sutures, with four shields; no preanal plate; rostral setae present ..... ***Haplochthonius*** Willmann.

– Notogaster without transverse suture 5

5. Body dichoid; preanal plate present ....LOHMANNIIDAE BERLESE–(iv).

(iv) Genital plate without transverse suture; ano-adanal setae four pairs .... ***Javacarus*** Balogh.

– Body holoid; preanal plate absent 6

6. Three pairs of setae on epimere-3 7

– Four to six pairs of setae on epimere 3; epimeral neotrichy strong .... NOTHRIDAE Berlese–(vi).

7. Genital setae 4-14 pairs; adanal setae two pairs ....TRHYPOCHTHONIIDAE Willmann (v).

(v) Quadrangular notogaster; notogastral setae simple; seven pairs of genital setae; legs monodactylous .... ***Archegozetes*** Grandjean.

– Pentagonal notogaster; notogastral setae spatulate; 7-14 pairs of genital setae; legs tridactylous .... ***Allonothrus*** Hammen.

(vi) Rostrum with median incision ....***Nothrus*** Koch.

8. Notogaster pycnonotic; usually pteromorphae absent 9

– Notogaster poronotic; pteromorphae usually present .....

9. Anogenital plate either schizogastric type or diagastric type 10

– Ventral plate hologastric type 11

10. Anogenital plate schizogastric type; 14 pairs of notogastral setae; genital setae 8 pairs; anal setae three pairs .... EPILOHMANNIIDAE Oudemans–(vii).

– Anogenital plate diagastric type; 15 pairs of notogastral setae; genital setae 1 pairs; anal setae 2 pairs .... NANHERMANNIIDAE Sellnick–(viii).

(vii) Transverse lines between genital and anal plates present; genital plates usually with more than 7 pairs of setae .... ***Epilohmannia*** Berlese.

(viii) Notogastral profile uneven due to presence of tubercles and indentations; notogastral setae short; 2 or 4 cornu on the posterior margin of prodorsum .... ***Cyrthermannia*** Balogh.

11. Prodorsum having lamellae 12

– Prodorsum without true lamellae; either thin crestshaped lamellae or thin costulae present or both lamellae and costulae absent 13

12. Dorsosejugal suture absent; lamellae with relatively long cuspides; lamellar interlamellar complex 'N'– shaped .... TECTOCEPHEIDAE Grandjean–(ix).

(ix) Lamellae wide; notogaster with 10 pairs of setae; genital setae 6 pairs; humeral appendages horizontal; legs monodactyle .... ***Tectocepheus*** Berlese.

13. Ventral neotrichy present, more than four pairs of aggenital adanal setae ..... 14.

– Ventral neotrichy absent ..... 15.

14. Exuvia never affixed by one tubercle to notogaster; pedotecta II present; notogaster usually withy polygonally arranged granulations; anal setae two pairs .... EREMOBELBIDAE Balogh–(x).

(x) Notogastral setae not blade-shaped; aggenital setae 6-23 pairs .... ***Eremobella*** Berlese.

15. Body elongate, mostly at least twice longer than wide; prodorsal and notogastral condyles present; notogastral setae 10-14 pairs .... OTOCEPHEIDAE Balogh–(xi).

– Body not elongate, mostly never twice as long as wide 16

(xi) Pedotecta 2+3 distinct but not so conspicuously developed; genital plates with 4 pairs of setae; anal plates with 2 pairs of setae ..... ***Dolicheremaeus*** Jacot.

16. Chelicera peloptoid; rostrum narrowing, mostly with lateral teeth; tectopodial fields and lamellar knob on prodorsum .... SUCTOBELBIDAE Grandjean–(xii).

– Chelicera normal; prodorsum without tectopodial fields and lamellar knob..... ..... ***Oppiidae*** Grandjean–(xiii).

(xii) Dorsosejual suture without teeth; notogaster without crista ..... ***Suctobelba*** Paoli.

(xiii) Fissure *iad* inverse apoanal; sensillus either pectinate, radiate or ciliate; genital plates with 4 or 5 pairs of setae; notogaster with 9 pairs of setae; setae ad_1 postanal; genital plates with 5 pairs of setae .... ***Brachioppiella*** Klammer.

– Fissure *iad* either paraanal, or direct apoanal–(xiv).

(xiv) Lamellar and translamellar lines absent; sensillus never pectinate, radiate or ciliate (exceptionally bifurcate); Interlamellar setae present; sensillus elongately fusiform or lanceolate; genital setae 5 pairs .... ***Oppia*** Koch.

– Lamellar and translamellar lines present .... (xv).

(xv) Lamellar and translamellar lines together forming a distinct arch; genital plates with 6 pairs of setae; sensillus radiate; rostrum tridentate ..... ***Arcoppia*** Hammer.

– Translamellar line, if present, never forming a distinct arch; genital plates with 4 or 5 pairs of setae; fissure *iad* paraanal; notogaster with 12 pairs of setae; usually three pairs of sigillae between interlamellar setae; senillus fusiform, ciliate or pectinate ..... ***Multioppia*** Hammer.

17. Pteromorphae movable, articulate or semicircular; prodorsum without true projecting lammellae; some chitinous lines present on prodorsum ..... GALUMNIDAE Jacot–(xvi).

– Pteromorphae immovable but not articulate, sometines absent ..... 18.

(xvi) Lamellar setae placed between lines *L* and *S* ..... ***Galumna*** Heyden.

18. Prodorsum with tutorium; lamellae broad, sometimes synlamella type .... AUSTRACHIPTERIIDAE Luxton (xvii)

– Prodorsum without tutorium; usually 3-5 pairs of genital setae (exceptionally 6 pairs) .. 19.

(xvii) Adanal region with 3 pairs of setae ..... ***Hypozetes*** Balogh.

– Adanal region with 1 or 2 pairs of setae–(xviii).

(xviii) Interlamellar area small; lamellae without free tips ..... ***Lamellobates*** Hammer.

– Interlamellar area large; lamellae with free tips ..... ***Paralamellobates*** Bhaduri and Raychaudhuri.

19. Notogaster with true areae porosae ... (xix).

– True areae porosae absent, notogaster with sacculi or pori ..... 20.

(xix) Sensillus long, reclinate, setiform, often slightly lanceolate at its tip ..... ***Xylobatidae*** Balogh and Blalogh Notogaster with 10 pairs of setae or alveoli; legs monodactyle ..... ***Xylobates*** Jacot.

20. Pteromorphae movable, hinged ....HAPLOZETIDAE Grandjean–(xx).

– Pteromorphae immovable or absent .... SCHELORIBATIDAE Grandjean–(xxi).

(xx) Interlamellar setae originating on dorsosejugal suture; genital setae 4 pairs .... ***Haplozetes*** Willmann.

– Interlamellar setae not originating on dorsosejugal suture; genital setae 5 pairs; dorsosejugal suture with three arches .... ***Rostrozetes*** Sellnick.

(xxi) Genital plates with 3 pairs of setae; notogastral setae 14 pairs; aggenital setae absent .... ***Rhabdoribates*** Aoki.

– Genital plates with 4 pairs of setae; notogastral setae normally 10 pairs; aggenital setae present .... ***Scheloribates*** Berlese.

Family 1. HAPLOCHTHONIIDAE Hammen, 1959.

1. Genus ***Haplochthonius*** Willmann

1930. *Haplochthonius* Willmann, *Abh. natur. Ver. Bremen*, **28** (1) : 2.

1. ***Haplochthonius clavatus*** (Hammer)

1958. *Tetrochthonius clavatus* Hammer, *Biol. Skr. Dan. Vid Selsk.*, **10** (1) : 23.

1961. *Haplochthonius clavatus* (Hammer), Balogh, *Acta Zool Hung.*, **7** : 243-244.

Diagnosis : Sanyal (1992) may be consulted.

Material examined : East Siang dist., 3 ♀ ♀, Pasighat, 8.v.1999, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Tripura, West Bengal.

Family 2. PHTHIRACARIDAE Perty, 1841

2. Genus ***Atropacarus*** Ewing

1917. *Atropacarus* Ewing, *J. Economic Ent. Concord*, **10** : 131.

Atropacarus (Hoplophorella) Niedbala

1986. *Atropararus (Hoplophorella)* Niedbala, *Acarologia*, **27** (1) : 80.

2. ***Atropacarus (Hoplophorella) scapellatus*** (Aoki)

1965. *Hoplophorella scapellata* Aoki, *Nat. Life. Southeast Asia*, **4** : 131.

1992. *Atropacarus (Hoplophorella) scapellatus*, Niedbala, In : *Phthiracaroidea (Acari, Oribatida). Systematic Studies*, Amsterdam, 226.

Diagnosis : Sanyal (2000) may be consulted.

Material examined : East Siang dist., 2♀♀, Debang, 4.v.1999, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Assam, Bihar, Manipur, Orissa, Tripura, West Bengal.

Family 3. EUPHTHIRACARIDAE Jacot, 1930

3. Genus ***Rhysotritia*** Markel and Meyer

1959. *Rhysotritia* Markel and Meyer, *Zool. Anz.*, **163** : 329.

3. ***Rhysotritia ardua ardua*** (Koch)

1841. *Hoplophorella ardua* Koch, Deutschlands Crustacean Myriapoden and Arachniden, **32** : 315.

1959. *Rhysotritia ardua ardua* Markel and Meyer, *Zool. Anz.*, **168** : 329.

Diagnosis : Sanyal (2000) may be consulted.

Material examined : Tirap dist., 4♀♀, Gibbon land, Namdapha, 4.v.1999, from soil and litter, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Himachal Pradesh, Orissa, Tripura, Uttar Pradesh, West Bengal.

4. Genus ***Euphthiracarus*** Ewing

1917. *Euphthiracarus* Ewing, *Ann. ent. Soc. Am.*, **10** : 125.

4. ***Euphthiracarus meghalayensis*** Sanyal

1988. *Euphthiracarus meghalayensis* Sanyal, *Rec. zool. Surv. India*, **85** (2) : 227.

Diagnosis : Aspis with two lateral carinae on each side; surface of aspis between the upper carinae and the whole surface of notogaster distinctly sculptured with papillae; rostral setae smooth, long, directed outward and bent downward; lamellar and interlamellar setae barbed; 14 pairs of barbed notogastral setae; genito-aggenital region with papillae.

Material examined : West Kameng dist., 4♀, Yak Research Centre, Dirang, 15.xi.1997, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Meghalaya.

Family 4. LOHMANIIDAE Berlese, 1916

5. Genus ***Javacarus*** Balogh

1961. *Javacarus* Balogh, *Acta Zool. Hung.*, **7** : 24.

5. ***Javacarus kuhnelti*** Balogh

1961. *Javacarus kuhnelti* Balogh, *Acta Zool. Hung.*, **7** : 31.

Diagnosis : Sanyal (2000) may be consulted.

Material examined : Papum pare dist., 3♀♀, Itafort Gate II, Itanagar, 7.xi.1997, from litter and soil, coll. A.K. Sanyal. Lohit dist., 2♀♀, F.R.I. campus, Tezu, 27.iv.1999, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Tripura, West Bengal.

Family 5. EPILOHMANNIIDAE Oudemans, 1923

6. Genus ***Epilohmannia*** Berlese

1916. *Epilohmannia* Berlese, *Redia*, **12** : 176.

6. ***Epilohmannia cylindrica*** (Berlese)

1904. *Lohmannia cylindrica* Berlese, *Rdia*, **2** : 33.

Diagnosis : Sanyal (2000) may be consulted.

Material examined : Lower Subansiri dist., 3♀♀, Circuit House surroundings, zero, 8.xi.1997, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Tripura.

Family 6. NOTHRIDAE Berlese, 1896

7. Genus *Nothrus* Koch

1936. *Nothrus* Koch, *Deutrchlands crustaceen, Myriapoden und Arachniden*, **2** : 17.

7. *Nothrus gracilis* Hammer

1961. *Nothrus gracilis* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **13** (1) : 28.

Diagnosis : Sanyal (1992) may be consulted.

Material examined : Papum pare dist., 1 ♀, Itafort, Gate II, Itanagar, 7.xi.1997, from litter and soil, coll. A.K. Sanyal. West Kameng dist. 1 ♀, Yak Research centre, Dirang, 15.xi.1997, from litter and soil, coll. A.K. Sanyal. Tirap dist., 5 ♀♀, Gibbon land, Namdapha, 4.v.1999, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, West Bengal.

Family 7. TRHYPOCHTHONIIDAE Willmann, 1831

8. Genus *Allonothrus* Hammen

1953. *Allonothrus* Hammen, *Proc. Acad. Sci. Amst.*, **56C** : 244.

8. *Allonothrus monodactylous* Wallwork

1960. *Allonothrus monodactylous* Wallwork, *Acarologia*, **2** (4) : 568.

Diagnosis : Sanyal (1992) may be consulted.

Material examined : Papum pare dist., 3 ♀♀, Itafort, Gate II, Itanagar, 7.xi.1997, from litter and soil, coll. A.K. Sanyal. Lohit dist. 1 ♀, Salangmi, Tezu, 28.iv.19999, from litter and soil, coll. A.K. Sanyal. Tirap dist., 2 ♀♀, Namdapha Research station, 4.v.1999, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Orissa, West Bengal.

9. Genus *Archegozetes* Grandjean

1931. *Archegozetes* Grandjean, *Bull. Mus. Hist. Nat. Paris*, **3** (2) : 144.

9. *Archegozetes longisetosus* Aoki

1965. *Archegozetes longisetosus* Aoki, *Nat Life Southeast Asia*, **4** : 147.

Diagnosis : Sanyal (1992) may be consulted.

Material examined : 7 ♀♀, Tibus village, Miao, 2.v.1999, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Assam, Kerala, Tripura, West Bengal.

Family 8. NANHERMANNIIDAE Sellnick, 1928

10. Genus *Cyrthermannia* Balogh

1958. *Cyrthermannia* Balogh, *Rev. Zool. Bot. Afr.*, **58** (102) : 3.

10. *Cyrthermannia quadricornuta* Chakrabarti and Bhaduri

1977. *Cyrthermannia quadricornuta* Chakrabarti and Bhaduri, *Indian J. Acar.*, **2** (2) : 49.

Diagnosis : Sanyal (1992) may be consulted.

Material examined : Papum pare dist., 2 ♀♀, Itafort, Gate II, Itanagar, 7.xi.1997, from litter and soil, coll. A.K. Sanyal.

Family 9. EREMULIDAE Grandjean, 1965

11. Genus *Eremulus* Berlese

1908. *Eremulus* Berlese, *Redia*, **5** : 10.

11. *Eremulus avenifer* Berlese

1913. *Eremulus avenifer* Berlese, *Redia*, **9** : 96.

Diagnosis : Sanyal (1992) may be consulted.

Material examined : 2 ♀♀, Naharlagun, 7.xi.1997, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Nagaland, West Bengal.

Family 10. EREMOBELBIDAE Balogh, 1961

12. Genus *Eremobelba* Berlese

1908. *Eremobelba* Berlese, *Redia*, **5** (1) : 9.

12. ***Eremobelba*** sp.

Material examined : West Kameng dist., 3♀♀, Bomdila, 13.xi.1997, from moss, coll. A.K. Sanyal. Lohit dist., 2♀♀, F.R.H. campus, Tezu, 27.iv.1999, from moss, coll. A.K. Sanyal.

Remarks : The specimens seen to be new. This will be published in a seperate publication.

Family 11. ZETORCHESTIDAE Michael, 1898

13. Genus ***Zetorchestes*** Berlese

1988. *Zetorchesters* Berlese, *Acari, Myriapoda et Scorpiones hucusqua in Italia reperta, padova.*

13. ***Zetorchestes saltator*** Oudemans

1915. *Zetorchester saltator* Oudemans, *Ber. Ned. Ent. Ver.*, **4** : 194.

Diagnosis : Sanyal (2000) may be consulted.

Material examined : Lower Subansiri dist., 3♀♀, Circuit House campus, Zero, 5.xi.1997, from rock moss, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Tripura, West Bengal.

Family 12. TECTOCEPHEIDAE Grandjean, 1954

14. Genus ***Tectocepheus*** Berlese

1913. *Tectocepheus* Berlese, *Redia*, **9** : 91.

14. ***Tectocepheus velatus*** (Michael)

1888. *Tectocepheus velatus* (Michael), *Ray. Soc.*, 65.

Diagnosis : Sanyal (2000) may be consulted.

Material examined : Lower Subansiri dist., 1♀, Circuit House campus, Zero, 5.xi.1997, from rock moss, coll. A.K. Sanyal; D.C. office surroundings, Zero, 5.xi.1997, from grassland soil, coll. A.K. Sanyal. Papum pare dist., 1♀, Itafort, gate II, Itanagar, 7.xi.1997, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Bihar, Himachal Pradesh, Orissa, Sikkim, Tripura, West Bengal.

Family 13. OTOCEPHEIDAE Balogh, 1961

15. Genus ***Dolicheremaeus*** Jacot

1938. *Dolicheremaeus* Jacot, *Florida Ent.*, **21** (4) : 51.

15. ***Dolicheremaeus geminus*** Mondal and Kundu

1986. *Dolicheremaeus geminus* Mondal and Kundu, *Rec. zool. Surv. India*, **83** (1 & 2) : 91.

Diagnosis : Sanyal (1992) may be consulted.

Material examined : Papum pare dist., 3♀♀, Naharlagun, 7.xi.1997, from litter and soil, coll. A.K. Sanyal.

Family 14. OPPIIDAE Grandjean, 1954

16. Genus ***Arcoppia*** Hammer

1977. *Arcoppia* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **21** (4) : 32.

16. ***Arcoppia bidentata*** Hammer

1979. *Arcoppia bidentata* Hammer, *Biol. Skr. Dan. Vid. selsk.*, **22** (9) : 29.

Diagnosis : Sanyal (2000) may be consulted.

Material examined : Subansiri dist., 2♀♀, Tippi orchid garden, Bhalukpong, 10.xi.1997, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Tripura.

17. Genus ***Brachioppiella*** Hammer

1962. *Brachioppiella* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **13** (2) : 47.

17. ***Brachioppiella*** sp.

Material examined : West Kameng dist., 3♀♀, Bomdila, 13.xi.1997, from moss, coll. A.K. Sanyal.

Remarks : The specimens were partly damaged and identification upto species level was not possible.

18. Genus ***Multioppia*** Hammer

1961. *Multioppia* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **13** (1) : 61.

18. *Multioppia radiata* Hammer

1961. *Multioppia radiata* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **13** (1) : 62.

Diagnosis : Sanyal (1992) may be consulted.

Material examined : West Kameng dist., 2♀♀, Regional Apple Research Centre, Dirang, 16.xi.1997, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, West Bengal.

19. Genus *Oppia* Koch

1836. *Oppia* Koch, *Deutschlands crustaceen, Myriapoden and Arachniden*, 1-9.

19. *Oppia yodai* Aoki

1965. *Oppia yodai* Aoki, *Nat. Life Southeast Asia*, **4** : 169.

Diagnosis : Sanyal (2000) may be consulted.

Material examined : Papum pare dist., 11♀♀, Itafort, Gute II, Itanagar, 7.xi.1997, from litter and soil, coll. A.K. Sanyal; Lohit dist., 1♀, F.R.H. campus, Tezu, 27.iv.1999, from moss, coll. A.K. Sanyal.

Family 15. SUCTOBELBIDAE Grandjean, 1954

20. Genus *Suctobelba* Paoli

1908. *Suctobelba* Paoli, *Redia*, **5** (1) : 72.

20. *Suctobelba elegantula* Hammer

1958. *Suctobelba elegantula* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **19** (1) : 48.

Diagnosis : Sanyal (1992) may be consulted.

Material examined : Papum pare dist., 2♀♀, Zoological Garden, Itanagar, 7.xi.1997, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, West Bengal.

Family 16. XYLOBATIDAE Balogh and Balogh, 1984

21. Genus *Xylobates* Jacot

1929. *Xylobates* Jacot, *Trans. Amer. Micr. Soc. Menasha*, **48** : 429.

21. *Xylobates seminudus* Hammer

1971. *Xylobates seminudus* Hammer, *Biol. Skr. Dan Vid Selsk.*, **16** : 38.

Diagnosis : Sanyal (2000) may be consulted.

Material examined : Papum pare dist., 2♀♀, Zoological Garden, Itanagar, 7.xi.1997, from litter and soil, coll. A.K. Sanyal. Tirap dist., 1♀, Namdapha Research Foundation, Namdapha, 4.v.1999, from soil, coll. A.K. Sanyal. East Siang dist., 1♀, Pasighat, 8.v.1999, from soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Tripura, West Bengal.

Family 17. CERATOZETIDAE Jacot, 1925

22. Genus *Ceratozetes* Berlese

1908. *Ceratozetes* Berlese, *Redia*, **5** : 4.

22. *Ceratozetes gracilis* Michael

1884. *Ceratozetes gracilis* Michael, *Ray. Soc.*, **61** 225.

Diagnosis : Sanyal (1992) may be consulted.

Material examined : Papum pare dist., 2♀♀, Itafort, Gate II, Itanagar, 7.xi.1997, from litter and soil, coll. A.K. Sanyal. West Kameng dist., 1♀, Regional Apple Research Centre, Dirang, 16.xi.1997, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, West Bengal.

Family 18. HAPLOZETIDAE Grandjean, 1936

23. Genus *Haplozetes* Willmann

1935. *Haplozetes* Willmann, *Zool. Jahrb., Syst.*, **66** 333.

23. *Haplozetes* sp.

Material examined : East Siang dist., 3♀♀, Pasighat, 8.v.1999, from soil, coll. A.K. Sanyal.

Remarks : The specimens seem to be new species and the description will be published in separate publication.

24. Genus ***Rostrozetes*** Sellnick

1925. *Rostrozetes* Sellnick, *Suppl. Ent. Berlin,* **11** : 84.

24. ***Rostrozetes foveolatus*** Sellnick

1925. *Rostrozetes foveolatus* Sellnick, *Suppl. Ent. Berlin,* **11** : 84.

Diagnosis : Sanyal (1992) may be consulted.

Material examined : Papum pare dist., 2♀♀, Itafort, Gate II, Itanagar, 7.xi.1997, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Bihar, Tripura, West Bengal.

Family 19. SCHELORIBATIDAE Grandjean, 1953

25. Genus ***Rhabdoribates*** Aoki

1967. *Rhabdoribates* Aoki, *Nat. Life Southeast Asia,* **5** : 197.

25. ***Rhabdoribates siamensis*** Aoki

1967. *Rhabdoribates siamensis* Aoki, *Nat. Life Southeast Asia,* **5** : 197.

Diagnosis : Sanyal (2000) may be consulted.

Material examined : Subansiri dist., 3♀♀, Bhalukpong, 10.xi.1997, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Tripura.

26. Genus ***Scheloribates*** Berlese

1908. *Scheloribates* Berlese, *Redia,* **5** : 2.

26. ***Scheloribates albialatus*** Hammer

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

Diagnosis : Sanyal (1992) may be consulted.

Material examined : Lower Subansiri dist., 2♀♀, Zero, 5.xi.1997, from rock moss, coll. A.K. Sanyal. Papum pare dist., 25♀♀, Itafort, Gate II, Itanagar, 7.xi.1997, from litter and soil, coll. A.K. Sanyal; 11♀♀, Zoological garden, Itanagar, 7.xi.1997, from litter and soil, coll. A.K. Sanyal. Subansiri dist., 3♀♀, Tippi orchid garden, Bhalukpong, 10.xi.1999, from litter and soil, coll. A.K. Sanyal. West kameng dist., 28♀♀, Yak Research Centre, Dirang, 15.xi.1997, from litter and soil, coll. A.K. Sanyal. Lohit dist. 7♀♀, Tezu, 28.iv.1999, from litter and soil, coll. A.K. Sanyal; 7♀♀, Miao, 2.v.1999, litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, West Bengal.

27. ***Scheloribates natalensis*** Pletzen

1963. *Scheloribates natalensis* Pletzen, *Acarologia,* **5** (4) : 700.

Diagnosis : Sanyal (1992) may be consulted.

Material examined : Lower Subansiri dist., 10♀♀, Circuit House surroundings, Zero, 8.xi.1997, from litter and soil, coll. A.K. Sanyal. Subansiri dist., 1♀, Tippi Orchid garden, Bhalukpong, 10.xi.1997, from litter and soil, coll. A.K. Sanyal; West Kameng dist., Yak Reseaech centre, Dirang, 15.xi.1997, from litter and sirl, coll. A.K. Sanyal. Lohit dist., 1♀♀, F.R.H. campus, Tezu, 27.iv.1999, from litter and soil, coll. A.K. Sanyal. Tirap dist., 9♀♀, Namdapha Research Foundation, Namdapha, 4.v.1999, from soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, West Bengal.

28. ***Scheloribates parvus*** Pletzen

1963. *Scheloribates parvus* Pletzen, *Acarologia,* **5** (4) : 701.

Diagnosis : Sanyal (1992) may be consulted.

Material examined : West Kameng dist., 17♀♀, Yak Research Centre, Dirang, 15.xi.1997, from litter and soil, coll. A.K. Sanyal. Lohit dist., 11♀♀, F. R. H. campus, Tezu, 27.iv.1999, from litter and soil, coll. A. K. Sanyal; East siang dist., 1♀, Pasighat, 8.v.1999, from soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Assam, West Bengal.

29. ***Scheloribates thermophilus*** Hammer

1961. *Scheloribates thermophilus* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **14** (1) : 95.

Diagnosis : Sanyal (1992) may be consulted.

Material examined : Lower Subansiri dist., 3♀♀, Circuit House suroundings, Zero, 8.xi.1997, from litter and soil, coll. A.K. Sanyal. West Kameng dist., 3♀♀, Bomdila, 12-13.xi.1997, from moss and soil, coll. A.K. Sanyal; 17♀♀, Yak Research Centre and Regional Apple Reserach centre, Dirang, 15-16.xi.1997, from litter and soil, coll. A.K. Sanyal.

Distribution : Arunachal Pradesh, West Bengal.

Family 20. AUSTRACHIPTERIIDAE Luxton, 1985

27. Genus ***Hypozetes*** Balogh

1959. *Hypozetes* Balogh, *Acta Zool. Hung.*, **5** : 15.

30. ***Hypozetes laysanensis*** Aoki

1964. *Hypozetes laysanensis* Aoki, *Pacific Ins.*, **6** : 655.

Diagnosis : Sanyal (2000) may be consulted.

Material examined : West Kameng dist., 1♀, Bomdila, 13.xi.1997, from moss, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Tripura, West Bengal.

28. Genus ***Lamellobates*** Hammer

1958. *Lamellobates* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **10** (1) : 100.

31. ***Lamellobates palustris*** Hammer

1958. *Lanellobates palustris* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **10** (1) : 100.

Diagnosis : Sanyal (2000) may be consulted.

Material examined : West Kameng dist., 1♀, Yak Research Centre, Dirang, 15.xi.1997, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Bihar, Meghalaya, Tripura, West Bengal.

29. Genus ***Paralamellobates*** Bhaduri and Raychaudhuri

1968. *Paralamellobates* Bhaduri and Raychaudhuri, *Oriental Ins.*, **2** (2) : 197.

32. ***Paralamellobates bengalensis*** Bhaduri and Raychaudhuri

1968. *Paralamellobates bengalensis* Bhaduri and Raychaudhuri, *Oriental Ins.*, **2** (2) : 197.

Diagnosis : Sanyal (2000) may be consulted.

Material examined : East Siang dist., 2♀♀, Pasighat, 8.v.1999, from soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Kerala, Sikkim, Tripura, West Bengal.

21. Family GALUMNIDAE Jacot, 1925

30. Genus ***Galumna*** Von Heyden

1826. *Galumna* Von Heyden, *Isis Oken*, **18** : 611.

33. ***Galumna crenata*** Deb and Raychudhuri

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

Diagnosis : Sanyal (2000) may be consulted.

Material examined : Lower Subansiri dist., 2♀♀, Circuit House surroundings, Zero, 5.xi.1997, from rock moss, coll. A.K. Sanyal. Papum pare dist., 7♀♀, Itafort, Gate II, Itanagar, 7.xi.1997, from litter and soil, coll. A.K. Sanyal. West Kameng dist., 8♀♀, Bomdila, 13.xi.1997, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, West Bengal.

34. ***Galumna flabellifera*** Hammer

1958. *Galumna flabelligera* Hammer, *Biol. Skr Dan Vid Selsk.*, **10** (1) : 93.

Diagnosis : Sanyal (2000) may be consulted.

Material examined : Papum pare dist., 3♀♀, Itafort, Gate II, Itanagar, 7.xi.1997, from litter and soil, coll. A.K. Sanyal. West Kameng dist., 1♀, Bomdila, 13.xi.1997, from litter and soil, coll. A.K. Sanyal.

Distribution : India : Arunachal Pradesh, Tripura.

35. ***Galumna*** sp.

Material examined : Papum pare dist., 1♀, Itafort, Gate II, Itanagar, 7.xi.1997, from litter and soil, coll. A.K. Sanyal. Lower Subansiri dist., 1♀,Circuit House surroundings, Zero, 8.xi.1997, from litter and soil, coll. A.K. Sanyal. Lohit dist., 1♀,F. R. H. campus, Tezu, 27.iv.1999, from litter and soil, coll. A.K. Sanyal. East Siang dist., 5♀♀, Debang, 4.v.1999, from litter and soil, coll. A.K. Sanyal. Tirap dist., 9♀♀, Namdapha Research Foundation, Namdapha, 4.v.1999, from soil, coll. A.K. Sanyal.

Remarks : Due to non availability of literature the specimens could not be identified upto species level.

DISCUSSION

The oribatid mite fauna so far recorded from Arunachal pradesh include a total of 35 secies under 30 genera and 21 families. All the taxa reported in this paper are the first record from the state. It may be recorded here that after this study the oribatid fauna of Arunachal Pradesh represents about 8.6% of the total oribatid rpecies in India. It is also noted that 5 species under 5 genera reported from this state are not yet known from outside India.

SUMMARY

The present paper deals with the oribatid mite fauna collected from different districts of Arunachal Pradesh. A total of 35 species belonging to 30 genera and 20 families have heen recorded. All the taxa reported here are the first record from the state. Key to the identification of families and genera; diagnostic characters and distribution of the species have also been incorporated in this paper.

ACKNOWLEDGEMENTS

The authors express their gratefulness to Dr. J.R.B. Alfred, Director, Zoological Survey of India, for encouragement and providing laboratory facilities.

REFERENCES

BALOGH, J. 1972. The oribatid genera of the world. Academiai Kiado, Budapest, Hungary, 138 pp.

BALOGH, J. and Balogh, P. 1992. *The oribatid mites genera of the world.* Hungarian Natural History Museum, Hungary, **1 & 2** : 1-263 & 1-375.

SANYAL, A.K. 1992. Oribatid mites (Acari). *zool. Surv. of India, Fauna of West Bengal, State Fauna Series,* **3**(Part-3) : 213-356.

SANYAL, A. K. 2000. Oribatid mites (Acari : Oribatei). *zool. Surv. of India, Fauna of Tripura, State Fauna Series,* 7(Part-2) : 33-112.

Zool. Surv. India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2) : 479-489, 2006

IXODID TICKS (ACARI : IXODIDAE)

A. K. SANYAL AND S. K. DE
Zoological Survey of India, M-Block, New Alipore, Kolkata-700053

INTRODUCTION

The ixodid ticks live as host on the bodies of domestic and wild animals and in vegetation. Many serious diseases of man and animals are transmitted by this tick.

Ixodid tick fauna of Arunachal Pradesh was first studied by Nuttall and Warburton (1915). Later through the works of Sharif (1928), Dhanda and Rao (1964), Hoogstraal *et al.* (1970), De and Gupta (1978) and De and Sanyal (1985) a total number of 19 species belonging to 8 genera were reported from Kameng, Lohit, Siang, Subansiri and Tirap districts of Himachal Pradesh.

The present work is based on collections made from the state by the authors and the specimens collected by other survey parties of the Zoological Survey of India, which are available in the National Zoological Collection. The work also includes the species which have not been studied by the authors but are reported from the state by the earlier workers.

A brief account of the surveys undertaken for the study and collection from other surveys is given below :

1. Namdapha Survey - Dr. S. Biswas and party (1984-85).
2. Namdapha Survey - Sri S.S. Saha and party (1988)
3. Arunachal Pradesh Survey - Dr. A.K. Sanyal and party (1997).
4. Arunachal Pradesh Survey - Dr. A.K. Sanyal and party (1999).

A complete list of 21 species under 8 genera of ixodid ticks hitherto known from Arunachal Pradesh has been incorporated in the paper. The original and other important references, diagnostic features, hosts of tick species known from Arunachal Pradesh, distribution of the species in India and key to the identification of genera known from the state have also been incorporated. The specimens studied by the present authors are deposited in the National Zoological Collection.

MATERIAL AND METHODS

The ixodid ticks were collected in the field by "Hand picking" and "Flag-dragging" methods. The details have been given in Sanyal and De (1992).

GENERAL MCRPHOLOGY AND TERMINOLOGY

The details of general morphology of ixodid ticks and terminology used in the text have been discussed in Sanyal and De (1992).

SYSTEMATIC ACCOUNT

List of Taxa Known From Arunachal Pradesh

Family IXODIDAE

1. Genus ***Amblyomma*** Koch

1. *A. testudinarium* Koch

2. Genus ***Aponomma*** Neumann

2. A. *pattoni* Neumann

3. Genus ***Boophilus*** Curtice

3. *B. microplus* (Canestrini)

4. Genus ***Dermacentor*** Koch

4. *D. auratus* Supino

5. Genus ***Haemaphysalis*** Koch

5. *H. aborensis* Warurton
6. *H. aponommoides* Warburton
7. *H. birmaniae* Supino
8. *H. bispinosa* Neumann
9. *H. cornigera shimoga* Trapido & Hoogstraal
10. *H. davisi* Hoogstraal, Dhanda and Bhat
11. *H. hystricis* Supino
12. *H. kyasanurensis* Trapido, Hoogstraal & Rajagopalon
13. *H. nepalensis* Hoogstraal
14. *H. spinigera* Neumann

6. Genus ***Hyalomma*** Koch

15. *H. marginatum isaaci* Sharif

7. Genus ***Ixodes*** Latreille

16. *I. acutitarsus* (Karsch)
17. *I. kashmiricus* Pomerentzev
18. *I. kempi* Nuttall
19. *I. ovatus* Neumann
20. *I. vespertiliones* Koch

8. Genus ***Rhipicephalus*** Koch

21. *R. heamaphysaloides* Supino

Key to the gerera of IXODID TICKS

1. Anal groove extending anteriorly around anus; eyes absent ..... ***Ixodes*** Latreille

– Anal groove extending posteriorly or absent, eyes present or absent 2

2. Eyes absent 3

– Eyes present 4

3. Capitulum long, no lateral salience on palpal article II; dorsal retroverted spur absent on trochanter I; coxa I usually bifid ..... ***Aponomma*** Neumann

– Capitulum short, with lateral salience on palpal article II; blade-like dorsal retroverted spur on torchanter I; coxa I never bifid ..... ***Haemaphysalis*** Koch

4. Capitulum long with narrow palps 5

– Capitulun short with sort broad palps 6

5. Ventral shields present in male; usually inornate; eyes spherical and orbital ..... ***Hyalomma*** Koch

– Ventral shields absent in male; scutum usually ornate; eyes usually flat and non-orbital ..... ***Amblyomma*** Koch

6. Basis-capituli rectangular dorsally, lateral saliences absent; scutum ornate; ventral shields when present six in male; coxa IV much longer than others ..... ***Dermacentor*** Koch

– Basis-capituli hexagonal dorsally, lateral saliences present; scutum inornate; ventral shields four in male 7

7. Spiracle oval; festoons and groove faint or obsolet; setiferous ventral plate on palpal article I absent ..... ***Boophilus*** Curtice

– Spiracle sub-triangular or comma-shaped; festoons and anal groove well developed; setiferous ventral plate on palpal article I present ..... ***Rhipicephalus*** Koch

1. Genus ***Amblyomma*** Koch

1844. *Amblyomma* Koch, *Arch. Naturgesch,* **10** : 223-231.

1. ***Amblyomma testudinarium*** Koch

1844. *Amblyomma testudinarium* Koch, *Arch. Naturgesch,* **10**(1) : 226.

1926. *Amblyomma testudinarium,* Robinson, *Tics A Monograph ot the Ixodoidea,* pt. 4 (Cambridge Univ. Press) : 257.

1928. *Amblyomma testudinarium,* Dhanda and Rao, *Ind. Jour. Med. Res.,* **52**(11) : 1142.

Diagnosis : Male-Scutum with ornamentations with dark-brown markings on pale ground; falciform stripe large and thick; deep punctations; coxa I with two unequal stout spurs; dentition 4/4.

Female : Scutum triangular with narrow posterior part, ground colour yellowish, punctations numerous; moderately large porose areas; coxa with moderaterly stout spurs; dentition 4/4.

Hosts : Cattle, tree shrew (*Tupaia glis versurae*), red jungle fowl (*Gallus gallus*), mithan, man, vegetation.

Distribution : India : Arunachal Pradesh (Lohit, Kameng, Siang, Subansiri), Assam, Karnataka, Maharashtra, Orissa, Meghalaya, Mizoram, Sikkim, West Bengal.

Remarks : The species was first reported from Arunachal Pradesh by Dhanda and Rao (1964). Krijgsman and Ponto (1932) stated that *A. testudinarium* transmits piroplasmosis and anaplasmosis. Sharif (1938) also considered this species as a vector of diseases.

2. Genus ***Aponomma*** Neumann

1831. *Ixodes* (en partim) Muller, Nova. *Acta Physico-Medical*, XV (Part 2), 235.

1899. *Aponomma* Neumann, *Mem. Soc. Zool. France*, **XII** : 180.

2. ***Aponomma pattoni*** Neumann

1910. *Aponmma pattoni* Neumann, *Ann. Sci. Nat.*, **12** : 163-165.

1985. *Aponomma pattoni*, De and Sanyal, *Rec. zool. Surv. India*, **82**(1-4) : 254.

1928. *Amblyomma testudinarium*, Dhanda and Rao, *Ind. Jour. Med. Res.*, **52**(11) : 1142.

Diagnosis : Male-Scutum inornate, punctations unequal; coxal spur sharp.

Female : Scutum little more punctate, coxal spur not so sharp.

Hosts : Sambar, reptiles.

Distribution : India : Arunachal Pradesh (Tirap), Tamil Nadu.

Remarks : The species was first reported from Arunachal Pradesh by De and Sanyal (1985). The reptiles are the major hosts of the species. The species is not much important from economic aspect.

3. Genus ***Boophilus*** Curtice

1891. *Boophilus* Curtice, *Journ. Compar. Med. Veter Arch.* **12** : 313.

3. ***Boophilus microplus*** (Canestrini)

1887. *Haemaphysalis micropla* Canestrini, *Atti Soc Veneto Trent, Sci. Nat.*, **11** : 104.

1890. *Rhipicaphalus micropla* Canestrini, *Padova*, **4** 493.

1943. *Boophilus microplus*, Fairchild, *An. J. Trop Med.* **23**(6) : 586.

1964. *Boophilus microplus*, Dhanda and Rao, *Ind Jour Med. Res.*, **52**(11) : 1142.

1978. *Boophilus microplus*, De and Gupta, *Indian Vet J.* **55** : 80.

1985. *Boophilus microplus*, De and Sanyal, *Rec zool Surv India*, **82**(1-4) : 254.

Diagnosis : Male - Scutum quite hirsute; caudal appendage short, tapering; dentition 4/4; inner margin of basal palpal segment ventrally concave.

Female : Coxa I with deep, inverted 'V'-shaped cleft, inner margin of basal palpal segment ventrally short, deeply concave; dention 4/4.

Material examined : Papumpare dist. : 2♀♀, 4 nymphs, zoo garden, Itanagar, 7.xi.1997, from cow, coll. A.K. Sanyal & S.K. De; 2♀♀, Circuit House surroundings, Itanagar, 7.xi.1997, from cow, coll. A.K. Sanyal & S.K. De. West Kameng dist. : 10♀♀, 1♂, Yak Research Centre, Dirang, 15.xi.1997, from cattle, coll, A.K. Sanyal & S.K. De. Siang dist. : 6♀♀, Sithe, 20 kms southwest of Pasighat, 27.iv.1999, from cow, coll. A.K. Sanyal & S.K. De; 20♀♀, 10♂♂, 5 nymphs, Miao, 1. v. 1999, from cow, coll. A.K. Sanyal & S.K. De. Lohit dist. : 19♀♀, 5♂♂, Tezu, Forest Rest House campus, 27.iv.1999, from goat, coll. A.K. Sanyal & S.K. De. Tirap dist. : 10♀♀, 1♂, Miao, Forest colony, 3.v.1999, from cow, coll. A.K. Sanyal, & S.K. De.

Hosts : Cattle, horse, goat, mithan and vegetation.

Distribution : India : Arunachal Pradesh (Kameng, Lohit, Siang, Tirap, Subansiri), A & N Islands, Assam, Bihar, Delhi, Gujarat, Himachal Pradesh, Manipur, Meghalaya, Mizoram,

Maharashtra, Madhya Pradesh, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Remarks : The species is a common cattle infesting tick.

4. Genus ***Dermacentor*** Koch

1844. *Dermacentor* Koch, *Arch. Naturgesch.*, **10**(1) : 235.

4. ***Dermacentor auratus*** Supino

1897. *Dermacentor auratus* Supino, *Atti. Soc. Veneto-Trent-Sci. Nat.*, **3**(2) : 235.

1928. *Dermacentor auratus*, Sharif, *Rec. Indian Mus.*, **30**(3) : 292.

1964. *Dermacentor auratus*, Dhanda and Rao, *Ind. Jour. Med. Res.*, **52**(11) : 1142.

Diagnosis : Male-Capitulum rectangular, dorsally ornate; palpi large, longer than basis; ventral ridge distinct; dentition 3/3; scutum with variable brown base colour markings in the form of lines; variable brown smaller patches in lateral field; cervical grooves deep, short; all festoons ornate.

Female : Capitulum rectangular, dorsally weekly ornate; palpi longer in comparison to male, palpal article I bears three long curved palpal setae; dentition 3/3; scutum with brown markings arranged as a longitudinal medial strip, all markings devoid of punctations; cervical grooves deep; thick white hairs from many large punctations; white hairs separating festoons.

Hosts : Tree shrew, horse and *Rattus rattus brunneusculus*.

Distribution : India : Arunachal Pradesh (Kameng, Lohit), Andaman Islands, Assam, Bihar, Karnataka, Manipur, Meghalaya, Mizoram, Orissa, Tripura, Uttar Pradesh, West Bengal.

Remarks : The species was first recorded from Arunachal Pradesh by Dhanda and Rao (1964).

5. Genus ***Haemaphysalis*** Koch

1844. *Haemaphysalis* Koch, *Arch. Naturgesch.*, **10**(1) : 217-239.

5. ***Haemaphysalis aborensis*** Warburton

1913. *Haemaphysalis aborensis* Warburton, *Parasitology*, **6** : 121-123.

Diagnosis : Male - Palpi compact, palpal segment I with short pedicle; ventral spur broadly triangular; length of coxal spurs subequal; spur I peg like, spur II to IV elongately triangular; dentition 4/4.

Female : Palpi compact, palpal segment I with pedicle relatively elongate; dentition 4/4; posterior margin of scutum rounded; cervical pits narrowly elongate; spur I peg-like, spurs II to IV short and triangular.

Hosts : Tree shrew, red jungle fowl and vegetation.

Distribution : India : Arunachal Pradesh (Kameng, Lohit, Siang), Assam, Manipur, Meghalaya, Mizoram, West Bengal.

6. ***Haemaphysalis aponommoides*** Warburton

1913. *Haemaphysalis aponommoides* Warburton, *Parasitology*, **6** : 128-130.

1964. *Haemaphysalis aponommoides*, Dhanda and Rao, *Ind. Jour. Med. Res.*, **52**(11) : 1144.

Diagnosis : Male - Punctations numerous; festoons 11 in number; ventrally lacking retrograde spur on segment 3; spiracular plate narrowly elongate; posterior integument forming two leathery pseudoshield pitted by numerous large punctations each bearing a short seta.

Female : Scutum broader than long; palps long and narrow; dentition 3/3; absence of spur or projection on dorso-basal margin of palpal segment 3; spurs on coxae I-IV subequal; spiracular plate short, comma-shaped.

Material examined : West Kameng dist. : 25♀♀, 7♂♂, Bomdilla, 2 kms northeast, 13.xi.1997, from cattle, coll. A.K. Sanyal & S.K. De.

Hosts : Sambar, horse and vegetation.

Distribution : India : Arunachal Pradesh (Kameng, Tirap), Sikkim, West Bengal.

Remarks : Dhanda and Rao (1964) first recorded the species from Arunachal Pradesh. Hoogstraal (1967) reported that biting and crawling on man by this species cause Himalayan haemorrhagic infection.

7. ***Haemaphysalis birmaniae*** Supino

1897. *Haemaphysalis birmaniae* Supino, *Atti. Soc. Ven. Tent. Sci. Nat. Padova,* **2,5,3**(1) : 251.

1964. *Haemaphysalis 'birmaniae,* Dhanda and Rao, *Ind. Jour. Med. Res.,* **52**(11) : 1144.

Diagnosis : Male - Scutum broadly rounded; cervical pits small; cervical and lateral grooves obsolete; palpi compact, segment 2 longer than segment 3, elongately triangular ventral spur on segment 3; dentition 4/4; coxal spur lanceolate; broadly triangular spur on coxae II and IV.

Female : Scutum as broad as long, margin gradually rounded; cervical grooves short; punctations few, small; palpi as in male except segment 2 which is as long as broad; dentition 4/4.

Hosts : Sambar and vegetation.

Distribution : India : Arunachal Pradesh (Lohit, Tirap, Subansiri), Mizoram, West Bengal.

Remarks : The species was first recorded from Arunachal Pradesh by Dhanda and Rao (1964), whcih was also the first record of the species from India.

8. ***Haemaphysalis bispinosa*** Neumann

1897. *Haemaphysalis bispinosa* Neumann, *Mem. Soc. Zool. France,* **10** : 341.

1964. *Haemaphysalis bispinosa,* Dhanda and Rao, *Ind. Jour. Med. Res.,* **52**(11) : 1147.

Diagnosis : Male - Scutum elongate-oval in shape; cervical grooves with convergent depressions; lateral grooves long, well marked, ending behind spiracles; festoons are twice as long as broad; palps slightly salient, segments 2 and 3 subequal, segment 3 bluntly conical and bears a prominent dorsal retrograde spur in the mid-dorsal line and a similar but longer spur; dentition 4/4; a moderate sharp spur on coxa I; a very slight protuburance on coxae II and IV.

Female : Scutum sub-cordiform, punctations little larger than male; basis capituli broader; cornua short; porose areas oval; palpi as in male.

Material examined : Papumpare dist. : 4♀♀, 1♂, zoogarden, Itanagar, 7.xi.1997, from calf, coll. A.K. Sanyal & S.K. De. Subansiri dist. : 21♀♀, 9♂♂, 6 nymphs, Koilabhati, Bhalukpong, 9.xi.1997, from cow, coll. A.K. Sanyal & S.K. De. Tirap dist. : 3♀♀, 4 nymphs, Miao, near Circuit House, i.v.1999, from vegetation, coll. A.K. Sanyal & S.K. De 14♀♀, 2♂♂, Deer Park, Miao, 3.v.1999, from barking deer, coll. A.K. Sanyal & S.K. De. Siang dist. : 2♀♀, Ruksin, 36 kms east of Pasighat, 8.v.1999, from goat, coll. A.K. Sanyal & S.K. De.

Hosts : Cattle, Horse, sheep, goat, deer, dog and vegetation.

Distribution : India : Arunachal Pradesh (Kameng, Siang, Subansiri), A & N Islands, Assam, Bihar, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Orissa, Punjab, Tamil Nadu, Tripura, Uttra Pradesh, West Bengal.

Remarks : Dhanda and Rao (1964) reported the species for the first time from Kameng, Lohit and Subansiri districts and De and Sanyal (1985) from Tirap district of Arunachal Pradesh. This is a common species and important pest of domestic animals.

9. ***Haemaphysalis cornigera shimoga*** Trapido and Hoogstraal

1964. *Haemaphysalis cornigera shimoga* Trapido and Hoogstraal, *J. Parasit.*, **50**(2) : 303.

1985. *Haemaphysalis cornigera shimoga,* De and Sanyal, *Rec. zool. Surv. India,* **82**(1-4) : 255.

Diagnosis : Male - Basis capituli rectangular; lateral grooves shallow; cervical grooves deep, short; punctations small, numerous, palpi short, widely salient, segment 2 with a prominant ventro lateral spur which is wide, pointed, posteriorly directed; segment 3 dorsally twice as wide as long, basal margin extended laterally to form a wing, widely overlaping apical margin of segment 2; dentition 5/5; coxa I with a long triangular spur, coxa 2 with spur bigger than spur 3; coxa 4 with two elongated spurs.

Female : Cervical grooves deep, narow; punctations small, numercus in lateral fields; palpi widely salient, segment 2 ventrally spurless to the inner margin, lateral profile as in male, segment 3 slightly wider than long with a ventral spur as in male; dentition 4/4; coxa 1 to 3 as in male, coxa 4 with one or two very small spurs, inner spur sometimes absent.

Hosts : Sambar, Cattle.

Distribution : India : Arunachal Pradesh (Lohit, Siang, Tirap), Kerala, Karnataka, Meghalaya, West Bengal.

Remarks : Dhanda and Rao (1964) recorded the species from Lohit and Siang districts of Arunachal Pradesh.

10. ***Haemaphysalis davisi*** Hoogstraal, Dhanda and Bhat

1970. *Haemaphysalis davisi* Hoogstraal, Dhanda and Bhat, *J. Parasit.*, **56**(3) : 588.

1985. *Haemaphysalis davisi*, De and Sanyal, *Rec. zool. Surv. India*, **82**(1-4) : 256.

Diagnosis : Male - Basis capituli dorsally 1.5 times as broad as long; cornua broadly triangular; palpi moderately salient posteriorly; hypostome slightly shorter than palpi, apex gradually rounded; scutum broadly oval, margins broadly rounded; lateral grooves narrow; cervical grooves short, obscure; punctations discrete, small, relatively numerous; dentition 6/6.

Female : Basis capituli dorsally 2 times as broad as long; hypostome as long as palpi; scutum as broad as long; cervical grooves deep, linear, slightly converging; dentition 5/5; other characters almost same as in male.

Hosts : Horse, sheep, mole, goat, mithan, sambar, cattle and vegetation.

Distribution : India : Arunachal Pradesh (Lohit, Makeng, Siang, Tirap, Subansiri), Sikkim.

Remarks : Hoogstraal *et al.* (1970) first described the species from Arunachal Pradesh. Economically the species is not much important.

11. ***Haemaphysalis hystricis*** Supino

1987. *Haemaphysalis hystricis* Supino, *Atti. Acad. Sci. Vent-Trent-istr.*, **2**(3) : 237.

1964. *Haemaphysalis hystricis*, Dhanda and Rao, *Ind. Jour. Med. Res.*, **52**(11) : 1151.

Diagnosis : Male - Scutum 1.4 times as long as wide; cervical grooves short; lateral grooves absent; punctations rare, small, scattered; palpi compact; basal margin ventrally with a widely triangular pointed spur; segment 3 with a median triangular dorsobasal and ventral spur; dentition 4/4.

Female : Scutum 1.1 to 1.3 times as wide as long; cervical grooves and punctations as in male. Palpi as in male except segments are slightly elongated and basoventral spur of segment 2 somewhat laterad; coxae as in male.

Material examined : Tirap dist. : 2 ♀ ♀, Deban, Namdapha Tiger Reserve, 25 kms east of Miao, 4.v.1999, from dog, coll. A.K. Sanyal & S.K. De.

Hosts : Tree shrew, *Rattus rattus brunneusculus*, man and vegetation.

Distribution : India : Arunachal Pradesh (Kameng, Lohit, Siang).

12. ***Haemaphysalis kyasanurensis*** Trapido, Hoogstraal and Rajagopalan

1964. *Haemaphysalis kyasanurensis* Trapido, Hoogstraal and Rajagopalan, *J. Parasit.*, **50**(2) : 295.

1964. *Haemaphysalis kyasanurensis*, Dhanda and Rao, *Ind. Jour. Med. Res.*, **52**(11) : 1148.

Diagnosis : Male-Basis capituli rectangular; palpi compact, subquadrate, with a slight, abrupt basolateral salience; hypostome short, stout, lateral margins convex; scutum flat or very slightly convex between deeply depressed lateral grooves and elevated lateral ridges; cervical grooves very narrow; punctations obsolete; dentition 4/4.

Female : Cornua shorter than those of male; palpi quite elongate, each palpus twice as long as wide; hypostome elongate, slightly longer than palpi; scutum glossy, subcircular; other characters almost similar to that of male.

Hosts : Tree shrew, *(Tupaia glis versurade), Gallus gallus.*

Distribution : India : Arunachal Pradesh (Lohit), Karnataka.

Remark : Dhanda and Rao (1964) first recorded the species from the State.

13. ***Haemaphysalis nepalensis*** Hoogstraal

1962. *Haemaphysalis nepalensis* Hoogstraal, *J. Parasit.*, **48** 195 : 203.

1964. *Haemaphysalis nepalensis*, Dhanda and Rao, *Ind. Jour. Med. Res.*, **52**(11) : 1151.

Diagnosis : Male-Basis capituli dorsally 1.5 times as wide as long, cornua widely triangular; lateral grooves very short; cervical grooves short-deep, comma-shaped, punctations fine, small, numerous; genital apron situated between coxae 2, fairly large, legs long, robust.

Female : Basis capituli with straight lateral and posterior margins, twice as wide as long (including cornua); scutum subcircular, porose areas deep, triangular, palpi dorsally with segment 1 visible, segment 2 with basal margins curved, segments 2 and 3 with parallel inner and lateral margins, only 2 setae on the internal margin of segment 2 ventrally, cervical grooves narrow, shallow, convergent to scutal mid length; punctations small, numerous, genital apron forming a short, transverse oval with median notch posteriorly; legs like male, coxae each with a very small, triangular spur arising near postero-internal juncture.

Hosts : Sheep and vegetation.

Distribution : India : Arunachal Pradesh (Kameng), Mizoram.

14. ***Haemaphysalis spinigera*** Neumann

1987. *Haemaphysalis spinigera* Neumann, *Mem. Soc. de France*, **10** : 324.

1985. *Haemaphysalis spinigera*, De and Sanyal, *Rec. zool. Surv. India*, **82**(1-4) : 256.

Diagnosis : Male - Scutum pyriform; cervical grooves absolete; basis capituli dorsally rectangular; palpi short, widely salient, as broad as long, segment 2 dorsally 1.5 times as broad as long, postero dorsal margin crenate forming obtuse angle at its juncture, segment 3 with ventral spur; dentition 5/5; spur of coxa 1 long, tapering, sharply pointed, spurs of coxae II and III small, triangular; spur of coxae 14 very long, dagger-like, sharply pointed.

Female : Scutum subcirular; cervical gooves deep, narrow; punctations moderate, deep; palpi as in male except segment 3 dorsally with a posteriorly directed triangular spur; genital operculum 'U'-shaped; dentition 4/4; coxae I with a long bluntly pointed spur, II to IV with small triangular spurs.

Hosts : Rat.

Distribution : India : Arunachal Pradesh (Tirap), A & N Islands, Andhra Pradesh, Madhya Pradesh, Maharashtra, Meghalaya, Karnataka, Kerala, Orissa, Tamil Nadu, West Bengal.

Remarks : The species was first recorded from Arunachal Pradesh by De and Sanyal (1985).

6. Genus ***Hyalomma*** Koch

1884. *Hyalomma* Koch, *Arch. Naturgesch.* **10**(1) : 220.

15. ***Hyalomma marginatum isaaci*** Sharif

1928. *Hyalomma marginatum isaaci* Sharif, *Rec Indian Mus.*, **30**(3) : 307.

1964. *Hyalomma marginatum isaaci*, Dhanda and Rao, *Ind. Jour. Med. Res.*, **52**(11) : 1152.

Diagnosis : Male - Lateral grooves long, distinct; punctations few, large; cervical grooves rounded and extend to the anterior third of scutal length; postero-median and paramedian grooves extend to the festoons; anal shield large, subanals small, situated on the midaxis of the adanals, spiracular plate pilose with a thick tail; parma absent; legs with sharply defined rings near joints.

Female : Scutum slightly longer than wide; cervical grooves smoothly rounded, extending to and breaking the posterior margin of the scutum; genital operculum profile, slightly bulging; legs with white; narrow, sharply defined rings.

Hosts : Horse, rabbit.

Distribution : India : Arunachal Pradesh (Kameng, Tirap), Andhra Pradesh, Bihar, Delhi, Gujarat, Himachal Pradesh, Jammu and Kashmir, Karnataka, Madhya Pradesh, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Remarks : The genus was first recorded from the state by Dhanda and Rao (1964), Grobov (1946) isolated the Crimean haemorrhagic fever virus from the nymphs of this species.

7. Genus ***Ixodes*** Latreille

1995. *Ixodes* Latreile, *Mag. Encyl. J. Sci. Lett. Arta.*, **4** : 15-20.

16. ***Ixodes acutitarsus*** (Karsch)

1880. *Haemalastor acutitatrsus* Karsch, *Mittcheil. Munchener Entomol. Vereine*, **4** : 142.

1901. *Ixodes acutitarsus*, Neumann, *Mem. Soc. Zool. France*, **14** : 285.

1964. *Ixodes acutitarsus*, Dhanda and Rao *Ind. Jour. Med. Res.*, **52**(11) : 1152.

Diagnosis : Male-Scutum smooth; punctations fine; lateral grooves continuous; capitulum 1.5 mm long; dentition 2/2 rows of ten teeth; coxa I with two very long spurs, on coxae II-IV short.

Female : Capitulum 1.68-1.95mm long; palps four times as long as broad; article II twice as long as article III; coxa I bidentate, internal spur thick, overlapping coxa II; other characters as in male.

Hosts : Vegetation.

Distribution : India : Arunachal Pradesh (Kameng, Subansiri), Assam, Himachal Pradesh, Manipur, Sikkim, West Bengal.

17. ***Ixodes kashmiricus*** Pomerentzev

1948. *Ixodes persulcatus kashmiricus* Pomerentzev, *Parasit. Born. Zool. Inst. Nauk. SSR.*, **10** : 20.

Diagnosis : Male - Scutum equally convex at both ends; scapulae long and round; cervical grooves faint; punctations fine, numerous; palpi short, broad, rounded apically; cornua absent; dentition 4/4.

Female : Scutum broadly rounded; scapulae well developed, pointed; palpi long; other characters as in male.

Material examined : West Kameng dist. : 3♀♀, Bomdilla, 2 kms northeast, 13.xi.1997, from cattle, coll. A.K. Sanyal & S.K. De.

Hosts : Cattle, Flying squirrel, *Tupaia glis.*

Distribution : India : Arunachal Pradesh (Tirap), Himachal Pradesh, Kashmir, Manipur, Uttar Pradesh.

Remark : This is the first record of the species from Arunachal Pradesh.

18. ***Ixodes kempi*** Nutrall

1914. *Ixodes kempi* Nuttall, *Parasitology*, **6** : 131-133.

1978. *Ixodes kempi*, De and Gupta, *Indian Vet. J.*, **55** : 81.

Diagnosis : Female-Scutum with pointed scapular angles, emarginate, longer than broad; cervical grooves shallow; lateral grooves marked by a more or less salient ridge attaining the postero-lateral border; punctations uniformly distributed; no hairs; palps long, article 3 shorter than 2; hypostome pointed; dentition 2/2 with 11 strong teeth; coxa I with sharp internal and short pointed external spurs; coxae II-IV with short extended spur.

Hosts : *Sciurus erythraeus intermedius.*

Distribution : India : Arunachal Pradesh (Siang).

19. ***Ixodes ovatus*** Neumann

1899. *Ixodes ovatus* Neumann, *Mem. Soc. Zool. France*, **12** : 116.

1964. *Ixodes ovatus*, Dhanda and Rao, *Ind. Jour. Med. Res.*, **52**(11) : 1152.

Diagnosis : Male-Auriculae absent; dentition 4/4; hypostome not bilobed; palpi pointed apically; coxa I with slight internal spur, III and IV each with internal spur, lacking membranous expansion; syncoxae present on I and II.

Female-Basis capituli with well developed cornua, porose areas round; coxa I with a short, blunt internal spur; absent in coxa II.

Material examined : West Kameng dist : 10♀♀, 5♂♂, Bomdilla, 2 kms northeast.

13.xi.1997. from cattle; 1 ♀, from goat; 1 ♀, from dog, coll. A.K. Sanyal & S.K. De.

Hosts : Tree shrew, sheep, mule, yak, man and vegetation.

Distribution : India : Arunachal Pradesh (Kameng, Lohit, Subansiri), Himachal Pradesh, Manipur, Mizoram, Sikkim, Uttar Pradesh, West Bengal.

Remark : The species was first recorded from the state by Dhanda and Rao (1964).

20. *Ixodes vespertiliones* Koch

1844. *Ixodes vespertilionis* Koch, *Arch. Naturgesch.* 10(1) : 217-230.

Diagnosis : Male-All coxae lack spurs; the anal groov is round in front of the anus and the posoterior arms are nearly straight or slightly converging; palps are clavate with numerous long setae; hypostone pointed at the tip, scale like teeth.

Female-Scutum is narrow and much longer than wide, broadest in the middle; basis capituli dorsally triangular and with flange externally directed at the posterior external juncture; hypostome lanceolate and with long denticles.

Material examined : Tirap dist : 1 ♀, Gandhigram, from *Rhinolophus affinis*, 21.ii.1988, coll. S. S. Saha.

Hosts : *Rhinolophus affinis.*

Distribution : India : Arunachal Pradesh (Tirap), Rajasthan.

Remark : This bat tick is reported from Arunachal Pradesh for the first time.

8. Genus *Rhipicephalus* Koch

1844. *Rhipicephalus* Koch, *Arch. Naturgesch.*, 10(1) : 238.

21. *Rhipicephalus haemaphysaloides* Supino

1897. *Rhipicephalus haemaphysaloides* Supino, *Atti. Soc. Veneto-Trent. Sci. Nat.*, 2s, 3(1) : 234.

1964. *Rhipicephalus haemaphysaloides*, Dhanda and Rao, *Ind. Jour. Med. Res.*, 52(11) : 1152.

Diagnosis : Male-Cervical grooves short converging pits, lateral grooves narrow, deep; few punctations of larger and smaller types; basis capituli twice as broad as long; palpi longer than broad; adanal shields sickle-shaped; spiracle comma-shaped; dentition 3/3.

Female-Cervical grooves deep shallow; punctations few, large, finer one hardly visible; spiracle subtriangular with a large mecula; cornua short; blunt palpi twice as long as broad.

Hosts : Goat, sheep, mole, horse, man.

Distribution : India : Arunachal Pradesh (Kameng, Subansiri), Assam, Bihar, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Gujarat, Himachal Pradesh, Karnataka, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal.

Remark : Dhanda and Rao (1964) first reported the species from Arunachal Pradesh.

SUMMARY

The paper deals with the ixodid tick fauna of Arunachal Pradesh. Altogether 21 species under 8 genera hitherto known from the state have been reoorded. Of these, two species *viz. Ixodes kashmiricus* and *I. vespertiliones* have been reported here for the first time from Arunachal Pradesh. The first and important references, diagnostic features, hosts and distribution of the tick species and key to the identification of genera have also been incorporated.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, Zoological Survey of India, Kolkata for kind encouragement and providing facilities.

REFERENCES

DE, S.K. and GUPTA, S.K. 1978. Ixodid tick fauna of Arunachal Pradesh (Acarina : Metastigmata). *Indian Vet. J.*, **55** : 80-82.

DE, S.K. and SANYAL, A.K. 1985. Ixodidae (Acarina : Metastigmata). *Rec. zool. Surv. India,* **82**(1-4) : 253-258.

DHANDA, V. and RAO, T. RAMACHANDRA 1964. A report on a collection of ixodid ticks made in the North East Frontier Agency, India. *Ind. Jour. Med. Res.*, **52**(11) : 1139-1153.

GROBOV, A.G. (1946). Carriers of Crimean haemorrhagic fever. *Med. Parazit. Moskova,* **15**(6) : 59-63.

HOOGSTRAAL, H., DHANDA, V. and BHAT, H.R. 1970. *Haemaphysalis* (*Kaseriana*) *davisi* sp. n. (Ixodoidea : Ixodidae). A parasite of domestic and wild mammals in Northeastern India, Sikkim and Burma. *J. Parasit.*, **56**(3) : 588-595.

KRIJGSMAN, B.J. and PONTO, S.A.S., 1932. Deteken Van den Oost Indischen Archiple. Veeartsenijk. *Meded. Batavia,* **79** : 62.

NUTTALL, G.H.F. and WARBURTON, C. 1915. The genus *Haemaphysalis. In* : Nuttall *et al. Ticks. A Monograph of the Ixodoidea,* Part 3 : 349-550.

SANYAL. A.K. and DE, S.K. 1992. Ixodid ticks (Acari : Ixodidae). *Fauna of West Bengal, State Fauna Series,* **3**(Part-3) (Arachnida and Acari), (ed. Director, *Zool. Surv. India,* Calcutta) : 17-60.

SHARIF, M. 1928 A revision of the Indian Ixodidae, with special reference to the collection in the Indian Museum. *Rec. Indian Mus.*, **30**(3) : 217-344.

Table 1 : Distribution of Ixodid ticks in different districts of Arunachal Pradesh.

Name of the species	DISTRICTS					
	Kameng	Siang	Tirap	Subansiri	Lohit	Papumpare
Amblyomma testudinarium	+	+	–	+	+	
Aponomma pattoni	–	–	+	–	–	
Boophilus microplus	+	+	+	+	+	+
Dermacentor auratus	+	–	–	–	+	
Haemaphysalis aborensis	+	+	–	–	+	
H. aponommoides	+	–	+	–	–	–
H. birmaniae	–	–	+	+	+	–
H. bispinosa	+	+	+	+	–	
H. cornigera shimoga	–	+	+	–	+	–
H. davisi	+	+	+	+	+	
H. hystricis	+	+	–	–	+	
H. kyasanurensis	–	–	–	–	+	
H. nepalensis	+	–	–	–	–	
H. spinigera	–	–	+	–	–	
Hyalomma marginatum isaaci	+	–	+	–	–	–
Ixodes acutitarsus	+	–	–	+	–	
I. kashmiricus	+	–	+	–	–	
I. kempi	–	+	–	–	–	
I. ovatus	+	–	–	+	+	
I. vespertiliones	–	–	+	–	–	
Rhipicephalus haemaphysaloides	+	–	–	+	–	

Zoolo Surv India
Fauna of Arunachal Pradesh, State Fauna Series, 13(Part-2): 491-518, 2006

ARANEAE : SPIDERS

BIJAN BISWAS AND KAJAL BISWAS
Zoological Survey of India, M-Block, New Alipore, Kolkata - 700053

INTRODUCTION

The spider fauna of Arunachal Pradesh has not yet been studied in a comprehensive manner. The present work taken up to give an up-to-date information regarding the families : Theraphosidae, Salticidae, Ctenidae, Thomisidae, Heteropodidae, Clubionidae, Gnaphosidae, Oxyopidae, Lycosidae, Zodaridae and Araneidae from Arunachal Pradesh in the light of modern taxonomic concept. It is hoped that the comprehensive account of the spider fauna of Arunachal Pradesh will prove quite useful to the future workers also. The work is based upon the specimens collected different parts of Arunachal Pradesh as well as those present in the National Zoological Collection, Zoological Survey of India, Calcutta. Altogether 58 species under 28 genera and 11 families are dealt with here of those, except (Ctenidae, Thomisidae and Araneidae) and rest species form new records for the state. Out of those, 4 species belonging to 4 genera under 3 families are described here as new to science. The entire material is deposited in the National Zoological Collection, Zoological Survey of India, Calcutta.

LIST OF TAXA KNOWN FROM ARUNACHAL PRADESH

Family I. THERAPHOSIDAE

Genus 1. ***Ishnocolus*** Ausserer

1. *I. khasiensis* Tikader

Genus 2. ***Plesiophrictus*** Pocock

2. *P. meghalyaensis* Tikader

Family II. ZODARIDAE

Genus 3. ***Storena*** Walckenaer

3. *S. dibangensis* Sp. nov.

Family III. SALTICIDAE

Genus 4. ***Phidippus*** Koch

4. *P. indicus* Tikader
5. *P. tirapensis* Sp. nov.

Genus 5. ***Plexippus*** Koch

6. *P. paykullii* (Audouin)

Genus 6. ***Salticus*** Latreille

7. *S. ranjitus* Tikader

Genus 7. ***Zygoballus*** Peckham

8. *Z. pashanensis* Tikader

Family IV. CTENIDAE

Genus 8. ***Ctenus*** Walckenaer

9. *C. indicus* Gravely
10. *C. bomdilaensis* Tikader & Malhotra
11. *C. meghalayensis* Tikader
12. *C. kapuri* Tikader

Family V. THOMISIDAE

Genus 9. ***Xysticus*** Koch

13. *X. sujatai* Tikader

Genus 10. ***Thomisus*** Walckenaer

14. *T. cherapunjeus* Tikader

Genus 11. ***Camaricus*** Thorell

15. *C. formosus* Thorell

Family VI. HETEROPODIDAE

Genus 12. ***Heteropoda*** Latreille

16. *H. venatoria* (Linn.)

Family VII. CLUBIONIDAE

Genus 13. ***Cheiracanthium*** Koch, C.L.

17. *C. trivialis* (Thorell)

Family VIII. GNAPHOSIDAE

Genus 14. ***Drassodes*** Westring

18. *D. himalayensis* Tikader & Gajbe

Genus 15. ***Zelotes*** Gistel

19. *Z. mandlaensis* Tikader & Gajbe

Family IX. OXYOPIDAE

Genus 16. ***Oxyopes*** Latreille

20. *O. shweta* Tikader

Family X. LYCOSIDAE

Genus 17. ***Hippasa*** Simon

21. *H. holmerae* Thorell
22. *H. partita* (Cambridge)
23. *H. agelenoides* (Simon)

Genus 18. ***Pardosa*** Koch

24. *P. birmanica* Simon
25. *Pardosa sumatrana* (Thorell)
26. *P. ladakhensis* Tikader
27. *P. heteropthalmus* Simon
28. *P. tatensis* (Tikader)
29. *P. pusiola* (Thorell)
30. *P. oakleyi* Gravely
31. *P. mysorensis* (Tikader & Malhotra)
32. *P. mukundi* Tikader

Genus 19. ***Lycosa*** Latreille

33. *L. prolifica* Pocock
34. *L. tista* Tikader
35. *L. kempi* Gravely
36. *L. bistriata* Gravely
37. *L. madani* Pocock
38. *L. carmichaeli* Gravely
39. *L. indagatrix* Walckenaer
40. *L. iranii* Pocock
41. *L. poonaensis* Tikader & Malhotra
42. *L. pictula* Pocock
43. *L. fuscana* Pocock

Genus 20. ***Evippa*** Simon

44. *E. shivajii* Tikader & Malhotra

Family XI ARANEIDAE

Genus 21. ***Argipoe*** Audouin

45. *A. pulchella* Thorell
46. *A. shillongensis* Sinha

Genus 22. ***Cyclosa*** Menge

47. *C. bifida* (Doleschall)
48. *C. mulmeinensis* (Thorell)
49. *C. spirifera* Simon

Genus 23. ***Cyrtarachne*** Thorell

50. *C. schmidi* Tikader

Genus 24. ***Neoscona*** Simon

51. *N. mukerjei* Tikader
52. *N. bomdilaensis* Sp. nov.

Genus 25. ***Gasteracantha*** Sundevall

53. *G. unguifera* Simon

Genus 26. ***Leucauge*** White

54. *L. celebesiana* (Walckenaer)
55. *L. tessellata* (Thorell)

Genus 27. ***Nephila*** Leach

56. *N. maculata* (Fabricious)
57. *N. dirangensis* Sp. nov.

Genus 28. ***Herennia*** Thorell

58. *H. ornatissima* (Doleschall)

Family I THERAPHOSIDAE

Key to the genera of the family THERAPHOSIDAE

1. Cephalothorax longer than wide, broader in front ..... ISCHNOCOLUS

   Cephalothorax not longer than wide and broader in front 2

2. Sternum nearly round in shape .... PLESIOPHRICTUS

Genus 1. *Ischnocolus* Ausserer

1871. *Ischnocolus* Ausserer, *Verh. z-b. Ges. Wien.*, **21** : 184.

1892. *Ischnocolus* : Simon, *Hist. Nat. Araign.*, **1** : 135.

Diagnosis : Carapace low; fovea straight, slightly curved; eyes of anterior row subeuual, slightly procurved. Legs are in typical form, spiny, especially on the tibiae and protarsi of II and III pairs; tarsal scopulae of all the legs are divided by a band of setae in the adult. No tibial spurs on anterior leg of male. Tarsal palp is long and subcylindrical and overlaps the palpal organ.

Type-species : *Ischnocolus holosericeus* Ausserer

Distribution : Palaearctic and Oriental regions.

1. *Ischnocolus khasiensis* Tikader,

1978. *Ischnocolus khasiensis* Tikader, *J. Bombay nat. Hist.Soc.*, 74(2) : 314.

Diagnosis : Cephalothorax and legs are reddish brown and abdomen brown in colour. Cephalic region longer than wide, slightly broader in front. Middle of cephalothorax provided with a deep, short, straight transverse fovea. Eyes are situated near to the edge of clypeus. Occular area is black. Chelicerae strong, clothed with thick hair and rostellum absent. Sternum nearly oval in shape. Abdomen is longer than wide, clothed with grey long hair.

Material examined : 1 ♀, 12 K.m. from Zero on Takim Road, Dist. Upper Subansiri, Arunachal Pradesh, India, 29.iii.1992, coll. *D.B. Bastawde.*

Distribution : India : Arunachal Pradesh (Dist. Upper Subansiri), New record; Meghalaya.

Genus 2. *Plesiophrictus* Simon

1885. *Plesiophrictus* Simon, *Bull. Soc. Zool France*, **10** 38.

1895. *Plesiophrictus* : Pocock, *A.M.N.H.*, **15** (6) : 170.

Diagnosis : Very large, variegated spiders with the carapace flattish; fovea small, straight; ocular tubercle low; ocular area more than twice as long as wide; eyes are of antertior row nearly equidistant, procurved. Mandible provided with externally in its lower half with many short spines. Maxilla with one or more black tooth-like tubercles. Legs are without spins; scopulae of the anterior pairs very thick. Palpal organ of male piriform, the spine thick, short and strongly and spirally crested.

Type-species : *Plesiophrictus fasciata* Latreille

Distribution : India and Sri Lanka.

2. *Plesiophrictus meghaalayensis* Tikader

1978. *Plesiophrictus meghaalayensis* Tikader, *J Bombay nat. Hist. Soc.*, **74** (2) : 314.

Diagnosis : Cephalothorax black, legs and abdomen are deep brown in colour, cephalic region longer than wide, low and nearly elliptical in shape, clothed with fine hair. Ocular tubercle near to the edge of clypeus. Anterior row of eyes are procurved and lateral eyes larger than the medians slightly closer to the adjucent laterals; posterior nearly straight or slightly recurved, irregular in shape. Chelicerae strong, clothed with thick hair and absent of rostellum. Sternum nearly round, clothed with spine-like hair, sternal sigilla marginal. Legs are long and moderately strong, I and IV pair longer than others. Matatarsi and tarsi of all legs provided with ventral scopulae. Abdomen longer than wide, clothed with fine hair. Dorsum of abdomen provided with fine pairs of insconspicuous longitudinal pale patches. Two pairs of spinnerets, anterior is small and posterior three segmented and long.

Material examined : 1 ♀, Deomali, Dist. Tirap, Arunachal Pradesh, India 01.iii.1991, coll. *P.T. Bhutia & party.*

Distribution : India : Arunachal Pradesh (Dist. Tirap), New record; Meghalaya.

II Family ZODARIDAE

Genus 3. ***Storena*** Walckenaer

1805. *Storena* Walckenaer, *C.A.Tablendes Araneides on Caracters essentielsdes*, Paris, : 1-88.

1992. *Storena* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*, **3** (Part-3) : 380.

Diagnoisis : Cephalothorax longer than wide, narrowing in front, anterior margin round and smooth, practically without hair except for a few spine-like hair on the cephalic region. Eyes are pearly white, two rows, four eyes in each row. Anterior median eyes are larger than others. Abdomen longer than wide, anterior spinnerets long and other two pairs comparatively short.

Type-species : *Storena cyanea* Walckenaer

Distrubution : India : Arunachal Pradesh.

Elsewhere : Australia, New Zealand, Syria, Lebanon, Morocco, Singapore, Java, Sumatra, Philippine, New Guinea.

3. ***Storena dibangensis*** Sp. nov.

General : Cephalothorax reddish brown, abdomen deep brown, legs light brown in colour. Total length 16.00 mm. Carapace 6.00 mm. long, 5.50 mm. wide; abdomen 10.00 mm. long, 7.00 mm. wide.

Cephalothorax : Longer than wide not narrower in front, almost parallel, anterior end smooth and rounded practically without hair except for a few spine on the cephalic region. Cephalothorax with fovea at the posterior end of the cephalic region. Eyes are pearly white arranged in two rows, both the rows are procurved. Anterior median eyes larger than the posterior medians; both the lateral anterior and posterior eyes are nearly contiguous. Ocular quadrate longer than wide. Legs are long and strongly clothed with hair and spines. Legs formula is 4312. Sternum heart shaped and pointed behind, clothed with hair and spines. Labium and maxillae are small, longer than wide. Chelicerae are small anterior and posterior margin provided with out any teeth.

Abdomen : Longer than wide and pointed behind, clothed with fine hair. Dorsal side of abdomen provided with a number of white dot-like patches. Anterior part of dorsal side provided with one pair of long white patches and middle with one pair of small white rounded patches. The anterior spinnerets comparatively longer than other pairs. Epigyne more or less rounded with copulatory opening. Epigyne and internal genitalia as in text figs 2-3.

Holotype : Female in spirit, deposited at Zoological Survey of India, Calcutta. Regd. No. 5535/18.

Type-locality : Dibang Valley, 3 km. from Mayodia, 2550 Mt. alt., Dist. Dibang Valley, Arunachal Pradesh, India, 16.ix.1991, coll. *T.K. Pal and party.*

The species is smaller to *Storena debasrae* Biswas & Biswas but differs from this on the following characters 1) Colour of cephalothorax reddish brown in *storena dibangensis* but in *S. debasrae* light brown 2) Inner and outer margin of chelicerae provided with two teeth in each in *S. debasrae* but in *S. dibangensis* no such teeth 3) Abdomen provided with two pairs of white patches one long and one small rounded but in *S. debasrae* only posterior part with whitish transverse patches 4) Epigyne and internal genitalia are also structurally different.

III. Family SALTICIDAE

Key to the genera of the family SALTICIDAE

1. Eyes are small in proportion to the spiders ***Phidippus***

– Eyes are not small in proportion to the spiders 2

2. Labium little, longer than wide; coxae of the I legs separated by less than the width of the labium ..... ***Plexippus***

– Labium not longer than wide; coxae of the I legs not separated by less than the width of the labium 3

3. The ocular trapezium is about one third broader than long ..... ***Salticus***

– The ocular trapezium is not about one third broader than long 4

4. The first legs are haviest than the rest .... ***Zygoballus***

4. Genus *Phidippus* Koch

1846. *Phidippus* Koch, *Die. Arachn.*, 73 : 125.

1992. *Phidippus* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series* 3, (Part - 3) : 395.

Type-species : *Phidippus variegatus* (Lucas)

Distribution : All tropical and sub-tropical countries of the World.

Key to the species of the genus *Phidippus* kochi

1. Cephalothorax brownish red in colour and pointed behind..... .....*indicus*

– Cephalothorax pale orange in colour and not pointed behind.....2

2. Dorsum is pale in colour and provided with one pair of sigilla.....*tirapensis*

4. *Phidippus indicus* Tikader

1974. *Phidippus indicus* Tikader, *Proc. Indian Acad. Sci.*, 79(3) : 122.

1992. *Phidippus indicus* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*, 3 (Part-3) : 396.

Material examined : 1♀, Ganga Lake, Itanagar, Dist. Papumpare, Arunachal Pradesh, 28.v.2000, coll. *B. Mitra.*

Distribution : India : Arunachal Pradesh (Dist. Papumpare), New record; West Bengal; Gujrat.

5. *Phidippus tirapensis* Sp. nov.

General : Cephalothorax, abdomen and legs are light to deep brown in colour. Total lenght 17.50 mm. Carapace 7.50 mm. long 6.50 mm. wide: abdomen 10.00 mm. long, 6.00 mm. wide.

Cephalothorax : Longer than wide, high in front, posterior and lateral sides are very sloping. Cephalic region flat clothed with fine pubescence and some spine-like hair. Outer side of lateral eyes provided with tuft of conspicuous long black hair. Eyes are comparatively small according to the size of the spider. Anterior row is recurved. Anterior middle eyes are pearly white others black. Base of the eyes encircled with black patch. Anterior and posterior lateral eyes are more or less same size; second pair of eyes very small and situated near the base of anterior lateral eyes than the posterior lateral eyes. Middle of the cephalothorax provided with a small fovea. Chelicerae with one moderate tooth on inner margin and two heterogenous teeth on outer margin. Sternum nearly oval, longer than wide, narrowing in behind. Legs of I and II more robust than III and IV. Legs formula is 4123. Tibiae and matatarsi of I and II provided with three and two pairs of ventral spines.

Abdomen : Longer than wide and pointed behind, clothed with hair. Dorsum is pale in colour and some black patches over it. One pair of sigilla is present.

Holotype : One female in spirit. Regd. No. 5536/18.

Type-locality : Hukanjuri, 36 km. from Khonsa, Dist. Tirap, Arunachal Pradesh, India, 14.iii.1990, coll. *T.K. Pal.*

This species resembles with *Phidippus punjabensis* Tikader but it is separated as follows 1) Provided with few longitudinal and transverse patches on the dorsum of the abdomen but in *P. punjabensis* is different. 2) One pair of sigilla present in *P. tirapensis* but in *P. punjabensis* there is no such sigilla present. 3) Epigyne and internal genitalia are also stucturally different.

Genus 5. *Plexippus* Koch

1846. *Plexippus* Koch, *Die. Arachn.*, 13 : 107.

1967. *Plexippus* : Tikader, *Proc. Indian Acad Sci.*, 66(4) : 118.

Type-species : *Plexippus paykullii* (Audouin)

Distribution : Cosmopolitan.

6. ***Plexippus paykullii*** (Audouin)

1825. *Attus paykullii* Audouin, *Descr. Egypte. 2nd. Ed.*, **22** : 172.

1995. *Plexippus paykullii* : Biswas & Majumder. Araneae : Spiders. *In : Fauna of Meghalaya, State Fauna Series*, **4** (Part-2) : 124.

Diagnosis : Cephalothorax longer than wide. Anterior row of eyes recurved; second row of eyes small and nearer to the first row. The third row situated of the broadest part of the cephalothorax. Legs I are robust and strongest of all the legs. Abdomen longer than broad, narrowing behind, clothed with fine hair.

Material examined : 1 ♀, Bhalukpong, Dist. West Kameng, Arunachal Pradesh, 9.xi.1997, coll. *Bijan Biswas*; 1 ♀, Circuit House, Itanagar, Dist. Papuimpare, Arunachal Pradesh, 6.xi.1997, coll. *Bijan Biswas.*

Distribution : India : Arunachal Pradesh (Dists. West Kameng, Papuimpare), New record; West Bengal; Meghalaya; Madhya Pradesh; Maharashtra.

Elsewhere : Africa, Myanmar, Europe, Sri Lanka, and in all of the warmer regions of the world.

Genus 6. ***Salticus*** Latreille

1804. *Salticus* Latreille, *Nouv. Dist. H. N.*, **24** : 135.

1992. *Salticus* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*, **3** (Part-2) : 400.

1995. *Salticus* : Biswas & Majumder. Araneae : Spiders. *In : Fauna of Meghalaya, State Fauna Series*, **4** (Part-2) : 125.

Type-species : *Salticus scenicus* Clerck

Distribution : Cosmopolitan except Australia.

7. ***Salticus ranjitus*** Tikader

1967. *Salticus ranjitus* Tikader, *Proc. Indian Acad. Sci.*, **66** (4) : 117.

1992. *Salticus ranjitus* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*, **3** (Part-3) : 400.

Diagnosis : Cephalothorax longer than wide, somewhat rectangular, clothed with fine black hair; cephalic and anterior thoracic regions high and flat, posterior thoracic region abruptly bend behind. Eyes are pearly white; anterior row slightly recurved and anterior medians larger than laterals by more than four times. Middle row of eyes are small and situated nearly equidistant from anterior and posterior rows. Chelicerae provided with one large tooth on inner and two smaller teeth on outer margin. Sternum oval, black, clothed with hair. Abdomen nearly egg-shaped, dorsum provided with irregular minute white dots; posterior end with transverse conspicuous white band.

Material examined : 1 ♀, Gohpur Road, Dist. Papuimpare, Arunachal Pradesh, 14.viii.1991, coll. *P.T.Bhutia;* 1 ♀, Palin Road, Ziro, Dist. Lower Subansiri, Arunachal Pradesh, 27.iii.1992, coll. *D.B.Bastawde.*

Distribution : India : Arunachal Pradesh (Dists. Papuimpare, Lower-Subansiri), New record; West Bengal; Maharashtra; Punjab; West Sikkim.

Genus 7. ***Zygoballus*** Peckham

1885. *Zygoballus* Peckham, *Proc. Nat. Hist. Soc. Wis.*, **1** : 82.

1992. *Zygoballus* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*, **3** (Part-3) : 401.

Type-species : *Zygoballus rufipes* Peckham

Distribution : India, America.

8. ***Zygoballus pashanensis*** Tikader

1975. *Zygoballus pashanensis* Tikader, *Proc. Indian Acad. Sci.*, **81**(4) : 151.

Diagnosis : Cephalothorax high and flat on the top, a little longer than wide, and behind with a very steep thoracic declivity over which the abdomen projects, clothed with small flat grey metalic scales and long black hair. The third row of eyes situated on the elevated ridge near the middle of cephalothorax and about as wide as cephalothorax. Chelicerae short, deep-

brown coloured with a single tooth on inner margin. First pair of legs are conspicuously robust and dorsal side of femora very much bulging. Female legs formula is 1432. Abdomen longer than wide, nearly elliptical in shape, narrowing behind, clothed with grey and some black hair. Dorsal side of posterior half of abdomen provided with grey chevron and posterior lateral sides also provided with two small grey spots.

Material examined : 1 ♀, 1 ♂, Jinning village, Dist. West Siang, Arunachal Pradesh, 1.xii.1988, coll. *P.T. Bhutia & party.*

Distribution : India : Arunachal Pradesh (Dist. West Siang), New record; Maharashtra.

IV. Family CTENIDAE

Genus : 8. *Ctenus* Walckenaer

1805. *Ctenus* Walckenaer, *Tab. Aran.*, **18** - Arachn.

1897. *Ctenus* : Simon, *Mem. Soc. zool. Fr.*, **10** : 252.

1931. *Ctenus* : Gravely, *Rec. Indian Mus.*, **33(3)** : 211.

Diagnosis : Both row of eyes are recurved but anterior row strongly recurve. Anterior lateral eyes are smaller than anterior medians. Tarsi bears two claws. Retromargin of chelicerae armed with four or sometimes with five teeth. Labium longer than broad. Trochanter of legs show a notch ventrally.

Type-species : *Ctenus dubius* Walckenaer

Distribution : Cosmopolitan and cosmotropical.

Key to the species of genus *Ctenus* Walckenaer

1. Median peice of epigyne longitudinally rect angular, lateral margins not dark .... *indicus*

   Lateral peice of valve clearly separeted from median peice 2

2. Horns arising from posterior lateral angles of epigyne, much smaller..... *bomdilaensis*

   Horns not arising from posterior lateral angles of epigyne, bigger 3

3. Fovea and longitudinal pale band extending from ocular area to base of cephalothorax ..... *meghalayaensis*

   Fovea and longitudinal pale band not extending from base of ocular area to base of cepha lothorax 4

4. Lateral peice bifurcated posteriorly .... *kapuri*

9. *Ctenus indicus* Gravely

1931. *Ctenus indicus* Gravely, *Rec. Indian Mus.*, 33(3) : 234.

1981. *Ctenus indicus* : Tikader & Malhotra, *Rec. zool Surv. India*, **79** : 114.

Material examined : 1 ♀, Ganga Lake and around, Dist. Papuimpare, Arunachal Pradesh, 15.v.1991, coll. *D.B. Bastawde;* 2 ♀, Horn-bill, Dist. Tirap, Arunachal Pradesh, 20.xii.1983, coll. *S. Biswas.*

Distribution : India : Arunachal Pradesh (Dists. Papuimpare, Tirap), New record; Kerala; Tamil Nadu.

10. *Ctenus bomdilaensis* Tikader & Malhotra

1981. *Ctenus bomdilaensis* Tikader & Malhotra, *Rec zool. Surv. India*, **79** : 114.

Material examined : 1 ♀, Bomdila, Dist. Tawang, Arunachal Pradesh, 22.vi.1966, coll. *A.N. T.Joseph.*

Distribution : India : Arunachal Pradesh (Dist. Tawang), Type-locality.

Elsewhere : Bhutan.

11. *Ctenus meghalayaensis* Tikader

1976. *Ctenus meghalayaensis* Tikader, *J Bombay nat Hist. Soc.*, **72(3)** : 791.

1981. *Ctenus meghalayaensis* : Tikader & Malhotra, *Rec zool. Surv. India*, **79** : 105.

Material examined : 1 ♀, Sille village, Dist. East siang, Arunachal Pradesh, 23.i.1993, coll. *P.T. Bhutia;* 2 ♀, Horn bill, N.E. of Miao, Dist. Tirap, Arunachal Pradesh, 13.xii.1993, coll. *S. Biswas.*

Distribution : India : Arunachal Pradesh (Dists. East Siang, Tirap), New record; Meghalaya; Manipur.

12. *Ctenus kapuri* Tikader

1973. *Ctenus kapuri* Tikader, *Currn. Sci.*, **42**(24) : 862.

1981. *Ctenus kapuri* : Tikader & Malhotra, *Rec. zool. Surv. India*, **79** : 116.

Material examined : 1 ♀, Horn bill, N.E. of Miao, Dist. Tirap, Arunachal Pradesh, 12.xii. 1983, coll. *S. Biswas.*

Distribution : India : Arunachal Pradesh (Dist. Tirap), New record; North Andaman (Type-locality).

V. Family THOMISIDAE

Key to the genera of the family THOMISIDAE

1. Anterior median eyes closer to the lateral eyes than to each other ..... ***Xysticus***
- Anterior median eyes not closer to the lateral than to each other 2
2. Abdomen widened and truncated behind .. .. ***Thomisus***

   Andomen not windened and truncated behind 3
3. Caphalic region as wider as thoracic region ..... ***Camaricus***

Genus 9. *Xysticus* Koch

1835. *Xysticus* Koch, *H. Schaeff. Deutschl. Ins.*. : 35.

1981. *Xysticus* : Tikader & Biswas, *Rec. zool. Surv. India, Occ. Pap.* No. **30** : 80.

Type-species : *Xysticus cristatus* Clerck

Distribution : Cosmpolitan except Australia.

13. *Xysticus sujatai* Tikader

1962. *Xysticus sujatai* Tikader, *J. Linn. Soc.*, London, **44**(300) : 572.

1995. *Xysticus sujatai* : Biswas & Majumder. Araneae : Spiders. *In : Fauna of Meghalaya, State Fauna Series*, **4** (Part-2) : 119.

Diagnosis : Cephalothorax as long as wide, densely and conspicuously spinned, the lateral margin with dark brown and two longitudinal broad dark brown bands extending from both the lateral eyes to nearly the base of cephalothorax. Clypeus high, margin with seven long, strong spines directed forward except the middle one which is directed upward. Eyes are round with dirty white tubercles. Sternum broadly oval slightly pointed behind with thick spiny hair. Legs are strong and spinned with irregular deep brown or black dots. Abdomen short, oval, wider behind, clothed with spines. Dorsum of the abdomen with paired transverse white lines.

Distribution : India : Arunachal Pradesh; Meghalaya; West Bengal.

Genus 10. *Thomisus* Walckenaer

1805. *Thomisus* Walckenaer, *Tabl. Aron.*, : 28.

1981. *Thomisus* : Tikader & Biswas, *Rec. zool. Surv. India, Occ. Pap.* No. **30** : 75.

Type-species : *Thomisus albus* Gmelin

Distribution : Asia, Africa, America, Australia, Eurpoe.

14. *Thomisus cherapunjeus* Tikader

1966. *Thomisus cherapunjeus* Tikader, *Proc. Indian Acad. Sci.*, **64**(1) : 54.

1995. *Thomisus cherapunjeus* : Biswas & Majumder. Araneae : Spiders. *In : Fauna of Meghalaya, State Fauna Series*, **4** (Part-2) : 120.

Diagnosis : Cephalothorax slightly longer than wide, clothed with fine hair, cephalic region slightly high and narrow. Lateral two sides probvided with conspicuous longitudinal broad deep brown patch extending from base of lateral eyes to base of thorax. Ocular tubercle high and laterally pointed and transversely jointed with an elevated ridge and chalk white in colour; mid-dorsally provided with a narrow longitudinal chalk-white line extending from ocular area to base of thorax. Ocular quad longer than wide and narrow in front. Sternum heart-shaped, pointed behind, clothed with hair. Abdomen longer than wide, nearly elliptical in shape, maximum width behind the middle. Dorsum

of abdomen provided with five sigilla marked with deep brown or black. Lateral side provided with three or four longitudinal deep brown thin lines and all lines joined.

Material examined : 2 ♀, Dirang Yak Research Centre, Dirang, Dist. Tawang, Arunachal Pradesh, 15.xi.1997, coll. *Bijan Biswas.*

Distribution : India : Arunachal Pradesh (Dist. Tawang), New record; West Bengal; Meghalaya; Assam.

11. Genus. *Camaricus* Thorell

1887. *Camaricus* Thorell, *Ann. Mus. civ. Genova,* : 261.

1980. *Camaricus* : Tikader, *Fauna of India, Araneae : Spiders,* 1(1) : 174.

Type-species : *Camaricus maugei* (Walckenaer)

Distribution : India, Tropical Africa and Malayasia.

15. *Camaricus formosus* Thorell

1887. *Camaricus formosus* Thorell, *Ann. Mus. civ. genova,* : 261.

1992. *Camaricus formosus* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series,* 3 (Part-3) : 404.

Diagnosis : Cephalothorax red, legs light greenish, abdomen dark brown in colour. Cephalothorax is high clothed with black hair. Centre of cephalothorax provided with deep brown patch but in male no such patch. Posterior row of eyes situated adjacent to lateral eyes. Legs are robust, clothed with hair and spines and ornamented with black patches. Tibia and metatarsi of I and II provided with three pairs of ventral spines. Chelicerae is moderate, dark brown in colour. Sternum heart shaped, pointed behind, clothed with fine hair. Abdomen longer than wide, widest behind the middle, clothed with black hair.

Material examined : 1 ♀, Naharlagun, Itanagar, Dist. Papuimpare, Arunachal Pradesh, 21.v.2000, coll. *B. Mitra.*

Distribution : India : Arunachal Pradesh (Dist. Papuimpare), New record; West Bengal; Karnataka; Maharashtra; Andaman Island.

VI. Family : HETEROPODIDAE

Genus 12. *Heteropoda* Latreille

1804. *Heteropoda* Latreille, *N. Die. hist. nat.,* **24** : 135.

1931. *Heteropoda* : Gravely, *Rec. Indian Mus.,* 33(3) : 247.

1992. *Heteropoda* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series,* 3 (Part-3) : 413.

Diagnosis : Carapace nearly as long as wide, moderate or very high posteriorly, its upper surface nearly flat, head lightly depressed in front, eyes of posterior line recurved, the laterals larger and prominent; eyes of anterior line straight or procurved, laterals larger than medians; quadrangle longer than wide, narrow in front. Maxillae not crested. Vulva consisting of pair of lobes, usually separated by a median skeletal peice, rarely in contact.

Type-species : *Heteropoda venatoria* (Linn.)

Distribution : From India eastward to Australia.

16. *Heteropoda venatoria* (Linn.)

1766. *Araneae venatoria* Linn., *Syst. Nat.,* **12** : 1035.

1988. *Heteropoda venatoria* : Sethi & Tikader, *Rec. zool Surv. India, Occ. Pap.* No. **93** : 16.

Diagnosis : Cephalothorax nearly as long as wider than long, cephalic region higher at the anterior end but flat posteriorly with the thoracic region on the top of the carapace. Anterior row of eyes procurved as seen from it front. Chelicerae very strong, armed with two to four teeth on the outer and inner margins of fangd furrow respectively. Sternum heart shaped, dark brown in colour. Abdomen elongated, tapering at the posterior end. Dorsum with two pairs of sigilla and posterior end with dark patches. Epigyne with lateral lobes directed inward posteriorly and at the middle they meet with each other.

Material examined : 2 ♀, Tamin Road, Dist.

Lower Subansiri, Arunachal Pradesh, 5.iv.1991, coll. *D.B. Bastwade.*

Distribution : India : Arunachal Pradesh (Dist. Lower Subansiri), New record; West Bengal; Bihar; Chennai; Tamil Nadu.

VII. Family : CLUBIONIDAE

Genus 13. ***Cheiracanthium*** Koch, C. L.

1839. *Cheiracanthium* Koch, C. L. *Die. Arach. Aeclhster Band,* : 9.

1991. *Cheiracanthium* : Majumder & Tikader, *Rec. zool. Surv. India, Occ. Pap.* No. **102** : 56.

Diagnosis : Cephalothorax ovoid in shape, longer than wide, convex anteriorly with no median fovea if present very inconspicuous. Eyes nearly uniform size, arranged in two transverse series - anterior and posterior. The anterior row slightly recurved, posterior row scarcely longer than the anterior row, straight and uniformly spaced, the laterals further remote from the medians; both the laterals, anterior and posterior close to each other. Chelicerae longer than wide, outer margin provided with two teeth and the inner margin with three teth respectively. Abdomen elongated, oval and pointed posteriorly. Epigyne with flat or concave plate, with copulatory opening situated at the lateral margin of the plate. They are nocturnal hunters. They are found on plant foliage or on buildings.

Type-species : *Cheiracanthium punctorium* Villars.

Distribution : All tropical parts of the world.

17. ***Cheiracanthium trivialis*** (Thorell)

1895. *Eutitha trivialis* Thorell, *Spiders of Burma,* : 40.

1981. *Cheiracanthium trivialis* : Tikader & Biswas, *Rec. zool. Surv. India, Occ. Pap.* No. **30**(1) : 71.

1991. *Cheiracanthium trivialis* : Majumder & Tikader, *Rec. zool. Surv. India, Occ. Pap.* No. **102** : 56.

Material examined : 1 ♀, Mokto, Dist. Tawang, Arunachal Pradesh, 12.iv.1991, coll. *P.T. Bhutia.*

Distribution : India : Arunachal Pradesh (Dist. Tawang), New record; West Bengal; Maharashtra; Madhya Pradesh; Goa; Tamil Nadu.

Elsewhere : Myanmar.

VIII. Family GNAPHOSIDAE

Key to the genera of the family GNAPHOSIDAE

1. Eye rows are widely separated; posterior median much nearer to each other than the laterals ..... ***Drassodes***

   Eye rows are close together; posterior me dian eyes otherwise 2

2. Posterior row of eyes straight or slightly procurved; the eyes are equidistant; the me dians are smaller or slightly larger than the laterals ..... ***Zelotes***

Genus 14. ***Drassodes*** Westring

1851. *Drassodes* Westring, *Goteborgs. K. Vetensk 0. Vitterh. Samh. Handle*, **2** : 25.

1995. *Drassodes* : Biswas & Majumder. Araneae : Spiders. *In : Fauna of Meghalaya, State Fauna Series*, **4** (Part-2) : 126.

Type-species : *Drassodes lepidosus* (Walckenaer)

Distribution : Oriental, Sub-tropical and temperate region of the world.

18. ***Drassodes himalayaensis*** Tikader & Gajbe

1975. *Drassodes himalayaensis* Tikader & Gajbe, *Oriental Inst.*, **9**(3) : 274.

1982. *Drassodes himalayaensis* : Tikader, *Fauna of India,* Araneae : Spiders, **2**(2) : 427.

Diagnosis : Cephalothorax longer than wide, flat, cephalic region slightly wide and high; clothed with fine pubescence and some spine like hair, centre with a conspicuous fovea. Eyes are pearly white except anterior medians. Chelicerae strong inner and outer margin provided with two small teeth. Abdomen longer than wide, slightly narrowing in front and wider portion behind the middle. The anterior spinnerets are cylindrical and longer than others.

Material examined : 1 ♀, Mokto, Dist. Tawang, Arunachal Pradesh, 12.vi.1991, coll. *P.T. Bhutia;* 1 ♀, Bomdila, Dist. Tawang, Arunachal Pradesh, 7.iv.1991, coll. *P.T. Bhutia;* 2 ♀, 12 km. from Zero on Tokin Road, Dist. Upper Subansiri, Arunachal Pradesh, 29.iii.1992, coll. *D.B. Bastwade*.

Distribution : India : Arunachal Pradesh (Dists. Upper Subansiri, Tawang), New record; Uttar Pradesh; Meghalaya; Jammu & Kashmir.

Genus 15. *Zelotes* Gistel

1848. *Zelotes* Gistel, *Nat. Thierr.*, : 11.

1982. *Zelotes* : Tikader, *Fauna of India*, Araneae : Spiders, 2(2) : 470.

1997. *Zelotes* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of Delhi, State Fauna Series*, 6 : 478.

Type-species : *Zelotes subterranea* (Koch)

Distribution : Oriental and temperate region of the world.

19. *Zelotes mandlaensis* Tikader & Gajbe

1976. *Zelotes mandlaensis* Tikader & Gajbe, *Proc. Indian Acad. Sci.*, 83(3) : 112.

1982. *Zelotes mandlaensis* : Tikader, *Fauna of India*. Ananeae : Spiders, 2(2) : 500.

Diagnosis : Cephalothorax longer than wide, narrowing in front, convex, clothed with pubescence, posterior middle provided with an inconspicuous, short fovea. Eyes are closely grouped, silvery white, except anterior medians. Anterior row of eyes nearly straight. Sternum oval, pointed behind, clothed with hair. Chelicerae moderately strong, verticle, inner and outer margin provided with three smaller and three slightly bigger teeth. Abdomen longer than wide, oval, clothed with fine hair and with three pairs of light spots. Spinnerets very prominent, anterior spinnerets cylindrical, larger and darker than others.

Material examined : 1 ♀, Tamin Road, Dist. Lower Subansiri, Arunachal Pradesh, 5.iv.1991, coll. *D.B. Bastwade*.

Distribution : Arunachal Pradesh (Dist. Lower Subansiri), New record; Madhya Pradesh.

IX. Family OXYOPIDAE

Genus 16. *Oxyopes* Latreille

1804. *Oxypoes* Latreille, *Hist. Nat. Arach.*, France, 14(7) : 144.

1900. *Oxyopes* : Pocock, *Fauna of Brit. India Arach.*, : 255.

1992. *Oxyopes* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*. 3 (Part-3) : 432.

Diagnosis : Posterior row of eyes are strongly recurved and equidistant from each other. Ocular quadrangle longer than wide and limited by the posrerior median eyes and the anterior lateral eyes.

Type-species : *Oxyopes heterohthalmus* Latreille

Distribution : Europe, Asia, Africa, Australia and America.

20. *Oxyopes shweta* Tikader

1970. *Oxyopes shweta* Tikader, *Rec. zool. Surv India*. 64(1-4) : 78.

1995. *Oxyopes shweta* : Biswas & Majumder. Araneae : Spiders. *In : Fauna of Meghalaya, State Fauna Series*, 4 (Part-2) : 121.

Diagnosis : Cephalothorax and legs are light brownish to green, abdomen chalk-white in colour. Cephalic region longer than wide, high clothed with fine hair; two longitudinal black lines of eighter side of cephalic region, centre provided with prominent fovea. Posterior row of eyes are procurved, in equal distance; base of each encircled with black patch. Sternum oval, pointed behind, clothed with fine hair. Abdomen long, narrowing behind, anterior mid-dorsally with a lance-shaped brown patch; lateral sides with longitudinal blackish line extending from base to end of abdomen. Dorsum of abdomen provided with minute net like chalk white patches.

Material examined : 1 ♀, 1 ♂, Brahmaputra I.B., Pasighat, Dist. East Siang, Arunachal Pradesh, 27.x.1992, coll. *P.T. Bhutia*.

Distribution : India : Arunachal Pradesh (Dist. East Siang), New record; Meghalaya; West Bengal; West Sikkim.

X. Family LYCOSIDAE

Key to the genera of the family LYCOSIDAE

1. Posterior spinnerets distinctly longer than the anterior spinnerets.....***Hippasa***

– Posterior spinnerets not distinctly longer than the anteroir spinnerets.....2

2. Cephalic region not much elevated from the thoracic region.....***Pardosa***

– Cephalic region much elevated from the tho racic region.....3

3. Superior claws long and slender and toothed only at the base.....***Evippa***

– Superior claws not long and slender and not toothed only at the base.....4

4. The labium is longer than wide and the basal excavation is prominent.....***Lycosa***

Genus 17. ***Hippasa*** Simon

1885. *Hippasa* Simon, *Bull. Soc. Zool. Fr.*, **10** : 31.

1980. *Hippasa* : Tikader & Malhotra, *Fauna of India*, Araneae : Spiders, **1**(2) : 272.

1995. *Hippasa* : Biswas & Majumder. Araneae : Spiders. *In : Fauna of Meghalaya, State Fauna Series*, **4** (Part-2) : 108.

Type-species : Hippasa agelenoides (Simon)

Distribution : India : Madagascar, Africa, Arabia, Malyasia.

Key to the species of the genus *Hippasa* Simon

1. Ventral side of the abdomen with three longitudinal dark bands extending from the epigastric fold to the base of spinnerets.....***partita***

– Ventral side of the abdomen without longitudinal dark bands extending from the epigastric fold to the base of spinnerets.....2

2. Plate of vulva strongly invaginated in front and hence with two distinct posteriorly directed truncated processess.....3

3. Plate of vulva produced into a tounge like process very much drawn out posteriorly .....***holmerae***

21. ***Hippasa partita*** (Cambridge)

1876. *Trochosa partita* Cambridge, *Proc. Zool. Soc.*, : 541.

1992. *Hippasa partita* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*, **3** (Part-3) : 439.

Material examined : 1♀, Basar, Dist. West Siang, Arunachal Pradesh, 4.xii.1998, coll. *P.T. Bhutia.*

Distribution : India : Arunachal Pradesh (Dist. West Siang), New record; West Bengal.

22. ***Hippasa agelenoides*** (Simon)

1884. *Pirata agelenoides* Simon, *Ann. Mus. civ. Stor. nat.*, Genova, **20** : 334.

1980. *Hippasa agelenoides* : Tikader & Malhotra, *Fauna of India*, Araneae : Spiders, **1**(2) : 293.

Material examined : 1♀, Ziro, Dist. Lower Subansiri, Arunachal Pradesh, 5.xi.1997, coll. *Bijan Biswas.*

Distribution : India : Arunachal Pradesh (Dist. Lower Subansiri), New record; Kerala; Karnataka; Maharashtra; Tamil Nadu; Uttaranchal; Uttar Pradesh.

Elsewhere : Myanmar.

23. ***Hippasa holmerae*** Thorell

1895. *Hippasa holmerae* Thorell, *Spiders of Burma*, : 218.

1992. *Hippasa holmerae* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*, **3** (Part-2) : 439.

Material examined : 1♀, Konkonnallah, Naharlagun, Dist. Lower Subansiri, Arunachal Pradesh, 8.iv.1988, coll. *P.T. Bhutia.*

Distribution : India : Arunachal Pradesh (Dist. Lower Subansiri), New record; West Bengal; Uttar Pradesh; Manipur.

Elsewhere : Myanmar, Singapore, West China.

Genus 18. *Pardosa* Koch

1848. *Pardosa* Koch, *Die. Arachnide*, **14** : 100.

1980. *Pardosa* : Tikader & Malhotra, *Fauna of India*, Araneae : Spiders, 1(2) : 315.

Type-species : *Pardosa striatipes* Koch

Distribution : Cosmopolitan except Australia.

Key to the species of the genus *Pardosa* Koch

1. No longitudinal black streak present on the dorsal side of patella; chelicerae uniform in colour ..... *birmanica*
- Longitudinal black streak present on the dor sal side of patella; chelicerae not uniform in colour 2
2. Maxillae provided with conspicuous scopulae; ocular area without black hairy .... *sumatrana*
- Maxillae without conspicuous scopulae; ocular area with black hairy 3
3. Femora of all legs provided with irregular greenish brown patches and strenum black *ladakhensis*
4. Abdomen ventrally provided with two lateral irregular brown patches on the side of spinnerets ..... *heterophthalmus*
- Abdomen ventrally not provided with two lateral irregular brown patches on the side of spinnerets 5
5. Median dorsal area of carapace not provided with a longitudinal pale area. Abdomen broadest behind the middle ..... *tatensis*
- Median dorsal area of carapace provided with a longitudinal pale area. Abdomen broadest in the middle 6
6. Dorsal side of abdomen dark brown with minute pale spots and mid-longitudinal area pale ..... *pusiola*
- Dorsal side of abdomen pale and without minute pale spots and mid-longitudinal area not pale 7
7. Abdomen oval in shape; anterior mid-dorsally provided with lance shaped marking .... *oakleyi*
- Abdomen not oval in shape; anterior mid-dorsally not provided with lance shaped marking 8
8. Legs are without patches; carapace provided with 'V' shaped markings just behind the third row of eyes ..... *mysorensis*
- Legs are provided with patches and carapace without 'V' shaped markings behind the third row of eyes 9
9. Abdomen mid-dorsally provided with a broad longitudinal; pale band; light brown irregular patches. Sub lateral sides with black patches with pale spots ..... *mukundi*

24. *Pardosa birmanica* Simon

1884. *Pardosa birmanica* Simon, *Ann. Mus. civ Stor nat.*, Genova, **20** : 333.

1992. *Pardosa birmanica* : Biswas & Biswas, Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*, **3** (Part-3) : 444.

Material examined : 1 ♀, Bhalukpong, Kameng river, Dist. West Kameng, Arunachal Pradesh, 13.x.1993, coll. *P.T. Bhutia;* 1 ♀, Pasighat, Dist. East Siang, Arunachal Pradesh, 18.xi.1988, coll. *P.T. Bhutia & party;* 1 ♀, Namsai, Dist. Lohit, Arunachal Pradesh, 14.ii.1991, coll. *P.T. Bhutia*

Distribution : India : Arunachal Pradesh (Dists. West Kameng, East Kameng, Lohit), New record; West Bengal; Bihar; Andhra Pradesh; Gujrat; Himachal Pradesh; Karnataka; Maharashtra; Madhya Pradesh; Meghalaya; Orissa; Punjab; Rajasthan; Uttar Pradesh; Tamil Nadu.

Elsewhere : Myanmar, Java, Pakistan.

25. *Pardosa sumatrana* (Thorell)

1980. *Lycosa sumatrana* Thorell, *Ann. Mus civ Stor nat.*, Genova, **30** : 136.

1992. *Pardosa sumatrana* : Biswas & Biswas. *Fauna of West Bengal*, Araneae : Spiders. *State Fauna Series*, **3** (Part-3) : 445.

Material Examined : 1♀, Pasighat, Dist. East Siang, Arunachal Pradesh, 18.xi.1988, coll. *P.T. Bhutia & Party*; 1♀, Gohpur Road, Dist. Papuimpare, Arunachal Pradesh, 14.viii.1991, coll. *P.T. Bhutia*; 1♀, Pasighat, Dist. East Siang, Arunachal Pradesh, 3.xi.1992, coll. *P.T. Bhutia*; 1♀, Tawang, Dist. Tawang, Arunachal Pradesh, 5.iv.1991, coll. *P.T. Bhutia*; 15♀, Lumla, Dist. Tawang, Arunachal Pradesh, 9.iv.1991, coll. *P.T. Bhutia.*

Distribution : India : Arunachal Pradesh (Dists. East Siang, Papuimpare, Tawang), West Bengal; Meghalaya; Arunachal Pradesh; Bihar; Andhra Pradesh; Gujrat; Madhya Pradesh; Maharashtra; Himachal Pradesh; Karnataka; Tamil Nadu.

Elsewhere : Bangla Desh, Sri Lanka, Sumatra.

26. ***Pardosa ladakhensis*** Tikader

1977. *Pardosa ladakhensis* Tikader, *J. Bombay nat. Hist. Soc.*, **74**(1) : 144.

1980. *Pardosa ladakhensis* : Tikader & Malhotra, *Fauna of India*, Araneae : Spiders, **1**(2) : 360.

Material examined: 1♀, Koromi, Dist. Dibang Valley, Arunachal Pradesh, 9.ix.1991, coll. *T.K. Pal.*

Distribution : India : Arunachal Pradesh (Dist. Dibang valley), New record; Jammu & Kashmir.

27. ***Pardosa heterophthalmus*** (Simon)

1898. *Acroniops heterophthalmus* Simon, *Hist. nat. des Araigness*, **2** : 362.

1992. *Pardosa heterophthalmus* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*, **3** (Part-3) : 444.

1995. *Pardosa heterophthalmus* : Biswas & Majumder. Araneae : Spiders. *In : Fauna of Meghalaya, State Fauna Series*, **4** (Part-2) : 110.

Material examined: 1♀, Koromi, Dist. Dibang valley, Arunachal Pradesh, 9.ix.1991, coll. *T.K. Pal.*

Distribution : India : Arunachal Pradesh (Dist. Dibang valley), New record; West Bengal; Meghalaya; Tamil Nadu.

Elsewhere : Java.

28. ***Pardosa tatensis*** (Tikader)

1964. *Lycosa tatensis* Tikader, *Rec. Indian Mus.*, **59** (3) : 265.

1980. *Pardosa tatensis* : Tikader & Malhotra, *Fauna of India*, Araneae : Spiders, **1**(2) : 358.

Material examined : 1♀, Konkon wallah, Naharlagun, Dist. Lower Subansiri, Arunachal Pradesh, 8.iv.1988, coll. *P.T. Bhutia.*

Distribution : India : Arunachal Pradesh (Dist. Lower Subansiri), New record.

Elsewhere : Nepal (Central Himalaya).

29. ***Pardosa pusiola*** (Thorell)

1891. *Lycosa pusiola* Thorell, *Sv.Ak.Handl.*, **24**(2) : 65.

1980. *Pardosa pusiola* : Tikader & Malhotra, *Fauna of India, Araneae : Spiders*, **1**(2) : 323.

Material examined : 1♀, Garu, Dist. West Siang, Arunachal Pradesh, 8.xii.1988, coll. *P.T. Bhutia & party;* 1♀, Nampong, Dist. Changlung, Arunachal Pradesh, 24.ii.1991, coll. *P.T. Bhutia.*

Distribution : India : Arunachal Pradesh (Dists. West Siang, Changulung), New record; West Bengal.

Elsewhere : Myanmar, Sri Lanka, Indonesia, Sumatra, Borneo, Java.

30. ***Pardosa oakleyi*** Gravely

1924. *Pardosa oakleyi* Gravely, *Rec. Indian Mus.*, **26** : 610.

1992. *Pardosa oakleyi* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*, **3** (Part-3) : 445.

Material examined : 3♀, Bomdila, Dist. Tawang, Arunachal Pradesh, 7.iv.1991, coll. *P.T. Bhutia.*

Distribution : India : Arunachal Pradesh (Dist. Tawang), New record; West Bengal; Bihar; Karnataka; Punjab; Tamil Nadu.

Elsewhere : Pakistan.

31. ***Pardosa mysorensis*** (Tikader & Mukerjei)

1971. *Lycosa mysorensis* Tikader & Mukerjei, *Sci & Cult.*, 37 : 531.

1980. *Pardosa mysorensis* : Tikader & Malhotra, *Fauna of India*, Araneae : Spiders, 1(2) : 332.

Material examined : 1 ♀, Basar, Dist. West Siang, Arunachal Pradesh, 4.xii.1988, coll. *P.T. Bhutia.*

Distribution : India : Arunachal Pradesh (Dist. West Siang), New record; Karnataka.

32. ***Pardosa mukundi*** Tikader & Malhotra

1980. *Pardosa mukundi* Tikader & Malhotra, *Fauna of India*, Araneae : Spiders, 1(2) : 325.

1992. *Pardosa mukundi* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*, 3 (Part-3) : 445.

Material examined : 1 ♀, Palin Road, Zero, Dist. Lower Subansiri, Arunachal Pradesh, 27.iii.1992, coll. *D.B. Bastwade.*

Distribution : India : Arunachal Pradesh (Dist. Lower Subansiri), New record; West Bengal; Maharashtra.

Genus 19. *Lycosa* Latreille

1804. *Lycosa* Latreille, *Nouv. Dist. d' Hist. Nat.*, 24 : 135

1970. *Lycosa* : Tikader, *Rec. zool. Surv. India*, 64(1-4) : 63.

Type-species : *Lycosa tarantula* Rossi

Distribution : All over the world.

Key to the species of the genus *Lycosa* Latreille

1. Sternum pale brown and ventral side of abdomen with three longitudinal broad, dark brown conspicuous bands ..... *prolifica*

– Sternum without pale brown and no conspicuous dark brown longitudinal bands on the ventral side of abdomen 2

2. Coxae of all legs provided with brown patches, dorsal side of abdomen dark, brown with small pale patches ..... *tista*

– Coxae of all legs not provided with any patches, dorsal side without small pale patches 3

3. Carapace redish brown and the femora of legs provided with light green patches ..... *kempi*

– Carapace not redish brown and the femora of the legs not provided with light green patches 4

4. Lateral side of cephalic region provided with longitudinal pale patches; mid-dorsal side of abdomen with longitudinal brown irregular markings ..... *bistriata*

– Lateral side no longitudinal pale patches; mid-dorsal side of abdomen without longitudinal irregular markings 5

5. Carapace mid-longitudinally not provided with light brown band; tips of palps dark brown in female ..... *madani*

– Carapace with mid-longitudinally light brown band. Tips of palps without dark brown in female 6

6. Coxae of all legs pale ventrally and extremeties of ventral side of IV tibia without any band ..... *carmichaeli*

– Coxae of all legs not pale ventrally and extremeties of ventral side of IV tibia provided with band 7

7. Dorsal side of abdomen uniform pale and without any patch. Carapace not provided with the mid-longitudinal broad pale brown band ..... *indagatrix*

– Dorsal side of abdomen provided with a lens shaped pale brown markings anteriorly ... 8

8. Proximal end of femora without light brown patches dorsally and distal end without any streaks ..... *iranii*

– Proximal end of femora provided with light brown patches dorsally and distal end also with streaks 9

9. Carapace brown and provided with mid-longitudinal and sub-marginal pale bands. Coxae not provided with any patches .... *poonaensis*

– Carapace without mid-longitudinal and submarginal pale bands. Coxae with patches 10

10. Abdomen anterior-mid-longitudinally provided with a lens shaped greenish brown patch. Ventro-lateral side of abdomen with two longitudinal rows of irregular dark brown patches ..... *pictula*

– No lens shaped greenish brown patch on the dorsum of abdomen. No longitudinal rows of irregular dark brown patches on the ventro-lateral side of abdomen 11

11. Posterior quardrangle of eyes as long as wide. Tibiae III and IV without bands at the extremeties ventrally ..... *fuscana*

33. ***Lycosa prolifica*** Pocock

1901. *Lycosa prolifica* Pocock, *J. Bombay nat. Hist. Soc.*, **13** : 485.

1997. *Lycosa prolifica* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of Delhi, State Fauna Series*, **6** : 480.

Material examined : 1 ♀, Brahmaputra I.B., Pasighat, Dist. East Siang, Arunachal Pradesh, 27.x.1992, coll. *P.T. Bhutia;* 1 ♀, Nirjuli, Dist. Lower Subansiri, Arunachal Pradesh, 19.vii.1991, coll. *P.T. Bhutia.*

Distribution : India : Arunachal Pradesh (Dists. East Siang, Lower Subansiri), New record; Uttar Pradesh; Maharashtra; Punjab.

34. ***Lycosa tista*** Tikader

1970. *Lycosa tista* Tikader, *Rec. zool. Surv. India*, **64**(1-4) : 67.

1980. *Lycosa tista* : Tikader & Malhotra, *Fauna of India*, Araneae : Spiders, **1**(2) : 384.

Material examined : 1 ♀, Hapoli, Dist. Lower Subansiri, Arunachal Pradesh, 25.iii.1994, coll. *P.T. Bhutia;* 1 ♀, Palin Road, Dist. Lower Subansiri, Arunachal Pradesh, 27.iii.1992, coll. *D.B. Bastwade;* 1 ♀, Kimin, Dist. Lower Subansiri, Arunachal Pradesh, 20.ix.1988, coll. *T.K. Pal;* 1 ♀, Kimin, Dist. Lower Subansiri, Arunachal Pradesh, 20.ix.1989, coll. *P.T. Bhutia;* 3 ♀, Pasighat, Dist. East Siang, Arunachal Pradesh, 16.ii.1989, coll. *P.T. Bhutia.*

Distribution : India : Arunachal Pradesh (Dists. Lower Subansiri, East Siang), New record; Sikkim.

35. ***Lycosa Kempi*** Gravely

1924. *Lycosa kempi* Gravaly, *Rec. Indian Mus.*, **26** : 602.

1970. *Lycosa Kempi* : Tikader, *Rec zool. Surv. India*, **64**(1-4) : 65.

1995. *Lycosa Kempi* : Biswas & Majumder. Araneae : Spiders. *In : Fauna of Meghalaya, State Fauna Series*, **4** (Part-2) : 112.

Material examined : 1 ♀, Koroni Roing, Dist. Dibang Valley, Arunachal Pradesh, 9.ix.1991, coll. *T.K. Pal;* 1 ♀, Garu, Dist. West Siang, Arunachal Pradesh, 8.xii.1988, coll. *P.T. Bhutia & party;* 1 ♀, Kimin, Dsit. Lower Subansiri, Arunachal Pradesh, 20.ix.1988, coll. *T.K. Pal.*

Distribution : India : Arunachal Pradesh (Dists. Dibang Valley, West Siang, Lower Subansiri), New record; West Bengal; Meghalaya; Assam; Sikkim.

Elsewhere : Bhutan, Pakistan.

36. ***Lycosa bistriata*** Gravely

1924. *Lycosa bistriata* Gravely, *Rec. Indian Mus.*, **26** : 600.

1980. *Lycosa bistriata* : Tikader & Malhotra, *Fauna of India*, Araneae : Spiders, **1**(2) : 385.

Material examined : 2 ♀, Palin Road, Dist. Lower Subansiri, Arunachal Pradesh, 27.iii.1992. coll. *D.B.Bastwade & party.*

Distribution : India : Arunachal Pradesh (Dist. Lower Subansiri), New record; West Bengal; Tamil Nadu.

37. ***Lycosa madani*** Pocock

1901. *Lycosa madani* Pocock, *J.Bombay nat. Hist. Soc.*, **13**(3) : 486.

1980. *Lycosa madani* : Tikader & Malhotra, *Fauna of India*, Araneae : Spiders, **1**(2) : 396.

Material examined : 3 ♀, Bomdila, Dist. Tawang, Arunachal Pradesh, 7.iv.1991, coll. *P.T. Bhutia & party;* 1 ♀, Nampong, Dist. Changlang, Arunachal Pradesh, 24.ii.1991, coll. *P.T. Bhutia;* 1 ♀, Yembung, Dist. East Siang, Arunachal Pradesh, 24.xi.1988, coll. *P.T. Bhutia.*

Distribution : India : Arunachal Pradesh (Dists. Tawang, Changlang, East siang), New record; Maharashtra.

38. *Lycosa carmichaeli* Gravely

1924. *Lycosa carmichaeli* Gravely, *Rec. Indian Mus.*, 26 : 604.

1980. *Lycosa carmichaeli* : Tikader & Malhotra, *Fauna of India*, Araneae : Spiders, 1(2) : 407.

1997. *Lycosa carmichaeli* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of Delhi, State Fauna Series*, 6 : 480.

Material examined : 1 ♀, Pitapol, Dist. Lower Subansiri, Arunachal Pradesh, 15.ix.1988, coll. *T.K. Pal.*

Distribution : India : Arunachal Pradesh (Dist. Lower Subansiri), New record; West Bengal; Meghalaya; Uttar Pradesh; Assam.

Elsewhere : Bhutan, Pakistan.

39. *Lycosa indagatrix* Walckenaer

1837. *Lycosa indagatrix* Walckenaer, *Ins. Apt.*, 1 : 339.

1980. *Lycosa indagatrix* : Tikader & Malhotra, *Fauna of India*, Araneae : Spiders, 1(2) : 411.

Material examined : 1 ♀, Nirjuli, Dist. Lower Subansiri, Arunachal Pradesh, 19.vii.1991, coll. *P.T. Bhutia.*

Distribution : India : Arunachal Pradesh (Dist. lower Subansiri), New record; Andhra Pradesh; Tamil Nadu.

Elsewhere : Sri Lanka.

40. *Lycosa iranii* Pocock

1901. *Lycosa iranii* Pocock, *J.Bombay nat. Hist. Soc.*, 13(3) : 485.

1995. *Lycosa iranii* : Biswas & Majumder. Araneae : Spiders. *In : Fauna of Meghalaya, State Fauna Series*, 4 (Part-2) : 112.

Material examined : 1 ♀, Basar, Dist. West Siang, Arunachal Pradesh, 4.xii.1988, coll. *P.T. Bhutia.*

Distriburion : India : Arunachal Pradesh (Dist. West Siang), New record; Meghalaya; Maharashtra.

41. *Lycosa poonaensis* Tikader & Malhotra

1980. *Lycosa poonaensis* Tikader & Malhotra, *Fauna of India*, Araneae : Spiders, 1(2) : 392.

1997. *Lycosa poonaensis* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of Delhi, State Fauna Series*, 6 : 480.

Material examined : 2 ♀, Namsai, Dist. Lohit, Arunachal Pradesh, 14.ii.1991, coll. *P.T. Bhutia.*

Distribution : India : Arunachal Pradesh (Dist. Lohit), New record; Maharashtra; Uttar Pradesh.

42. *Lycosa pictula* Pocock

1901. *Lycosa pictula* Pocock, *J. Bombay nat. Hist Soc.*, 13(3) : 486.

1980. *Lycosa pictula* : Tikader & Malhotra, *Fauna of India*, Araneae : Spiders, 1(2) : 424.

Material examined : 1 ♀, Mokto, Dost. Tawang, Arunachal Pradesh, 12.iv.1991, coll. *P.T. Bhutia.*

Distribution : India : Arunachal Pradesh (Dist. Tawang), New record; Maharashtra.

43. *Lycosa fuscana* Pocock

1901. *Lycosa fuscana* Pocock, *J.Bombay nat Hist Soc.*, 13(3) : 485.

1980. *Lycosa fuscana* : Tikader & Malhotra, *Fauna of India*, Araneae : Spiders, 1(2) : 428.

Material examined : 1 ♀, Kimin, Dist. Lower Subansiri, Arunachal Pradesh, 23.ix.1988, coll. *T.K. Pal.*

Distribution : India : Arunachal Pradesh (Dist. Lower Subansiri), New record; Maharashtra.

20. Genus ***Evippa*** Simon

1882. *Evippa* Simon, *Ann. Mus. civ. Stor. Nat.*, Genova, **18** :122.

1995. *Evippa* : Biswas & Majumder. Araneae : Spiders. *In : Fauna of Meghalaya, State Fauna Series*, **4** (Part-2) : 108.

Type-species : *Evippa arenaria* (Audouin)

Distribution : Africa, Egypt, Asia.

44. ***Evippa shivajii*** Tikader & Malhotra

1980. *Evippa shivajii* Tikader & Malhotra, *Fuana of India*, Araneae : Spiders, 1(2) : 312.

Material examined : 1♀, Konkon nallah, Naharlagun, Dist. Lower Subansiri, Arunachal Pradesh 8.iv.1988, coll. *P.T. Bhutia.*

Distribution : India; Arunachal Pradesh (Dist Lower Subansiri), New record; Maharashtra.

XI. Family ARANEIDAE

Key to the genera of the family ARANEIDAE

1. Eyes of anterior row not evently spaced or medians closer to each other than to laterals ..... ***Argiope***
- Eyes of anterior row evently spaced or medians not closer to each other than laterals 2
2. Posterior median eyes are very close, nearly touching; carapace provided with a "U" shaped junction between cephalic and thoracic region ..... ***Cyclosa***
- Posterior median eyes are not very close, carapace not having any "U" shaped junction between cephalic and thoracic region 3
3. Integument of abdomen leathery; dorsum of abdomen strongly convex; epigyne provided with short blunt scape ..... ***Cyrtarachne***
- Integument of abdomen not leathery; provided with numerous tubercles; dorsum of abdomen not strongly convex; epigyne with no scape 4
4. Thoracic groove longitudinal, epigyne with unwrinkled scape and provided with one or two pairs of lateral lobes ..... ***Neoscona***
- Thoracic groove not longitudinal; epigyne without unwrinkled scape and without any lateral lobes 5
5. Spinnerets situated on an elevated circular space surrounded by a thick flange of a ring ..... ***Gasteracantha***
- Spinnerets not on an elevated circular space surrounded by a thick flange in a form of a ring 6
6. Femora of IV with a double fringe of hair on the polateral surface of the basal half. ..... ***Leucauge***
- Femora of IV without a double fringe of hair on the polateral surface of the basal half 7
7. Abdomen elongated; cephalothorax with convex and elevated cephalic region ..... ***Nephila***
- Abdomen not elongated; cephalothorax without convex and elevated cephalic region 8
8. Carapace flat; abdomen flat dorsally, lobate literally ..... ***Herennia***

Genus 21. ***Argiope*** Audouin

1826. *Argiope* Audouin, *in Savigny, Descriptions de l' Egypte*, 1(4) : 121.

1995. *Argiope* : Biswas & Majumder. Araneae : Spiders. *In : Fauna of Meghalaya, State Fauna Series*, **4** (Part-2) : 94.

Type-species : *Argiope lobata* (Thorell)

Distribution : Tropical and temperate countries of the world.

Key to the species of the genus *Argiope* Audouin

1. Maxillae roundish in shape, dark brown at the proximal part ..... *pulchella*
- Maxillae not roundish, not dark brown at the proximal part 2

2. Cephalothorax and legs are light brownish yellow in colour ..... ***shillongensis***

45. *Argiope pulchella* Thorell

1881. *Argiope pulchella* Thorell, *Annli. Mus. civ. Stor.*, Ganova, **18** : 74.

1997. *Argiope pulchella* : Biaswas & Biswas, Araneae : Spiders *In : Fauna of Delhi, State Fauna Series*, **6** : 482.

Material examined : 1 ♀, Pasighat, Dist. East Siang, Arunachal Pradesh, 16.ii.1989, coll. *T.K. Pal;* 1 ♀, P. Sector, Itanagar, Dist. Papumpare, Arunachal Pradesh, 7.xi.1997, coll. *Bijan Biswas;* 1 ♀, Kimin Dist. Lower Subansiri, Arunachal Pradesh, 20.ix.1989, coll. *P.T. Bhutia.*

Distribution : India : Arunachal Pradesh (Dists. East Siang, Papumpares, Lower Subansiri), New record; West Bengal; Assam; Orrisa; Uttar Pradesh; Madhya Pradesh; Maharashtra; Tamil Nadu.

Elsewhere : Myanmar, Malaya Peninsula.

46. *Argiope shillongensis* Sinha

1951. *Argiope shillongensis* Sinha, *Rec. Indian Mus.*, **49** : 75.

1992. *Argiope shillongensis* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*, **3** (Part-3) : 455.

1995. *Argiope shillongensis* : Biswas & Majumder. Araneae : Spiders. *In : Fauna of Meghalaya, State Fauna Series*, **4** (Part-2) : 94.

Material examined : 1 ♀, Tipi, Dist. West Kameng. Arunachal Pradesh. 10.xi.1997, coll. *Bijan Biswas.*

Distribution : India : Arunachal Pradesh (Dist. West Kameng), New record; West Bengal; Meghalaya.

Genus 22. *Cyclosa* Menge

1866. *Cyclosa* Mange, *Schrift, Nat. Ges. Danzig*(N.F.), **1** : 73.

1982. *Cyclosa* : Tikader, *Fauna of India*, Araneae : Spiders, **2**(1) : 183.

1992. *Cyclosa* : Biswas & Biswas. FAraneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*, **3** (Part-3) : 456.

Type-species : *Cyclosa conica* (Pallas)

Distribution : Cosmopolitan.

Key to the species of the genus *Cyclosa* Menge

1. Abdomen having no paired tubercles; long blunt caudal tubercle ..... ***bifida***

– Abdomen having paired tubercles; madian caudal tubercle at the posterior part of abdomen 2

2. One pair of prominent tubercles present anteriorly; no caudal tubercles ..... ***mulmeinensis***

– No prominent tubercles present anteriorly; two median tubercles present 3

3. One pair of distinct tubercles of the base of the caudal tubercle; epigyne with contraction; narrow tip of the scape bent nearly at right angle to the base ..... ***spirifera***

47. *Cyclosa bifida* (Doleschall)

1859. *Epeira bifida* Doleschall, *Act Soc India Neerl.*, **5** : 38.

1995. *Cyclosa bifida* : Biswas & Majunder. Araneae : Spiders. *In : Fauna of Meghalaya, State Fauna Series*, **4** (Part-2) : 101.

Material examined : 1 ♀, Tipi, Dist. West Kameng, Arunachal Pradesh. 10.xi.1997, coll. *Bijan Biswas.*

Distribution : India : Arunaachal Pradesh (Dist. West Kameng). New record; Meghalaya; Sikkim;

Elsewhwere : Sri Lanha, New Guinea, Malaysia.

48. *Cyclosa mulmeinensis* (Thorell)

1887. *Epeira mulmeinensis* Thorell, *Annli Mus civ.*, Genova, **25** : 221.

1982. *Cyclosa mulmeinensis* : Tikader, *Fauna of India*, Araneae : Spiders, **2**(1) : 187.

Material examined : 1♀, Tipi, Dist. West Kameng, Arunachal Pradesh, 10.xi.1997, coll. *Bijan Biswas.*

Distribution : India : Arunachal Pradesh (Dist. West Kameng), New record; Maharashtra.

Elsewhere : Africa, Burma, Arabia, Malacca, Malaysia.

49. *Cyclosa spirifera* Simon

1889. *Cyclosa spirifera* Simon, *J. Asat. Soc. Beng.*, **58** : 337.

1992. *Cyclosa spirifera* : Biswas & Biswas. Araneae : Spiders. *Fauna of West Bengal, State Fauna Series,* **3** (Part-3) : 458.

Material examined : 3♀, I.B. of Dirang, Dist. Tawang, Arunachal Pradesh, 15.xi.1997, coll. *Bijan Biswas.*

Distribution : India : Arunachal Pradesh (Dist. Tawang), New record; West Bengal.

Genus 23. *Cyrtarachne* Thorell

1868. *Cyrtarachne* Thorell, *Eug. Resa. Arachn.*, : 10.

1995. *Cyrtarachne* : Biswas & Majumder. Araneae : Spiders. *Fauna of Meghalaya, State Fauna Series,* **4** (Part-2) : 100.

Type-species : *Cyrtarachne qrubei* (Keserling)

Distribution : Asia, Africa and Australia.

50. *Cyrtarachne schmidii* Tikader

1963. *Cyrtarachne schmidii* Tikader, *J. Bombay nat. Hist. Soc.*, **60**(1) : 271.

1982. *Cyrtarachne schmidii* : Tikader, *Fauna of India,* Araneae : Spiders, **2**(1) : 152.

Diagnosis : Cephalothorax moderately convex, scarcely clothed with hair. Ocular quad slightly longer than wide, anteriorly and posteriorly same in width, median eyes are equal in size; laterals smaller than medians; both rows of eyes are recurved. Chelicerae small but strong and stout, yellowish, provided with moderate boss. Abdomen large, more than twice wider than long. Dorsum of abdomen light greenish but anteriorly dark greenish; lateral and posterior side white, provided with a few conspicuous sigilla. Epigyne buldge capsule-like, provided with a wide, thick rim like structure instead of scape.

Distribution : India : Arunachal Pradesh (Dist. Kameng), Amatulla.

Genus 24. *Neoscona* Simon

1864. *Neoscona* Simon, *Hist. nat. des. Aragin.*, **1** : 261.

1992. *Neoscona* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series,* **3** (Part-3) : 465.

Type-species : *Neoscona anabesca* (Walckenaer)

Distribution : Cosmopolitan.

Key to the species of the genus *Neoscona* Simon

1. Cephalic region provided with a conspicuous dark brown "V" shaped patch; epigynal scape with deep constriction ..... *mukerjei*
- Cephalic region not having any "V" shaped patch; epigynal scape without a deep constriction 2
2. Dorsum of abdomen provided with four chalk-white big spots and scattered white dots ..... *bomdilaensis*

51. *Neoscona mukerjei* Tikader

1980. *Neoscona mukerjei* Tikader, *Proc. Indian Acad. Sci.*, **89**(3) : 247.

1992. *Neoscona mukerjei* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series,* **3** (Part-3) : 467.

Material examined : 2♀, Tipi, Dist. West Kameng, Arunachal Pradesh, 10.xi.1997, coll. *Bijan Biswas;* 2♀, Bomdila, Dist. Tawang, Arunachal Pradesh, 13.xi.1997, coll. *Bijan Biswas;* 4♀, Patapol, Dist. Lower Subansiri, Arunachal Pradesh, 15.ix.1988, coll. *T.K. Pal.*

Distribution : India : Arunachal Pradesh (Dists. West Kameng, Tawang, Lower Subansiri), New record; West Bengal; Meghalaya; Maharashtra.

52. ***Neoscona bomdilaensis*** Sp. nov.

General : Cephalothorax, legs and abdomen are blackish brown in colour. Total length 16.00 mm. Carapace 6.00 mm. long, 5.00 mm. wide; abdomen 10.50 mm. long, 8.00 mm. wide.

Cephalothorax : Longer than wide, narrowing in front, clothed with grey pubescence, hair and spines. Lateral side of cephalic region having a row of fringed hair, thoracic region provided with a distinct longitudinal groove. Ocular quad larger than wide and wider in front than behind; anterior median eyes larger than postereior medians and posterior medians encircled by black rings; lateral close and each situated on a tubercle; both rows of eyes are recurved but anterior row more recurved than the posterior row. Sternum heart-shaped, pointed behind, deep brown in colour, clothed with fine pubescence. Labium wider than long, dark brown in colour. Maxillae broad, roundish, dark brown with pale outer margin with indistinct scopulae. Chelicerae strong, dark brown, provided with moderate boss. Legs are long and strong, dark brown, provided with moderate boss. Legs are long and strong with blackish transverse bands, clothed with pubescence, hair and spines.

Abdomen : Nearly triangular, posteriorly narrow; clothed with pubescence and hair, overlapping on the carapace. Dorsum of abdomen provided with four chalk-white big spots and dorso-laterally scattered white dots. Epigyne with short, broad and triangular scape as in text fig 8; scape provided with a pair of inconspicuous lateral lobes and without any constriction. Internal genitalia as in text fig 10.

Holotypa : Female in spirit, deposited in Zoological Survey of India, Kolkata, Regd. No. 5537/18.

Type-locality : Near Bomdila Circuit House, Dist. Tawang, Alt. 8.400' ft., Arunachal Pradesh, India, 14.xi.1997, coll. *Bijan Biswas.*

Discussion : This species very close to *Neoscona nautica* (L. Koch) but differs as follows. (1) Cephalothorax, legs and abdomen are blackish brown in colour but in *N. nautica* yellowish and greenish brown in colour. (2) Dorsum of abdomen with four chalk-white big spots but in *N. nautica* four pairs of sigilla present. (3) Epigyne and internal genitalia are also structurelly different.

Genus 25. *Nephila* Leach

1815. *Nephila* Leach. *Zoological Miscellany.* : 133.

1992. *Nephila* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal. State Fauna Series.* 3 (Part-3) : 473.

Type-species : ***Nephila maculata*** (Fabricious)

Distribution : Tropical and nearly sub-tropical countries of the world.

Key to the species of the genus *Nephila* Leach

1. Cephalothorax relatively broad in front; a deep groove in the middle, with a pair of sharp tubercles in front ..... ***maculata***

– Cephalothorax not broad; no such groove in the middle and sharp tubercles in front 2

2. Cephalothorax longer than wide, densely clothed with yellowish pubescence; slightly narrower in front..... ***dirangensis***

53. ***Nephila maculata*** (Fabricious)

1793. *Aranea maculata* Fabricious, *Ent. Syst.*, 2 : 425.

1995. *Nephila maculata* : Biswas & Majumder. Araneae : Spiders. *In : Fauna of Meghalaya. State Fauna Series.* 4 (Part-2) : 97.

Material examined : 1 ♀, Mehao, Dibang Valley, Dist. Dibang Valley, Arunachal Pradesh, 10-13.ix.1991, coll. *T.K. Pal.*

Distribution : India : Arunachal Pradesh (Dist. Dibang Valley), New record; West Bengal; Meghalaya; Assam; Sikkim; Maharashtra; Gujrat; Uttar Pradesh; Madhya Pradesh; Karnataka; Tamil Nadu; Andaman Nicobar Island.

Elsewhere : Burma, Sri Lanka, Chin, Japan, Australia.

54. *Nephila dirangensis* Sp. nov.

General : Cephalothorax, legs and abdomen are reddish green in colour. Total length 29.00 mm. Carapace 5.50 mm. long; 5.00 mm wide; abdomen 24.00 mm. long, 16.00 mm. wide.

Cephalothorax : Longer than wide, densely clothed with yellowish pubescence, slightly narrower in front; cephalic region not tuberclate, thoracic region dark brown in colour with shallow fovea. Ocular quad as long as wide behind and slightly narrower in front than behind; median eyes are equal in size; lateral subequal in size, a little away from each other and situated on prominent tubercles; both rows of eyes slightly recurved. Sternum triangular rather elongated, pointed behind, dark brown in colour. Labium distinctly elongated than wide, dark brown with pale distal border, maxillae broader distally dark with pale outer margins provided with distinct scopulae. Chelicerae strong, stout, reddish brown with moderate boss. Legs are very long and strong clothed with hair and spines; tarsi and metatarsi together longer than patellae and tibiae together; femora and tibiae with yellowish transverse patches in the middle.

Abdomen : Oval, clothed with hair, slightly overlapping on the carapace. Dorsum of abdomen provided with two pairs of sigillae. Ventral side olive brown with some reddish patches. Epigyne plate like as in text fig. 12.

Holotype : Female, paratype ten females in spirit, deposited in Zoological Survey of India, Kolkata, Regd. No. 5538-39/18.

Type-locality : Dirang Yak Research Centre, Dirang, Dist. Tawang, Arunachal Pradesh, India, 15.xi.1997, coll. *Bijan Biswas.*

Discussion : This species is very close to *Nephila clavata* L. Koch but differs as follows : (1) There is no "V" shaped yellowish patch posteriorely on cephalic require : but in *N. Clavata* "V" shaped yellowish patch present. (2) Abdomen oval and provided with two pairs of sigillae but in *N. clavata* abdomen ellongated and provided with five pairs of sigillae. (3) Epigyne and internal genitalia are also structurally different.

26. Genus *Leucauge* White

1841. *Leucauge* White, *Ann. Mag. nat. Hist.*, 7(1) : 463.

1992. *Leucauge* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*, 3 (Part-3) : 471

Type-species : *Leucauge hortorum* (Hents)

Distribution : Tropical and sub-tropical countries of the world.

Key to the species of the genus *Leucauge* White

1. Abdomen uniformly silver white and decorated with longitudinal black bands ..... *celebesiana*
– Abdomen having some silver white pecks and not decorated with longitudinal black bands 2
2. Abdomen with two blunt rounded prominences and blunt caudal hump at the posterior end ..... *tessellata*

55. *Leucauge celebesiana* (Walckenaer)

1841. *Tetregnatha celebesiana* Walckenaer, *Hist. Nat. Ins. Apt.*, 2 : 222.

1992. *Leucauge celebesiana* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series*, 3 (Part-3) : 472.

Material examined : 3♀, 1♂, I.B. Bunglow, Dirang, Dist. Tawang, Arunachal Pradesh, 15.xi.1997, coll. *Bijan Biswas;* 4♀, Ziro, Dist. Lower Subansiri, Arunachal Pradesh, 5.xi.1997, coll. *Bijan Biswas*; 2♀,Cambo, Along, Dist. West Siang, Arunachal Pradesh, 9.vi.2000, coll. *B. Mitra.*

Distribution : India : Arunachal pradesh (Dists. Tawang, Lower Subansiri, West Siang), New record; West Bengal; Meghalaya; Assam; Maharashtra; Tamil Nadu.

Elsewhere : Myanmar, China, Sri Lanka.

56. *Leucauge tessellata* (Thorell)

1887. *Callinethis tessellata* Thorell, *Annali. Mus. civ.*, Genova, 25 : 153.

1992. *Leucauge tessellata* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series,* 3 (Part-3) : 473.

1995. *Leucauge tessellata* : Biswas & Majumder. Araneae : Spiders. *In : Fauna of Meghalaya, State Fauna Series,* 4 (Part-2) : 100.

Material examined : 2♀, Tipi, Dist. West Kameng, Arunachal Pradesh 10.xi.19997, coll. *Bijan Biswas.*

Diatribution : India : Arunachal Pradesh, (Dist. West Kameng), New record; West Bengal; Meghalaya; Assam; Sikkim; Gujrat; Karnataka; Kerala.

Distribution : India : Arunachal Pradesh.

Elsewhere : Myanmar, Bhutan.

Genus : 27. *Gasteracantha* Sundevall

1833. *Gasteracantha* Sundevall, *Conspectus Arachniden* 14.

1992. *Gasteracantha* : Biswas & Biswas. Araneae : Spiders. *Fauna of West Bengal, State Fauna Series,* 3 (Part-3) : 469.

Type-species : *Gasteracantha cancriformis* (Linnaeus)

Distribution : Tropical countries of the world.

57. *Gasteracantha unguifera* Simon

1889. *Gasteracantha unguifera* Simon, *J. Asiat. Soc. Beng.,* 58 : 336:

1992. *Gasteracantha unguifera* : Biswas & Biswas. Araneae : Spiders. *In : Fauna of West Bengal, State Fauna Series,* 3 (Part-3) : 471.

Diagnosis : Cephalothorax slightly longer than wide, anteriorly blunt, clothed with grey hair. Both cephalic and thoracic regions having anterior and posterior sloping; former part with a firm groove. Chelicerae very short and much stout, having moderate boss. Legs short and strong, distal ends of segments clothed with hair. Abdomen roughly octogonal, much wider than long, overlapping anteriorly on the thoracic region of cephalothorax. Dorsum moderately concave; provided with a transverse chalk white bar and few pairs of conspicuous sigilla. Median pair of spines largest and stout with bulged bases.

Material examined : 6♀, Tipi Orchid garden, Tipi, Dist. West Kameng. Arunachal Pradesh, 10.xi.1997. coll. *Bijan Biswas.*

Distribution : India : Arunachal Pradesh (Dist. West Kameng). New record; West Bengal; Sikkim.

Genus 28. *Herennia* Thorell

1877. *Herennia* Thorell. *Annali. Mus. civ.* Genova, 10 : 370.

1951. *Herennia Sinha,* : *Rec. Indian Mus.,* 49 : 70.

1982. *Herennia* : Tikader, *Fauna of India.* Araneae : Spiders, 2 (1) : 106.

Type species : *Herennia ornatissima* (Doleschall)

Distribution : India : Arunachal Pradesh.

Elewhere : Sri Lanka, Malayasia.

58. *Herennia ornatissima* (Doleschall)

1859. *Epiira ornatissima* Doleschall, *Acat. Soc. Ind Neerl.,* 5 : 32.

1900. *Herennia ornatissima* : Pocock, *Fauna of Brit India Arachn.* : 219.

1982. *Herennia ornatissima* : Tikader, *Fauna of India.* Araneae : Spiders, 2 (1) : 106.

Diagnosis : Cephalothorax brownish with yellowish white patches. Legs yellowish with brownih patches, abdomen greyish white in colour. Cephalic region longer than wide, flat, narrowing in front, clothed with pubessence and hair, with a "U" shaped yellowish white patch. Ocular quad as long as wider behind and slightly wider; anterior median eyes larger than posterior medians; lateral eyes subequal in size, close and situated on prominent tubercles; anterior row of eyes recurved and posterior row nearly straight. Sternum heart-shaped, broad anteriorly, but not pointed posteriorly. Chelicerae strong and stout provided with moderate boss. Legs are long and slender clothed with hair and spines. Abdomen flat, lobate having four pairs of lateral lobes. Dorsum of abdomen provided with numerous greyish speaks with distinct centres, five pairs of distinct sigilla arranged mid-longitudinally and a few longitudinal lines posteriorly. Epigyne palte like with a thin median septum.

Material examined : 1♀, Laa, Daporizo, Dist. Upper Subansiri. Arunachal Pradesh 4.vi.2000, coll. *R.S. Mridha.* New record; Meghalaya; Tamil Nadu; Goa.

Distribution : India : Arunachal Pradesh (Dist. Lower Subansiri).

Elsewhere : Sri Lanka, Myanmar, Austro-Malaysia.

SUMMARY

About 350 examples of spider have been studied and indentified. A total 58 species belonging to 28 genera under 11 families are dealt with here of those 9 families 26 genera 54 species form new records for the state. Out of these, 4 species 4 genera under 3 families are new to science. Keys to all the families are followed. All the relivant literatures pertaining to these families are reviewed under history.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. J. R. B. Alfred, Director, Zoological Survey of India, Kolkata for kind encouragement and providing facilities. They also express sincere thanks to Dr. A. K. Sanyal, Joint Director, Zoological Survey of India for suggestions.

REFERANCES

1987. Biswas Bijan, Araneae : Spiders. *Fauna of Orissa, State Fauna Series,* **1**(Part-1) : 257-272.

1992. Biswas Bijan and Biswas Kajal. Araneae : Spiders. *Fauna of West Bengal, State Fauna Series,* **3**(Part-3) : 357-500.

1995. Biswas Bijan and Majumder, S.C. Araneae : Spiders. *Fauna of Meghalaya, State Fauna Series,* **4**(Part-2) : 93-128.

1997. Biswas Bijan and Biswas Kajal. Araneae : Spiders. *Fauna of Delhi, State Fauna Series,* **6** : 477-484.

1997. Biswas, B.K. and Biswas. A.T. Araneae : Spiders. *In : Fauna of Nanda Devi Biosphere Reserve, Conservation Area series,* **9** : 35-39.

1940. Comstock, J.H. *The Spider Book,* New York.

1935. Dyal, S. *Bull. Zool. Punjab Univ.*, **1** : 117-252.

1980. Tikader, B.K. *Fauna of India,* Araneae & Spiders, **1**(1) : 1-247.

1970. Tikader, B.K. *Rec. zool. Surv. India,* **64**(1-4) : 1-84.

1981. Tikader, B.K. & Biswas Bijan *Rec. zool. Surv. India, Occ. Paper* No. **30**(1) : 1-149.

1982. Tikader, B.K., *Fauna of India,* Araneae : Spiders, **2**(1-2) : 1-536

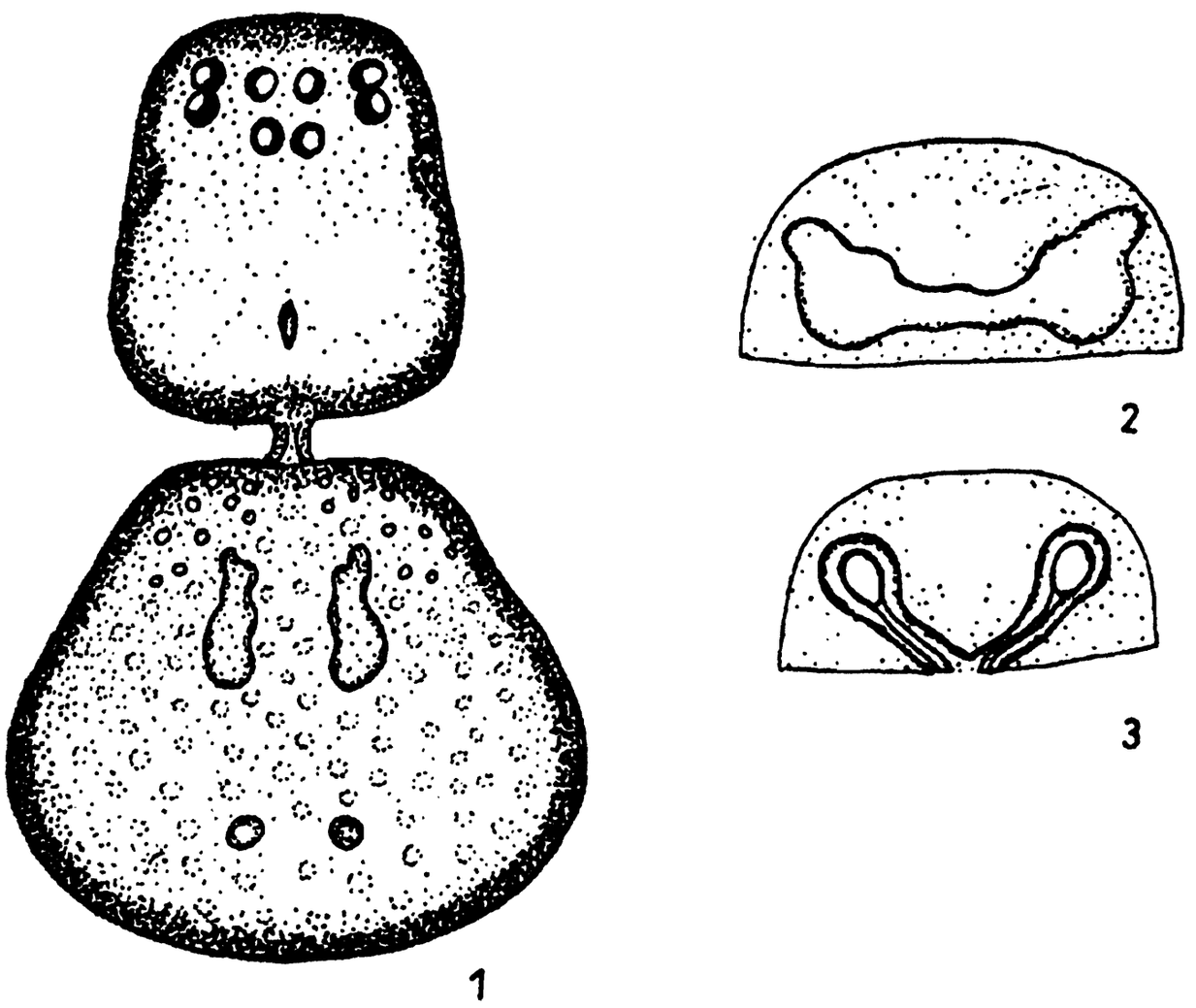
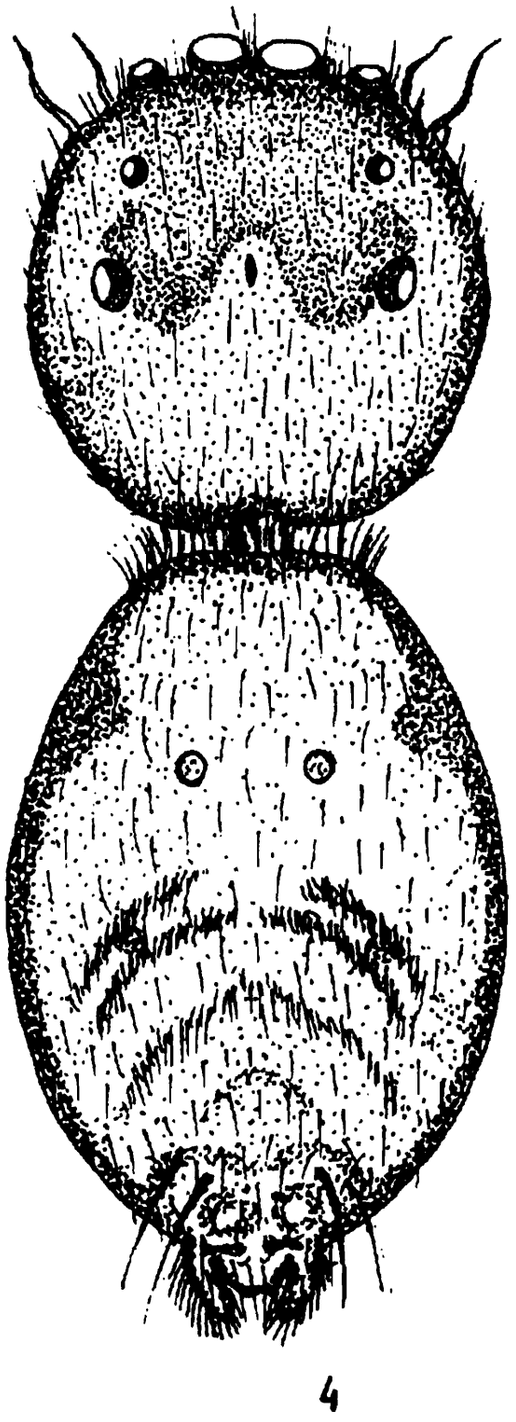
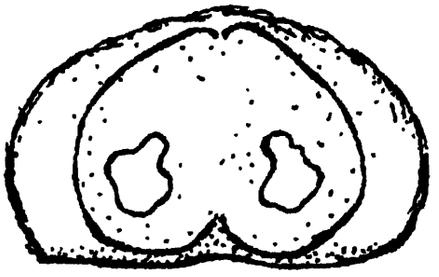


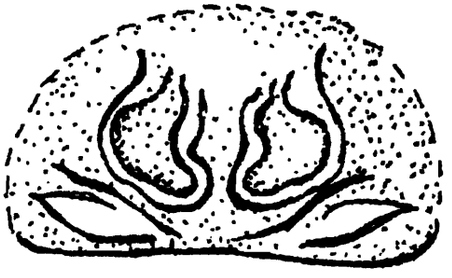
Fig. 1-3 : *Storena dipanaensis;* 1. Dorsal view of female, Holotype (Legs are omitted); 2. Epigyne, 3. Internal genitalia.



4

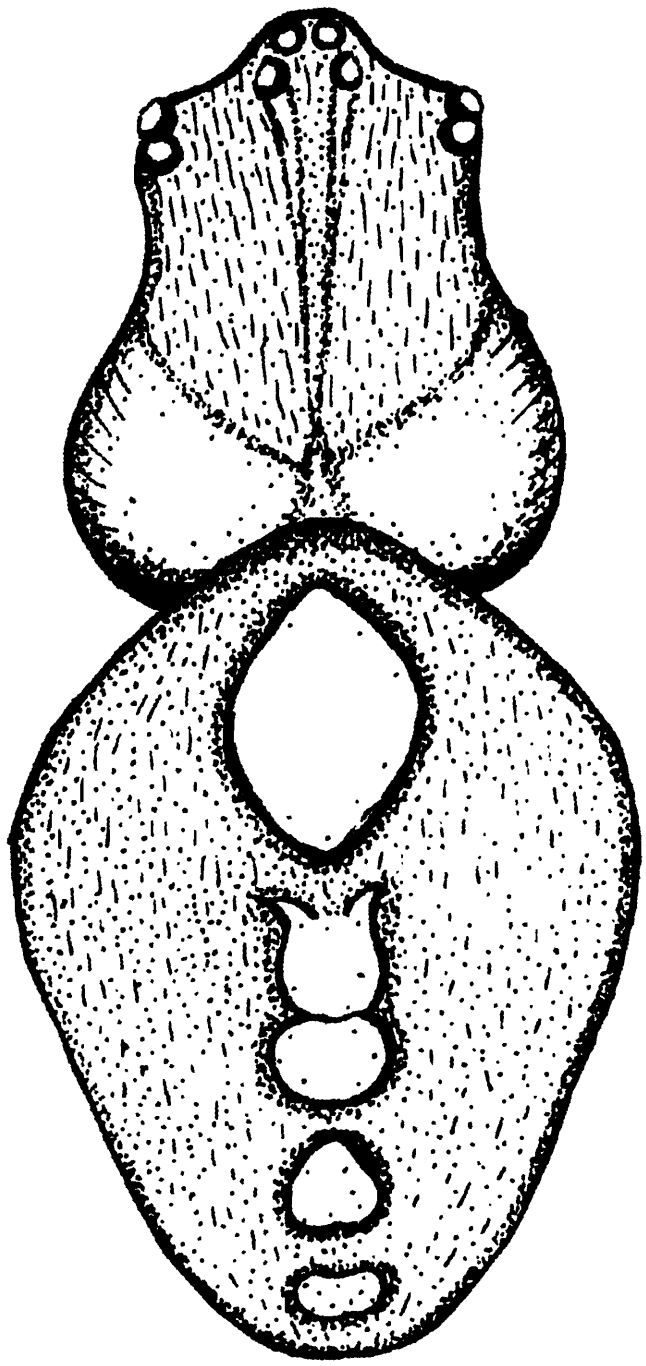


5



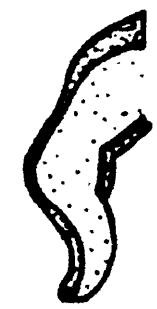
6

Fig. 4-6 : *Phidippus tirapensis;* 4. Dorsal view of female, Holotype (Legs are omitted); 5. Epigyme; 6. Intermal genitalia.

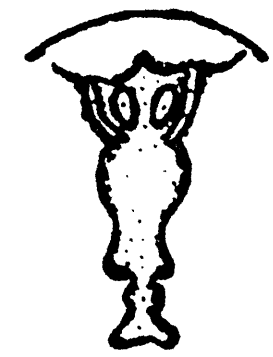


7

8

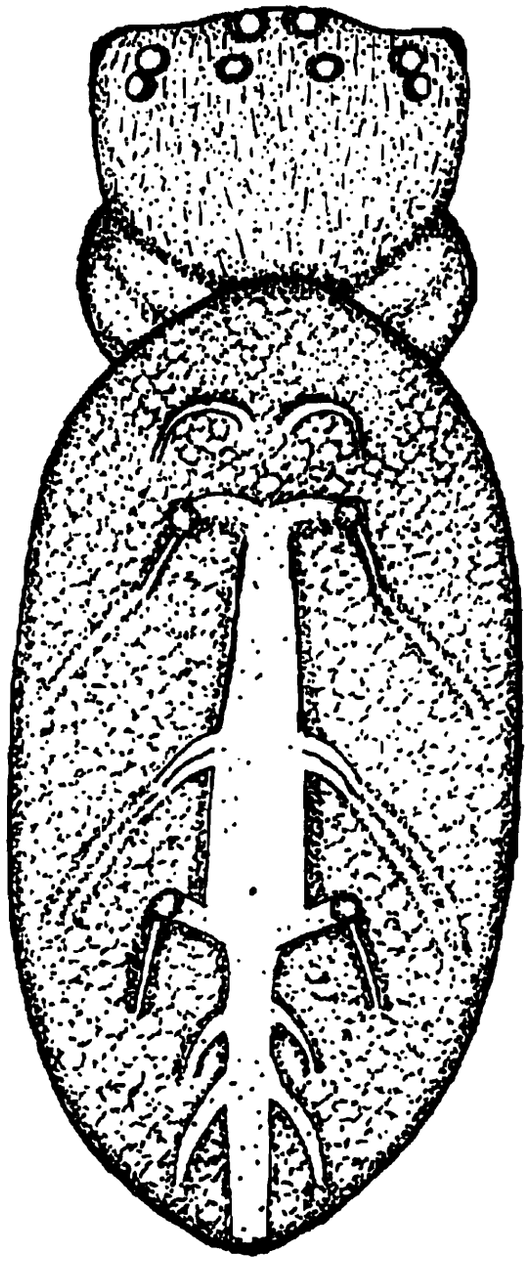


9

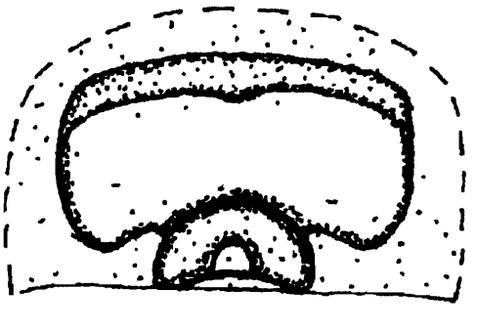


10

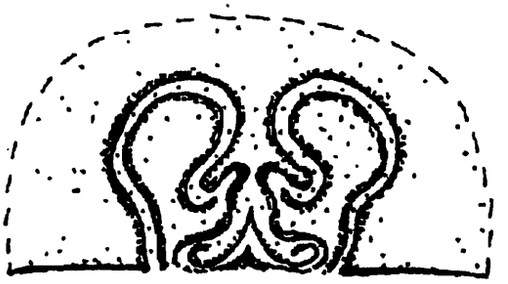
Fig. 7-10 : *Neoscona bomdilaensis;* 7. Dorsal view of female, Holotype (Legs are omited); 8. Epigyne with tringular scape; 9. Lateral view of epigyme; 10. Internal genitalia.



11



12



13

Fig. 11-13 : *Nephila dirangensis;* 11. Dorsal view of female, Holotype (legs are omitted); 12. Epigyne; 13. Internal genitalia.